Каталог Beckhoff

Автоматизация

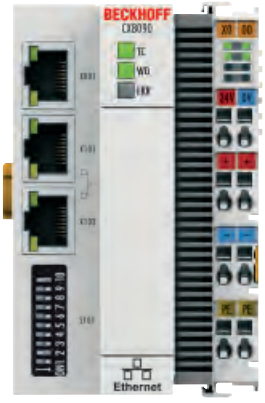
CANopen

RS232
RS485

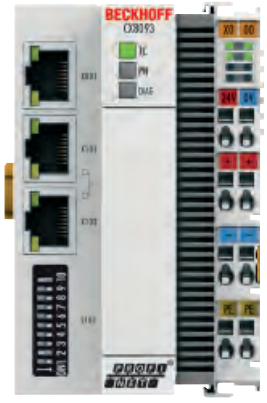
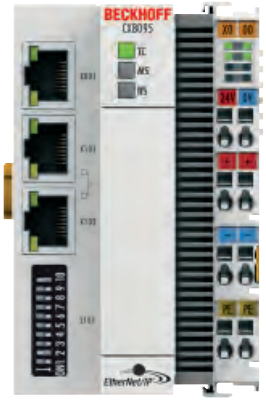
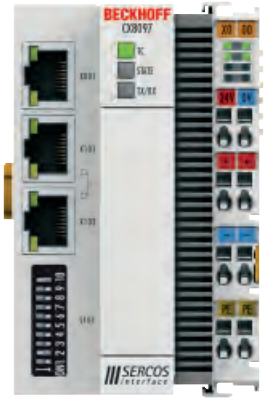
	Embedded PC for CANopen	Embedded PC for CANopen	Embedded PC for RS232/RS485
	CX8050	**CX8051**	**CX8080**
	CANopen (master)	CANopen (slave)	serial communication
	only limited by memory	16 Tx/Rx PDOs + 3 virtual slaves	512 byte input and 512 byte output
	up to 1 Mbaud (automatic detection)	up to 1 Mbaud (automatic detection)	300 baud…115 kbaud
	D-sub connector, 9-pin according to CANopen specification, galvanically decoupled	D-sub connector, 9-pin according to CANopen specification, galvanically decoupled	D-sub socket, 9-pin, 1 x RS232, 1 x RS485
			
	The CX8050 controller is equipped with a CANopen master interface. Apart from offering the CANopen master functionality, it can optionally be used to support CAN layer 2 communication.	The CANopen address is set via two rotary selection switches. The CX8051 offers automatic baud rate detection.	The CX8080 has two serial interfaces: one with RS232 and one with RS485 physics. Both serial interfaces are on the D-sub socket. The interface is not bound to a particular protocol and can be expanded with the appropriate TwinCAT supplements for the different serial communication protocols.
	E-bus (EtherCAT Terminals) or K-bus (Bus Terminals), automatic recognition	E-bus (EtherCAT Terminals) or K-bus (Bus Terminals), automatic recognition	E-bus (EtherCAT Terminals) or K-bus (Bus Terminals), automatic recognition
	K-bus 2 kByte IN/OUT, E-bus only limited by memory	K-bus 2 kByte IN/OUT, E-bus only limited by memory	K-bus 2 kByte IN/OUT, E-bus only limited by memory
	CE, UL	CE, UL	CE, UL
	www.beckhoff.com/CX8050	www.beckhoff.com/CX8051	www.beckhoff.com/CX8080

EtherCAT Terminals see page 340, EtherCAT Box modules see page 466, Bus Terminals see page 590

CX80xx | Embedded PCs with fieldbus interface

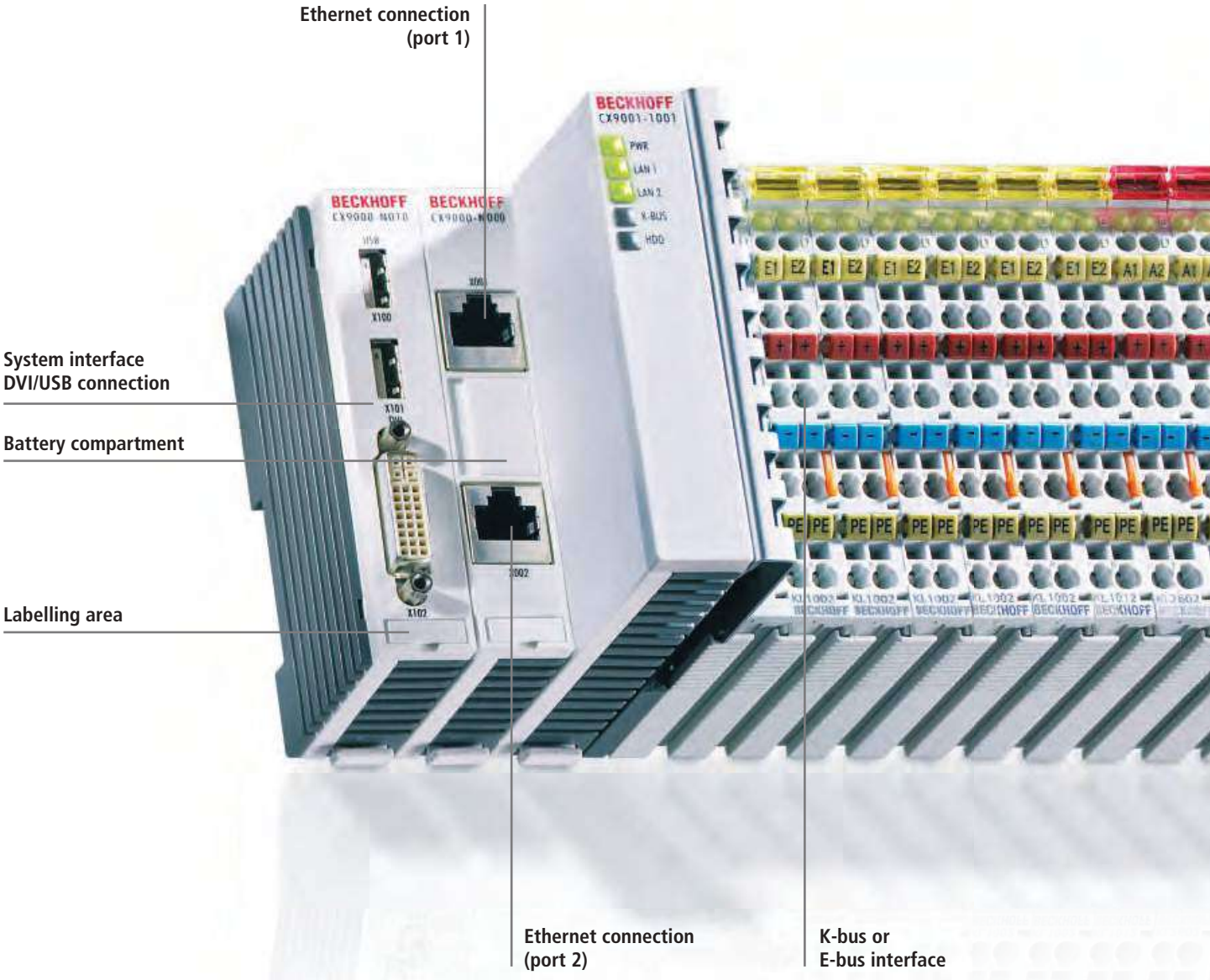
	Ethernet	BACnet/IP OPC UA
	Embedded PC for different Ethernet protocols	Embedded PC for BACnet/IP and OPC UA
Technical data	**CX8090**	**CX8091**
Protocol	real-time Ethernet, ADS TCP, Modbus TCP, TCP/IP, UDP/IP, EAP (EtherCAT Automation Protocol)	BACnet/IP or OPC UA
Max. number of bytes fieldbus	protocol dependency	
Data transfer rates	100 Mbaud	100 Mbaud
Bus interface	2 x RJ45 (switched)	2 x RJ45 (switched)
	 It supports protocols such as realtime Ethernet, ADS UDP/TCP, Modbus TCP client/server or open TCP/IP-UDP/IP communication.	 It supports the BACnet/IP and OPC UA protocols.
I/O connection	E-bus (EtherCAT Terminals) or K-bus (Bus Terminals), automatic recognition	E-bus (EtherCAT Terminals) or K-bus (Bus Terminals), automatic recognition
Type/number of peripheral signals	K-bus 2 kByte IN/OUT, E-bus only limited by memory	K-bus 2 kByte IN/OUT, E-bus only limited by memory
Approvals	CE, UL	CE, UL
Further information	www.beckhoff.com/CX8090	www.beckhoff.com/CX8091

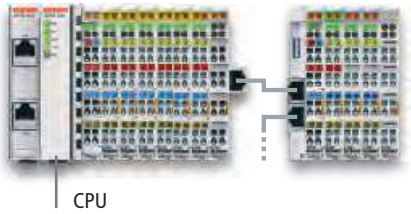
i For availability status see Beckhoff website at: www.beckhoff.com/CX8000

	PROFINET	EtherNet/IP	sercos the automation bus
	Embedded PC for PROFINET RT	Embedded PC for EtherNet/IP	Embedded PC for SERCOS III
	CX8093	**i CX8095**	**i CX8097**
	PROFINET RT device	EtherNet/IP (slave)	SERCOS III I/O profile
	1,024 byte input and 1,024 byte output + 1 virtual slave		
	100 Mbaud	100 Mbaud	100 Mbaud
	2 x RJ45 (switched)	2 x RJ45 (switched)	2 x RJ45 (switched)
			
	The PROFINET interface is designed as a 2-port switch for realisation of daisy-chain cabling.	The EtherNet/IP interface is designed as a 2-port switch for realisation of daisy-chain cabling.	The CX8097 is a controller with a Sercos III slave interface. The Sercos III interface can be freely configured and the process image of the Sercos interface can be individually adjusted.
	E-bus (EtherCAT Terminals) or K-bus (Bus Terminals), automatic recognition	E-bus (EtherCAT Terminals) or K-bus (Bus Terminals), automatic recognition	E-bus (EtherCAT Terminals) or K-bus (Bus Terminals), automatic recognition
	K-bus 2 kByte IN/OUT, E-bus only limited by memory	K-bus 2 kByte IN/OUT, E-bus only limited by memory	K-bus 2 kByte IN/OUT, E-bus only limited by memory
	CE, UL	CE, UL	CE, UL
	www.beckhoff.com/CX8093	www.beckhoff.com/CX8095	www.beckhoff.com/CX8097

EtherCAT Terminals see page 340, EtherCAT Box modules see page 466, Bus Terminals see page 590

CX9000, CX9010 | Embedded PCs





Application example
"Headless" PLC system
– PLC system without control panel
– Windows CE 5 and TwinCAT 2 PLC

Components
– CPU CX9010-1001

The CX9000 and CX9010 Embedded PCs offer a compact and high-performance yet cost-effective PLC and Motion Control system for DIN rail installation. Within the Beckhoff control world they are positioned between the BX Bus Terminal Controller series and the CX1010 Embedded PC.

The main feature of these units is the energy-saving Intel®-IXP420 CPU with XScale®technology and the Microsoft Windows CE 5 operating system.

Two controllers with different processors are available:
CX9010: Intel® IXP420, 533 MHz
CX9000: Intel® IXP420, 266 MHz

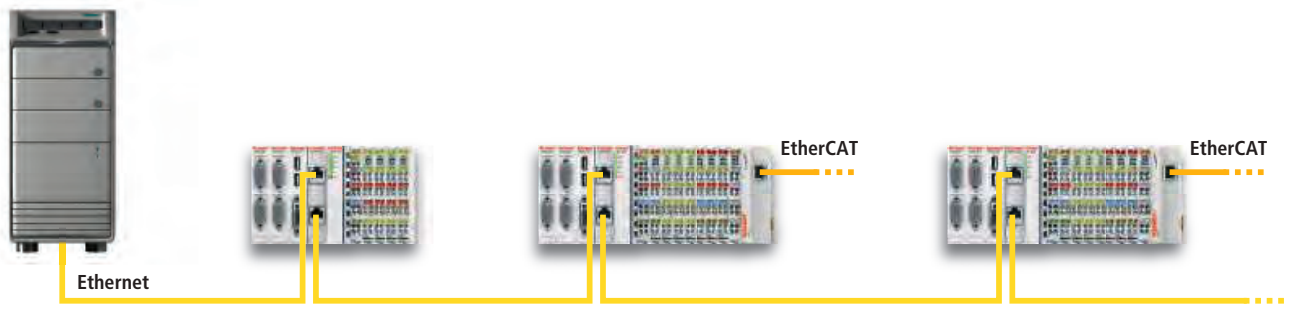
The CX9000 family requires no external storage media – the device boots the operating system from the internal flash. The CX9000/CX9010 Embedded PCs are passively cooled and therefore do without rotating components. As usual for the CX series, the device features a modular mechanical design. In its basic configuration, the compact device only measures 58 x 100 x 91 mm.

The CX9000/CX9010 controllers are available in two versions: with K-bus for direct connection of Bus Terminals, and as an E-bus version for direct connection of EtherCAT Terminals. In the basic configuration, two RJ45 sockets that are internally connected to an integrated switch are available as interfaces. This simplifies wiring of several CX9000/CX9010 within a line topology. No separate switch hardware is required. The two externally accessible Ethernet ports are independent of the EtherCAT interface, which is served by a second MAC (Media Access Controller) provided by the CPU.

Further interfaces may be added ex works as required. If a screen display is desired, this is realised by a CX90x0-N010 – a combined DVI/VGA + 2 x USB 2.0 module. The combination of DVI and USB enables all types of Beckhoff Control Panels with DVI/USB interface to be used. Touch functionality is connected via USB. As further optional interfaces, two RS232 modules or two RS422/RS485 modules can be configured as – opto-decoupled – COM1 and COM2. Mass storage devices, in the form of a Compact Flash card, can be used with the aid of the CX9000-A001 module.

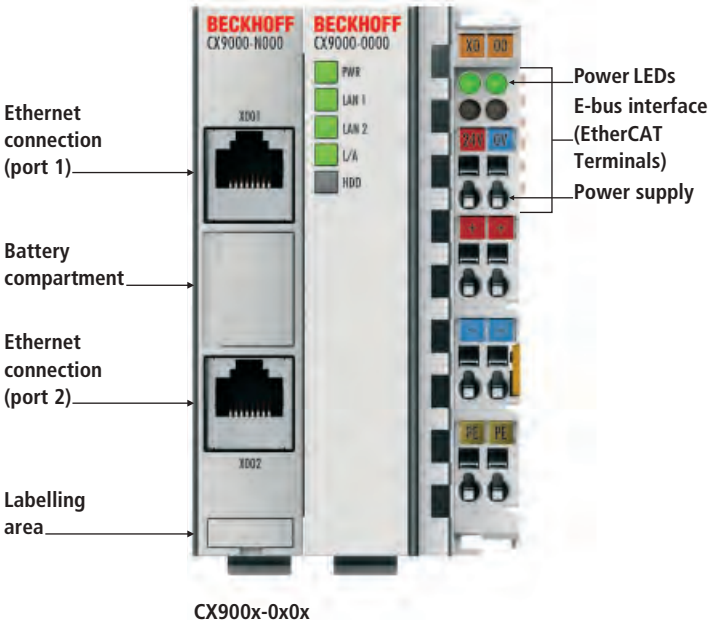
As with all Beckhoff controllers, programming as an automation device takes place using TwinCAT 2; the runtime environment for PLC (CX9000/CX9010) and Motion Control (CX9010) is located on the device itself. One of the two Ethernet interfaces is used as programming interface.

Microsoft Windows CE 5 enables the creation of fully graphic user programs, which are able to satisfy high expectations thanks to the graphics chip integrated in the CX9000/CX9010. The result is a compact Ethernet controller that enables short I/O cycle times in conjunction with EtherCAT Terminals and offers high-performance software with Windows CE and TwinCAT 2.



The CX9000 and the CX9010 enable configuration of an IT line topology with subordinate EtherCAT devices.

▶ www.beckhoff.com/CX9000

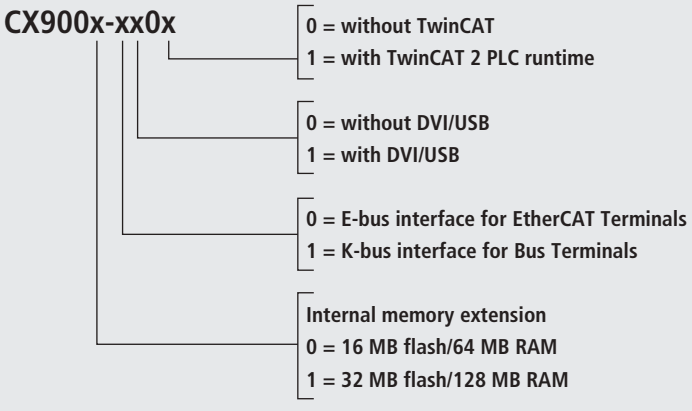


CX9000 | Basic CPU module

The CX9000 is a compact, DIN rail-mountable Ethernet controller with Intel® IXP420 with XScale® technology and 266 MHz clock frequency. The connection for the Beckhoff I/O systems is directly integrated in the CPU module. The CX9000 is available in two basic versions: one version for Bus Terminals with K-bus, the other one for EtherCAT Terminals with E-bus. The CX9000 comprises the CPU, the internal flash memory with two configuration options, the main memory (RAM) (available in two different sizes), and NOVRAM as non-volatile memory. Two Ethernet RJ45 interfaces are also part of the basic configuration. These interfaces are connected to an internal switch and offer a simple option for creating a line topology without the need for additional Ethernet switches.

A memory medium in Compact Flash format I and II is available as an optional module. The operating system is Microsoft Windows CE 5. The TwinCAT 2 automation software transforms a CX9000 system into a powerful PLC and Motion Control system that can be operated with or without visualisation. Further system interfaces can be connected to the CPU module ex factory. The CX9000-N010 option can be connected to Beckhoff Control Panels or standard monitors with DVI or VGA input via the DVI and USB interfaces. Devices such as printer, scanner, mouse, keyboard, mass storage, etc. can be connected via the USB 2.0 interfaces. The module CX9000-N030 offers two serial RS232 interfaces with a maximum transfer speed of 115 kbaud. These two interfaces can be implemented as RS422/RS485, in which case they are identified as CX9000-N031.

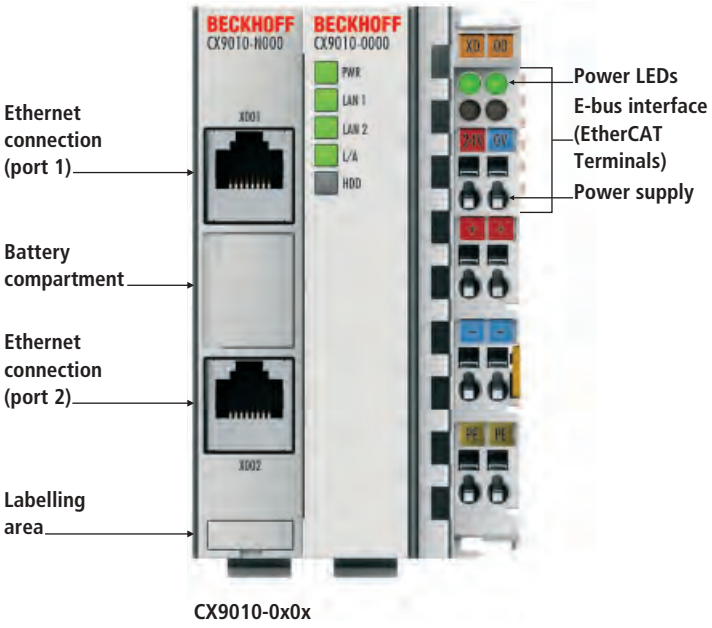
The order identifier of the basic CPU module is derived as follows:



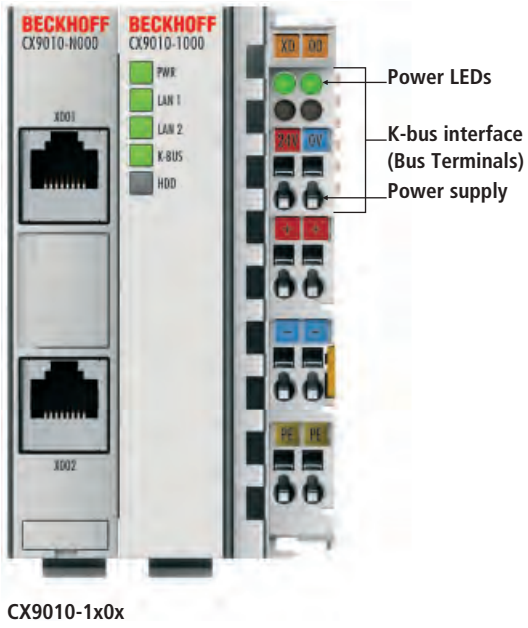
Since not all combinations make sense, the table "Ordering information" contains a breakdown of the permissible combinations.

Technical data	CX900x-0x0x	CX900x-1x0x
Processor	266 MHz Intel® IXP420 with XScale® technology	
Flash memory	16 MB flash (internal, optionally 32 MB)	
Internal main memory	64 MB RAM (internal, optionally 128 MB)	
Interfaces	2 x RJ45 (Ethernet, internal switch), 10/100 Mbit/s	
Diagnostics LED	1 x power, 2 x LAN, 1 x L/A, 1 x flash access	1 x power, 2 x LAN, 1 x K-bus, 1 x flash access
Clock	internal battery-backed clock for time and date (battery exchangeable)	
Operating system	Microsoft Windows CE 5	
Control software	TwinCAT 2 CE PLC runtime	
I/O connection	E-bus (EtherCAT Terminals)	K-bus (Bus Terminals)
Power supply	24 V DC (-15 %/+20 %)	
NOVRAM	128 kbytes	
I/O-DPRAM	–	4 kbytes
Current supply E-bus/K-bus	2 A	
Max. power loss	6 W (including the system interfaces CX9000-xxxx)	
Dimensions (W x H x D)	59 mm x 100 mm x 91 mm	
Weight	approx. 250 g (without heat sink), approx. 375 g (with heat sink for variants with DVI/USB interface)	
Operating/storage temperature	0…+55 °C/-25…+85 °C	
Relative humidity	95 %, no condensation	
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27	
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4	
Protection class	IP 20	
Approvals	CE, UL	
Further information	www.beckhoff.com/CX9000	

Ordering information	16 MB flash 64 MB RAM	32 MB flash 128 MB RAM	E-bus	K-bus	DVI/USB	no TwinCAT	TwinCAT 2 PLC runtime
CX9000-0000	x	–	x	–	–	x	–
CX9000-0001	x	–	x	–	–	–	x
CX9001-0000	–	x	x	–	–	x	–
CX9001-0001	–	x	x	–	–	–	x
CX9001-0100	–	x	x	–	x	x	–
CX9001-0101	–	x	x	–	x	–	x
CX9000-1000	x	–	–	x	–	x	–
CX9000-1001	x	–	–	x	–	–	x
CX9001-1000	–	x	–	x	–	x	–
CX9001-1001	–	x	–	x	–	–	x
CX9001-1100	–	x	–	x	x	x	–
CX9001-1101	–	x	–	x	x	–	x



CX9010-0x0x



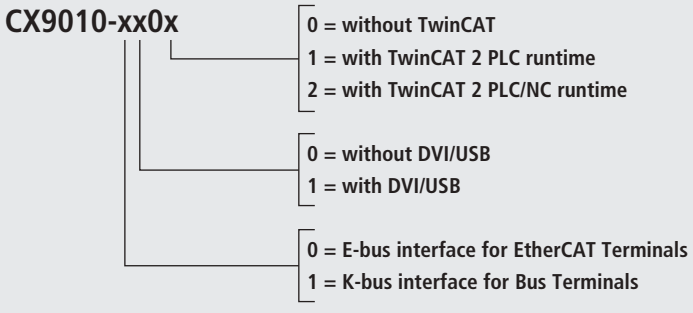
CX9010-1x0x

CX9010 | Basic CPU module

The CX9010 is a compact, DIN rail-mountable Ethernet controller with Intel® IXP420 with XScale® technology and 533 MHz clock frequency. The connection for the Beckhoff I/O systems is directly integrated in the CPU module. The CX9010 is available in two basic versions: one version for Bus Terminals with K-bus, the other one for EtherCAT Terminals with E-bus. The CX9010 comprises the CPU, the internal flash memory, the main memory (RAM) and NOVRAM as non-volatile memory. Two Ethernet RJ45 interfaces are also part of the basic configuration. These interfaces are connected to an internal switch and offer a simple option for creating a line topology without the need for additional Ethernet switches.

A memory medium in Compact Flash format I and II is available as an optional module. The operating system is Microsoft Windows CE 5. The TwinCAT 2 automation software transforms a CX9010 system into a powerful PLC and Motion Control system that can be operated with or without visualisation. Further system interfaces can be connected to the CPU module ex factory. The CX9010-N010 option can be connected to Beckhoff Control Panels or standard monitors with DVI or VGA input via the DVI or USB interfaces. Devices such as printer, scanner, mouse, keyboard, mass storage, etc. can be connected via the USB 2.0 interfaces. The module CX9010-N030 offers two serial RS232 interfaces with a maximum transfer speed of 115 kbaud. These two interfaces can be implemented as RS422/RS485, in which case they are identified as CX9010-N031.

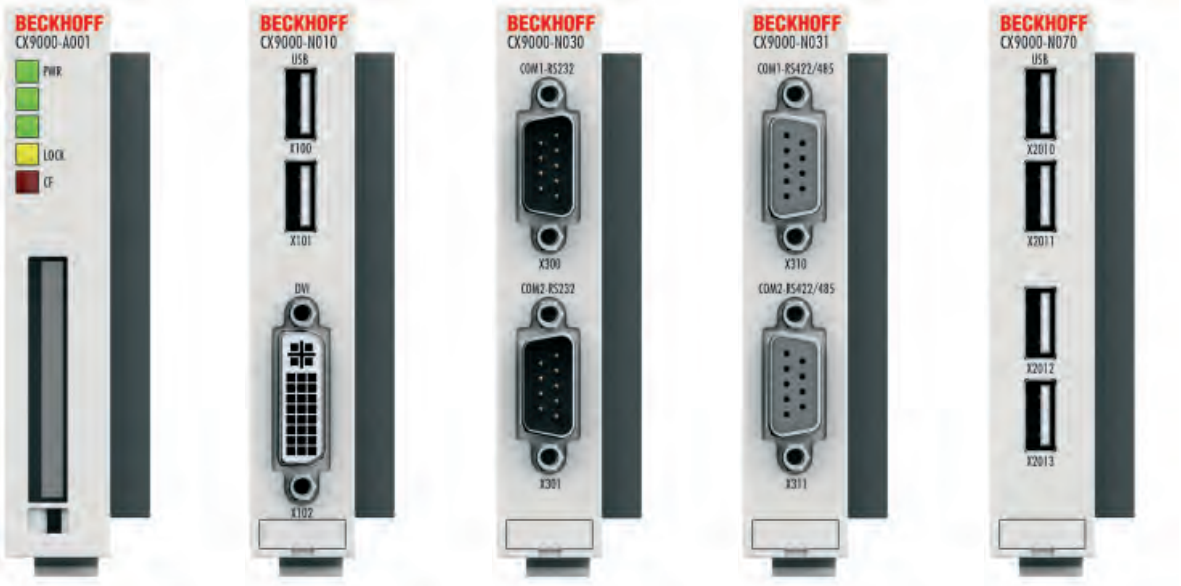
The order identifier of the basic CPU module is derived as follows:



Since not all combinations make sense, the table "Ordering information" contains a breakdown of the permissible combinations.

Technical data	CX9010-0x0x	CX9010-1x0x
Processor	Intel® IXP420 with XScale® technology, clock frequency 533 MHz	
Flash memory	32 MB Flash (internal, not expandable)	
Internal main memory	128 MB RAM (internal, not expandable)	
Interfaces	2 x RJ45 (Ethernet, internal switch), 10/100 Mbit/s	
Diagnostics LED	1 x power, 2 x LAN, 1 x L/A, 1 x flash access	1 x power, 2 x LAN, 1 x K-bus, 1 x flash access
Clock	internal battery-backed clock for time and date (battery exchangeable)	
Operating system	Microsoft Windows CE 5	
Control software	TwinCAT 2 CE PLC runtime or TwinCAT 2 CE NC PTP runtime	
I/O connection	E-bus (EtherCAT Terminals)	K-bus (Bus Terminals)
Power supply	24 V DC (-15 %/+20 %)	
NOVRAM	128 kbytes	
I/O-DPRAM	–	4 kbytes
Current supply E-bus/K-bus	2 A	
Max. power loss	6.5 W (including the system interfaces CX9010-xxxx)	
Dimensions (W x H x D)	59 mm x 100 mm x 91 mm	
Weight	approx. 250 g	
Operating/storage temperature	0…+50 °C/-25…+85 °C	
Relative humidity	95 %, no condensation	
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27	
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4	
Protection class	IP 20	
Approvals	CE, UL	
Further information	www.beckhoff.com/CX9010	

Ordering information	E-bus	K-bus	DVI/USB	no TwinCAT	TwinCAT 2 PLC runtime	TwinCAT 2 NC runtime
CX9010-0000	x	–	–	x	–	–
CX9010-0001	x	–	–	–	x	–
CX9010-0002	x	–	–	–	x	x
CX9010-0100	x	–	x	x	–	–
CX9010-0101	x	–	x	–	x	–
CX9010-0102	x	–	x	–	x	x
CX9010-1000	–	x	–	x	–	–
CX9010-1001	–	x	–	–	x	–
CX9010-1002	–	x	–	–	x	x
CX9010-1100	–	x	x	x	–	–
CX9010-1101	–	x	x	–	x	–
CX9010-1102	–	x	x	–	x	x



Compact Flash module | **DVI/USB interface** | **RS232 interface** | **RS422/RS485 interface** | **4-port USB hub**

CX9000/CX9010-A001/N0xx | System interfaces

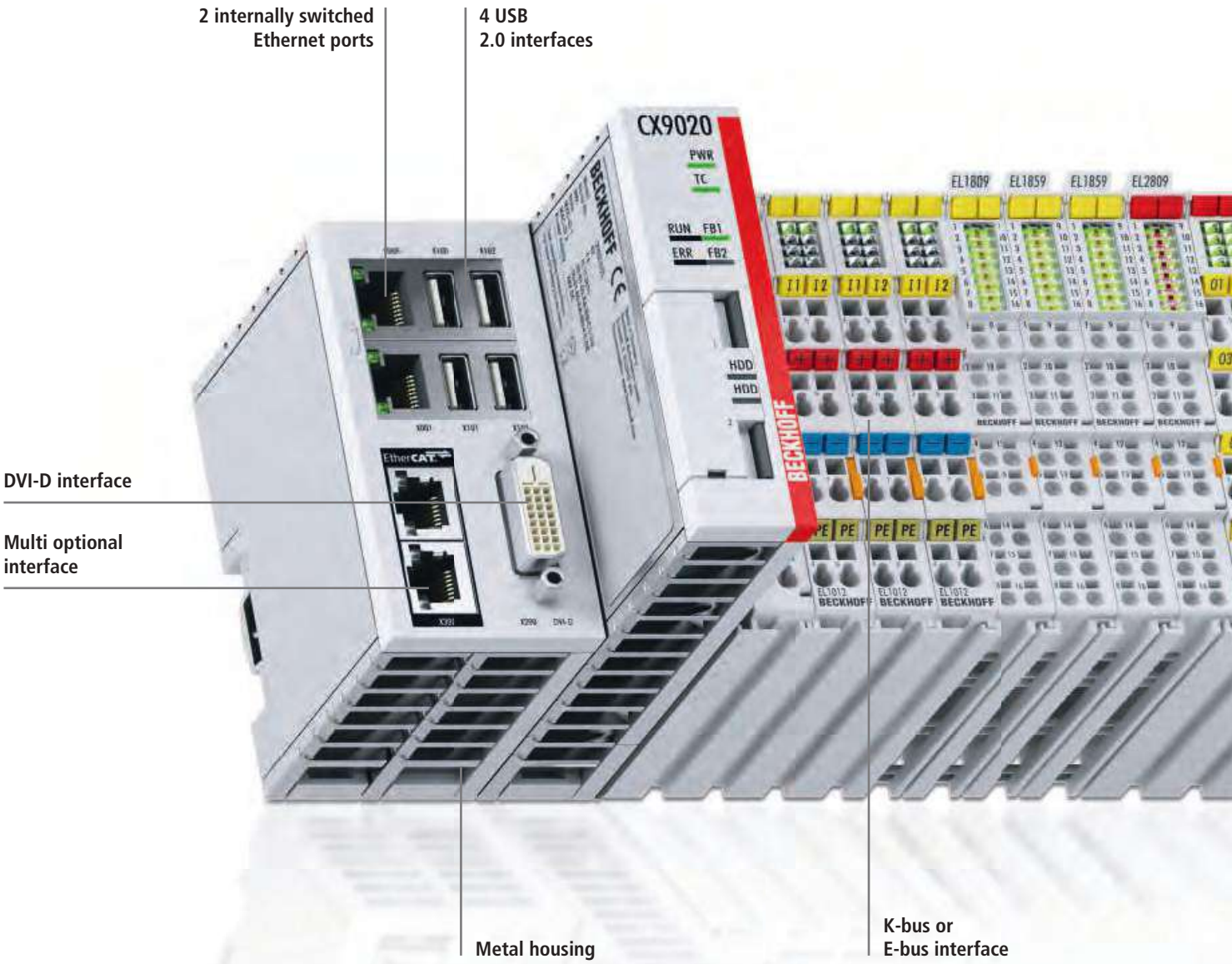
A number of optional interface modules are available for the CX9000/CX9010 Embedded PCs that can be connected to the basic module ex factory. The system interfaces cannot be retrofitted or expanded in the field. They are supplied ex factory in the specified configuration and cannot be separated from the CPU module. The power supply of the system interface modules is ensured via the internal bus.

The CX90x0-N010 option connects Beckhoff Control Panels or standard monitors with DVI or VGA input via the DVI or USB interfaces. Devices such as printer, scanner, mouse, keyboard, etc. can be connected via the USB 2.0 interfaces. The CX90x0-N030 module offers two additional serial RS232 interfaces with a maximum transmission speed of 115 kbaud. Alternatively, the two serial interfaces are also available as RS422/RS485 signal types (CX90x0-N031). The CX90x0-N070 4-port USB hub extends the number of available USB 2.0 ports, whereby each port can handle a load of max. 500 mA (however, not all four at the same time). In this way, a total of six USB interfaces per CX are available to the user.

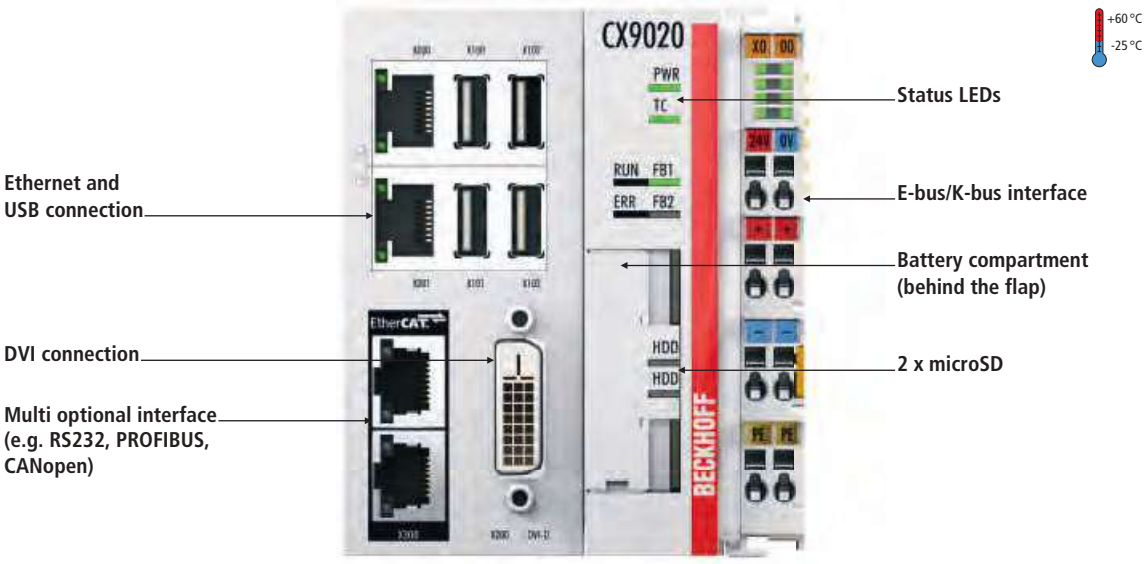
If additional mass storage is required, the CX90x0-A001 extension module provides a Compact Flash interface for type I or II CF cards. Unlike other system interfaces, this module can be upgraded in the field. Cards may only be inserted or removed when the system is switched off.

Technical data	CX9000-A001 CX9010-A001	CX9000-N010 CX9010-N010	CX9000-N030 CX9010-N030	CX9000-N031 CX9010-N031	CX9000-N070 CX9010-N070
Interfaces	Compact Flash module	1 x DVI + 2 x USB 2.0 (max. 500 mA per port)	1 x COM1 + 1 x COM2, RS232	1 x COM1 + 1 x COM2, RS422/RS485	4 x USB 2.0
Type of connection	Compact Flash slot for type I + II cards	DVI-I 29-pin socket + 2 USB ports type A	2 x D-sub plug, 9-pin	2 x D-sub socket, 9-pin	4 x USB ports type A
Properties	Compact Flash mass storage	DVI-I interface also carries out VGA signals (DVI-A)	max. baud rate 115 kbaud, cannot be used simultaneously with N031	max. baud rate 115 kbaud, cannot be used simultaneously with N030	max. baud rate 480 Mbit/s, max. output current per port 500 mA, max. total current 500 mA
Power supply	via system bus (through power supply unit in the CX9000/CX9010)				
Dimensions (W x H x D)	19 mm x 100 mm x 51 mm				
Weight	approx. 80 g				
Operating/storage temperature	0…+55 °C/-25…+85 °C				
Relative humidity	95 %, no condensation				
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27				
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4				
Protection class	IP 20				
Approvals	CE, UL				
Further information	www.beckhoff.com/CX9000-A001				

CX9020 | Embedded PCs



▶ www.beckhoff.com/CX9020



CX9020 | Basic CPU module

The CX9020 is a compact, DIN rail-mountable Ethernet control system with 1 GHz ARM Cortex™-A8 CPU. The connection for the Beckhoff I/O systems is directly integrated into the CPU module. The unit offers automatic bus system identification (K-bus or E-bus) and independently switches in the corresponding mode. The CX9020 comprises the CPU with two microSD card slots, the internal RAM and 128 kB NOVRAM as non-volatile memory. The basic configuration also includes two switched Ethernet RJ45 interfaces, four USB-2.0 interfaces and a DVI-D interface. The RJ45 interfaces are connected to an internal switch and offer a simple option for creating a line topology without the need for additional Ethernet switches. The operating system is Microsoft Windows Embedded Compact 7. TwinCAT 2 automation software transforms a CX9020 system into a powerful PLC and Motion Control system that can be operated with or without visualisation. Optionally, the unit can be ordered with a fieldbus, serial or audio interface.

The extended operating temperature range between -25 and +60 °C enables application in climatically demanding situations.

The order identifier of the basic CPU module is derived as follows:

CX9020-011T

- 0 = operating system only/ optional TwinCAT 3
- 1 = with TwinCAT 2 PLC runtime
- 2 = with TwinCAT 2 PLC/NC runtime

Optional interfaces:

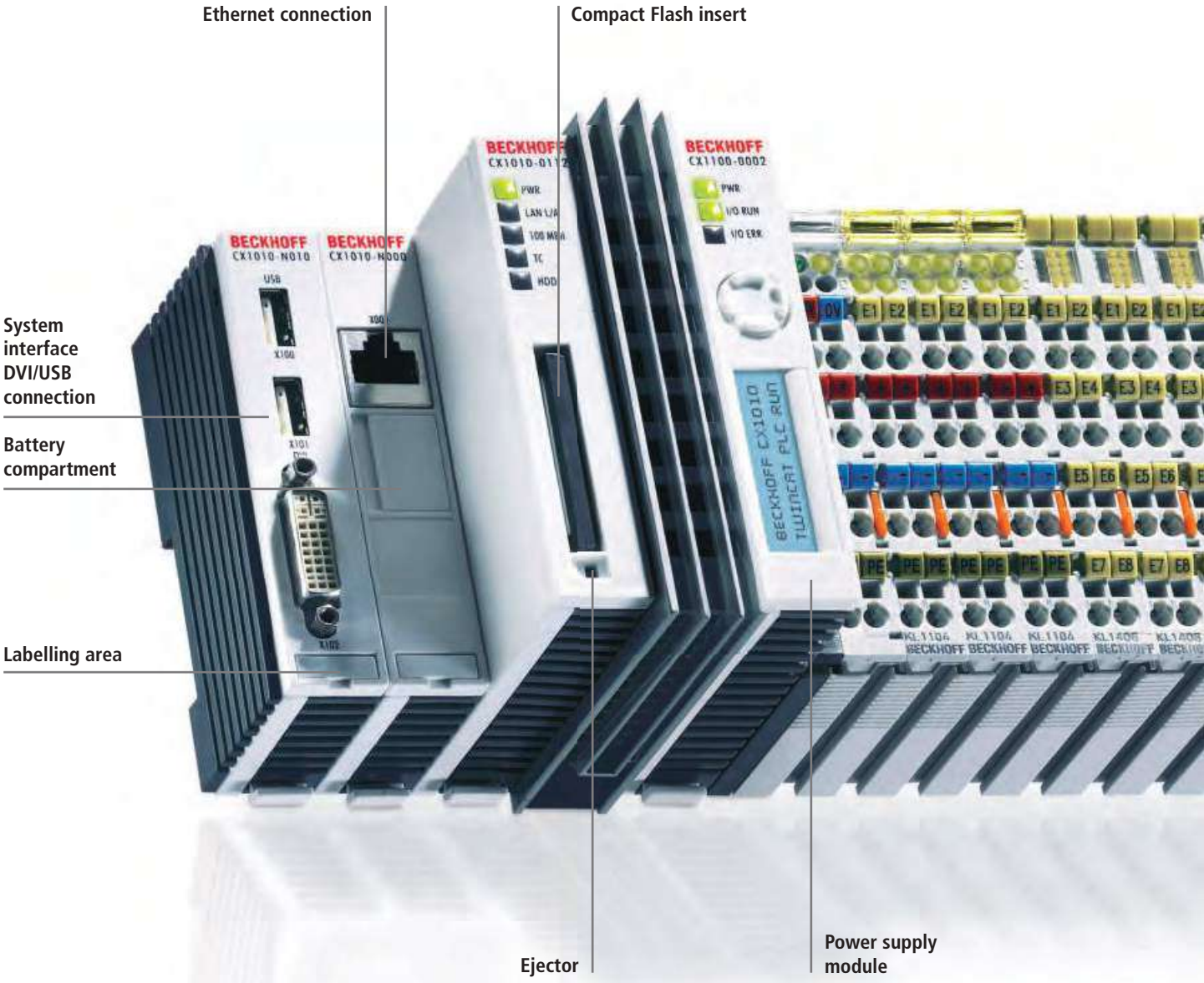
- CX9020-N020 = audio interface
- CX9020-N030 = RS232, D-sub plug
- CX9020-N031 = RS422/RS485, D-sub socket
- CX9020-B110 = EtherCAT slave, EtherCAT IN and OUT (2 x RJ45)
- CX9020-M310 = PROFIBUS master, D-sub socket, 9-pin
- CX9020-B310 = PROFIBUS slave, D-sub socket, 9-pin
- CX9020-M510 = CANopen master, D-sub plug, 9-pin
- CX9020-B510 = CANopen slave, D-sub plug, 9-pin
- CX9020-M930 = PROFINET RT, controller
- CX9020-B930 = PROFINET RT, device, Ethernet (2 x RJ45 switch)
- CX9020-B950 = EtherNet/IP slave, Ethernet (2 x RJ45 switch)

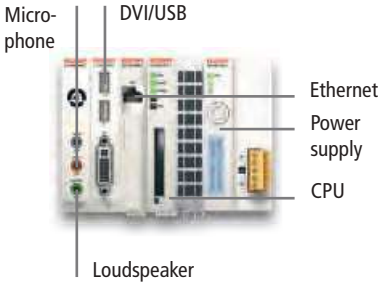
Technical data	CX9020
Processor	ARM Cortex™-A8, 1 GHz (TC3: 30)
Flash memory	512 MB microSD (optionally expandable), 2 x microSD card slot
Internal main memory	1 GB DDR3 RAM
Persistent memory	128 KB NOVRAM integrated
Interfaces	2 x RJ45 (Ethernet, internal switch), 10/100 Mbit/s, DVI-D, 4 x USB 2.0, 1 x optional interface
Diagnostics LED	1 x power, 1 x TC status, 2 x flash access, 2 x bus status
Clock	internal battery-backed clock for time and date (battery exchangeable)
Operating system	Microsoft Windows Embedded Compact 7, English
Control software	TwinCAT 2 PLC runtime or TwinCAT 2 NC PTP runtime | TwinCAT 3, see price list TwinCAT 3
Power supply	24 V DC (-15 %/+20 %)
Current supply E-bus/K-bus	2 A
Max. power loss	5 W (including the system interfaces)
Dimensions (W x H x D)	84 mm x 99 mm x 91 mm
Weight	approx. 590 g
Operating/storage temperature	-25…+60 °C/-40…+85 °C
Relative humidity	95 %, no condensation
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4
Protection class	IP 20
Approvals	CE, UL, GL
TC3 performance class	economy plus (30); for further information on TwinCAT 3 see page 898
Further information	www.beckhoff.com/CX9020

Ordering information	optional TwinCAT 3	TwinCAT 2 PLC runtime	TwinCAT 2 NC PTP runtime
CX9020-0110	x	–	–
CX9020-0111	–	x	–
CX9020-0112	–	–	x

Option	
CX9020-U900	internal, capacitive 1-second UPS to ensure secure backup of persistent application data on the microSD card

CX1010 | Embedded PCs





Application example multimedia system with audio connection
- multimedia system (e.g. building automation)
- audio interface
- Windows Embedded Standard 2009 (no TwinCAT)

Components
- CPU CX1010-0120 (DVI/USB, audio interface)
- power supply CX1100-0001

The basic CX1010 module is the basic device of the CX family. With a 500 MHz Pentium® MMX-compatible processor it offers average CPU performance. Depending on the application the CX1010 can also be operated in "headless" mode, i.e. without display and keyboard. If local visualisation is required, this can be implemented via a DVI (digital video interface), to which all Beckhoff Control Panels and all commercially available monitors with DVI input or VGA input can be connected. The touch screen signal is read via one of the two available USB interfaces.

The components

The individual system components are modules with a width of 19 mm (single) or 38 mm (double) that can be arranged in series. The basic unit consists of a (CX1010) CPU module and a power supply module (CX1100-000x).

The CPU module is available in several variants, e.g.:
- System interfaces: as an option, a DVI and two USB interfaces can be added to the existing Ethernet interface. Further system interfaces for serial communication (2 x RS232 or 2 x RS422/485) or audio signals can be ordered separately.
- Operating system: There is a choice of no operating system, Microsoft Windows Embedded CE 6 or Microsoft Windows Embedded Standard 2009.
- TwinCAT 2 software (pre-installed): without a TwinCAT 2 system, with TwinCAT 2 CE PLC or with TwinCAT 2 CE NC PTP, or with the associated full version of the individual TwinCAT 2 levels for PLC and NC PTP

Power supply unit with integrated I/O interface

For the 24 V DC power supply unit there is a choice of four different versions:
- CX1100-0001: without I/O interface
- CX1100-0002: with terminal bus interface for Beckhoff Bus Terminals
- CX1100-0003: with terminal bus interface for Beckhoff Bus Terminals and IP-Link interface for Beckhoff Fieldbus Box modules
- CX1100-0004: with terminal bus interface for Beckhoff EtherCAT Terminals

All power supply variants have an illuminated, low-glare LC-display with FSTN technology and two rows with 16 characters each for displaying status messages. The application programs can also use the display for displaying application-specific texts. 8 kB of non-volatile memory for remanent data are also included.

The range of optional modules is complemented by fieldbus connections for PROFIBUS, CANopen, DeviceNet, SERCOS interface and Lightbus, both as master or slave versions.

PLC, Motion Control and visualisation

In combination with TwinCAT 2 automation software, the CX1010 Embedded PC becomes a powerful IEC 61131-3 PLC with up to four user tasks. Additionally, Motion Control tasks can also be executed. Depending on the required cycle time, several servo axes can be controlled. Even special functions such as "flying saw", "electronic gearbox" and cam plate can be realised. Under Windows Embedded CE 6, thanks to the real-time capability of the operating system, user tasks written in high-level languages can be processed in real-time in parallel with TwinCAT 2.

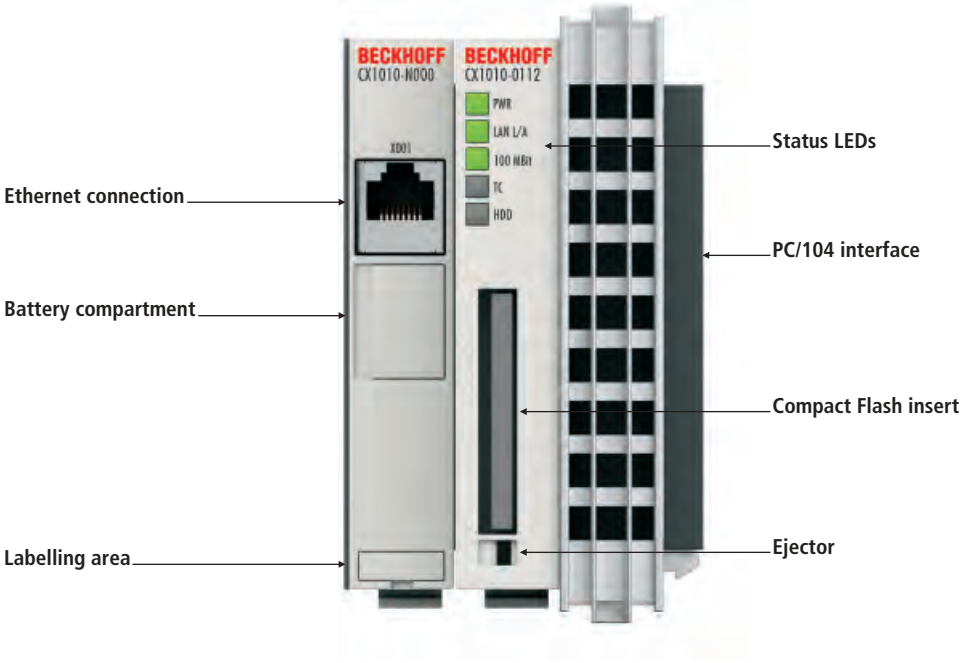
Remote programming via Ethernet

The CX1010 units are programmed via a laptop or a desktop PC that is connected with the CX1010 via Ethernet (network or crossover cable). The programs are developed on the lap top with a standard TwinCAT 2 software license and then loaded into the target device.

Operating systems

As with all x86-based CX devices, both Windows Embedded Standard 2009 and Windows Embedded CE 6 are available as the operating system. The latter has the advantages of faster boot up and lower license costs. The Beckhoff OPC server for connection to SCADA packages is available for both operating systems variants. The same applies to the CX1010: easy visualisation and at the same time real-time control on one system.

▶ **www.beckhoff.com/CX1010**



CX1010 | Basic CPU module

The CX1010 CPU module is the basic module of the CX system. It comprises the CPU and the internal flash memory in two implementation levels and offers the option to operate an additional memory medium in Compact Flash format II. An Ethernet interface is also part of the basic configuration. All other CX family components can be connected via the PC/104 interface that is available on both sides. The CPU module can be equipped with different hardware and software options: the operating system can be Windows Embedded CE 6 or Windows Embedded Standard 2009.

The basic configuration of the CX1010 includes a 128 MB Compact Flash card. The TwinCAT 2 automation software transforms a CX1010 system into a powerful PLC and Motion Control system that can be operated with or without visualisation. Further system interfaces or fieldbus connections can be added to the basic CPU module. The passive cooling module is included in the scope of supply. The CPU module requires a CX1100 type power supply module.

The order identifier of the basic CPU module is derived as follows:

CX1010-0xxx

- 0 = without TwinCAT
- 1 = with TwinCAT 2 PLC runtime
- 2 = with TwinCAT 2 PLC/NC runtime

- 0 = without operating system
- 1 = operating system Windows Embedded CE 6
- 2 = operating system Windows Embedded Standard 2009

- 0 = CPU with Ethernet
- 1 = CPU with Ethernet + 2 x USB + DVI

Since not all combinations make sense, the table "Ordering information" contains a breakdown of the permissible combinations.

Embedded PC interfaces for CX1010
see page 238

Technical data	CX1010-0xxx
Processor	compatible with Pentium® MMX, clock frequency 500 MHz
Flash memory	128 MB Compact Flash card (optionally extendable)
Internal main memory	256 MB DDR RAM (not expandable)
Interfaces	1 x RJ45 (Ethernet), 10/100 Mbit/s
Diagnostics LED	1 x power, 1 x LAN speed, 1 x LAN activity, TC status, 1 x flash access
Expansion slot	1 x Compact Flash type II insert with ejector
Clock	internal battery-backed clock for time and date (battery exchangeable)
Operating system	Microsoft Windows Embedded CE 6 or Microsoft Windows Embedded Standard 2009
Control software	TwinCAT 2 PLC runtime or TwinCAT 2 NC PTP runtime
System bus	16 bit ISA (PC/104)
Power supply	via system bus (through CX1100-xxxx power supply modules)
Max. power loss	8 W (including the system interfaces CX1010-N0xx)
Dimensions (W x H x D)	58 mm x 120 mm x 91 mm
Weight	approx. 355 g
Operating/storage temperature	0…+50 °C/-25…+85 °C
Relative humidity	95 %, no condensation
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4
Protection class	IP 20
Approvals	CE, UL
Further information	www.beckhoff.com/CX1010

Ordering information	DVI/USB	Windows Embedded CE 6	Windows Embedded Standard 2009	TwinCAT 2 PLC runtime	TwinCAT 2 NC runtime
CX1010-0000	–	–	–	–	–
CX1010-0010	–	x	–	–	–
CX1010-0011	–	x	–	x	–
CX1010-0012	–	x	–	x	x
CX1010-0020	–	–	x*	–	–
CX1010-0021	–	–	x*	x	–
CX1010-0022	–	–	x*	x	x
CX1010-0100	x	–	–	–	–
CX1010-0110	x	x	–	–	–
CX1010-0111	x	x	–	x	–
CX1010-0112	x	x	–	x	x
CX1010-0120	x	–	x*	–	–
CX1010-0121	x	–	x*	x	–
CX1010-0122	x	–	x*	x	x

*CX1010 systems with Microsoft Embedded Standard 2009 require Compact Flash with a capacity of at least 2 GB (must be ordered separately).

DVI/USB interface

Audio interface

RS232 interface

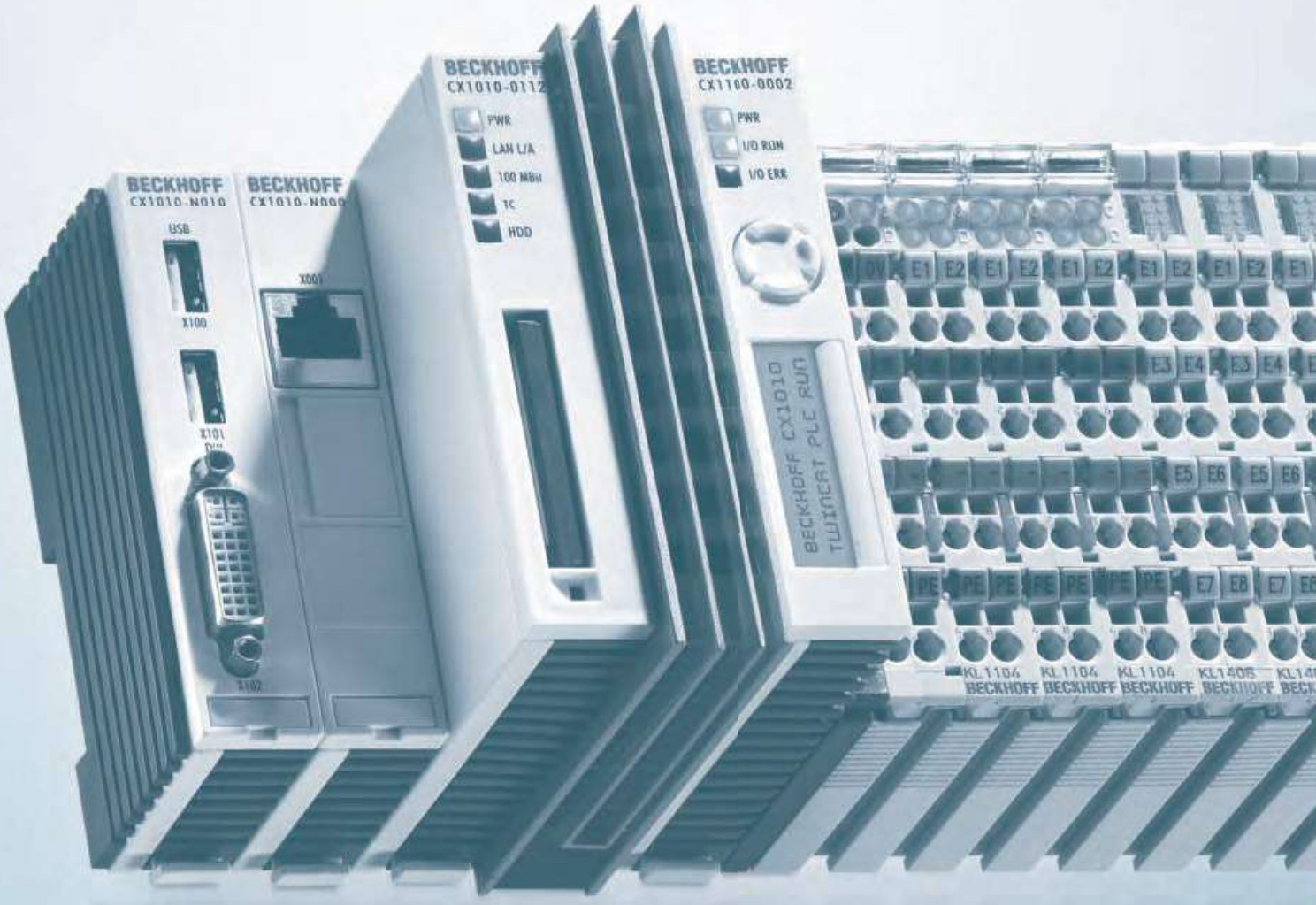
RS422/RS485 interface

Ethernet interface

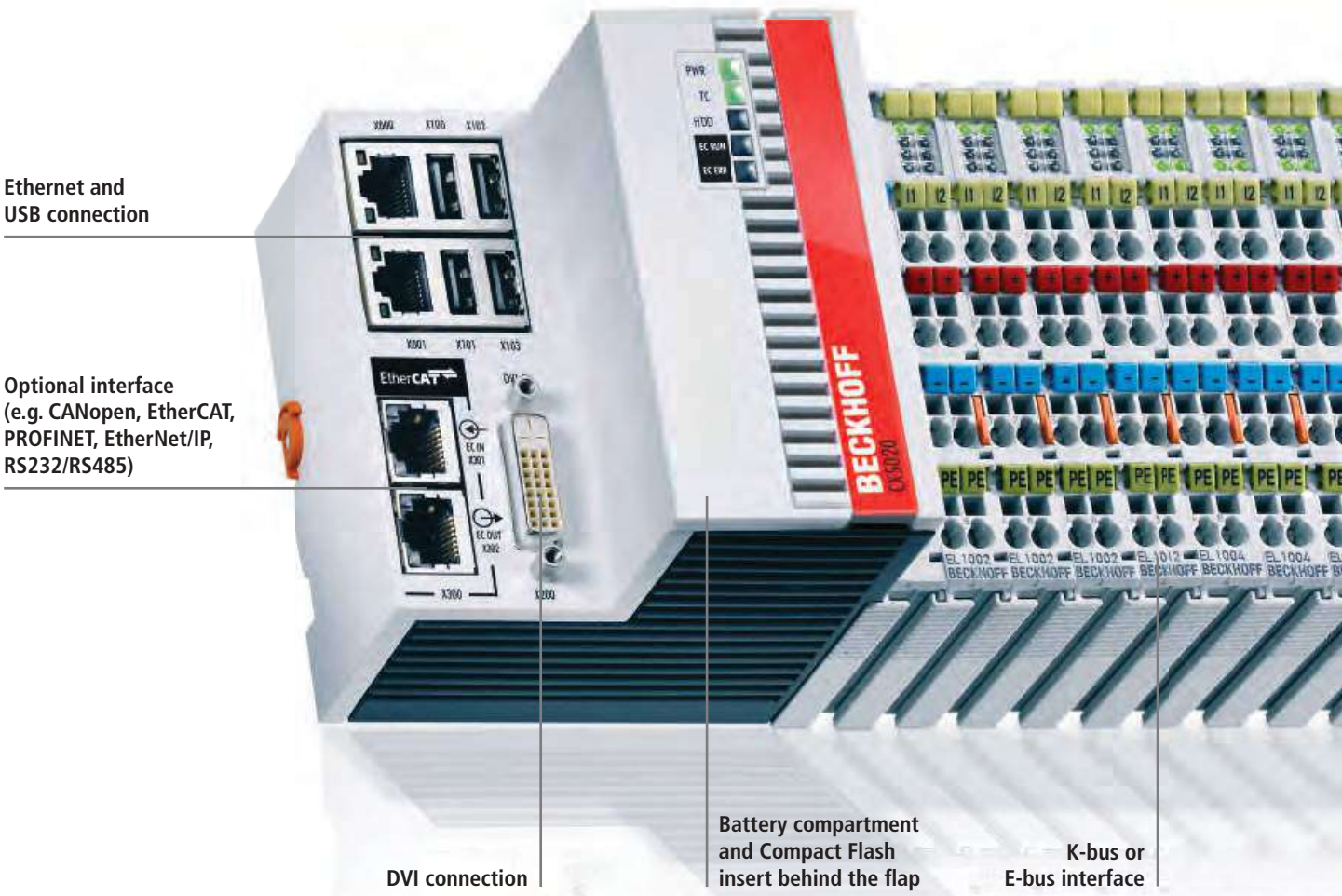
CX1010-N0xx | System interfaces

A number of optional interface modules are available for the basic CX1010 CPU module that can be installed ex factory. The CX1010-N010 option connects Beckhoff Control Panels or standard monitors with DVI or VGA input via the DVI or USB interfaces. Devices such as printer, scanner, mouse, keyboard, mass storage, etc. can be connected via the USB 2.0 interfaces. Multimedia capability is realised via the CX1010-N020 audio interface. The modules CX1010-N030 and CX1010-N040 offer a total of four serial RS232 interfaces with a maximum transfer speed of 115 kbaud. These four interfaces can be implemented in pairs as RS422/RS485, in which case they are identified as CX1010-N031 and CX1010-N041 respectively. The system interfaces cannot be retrofitted or expanded in the field. They are supplied ex factory in the specified configuration and cannot be separated from the CPU module. The internal PC/104 bus runs through the system interfaces, so that further CX components can be connected. The power supply of the system interface modules is ensured via the internal PC/104 bus.

Technical data	CX1010-N010	CX1010-N020	CX1010-N030 CX1010-N040	CX1010-N031 CX1010-N041	CX1010-N060
Interfaces	1 x DVI + 2 x USB 2.0 (max. 500 mA per port)	Line IN, Line Mic IN, Line OUT	1 x COM1+2, RS232, 1 x COM3+4, RS232	1 x COM1+2, RS422/ RS485, 1 x COM3+4, RS422/RS485	1 x Ethernet, 10/100 Mbit/s
Type of connection	DVI-I 29-pin socket + 2 USB ports type A	3.5 mm socket for jack plug	2 x D-sub plug, 9-pin	2 x D-sub socket, 9-pin	1 x RJ45
Properties	DVI-I interface also carries out VGA signals (DVI-A)	built-in PC beeper, Line OUT output, max. 200 mW, suitable for ear-phones	max. baud rate 115 kbaud, cannot be used simultaneously with N031/N041	max. baud rate 115 kbaud, cannot be used simultaneously with N030/N040	max. baud rate 100 Mbit/s, max. 20 m cable length CAT5, cannot be used simultaneously with CX1100-0004
Power supply	via system bus (through CX1100-xxxx power supply modules)				
Dimensions (W x H x D)	19 mm x 100 mm x 51 mm				
Weight	approx. 80 g				
Operating/storage temperature	0…+55 °C/-25…+85 °C				
Relative humidity	95 %, no condensation				
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27				
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4				
Protection class	IP 20				
Approvals	CE, UL				
Further information	www.beckhoff.com/CX1010-N010				


BECKHOFF
CX1010-N010
BECKHOFF
CX1010-N000
BECKHOFF
CX1010-0112
BECKHOFF
CX1100-0002
USB
X100
X101
X102
X001
PWR
LAN L/A
100 MBit
TC
HDD
PWR
I/O RUN
I/O ERR
BECKHOFF CX1010
TWINCAT PLC RUN
KL1104
KL1104
KL1104
KL1408
BECKHOFF
BECKHOFF
BECKHOFF
BECKHOFF

CX5000 | Embedded PC series with Intel® Atom™ processor



CX5020 with optional PROFINET interfaces

CX5020 with D-sub plug, 9-pin

CX5020 with audio interface

The CX5000 series devices are DIN rail-mountable, fanless Embedded PCs with direct connection for Beckhoff Bus Terminals or EtherCAT Terminals.

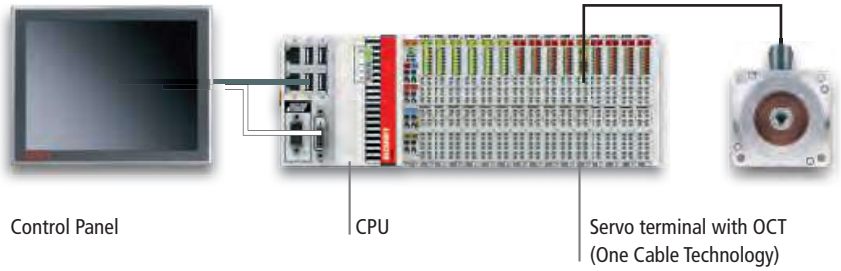
The housing concept of this series is optimised for sturdiness and compactness; the individual housing parts are made of metal (magnesium). Apart from the electrical advantages of better screening and ESD protection, the user also benefits from the weight-saving magnesium construction.

The I/O level can be implemented both with Bus Terminals and with EtherCAT Terminals. The connection of EtherCAT gives rise to many different extension options. Further master/slave fieldbus connections (PROFIBUS, CANopen, DeviceNet) or communication interfaces (RS232, RS422/RS485) and all other signal types accessible via EtherCAT can be directly connected as EtherCAT Terminals.

Two independent Gigabit Ethernet ports and four USB 2.0 interfaces are available. A Beckhoff Control Panel or a commercially available DVI monitor can be connected to the DVI-D interface. Unlike the other CX device families, the CX5000 series has no option for expansion using attachable expansion modules to the left. There is, however, a factory-fitted option slot in the basic housing. For example, a serial port (RS232/RS422/RS485) or a fieldbus connection with master or slave function can be added here as an optional interface as required. Particularly worth mentioning is the function as an EtherCAT slave, as a result of which the CX5000 becomes a programmable local controller within an EtherCAT network.

The operating system can be Windows Embedded CE 6 or Windows Embedded Standard 2009. An exchangeable, industrially-compatible CF card, which can be accessed behind a panel, is used as boot and storage medium. The CF card serves as a substitute for a hard disk; i.e. the operating system as well as TwinCAT and user projects are stored on it. This way, in the case of service, hardware can be exchanged quickly or a software update can be performed on site by simply exchanging the CF card. The builtin capacitive 1-second UPS ensures secure backup of persistent application data on the CF card. The date and time are buffered via a replaceable battery.

TwinCAT automation software transforms a CX5000 system into a powerful PLC and Motion Control system that can be operated with or without visualisation.



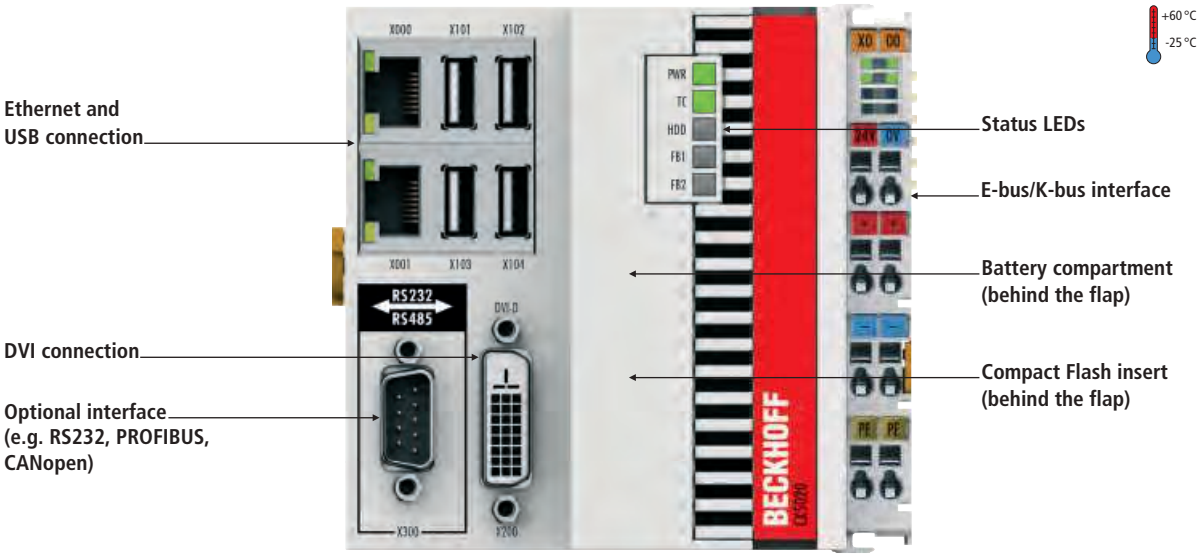
Application example: PLC and Motion Control system with DVI/USB interface

- PLC and Motion Control software
- Control Panel connection via DVI/USB
- Windows Embedded CE 6 and TwinCAT NC

Components

- CPU CX5020-0112
- display CP39xx
- drive: EL7211-0010 servo terminal and AM8131-wF1z motor

▶ **www.beckhoff.com/CX5000**



CX5000 | Embedded PC series with Intel® Atom™ processor

The CX5010 and CX5020 are Embedded PCs from the CX5000 series based on Intel® Atom™ processors and differ only by the CPU version. The CX5010 has a 1.1 GHz Intel® Atom™ Z510 processor, while the CX5020 has a 1.6 GHz Intel® Atom™ Z530 processor. Apart from the clock speed, the two processors also differ by the fact that the Z530 features hyperthreading technology, i.e. it has two virtual CPU cores for more effective execution of software.

Depending on the installed TwinCAT runtime environment, the CX5010/CX5020 can be used for the implementation of PLC or PLC/Motion Control projects (with or without visualisation).

+60 °C
-25 °C

The extended operating temperature range between -25 and +60 °C enables application in climatically demanding situations.

The order identifier of the CX5000 devices is derived as follows:

CX50x0-x1xx

- 0 = operating system only/optional TwinCAT 3
- 1 = with TwinCAT 2 PLC runtime
- 2 = with TwinCAT 2 NC PTP runtime

- 0 = no operating system
- 1 = operating system Windows Embedded CE 6
- 2 = operating system Windows Embedded Standard 2009

- 0 = E-bus interface for EtherCAT Terminals
- 1 = K-bus interface for Bus Terminals

- 1 = Intel® Atom™ processor 1.1 GHz
- 2 = Intel® Atom™ processor 1.6 GHz

Since not all combinations make sense, the table "Ordering information" contains a breakdown of the permissible combinations.

Optional interfaces:

CX50x0-N020 = audio interface
CX50x0-N030 = RS232, D-sub plug
CX50x0-N031 = RS422/RS485, D-sub socket
CX50x0-M310 = PROFIBUS master, D-sub socket, 9-pin
CX50x0-B310 = PROFIBUS slave, D-sub socket, 9-pin
CX50x0-M510 = CANopen master, D-sub plug, 9-pin
CX50x0-B510 = CANopen slave, D-sub plug, 9-pin
CX50x0-M930 = PROFINET RT, controller
CX50x0-B930 = PROFINET RT, device, Ethernet (2 x RJ45 switch)
CX50x0-B950 = EtherNet/IP slave, Ethernet (2 x RJ45 switch)
CX50x0-B110 = EtherCAT slave, EtherCAT IN and OUT (2 x RJ45)

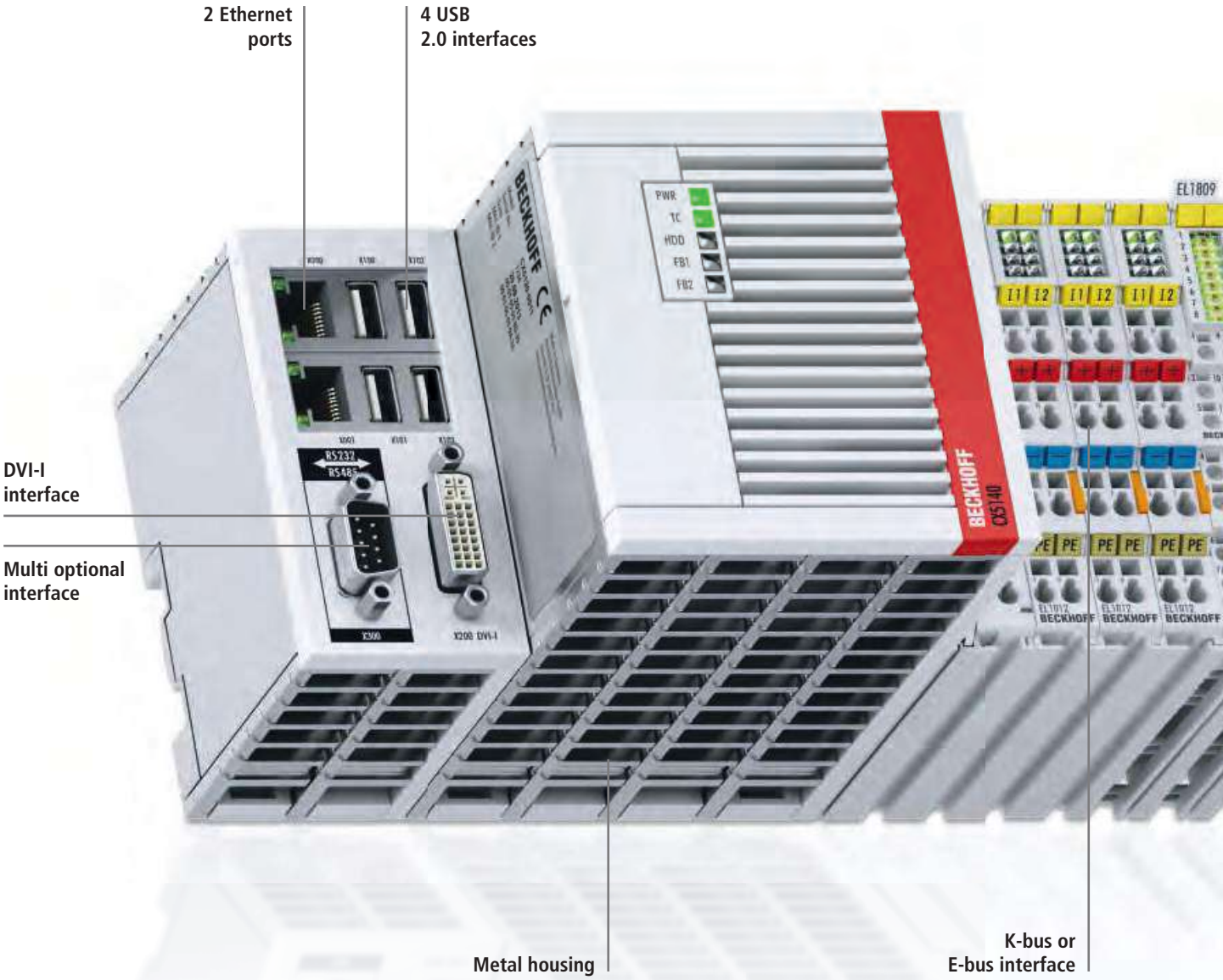
Options	
CX1900-0204	1 GB DDR2 RAM for CX5020, instead of 512 MB DDR2 RAM; pre-assembled ex factory
CX1800-0400	Microsoft Windows Embedded Standard 7 E instead of Windows Embedded Standard
CX1800-0401	Microsoft Windows Embedded Standard 7 P instead of Windows Embedded Standard

Technical data	CX5010-x1xx	CX5020-x1xx
Processor	processor Intel® Atom™ Z510, 1.1 GHz clock frequency (TC3: 40)	processor Intel® Atom™ Z530, 1.6 GHz clock frequency (TC3: 40)
Flash memory	128 MB Compact Flash card (optionally extendable)	
Internal main memory	512 MB RAM (internal, not expandable)	512 MB RAM (optionally 1 GB installed ex factory)
Persistent memory	integrated 1-second UPS (1 MB on Compact Flash card)	
Interfaces	2 x RJ45, 10/100/1000 Mbit/s, DVI-D, 4 x USB 2.0, 1 x optional interface	
Diagnostics LED	1 x power, 1 x TC status, 1 x flash access, 2 x bus status	
Clock	internal battery-backed clock for time and date (battery exchangeable)	
Operating system	Microsoft Windows Embedded CE 6 or Microsoft Windows Embedded Standard 2009	
Control software	TwinCAT 2 PLC runtime or TwinCAT 2 NC PTP runtime | TwinCAT 3, see price list TwinCAT 3	
Power supply	24 V DC (-15 %/+20 %)	
Current supply E-bus/K-bus	2 A	
Max. power loss	12 W (including the system interfaces)	12.5 W (including the system interfaces)
Dimensions (W x H x D)	100 mm x 106 mm x 92 mm	
Weight	approx. 575 g	
Operating/storage temperature	-25…+60 °C/-40…+85 °C	
Relative humidity	95 %, no condensation	
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27	
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4	
Protection class	IP 20	
Approvals	CE, UL, Ex, GL	
TC3 performance class	performance (40); for further information on TwinCAT 3 see page 898	
Further information	www.beckhoff.com/CX5010	

Ordering information	E-bus	K-bus	no operating system	Windows Embedded CE 6	Windows Embedded Standard 2009	optional TwinCAT 3	TwinCAT 2 PLC runtime	TwinCAT 2 NC PTP runtime
CX5010-0100	x	–	x	–	–	–	–	–
CX5010-0110	x	–	–	x	–	x	–	–
CX5010-0111	x	–	–	x	–	–	x	–
CX5010-0112	x	–	–	x	–	–	x	x
CX5010-0120	x	–	–	–	x*	x	–	–
CX5010-0121	x	–	–	–	x*	–	x	–
CX5010-0122	x	–	–	–	x*	–	x	x
CX5010-1100	–	x	x	–	–	–	–	–
CX5010-1110	–	x	–	x	–	x	–	–
CX5010-1111	–	x	–	x	–	–	x	–
CX5010-1112	–	x	–	x	–	–	x	x
CX5010-1120	–	x	–	–	x*	x	–	–
CX5010-1121	–	x	–	–	x*	–	x	–
CX5010-1122	–	x	–	–	x*	–	x	x
CX5020-0100	x	–	x	–	–	–	–	–
CX5020-0110	x	–	–	x	–	x	–	–
CX5020-0111	x	–	–	x	–	–	x	–
CX5020-0112	x	–	–	x	–	–	x	x
CX5020-0120	x	–	–	–	x*	x	–	–
CX5020-0121	x	–	–	–	x*	–	x	–
CX5020-0122	x	–	–	–	x*	–	x	x
CX5020-1100	–	x	x	–	–	–	–	–
CX5020-1110	–	x	–	x	–	x	–	–
CX5020-1111	–	x	–	x	–	–	x	–
CX5020-1112	–	x	–	x	–	–	x	x
CX5020-1120	–	x	–	–	x*	x	–	–
CX5020-1121	–	x	–	–	x*	–	x	–
CX5020-1122	–	x	–	–	x*	–	x	x

*CX50x0 systems with Microsoft Embedded Standard 2009 require Compact Flash with a capacity of at least 2 GB (must be ordered separately).

CX5100 | Embedded PCs



CX5120

CX5130

CX5140

The DIN-rail-mountable, fanless Embedded PCs from the CX5100 series are equipped with Intel® Atom™ multi-core processors. The series encompasses three devices that differ from each other by processor type, RAM size and housing size. The new CX5100 PCs supplement the existing devices of the CX5000 series which are equipped with processors of the first Intel® Atom™ generation. In direct comparison the new processors are considerably more efficient: the out-of-order architecture and the modern 22-nm technology enable higher clock rates combined with reduced power losses.

– CX5120: Intel® Atom™ CPU, 1.46 GHz, 1 core
– CX5130: Intel® Atom™ CPU, 1.75 GHz, 2 cores
– CX5140: Intel® Atom™ CPU, 1.91 GHz, 4 cores

The CX5100 has a fixed number of system interfaces, which in the basic version is identical to previous CX5000 devices. Two independent Gigabit Ethernet ports and four USB 2.0 interfaces are available. To the DVI-I interface either a Beckhoff Control Panel or a commercially available DVI or VGA monitor can be connected. Like the CX5000 the CX5100 series has a compact design; a modular device with extension modules like in the CX2000 series is not available. The option interface of the CX5100 can be factory-fitted with various interfaces depending on needs: e.g. with a serial port (RS232/RS422/RS485) or a fieldbus connection for master or slave function. If the EtherCAT Slave option is selected, the CX5100 becomes a programmable, decentralised controller within an EtherCAT network.

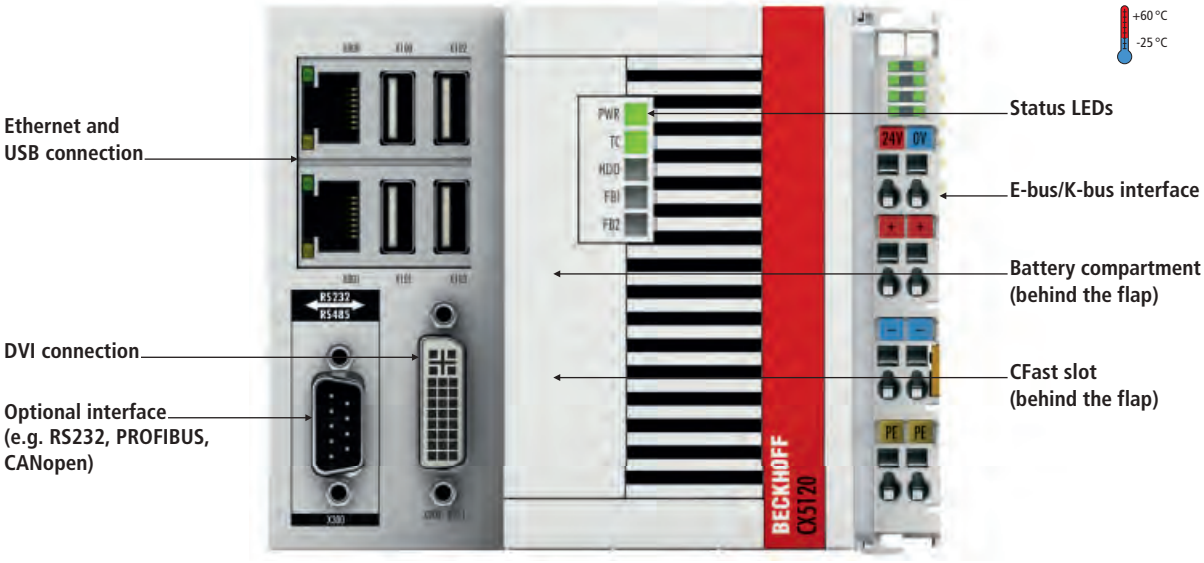
At I/O level either Bus Terminals or EtherCAT Terminals can be used. Like all Embedded PCs of the second generation, the CX5100 automatically recognises the I/O type that is plugged-in. With EtherCAT many different extension options are available: further master/slave fieldbus connections (PROFIBUS, CANopen, DeviceNet, etc.) and communication interfaces (RS232, RS422/RS485) as well as all other signal types supported by EtherCAT can be directly connected as EtherCAT Terminals.

The extended operating temperature range between -25 and +60 °C enables application in climatically demanding environments.

The operating system is Windows Embedded Standard 7 P, optionally in a 32-bit or 64-bit version. The boot and storage medium is an interchangeable, industrially compatible CFast card with a slot that is accessible behind a cover. The CFast card serves as a substitute for a hard disk; i.e. the operating system as well as TwinCAT and user projects are stored on it. Fast hardware exchange is thus possible if service is required; a software update can be performed simply by replacing the card on site. The built-in capacitive 1-second UPS ensures secure backup of persistent application data on the CFast card. Date and time are buffered via a replaceable battery.

The new CX5100 Embedded PCs are positioned in terms of both price and performance below the CX2000 series with multi-core-i CPU. If the machine and plant programmer uses the CX5100 in combination with the TwinCAT 3 automation suite, he now benefits from the availability of genuine multi-core processors and the optimised allocation of different program sections to individual cores, even with Intel® Atom™-based devices.

▶ **www.beckhoff.com/CX5100**



CX5100 | Embedded PC series with Intel® Atom™ processor

CX5120, CX5130 and CX5140 are Embedded PCs from the CX5100 series based on the Intel® Atom™ multi-core processors. They differ from one another in housing width and CPU type. What is new is that the available Atom™ CPUs now also introduce genuine multi-core technology, extending up to quad-core, into the compact Embedded PC segment. Since the new devices are an extension of the existing CX5000 series, they are equipped with identical hardware interfaces. Two independent Gigabit-capable Ethernet interfaces as well as four USB 2.0 and one DVI-I interface are available. A multitude of further connection options and gateway functions is created by the multi-option interface, which can be pre-equipped ex factory, as well as the I/O level, which can optionally consist of either E-Bus or K-Bus Terminals.

All devices in the series are characterised by low power consumption and fanless design.

Depending on the installed TwinCAT runtime environment, the CX5100 can be used for implementing PLC or PLC/Motion Control projects with or without visualisation. The execution of Motion Control applications with interpolating axis movements is also possible.

The extended operating temperature range from -25 to +60 °C enables the use of the CX5100 Embedded PCs in climatically demanding environments.

Like the CX5000, the CX5100 series has a compact design; a modular device with extension modules like in the CX2000 series is not available.

The order number for CX5100 units can be derived as follows:

CX51x0-01xx

- 0 = operating system only/optional TwinCAT 3
- 1 = with TwinCAT 2 PLC runtime
- 2 = with TwinCAT 2 NC PTP runtime
- 3 = with TwinCAT 2 NC I runtime

- 0 = no operating system
- 2 = operating system Windows Embedded Standard 7 P 32 bit
- 3 = operating system Windows Embedded Standard 7 P 64 bit

- 2 = Intel® Atom™ processor 1.46 GHz, 1 core
- 3 = Intel® Atom™ processor 1.75 GHz, 2 cores
- 4 = Intel® Atom™ processor 1.91 GHz, 4 cores

Since not all combinations make sense, the table "Ordering information" contains a breakdown of the permissible combinations.

Optional interfaces:

CX51x0-N020 = audio interface
CX51x0-N030 = RS232, D-sub plug
CX51x0-N031 = RS422/RS485, D-sub socket
CX51x0-M310 = PROFIBUS master, D-sub socket, 9-pin
CX51x0-B310 = PROFIBUS slave, D-sub socket, 9-pin
CX51x0-M510 = CANopen master, D-sub plug, 9-pin
CX51x0-B510 = CANopen slave, D-sub plug, 9-pin
CX51x0-M930 = PROFINET RT, controller
CX51x0-B930 = PROFINET RT, device, Ethernet (2 x RJ45 switch)
CX51x0-B950 = EtherNet/IP slave, Ethernet (2 x RJ45 switch)
CX51x0-B110 = EtherCAT slave, EtherCAT IN and OUT (2 x RJ45)

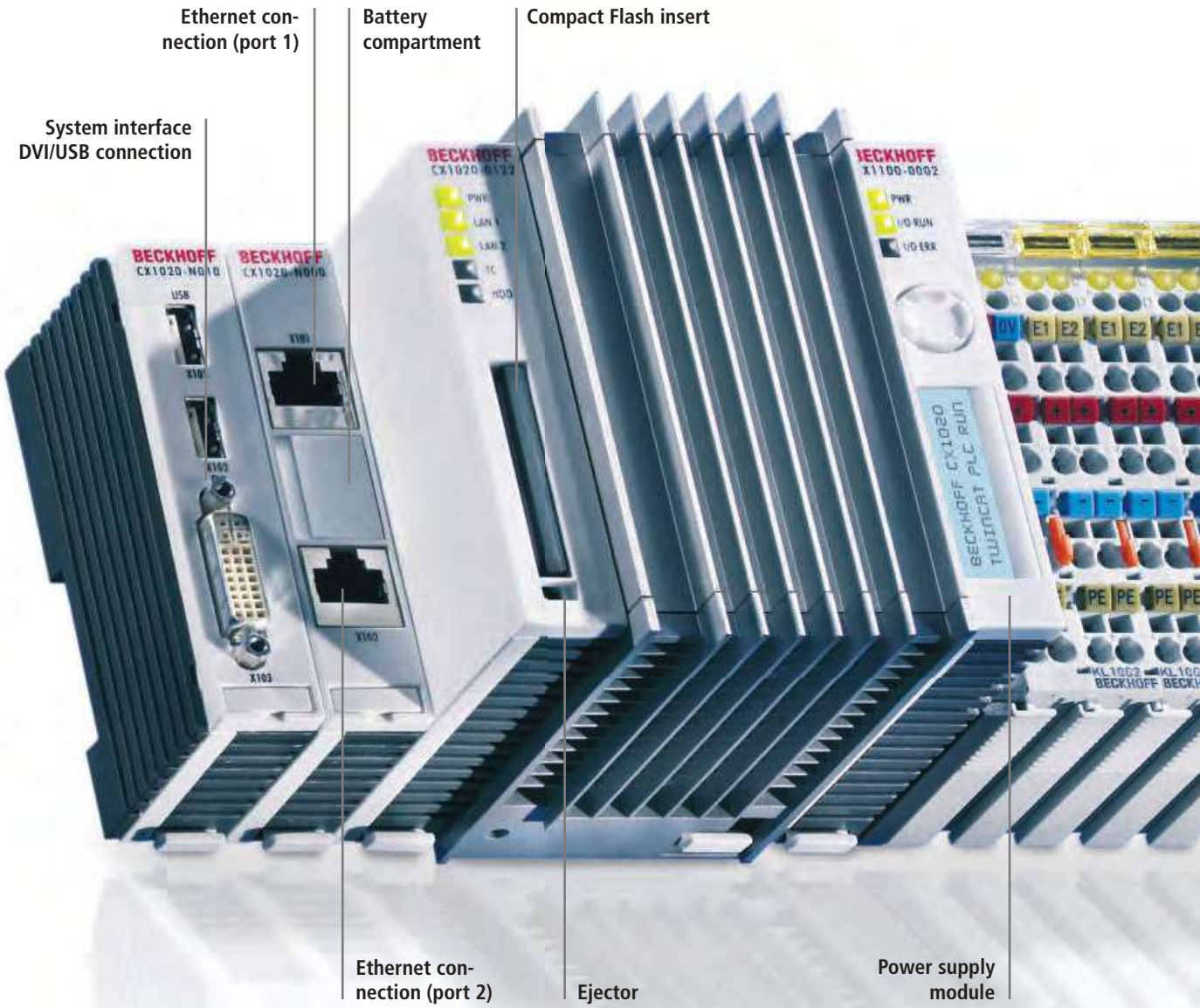
Technical data	CX5120	CX5130	CX5140
Processor	processor Intel® Atom™ E3815, 1.46 GHz, 1 core (TC3: 40)	processor Intel® Atom™ E3827, 1.75 GHz, 2 cores (TC3: 40)	processor Intel® Atom™ E3845, 1.91 GHz, 4 cores (TC3: 50)
Flash memory	slot for CFast card (card not included), slot for microSD card		
Internal main memory	2 GB DDR3 RAM (not expandable)	4 GB DDR3 RAM (not expandable)	4 GB DDR3 RAM (not expandable)
Persistent memory	integrated 1-second UPS (1 MB on CFast card)		
Interfaces	2 x RJ45, 10/100/1000 Mbit/s, DVI-I, 4 x USB 2.0, 1 x optional interface		
Diagnostics LED	1 x power, 1 x TC status, 1 x flash access, 2 x bus status		
Clock	internal battery-backed clock for time and date (battery exchangeable)		
Operating system	Microsoft Windows Embedded Standard 7 P		
Control software	TwinCAT 2 PLC runtime or TwinCAT 2 NC PTP runtime | TwinCAT 3, see price list TwinCAT 3		
I/O connection	E-bus (EtherCAT Terminals) or K-bus (Bus Terminals), automatic recognition		
Power supply	24 V DC (-15 %/+20 %)		
Current supply E-bus/K-bus	2 A		
Max. power loss	9 W (including the system interfaces)	11 W (including the system interfaces)	12 W (including the system interfaces)
Dimensions (W x H x D)	124 mm x 100 mm x 92 mm	142 mm x 100 mm x 92 mm	142 mm x 100 mm x 92 mm
Weight	approx. 860 g	approx. 960 g	approx. 960 g
Operating/storage temperature	-25…+60 °C/-40…+85 °C		
Relative humidity	95 %, no condensation		
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27		
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4		
Protection class	IP 20		
Approvals	CE, UL		
TC3 performance class	performance (40); for further information on TwinCAT 3 see page 898	performance (40); for further information on TwinCAT 3 see page 898	performance plus (50); for further information on TwinCAT 3 see page 898
Further information	www.beckhoff.com/CX5100		

Ordering information	no operating system	Windows Embedded Standard 7 P 32 bit	Windows Embedded Standard 7 P 64 bit	optional TwinCAT 3	TwinCAT 2 runtime PLC	TwinCAT 2 runtime NC PTP	TwinCAT 2 runtime NC I
CX5120-0100	x	–	–	–	–	–	–
CX5120-0120	–	x	–	x	–	–	–
CX5120-0121	–	x	–	–	x	–	–
CX5120-0122	–	x	–	–	–	x	–
CX5120-0123	–	x	–	–	–	–	x
CX5120-0130	–	–	x	x	–	–	–

Ordering information	no operating system	Windows Embedded Standard 7 P 32 bit	Windows Embedded Standard 7 P 64 bit	optional TwinCAT 3	TwinCAT 2 runtime PLC	TwinCAT 2 runtime NC PTP	TwinCAT 2 runtime NC I
CX5130-0100	x	–	–	–	–	–	–
CX5130-0120	–	x	–	x	–	–	–
CX5130-0121	–	x	–	–	x	–	–
CX5130-0122	–	x	–	–	–	x	–
CX5130-0123	–	x	–	–	–	–	x
CX5130-0130	–	–	x	x	–	–	–

Ordering information	no operating system	Windows Embedded Standard 7 P 32 bit	Windows Embedded Standard 7 P 64 bit	optional TwinCAT 3	TwinCAT 2 runtime PLC	TwinCAT 2 runtime NC PTP	TwinCAT 2 runtime NC I
CX5140-0100	x	–	–	–	–	–	–
CX5140-0120	–	x	–	x	–	–	–
CX5140-0121	–	x	–	–	x	–	–
CX5140-0122	–	x	–	–	–	x	–
CX5140-0123	–	x	–	–	–	–	x
CX5140-0130	–	–	x	x	–	–	–

CX1020, CX1030 | Embedded PCs



CX1020

CX1030

The CX1020 and CX1030 Embedded PCs extend the CX product family by versions with high CPU performance and enable the direct connection of Bus Terminals and EtherCAT Terminals. The CX1020 is equipped with a 1 GHz Intel® Celeron® M CPU. It is an energy-saving device that operates with ultra-low core voltage and features low thermal power dissipation of only 7 W TDP (thermal design power). This means that a fan can be dispensed with even in the small form factor of the CX1020 Embedded PCs. Since Compact Flash is used as the boot and storage medium, the controller contains no rotating media.

The CX1030 is equipped with a 1.8 GHz Intel® Pentium® M processor. Apart from the CPU and the fan cartridge required with this level of CPU performance, neither the hardware nor the software of the CX1030 differs from that of the CX1020. The high-quality fan is supported by dual ball bearings and mounted in a tray so that it can be replaced in the field without tools or wiring, if required. The fan speed is monitored and can be queried via software. The combination of CX1030, EtherCAT and TwinCAT 2 enables very fast control processes in the sub-millisecond range (eXtreme Fast Control Technology).

The basic CPU modules come with two RJ45 sockets, behind which there is an integrated 3-port switch in order to enable the construction of a line topology without additional switches.

The components

The individual system components are modules with a width of 19 mm (single) or 38 mm (double) that can be arranged in series. The basic unit consists of a CPU module CX1020/CX1030 and a power supply module (CX1100-00xx).

The range of modules is complemented by fieldbus connections for PROFIBUS, CANopen, DeviceNet, SERCOS interface and Lightbus, both as master or slave versions.

Power supply unit with integrated I/O interface

For the 24 V DC power supply unit there is a choice of three or four different versions:

– CX1100-0001: without I/O interface, CX1020 only
– CX1100-00x2: with terminal bus interface for Beckhoff Bus Terminals
– CX1100-00x3: with terminal bus interface for Beckhoff Bus Terminals and IP-Link interface for Beckhoff Fieldbus Box modules
– CX1100-00x4: with terminal bus interface for Beckhoff EtherCAT Terminals

All power supply variants have an illuminated, low-glare LC-display with FSTN technology and two rows with 16 characters each for displaying status messages. The application programs can also use the display for displaying application-specific texts. 8 kB of non-volatile memory for remanent data are also included.

EtherCAT as a fast I/O system

The CX1020 and CX1030 Embedded PCs were developed with a view towards optimised interaction with EtherCAT. The use of EtherCAT gives rise to several options for connecting classic fieldbus systems to the CX1020/CX1030: either as a CX1500 module directly at the CPU or as an EtherCAT device in terminal form. The PROFIBUS master is available either as a CX1500-M310 or as a EL6731 EtherCAT Terminal.

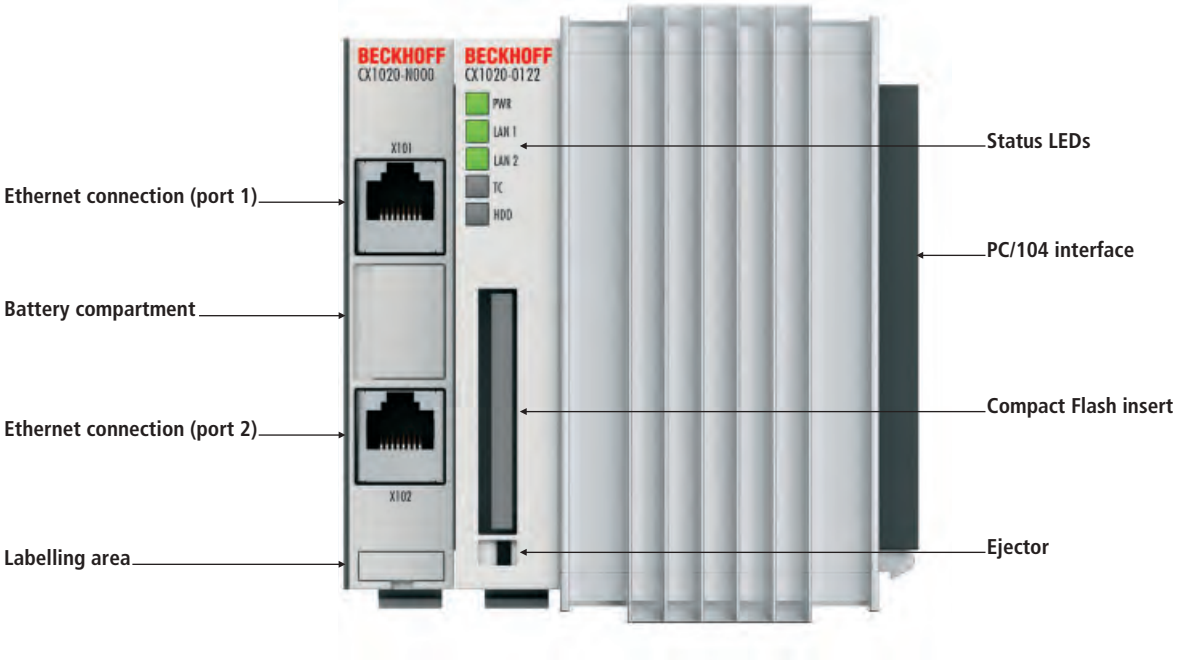
PLC, Motion Control, interpolation and visualisation

As a DIN rail IPC and in conjunction with TwinCAT 2 software from Beckhoff, the CX1020/CX1030 offers the same functionality as large Industrial PCs. In terms of PLC, up to four virtual IEC 61131-3 CPUs can be programmed with up to four tasks each.

Moreover, all TwinCAT 2 functionalities are available for Motion Control applications. In theory, up to 256 axes can be controlled. In addition to simple point-to-point movements, more complex multi-axis functions such as "electronic gearbox", "cam plates" and "flying saw" can be implemented. Due to the higher-performance CPU in the CX1020 and the CX1030, interpolating 3-D path movements can also be implemented and DIN 66025 programs executed.

In addition to real-time execution of control tasks, the TwinCAT 2 real-time kernel ensures that enough time remains for the user interface (HMI), to communicate with the real-time components via software interfaces such as ADS or OPC.

▶ **www.beckhoff.com/CX1020**



CX1020 | Basic CPU module

The basic CX1020 CPU module has a 1 GHz Intel® CPU. The controller does not require a fan or other rotating components. In addition to the CPU and the chipset, the CX1020 module also contains the main memory, which is available in different sizes. The controller boots from the Compact Flash.

The basic configuration of the CX1020 includes a 128 MB Compact Flash card and two Ethernet RJ45 interfaces. These interfaces are connected to an internal switch and offer a simple option for creating a line topology without the need for additional Ethernet switches. All other CX family components can be connected via the PC/104 interface that is available on both sides. The passive cooling module is included in the scope of supply. The operating system can be Windows Embedded CE 6 or Windows Embedded Standard 2009. The TwinCAT 2 automation software transforms a CX1020 system into a powerful PLC and Motion Control system that can be operated with or without visualisation. In contrast to the CX1010, the CX1020 can also be used for interpolating axis movements with TwinCAT 2 NC I.

Further system interfaces or fieldbus connections can be added to the basic CPU module. The CPU module requires a CX1100 type power supply module. All CX1500 fieldbus modules and all CX1100 power supplies from the CX series can be used in combination with the CX1020.

The Embedded PC CX1020 is also available as the ordering option CX1900-0320 with zero second level cache. Instead of the 1 GHz processor with 512 kB second level cache (L2), a less expensive variant of the processor without a second level cache (L2 = 0 kB) is used. Since the CX1900-0320 has the same 855GME chipset as the CX1020, none of the basic characteristics of the CX1020 are changed, apart from the slightly lower CPU power.

The order identifier of the basic CPU module is derived as follows:

CX1020-0xxx

- **0 = without TwinCAT**
- **1 = with TwinCAT 2 PLC runtime**
- **2 = with TwinCAT 2 PLC/NC runtime**
- **3 = with TwinCAT 2 PLC/NC I runtime**

- **0 = without operating system**
- **1 = operating system Windows Embedded CE 6**
- **2 = operating system Windows Embedded Standard 2009**

- **0 = CPU with 2 Ethernet ports**
- **1 = CPU with 2 Ethernet ports + 2 x USB + DVI**

Since not all combinations make sense, the table "Ordering information" contains a breakdown of the permissible combinations.

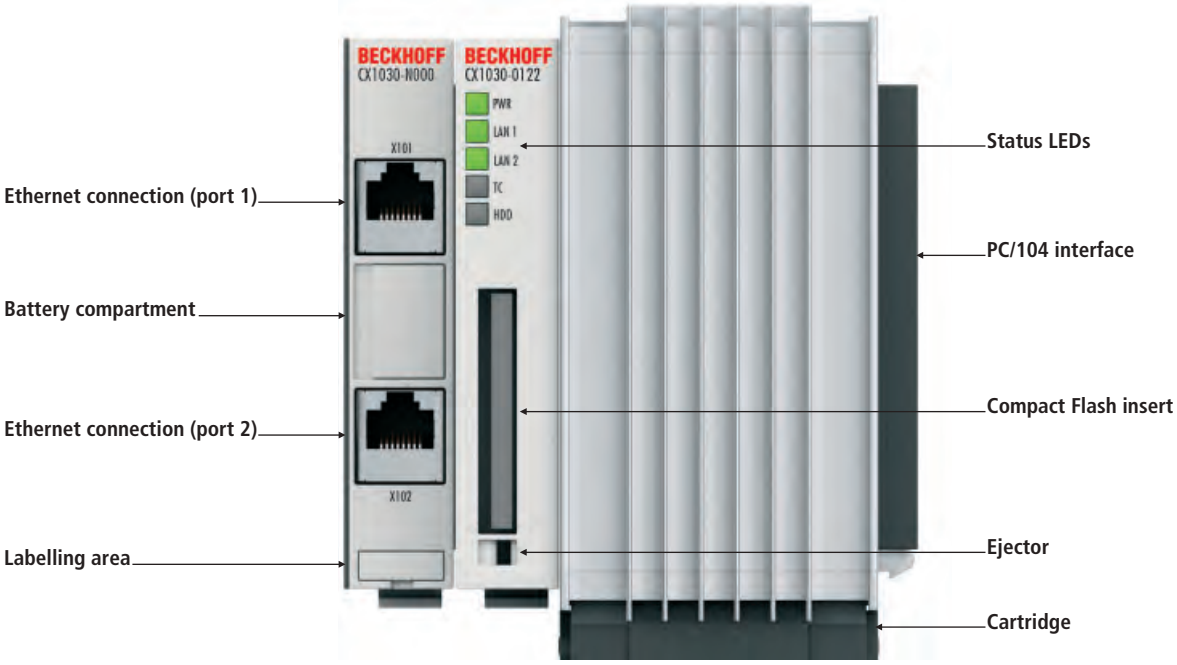
Embedded PC interfaces for CX10x0
see page 238

Technical data	CX1020-0xxx
Processor	Intel® Celeron® M ULV, 1 GHz clock frequency
Flash memory	128 MB Compact Flash card (optionally extendable)
Internal main memory	256 MB DDR RAM (expandable to 512 MB, 1 GB)
Interfaces	2 x RJ45 (Ethernet, internal switch)
Diagnostics LED	1 x power, 2 x LAN link/activity, TC status, 1 x flash access
Expansion slot	1 x Compact Flash type I+II insert with eject mechanism
Clock	internal battery-backed clock for time and date (battery exchangeable)
Operating system	Microsoft Windows Embedded CE 6 or Microsoft Windows Embedded Standard 2009
Control software	TwinCAT 2 PLC runtime, NC PTP runtime, NC I runtime
System bus	16 bit ISA (PC/104)
Power supply	via system bus (through CX1100-xxxx power supply modules)
Max. power loss	11 W (including CX1020-N0xx system interfaces)
Dimensions (W x H x D)	96 mm x 112 mm x 99 mm
Weight	approx. 550 g
Operating/storage temperature	0…+50 °C/-25…+85 °C
Relative humidity	95 %, no condensation
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4
Protection class	IP 20
Approvals	CE, UL
Further information	www.beckhoff.com/CX1020

Ordering information	DVI/USB	no operating system	Windows Embedded CE 6	Windows Embedded Standard 2009	no TwinCAT	TwinCAT 2 PLC runtime	TwinCAT 2 NC runtime	TwinCAT 2 NC I runtime
CX1020-0000	–	x	–	–	x	–	–	–
CX1020-0010	–	–	x	–	x	–	–	–
CX1020-0011	–	–	x	–	–	x	–	–
CX1020-0012	–	–	x	–	–	x	x	–
CX1020-0013	–	–	x	–	–	x	x	x
CX1020-0100	x	x	–	–	x	–	–	–
CX1020-0110	x	–	x	–	x	–	–	–
CX1020-0111	x	–	x	–	–	x	–	–
CX1020-0112	x	–	x	–	–	x	x	–
CX1020-0113	x	–	x	–	–	x	x	x
CX1020-0020	–	–	–	x*	x	–	–	–
CX1020-0021	–	–	–	x*	–	x	–	–
CX1020-0022	–	–	–	x*	–	x	x	–
CX1020-0023	–	–	–	x*	–	x	x	x
CX1020-0120	x	–	–	x*	x	–	–	–
CX1020-0121	x	–	–	x*	–	x	–	–
CX1020-0122	x	–	–	x*	–	x	x	–
CX1020-0123	x	–	–	x*	–	x	x	x

Options	
CX1900-0320	option for basic CPU module: Intel® Celeron® M processor 1 GHz, zero second level cache
CX1900-0120	"Active cooling": factory conversion of the CX1020 CPU module for active cooling in order to enable flexible installation positions (see documentation). Active cooling takes place via a fan cartridge. This option requires the use of a power supply unit type CX1100-001x.

*CX1020 systems with Microsoft Embedded Standard require Compact Flash with a capacity of at least 2 GB (must be ordered separately).



CX1030 | Basic CPU module

The CX1030 basic CPU module offers Pentium® M power on the DIN rail. The CX1030 has a 1.8 GHz Intel® Pentium® M CPU. The CPU is cooled via the cooling module and an easily exchangeable fan cartridge located on the underside of the housing. The fan speed can be read via software and can therefore be monitored.

In addition to the CPU and the chipset, the CX1030 module also contains the RAM, which is available in different sizes. The controller boots from the Compact Flash. The basic configuration of the CX1030 includes a 128 MB Compact Flash card and two Ethernet RJ45 interfaces. These are connected to an internal switch and offer a simple option for creating a line topology without the need for additional Ethernet Switches. All other CX family components can be connected via the PC/104 interface that is available on both sides. The passive cooling module is included in the scope of supply.

The operating system can be Windows Embedded CE 6 or Windows Embedded Standard 2009. The TwinCAT 2 automation software transforms a CX1030 system into a powerful PLC and Motion Control system that can be used with or without visualisation. In contrast to the CX1010, the CX1030 can also be used for interpolating axis movements with TwinCAT 2 NC I.

Further system interfaces or fieldbus connections can be added to the basic CPU module. The CPU module requires a CX1100-001x type power supply module. All CX1500 fieldbus modules and all CX1100-001x power supply units from the CX series can be used in combination with the CX1030.

The order identifier of the basic CPU module is derived as follows:

CX1030-0xxx

- **0 = without TwinCAT**
  1 = with TwinCAT 2 PLC runtime
  2 = with TwinCAT 2 PLC/NC runtime
  3 = with TwinCAT 2 PLC/NC I runtime
- **0 = without operating system**
  1 = operating system Windows Embedded CE 6
  2 = operating system Windows Embedded Standard 2009
- **0 = CPU with 2 Ethernet ports**
  1 = CPU with 2 Ethernet ports + 2 x USB + DVI

Since not all combinations make sense, the table "Ordering information" contains a breakdown of the permissible combinations.

Embedded PC interfaces for CX10x0
see page 238

Technical data	CX1030-0xxx
Processor	Intel® Pentium® M, 1.8 GHz clock frequency
Flash memory	128 MB Compact Flash card (optionally extendable)
Internal main memory	256 MB DDR RAM (expandable to 512 MB, 1 GB)
Interfaces	2 x RJ45 (Ethernet, internal switch), 10/100 Mbit/s
Cooling	cooling module + fan cartridge featuring speed control with double ball bearing fans, easily replaceable
Diagnostics LED	1 x power, 2 x LAN link/activity, TC status, 1 x flash access
Expansion slot	1 x Compact Flash type I+II insert with eject mechanism
Clock	internal battery-backed clock for time and date (battery exchangeable)
Operating system	Microsoft Windows Embedded CE 6 or Microsoft Windows Embedded Standard 2009
Control software	TwinCAT 2 PLC runtime, NC PTP runtime, NC I runtime
System bus	16 bit ISA (PC/104)
Power supply	via system bus (through CX1100-0012 [K-bus], CX1100-0013 [K-bus, IP-Link], CX1100-014 [E-bus] power supply module)
Max. power loss	32 W (including CX1030-N0xx system interfaces)
Dimensions (W x H x D)	96 mm x 112 mm x 99 mm
Weight	approx. 580 g
Operating/storage temperature	0…+50 °C/-25…+85 °C
Relative humidity	95 %, no condensation
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4
Protection class	IP 20
Approvals	CE, UL
Further information	www.beckhoff.com/CX1030

Ordering information	DVI/USB	no operating system	Windows Embedded CE 6	Windows Embedded Standard 2009	no TwinCAT	TwinCAT 2 PLC runtime	TwinCAT 2 NC runtime	TwinCAT 2 NC I runtime
CX1030-0000	–	x	–	–	x	–	–	–
CX1030-0010	–	–	x	–	x	–	–	–
CX1030-0011	–	–	x	–	–	x	–	–
CX1030-0012	–	–	x	–	–	x	x	–
CX1030-0013	–	–	x	–	–	x	x	x
CX1030-0100	x	x	–	–	x	–	–	–
CX1030-0110	x	–	x	–	x	–	–	–
CX1030-0111	x	–	x	–	–	x	–	–
CX1030-0112	x	–	x	–	–	x	x	–
CX1030-0113	x	–	x	–	–	x	x	x
CX1030-0020	–	–	–	x*	x	–	–	–
CX1030-0021	–	–	–	x*	–	x	–	–
CX1030-0022	–	–	–	x*	–	x	x	–
CX1030-0023	–	–	–	x*	–	x	x	x
CX1030-0120	x	–	–	x*	x	–	–	–
CX1030-0121	x	–	–	x*	–	x	–	–
CX1030-0122	x	–	–	x*	–	x	x	–
CX1030-0123	x	–	–	x*	–	x	x	x

*CX1030 systems with Microsoft Embedded Standard 2009 require Compact Flash with a capacity of at least 2 GB (must be ordered separately).

DVI/USB interface

Audio interface

RS232 interface

RS422/RS485 interface

Ethernet interface

CX1020-N0xx | System interfaces

A number of optional interface modules are available for the basic CX1020 CPU module that can be installed ex factory. The CX1020-N010 option connects Beckhoff Control Panels or standard monitors with DVI or VGA input via the DVI or USB interfaces. Devices such as printer, scanner, mouse, keyboard, mass storage, etc. can be connected via the USB 2.0 interfaces. Multimedia capability is realised via the CX1020-N020 audio interface. The modules CX1020-N030 and CX1020-N040 offer a total of four serial RS232 interfaces with a maximum transfer speed of 115 kbaud. These four interfaces can be implemented in pairs as RS422/RS485, in which case they are identified as CX1020-N031 and CX1020-N041 respectively. The system interfaces cannot be retrofitted or expanded in the field. They are supplied ex factory in the specified configuration and cannot be separated from the CPU module. The internal PC/104 bus runs through the system interfaces, so that further CX components can be connected. The power supply of the system interface modules is ensured via the internal PC/104 bus.

Technical data	CX1020-N010	CX1020-N020	CX1020-N030 CX1020-N040	CX1020-N031 CX1020-N041	CX1020-N060
Interfaces	1 x DVI + 2 x USB 2.0 (max. 500 mA per port)	Line IN, Line Mic IN, Line OUT	1 x COM1+2, RS232, 1 x COM3+4, RS232	1 x COM1+2, RS422/ RS485, 1 x COM3+4, RS422/RS485	1 x Ethernet, 10/100 Mbit/s
Type of connection	DVI-I 29-pin socket + 2 USB ports type A	3.5 mm socket for jack plug	2 x D-sub plug, 9-pin	2 x D-sub socket, 9-pin	1 x RJ45
Properties	DVI-I interface also carries out VGA signals (DVI-A)	built-in PC beeper, Line OUT output, max. 200 mW, suitable for ear-phones	max. baud rate 115 kbaud, cannot be used simultaneously with N031/N041	max. baud rate 115 kbaud, cannot be used simultaneously with N030/N040	max. baud rate 100 Mbit/s, max. 20 m cable length CAT5, cannot be used simultaneously with CX1100-0004
Power supply	via system bus (through CX1100-xxxx power supply modules)				
Dimensions (W x H x D)	19 mm x 100 mm x 51 mm				
Weight	approx. 80 g				
Operating/storage temperature	0…+55 °C/-25…+85 °C				
Relative humidity	95 %, no condensation				
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27				
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4				
Protection class	IP 20				
Approvals	CE, UL				
Further information	www.beckhoff.com/CX1020-N010				

DVI/USB interface

Audio interface

RS232 interface

RS422/RS485 interface

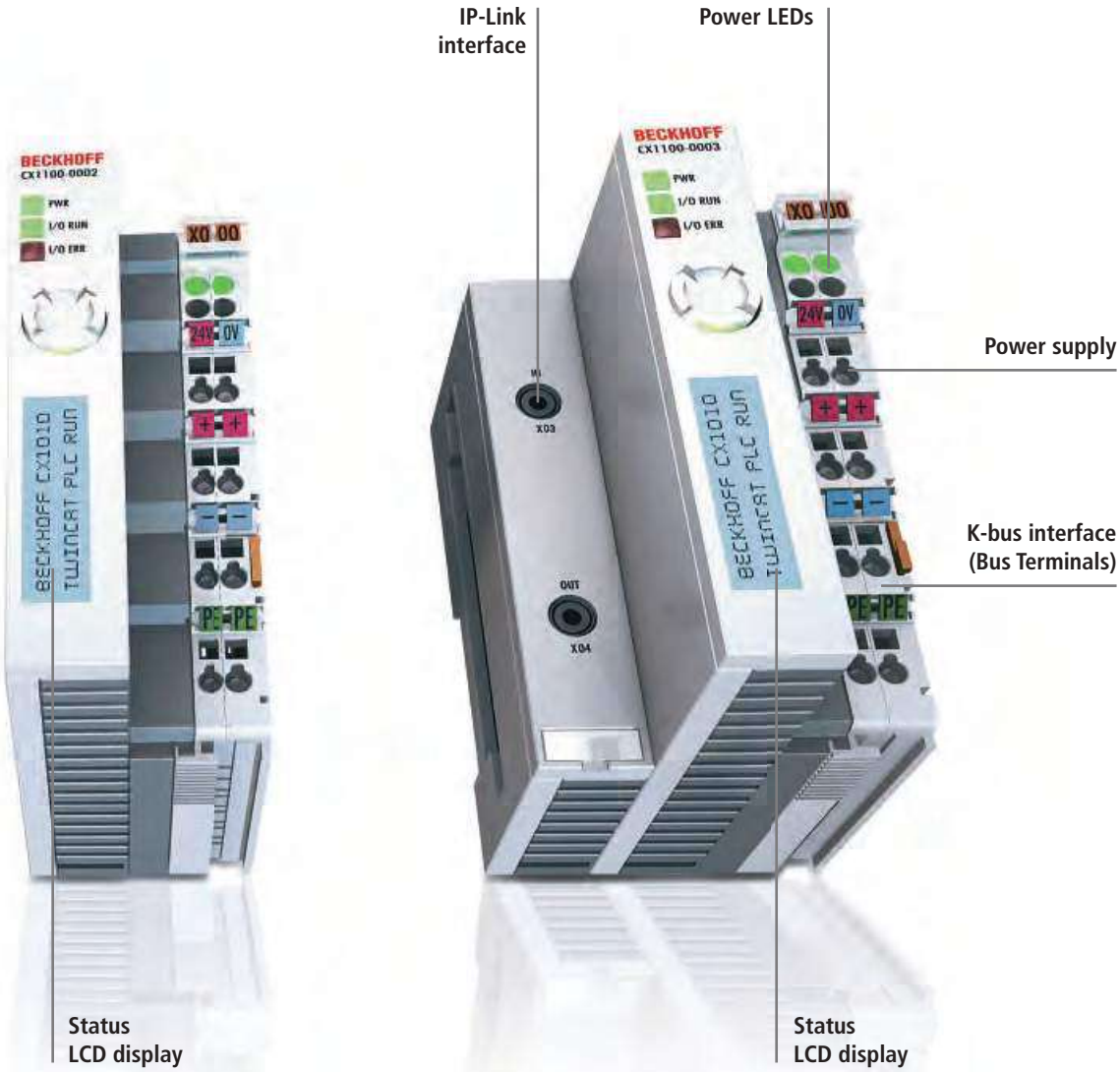
Ethernet interface

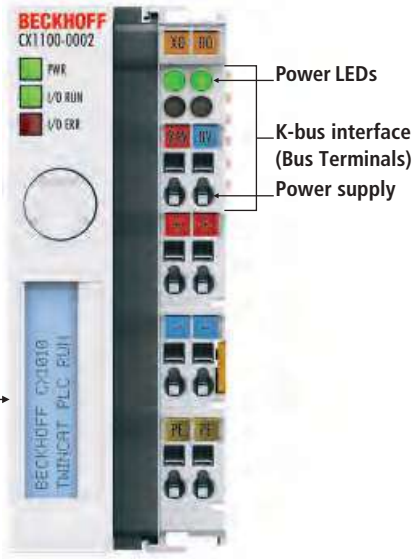
CX1030-N0xx | System interfaces

A number of optional interface modules are available for the basic CX1030 CPU module that can be installed ex factory. The CX1030-N010 option connects Beckhoff Control Panels or standard monitors with DVI or VGA input via the DVI or USB interfaces. Devices such as printer, scanner, mouse, keyboard, mass storage, etc. can be connected via the USB 2.0 interfaces. Multimedia capability is realised via the CX1030-N020 audio interface. The modules CX1030-N030 and CX1030-N040 offer a total of four serial RS232 interfaces with a maximum transfer speed of 115 kbaud. These four interfaces can be implemented in pairs as RS422/RS485, in which case they are identified as CX1030-N031 and CX1030-N041 respectively. The system interfaces cannot be retrofitted or expanded in the field. They are supplied ex factory in the specified configuration and cannot be separated from the CPU module. The internal PC/104 bus runs through the system interfaces, so that further CX components can be connected. The power supply of the system interface modules is ensured via the internal PC/104 bus.

Technical data	CX1030-N010	CX1030-N020	CX1030-N030 CX1030-N040	CX1030-N031 CX1030-N041	CX1030-N060
Interfaces	1 x DVI + 2 x USB 2.0 (max. 500 mA per port)	Line IN, Line Mic IN, Line OUT	1 x COM1+2, RS232, 1 x COM3+4, RS232	1 x COM1+2, RS422/ RS485, 1 x COM3+4, RS422/RS485	1 x Ethernet, 10/100 Mbit/s
Type of connection	DVI-I 29-pin socket + 2 USB ports type A	3.5 mm socket for jack plug	2 x D-sub plug, 9-pin	2 x D-sub plug, 9-pin	1 x RJ45
Properties	DVI-I interface also carries out VGA signals (DVI-A)	built-in PC beeper, Line OUT output, max. 200 mW, suitable for ear-phones	max. baud rate 115 kbaud, cannot be used simultaneously with N031/N041	max. baud rate 115 kbaud, cannot be used simultaneously with N030/N040	max. baud rate 100 Mbit/s, max. 20 m cable length CAT5, cannot be used simultaneously with CX1100-0004
Power supply	via system bus (through CX1100-xxxx power supply modules)				
Dimensions (W x H x D)	19 mm x 100 mm x 51 mm				
Weight	approx. 80 g				
Operating/storage temperature	0…+55 °C/-25…+85 °C				
Relative humidity	95 %, no condensation				
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27				
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4				
Protection class	IP 20				
Approvals	CE, UL				
Further information	www.beckhoff.com/CX1030-N010				

CX1100-, CX1500-xxxx | Embedded PC interfaces for CX10xx





Power supply
with K-bus interface

Power supply
with E-bus interface

Power supply

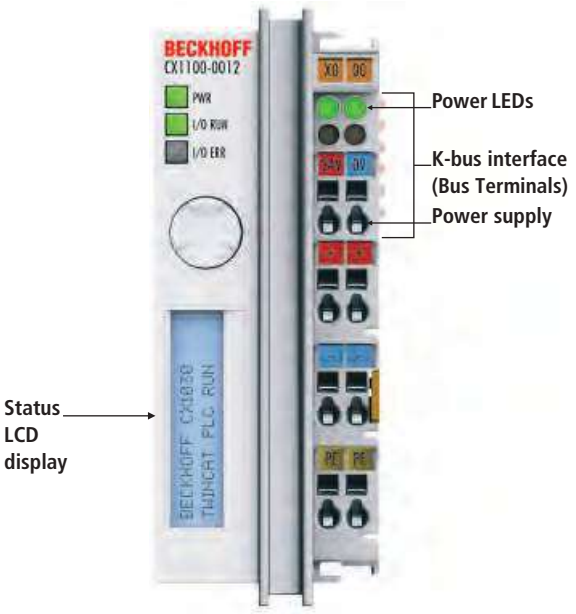
Power supply
with K-bus/IP-Link interface

CX1100-000x | Power supply units and I/O interfaces for CX1010/CX1020

Four power supplies are optionally available for CX1010/CX1020 systems; all other system components are powered via the internal PC/104 bus. Each CX1100-000x power supply module contains an integrated NOVRAM for the non-volatile storage of process data and a LC display (two lines of 16 characters). The CX1100-0002 version is suitable for the direct connection of Beckhoff Bus Terminals (KLxxxx); the Extension Box modules (IExxxx) from the Fieldbus Box range can be connected to the CX1100-0003 in addition to the Bus Terminals. The CX1100-0004 power supply unit is available for the connection of EtherCAT Terminals (ELxxxx). All power supply units for the CX1100-000x system can be exchanged in the field.

Technical data	CX1100-0002	CX1100-0004	CX1100-0001	CX1100-0003
Power supply	24 V DC (-15 %/+20 %)			
E-bus connection	–	yes (adapter terminal)	–	–
K-bus connection	yes (adapter terminal)	–	–	yes (adapter terminal)
IP-Link connection	–	–	–	yes
Current supply K-bus	up to max. 1.75 A	2 A	–	1.75 A
Type of connection	spring-loaded technique (adapter terminal)	spring-loaded technique (adapter terminal)	1 x open style connector, 5-pin	spring-loaded technique (adapter terminal)
NOVRAM	8 kbytes			
Display	FSTN display 2 lines x 16 characters of text, illuminated			
I/O-DPRAM	4 kbytes	–	–	4 kbytes
Diagnostics LED	1 x PWR, 1 x I/O Run, 1 x I/O Err	1 x PWR, 1 x L/A, 1 x Run	1 x PWR	1 x PWR, 1 x I/O Run, 1 x I/O Err
Max. power consumption	3.5 W	3.5 W	2.5 W	4 W
Dimensions (W x H x D)	40 mm x 100 mm x 91 mm	40 mm x 100 mm x 91 mm	45 mm x 100 mm x 91 mm	58 mm x 100 mm x 91 mm
Weight	approx. 250 g	approx. 250 g	approx. 180 g	approx. 350 g
Operating/storage temperature	0…+55 °C/-25…+85 °C			
Relative humidity	95 %, no condensation			
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27			
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4			
Protection class	IP 20			
Approvals	CE, UL			
Further information	www.beckhoff.com/CX1100-0001			

EtherCAT Terminals see page 340, Bus Terminals see page 590, Fieldbus Box modules see page 726



Power supply
with K-bus interface

Power supply
with E-bus interface

Power supply
with K-bus/IP-Link interface

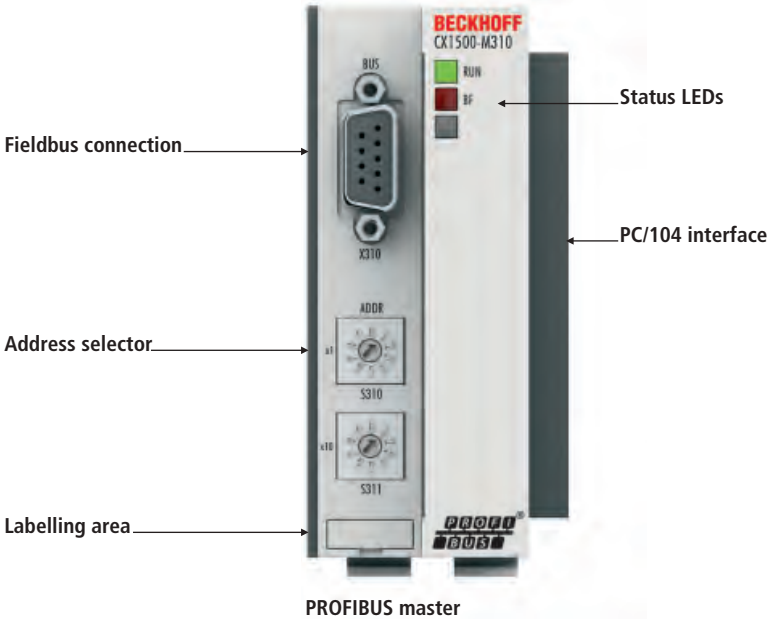
CX1100-001x | Power supply units and I/O interfaces for CX1030

Three power supplies are optionally available for CX1030 systems; all other system components are powered via the internal PC/104 bus. Each CX1100-001x power supply module contains an integrated NOVRAM for the non-volatile storage of process data and an LC display (two lines of 16 characters). The CX1100-0012 version is suitable for the direct connection of Beckhoff Bus Terminals (KLxxxx); the Extension Box modules (IExxxx) from the Fieldbus Box range can be connected to the CX1100-0013 in addition to the Bus Terminals. The CX1100-0014 power supply unit is available for EtherCAT Terminals (ELxxxx). The power supply units of the CX system can be changed in the field.

The CX1100-001x power supply units are electronically identical to the CX1100-000x series, but have an internal heat sink and additional ventilation slits. The CX1100-001x series is suitable for non-standard assembly directions, even when using a CX1020 or a CX1010 (see documentation).

Technical data	CX1100-0012	CX1100-0014	CX1100-0013
Power supply	24 V DC (-15 %/+20 %)		
E-bus connection	–	yes (adapter terminal)	–
K-bus connection	yes (adapter terminal)	–	yes (adapter terminal)
IP-Link connection	–	–	yes
Current supply K-bus	up to max. 1.75 A		
Type of connection	spring-loaded technique (adapter terminal)		
NOVRAM	8 kbytes		
Display	FSTN display 2 lines x 16 characters of text, illuminated		
I/O-DPRAM	4 kbytes	–	4 kbytes
Diagnostics LED	1 x PWR, 1 x I/O Run, 1 x I/O Err	1 x PWR, 1 x L/A, 1 x Run	1 x PWR, 1 x I/O Run, 1 x I/O Err
Dimensions (W x H x D)	42 mm x 109 mm x 92 mm	42 mm x 109 mm x 92 mm	58 mm x 109 mm x 92 mm
Weight	approx. 240 g	approx. 235 g	approx. 325 g
Operating/storage temperature	0…+55 °C/-25…+85 °C		
Relative humidity	95 %, no condensation		
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27		
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4		
Protection class	IP 20		
Approvals	CE, UL		
Further information	www.beckhoff.com/CX1100-0012		

EtherCAT Terminals see page 340, Bus Terminals see page 590, Fieldbus Box modules see page 726



PROFIBUS master

Lightbus master

CANopen master

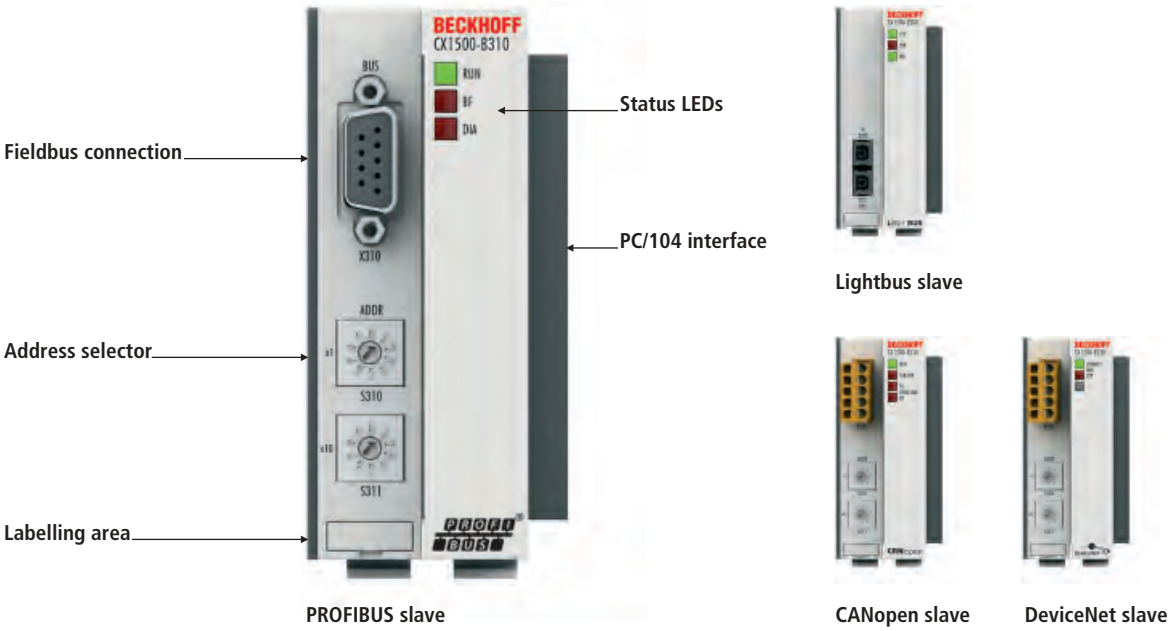
DeviceNet master

SERCOS interface master

CX1500-Mxx0 | Master fieldbus connections for CX10x0

The use of CX1010, CX1020 or CX1030 systems with fieldbus master modules enables the segment-like construction of control structures in extensive plants and machines using all Beckhoff fieldbus components (Bus Couplers, Bus Terminal Controllers, Drive Technology, etc.). The parallel operation of several identical or different masters is possible, e.g. two PROFIBUS masters or a PROFIBUS master and a SERCOS interface master simultaneously in a system. In the case of mixed operation of master and slave connections, CX systems act as intelligent gateways between different fieldbuses: data are received, processed and fed into other fieldbuses. Compared with the Beckhoff PC Fieldbus Cards, the performance data of the fieldbus master modules are almost identical; CX variants are single-channel, however. Master or slave connections network several CX systems with one another strictly deterministically via the fieldbus level. CX fieldbus modules can be retrofitted/exchanged by adding them to existing CX systems. The fieldbus connections are powered via the PC/104 bus. The scanning and recognising of the modules, the parameterisation, the configuration of the connected I/O components and the online diagnosis of the process/fieldbus status take place in the TwinCAT System Manager.

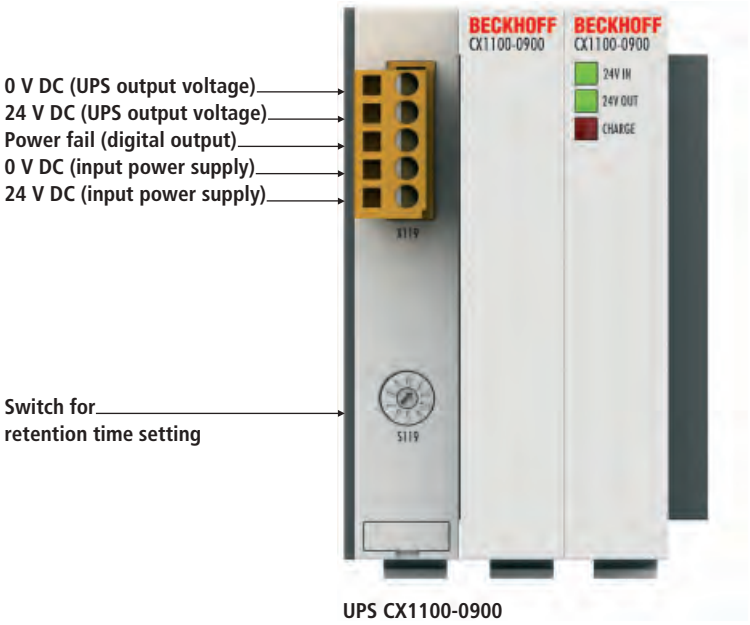
Technical data	CX1500-M200	CX1500-M310	CX1500-M510	CX1500-M520	CX1500-M750
Fieldbus	Lightbus	PROFIBUS DP, DP-V1, DP-V2 (MC)	CANopen	DeviceNet	SERCOS interface
Data transfer rates	2.5 Mbaud, 32 bits of process data in 25 µs	9.6 kbaud… 12 Mbaud	10, 20, 50, 100, 125, 250, 500, 800, 1,000 kbaud	125, 250, 500 kbaud	2, 4, 8, 16 Mbaud
Bus interface	2 x fibre optic	1 x D-sub socket, 9-pin	open style connector, 5-pin	open style connector, 5-pin	F-SMA standard, IEC 872-2
Bus device	max. 254 nodes with a max. of 65,280 I/O points	max. 125 slaves with up to 244 bytes input, output, parameter, configuration or diagnostic data per slave	max. 127 slaves	max. 63 slaves	max. 254 slaves
Interface to the CPU	ISA plug and play, 2 kbyte DPRAM				
Max. power loss	2 W	1.8 W	1.8 W	1.8 W	1.3 W
Dimensions (W x H x D)	38 mm x 100 mm x 91 mm				
Weight	approx. 190 g				
Operating/storage temperature	0…+55 °C/-25…+85 °C				
Relative humidity	95 %, no condensation				
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27				
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4				
Protection class	IP 20				
Approvals	CE, UL				
Further information	www.beckhoff.com/CX1500-M200				



CX1500-Bxx0 | Slave fieldbus connections for CX10x0

Fieldbus slave modules enable the use of a CX1010, CX1020 or CX1030 system as a subordinate local controller for the construction of complex or modular systems. External process data are received from the master and processed, or data from its own process peripherals are returned to the master controller directly or processed. The interface between the respective bus system and the CX CPU module is the DPRAM, which is addressed by the CPU module via the internal ISA bus. The parallel operation of several identical or different slave connections is possible, e.g. two PROFIBUS slaves or a PROFIBUS slave and a SERCOS interface slave simultaneously in a system. In the case of mixed operation of master and slave connections, CX systems act as intelligent gateways between different fieldbuses: data are received, processed and fed into other fieldbuses. The CX fieldbus modules are single-channel. Master or slave connections network several CX systems with one another strictly deterministically via the fieldbus level. CX fieldbus modules can be retrofitted/exchanged by adding them to existing CX systems. The fieldbus connections are powered via the PC/104 bus. The integration of the fieldbus connections in TwinCAT 2 automation software is simple, as usual. The scanning and recognising of the modules, the parameterisation, the configuration of the connected I/O components and the online diagnosis of the process/fieldbus status take place in the TwinCAT 2 System Manager.

Technical data	CX1500-B200	CX1500-B310	CX1500-B510	CX1500-B520
Fieldbus	Lightbus	PROFIBUS DP, DP-V1, DP-V2 (MC)	CANopen	DeviceNet
Data transfer rates	2.5 Mbaud, 32 bits of process data in 25 µs	9.6 kbaud…12 Mbaud	10, 20, 50, 100, 125, 250, 500, 800, 1,000 kbaud	125, 250, 500 kbaud
Bus interface	2 x fibre optic	1 x D-sub socket, 9-pin	open style connector, 5-pin	open style connector, 5-pin
Bus device	max. 255 slaves	max. 125 slaves	max. 127 slaves	max. 63 slaves
Max. number of bytes	max. 512 byte input/ 512 byte output	max. 244 byte input/ 244 byte output	max. 1,536 byte input/ 1,536 byte output	max. 255 byte input/ 255 byte output
Max. power loss	1.8 W			
Dimensions (W x H x D)	38 mm x 100 mm x 91 mm			
Weight	approx. 190 g			
Operating/storage temperature	0…+55 °C/-25…+85 °C			
Relative humidity	95 %, no condensation			
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27			
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4			
Protection class	IP 20			
Approvals	CE, UL			
Further information	www.beckhoff.com/CX1500-B200			



UPS CX1100-0900

UPS CX1100-0910

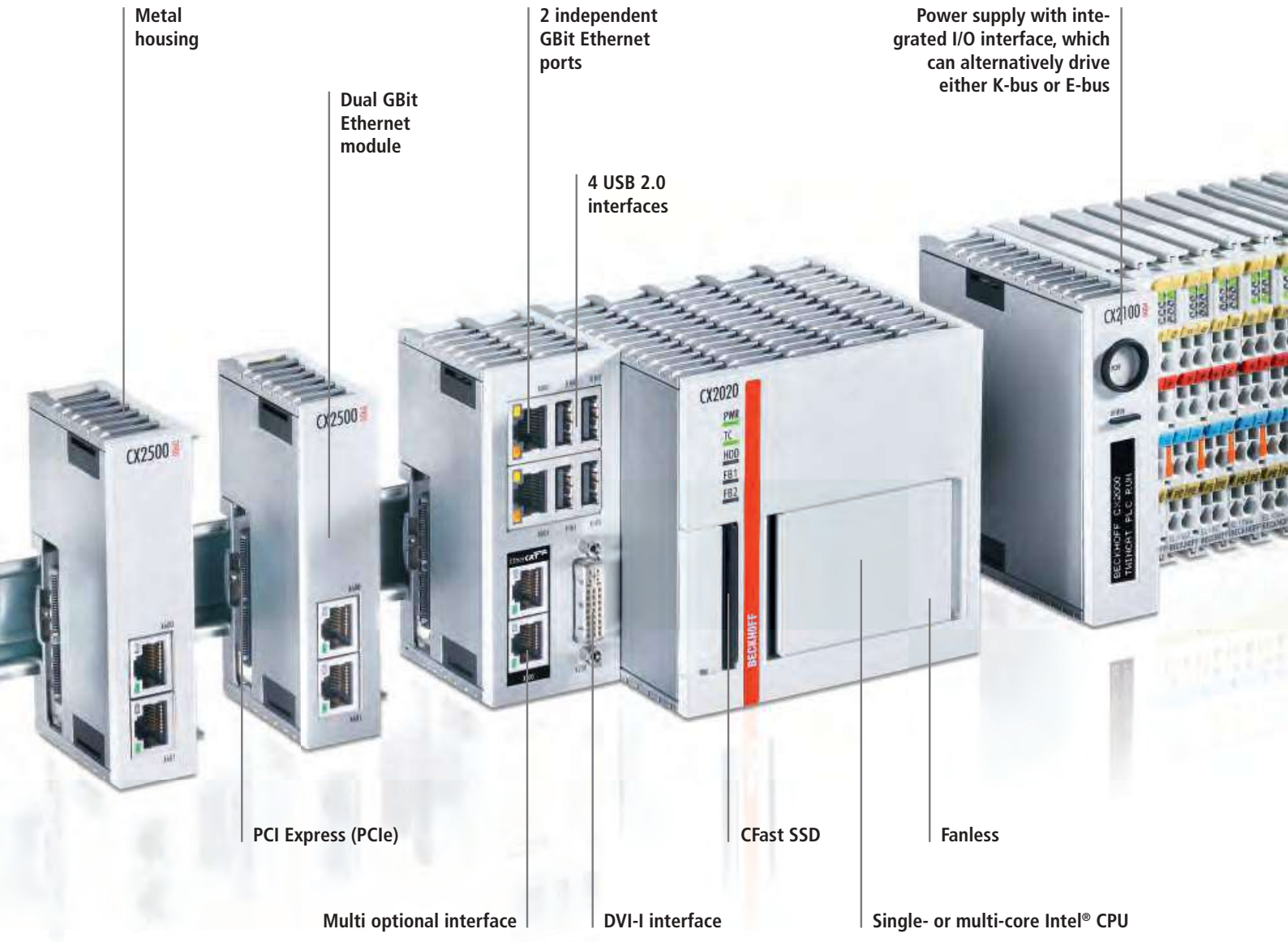
UPS CX1100-0920, CX1100-0930

CX1100-09x0 | UPS modules for CX10x0

The CX1100-09x0 UPS module (uninterruptible power supply) for CX1010, CX1020 or CX1030 CPUs and the connected CX components ensures that important data are stored safely by the user software if the external voltage fails. As opposed to battery operated methods, the use of the latest capacitor technologies enables absolute freedom from maintenance and fast charging. By storing the data, for example on a Compact Flash card, in NOVRAM or via the network in a database, the machine or the process can be placed in a defined condition during the retention time of the UPS and the operating system can be shut down. The retention time can be set via a rotary switch or via software. UPS settings are made and its status messages are output via a DPRAM interface. The functionality of the UPS is therefore independent of the operating system to be used. No driver software is required. The TwinCAT System Manager recognises the UPS module automatically, and the signals are available to the PLC programmer. The module is installed by simply adding it to a CX system in addition to wiring a 24 V DC supply line, and it can also be retrofitted on site. The 24 V DC output voltage of the UPS is protected against short circuit and overload. When dimensioning the UPS, the power consumption of the CX device being powered must be considered. For the supply, a regulated 24 V DC power supply unit with an output current of at least 4 A is required. The CX1100-0920 UPS is recommended for UPS use with a CX1020 and the CX1100-0930 UPS for use with a CX1030.

Technical data	CX1100-0900	CX1100-0910	CX1100-0920	CX1100-0930
Power supply	24 V DC (-15 %/+20 %)			
Storage technology	capacitive			
Charge	20 As	20 As	40 As	40 As
Retention time	adjustable, load-dependent			
Max. output current	550 mA (24 V DC)	1.1 A (24 V DC)	1.1 A (24 V DC)	2.0 A (24 V DC)
Charging current	max. 4 A			
Diagnostics LED	24 V DC input, 24 V DC output, Charge			
Interface to the CPU	16 bit ISA (PC/104 standard)			
Max. power loss	2 W			
Dimensions (W x H x D)	57 mm x 100 mm x 91 mm	76 mm x 100 mm x 91 mm	95 mm x 100 mm x 91 mm	95 mm x 100 mm x 91 mm
Weight	approx. 346 g	approx. 465 g	approx. 617 g	approx. 650 g
Operating/storage temperature	0…+55 °C/-25…+85 °C			
Relative humidity	95 %, no condensation			
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27			
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4			
Protection class	IP 20			
Approvals	CE, UL			
Further information	www.beckhoff.com/CX1100-0900			

CX2000 | Embedded PCs



CX2020

CX2030

CX2040

The CX2020, CX2030 and CX2040 Embedded PCs extend the CX product family with versions with very high CPU power (optionally with multi-core) and enable direct connection of Bus Terminals or EtherCAT Terminals.
The CX2000 in conjunction with EtherCAT and TwinCAT enables very fast control processes in the microsecond range (eXtreme Fast Control Technology).

The basic CPU modules have a CFast memory card, two independent Gbit Ethernet interfaces, four USB 2.0 interfaces and a DVI-I interface as standard. In addition there are fieldbus or serial connection options. Please note that these have to be specified with the order, i.e. retrospective installation is not possible. Other components from the CX2000 family can be connected via the multi-pin terminals on either side. The multi-pin terminal on the left-hand side enables the connection of up to four further optional modules.

The components

The individual system component are 22 mm wide or a multiple thereof. The basic unit consists of the CX20x0 CPU module and a power supply module (CX2100-0xxx).

Power supply unit with integrated I/O interface and optional UPS

The 24 V DC power supply unit is available in four different versions:

- CX2100-0004: E-bus/K-bus power supply unit with automatic switchover
- CX2100-0014: E-bus/K-bus power supply unit with automatic switchover and passive ventilation
- CX2100-0904: E-bus/K-bus power supply unit with automatic switchover and integrated capacitive UPS
- CX2100-0914: E-bus/K-bus power supply unit with automatic switchover and integrated electronic charging unit for external battery packs in order to maintain UPS functionality

All power supply units feature an illuminated anti-glare LC display with two rows of 16 characters each for displaying status messages.

The application programs can also use the display for displaying application-specific texts.

EtherCAT as a fast I/O system

The CX2020, CX2030 and CX2040 Embedded PCs were developed with a view towards optimised interaction with EtherCAT. EtherCAT offers a wide range of application options. The separate Gbit Ethernet interfaces enable EtherCAT to be used with cable redundancy by using one of the Ethernet interfaces as redundancy port. In addition, devices with EtherCAT slave interface can be operated such that several intelligent controllers can be synchronised via an EtherCAT network.

PLC, Motion Control, interpolation and visualisation

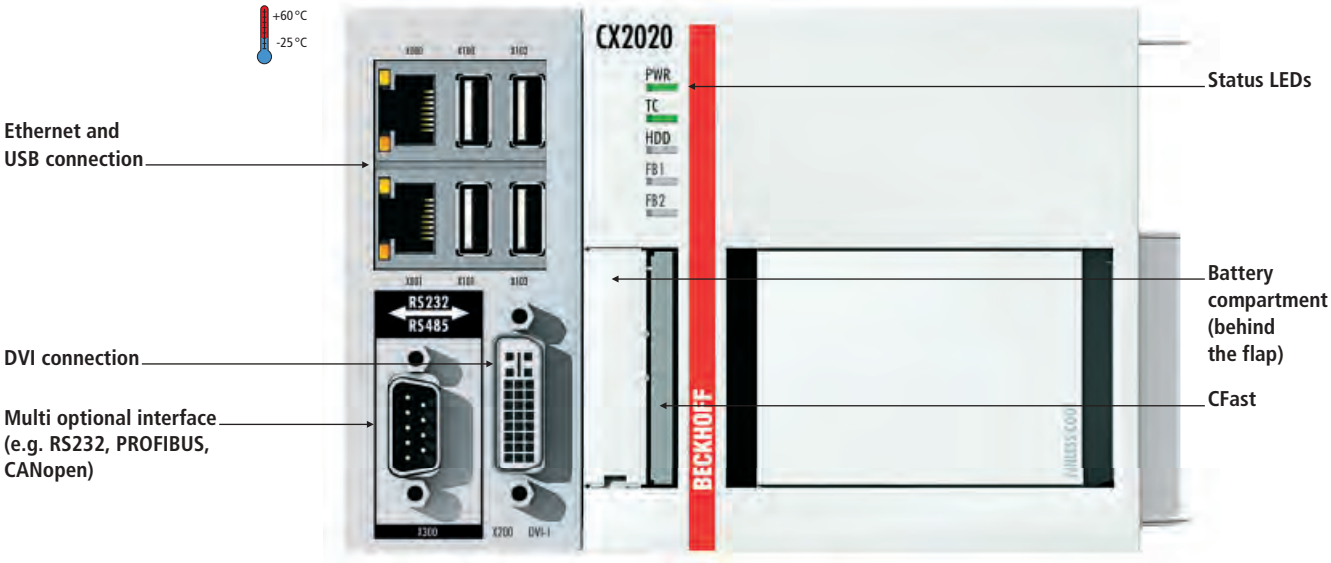
As IPC on a DIN rail the CX2000 in conjunction with TwinCAT offers the functionality of large Industrial PCs. Multi-core CPUs in conjunction with TwinCAT 3 enable PLC projects to be distributed to several cores, resulting in significant performance gains.

Moreover, all TwinCAT functionalities are available for Motion Control applications: in theory, up to 256 axes can be controlled. In addition to simple point-to-point movements, more complex multi-axis functions (electronic gearbox, cam plates, flying saw etc.) can be implemented. Due to the high-performance CPUs in the CX2000, interpolating 3-D path movements can also be implemented and DIN 66025 programs executed.

In addition to handling real-time control tasks the TwinCAT real-time kernel leaves enough time for the user interface (HMI). The high performance of the graphics kernel integrated in the CPU enables demanding visualisations with advanced user interfaces to be realised.

The extended operating temperature range between -25…+60 °C enables application in climatically demanding situations.

▶ **www.beckhoff.com/CX2000**



CX2020, CX2030, CX2040 | **Basic CPU module**

The CX2020 has a 1.4 GHz Intel® Celeron® CPU, the CX2030 has a 1.5 GHz Intel® Core™ i7 dual-core CPU and the CX2040 has a 2.1 GHz Intel® Core™ i7 quad-core CPU. In the CX2020 and CX2030 the controller is fanless and has no rotating components. Due to its high power, the CX2040 has a fan with ball bearings and speed monitoring. In addition to the CPU and chipset the basic modules also contain the main memory. For the CX2020 and CX2030 the size is 2 GB. 4 GB is possible as option. The CX2040 has 4 GB of RAM as standard. The controller boots from the CFast flash memory card.

The CPU has a 128 kB NOVRAM persistent data memory for situations where no UPS is used.

The operating system is Microsoft Windows Embedded Compact 7 or Windows Embedded Standard 7 P.

Up to four modules can be connected to the basic CPU module. The connection order is irrelevant. Internally the modules are connected via PCI Express and can be connected subsequently to the CPU "in the field".

The power supply for the CPU module comes from a CX2100 power supply module, which is connected on the right-hand side of the CPU. Two further CFast memory card modules (CX2550 0010) can be connected between the power supply unit and the CPU, so that a total of up to three CFast cards can be used. RAID can be used in situations where more than one CFast card is used.

The order identifier of the basic CPU module is derived as follows:

CX20x0-01xT

- **0 = operating system only/optional TwinCAT 3**
- **1 = with TwinCAT 2 PLC runtime**
- **2 = with TwinCAT 2 NC PTP runtime**
- **3 = with TwinCAT 2 NC I runtime**

- **0 = no operating system**
- **1 = operating system Microsoft Windows Embedded Compact 7**
- **2 = operating system Microsoft Windows Embedded Standard 7 P 32 bit**
- **3 = operating system Microsoft Windows Embedded Standard 7 P 64 bit**

- **2 = Intel® Celeron® processor 1.4 GHz, 1 core**
- **3 = Intel® Core™ processor 1.5 GHz, 2 cores**
- **4 = Intel® Core™ processor 2.1 GHz, 4 cores**

Optional interfaces:

CX20x0-N010 = second DVI connection, DVI-D port
CX20x0-N030 = RS232, D-sub plug
CX20x0-N031 = RS422/RS485, D-sub socket
CX20x0-B110 = EtherCAT slave, EtherCAT IN and OUT (2 x RJ45)
CX20x0-M310 = PROFIBUS master, D-sub socket, 9-pin
CX20x0-B310 = PROFIBUS slave, D-sub socket, 9-pin
CX20x0-M510 = CANopen master, D-sub plug, 9-pin
CX20x0-B510 = CANopen slave, D-sub plug, 9-pin
CX20x0-M930 = PROFINET RT, controller
CX20x0-B930 = PROFINET RT, device, Ethernet (2 x RJ45 switch)
CX20x0-B950 = EtherNet/IP slave, Ethernet (2 x RJ45 switch)

Since not all combinations make sense, the table "Ordering information" contains a breakdown of the permissible combinations.

Technical data	CX2020	CX2030	CX2040
Processor	Intel® Celeron® 827E 1.4 GHz, 1 core (TC3: 50)	Intel® Core™ i7 2610UE 1.5 GHz, 2 cores (TC3: 60)	Intel® Core™ i7 2715QE 2.1 GHz, 4 cores (TC3: 70)
Flash memory	4 or 8 GB CFast flash card (optionally extendable)		
Internal main memory	2 GB DDR3 RAM	2 GB DDR3 RAM	4 GB DDR3 RAM
Persistent memory	128 KB NOVRAM integrated		
Interfaces	2 x RJ45, 10/100/1000 Mbit/s, DVI-I, 4 x USB 2.0, 1 x optional interface		
Diagnostics LED	1 x power, 1 x TC status, 1 x flash access, 2 x bus status		
Clock	internal battery-backed clock for time and date (battery exchangeable)		
Operating system	Microsoft Windows Embedded Compact 7 or Microsoft Windows Embedded Standard 7 P		
Control software	TwinCAT 2 PLC runtime, NC PTP runtime, NC I runtime | TwinCAT 3, see price list TwinCAT 3		
Power supply	24 V DC (-15 %/+20 %)		
Max. power loss	15 W (including the system interfaces)	20 W (including the system interfaces)	42 W (including the system interfaces)
Dimensions (W x H x D)	144 mm x 100 mm x 91 mm		
Weight	approx. 1160 g	approx. 1165 g	approx. 1230 g
Operating/storage temperature	-25…+60 °C/-40…+85 °C		
Relative humidity	95 %, no condensation		
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27		
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4		
Protection class	IP 20		
Approvals	CE, UL		
TC3 performance class	performance plus (50); for further information on TwinCAT 3 see page 898	mid performance (60); for further information on TwinCAT 3 see page 898	high performance (70); for further information on TwinCAT 3 see page 898
Further information	www.beckhoff.com/CX2020	www.beckhoff.com/CX2030	www.beckhoff.com/CX2040

Ordering information	no operating system	Windows Embedded Compact 7	Windows Embedded Standard 7 P 32 bit	Windows Embedded Standard 7 P 64 bit	optional TwinCAT 3	TwinCAT 2 PLC runtime	TwinCAT 2 NC PTP runtime	TwinCAT 2 NC I runtime
CX20x0-0100	x	–	–	–	–	–	–	–
CX20x0-0110	–	x	–	–	x	–	–	–
CX20x0-0111	–	x	–	–	–	x	–	–
CX20x0-0112	–	x	–	–	–	–	x	–
CX20x0-0113	–	x	–	–	–	–	–	x
CX20x0-0120	–	–	x	–	x	–	–	–
CX20x0-0121	–	–	x	–	–	x	–	–
CX20x0-0122	–	–	x	–	–	–	x	–
CX20x0-0123	–	–	x	–	–	–	–	x
CX20x0-0130	–	–	–	x	x	–	–	–

Power supply unit with E-bus/K-bus interface

Power supply unit with E-bus/K-bus interface and passive ventilation

Power supply unit with integrated capacitive UPS and E-bus/K-bus interface

Power supply unit with integrated Smart Battery charger and E-bus/K-bus interface

CX2100-0xxx | Power supply units and UPS modules for CX2000

Each of the four CX2100 power supply modules has an LC display with 2 x 16 characters. It is controlled via TwinCAT. All power supply modules feature automatic K-bus/E-bus detection and therefore support both I/O systems. The standard power supply CX2100-0004 provides a maximum output of 45 W. The more powerful CX2100-0014 power supply unit offers a maximum output of 90 W. It has to be used for CX2040 quad-core CPU systems. Thanks to its wider housing front the CX2100-0014 also allows passive ventilation through the front and is thus also suitable for horizontal mounting positions. Optionally it can be equipped with active ventilation (fan option) to provide the normally fanless CX2020/CX2030 with a better heat dissipation for operation in different ambient conditions. The CX2100-0904 module also features integrated capacitive UPS. In the event of a power failure this enables the system to save data on the storage medium and then shut down in an orderly manner. The CX2100-0914 module can be used to charge external battery packs in order to provide backup power for the system and external components such as Control Panels. All power supply units from the CX2000 series are in principle passively cooled and fanless.

Technical data	CX2100-0004	CX2100-0014	CX2100-0904	CX2100-0914
Power supply	24 V DC (-15 %/+20 %)			
Max. output	45 W	90 W	45 W	90 W
I/O connection	E-bus (EtherCAT Terminals) or K-bus (Bus Terminals), automatic recognition			
Current supply E-bus/K-bus	2 A			
UPS	–	–	capacitively integrated	external Smart Battery
Charge	–	–	75 As	dependent on battery
Type of connection	spring-loaded technique (adapter terminal)			
Display	FSTN display 2 lines x 16 characters of text, illuminated			
Diagnostics LED	1 x PWR, 1 x I/O Run, 1 x I/O Err			
Max. power consumption	3.5 W			
Dimensions (W x H x D)	39 mm x 100 mm x 91 mm	64 mm x 100 mm x 91 mm	117 mm x 100 mm x 91 mm	73 mm x 100 mm x 91 mm
Weight	approx. 375 g	approx. 550 g	approx. 1030 g	approx. 800 g
Operating/storage temperature	-25…+60 °C/-40…+85 °C	-25…+60 °C/-40…+85 °C	-25…+50 °C/-25…+60 °C	-25…+60 °C/-25…+85 °C
Relative humidity	95 %, no condensation			
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27			
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4			
Protection class	IP 20			
Approvals	CE, UL	CE, UL	CE	CE
Further information	www.beckhoff.com/CX2100-0004			
Option				
CX2900-0192	battery pack for CX2100-0914			

EtherCAT Terminals see page 340, Bus Terminals see page 590

Audio interface

RS232 interface

RS422/RS485 interface

Dual GBit Ethernet interface

USB interface

CX2500-00xx | System modules for CX2000

The system modules for the CX2000 family are connected to the CPU on the left-hand side via a multi-pin connector. Internally they are connected via PCI Express. Up to four modules can be connected in any order. The CX2500-0020 audio module has jack plug (5 x 3.5 mm) and cinch plug for digital signals (SPDIF). Up to 7.1 multi-channel audio can be used. Serial interfaces can be added with the modules CX2500-0030 (RS232) and CX2500-0031 (RS422/RS485). The CX2500-0060 module provides two further independent Gbit Ethernet interfaces. The CX2500-0070 module can be used to add up to four further USB 3.0 interfaces.

Technical data	CX2500-0020	CX2500-0030	CX2500-0031	CX2500-0060	CX2500-0070
Interfaces	Line IN, Line OUT, Mic IN, 7.1, SPDIF	RS232	RS422/RS485	2 x Ethernet, 10/100/1000 Mbit/s	4 x USB 3.0 (max. 2 A total current)
Type of connection	3.5 mm socket for jack plug, RCA socket	2 x D-sub plug, 9-pin	2 x D-sub plug, 9-pin	2 x RJ45	4 x USB 3.0, type A
Power supply	via system bus (through CX2100-0xxx power supply modules)				
Dimensions (W x H x D)	24 mm x 99 mm x 54.5 mm				
Weight	approx. 180 g	approx. 205 g	approx. 203 g	approx. 195 g	approx. 195 g
Operating/storage temperature	-25…+60 °C/-40…+85 °C				
Relative humidity	95 %, no condensation				
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27				
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4				
Protection class	IP 20				
Approvals	CE, UL				
Further information	www.beckhoff.com/CX2500-0020				

CFast slot

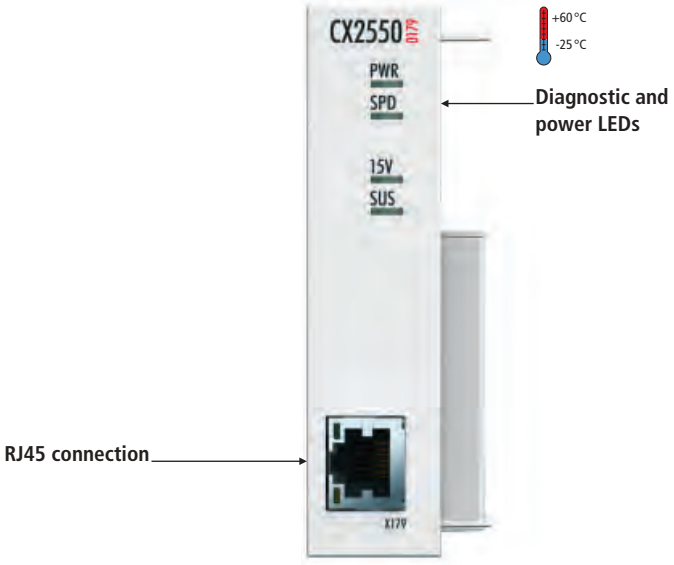
2½-inch HDD/SSD

CX2550-00x0 | Extension modules for CX2000

The extension modules for the CX2000 family are connected to the CPU on the right-hand side via a multi-pin connector. Up to two CX2550-0010 CFast or CX2550-0020 HDD/SSD modules can be connected, so that a total of up to three storage media are available. The storage media can be mounted at the front without tools (CX2550-0010) or by means of a plug-in frame (CX2550-0020), enabling fast and uncomplicated exchange of the storage medium.

The CX2550-0020 module can accept 2½-inch storage media with a thickness of up to 9.5 mm. The internal SATA 6G port offers sufficient bandwidth even for the latest SSD storage media. The storage medium is protected by the attachable cap, which latches to the housing of the module.

Technical data	CX2550-0010	CX2550-0020
Interfaces	SATA	
Type of connection	CFast slot	2½-inch slot
Diagnostics LED	1 x RDY, 1 x HDD	–
Power supply	via system bus (through CX2100-0xxx power supply modules)	
Dimensions (W x H x D)	24 mm x 99 mm x 91 mm	24 mm x 99 mm x 125 mm
Weight	approx. 280 g (without medium)	approx. 290 g (without medium)
Operating/storage temperature	-25…+60 °C/-40…+85 °C	
Relative humidity	95 %, no condensation	
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27	
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4	
Protection class	IP 20	
Approvals	CE, UL	
Further information	www.beckhoff.com/CX2550-0010	www.beckhoff.com/CX2550-0020



USB Extended 1.1 interface

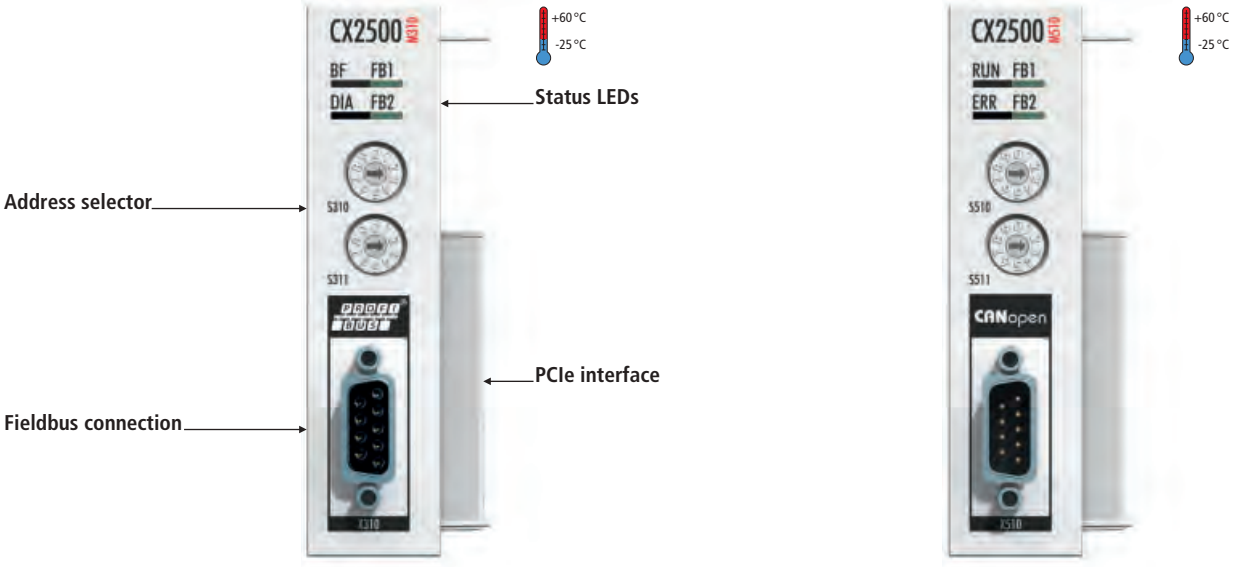
USB Extended 2.0 interface

CX2550-0x79 | System modules USB extension for CX2000

The CX2550-0x79 system modules are attachments for the CX2000 Embedded PC series. They transmit USB signals via a CAT 5e cable over distances of up to max. 50 m. The CX2550-0179 system module transmits USB signals according to the USB 1.1 standard (full speed, max. 12 Mbit/s) while the CX2550-0279 system module transmits USB signals according to the USB 2.0 standard (high speed, max. 480 Mbit/s). Both modules can be attached at the right-hand side of a CX20x0-CPU and are placed between the power supply unit and the CPU. The internal connection is made via a USB port of the CX20x0-CPU; this way, no PCI Express resources are required or used. No additional drivers are required for operation since signal transformation and forwarding of the USB signals take place at the electrical level and are completely transparent for the operating system. Each module has four diagnostic LEDs, which indicate the status of the transmission standard in addition to the power. For better visibility the LEDs of the RJ45 sockets are redundantly implemented on the lower diagnostic LEDs.

The CX2550-0179 and CX2550-0279 modules supplement the CX2000 series by the function of the CU8800 and CU8801 USB extension for Industrial PCs and enable the direct connection of Beckhoff Control Panels with USB Extended interface. The CX2550-0179 system module is suitable for the connection of the Beckhoff CP69xx and CP79xx Control Panel series with USB Extended 1.1 connection. The CX2550-0279 system module is suitable for the connection of the Beckhoff CP29xx and CP39xx Control Panel series with USB Extended 2.0 connection.

Technical data	CX2550-0179	CX2550-0279
Interfaces	1 x USB Extended 1.1	1 x USB Extended 2.0
Type of connection	RJ45 socket	
Properties	transmission of USB 1.1 up to max. 50 m via CAT5e cable	transmission of USB 2.0 up to max. 50 m via CAT5e cable
Diagnostics LED	1 x power, 1 x speed, 1 x +15 V, 1 x suspend	1 x power, 1 x host, 1 x activity, 1 x link
Power supply	via system bus (through CX2100-0xxx power supply modules)	
Dimensions (W x H x D)	24 mm x 99 mm x 54.5 mm	
Weight	approx. 190 g	
Operating/storage temperature	-25…+60 °C/-40…+85 °C	
Relative humidity	95 %, no condensation	
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27	
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4	
Protection class	IP 20	
Approvals	CE, UL	
Further information	www.beckhoff.com/CX2550-0179	



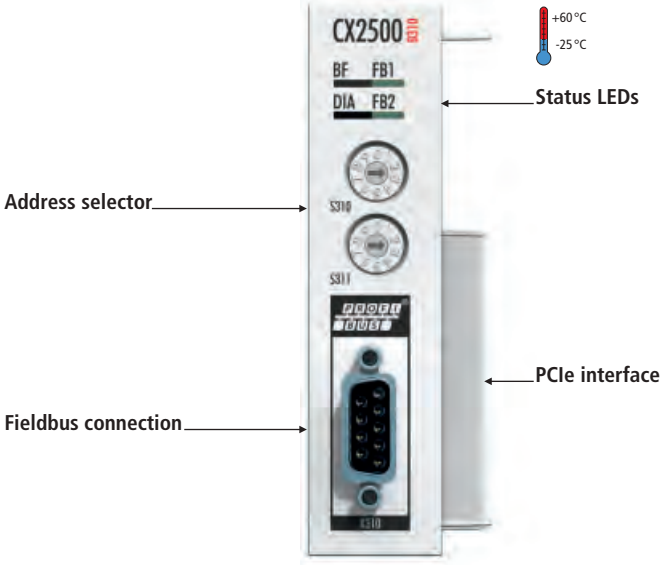
PROFIBUS master

CANopen master

CX2500-Mxxx | Master fieldbus modules for CX2000

The CX2500-Mxxx fieldbus master modules are left-sided attachments for the CX2000 Embedded PC series. The use of CX2000 systems with fieldbus master modules enables the segment-like construction of control structures in extensive plants and machines using further fieldbus components (Bus Couplers, Bus Terminal Controllers, Drive Technology, etc.). The CX2500-M310 fieldbus master module assumes the function of a PROFIBUS master, while the CX2500-M510 is a CANopen master. Each of these modules occupies a PCI Express lane, so that a total of four modules can be connected in any desired combination to the left side of a CX2000 group. Compared with the Beckhoff PCIe Fieldbus Cards, the technical data of the fieldbus master modules are almost identical, but with single channels. The parallel operation of several identical or different masters is possible, e.g. two PROFIBUS masters or a PROFIBUS master and a CANopen master. In the case of mixed operation of master and slave connections, CX systems act as intelligent gateways between different fieldbuses: data are received, processed and fed into other fieldbuses. Master or slave connections network several CX systems with one another strictly deterministically via the fieldbus level. CX fieldbus modules can be retrofitted/exchanged by adding them to existing CX systems. The scanning and recognising of the modules, the parameterisation, the configuration of the connected I/O components and the online diagnosis of the process/fieldbus status take place in the TwinCAT System Manager.

Technical data	CX2500-M310	CX2500-M510
Fieldbus	PROFIBUS DP, DP-V1; DP-V2 (MC) in preparation	CANopen
Data transfer rates	9.6 kbaud…12 Mbaud	10, 20, 50, 100, 125, 250, 500, 800, 1,000 kbaud
Bus interface	1 x D-sub socket, 9-pin	
Bus device	max. 125 slaves with up to 244 bytes input, output, parameter, configuration or diagnostic data per slave	max. 127 slaves
Interface to the CPU	PCI Express	
Max. power loss	2.8 W	
Properties	PROFIBUS – different DP cycle times are possible for each slave. The error management for each user is freely configurable.	CANopen – supported PD communication types: event driven, time-controlled, synchronous, polling; emergency message handling, guarding and heartbeat, boot-up according to DS302, Online Bus Load Monitor and Bus Trace, the error management for each user is freely configurable.
Dimensions (W x H x D)	24 mm x 99 mm x 54.5 mm	
Weight	approx. 180 g	
Operating/storage temperature	-25…+60 °C/-40…+85 °C	
Relative humidity	95 %, no condensation	
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27	
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4	
Protection class	IP 20	
Approvals	CE, UL	
Further information	www.beckhoff.com/CX2500-Mxxx	



CX2500-Bxxx | Slave fieldbus modules for CX2000

The CX2500-Bxxx fieldbus slave modules are left-sided attachments for the CX2000 Embedded PC series. The use of CX2000 systems with fieldbus slave modules enables the use of a CX system as a subordinate local controller for the construction of complex or modular systems. External process data are received from the master and processed, or data from its own process peripherals are returned to the master controller directly or processed.

The CX2500-B310 fieldbus slave module assumes the function of a PROFIBUS slave, while the CX2500-B510 is a CANopen slave. Each of these modules occupies a PCI Express lane, so that a total of four of these modules can be connected in any desired combination to the left side of a CX2000 group. The fieldbus slave modules are single-channel modules. The CX2500-B310 fieldbus slave module for PROFIBUS can present itself to the master as a multiple (max. quadruple) "virtual" slave station, resulting in a four-fold increase in the quantity of exchanged process data.

The parallel operation of several identical or different slaves is possible, e.g. two PROFIBUS slaves or a PROFIBUS slave and a CANopen slave. In the case of mixed operation of master and slave connections, CX systems act as intelligent gateways between different fieldbuses: data are received, processed and fed into other fieldbuses.

Master or slave connections network several CX systems with one another strictly deterministically via the fieldbus level. CX fieldbus modules can be retrofitted/exchanged by adding them to existing CX systems. The scanning and recognising of the modules, the parameterisation, the configuration of the connected I/O components and the online diagnosis of the process/fieldbus status take place in the TwinCAT System Manager.

Technical data	CX2500-B310	CX2500-B510
Fieldbus	PROFIBUS DP, DP-V1	CANopen
Data transfer rates	9.6 kbaud…12 Mbaud	10, 20, 50, 100, 125, 250, 500, 800, 1,000 kbaud
Bus interface	1 x D-sub socket, 9-pin	
Bus device	max. 125 slaves	max. 127 slaves
Interface to the CPU	PCI Express	
Max. number of bytes	max. 244 byte input/244 byte output	
Max. power loss	2.8 W	
Dimensions (W x H x D)	24 mm x 99 mm x 54.5 mm	
Weight	approx. 180 g	
Operating/storage temperature	-25…+60 °C/-40…+85 °C	
Relative humidity	95 %, no condensation	
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27	
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4	
Protection class	IP 20	
Approvals	CE, UL	
Further information	www.beckhoff.com/CX2500-Bxxx	

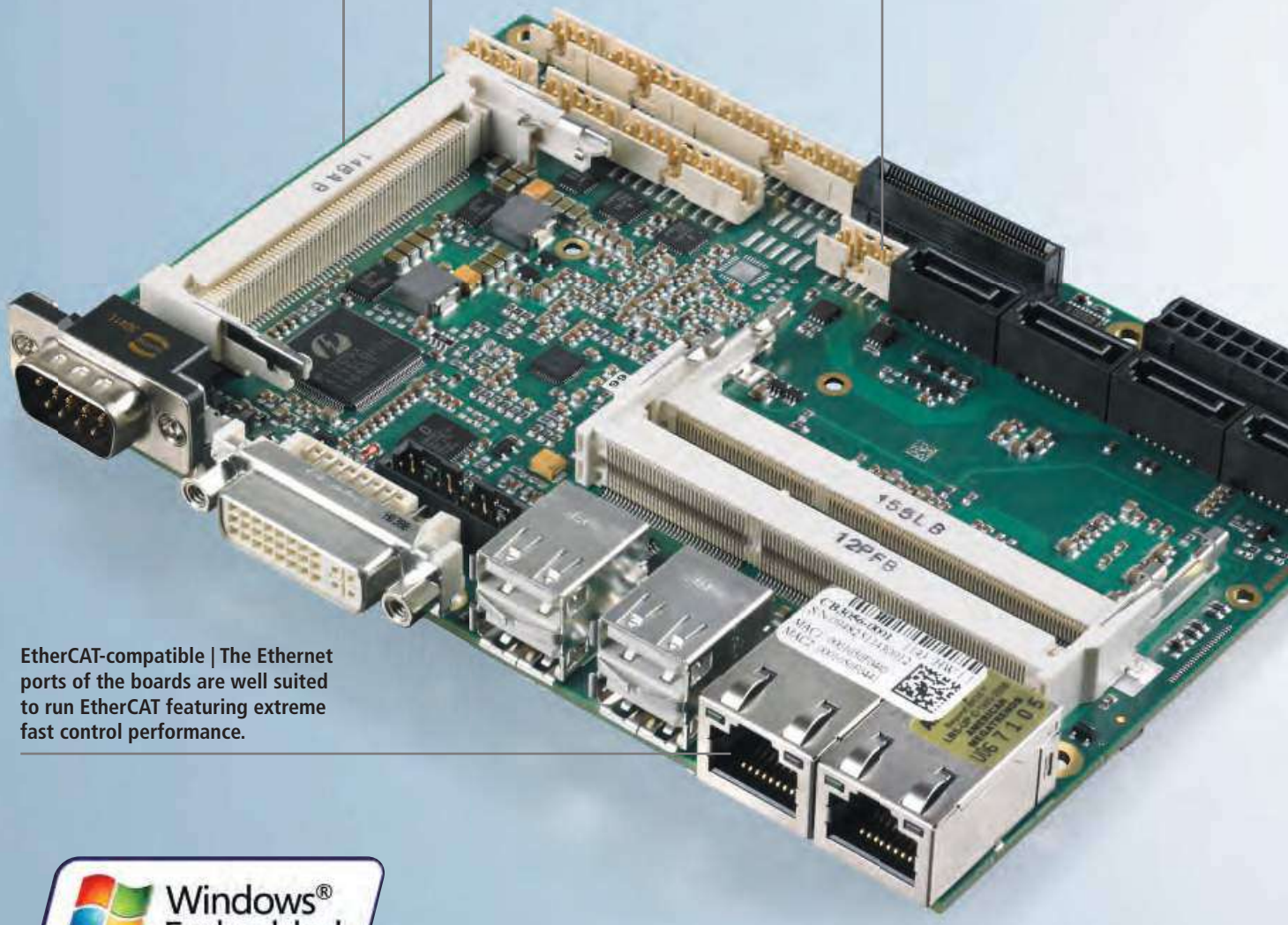
CBxxxx | Industrial Motherboards

Motherboards with Intel® x86 and ARM architecture

Simple cooling adaptation | The layout of the boards is optimised for simple and efficient cooling.

Operating system support | Beckhoff supports all Microsoft operating systems like Windows NT, 2000, XP, XP Embedded, Windows 7 and Windows CE.

Auxiliary on-board interfaces | On-board touch screen controller, I²C, SMB, and GPIO reduce the overall bill of material for a device.



EtherCAT-compatible | The Ethernet ports of the boards are well suited to run EtherCAT featuring extreme fast control performance.

Windows® Embedded Gold Partner

Beckhoff is Microsoft Embedded Gold Partner and recognized for excellence as a proven industry leader with exceptional expertise in building and enabling Windows embedded solutions.

Motherboard series ATX

Motherboard series 3½-inch

Motherboards with Intel® x86 and ARM architecture
Beckhoff has expanded the "Industrial Motherboards" line of business into an independent product segment, with in-house board development, design and production. In addition, the own motherboard and BIOS development initiatives enable Beckhoff to respond more quickly to new technologies in the PC market and to customer-specific requirements.

Flexible PC BIOS software
Full BIOS source code access for Phoenix and AMI BIOS makes it possible to adapt to special board functions or introduce specific customer requirements. BIOS functionality very much depends on the field of usage for a motherboard: commercial applications typically require a balance between power dissipation and program load, the industrial usage often requires full CPU availability at any time. For example, settings for speed stepping and thermal monitoring need to be adapted in the BIOS to reflect the different usage modes.

Standard form factors
ATX and 3½-inch are the supported standard form factors. The 3½-inch form factor is characterised by its compact dimensions and simple cooling adaptation. No specially adapted cables are required for fast commissioning. In general, Beckhoff provides all form factors with one chipset: the chipset Intel® QM87, for example, is available on all of the above mentioned board shapes. This allows the construction of a family with architecture-identical devices.

Long-term availability
Boards are made available for a minimum of five years, based on the general market availability of the components. All components are selected according to the longevity of supply. CPUs and chipsets, for example, are selected only if they are part of the embedded product line of the manufacturer.

Manufacturing quality
Since Beckhoff is using many of the motherboard products in their own PCs, quality is the number one goal. The focus is robustness and reliability; only high quality electronic components are used. All boards must pass a visual, electrical and functional inspection. The manufacturing date and serial number are clearly marked on the boards.

Customer-specific adaptation and integration services
Board and BIOS can be adapted to meet the needs of a customized device. Furthermore, Beckhoff is experienced in designing and producing complete embedded units, including the housing, display, various other electrical and mechanical interfaces, operating systems and application software.

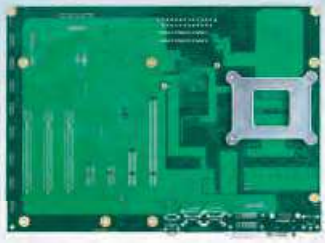
Beckhoff Motherboards – Hightech from Westphalia, Germany
The complete engineering and design cycle as well as manufacturing of the boards takes place in Westphalia, Germany, at two locations: in Münster and at the Beckhoff headquarters in Verl. This local geographical context ensures short turnaround cycles between engineering, production and quality control. It also ensures that reaction time on customer feedback is the shortest possible.

▶ **www.beckhoff.com/Motherboards**

Product overview Industrial Motherboards

	ATX		3½-inch		
	CB1056 257	CB1061 258	CB3056 259	CB3060 260	CB3063 261
CPU type					
CPU	Intel® Celeron®/ Core™ i3/ Core™ i5/ Core™ i7	Intel® Core™ i3/ Core™ i5/ Core™ i7	Intel® Celeron®/ Core™ i3/ Core™ i5/ Core™ i7	Intel® Core™ i3/ Core™ i5/ Core™ i7	Intel® Atom™ E38xx
Performance	1.1…2.5 GHz	depending on selected CPU	1.1…2.5 GHz	depending on selected CPU	1.46…1.91 GHz
Chipset	Intel® QM67	Intel® Q87	Intel® QM67	Intel® QM87	Intel® Atom™ E38xx
Memory					
Type	2 x SODIMM204– 1.5 V/DDR3	4 x SODIMM204– 1.35 V/DDR3L	2 x SODIMM204– 1.5 V/DDR3	2 x SODIMM204– 1.35 V/DDR3L	SODIMM204– 1.35 V/DDR3L
Speed max.	DDR3 1066	DDR3L 1600	DDR3 1600	DDR3L 1600	DDR3L 1333
Slots					
ISA/PCI	–/3 x PCI32 slot	–/3 x PCI32 slot	–/Mini PCI	–/Mini PCI	–
PCIe x1/x4/x16	2x/1x/1x (PCIe V 2.0)	2 x PCIe x1(2.0) + 1 x PCIe x16(3.0)	4 x 1 or 1 x 4	4 x PCIe x1(2.0) or 1 x PCIe x4(2.0)	1 x PCIe x1

Front side



Back side

CB1056 | ATX Industrial Motherboard

CPU type, chipset	CPU	Intel® Celeron®/Core™ i3/ Core™ i5/Core™ i7
	Socket	PGA988
	2nd level cache	max. 6 MB
	FSB	–
	Performance	1.1…2.5 GHz
	Chipset	Intel® QM67

Memory	Type	2 x SODIMM204–1.5 V/DDR3
	Max. memory/speed	8,192 MB/DDR3 1600
	On-board flash	–

Interfaces	ATA primary/secondary	–
	ATA RAID	–
	PIO	–
	DMA	–
	SATA	2 x 6 G, 4 x 3 G
	SATA RAID	0/1/5/10
	1.5 Gbs/3.0 Gbs	yes/yes/yes
	Boot	HD/FDD/CD-ROM/FD/ZIP
	USB channels	14
	USB	1.0/2.0/host
	Specials/options	–
	COM1/2	(TTL)/RS232
	COM3/4	(TTL)/RS232
	LPT1	–
	LPT2	–
	PS/2 keyboard/mouse	yes/yes
	Floppy interface FCC/LPT	–
	Touch controller ELO resistive	–
	TPM/Watchdog	–/yes
	Supply voltage	ATX

Audio	Controller and codec	Intel® QM67/Realtek ALC889 (HDA)
	Support for 2.0/5.1/7.1	yes/yes/yes
	Analog input	Line/CD/Mic1/Mic2/PCBeep
	Analog output Line/Mono out	yes/–
	Digital input/output	yes/yes

LAN	LAN1 controller	Intel® QM67/82579L Phy
	LAN1	10/100/1000
	LAN1 boot option	RPL/PXE/WOL
	LAN2 controller	Intel® 82574L
	LAN2	10/100/1000
	LAN2 boot option	RPL/PXE/WOL

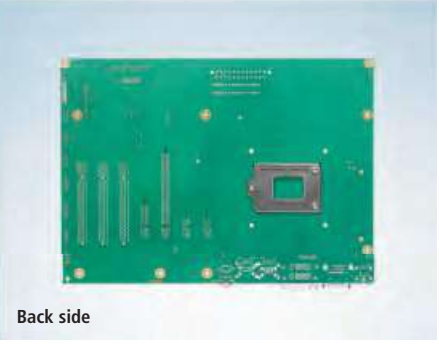
Graphic	Controller	CPU integrated
	Video BIOS	Intel® Extreme
	Memory	512 MB DVMT
	CRT/CRT resolution	yes/2048 x 1536
	DVI	2 x DVI, 1 x DisplayPort
	LCD TTL	–
	LCD LVDS	–
	LCD resolution	1920 x 1200 (DVI)

BIOS	Manufacturer/BIOS chip	AMI Aptio/2 x FWH (SPI-Flash)
	Power management APM/ACPI	yes/yes
	SpeedStep®/ATM	yes/(yes)
	Selectable fixed frequency	yes
	Power states	S0/S3/S4/S5

Buses	ISA/PCI	–/3 x PCI32 slot
	AGP 3.3 V/1.5 V	–
	PCIe x1/x4/x16	2x/1x/1x (PCIe V 2.0)

Dimen.	Format	ATX
	Dimensions (W x H x D)	305 mm x 41 mm x 220 mm
	Further information	www.beckhoff.com/CB1056

Front side



Back side

CB1061 | ATX Industrial Motherboard

CPU type, chipset	CPU	Intel® Core™ i3/Core™ i5/ Core™ i7
	Chipset	Intel® Q87
	Super IO1	SMSC SCH3114
	Super IO2	–
	Hardware monitoring	Super IO1

Memory	Type	4 x SODIMM204–1.35 V/DDR3L
	Max. memory/speed	32 GB/DDR3L 1600
	On-board flash	–

Interfaces	SATA	6 x SATA 6 G
	SATA RAID	0/1/5/10
	Boot	HD/FDD/CD-ROM/FD/ZIP
	USB channels	14
	USB	1.0/2.0/4 x USB 3.0
	COM1/2	RS232/RS232
	COM3/4	RS232/RS232
	PS/2 keyboard/mouse	yes/yes
	Touch controller ELO resistive	–
	TPM/Watchdog	yes/yes
	Supply voltage	ATX 24

Audio	Controller and codec	Intel® Q87/Realtek ALC889 (HDA)
	Support for 2.0/5.1/7.1	yes/yes/–
	Analog input	Line/CD/Mic1/Mic2/PCBeep
	Analog output Line/Mono out	yes/–
	Digital input/output	yes/yes

LAN	LAN1 controller	Intel® Q87/i218 Phy
	LAN1	10/100/1000
	LAN1 boot option	PXE/WOL
	LAN2 controller	Intel® i210
	LAN2	10/100/1000
	LAN2 boot option	–

Graphic	Controller	CPU integrated
	Video BIOS	Intel® Extreme
	Memory	512 MB DVMT
	CRT/CRT resolution	yes/1920 x 1200
	DVI	2 x DVI, 1 x DisplayPort
	LCD TTL	–
	LCD LVDS	–
	LCD resolution	1920 x 1200 (DVI, HDMI)

BIOS	Manufacturer/BIOS chip	AMI Aptio/128 Mbit SPI-Flash
	Power management APM/ACPI	yes/yes
	SpeedStep®/ATM	yes/yes
	Selectable fixed frequency	yes
	Power states	S0/S1/(S3)/S4/S5

Buses	ISA/PCI	–/3 x PCI32 slot
	AGP 3.3 V/1.5 V	–
	PCIe x1/x4/x16	2 x PCIe x1(2.0) + 1 x PCIe x16(3.0)

Dimen.	Format	ATX
	Dimensions (W x H x D)	305 mm x 41 mm x 220 mm
	Further information	www.beckhoff.com/CB1061

Front side

Back side

CB3056 | 3½-inch Industrial Motherboard

CPU type, chipset	CPU	Intel® Celeron®/Core™ i3/ Core™ i5/Core™ i7
	Socket	PGA988
	2nd level cache	max. 6 MB
	FSB	–
	Performance	1.1…2.5 GHz
	Chipset	Intel® QM67

Memory	Type	2 x SODIMM204–1.5 V/DDR3
	Max. memory/speed	8,192 MB/DDR3 1600
	On-board flash	–

Interfaces	ATA primary/secondary	–
	ATA RAID	–
	PIO	–
	DMA	–
	SATA	4
	SATA RAID	0/1/5/10
	1.5 Gbs/3.0 Gbs	yes/yes/yes
	Boot	HD/FDD/CD-ROM/FD/ZIP
	USB channels	10
	USB	1.0/2.0/Host
	Specials/options	–
	COM1/2	RS232/RS232
	COM3/4	RS232/RS232
	LPT1	–
	LPT2	–
	PS/2 keyboard/mouse	(yes)/(yes)
	Floppy interface FCC/LPT	–
	Touch controller ELO resistive	–
	TPM/Watchdog	–/yes
	Supply voltage	5 V and 5 V standby (12 V for fans)

Audio	Controller and codec	Intel® QM67/Realtek ALC889 (HDA)
	Support for 2.0/5.1/7.1	yes/yes/–
	Analog input	Line/Mic1/Mic2/PCBeep
	Analog output Line/Mono out	yes/–
	Digital input/output	yes/yes

LAN	LAN1 controller	Intel® QM67/82579L Phy
	LAN1	10/100/1000
	LAN1 boot option	RPL/PXE/WOL
	LAN2 controller	Intel® 82574L
	LAN2	10/100/1000
	LAN2 boot option	RPL/PXE/WOL

Graphic	Controller	CPU integrated
	Video BIOS	Intel® Extreme
	Memory	512 MB DVMT
	CRT/CRT resolution	yes/2048 x 1536
	DVI	2 x
	LCD TTL	–
	LCD LVDS	–
	LCD resolution	–

BIOS	Manufacturer/BIOS chip	AMI Aptio/SPI-Flash
	Power management APM/ACPI	yes/yes
	SpeedStep®/ATM	yes/–
	Selectable fixed frequency	yes
	Power states	S0/S1/(S3)/S4/S5

Buses	ISA/PCI	–/Mini PCI
	AGP 3.3 V/1.5 V	–
	PCIe x1/x4/x16	4 x 1 or 1 x 4

Dimen.	Format	3½-inch
	Dimensions (W x H x D)	147 mm x 20 mm x 102 mm
	Further information	www.beckhoff.com/CB3056

Front side

Back side

CB3060 | 3½-inch Industrial Motherboard

CPU type, chipset	CPU	Intel® Core™ i3/Core™ i5/ Core™ i7
	Chipset	Intel® QM87
	Super IO1	SMSC SCH3114
	Super IO2	–
	Hardware monitoring	Super IO1

Memory	Type	2 x SODIMM204–1.35 V/DDR3L
	Max. memory/speed	16 GB/DDR3L 1600
	On-board flash	–

Interfaces	SATA	2 x SATA 3G/2 x SATA 6G
	SATA RAID	0/1/5/10
	Boot	HD/FDD/CD-ROM/FD/ZIP
	USB channels	11
	USB	1.0/2.0/3 x USB 3.0
	COM1/2	RS232/RS232
	COM3/4	RS232/RS232
	PS/2 keyboard/mouse	yes/yes (replaces COM3)
	Touch controller ELO resistive	–
	TPM/Watchdog	–/yes
	Supply voltage	5 V and 5 V standby (12 V for fans)

Audio	Controller and codec	Intel® QM87/Realtek ALC889 (HDA)
	Support for 2.0/5.1/7.1	yes/yes/–
	Analog input	Line/Mic1/Mic2/PCBeep
	Analog output Line/Mono out	yes/–
	Digital input/output	yes/yes

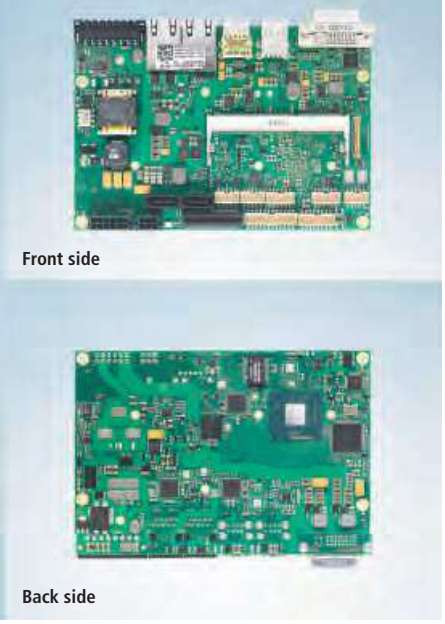
LAN	LAN1 controller	Intel® Q87/i218 Phy
	LAN1	10/100/1000
	LAN1 boot option	PXE/WOL
	LAN2 controller	Intel® i210
	LAN2	10/100/1000
	LAN2 boot option	–

Graphic	Controller	CPU integrated
	Video BIOS	Intel® Extreme
	Memory	512 MB DVMT
	CRT/CRT resolution	yes/1920 x 1200
	DVI	2 x DVI/HDMI
	LCD TTL	–
	LCD LVDS	–
	LCD resolution	1920 x 1200 (DVI, HDMI)

BIOS	Manufacturer/BIOS chip	AMI Aptio/128 Mbit SPI-Flash
	Power management APM/ACPI	yes/yes
	SpeedStep®/ATM	yes/yes
	Selectable fixed frequency	yes
	Power states	S0/S1/(S3)/S4/S5

Buses	ISA/PCI	–/Mini PCI
	AGP 3.3 V/1.5 V	–
	PCIe x1/x4	4 x PCIe x1(2.0) or 1 x PCIe x4(2.0)

Dimen.	Format	3½-inch
	Dimensions (W x H x D)	147 mm x 20 mm x 102 mm
	Further information	www.beckhoff.com/CB3060



Front side

Back side

CB3063 | 3½-inch Industrial Motherboard

CPU type, chipset	CPU	Intel® Atom™ E38xx
	Chipset	Intel® Atom™ E38xx
	Super IO1	SMSC SCH3114
	Super IO2	–
	Hardware monitoring	Super IO1

Memory	Type	SODIMM204–1.35 V/DDR3L
	Max. memory/speed	8 GB/DDR3L 1333
	On-board flash	–

Interfaces	SATA	2 x SATA 3G
	SATA RAID	–
	Boot	HD/FDD/CD-ROM/FD/ZIP
	USB channels	9
	USB	8 x USB 2.0, 1 x USB 3.0
	COM1/2	RS232/–
	COM3/4	–
	PS/2 keyboard/mouse	yes/yes (replaces COM3)
	Touch controller ELO resistive	–
	TPM/Watchdog	–/yes
	Supply voltage	24 V

Audio	Controller and codec	–
	Support for 2.0/5.1/7.1	–
	Analog input	–
	Analog output Line/Mono out	–
	Digital input/output	–

LAN	LAN1 controller	Intel® i210
	LAN1	10/100/1000
	LAN1 boot option	PXE/WOL
	LAN2/3 controller	Intel® i210
	LAN2/3	10/100/1000
	LAN2/3 boot option	WOL

Graphic	Controller	CPU integrated
	Video BIOS	Intel® Extreme
	Memory	512 MB DVMT
	DVI-I: DVI resolution	1920 x 1080
	DVI-I: CRT resolution	2560 x 1600
	DVI internal: resolution	1920 x 1080
	DP internal: resolution	2560 x 1600

BIOS	Manufacturer/BIOS chip	AMI Aptio/128 Mbit SPI-Flash
	Power management APM/ACPI	yes/yes
	SpeedStep®/ATM	yes/yes
	Selectable fixed frequency	yes
	Power states	S0/S1/(S3)/S4/S5

Buses	ISA/PCI	–
	AGP 3.3 V/1.5 V	–
	PCIe x1/x4/x16	1 x PCIe x1

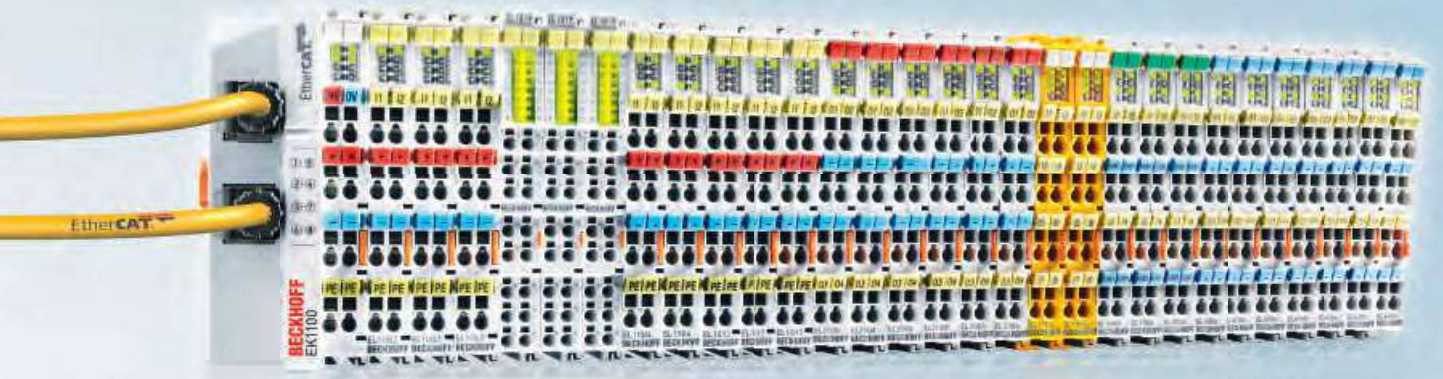
Dimen.	Format	3½-inch
	Dimensions (W x H x D)	147 mm x 20 mm x 102 mm
	Further information	www.beckhoff.com/CB3063


EQ2008-0002
BECKHOFF
BECKHOFF
BECKHOFF
IN
OUT
BECKHOFF
BX3120
KL1012
KL2012

Fieldbus Components

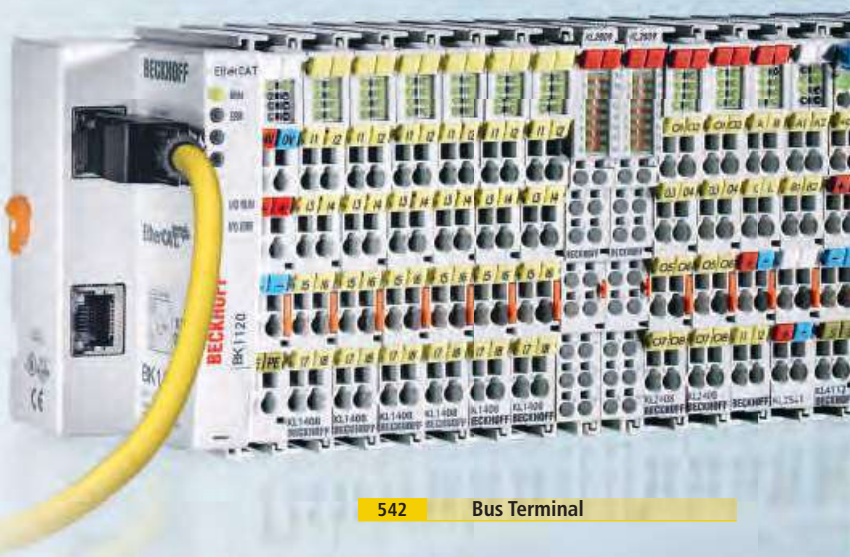
I/Os for all common fieldbus systems

766 Infrastructure Components



314 EtherCAT Terminal

450 EtherCAT Box



542 Bus Terminal

Fieldbus Components

I/Os for all common fieldbus systems

The fieldbus toolkit

Beckhoff provides an extensive range of fieldbus components for all common I/O and fieldbus systems. The wide choice of I/O components means that the bus system best suited to the particular application can be chosen:

EtherCAT
EtherCAT (Ethernet Control Automation Technology) is the Ethernet solution for industrial automation, characterised by outstanding performance and particularly simple handling.

Ethernet
The advantages of Ethernet, such as high data transmission rates, easy methods of integration into existing networks, and a wide range of services and interfaces are also found in the Beckhoff Ethernet products.

Lightbus
This well proven fibre optics bus system from Beckhoff is characterised by particularly good immunity to EMI, easy installation and a very fast, cyclic and deterministic data flow.

PROFIBUS
PROFIBUS is widely used as a fast bus for decentralised peripheral components (PROFIBUS DP). In addition to PROFIBUS DP and FMS, Beckhoff also supports the standard for drive communication, PROFIBUS MC.

PROFINET
PROFINET is the open Industrial Ethernet standard of the PNO (PROFIBUS users organisation). Internationally established IT standards such as TCP/IP are used for communication.

EtherNet/IP
Ethernet/IP is the Industrial Ethernet standard of the ODVA (Open DeviceNet Vendor Association). Ethernet/IP is based on Ethernet TCP/IP and UDP/IP.

CANopen
The effective utilisation of the bus bandwidth allows CANopen to achieve a short system reaction time at comparatively low data rates. The typical advantages of CAN, such as high data security and multi-master capability are retained.

DeviceNet
DeviceNet is a sensor/actuator bus system that originated in the USA, but which meanwhile is increasingly being used in Europe and Asia. DeviceNet is CAN-based (Controller Area Network).

SERCOS interface
SERCOS was originally developed as a fast fibre optic bus system for drives. Thanks to the Beckhoff SERCOS Bus Coupler, the advantages such as high data rate and short cycle times can now be provided for the I/O peripherals too.

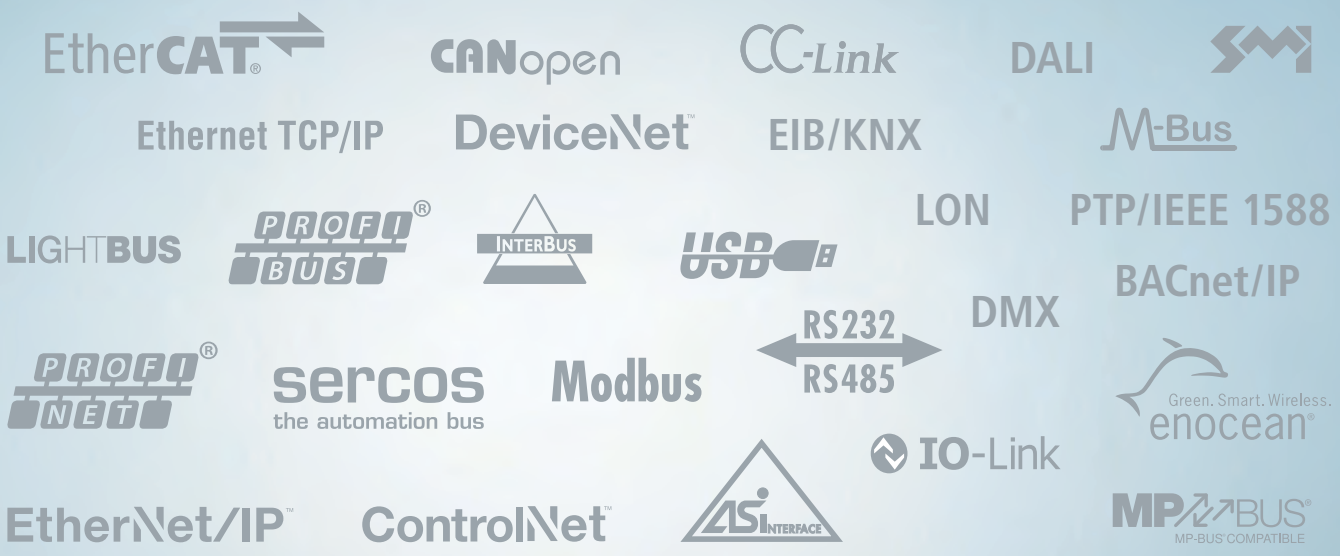
ControlNet
ControlNet is an open, standardised fieldbus system. The protocol allows both cyclic and acyclic data to be exchanged over the bus without affecting each other.

CC-Link
CC-Link (Control & Communication Link) is an open bus system for communication between the control and fieldbus level. It is predominately used in Asia.

USB
USB has grown into a standard interface for PC technology. Thanks to its high transmission rate, flexible topology through integrated hubs and the Beckhoff USB Bus Coupler, this system can be used as a substitute for a fieldbus when distances are small.

Modbus RTU
Modbus RTU is an open, serial communications protocol based on the master/slave architecture. Since it is extremely easy to implement on all kinds of serial interfaces, it has gained wide acceptance.

Modbus TCP
Due to its open standards Modbus TCP is common for the use of Ethernet in the fields of automation. Modbus TCP has a so called "Well known port (Port 502)", which makes it routable via the Internet.



RS232/RS485
The "classic" serial interfaces, RS232 and RS485, continue in wide use. The Beckhoff RS485/RS232 I/O modules use a simple, published serial communication protocol that is easy to implement.

AS-Interface
AS-Interface connects sensors and actuators with the higher control level via a simple and low-priced wiring method. AS-Interface is internationally standardised through EN 50295 and IEC 62026-2.

IO-Link
IO-Link serves to connect sensors and actuators to the control level by means of an inexpensive point-to-point connection. As an open interface, IO-Link can be integrated in all common fieldbus systems.

DALI
In building automation DALI is a standard for digital control of electronic ballasts for lighting.

EIB/KNX
The local two-wire bus system EIB/KNX for the connection of sensors and actuators has its main area of use in building automation, since it is well suited for implementation in various functionalities.

LON
LON (Local Operating Network) is a multi-network-capable communication system for distributed applications. It is predominately used for automation applications in commercial buildings.

EnOcean
EnOcean enables the battery-free transmission of switching signals and measured values and is mainly used in building automation.

DMX
As bus system for professional lighting equipment DMX (Digital Multiplexing) controls dynamic lighting in stage- and event-business as well as lighting of exclusive displays of light and color in high-profile buildings.

MP-Bus
As simple sensor/actuator bus for HVAC systems the MP-Bus (Multi Point Bus) serves to control flaps and volumetric flow rate controllers alongside valves and window ventilation systems.

SMI
Standard Motor Interface (SMI) is a standard interface for the control of electronic drives for sun blinds and roller shutters e.g. via bus topologies used in building automation.

M-Bus
The M-Bus (Metering Bus) is used as a standardised system for reading energy and consumption meters or other end devices in buildings and properties with a large number of end users (see EN 13757).

PTP/IEEE 1588
The Precision Time Protocol (PTP) secures the synchronicity of the time settings of several devices in a network and is defined in IEEE 1588 as the protocol standard for the synchronisation of distributed clocks in networks.

BACnet/IP
BACnet (Building Automation Control Network) is a standardised, manufacturer-independent communication protocol for building automation, based on Ethernet. Areas of application include HVAC, lighting control, safety and fire alarm technology.

Product overview fieldbus systems

Fieldbus	EtherCAT Terminal 314	EtherCAT Box 450	EtherCAT Plug-in Modules 526	Bus Terminal 542		Fieldbus Box	
	Couplers/ Gateways	Modules		Bus Couplers/Master terminals	PLC (IEC 61131-3)	Compact Box	Coupler Box
EtherCAT	EK1xxx 332	EPxxxx 462	EJxxxx 536	BK1120 566			IL230x-B110 709
	EL6695 bridge terminal 418	EQxxxx 504		BK1150 566			
		ERxxxx 464		BK1250 566			
LIGHTBUS	EL6720 master terminal 426			BK20x0 567		IPxxxx-B200 709	IL230x-B200 709
PROFIBUS	EK3100 338			BK3xx0 568	BC31x0 582	IPxxxx-B31x 710	IL230x-B31x 710
	EL6731 master/slave terminal 423			LC3100 569	BX3100 583		
INTERBUS	EL6740 426 slave terminal			BK40x0 570		IPxxxx-B400 711	IL230x-B400 711
CANopen	EL6751 master/slave terminal 424			BK51xx 570	BC5150 583	IPxxxx-B51x 712	IL230x-B51x 712
				LC5100 571	BX5100 583		
DeviceNet	EL6752 master/slave terminal 425			BK52x0 572	BC5250 584	IPxxxx-B52x 713	IL230x-B52x 713
				LC5200 573	BX5200 584		
ControlNet				BK7000 574			
CC-Link				BK7150 574			
Modbus				BK73x0 575	BC7300 585	IPxxxx-B730 714	IL230x-B730 714
sercos the automation bus	EK9700 339			BK75x0 576			
RS485	EL6021, EL6022 412	EP600x 494		BK8000 576	BC8050 585	IPxxxx-B800 714	IL230x-B800 715
					BX8000 586		
RS232	EL6001, EL6002 412	EP600x 494		BK8100 577	BC8150 586	IPxxxx-B810 715	IL230x-B810 715
Ethernet TCP/IP	EK9000 338			BK9xx0 577	BC9xxx 587		IL230x-B90x 716
	EL6601, EL6614 416 switch port				BX9000 589		
PROFINET	EK9300 339	EP9300 502		BK9xx3 578			IL230x-B903 717
	EL6631 421 RT controller/device terminal						
	EL6632 421 IRT controller terminal						
EtherNet/IP	EK9500 339			BK9xx5 579			IL230x-B905 717
	EL6652 master/slave terminal 422						
USB				BK9500 579			

AS-Interface	EL6201 419			KL62x1 662			
IO-Link	EL6224 420	EP6224 495		KL6224 666			
EIB/KNX				KL6301 666			
LON				KL6401 667			
MP-Bus				KL6771 667			
M-Bus				KL6781 667			
DALI/DSI				KL6811 668			
IEEE 1588	EL6688 417						
DMX	EL6851 427						
EnOcean				KL658x 664			
SMI				KL68x1 668			

		Fieldbus Modules 696	Infrastructure Components 762	Embedded PC 766	Drive Technology 184	Accessories 790
PLC Box (IEC 61131-3)	IO-Link box	Modules	Interfaces	Master/Slave	Servo Drives	Connectors/ Cables
		FM33xx-B110 762	FC90xx, FC11xx 778	CXxxxx 192	AX5xxx 770	ZS1090-00xx 516
			CUxxxx 782		AX8xxx 808	ZK1090-9191 446
			EP9xxx 788			ZK1090-xxxx 514
			FC200x 771	CX1500-M/B200 241		Z1xxx 688
IL230x-C31x 711		FM33xx-B310 764	FC31xx 772	CXxxxx 192		ZB3xxx 688
				CX2500-M/B310 252		ZK/ZS1031 688
						ZB4200 689
			FC51xx 774	CXxxxx 192		ZB51xx 690
				CX2500-M/B510 252		ZK/ZS1052 688
			FC52xx 776	CX1500-M/B520 241		ZB52xx 690
						ZK/ZS1052 688
				CXxxxx 192		ZK/ZS1031 688
			FC75xx 777	CXxxxx 192		
				CXxxxx 192		ZK/ZS1031 688
IL230x-C810 715				CXxxxx 192		ZK/ZS1031 688
IL230x-C900 716			FC90xx 778	CXxxxx 192		ZS1090-00xx 516
			CU2xxx, CU2508 782 Ethernet Switch			ZB90x0 690
						ZK1090-xxxx 514
			CU2508 784	CXxxxx 192		ZS1090-00xx 516
						ZB90x0 690
						ZK1090-xxxx 514
			CU2508 784	CXxxxx 192		ZS1090-00xx 516

	EPIxxxx, ERIxxxx 748					

Product overview signal types

Signal	EtherCAT Terminal 314		EtherCAT Box 450						EtherCAT Plug-in Modules 526	
			Industrial housing		Stainless steel housing		Zinc die-cast housing			
Digital input										
5 V DC/12 V DC	EL1xxx	349								
24 V DC	EL1xxx	342	EP1xxx	466	EQ1xxx	506	ER1xxx	466	EJ1xxx	536
48 V DC	EL1134	349								
60 V DC										
120 V AC/DC	EL1712	349								
230 V AC	EL17x2	349								
Safety	EL19xx	351	EP19xx	472						
Namur										
Thermistor	EL1382	345								
Counter	EL15x2	350	EP1518	468			ER1518	468		
Digital output										
5 V DC/12 V DC	EL2x24	359								
24 V DC	EL2xxx	352	EP2xxx	473	EQ2xxx	507	ER2xxx	473	EJ2xxx	537
30 V AC/DC	EL27xx	360								
125 V AC/DC			EP2624	479			ER2624	479		
230 V AC	EL2xxx	366								
400 V AC										
Safety	EL29xx	369								
PWM	EL25xx	364								
Digital combi										
24 V DC	EL1859	343	EP23xx	480	EQ23xx	508	ER23xx	480	EJ1859	536
	EL1259	347								
Analog input										
0…2 V, ±2 V										
0…10 V	EL3x6x	374	EP31xx	486	EQ3174	510	ER31x4	486		
±10 V	EL3x0x	370	EP31xx	487	EQ3174	510	ER31x4	487	EJ3x0x	538
0…20 mA	EL3xxx	376	EP31xx	487	EQ3174	510	ER31x4	487		
4…20 mA	EL3xxx	380	EP31xx	487	EQ3174	510	ER31x4	487		
Resistance thermometer	EL32xx	385	EP32xx	487	EQ3204	511	ER3204	487		
Thermocouple/mV	EL331x	388	EP3314	488	EQ3314	511	ER3314	488		
Resistor bridge	EL335x	392	EP3356	489						
Potentiometer	EL3255	397								
Power measurement	EL3xxx	391								
Condition Monitoring	EL3632	390								
Pressure measurement	EM37xx	398	EP3744	490						
Analog output										
0…10 V	EL4x0x	402	EP4x74	491			ER4x74	491	EJ4002	539
±10 V	EL4x3x	400	EP4x74	491			ER4x74	491	EJ4134	539
0…20 mA	EL4x1x	404	EP4x74	491			ER4x74	491		
4…20 mA	EL4x2x	406	EP4x74	491			ER4x74	491		
Special functions										
SSI sensor interface	EL500x	408								
EnDAT 2.2 interface	EL5032	409								
Incremental encoder interface	EL51xx	410	EP51x1	492			ER51x1	492		
RS232, RS485	EL60xx	412	EP600x	494			ER600x	494		
TTY										
Motion Control	EL7xxx	431	EP7xxx	496			ER7x4x	496	EJ7xxx	540
Manual operating modules										
Multi-functional			EP8309	499			ER8309	499		

The standard EtherCAT Terminals (ELxxxx)/Bus Terminals (KLxxxx) can be optionally ordered with pluggable wiring level as ESxxxx or KSxxxx respectively.

Bus Terminal 542				Fieldbus Box								Fieldbus Modules 762	
Bus Terminal		Terminal Modules		Compact Box, Coupler/PLC Box		Extension Box		IO-Link box (industrial housing)		IO-Link box (zinc die-cast housing)		Modules	
KL1124	598												
KL1xxx	594	KM1xxx	600	IP10xx-Bxxx	728	IE10xx	728	EPI1xxx	748	ERI1xxx	748		
KL1032	598												
KL1712	599												
KL1712	599												
KL17x2	599												
KL1904	605												
KL1352	603												
KL1382	603												
KL15xx	604			IP1502-Bxxx	729	IE1502	729						
KL2124	611												
KL2xxx	608	KM20xx	609	IP20xx-Bxxx	730	IE2xxx	730	EPI2xxx	750	ERI2xxx	750		
KL27xx	613												
KL2612	614												
KL2xxx	614	KM2xxx	616										
KL2631	615												
KL2904	629												
KL25xx	622			IP2512-Bxxx	733	IE2512	733						
KL1859	593			IP/IL23xx-Bxxx	720	IE23xx	734	EPI23xx	752	ERI23xx	752		
				IL230x-Cxxx	722								
KL31x2	633												
KL3x6x	632			IP3102-Bxxx	738	IE3102	738	EPI3174	754	ERI3174	754		
KL3xxx	630			IP3102-Bxxx	738	IE3102	738	EPI3174	754	ERI3174	754		
KL3xxx	634			IP3112-Bxxx	739	IE3112	739	EPI3174	754	ERI3174	754		
KL3xxx	636			IP3112-Bxxx	739	IE3112	739	EPI3174	754	ERI3174	754		
KL32xx	639			IP3202-Bxxx	739	IE3202	739						
KL331x	640			IP3312-Bxxx	739	IE3312	739					FM33xx	762
KL335x	642												
KL3xxx	643												
KM37xx	646												
KL4x0x	650	KM4602	651	IP4132-Bxxx	740	IE4132	740	EPI4374	755	ERI4374	755		
KL4xxx	648			IP4132-Bxxx	740	IE4132	740	EPI4374	755	ERI4374	755		
KL4x1x	652			IP4112-Bxxx	740	IE4112	740	EPI4374	755	ERI4374	755		
KL402x	654			IP4112-Bxxx	740	IE4112	740	EPI4374	755	ERI4374	755		
KL50x1	656			IP5009-Bxxx	742	IE5009	742						
KL51xx	658			IP5109-Bxxx	743	IE5109	743						
KL60x1	660			IP60x2-Bxxx	744	IE60x2	744						
KL6011	661			IP6012-Bxxx	745	IE6012	745						
KL2xxx	625												
KL85xx	671												

System overview EtherCAT

Automation

TwinCAT
892

TwinCAT
– configuration with TwinCAT System Manager
– TwinCAT as EtherCAT master

IPC

Industrial PC/ Embedded PC
28

EtherCAT master: IPC

EtherCAT master: Embedded PC

PCI slave card FC1100

PCIe slave card FC1121

I/O

Bus Terminals
542

EtherCAT slave: Bus Coupler BK1120, Bus Terminals

EtherCAT slave: Embedded PC CX8010, Bus Terminals

EtherCAT slave: Embedded PC CX9020-B110, Bus Terminals

EtherCAT slave: Embedded PC CX50xx-B110, Bus Terminals

EtherCAT Terminals
314

EtherCAT

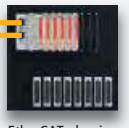
EtherCAT slave: Coupler EK1100, 2-port junction EK1122, EtherCAT Terminals

EtherCAT slave: Embedded PC CX8010, EtherCAT Terminals

EtherCAT slave: Embedded PC CX9020-B110, EtherCAT Terminals

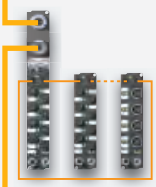
EtherCAT slave: Embedded PC CX50xx-B110, EtherCAT Terminals

EtherCAT Plug-in Modules
526



EtherCAT plug-in modules EJxxxx

Fieldbus Box
696



IP-Link

EtherCAT slave: Coupler Box IL230x-B110 with Extension Box IExxxx

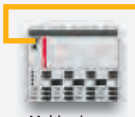
EtherCAT slave: Fieldbus Module FM33x2-B110

EtherCAT Box
450

EtherCAT slave: EtherCAT Box EPxxxx

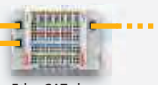
Motion

Drive Technology
790



Multi-axis servo system AX8000

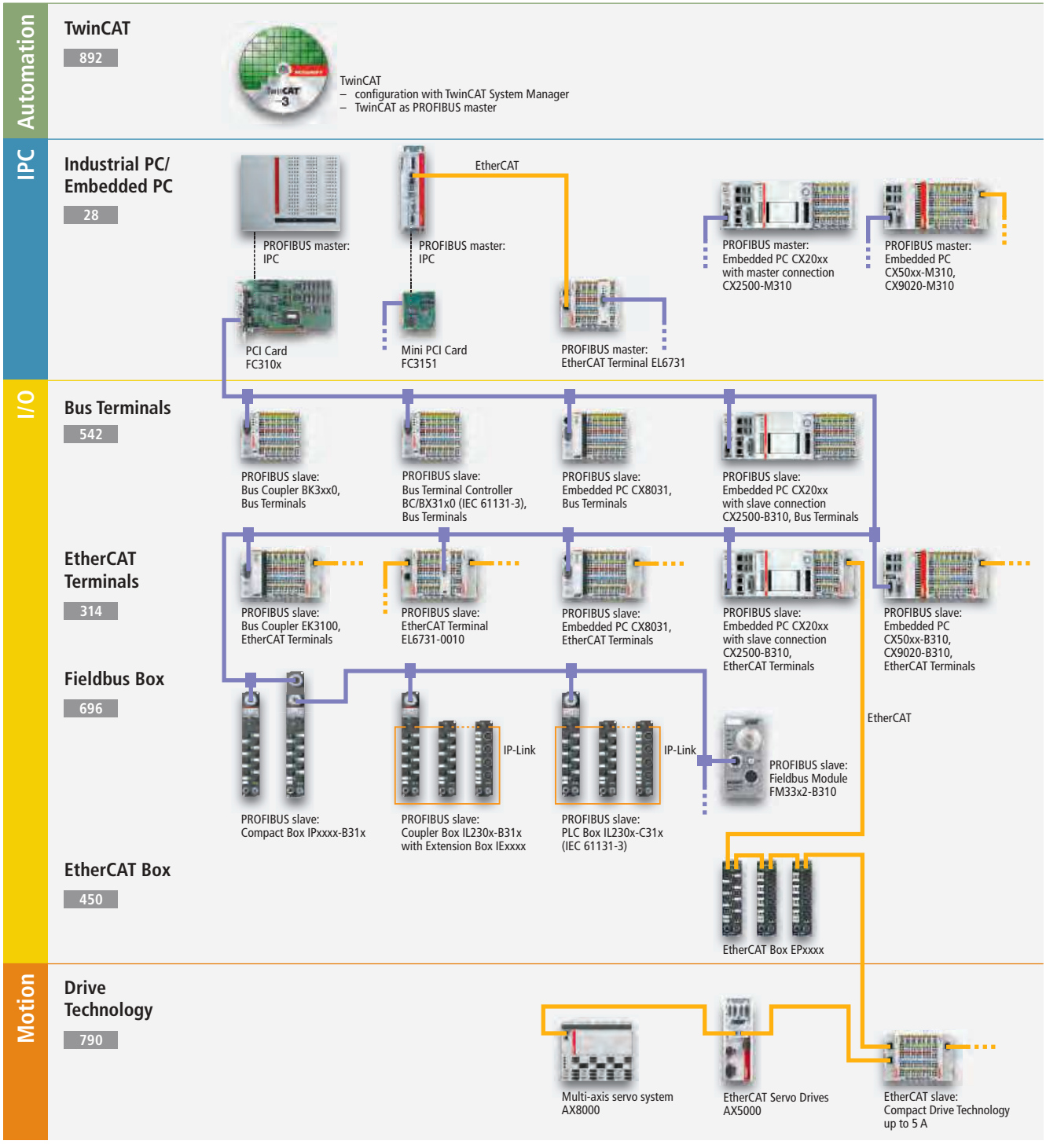
EtherCAT Servo Drives AX5000



EtherCAT slave: Compact Drive Technology up to 5 A

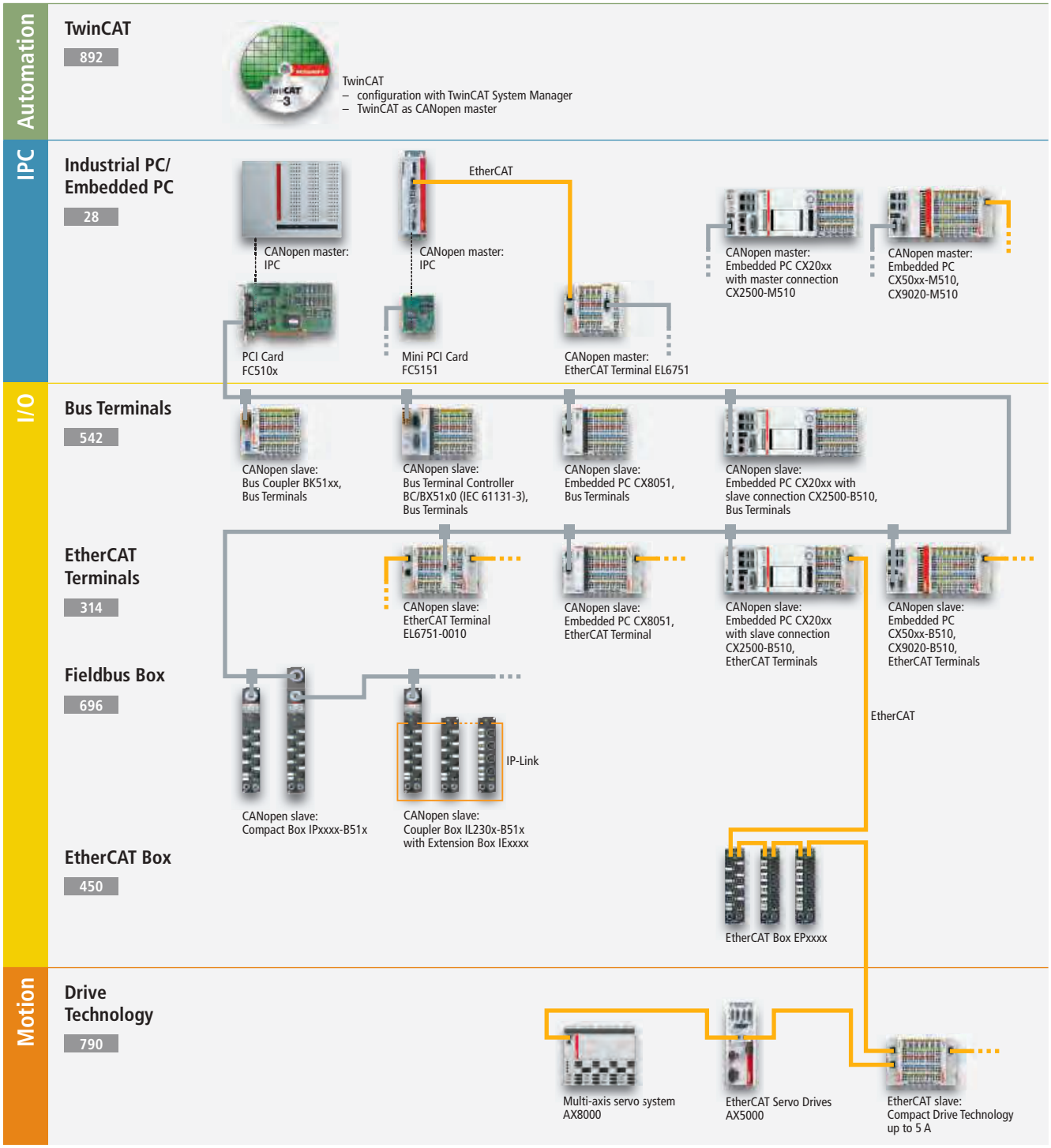
For further information see the EtherCAT chapter on page 284 or
▶ www.beckhoff.com/EtherCAT

System overview PROFIBUS



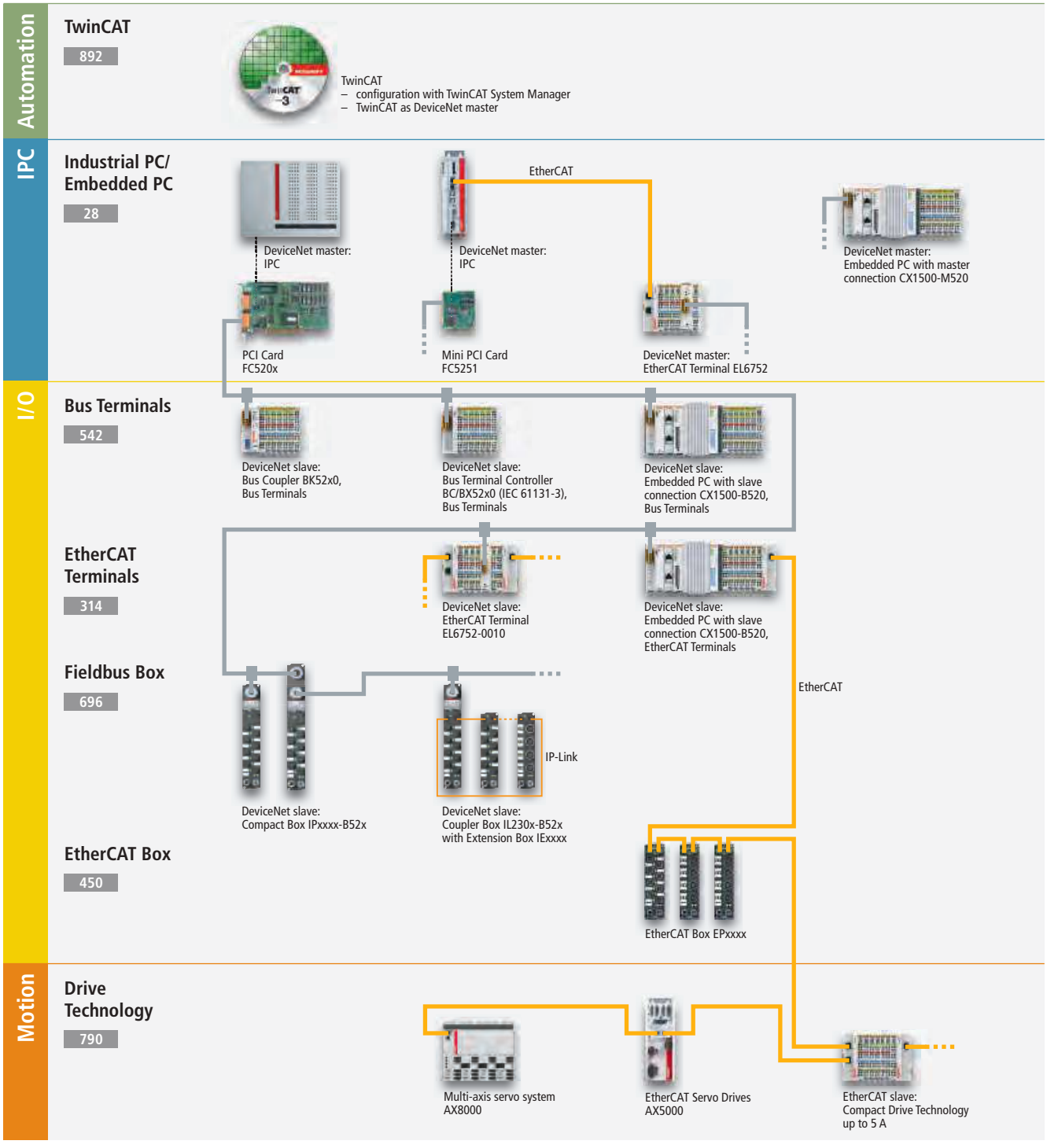
▶ **www.beckhoff.com/profibus**

System overview CANopen



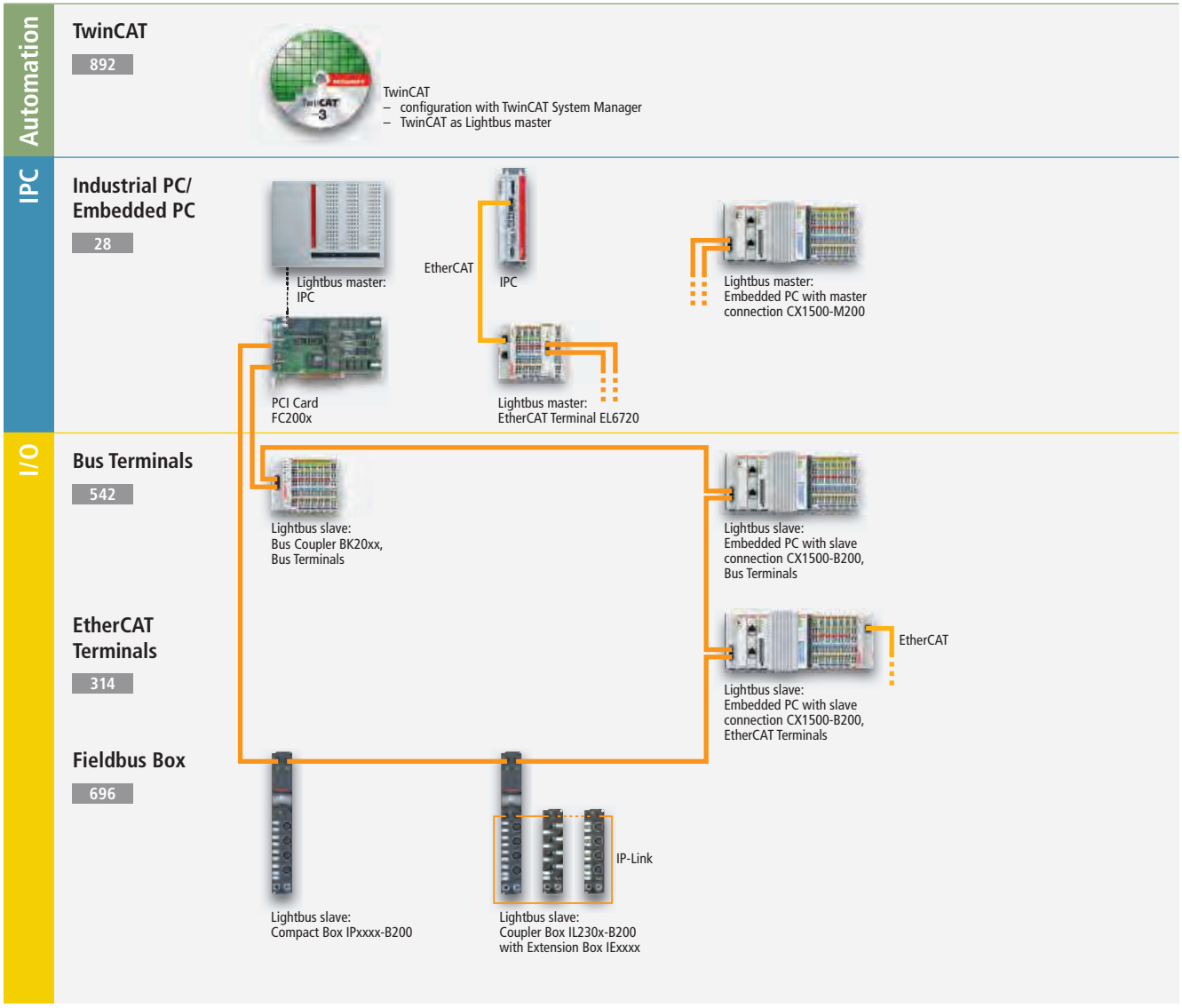
▶ **www.beckhoff.com/canopen**

System overview DeviceNet



▶ **www.beckhoff.com/devicenet**

System overview Lightbus



▶ **www.beckhoff.com/lightbus**

System overview PROFINET

Automation

TwinCAT
892

TwinCAT
- configuration with TwinCAT System Manager
- TwinCAT as PROFINET controller with "TwinCAT PROFINET RT Controller"
- TwinCAT as PROFINET device with "TwinCAT PROFINET RT Device"

IPC

Industrial PC/ Embedded PC
28


PROFINET controller: IPC


EtherCAT

PROFINET controller: IPC


PROFINET controller: Embedded PC CX20xx-M930


PROFINET controller: Embedded PC CX50xx-M930, CX9020-M930


PCI Card FC900x


Mini PCI Card FC905x


PROFINET controller: EtherCAT Terminal EL6631


PROFINET IRT controller: EtherCAT Terminal EL6632

I/O

Bus Terminals
542


PROFINET device: Bus Coupler BK9xx3, Bus Terminals

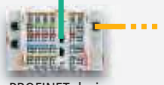

PROFINET device: Embedded PC CX8093, Bus Terminals

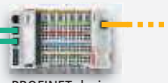

PROFINET device: Embedded PC CX20xx-B930, Bus Terminals

EtherCAT Terminals
314


EtherCAT

PROFINET device: Bus Coupler EK9300, EtherCAT Terminals

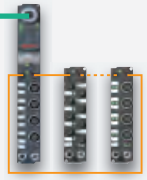

PROFINET device: EtherCAT Terminal EL6631-0010


PROFINET device: Embedded PC CX8093, EtherCAT Terminals


PROFINET device: Embedded PC CX20xx-B930, EtherCAT Terminals


PROFINET device: Embedded PC CX50xx-B930, CX9020-B930, EtherCAT Terminals

Fieldbus Box
696


IP-Link

PROFINET device: Coupler Box IL230x-B903 with Extension Box IExxxx

EtherCAT

EtherCAT Box
450

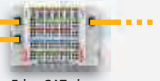

EtherCAT Box EPxxxx

Motion

Drive Technology
790


Multi-axis servo system AX8000


EtherCAT Servo Drives AX5000


EtherCAT slave: Compact Drive Technology up to 5 A

▶ **www.beckhoff.com/profinet**

System overview EtherNet/IP

Automation

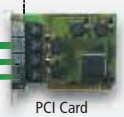
TwinCAT
892

TwinCAT
– configuration with TwinCAT System Manager
– TwinCAT as EtherNet/IP master/slave with "TwinCAT EtherNet/IP Master/Slave"

IPC

Industrial PC/ Embedded PC
28

EtherNet/IP master/slave: IPC

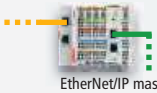


PCI Card FC900x

EtherNet/IP master/slave: IPC

Mini PCI Card FC9x51

EtherNet/IP master/slave: Embedded PC



EtherNet/IP master: EtherCAT Terminal EL6652

EtherNet/IP slave: Embedded PC CX20xx-B950

EtherNet/IP slave: Embedded PC CX50xx-B950, CX9020-B950

I/O

Bus Terminals
542

EtherNet/IP slave: Bus Coupler BK91x5, Bus Terminals

EtherNet/IP slave: Embedded PC CX8095, Bus Terminals

EtherCAT Terminals
314

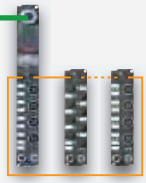
EtherCAT

EtherNet/IP slave: Bus Coupler EK9500, EtherCAT Terminals

EtherNet/IP slave: EtherCAT Terminal EL6652-0010

EtherNet/IP slave: Embedded PC CX8095, EtherCAT Terminals

Fieldbus Box
696



IP-Link

EtherNet/IP slave: Coupler Box IL230x-B905 with Extension Box IExxxx

EtherCAT

EtherCAT Box
450

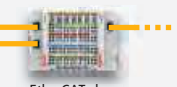
EtherCAT Box EPxxxx

Motion

Drive Technology
790

Multi-axis servo system AX8000

EtherCAT Servo Drives AX5000



EtherCAT slave: Compact Drive Technology up to 5 A

▶ **www.beckhoff.com/ethernet-ip**

System overview Ethernet TCP/IP

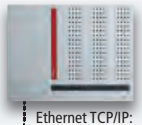
Automation

TwinCAT
892

TwinCAT
- configuration with TwinCAT System Manager
- TwinCAT as TCP/IP client/server with "TwinCAT TCP/IP Server"
- TwinCAT as FTP client mit "TwinCAT FTP Client"
- TwinCAT as OPC UA client/server with "TwinCAT OPC UA"

IPC

Industrial PC/ Embedded PC
28



Ethernet TCP/IP: IPC

PCI Card FC90xx

Ethernet TCP/IP: IPC

Mini PCI Card FC9x51

Ethernet TCP/IP: Embedded PC

I/O

Switches
782

Ethernet switch CU20xx

Bus Terminals
542

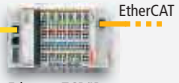
Ethernet TCP/IP: Bus Coupler BK9xx0, Bus Terminals

Ethernet TCP/IP: Bus Terminal Controller BC9xxx (IEC 61131-3), Bus Terminals

Ethernet TCP/IP: Embedded PC CX8090, Bus Terminals

Ethernet TCP/IP: Embedded PC CX5000, CX9020, Bus Terminals

EtherCAT Terminals
314



EtherCAT

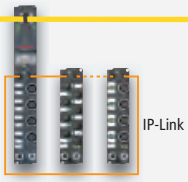
Ethernet TCP/IP: Bus Coupler EK9000, EtherCAT Terminals

Ethernet TCP/IP: EtherCAT Terminals EL6601 and EL6614

Ethernet TCP/IP: Embedded PC CX8090, EtherCAT Terminals

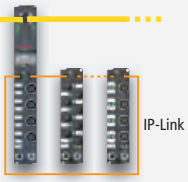
Ethernet TCP/IP: Embedded PC CX5000, CX9020, EtherCAT Terminals

Fieldbus Box
696



IP-Link

Ethernet TCP/IP: Coupler Box IL230x-B90x with Extension Box IExxxx

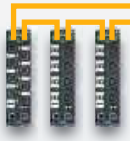


IP-Link

Ethernet TCP/IP: PLC Box IL230x-C900 (IEC 61131-3)

EtherCAT

EtherCAT Box
450

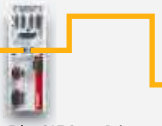


EtherCAT Box EPxxxx

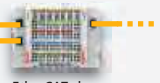
Motion

Drive Technology
790

Multi-axis servo system AX8000



EtherCAT Servo Drives AX5000



EtherCAT slave: Compact Drive Technology up to 5 A

▶ **www.beckhoff.com/ethernet**

System overview SERCOS interface

Automation

TwinCAT
892

TwinCAT
– configuration with TwinCAT System Manager
– TwinCAT as SERCOS master

IPC

Industrial PC/ Embedded PC
28

SERCOS II master:
IPC

PCI Card FC750x

SERCOS II master:
IPC

Mini PCI Card FC7551

SERCOS II master:
Embedded PC with master
connection CX1500-M750

SERCOS III slave:
Embedded PC CX8097

I/O

Bus Terminals
542

SERCOS II slave:
Bus Coupler BK75x0, Bus Terminals

EtherCAT Terminals
314

SERCOS III slave:
Bus Coupler EK9700, EtherCAT Terminals

▶ www.beckhoff.com/sercos

System overview Modbus

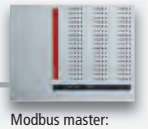
Automation

TwinCAT
892

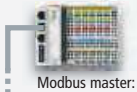
TwinCAT
– configuration with TwinCAT System Manager
– TwinCAT as Modbus RTU device with "TwinCAT Modbus RTU"
– TwinCAT as Modbus TCP server with "TwinCAT Modbus TCP Server"

IPC

Industrial PC/ Embedded PC
28



Modbus master:
IPC



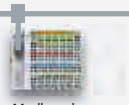
Modbus master:
Embedded PC CX8090
with Modbus TCP protocol implementation

I/O

Bus Terminals
542

Modbus slave:
Bus Coupler BK73x0,
Bus Terminals

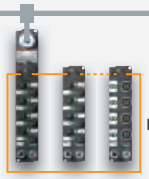
Modbus slave:
Bus Terminal Controller
BC7300 (IEC 61131-3),
Bus Terminals



Modbus slave:
Bus Terminal Controller
BC8050/BC8150 (IEC 61131-3)
with Modbus RTU protocol implementation,
Bus Terminals

Fieldbus Box
696

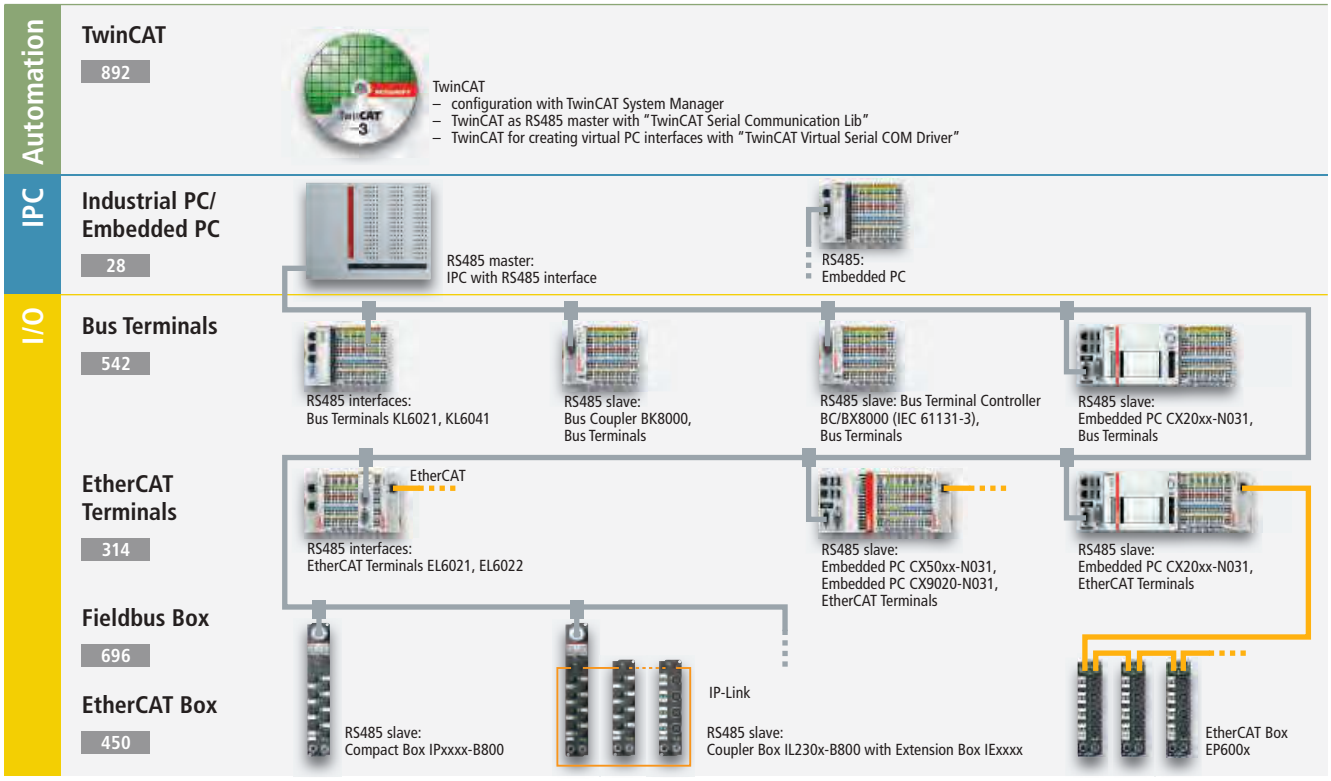
Modbus slave:
Compact Box IPxxxx-B730



Modbus slave:
Coupler Box IL230x-B730 with Extension Box IExxxx

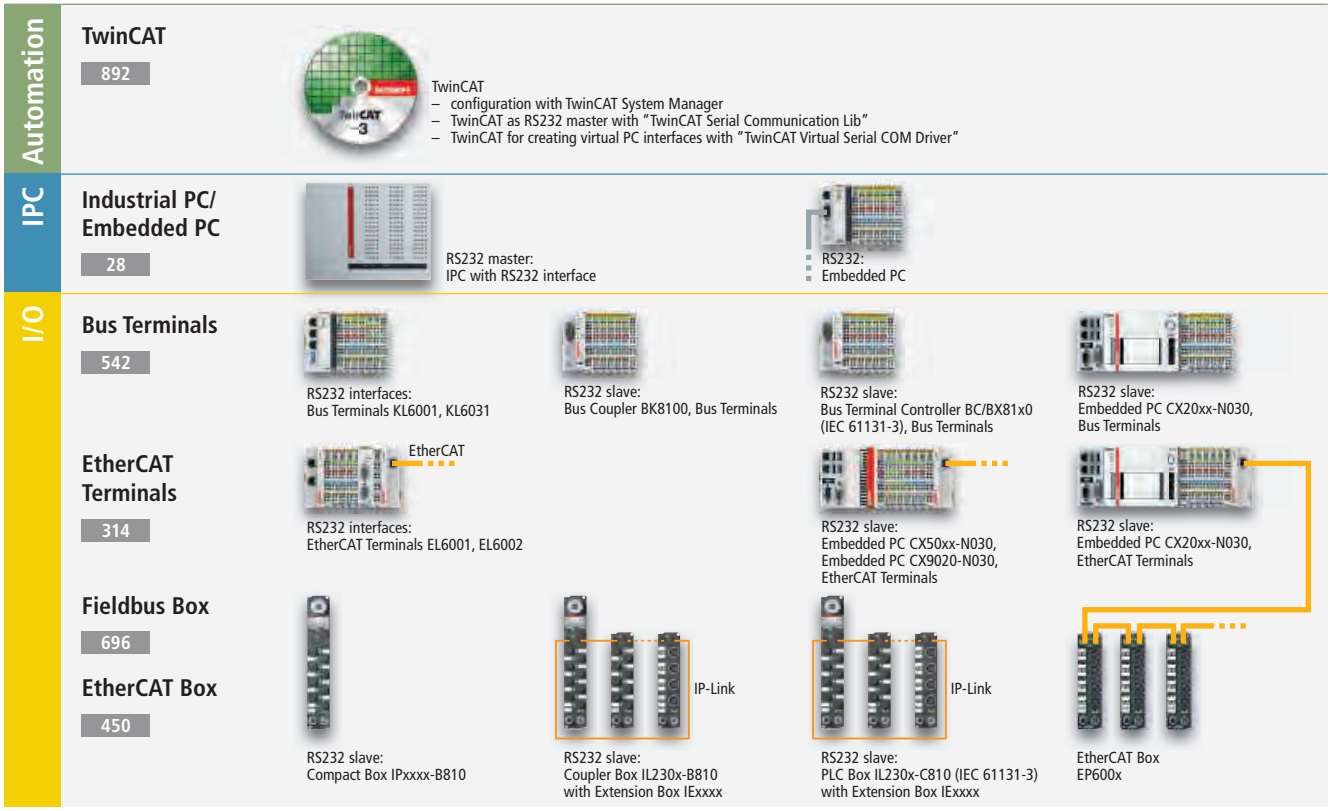
▶ www.beckhoff.com/modbus

System overview RS485



▶ **www.beckhoff.com/RS485**

System overview RS232



▶ **www.beckhoff.com/RS232**

System overview EnOcean

Automation

TwinCAT

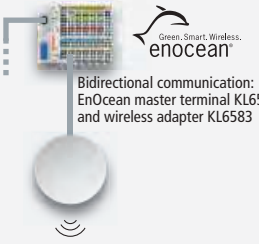
892

TwinCAT
– configuration with TwinCAT System Manager
– TwinCAT as EnOcean device with "TwinCAT PLC Serial Communication EnOcean"

I/O

Bus Terminals

542



Bidirectional communication:
EnOcean master terminal KL6581
and wireless adapter KL6583

Unidirectional communication:
serial Bus Terminal KL6021-0023
and wireless adapter KL6023

▶ **www.beckhoff.com/enocean**

System overview IO-Link

Automation

TwinCAT

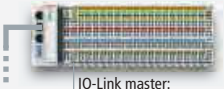
892

TwinCAT
– configuration with TwinCAT System Manager

I/O

Bus Terminals

542



IO-Link master:
Bus Terminal
KL6224

EtherCAT Terminals

314

IO-Link master:
EtherCAT Terminal
EL6224

Fieldbus Box

696

IO-Link slave:
IO-Link box modules
EPIxxxx

IO-Link slave:
IO-Link box modules
ERIxxxx

EtherCAT Box

450

IO-Link master:
EtherCAT Box
EP6224

▶ **www.beckhoff.com/io-link**

System overview BACnet/IP

Automation

TwinCAT

892

TwinCAT
– configuration with TwinCAT System Manager
– TwinCAT as BACnet/IP server and client with "TwinCAT BACnet/IP"

IPC

Industrial PC/ Embedded PC

28

BACnet/IP server/client:
IPC

BACnet/IP server/client:
built-in Panel PC

Certified to
ISO 16484-5:2012

BACnet/IP server/client:
Embedded PC CX8091

BACnet/IP server/client:
Embedded PC CX5010

BACnet/IP server/client:
Embedded PC CX9020

BACnet/IP server/client:
Embedded PC CX5020

▶ **www.beckhoff.com/bacnet**

System overview subsystem: AS-Interface, EIB/KNX, LON, MP-Bus, M-Bus, DALI/DSI, SMI, IEEE 1588, DMX

Automation

TwinCAT

892

TwinCAT
– configuration with TwinCAT System Manager

I/O

Bus Terminals

542

AS-Interface
master terminals
KL6201, KL6211

EIB/KNX
EIB/KNX
Bus Terminal
KL6301

LON
LON
Bus Terminal
KL6401

MP-Bus
master terminal
KL6771

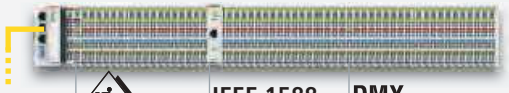
M-Bus
master terminal
KL6781

DALI
DALI/DSI
master terminal
KL6811

SMI
Bus Terminals
KL6831, KL6841

EtherCAT Terminals

314



AS-Interface
master terminal
EL6201

IEEE 1588
IEEE 1588 external
synchronisation
interface EL6688
(master/slave)

DMX
DMX master terminal
EL6851,
DMX slave terminal
EL6851-0010

▶ **www.beckhoff.com/subsystem**

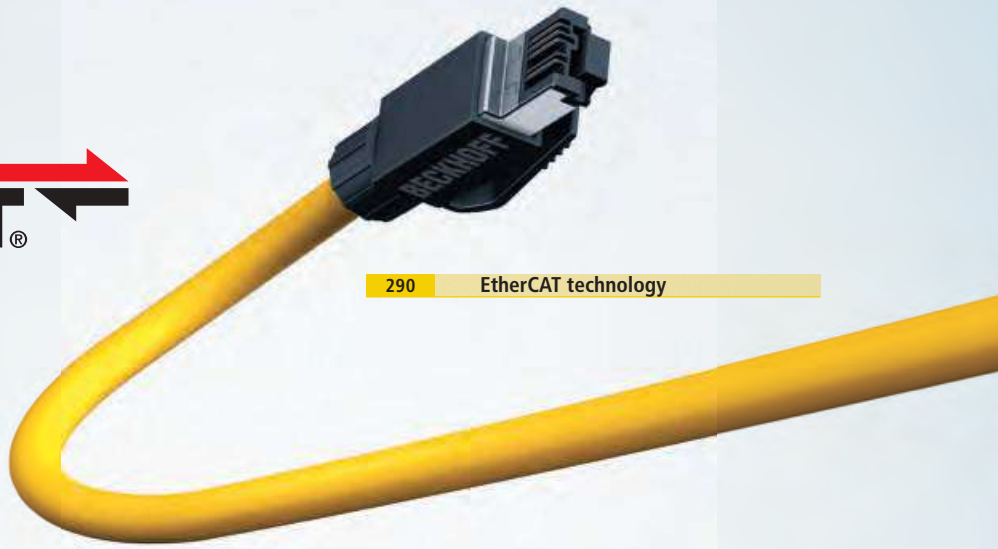

X11
X12
X21
X22
X04
link/act
X04
X05
link/act
DC+
DC-
X02
X01
L1
L2
L3/N
PE
BECKHOFF
BECKHOFF
EtherCAT

EtherCAT®

EtherCAT

The real-time Ethernet fieldbus

EtherCAT®



XFC

EtherCAT

Ethernet for Control Automation Technology

Product overview EtherCAT components

EtherCAT components

PC-based Control

Industrial PCs
- **CPxxxx** 46 — Panel PCs (EtherCAT masters)
- **Cxxxx** 100 — control cabinet PCs (EtherCAT masters)

Embedded PCs
- **CXxxxx** 184 — Embedded PCs (EtherCAT masters)

Software PLC/Motion Control
- **TwinCAT** 892 — EtherCAT masters and development environment

Safety
- **TwinSAFE** 966 — open and scalable control technology

Redundancy
- **TwinCAT EtherCAT Redundancy** 951 — extension of the EtherCAT master with cable redundancy capability

EtherCAT Terminal

Couplers
- **EK1xxx** 330 — EtherCAT Coupler E-bus
- **BK1xxx** 337 — EtherCAT Coupler K-bus
- **EKxxxx** 338 — Bus Coupler for EtherCAT Terminals

Digital I/O
- **EL1xxx** | ES1xxx 342 — digital input
- **EL2xxx** | ES2xxx 352 — digital output

Analog I/O
- **EL3xxx** | ES3xxx 370 — analog input
- **EL4xxx** | ES4xxx 400 — analog output

Special functions
- **EL5xxx** | ES5xxx 408 — position measurement
- **EL6xxx** | ES6xxx 412 — communication
- **EL7xxx** | ES7xxx 429 — motion

System terminals
- **EL9xxx** | ES9xxx 436 — system terminals

EtherCAT Box

Digital I/O
- **EP1xxx, EQ1xxx, ER1xxx*** 466 — digital input
- **EP2xxx, EQ2xxx, ER2xxx*** 473 — digital output
- **EP23xx, EQ23xx, ER23xx*** 480 — digital combi

Analog I/O
- **EP3xxx, EQ3xxx, ER3xxx*** 486 — analog input
- **EP4xxx, ER4xxx*** 491 — analog output

Special functions
- **EP5xxx, ER5xxx*** 492 — position measurement
- **EP6xxx, ER6xxx*** 494 — communication
- **EP7xxx, ER7xxx*** 496 — motion
- **EP8xxx, ER8xxx*** 499 — multi-functional I/O box

System
- **EP1111** 500 — EtherCAT Box with ID switch
- **EP1122** 500 — 2-port EtherCAT junction
- **EP9214, EP9224** 501 — 4/4-channel power distribution for EtherCAT Box modules

EtherCAT Plug-in Modules

Couplers
- **EJ1100** 535 — EtherCAT Coupler E-bus

Digital I/O
- **EJ1xxx** 536 — digital input
- **EJ2xxx** 537 — digital output

Analog I/O
- **EJ3xxx** 538 — analog input
- **EJ4xxx** 539 — analog output

Special functions
- **EJ7xxx** 540 — motion

System modules
- **EJ9xxx** 541 — system modules

*EPxxxx: industrial housing in IP 67, EQxxxx: stainless steel housing in IP 69K, ERxxxx: zinc die-cast housing in IP 67

Fieldbus Box

Infrastructure Components

Drive Technology

EtherCAT – Ultra high-speed for automation

Highlights

- Ethernet up to the terminal – complete continuity
- Ethernet process interface scalable from 1 bit to 64 kbyte
- first true Ethernet solution for the field level
- exact timing and adapted to synchronisation

Performance

- 256 digital I/Os in 12 µs
- 1,000 digital I/Os in 30 µs
- 200 analog I/Os (16 bit) in 50 µs, corresponding to 20 kHz sampling rate
- 100 servo axes every 100 µs
- 12,000 digital I/Os in 350 µs

Topology

- line, tree or star topology
- up to 65,535 devices within one network
- network size: almost unlimited (> 500 km)
- operation with or without switches
- cost-effective cabling: Industrial Ethernet patch cable (CAT 5)
- physical layer:
  - Ethernet 100BASE-TX via twisted pair, up to 100 m between 2 slaves
  - Ethernet 100BASE-FX via fibre optic cable, up to 20 km between 2 slaves
- hot connect of bus segments

Address space

- network-wide process image: 4 Gbyte
- device process image: 1 bit to 64 kbyte
- address allocation: freely configurable
- device address selection: automatically via software

Cost benefits

- no more network tuning: lower engineering costs
- hard real-time with software master: no plug-in cards required
- no active infrastructure components (switches, etc.) required
- Ethernet cable and connector costs lower than for traditional fieldbuses
- EtherCAT down to the I/O terminal: no complex Bus Couplers
- low interface costs due to highly integrated EtherCAT Slave Controller

Protocol

- optimised protocol directly within the Ethernet frame
- fully hardware-implemented
- for routing and socket interface: UDP datagram
- processing while passing
- distributed clocks for accurate synchronisation
- timestamp data types for resolution in the nanosecond range
- oversampling data types for high-resolution measurements

Diagnostics

- breaking point detection
- continuous "quality of line" measurement enables accurate localisation of transmission faults
- Topology View

Interfaces

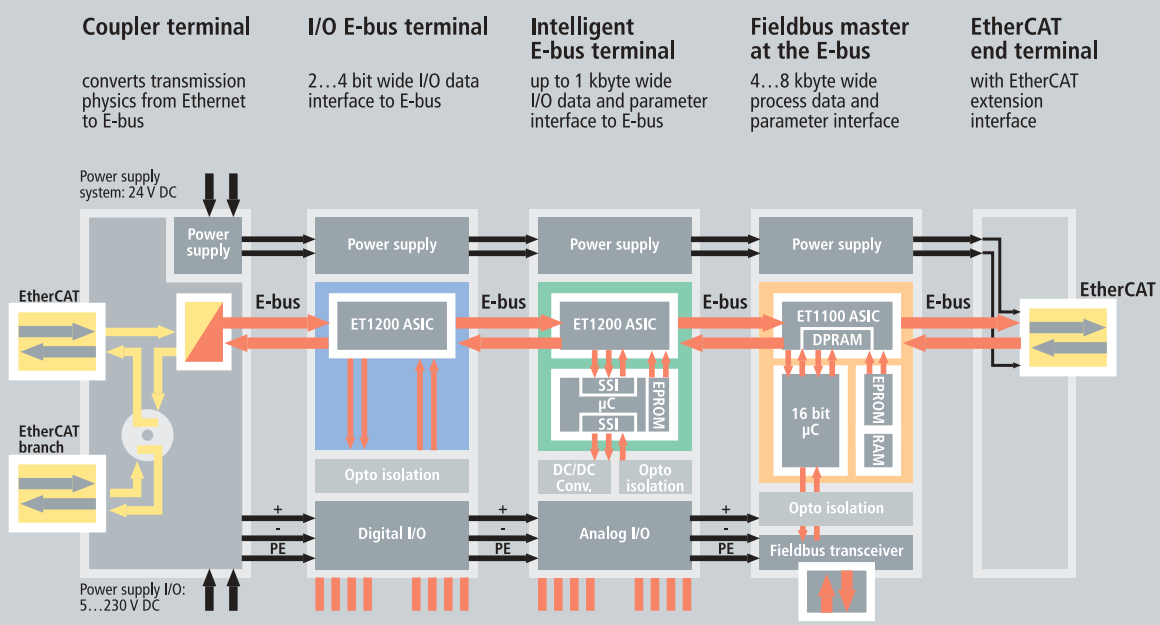
- switch port terminal for standard Ethernet devices
- fieldbus terminals for fieldbus devices
- decentralised serial interfaces
- communication gateways
- gateway to other EtherCAT systems

Openness

- fully Ethernet-compatible
- operation with switches and routers possible
- mixed operation with other protocols also possible
- internet technologies (Web server, FTP, etc.)
- compatible with the existing Bus Terminal range
- protocol is published completely
- EtherCAT is IEC, ISO and SEMI standard.

EtherCAT Technology Group

- international pool of companies
- includes users and manufactures
- supports technology development
- ensures interoperability
- integration and development of device profiles



Protocol processing completely in hardware | Protocol ASICs flexibly configurable. Process interface from 1 bit to 64 kbyte.

Ethernet for Control Automation Technology

Real-time Ethernet: Ultra high-speed right up to the terminal

Outstanding performance, flexible topology and simple configuration characterise EtherCAT (Ethernet for Control Automation Technology), the real-time Ethernet technology from Beckhoff. EtherCAT sets standards where conventional fieldbus systems reach their limits: 1,000 distributed I/Os in 30 µs, almost unlimited network size, and optimum vertical integration thanks to Ethernet and Internet technologies. With EtherCAT, the costly Ethernet star topology can be replaced with a simple line or tree structure – no expensive infrastructure components are required. All types of Ethernet devices can be integrated via a switch port.

Where other real-time Ethernet approaches require special master hardware or scanner cards, EtherCAT manages with very cost-effective standard Ethernet interface cards in the master.

Principle of operation

There are many different approaches that try to provide real-time capability for Ethernet: for example, the CSMA/CD access procedure is disabled via higher level protocol layers and replaced by time slicing or polling. Other propositions use special switches that distribute Ethernet telegrams in a precisely controlled timely manner. While these solutions are able to transport data packets more or less quickly and accurately to the connected Ethernet node, bandwidth utilisation is very poor, particularly for typical automation devices, since even for very small data quantities a complete Ethernet frame has to be sent. Moreover, the times required for the redirection to the outputs or drive controllers and for reading the input data strongly depend on the implementation. A sub-bus is usually also required, particularly in modular I/O systems, which, like the Beckhoff K-bus, may be synchronised and fast, but nevertheless always adds small delays to the communication that cannot be avoided.

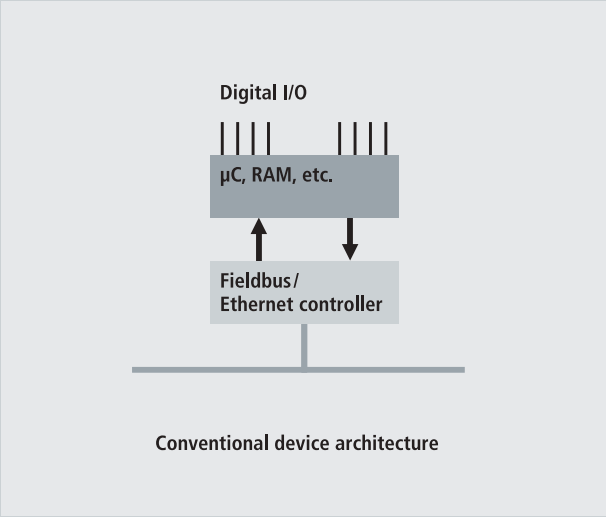
With EtherCAT technology, Beckhoff overcomes these system limitations of other Ethernet solutions: the process no longer involves consecutive steps for receiving and interpreting telegrams and copying the process data. In each device (down to the individual terminals) the EtherCAT Slave Controller reads the data relevant for the device while the frame passes through it. Similarly, input data is inserted into the data stream on the fly. While the frames (delayed by only a few bit times) are already passed on, the slave recognises relevant commands and executes them accordingly. The process is hardware-implemented in the slave controller and is, therefore, independent of the protocol stack software runtimes or the processor power. The last EtherCAT slave in the segment returns the fully processed frame, so that the first slave device forwards it to the master as a kind of response telegram.

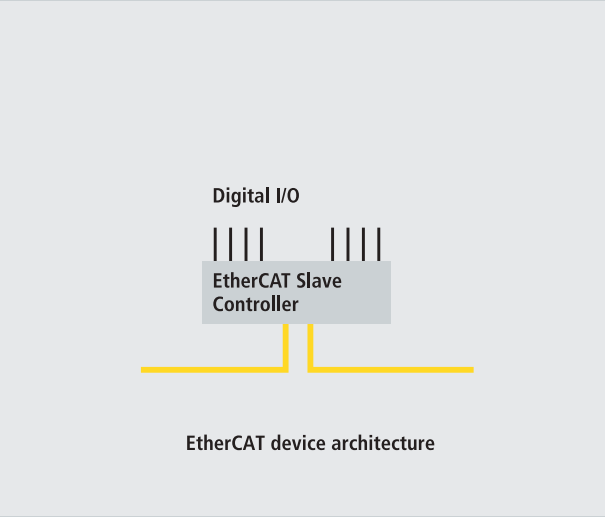
From an Ethernet point of view, an EtherCAT bus segment is simply a single large Ethernet device that receives and sends Ethernet frames. However, the "device" does not contain a single Ethernet controller with downstream microprocessor, but a large number of EtherCAT slaves. Like for any other Ethernet device, direct communication may be established without a switch, thereby creating a pure EtherCAT system.

Ethernet down to the terminal

The Ethernet protocol remains intact right down to the individual devices, i.e. down to the individual terminals; no sub-bus is required. Only the physical layer is converted in the coupler from 100BASE-TX or -FX to E-bus, in order to meet the requirements of the electronic terminal block. The E-bus signal type (LVDS) within the terminal block is nothing proprietary, it is also used for 10 Gbit Ethernet. At the end of the terminal block, the physical bus characteristics are converted back to the 100BASE-TX standard.

The on-board Ethernet MAC is sufficient as hardware in the master device. DMA (direct memory access) is used for data transfer to the main memory. That means that the network data access burden is lifted from the CPU. The same principle is also used in the Beckhoff multiport cards, which bundle up to four Ethernet channels on one PCI slot.





EtherCAT Slave Controller (ESC) | EtherCAT is not only faster outside the I/O device, but also inside. Digital I/Os are directly operated by the EtherCAT Slave Controller, without delays through local firmware and independent of the installed µC performance.

Protocol

The EtherCAT protocol is optimised for process data and is either transported directly in the Ethernet frame or packed into UDP/IP datagrams. The UDP version is used in situations where EtherCAT segments in other subnets are addressed via routers. Ethernet frames may contain several EtherCAT telegrams, with each telegram serving a particular memory area of the logical process image with an addressable size of up to 4 GB. The data sequence is independent of the physical order of the EtherCAT Terminals in the network; addressing can be in any order. Broadcast, Multicast and communication between slaves are possible.

The protocol can also handle parameter communication, which typically is acyclical. The structure and meaning of the parameters is specified via CANopen device profiles, which are available for a wide range of device classes and applications. EtherCAT also supports the SERCOS servo profile according to IEC 61800-7-204.

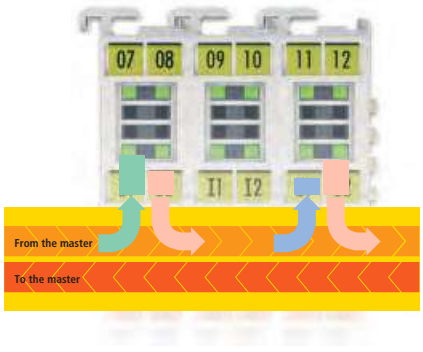
In addition to data exchange according to the master/slave principle, EtherCAT is also very suitable for communication between controllers (master/master). Freely addressable network variables for process data and a variety of services for parameterisation, diagnosis, programming and remote control cover a wide range of requirements. The data interfaces for master/slave and master/master communication are identical.

Performance

EtherCAT reaches new dimensions in network performance. The update time for the data from 1,000 distributed inputs/outputs is only 30 µs – including terminal cycle time. Up to 1,486 byte of process data can be exchanged with a single Ethernet frame – this is equivalent to almost 12,000 digital inputs and outputs. The transfer of this data quantity only takes 300 µs.

The communication with 100 servo axes takes place every 100 µs. With this cycle time, all axes are provided with set values and control data and report their actual position and status. The distributed clocks technique enables the axes to be synchronised with a jitter of significantly less than 1 microsecond.

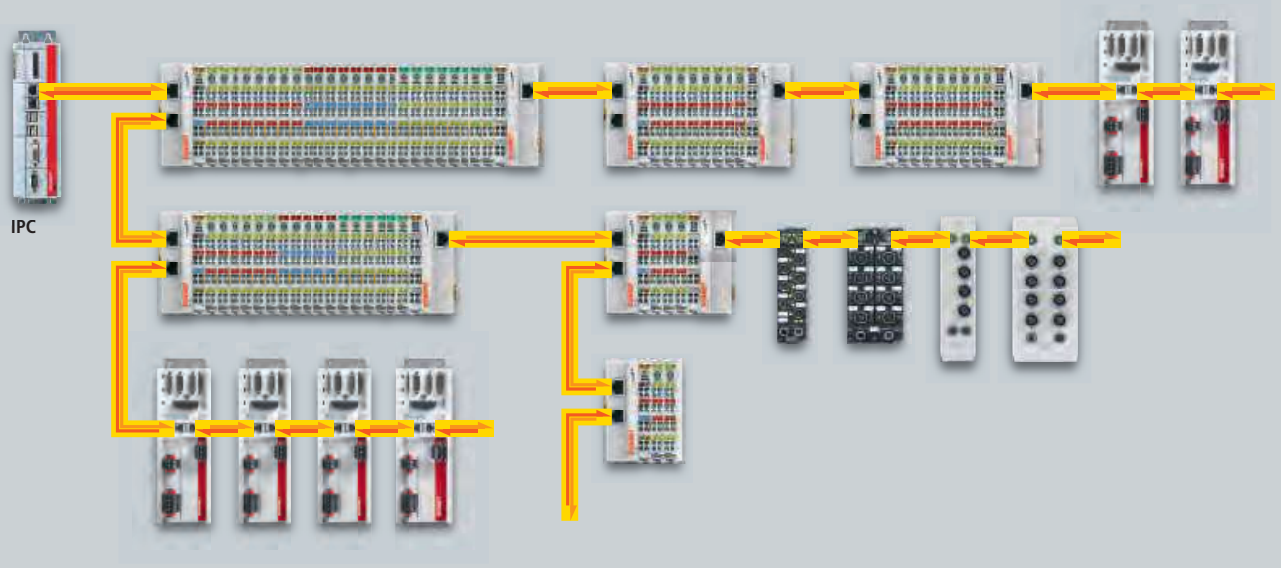
The extremely high performance of the EtherCAT technology enables control concepts that could not be realised with classic fieldbus systems. Very fast control loops can thus also be closed via the bus. Functions that previously required dedicated local hardware support can now be mapped in software. The tremendous bandwidth enables status information to be transferred with each data item. With EtherCAT, a communication technology is available that matches the superior computing capacity of modern Industrial PCs. The bus system is no longer the "bottleneck" of the control concept. Distributed I/Os are recorded faster than is possible with most local I/O interfaces.



FMMU: telegram processing completely in hardware

The benefits of this network performance also become apparent in smaller controllers with comparatively moderate computing capacity. The EtherCAT cycle is so fast that it can be executed between two control cycles. The controller thus always has the latest input data available; the outputs are addressed with minimum delay. The response behaviour of the controller is improved significantly without increasing the computing capacity itself.

The EtherCAT technology principle is scalable and not bound to the baud rate of 100 Mbaud – extension to Gbit Ethernet is possible.



Freedom in the choice of topology | Maximum flexibility for wiring: with or without switch, line or tree topologies can be freely selected and combined. Address assignment is automatic; no IP address setting is required.

EtherCAT instead of PCI

With increasing miniaturisation of the PC components, the physical size of Industrial PCs is increasingly determined by the number of required slots. The bandwidth of Fast Ethernet, together with the data width of the EtherCAT communication hardware (EtherCAT Slave Controller) enables the transfer of PC interfaces to intelligent interface terminals at the EtherCAT system. Apart from the decentralised I/Os, axes and control units, complex systems such as fieldbus masters, fast serial interfaces, gateways and other communication interfaces can be addressed via a single Ethernet port in the PC. Even further Ethernet devices without restriction on protocol variants can be connected via decentralised switch port terminals. The central IPC becomes smaller and therefore more cost-effective, one Ethernet interface is sufficient for the complete communication with the periphery.

Topology

Line, tree or star: EtherCAT supports almost any topology. The bus or line structure known from the fieldbuses thus also becomes available for Ethernet. Particularly useful for system wiring is the combination of lines and branches or stubs. The required interfaces exist on the couplers; no additional switches are required. Naturally, the classic Ethernet star topology with junction terminals can also be used.

Wiring flexibility is further maximised through the choice of different cables. Flexible and inexpensive shielded Industrial Ethernet fieldbus cables transfer the signals in Ethernet mode (100BASE-TX) up to a cable length of 100 m between two devices. The complete bandwidth of the Ethernet network – such as different optical fibres and copper cables – can be used in combination with switches or media converters. For each cable distance, the signal variant can be selected individually. Since up to 65,535 devices can be connected, the size of the network is almost unlimited.

Distributed clocks

Accurate synchronisation is particularly important in cases where spatially distributed processes require simultaneous actions. This may be the case, for example, in applications where several servo axes carry out coordinated movements simultaneously.

The most powerful approach for synchronisation is the accurate alignment of distributed clocks. In contrast to fully synchronous communication, where synchronisation quality suffers immediately in the event of a communication fault, distributed aligned clocks have a high degree of tolerance vis-à-vis possible fault-related delays within the communication system. With EtherCAT, the data exchange is fully based on a pure hardware machine. Since the communication utilises a logical (and thanks to full-duplex Fast Ethernet, also physical) ring structure, the reference clock can determine the runtime offset to the individual local clocks simply and accurately – and vice versa. The distributed clocks are adjusted based on this value, which means that a very precise network-wide timebase with a jitter of significantly less then 1 microsecond is available.

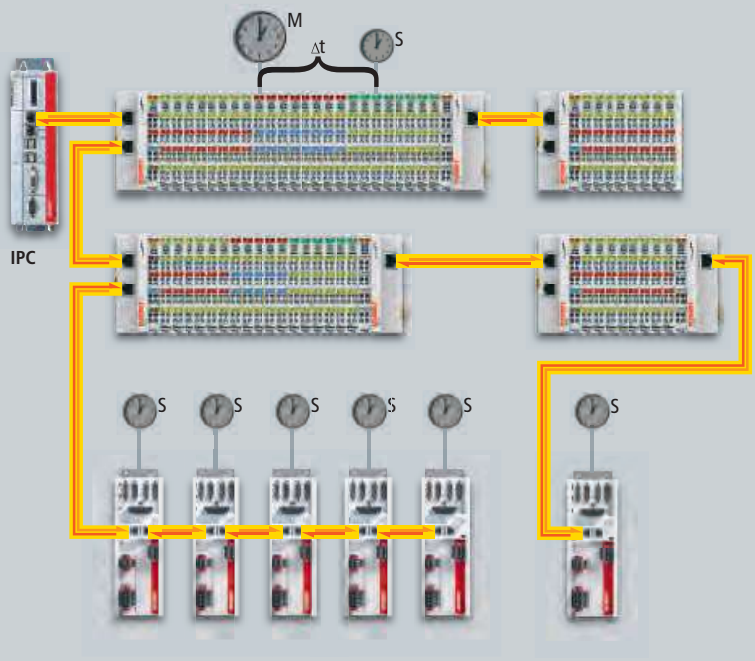
However, high-resolution distributed clocks are not only used for synchronisation, but can also provide accurate information about the local timing of the data acquisition. Thanks to extended data types, very precise time stamps can be assigned to measured values.

Hot Connect

Many applications require a change in I/O configuration during operation. Examples are machining centres with changing, sensor-equipped tool systems or transfer systems with intelligent, flexible workpiece carriers, or printing machines in which individual printing units are switched off. The protocol structure of the EtherCAT system takes account of these requirements: the Hot Connect function enables parts of the network to be linked and decoupled or reconfigured "on the fly", offering flexible response capability for changing configurations.

High availability

Increasing demands in terms of system availability are catered for with optional



Distributed clocks | Local absolute system synchronisation for CPU, I/O and drive units

cable redundancy that enables devices to be changed without having to shut down the network. EtherCAT also supports redundant masters with hot standby functionality. Since the EtherCAT Slave Controllers immediately return the frame automatically if an interruption is encountered, failure of a device does not lead to the complete network being shut down. Dragchain applications, for example, can thus be specifically configured as stubs in order to be prepared for cable break.

Safety over EtherCAT

In the interest of achieving safe data communication with EtherCAT, the Safety over EtherCAT protocol has been created. The protocol meets the requirements of IEC 61508 up to Safety Integrity Level (SIL) 3 and IEC 61784-3, as approved by the German Technical Inspection Agency (TÜV).

EtherCAT is used as a single-channel communication system. The transport medium is regarded as a "black channel" and is not included in the safety considerations. Thus, the protocol can also be transmitted by other communication systems, backplanes, WLAN, etc. The transfer cycle can be as short as required without affecting residual error probability. The cyclic exchange of safe data between a Safety over EtherCAT master and a Safety over EtherCAT slave is referred to as a connection that is monitored via a watchdog timer. A master can establish and monitor several connections to different slaves.

Diagnostics

The diagnostic capability of a network is a crucial factor for availability and commissioning times – and therefore overall costs. Only faults that are detected quickly and accurately and located unambiguously can be rectified quickly. Therefore, special attention was paid to comprehensive diagnostic features during the development of EtherCAT.

During commissioning, the actual configuration of the I/O terminals should be checked for consistency with the specified configuration. The topology should also match the configuration. Due to the built-in topology recognition down to the individual terminals, the verification can not only take place during system start-up, automatic reading in of the network is also possible (configuration upload).

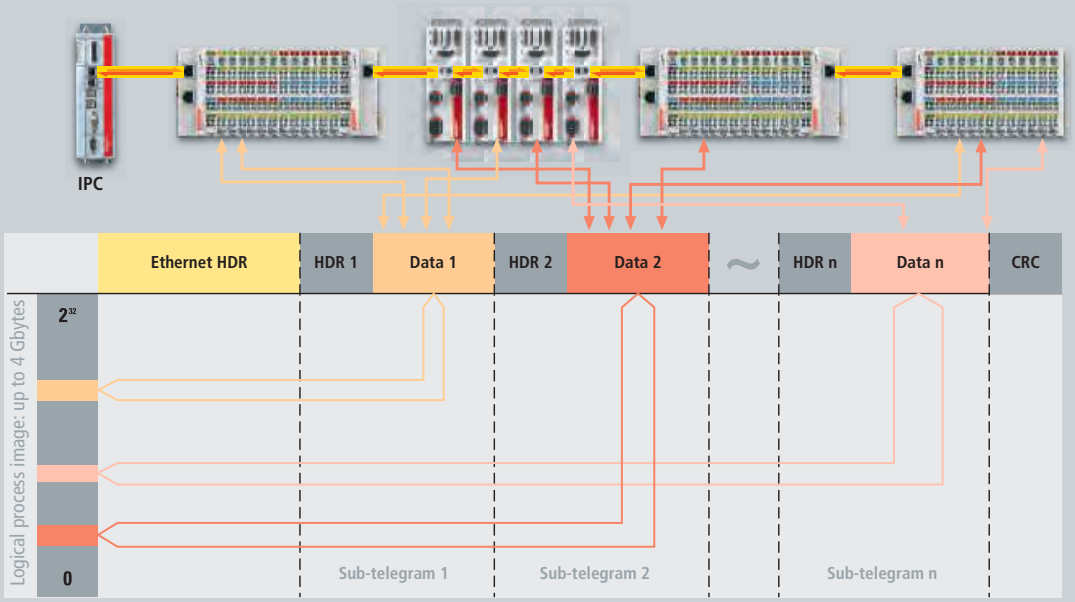
Bit faults during the transfer are reliably detected through evaluation of the CRC checksum in each device. Apart from breaking point detection and localisation, the protocol, transfer physics and topology of the EtherCAT system enable individual quality monitoring of each individual transmission segment. The automatic evaluation of the associated error counters enables precise localisation of critical network sections. Gradual or changing sources of error such as EMC influences, defective connectors or cable damage are detected and located.

EtherCAT components

On the hardware side, EtherCAT technology is located in EtherCAT Terminals, for example. The I/O system in protection class IP 20 is based on the housing of the tried and tested Beckhoff Bus Terminal system. In contrast to Bus Terminals, where the fieldbus protocol data is converted within the Bus Coupler to the internal, fieldbus-independent terminal bus, the EtherCAT protocol remains fully intact down to the individual terminal. In addition to EtherCAT Terminals with E-bus connection, the proven standard Bus Terminals with K-bus connection can also be connected via the BK1120 EtherCAT Bus Coupler. This ensures compatibility and continuity with the prevalent system. Existing and future investments are protected.

EtherCAT is fully integrated into the Beckhoff control architecture. The EtherCAT Box modules feature an integrated EtherCAT interface and can be connected directly to an EtherCAT network without an additional Coupler Box. The EPxxxx series with industrial housing and protection class IP 67 is suitable for application directly at the machine in harsh industrial environments. The EQxxxx series with stainless steel housing and protection class IP 69K is suitable for applications with high hygienic standards, such as in the food, chemical or pharmaceutical industries.

The Beckhoff Industrial PCs, the Embedded PCs of the CX series, the Control Panels



Protocol structure | The process image allocation is freely configurable. Data are copied directly in the I/O terminal to the desired location within the process image: no additional mapping is required. There is a very large address space of 4 Gbytes.

with control functionality, and the Ethernet PCI cards already offer inherent EtherCAT capability. The Beckhoff Servo Drives are also available with EtherCAT interface.

Openness

The EtherCAT technology is not only fully Ethernet-compatible, but also characterised by particular openness "by design": the protocol tolerates other Ethernet-based services and protocols on the same physical network – usually only with minimum loss of performance. Any Ethernet device can be connected within the EtherCAT segment via a switch port terminal without influencing the cycle time. Devices with fieldbus interface are integrated via EtherCAT fieldbus master terminals. The UDP protocol variant can be implemented on each socket interface. EtherCAT is a fully open protocol. It is recognised and available as an official IEC specification (IEC 61158, type 12).

EtherCAT Technology Group

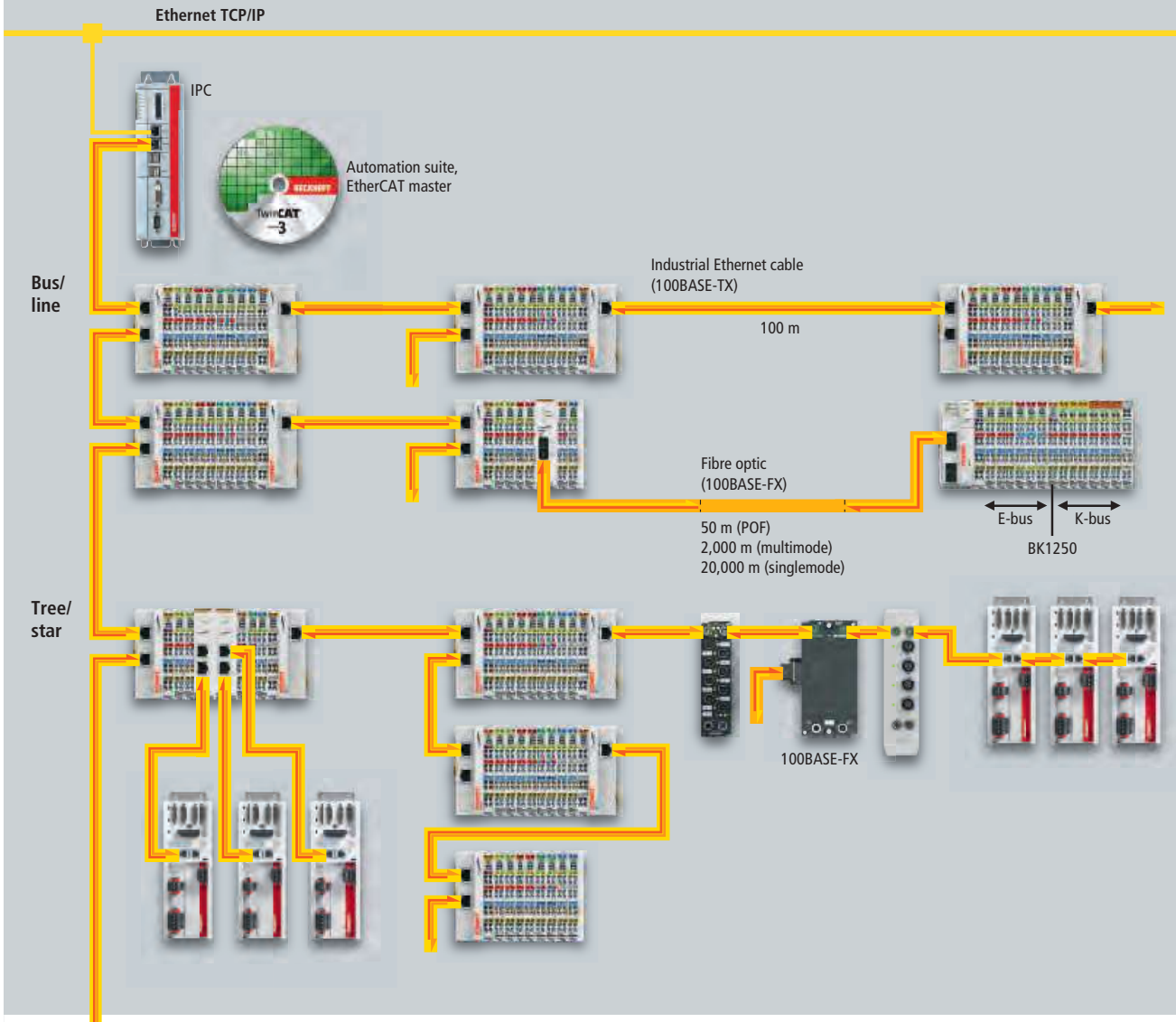
The EtherCAT Technology Group (ETG) is an association of automation users and manufacturers with a mission to support the development of EtherCAT technology. The group represents a variety of industry sectors and application areas. This ensures that the EtherCAT technology functions and interfaces are ideally prepared for the widest range of applications. The organisation ensures that EtherCAT can be easily and cost-effectively integrated in all kinds of automation devices, while ensuring interoperability of these implementations. The EtherCAT Technology Group is the official IEC partner organisation for fieldbus standardisation. Membership is open to all companies.

For further information see
www.ethercat.org

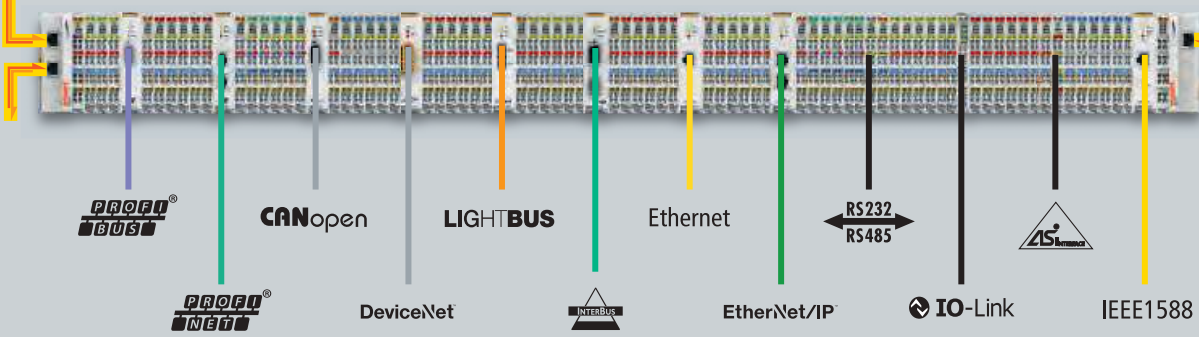
EtherCAT® Technology Group

EtherCAT system overview

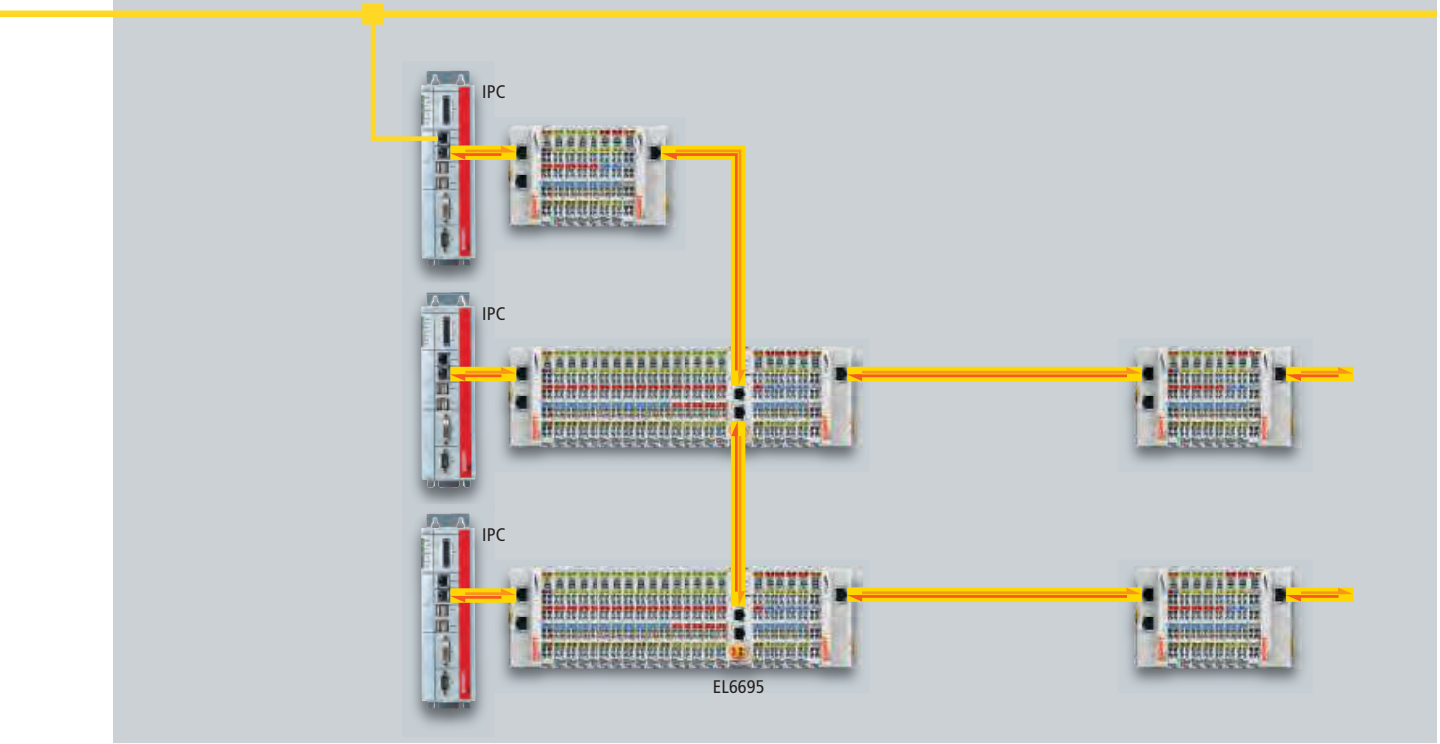
Flexible topology



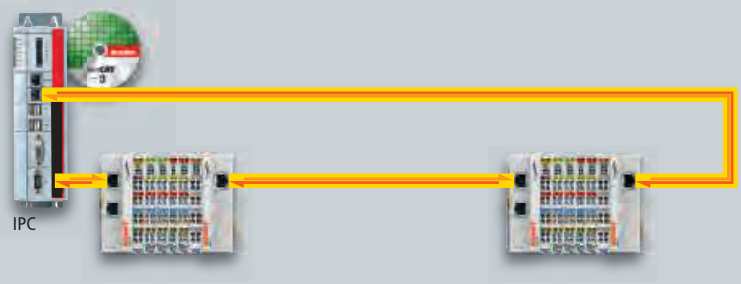
Fieldbus integration



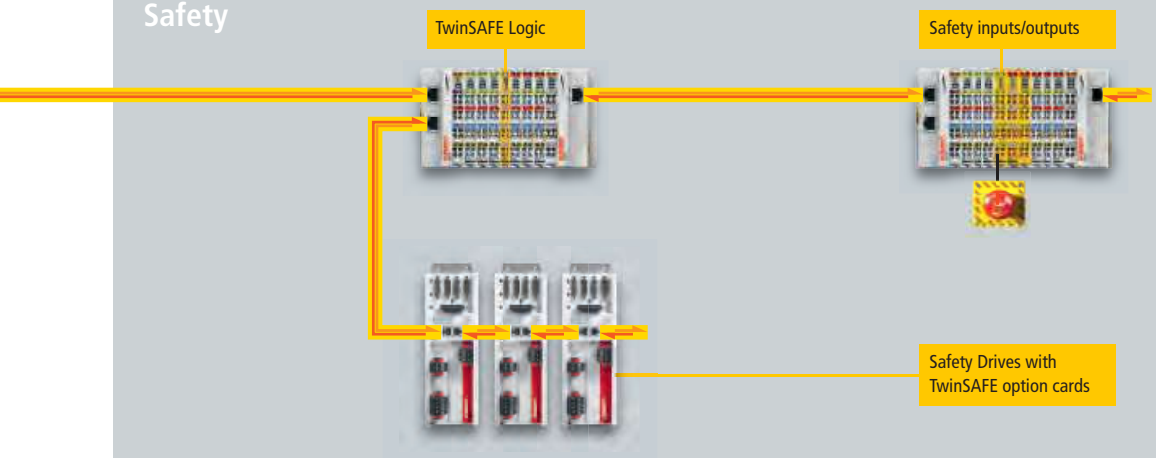
EtherCAT bridge



Cable redundancy

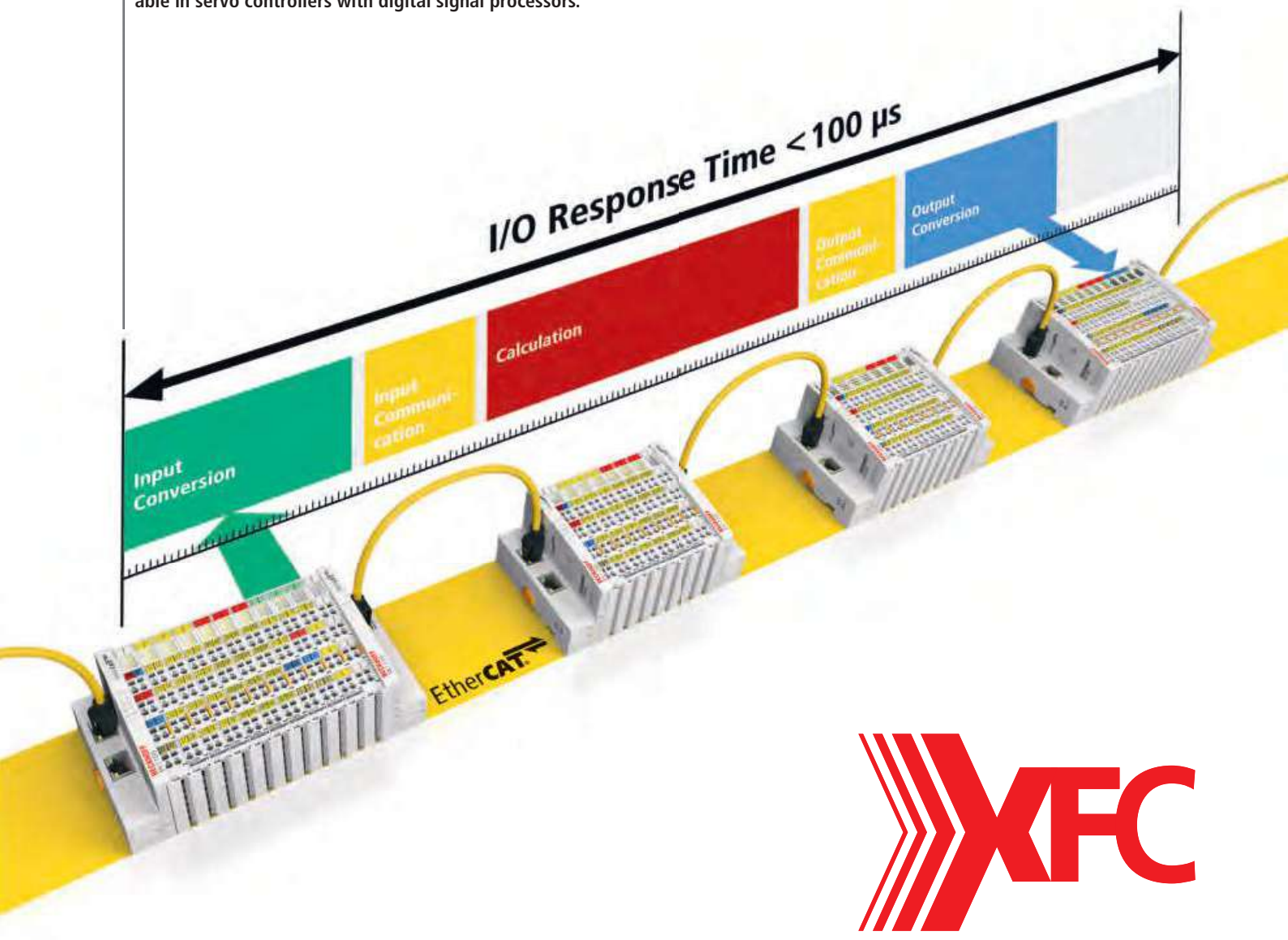


Safety



XFC | Higher production efficiency with extremely fast control technology

The I/O response time includes all hardware processing times (IPC, EtherCAT and I/O system), ranging from physical input event to output response. With an I/O response time of < 100 µs, PLC programmers have access to performance that in the past was only available in servo controllers with digital signal processors.



XFC

TwinCAT

Industrial PC

Fast I/O

Drive Technology

EtherCAT | Even faster with XFC

With XFC technology (eXtreme Fast Control) Beckhoff presents an ultra fast control solution: XFC is based on optimised control and communication architectures comprising an advanced Industrial PC, ultra-fast I/O terminals with extended real-time characteristics, the EtherCAT high-speed Ethernet system, and the TwinCAT automation software. With XFC it is possible to achieve I/O response times < 100 µs. This technology opens up new process optimisation opportunities for the user that were not possible in the past due to technical limitations.

XFC represents a control technology that enables very fast and highly deterministic responses. It includes all hardware and software components involved in control applications: optimised input and output components that can detect signals with high accuracy or initiate tasks; EtherCAT as very fast communication network; high-performance Industrial PCs; and TwinCAT, the automation software that links all system components.

Not long ago, control cycle times around 10 to 20 ms were normal. The communications interface was free-running, with corresponding inaccuracy of the determinism associated with responses to process signals. The increased availability of high-performance Industrial PC controllers enabled a reduction in cycle times down to 1–2 ms, i.e. by about a factor of 10. Many special control loops could thus be moved to the central machine controller, resulting in cost savings and greater flexibility in the application of intelligent algorithms.

XFC offers a further reduction of response times by a factor of 10, and enables cycle times of 100 µs and below, without having to give up central intelligence and associated high-performance algorithms. XFC also includes additional technologies that not only improve cycle times, but also temporal accuracy and resolution.

Users benefit from options for enhancing the quality of their machines and reducing response times. Measuring tasks such as preventive maintenance measures, monitoring of idle times or documentation of parts quality can simply be integrated in the machine control without additional, costly special devices.

In a practical automation solution, not everything has to be extremely fast and accurate – many tasks can still be handled with "normal" solutions. XFC technology is therefore fully compatible with existing solutions and can be used simultaneously with the same hardware and software.

TwinCAT – The extreme fast real-time control software

- real-time under Microsoft Windows down to 12.5 µs cycle time
- standard IEC 61131-3 programming in XFC real-time tasks
- Standard features of Windows and TwinCAT are XFC-compliant.

EtherCAT – The extreme fast control communication technology

- 1,000 distributed digital I/Os in 30 µs
- EtherCAT down to the individual I/O terminals, no sub bus required
- optimised use of standard Ethernet Controllers, e.g. Intel® PC chipset architecture in the EtherCAT master
- advanced real-time feature based on distributed clocks
  - synchronisation
  - time stamping
  - oversampling

EtherCAT Terminals – The extreme fast I/O technology

- full range I/O line for all signal types
- high-speed digital and analog I/Os
- Time stamping and oversampling features allow extreme high timing resolution (down to 10 ns).

IPC – The extreme fast control CPU

- Industrial PC based on high-performance real-time motherboards
- compact form factors optimised for control applications

▶ **www.beckhoff.com/XFC**

XFC technologies

Distributed clocks

In a normal, discrete control loop, actual value acquisition occurs at a certain time (input component), the result is transferred to the control system (communication component), the response is calculated (control component), the result is communicated to the set value output module (output component) and issued to the process (controlled system).

The crucial factors for the control process are: minimum response time, deterministic actual value acquisition (i.e. exact temporal calculation must be possible), and corresponding deterministic set value output. At what point in time the communication and calculation occurs in the meantime is irrelevant, as long as the results are available in the output unit in time for the next output, i.e. temporal precision is required in the I/O components, but not in the communication or the calculation unit.

The distributed EtherCAT clocks therefore represent a basic XFC technology and are a general component of EtherCAT communication. All EtherCAT devices have their own local clocks, which are automatically and continuously synchronised with all other clocks via the EtherCAT communication. Different communication runtimes are compensated, so that the maximum deviation between all clocks is generally less than 100 nanoseconds. The current time of the distributed clocks is therefore also referred to as system time, because it is always available across the whole system.

Distributed clocks
- distributed absolute system synchronisation for CPU, I/O and drive devices
- internal sampling 10 ns
- distributed clock precision << 1 µs

Timestamp/multi-timestamp

Process data is usually transferred in its respective data format (e.g. one bit for a digital value or one word for an analog value). The temporal relevance of the process record is therefore inherent in the communication cycle during which the record is transferred. However, this also means that the temporal resolution and accuracy is limited to the communication cycle.

Timestamped data types contain a timestamp in addition to their user data. This timestamp – naturally expressed in the ubiquitous system time – enables provision of temporal information with significantly higher precision for the process record. Timestamps can be used for inputs (e.g. to identify the time of an event occurred) and outputs (e.g. timing of a response). This way it is possible to determine, for example, the precise point in time when an output is to be switched. The switching task is executed independently of the bus cycle.

While timestamp terminals can execute one switching task or switching event per bus cycle, multi-timestamp terminals can execute up to 32 switching tasks or switching events per cycle.

Signal technology for terminals with timestamping (64 bit time resolution)
- extremely precise time measurement for digital single shot events per cycle: resolution 1 ns, internal sampling 10 ns, accuracy with distributed clocks << 1 µs (+ input delay)
- exact time measurement of rising or falling edges of distributed digital inputs
- exact timing of distributed output signals, independent of control cycle
- absolute distributed clocks time with 64 bit resolution, easy time handling over > 580 years

Signal technology for terminals with multi-timestamping (32 bit time resolution)
- precise time measurement of up to 32 events per cycle: resolution 1 ns, internal sampling 10…40 µs dependent on the configuration
- exact time measurement of rising or falling edges of distributed digital inputs
- exact timing of distributed output signals, independent of control cycle
- distributed clocks time with 32 bit resolution, sufficient for actions in a ±4-second time frame

Oversampling

Process data is usually transferred exactly once per communication cycle. Conversely, the temporal resolution of a process record directly depends on the communication cycle time. Higher temporal resolution is only possible through a reduction in cycle time – with associated practical limits.

Oversampling data types enable multiple sampling of a process record within a communication cycle and subsequent (inputs) or prior (outputs) transfer of all data contained in an array. The oversampling factor describes the number of samples within a communication cycle and is therefore a multiple of one. Sampling rates of 200 kHz can easily be achieved, even with moderate communication cycle times.

Triggering of the sampling within the I/O components is controlled by the local clock (or the global system time), which enables associated temporal relationships between distributed signals across the whole network.

Signal oversampling
- multiple signal conversion within one control cycle
- hard time synchronisation through distributed clocks
- for digital input/output signals
- for analog input/output signals
- support of analog I/O EtherCAT Terminals
  - up to 100 kHz signal conversion
  - down to 10 µs time resolution
- support of digital I/O EtherCAT Terminals
  - up to 1 MHz
  - up to 1 µs time resolution
- application
  - fast signal monitoring
  - fast function generator output
  - signal sampling independent of cycle time
  - fast loop control

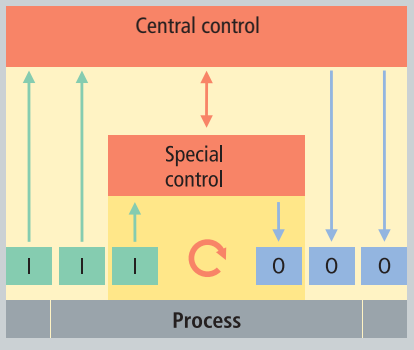
Fast I/O

Very fast physical responses require suitably short control cycle times in the associated control system. A response can only take place once the control system has detected and processed an event.

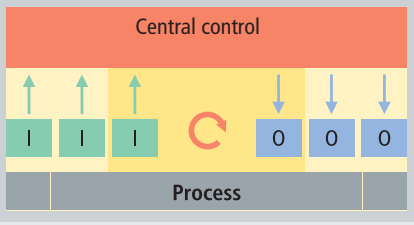
The traditional approach for achieving cycle times in the 100 µs range relies on special separate controllers with their own, directly controlled I/Os. This approach has clear disadvantages, because the separate controller has only very limited information about the overall system and therefore cannot make higher-level decisions. Reparameterisation options (e.g. for new workpieces) are also limited. Another significant disadvantage is the fixed I/O configuration, which generally cannot be expanded.

Extreme fast I/O response time
- from 85 µs
- Deterministic synchronised input and output signal conversion leads to low process timing jitter.
- Process timing jitter is independent of communication and CPU jitter.

Extreme short control cycle time
- 100 µs (min. 12.5 µs)
- new performance class for PLC application: control loops with 100 µs



Subordinate special control (limited process image)



Fast central control (complete process image)

XFC components

Implementation of the XFC technologies described above requires full support for all hardware and software components involved in the control system, including fast, deterministic communication and I/O and control hardware. A significant part of XFC are the software components responsible for fast processing of the control algorithms and optimised configuration of the overall system.

Beckhoff offers a special XFC product range based primarily on four categories: EtherCAT as fieldbus, EtherCAT Terminals as I/O system, IPCs as hardware platform, and TwinCAT as higher-level software. All components are based on open standards, which means that any engineer or programmer can develop very fast control solutions with high performance based on standard components (i.e. without special hardware).

I/O component with XFC technology

Standard EtherCAT Terminals already offer full support for XFC technology. Synchronisation of the I/O conversion with the communication or – more precisely – with the distributed clocks is already standard in EtherCAT and is therefore supported by the corresponding terminals.

XFC terminals offer additional special features that make them particularly suitable for fast or high-precision applications:

- digital EtherCAT Terminals with very short T_{ON}/T_{OFF} times, or analog terminals with particularly short conversion times
- EtherCAT Terminals and EtherCAT Box modules with timestamp/multi-time-stamping latching at the exact system time at which digital or analog events occur. Output of digital or analog values can occur at exactly predefined times.
- Terminals with oversampling enable actual value acquisition or set value output with significantly higher resolution than the communication cycle time.

Communication component – EtherCAT fully utilised

With high communication speed and usable data rates EtherCAT offers the basic prerequisites for XFC. However, speed is not everything. The option of using the bus to exchange several independent process images arranged according to the control application enables parallel application of XFC and standard control technology. The central control system is relieved of time-consuming copying and mapping tasks and can fully utilise the available computing power for the control algorithms.

The distributed EtherCAT clocks that form the temporal backbone of the XFC technologies are available in all communication devices without significant additional effort.

The crucial point of XFC is the option of integrating all I/O components directly in the EtherCAT communication, so that no subordinate communication systems (sub bus) are required. In many XFC terminals the AD or DA converter is connected directly to the EtherCAT chip, so that delays are avoided.

Control component – High-performance Industrial PCs

Central control technology can be particularly advantageous if it can run faster and more powerful control algorithms than would be the case with many distributed small controllers.

Fast multi-core processors are ideal for running the operator interface of the machine in parallel with the control tasks. Large caches available with modern CPUs are ideal for XFC technology, because fast algorithms run in the cache and can therefore be processed even faster.

An important factor for short XFC cycle times is the fact that the CPU is not burdened with complex process data copying tasks needed by traditional fieldbuses with their DPRAM-based central boards. EtherCAT process data communication can be handled entirely by the integrated Ethernet controller (NIC with bus master DMA).

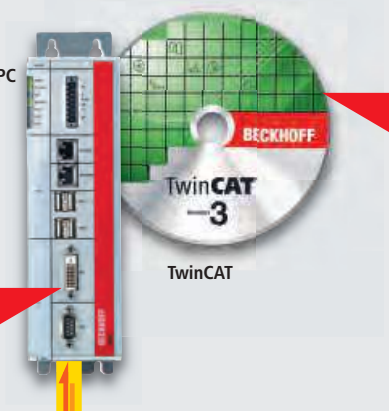
Software component – TwinCAT automation suite

TwinCAT as high-performance automation suite fully supports the XFC technologies while retaining all the familiar features. The real-time implementation of TwinCAT supports different tasks with different cycle times. Modern Industrial PCs can achieve cycle times of 100 µs or less without problem. Several (different) fieldbuses can be mixed. The associated allocations and communication cycles are optimised according to the fieldbus capabilities. The EtherCAT implementation in TwinCAT makes full use of the communication system and enables application of several independent time levels. It uses distributed clocks. Different time levels enable coexistence of XFC and normal control tasks in the same system, without the XFC requirements becoming a "bottleneck".

An option specially designed for XFC enables inputs to be read during independent communication calls and outputs to be sent directly after the calculation. Due to the speed offered by EtherCAT the inputs are read and processed "just" before the start of the control tasks, followed by immediate distribution of the outputs with a second fieldbus cycle. The resulting response times are faster than the fieldbus cycle time in some cases.

Special TwinCAT extensions facilitate handling of the XFC data types (timestamp and oversampling). PLC blocks enable simple analysis and calculation of the time stamps. The TwinCAT scope can display the data picked up via oversampling according to the allocated oversampling factor and enables precise data analyses.

Industrial PC



TwinCAT

XFC

TwinCAT

The TwinCAT automation suite supports XFC technology with real-time implementation and extensions for the XFC functions oversampling, timestamp and distributed clocks.

XFC

Industrial PC

High-performance Industrial PCs offer plenty of computing power for short XFC cycle times.

EtherCAT

XFC

Timestamp

Timestamp input/output modules can be used to realise responses with equidistant time intervals.

EtherCAT Terminals

EtherCAT Box

XFC

Oversampling

Oversampling offers refined temporal resolution of a signal through multiple signal sampling.

XFC

Fast I/O

Fast I/O make delays in the hardware negligible.

XFC

EtherCAT

EtherCAT offers the basis for XFC with an extremely fast communication technology.

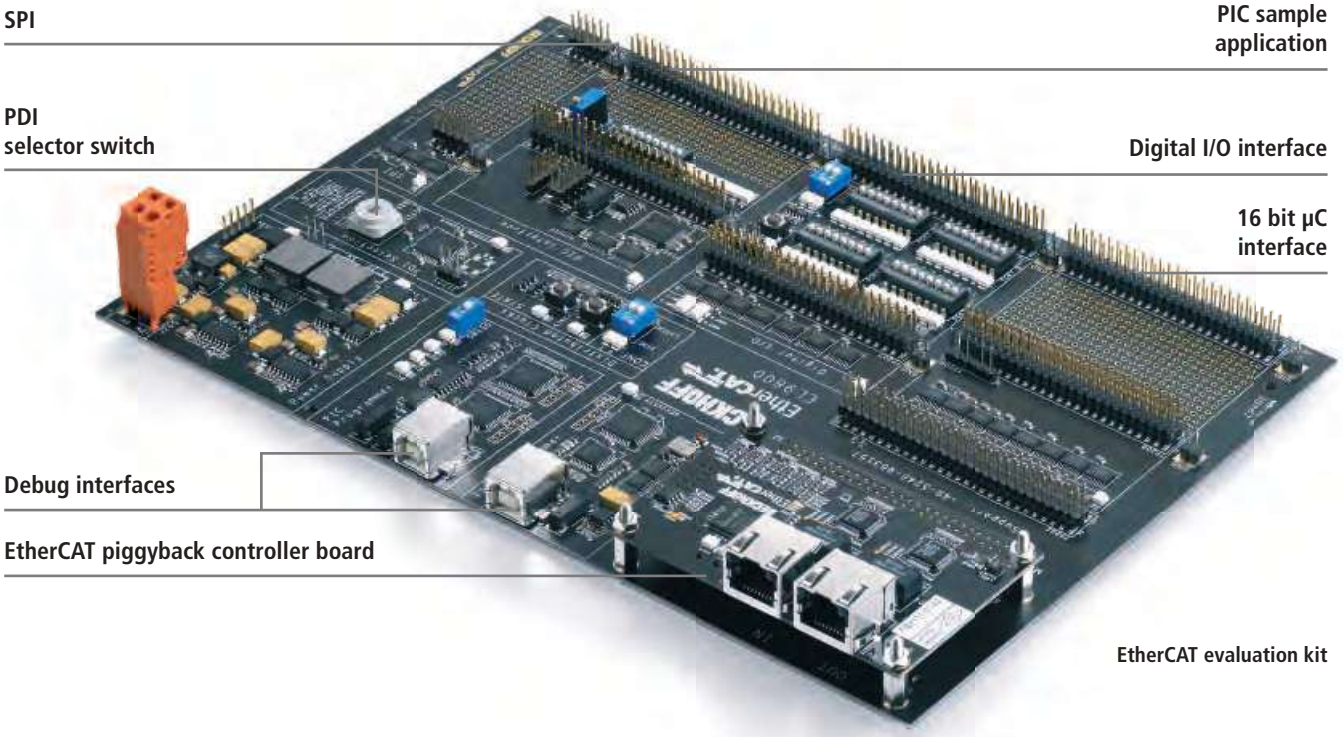
EtherCAT
Servo Drives

XFC

Drive Technology

The flexible drive interface with short cycle times enables highly dynamic, strictly synchronous control processes covering multiple axes.

EtherCAT | Development Products



EtherCAT evaluation kit

▶ www.beckhoff.com/EtherCAT-development-products

ET1100, ET1200 | **EtherCAT ASICs**

The ET1100 and ET1200 EtherCAT ASICs offer a cost-effective and compact solution for realising EtherCAT slaves. They process the EtherCAT protocol in the hardware and therefore ensure high-performance and real-time capability, independent of any downstream slave microcontrollers and associated software. Through their three process data interfaces – digital I/O, SPI and 8/16 bit µC (not for ET1200) – the EtherCAT ASICs enable realisation of simple digital modules without microcontrollers and development of intelligent devices with own processor. Both ASICs feature distributed clocks that enable high-precision synchronisation (<< 1 µs) of the EtherCAT slaves. The supply voltage is 3.3 V or 5 V; the core voltage of 2.5 V is generated by the integrated in-phase regulator or can be supplied directly. The ET1100 is suitable as a universal solution for all types of EtherCAT devices; the ET1200 is optimised for modular devices using E-bus/LVDS (Low Voltage Differential Signalling) as internal interface. Due to their compact design and small number of external components, both ASICs only require minimum space on the board.

The ET1100 ASIC housing (BGA128) only measures 10 x 10 mm. The chip can support up to four EtherCAT ports. The 8 kB internal memory (DPRAM) for access to process and parameter data is optionally addressed via parallel or serial data bus. Alternatively, the ASICs can also be used without controller. In this case up to 32 digital signals can be connected directly.

The ET1200 ASIC is the "small" variant of the ET1100; with its QFN48 housing measuring only 7 x 7 mm, the chip is even more compact. The device offers 16 digital I/O interfaces and distributed clock hardware for high-precision synchronisation. The 1 kB internal DPRAM is addressed via a fast (20 Mbit/s) serial interface. The "small ASIC" offers up to three EtherCAT ports, one of which can be used as MII for connecting a standard PHY. The other ports are used for LVDS, which makes the ET1200 the right choice for modular devices using LVDS as internal bus physics.

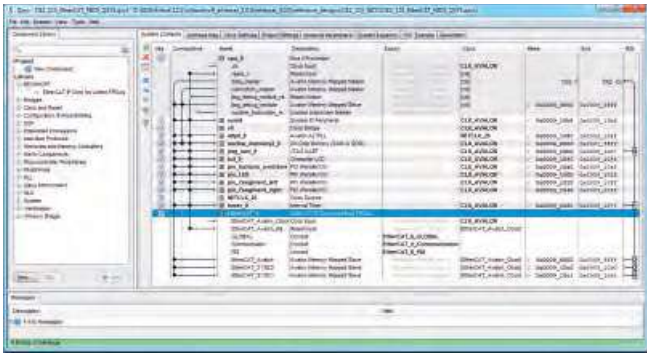
Technical data	ET1100	ET1200
Number of EtherCAT ports	4 (max. 4 x MII)	3 (max. 1 x MII)
FMMUs	8	3
SYNC manager	8	4
DPRAM	8 kbyte	1 kbyte
Distributed clocks	yes (64 bit)	yes (64 bit)
Process data interfaces	32 bit digital I/O	16 bit digital I/O
	SPI	SPI
	8/16 bit µC	–
Housing	BGA128, 10 x 10 mm	QFN48, 7 x 7 mm
Further information	www.beckhoff.com/ET1100	www.beckhoff.com/ET1200

ET1810, ET1811, ET1812 | **EtherCAT IP core for Altera® FPGAs**

The EtherCAT IP core enables the EtherCAT communication function and application-specific functions to be implemented on an FPGA (Field Programmable Gate Array – i.e. a device containing programmable logical components). The EtherCAT functionality is freely configurable. The IP core can be combined with own FPGA designs, and it can be integrated in System-on-Chips (SoCs) with soft core processors or hard processor systems via the Avalon® or AMBA® AXI™ interfaces. The physical interfaces and internal functions, such as the number of FMMUs and SYNC managers, the size of the DPRAM, etc., are adjustable. The process data interface (PDI) and the distributed clocks are also configurable. The functions are compatible with the EtherCAT specification and the EtherCAT ASICs (ET1100, ET1200).

The ET1811 quantity-based license for Altera® FPGAs offers manufacturers of small lots and development service providers the possibility of entering the world of EtherCAT development with low initial investment. For the development of an EtherCAT device, the ET1811 one-time kick-off charge is required, plus the ET1811-1000 royalty for 1,000 devices. The royalties for 1,000 devices must be paid in advance each time.

For development service providers only the ET1811 one-time kick-off charge will be required; the ET1811-0030 system integrator OEM license will be required for each customer implementation. The end customer will be required to pay the royalty license (ET1811-1000).



Configurable features	ET1810, ET1811, ET1812
PHY interface	1…3 ports MII, 1…3 ports RGMII or 1…2 ports RMII
FMMUs	0…8
SYNC manager	0…8
DPRAM	0…60 KB
Distributed clocks	0…2 SYNC outputs, 0…2 latch inputs (32/64 bit)
Process data interfaces	32 bit digital I/O, SPI, 8/16 bit asynchronous µC interface, Avalon interface, AMBA AXI3 interface, 64 bit general purpose I/O
Further information	www.beckhoff.com/ET1810

Ordering information	
Node-locked buy out license	
ET1810	Node-locked license for using the EtherCAT IP core on one workstation. The license includes 1 year of maintenance and updates.
ET1810-0010	Extension of the node-locked Altera license (ET1810) for one additional workstation
ET1810-0020	One-year maintenance extension for node-locked license (ET1810)
Node-locked quantity-based license	
ET1811	One-time kick-off charge for the node-locked quantity-based license for using the freely configurable EtherCAT IP cores on one workstation
ET1811-1000	Royalty for 1,000 devices, ET1811 required
ET1811-0020	One-year maintenance extension, ET1811 required
ET1811-0030	System integrator OEM license
Floating buy out license	
ET1812	Floating buy out license for Altera FPGAs
ET1812-0010	Extension of the floating license (ET1812) for one additional workstation
ET1812-0020	One-year maintenance extension for floating license (ET1812)

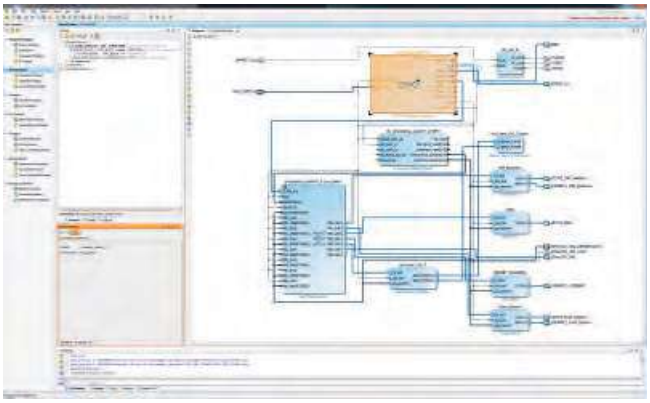
Evaluation license (Open Core Plus IP)
Full-featured, time-limited version available. ▶ **www.beckhoff.com/ET1810**

ET1815, ET1816 | EtherCAT IP core for Xilinx® FPGAs

The EtherCAT IP core enables the EtherCAT communication function and application-specific functions to be implemented on an FPGA (Field Programmable Gate Array – i.e. a device containing programmable logical components). The EtherCAT functionality is freely configurable. The IP core can be combined with own FPGA designs, and it can be integrated in System-on-Chips (SoCs) with soft core processors or hard processing systems via the AMBA® AXI™ interfaces. The physical interfaces and internal functions, such as the number of FMMUs and SYNC managers, the size of the DPRAM, etc., are adjustable. The process data interface (PDI) and the distributed clocks are also configurable. The functions are compatible with the EtherCAT specification and the EtherCAT ASICs (ET1100, ET1200).

The ET1816 quantity-based license offers manufacturers of small lots and development service providers the possibility of entering the world of EtherCAT development with low initial investment. For the development of an EtherCAT device, the ET1816 one-time kick-off charge is required, plus ET1816-1000 royalty for 1,000 devices. The royalties for 1,000 devices must be paid in advance each time.

Development service providers only require ET1816 one-time kick-off charge; the ET1811-0030 system integrator OEM license is required for each customer implementation. The end customer requires the royalty license (ET1816-1000).



Configurable features	ET1815, ET1816
PHY interface	1…3 ports MII, 1…3 ports RGMII or 1…2 ports RMII
FMMUs	0…8
SYNC manager	0…8
DPRAM	0…60 KB
Distributed clocks	0…2 SYNC outputs, 0…2 latch inputs (32/64 bit)
Process data interfaces	32 bit digital I/O, SPI, 8/16 bit asynchronous µC interface, AMBA AXI4/AXI4 LITE interface, 64 bit general purpose I/O
Further information	www.beckhoff.com/ET1815

Ordering information	
Node-locked buy out license	
ET1815	Node-locked license for using the EtherCAT IP core on one workstation. The license includes 1 year of maintenance and updates.
ET1815-0010	Extension of the node-locked Xilinx license (ET1815) for one additional workstation
ET1815-0020	One-year maintenance extension for node-locked license (ET1815)
Node-locked quantity-based license	
ET1816	One-time kick-off charge for the node-locked quantity-based license for using the freely configurable EtherCAT IP cores on one workstation; target hardware: selected Xilinx devices
ET1816-1000	Royalty for 1,000 devices, ET1816 required
ET1816-0020	One-year maintenance extension, ET1816 required
ET1811-0030	System integrator OEM license

Evaluation license

Full-featured, time-limited version available. ▶ **www.beckhoff.com/ET1815**

EL9820 | EtherCAT evaluation kit

The evaluation kit serves as platform for the development of EtherCAT slaves. The piggyback controller board supplied with the kit realises the complete EtherCAT connection with the ASIC ET1100. All digital I/O, SPI and asynchronous µController process data interfaces (PDIs) are connected to pin strips and can be selected via PDI selector switch. The SPI interface can optionally be connected with a PIC microcontroller included with the kit or directly to the pin strip. A programming and debugging interface for the controller is also provided. The EL9820 can therefore also be used as platform for the ET9300 EtherCAT Slave Stack Code provided with the evaluation kits.

Technical data	EL9820
Evaluation kit	base board
EtherCAT Slave Controller	ASIC ET1100
EtherCAT piggyback controller board	FB1111-0142 with ASIC ET1100
Software	EtherCAT Slave Stack Code ET9300
Accessories	cables, documentation
Workshop	optionally available as TR8100
Further information	www.beckhoff.com/EL9820

FB1111 | EtherCAT piggyback controller boards

The FB1111 EtherCAT piggyback controller board offers complete EtherCAT connection based on the ET1100 EtherCAT ASIC. All variants of the FB1111 have the same form factor and can be used with the EtherCAT evaluation kit. They can be integrated as EtherCAT interfaces in devices.

Ordering information	
FB1111-0140	EtherCAT piggyback controller board with ET1100 and µC interface; can be integrated as EtherCAT interface in devices.
FB1111-0141	EtherCAT piggyback controller board with ET1100 and SPI interface; can be integrated as EtherCAT interface in devices.
FB1111-0142	EtherCAT piggyback controller board with ET1100 and digital I/O interface; can be integrated as EtherCAT interface in devices; included in the EL9820 evaluation kit.

▶ **www.beckhoff.com/FB1111**

ET2000 | Industrial Ethernet multi-channel probe

The ET2000 multi-channel probe from Beckhoff is a versatile piece of hardware for analysing any Industrial Ethernet solution. With eight ports this device enables unlimited synchronised recording of up to four independent channels at a speed of 100 Mbit/s. All real-time Ethernet standards such as EtherCAT, PROFINET, etc. and conventional office Ethernet networks are supported.

Through its compact and rugged design the ET2000 is ideal both for the local application at machines or in the laboratory. The four channels enable recording and analysis of separate networks or different points within the same network. All frames in transit – in both directions – are furnished with a high-precision time stamp in the probe hardware and copied to the Gbit uplink port. The high time stamp resolution of 1 ns enables very precise timing analysis of the connected network segments. The ET2000 probe is transparent for the connected buses. Thanks to the low cycle delay of 1 µs the influence on the system is very small.

The device can be connected to any Gbit Ethernet interfaces on the PC side. A plug-in for the free Wireshark network monitor enables this network monitor to be used for analysing recordings and high-precision time stamps.

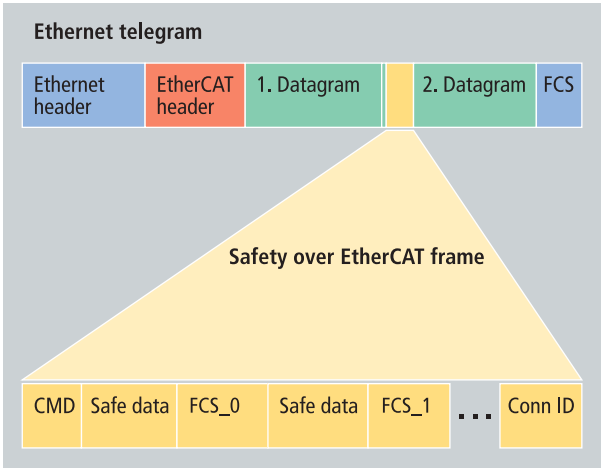
Technical data	ET2000
Number of ports/channels	8/4
Uplink port	1 Gbit/s
Delay	approx. 1 µs
Resolution timestamp	1 ns (channel 0/1)
Software interface	WinPcap
Data transfer rates	probe ports: 100 Mbit/s, uplink port: 1 Gbit/s
Hardware diagnosis	link/activity LED per channel, 1 power LED
Power supply	24 (18…30) V DC, 500 mA, 3-pole terminal (+, -, PE)
Dimensions (W x H x D)	approx. 100 mm x 150 mm x 40 mm
Operating temperature	0…+55 °C
Further information	www.beckhoff.com/ET2000

Safety over EtherCAT

In the interest of realising safe data communication for EtherCAT, the Safety over EtherCAT protocol has been disclosed. The protocol meets the requirements of IEC 61508 up to Safety Integrity Level (SIL) 3 and of IEC 61784-3, as approved by the TÜV.

EtherCAT is used as a single-channel communication system. The transport medium is regarded as a "black channel" and not included in the safety considerations. Thus, the protocol can also be transmitted by other communication systems, backplanes, WLAN. The cyclic exchange of safe data between a Safety over EtherCAT master and a Safety over EtherCAT slave is referred to as a connection that is monitored via a watchdog timer.

The license for implementation of the Safety over EtherCAT master and slave technology in a device is free of charge.



ET9402 | Safety over EtherCAT Conformance Test Tool

The FSoE Conformance Test Tool (FSoE CTT) enables in-house testing of Safety over EtherCAT (FSoE) slave devices with EtherCAT interface. The utilisation of the ET9402 tool during the development of Safety over EtherCAT devices helps to ensure the conformity and to prepare the device for the official, independent FSoE Conformance Test in an ETG accredited EtherCAT Test Center.

The tool is based on the EtherCAT Conformance Test Tool (ET9400) with extensions regarding to Safety over EtherCAT functionality. A valid subscription of the ET9400 is a prerequisite for the FSoE CTT.

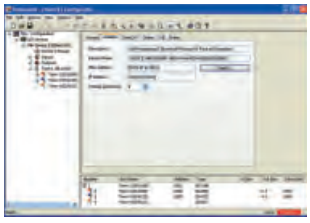
The test includes a complete test set for testing the conformance of FSoE slave devices. The test set is approved by TÜV. According to the Safety over EtherCAT Conformance Test Policy of the EtherCAT Technology Group (ETG), every manufacturer of EtherCAT devices with Safety over EtherCAT is obliged to prove the compatibility of the Safety over EtherCAT implementation by means of the current version of the FSoE tests and the required FSoE Conformance Test Tools.

Ordering information	
ET9402	Safety over EtherCAT Conformance Test Tool – includes a complete test set for testing the conformance of FSoE slave devices – The test set is approved by TÜV. – A valid subscription of the ET9400 is a prerequisite for the FSoE CTT.

▶ **www.beckhoff.com/ET9402**

ET9000, ET9200, ET9300 | **EtherCAT development software**

ET9000 | **EtherCAT configurator**



Through clear definition of the interfaces in the EtherCAT specification an EtherCAT master can be developed without having to develop a configurator at the same time. The EtherCAT configurator is aimed at EtherCAT master developers who want to use it or integrate and distribute it with their software package.

The Windows software for configuring an EtherCAT network includes a configurator for:

- reading XML device descriptions (ESI)
- generating XML configuration descriptions (ENI)

Properties

- online features
  - scanning of EtherCAT networks
  - diagnostics
  - free-run online mode for commissioning
- topology representation
- Automation software interface starts the configurator as COM server.
  - COM interface
  - XML interface for parameter exchange between client and server
  - Safety configuration, EL69xx Safety PLC (Safety over EtherCAT)
- including embedded graphical user interface
- EXE file, executable under Windows XP, Vista and Windows 7 (32 bit)

The EtherCAT configurator is not required if the TwinCAT software from Beckhoff is used.

Ordering information	
ET9000	license for using the EtherCAT configurator

▶ **www.beckhoff.com/ET9000**

ET9200 | **EtherCAT Master Sample Code**

The EtherCAT Master Sample Code is a user mode Windows application that demonstrates implementation of the EtherCAT master. The TR8200 workshop for EtherCAT master developers is based on the ET9200.

Features

- boot-up and configuration
- sending and receiving of "raw" EtherCAT frames to/from a network adapter
- management of EtherCAT slave states
- reading of XML configuration descriptions
- sending of the initialisation commands that are defined for the different state changes to the slave device
- mailbox communication
- CoE (CAN Application protocol over EtherCAT)
- SoE (Servodrive Profile over EtherCAT)
- EoE (Ethernet over EtherCAT)
- FoE (File Access over EtherCAT)
- AoE (ADS over EtherCAT)
- integrated virtual switch functionality
- cyclical process data communication
- distributed clocks state machine

The software is sent as source code and can be adapted to the hardware environment (Ethernet controller) and integrated in a real-time environment.

Ordering information	
ET9200	license for using the EtherCAT Master Sample Code

▶ **www.beckhoff.com/ET9200**

ET9300 | **EtherCAT Slave Stack Code**

The EtherCAT Slave Stack Code (SSC) is a code written in ANSI C. Its modular and simple structure enables fast entry into slave development.

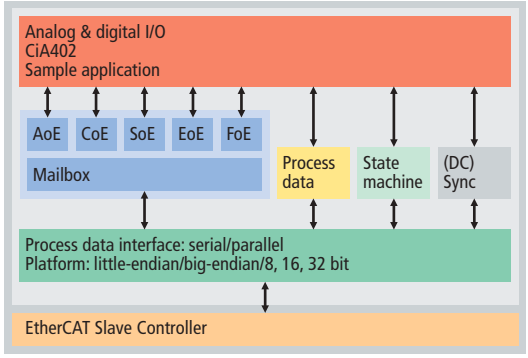
A large number of EtherCAT slaves can be realised with the SSC, from the I/Os to the drives. The stack can be easily adapted to different platforms since it provides a defined hardware access layer and also supports different controller architectures.

The SSC, which has been available since 2004 and has been continously maintained and enhanced in collaboration with the EtherCAT Technology Group, is considered to a certain extent to be the reference for an EtherCAT slave device implementation. Particular attention was paid to the conformity with the protocol specification.

The slave stack code tool provided offers the possibility to generate a slave stack code, device description files (ESI) and individual source code documentation to suit the developer's own needs.

Functionality (excerpt)

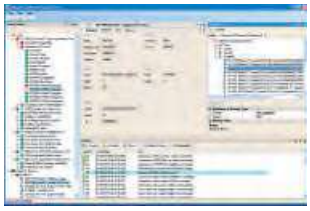
- ESM (EtherCAT State Machine)
- mailbox protocols:
  - CoE (CAN application protocol over EtherCAT)
  - AoE (ADS over EtherCAT)
  - EoE (Ethernet over EtherCAT)
  - FoE (File Transfer over EtherCAT)
  - preparation for SoE (Servo drive profile over EtherCAT)
- preparation for boot loader support
- various synchronisations (e.g. DC), including Sync Watchdog
- example implementation of the CiA402 drive profile according to ETG.6010 specification



Ordering information	
ET9300	license for using the EtherCAT Slave Stack Code (free download from Beckhoff website via Member Area of the EtherCAT Technology Group web page)

▶ **www.beckhoff.com/ET9300**

ET9400 | **EtherCAT Conformance Test Tool**



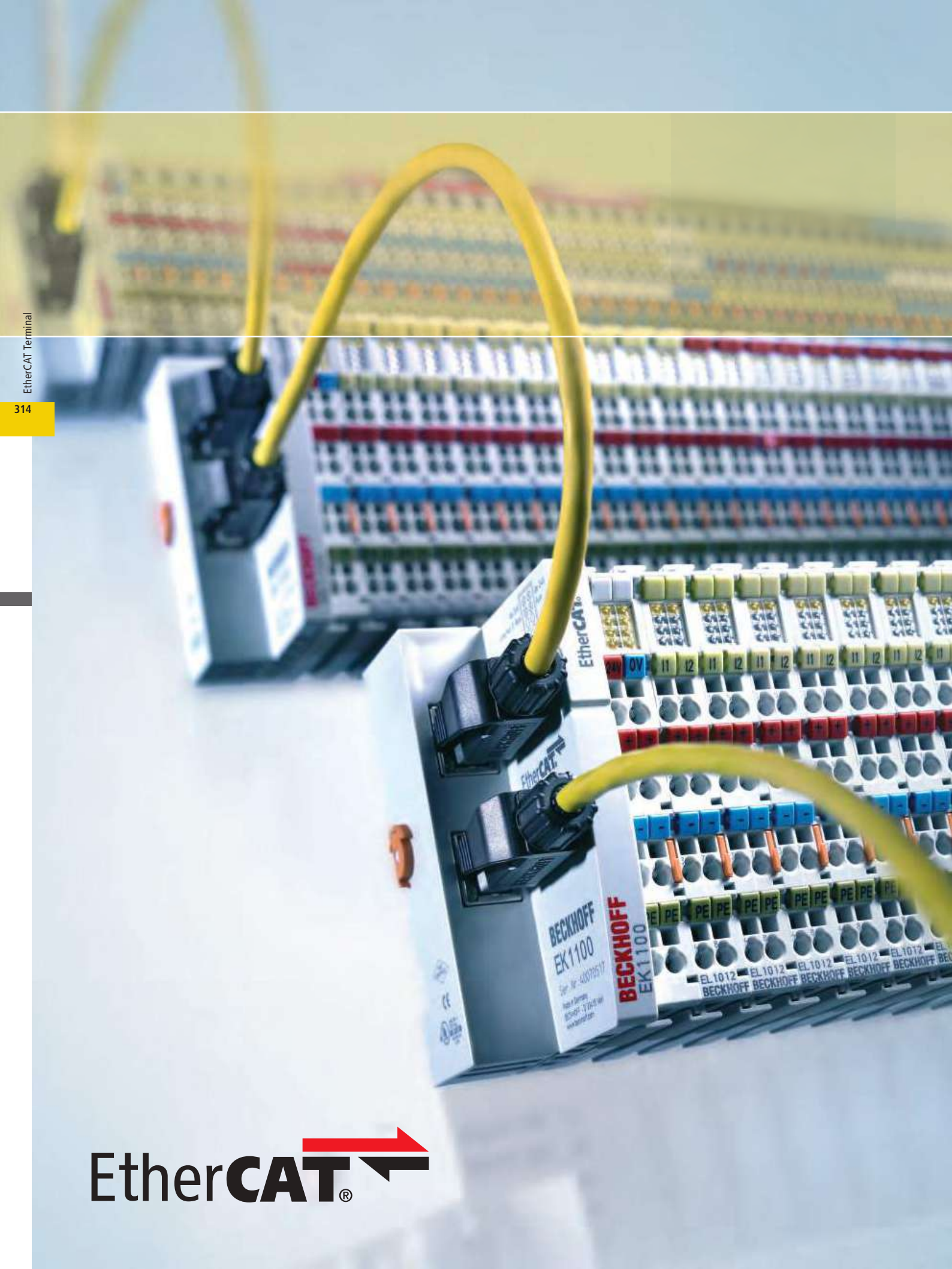
The Conformance Test Tool (CTT) enables in-house testing of EtherCAT slave devices. Use of the ET9400 tool during the development of an EtherCAT device assists in ensuring conformity and in preparing the device for the official, independent conformance test in an accredited EtherCAT Test Center (ETC) of the EtherCAT Technology Group.

The ET9400 tool requires a standard PC with Windows OS; special hardware is not required. The EtherCAT frames for stimulation of the device under test are sent via the standard Ethernet port. The tool processes the standard test cases supplied (XML files) sequentially. In this way, extensions of the test cases are possible without modifying the EtherCAT conformance test tool itself. The official test cases can be supplemented by their own routines. Test results and remarks are shown in a logger window and can in turn be saved as XML files. The tool also tests the electronic description of the EtherCAT device (EtherCAT slave information, ESI) and includes an editor for this file format, in order to be able to process the ESI file temporarily for test purposes. EEPROM (Slave Information Interface, SII) data can also be read, edited and written. Besides the items described above, the following items are also tested, among others:

- consistency check of CoE object directory, SII and ESI
- plausibility of device description information from SII and ESI
- test of EtherCAT State Machine (ESM)
- mailbox communication using SoE and CoE
- object dictionary consistency check according to CiA 402 profile
- extendable by FSoE protocol tests (ET9402 needed)

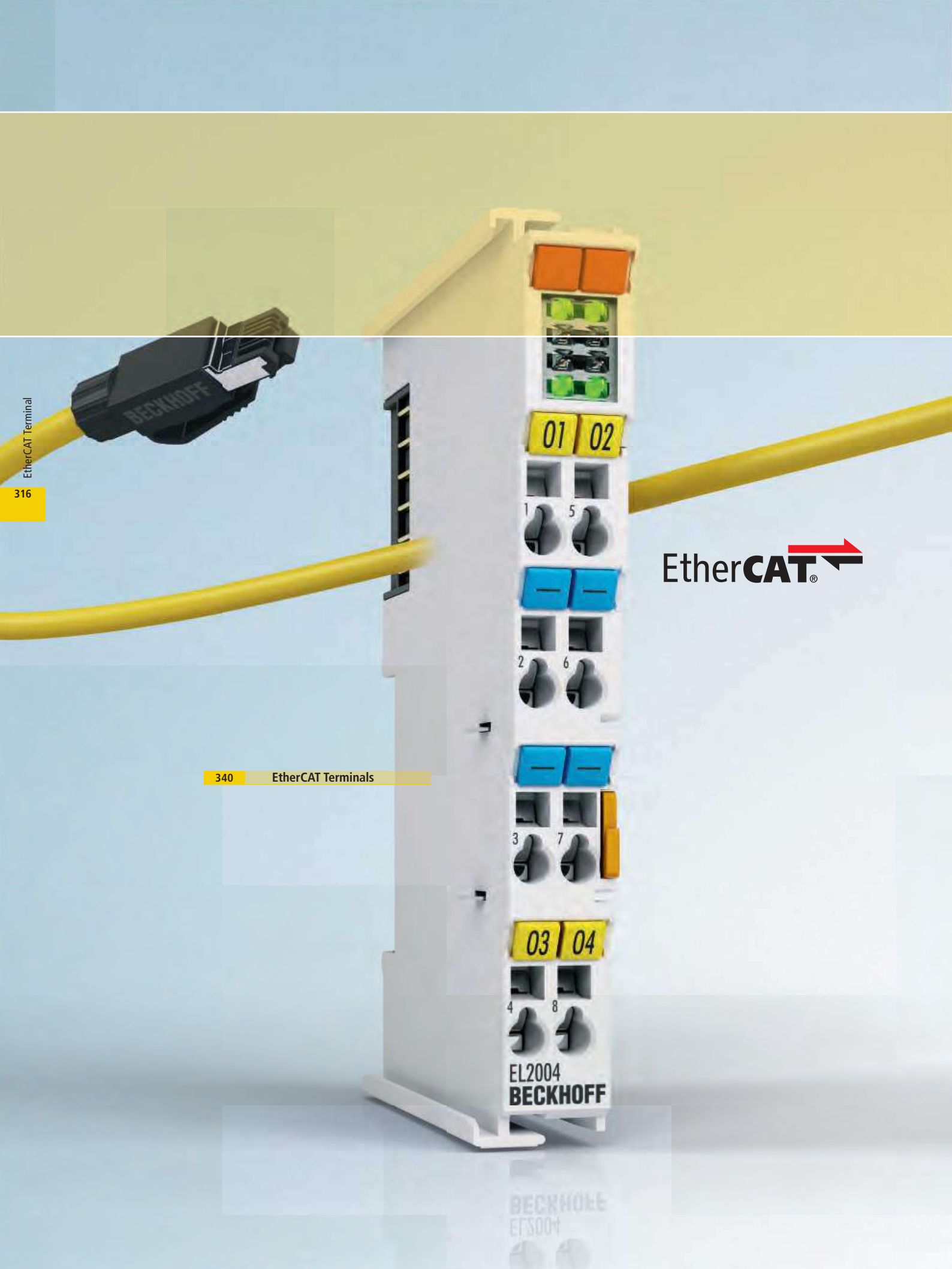
Ordering information	
ET9400	1-year license for using the EtherCAT Conformance Test Tool

▶ **www.beckhoff.com/ET9400**


EtherCAT
BECKHOFF
EK1100
BECKHOFF
EK1100
EL1012
BECKHOFF

EtherCAT Terminal

Ultra high-speed communication



340 EtherCAT Terminals

EtherCAT Terminal

Ethernet for Control Automation Technology

Product overview EtherCAT Terminals

EtherCAT Couplers

EtherCAT Couplers E-bus	**EK1100** 332	**EK1101** 332 ID switch	**EK1101-0080** 332 ID switch, Fast Hot Connect	
	EK1501 334 ID switch, multimode fibre optic	**EK1501-0010** 334 ID switch, singlemode fibre optic	**EK1541** 334 ID switch, POF	
EtherCAT Couplers E-bus with integrated digital I/Os	**EK1814** 333 4 inputs + 4 outputs	**EK1818** 333 8 inputs + 4 outputs	**EK1828** 333 4 inputs + 8 outputs	**EK1828-0010** 333 8 outputs
	EK1914 332 4 inputs + 4 outputs, 2 safe inputs + 2 safe outputs	**EK1960** TwinSAFE 976 Compact Controller, 20 safe digital inputs, 10 safe digital outputs		
EtherCAT Couplers K-bus	**BK1120** 337	**BK1150** 337 "Compact"	**BK1250** 337 between E-bus and K-bus terminals	
Bus Couplers (for ELxxxx)	**EK3100** 338 PROFIBUS	**EK9000** 338 Ethernet	**EK9300** 339 PROFINET RT	**EK9500** 339 EtherNet/IP	**EK9700** 339 Sercos III
Extension system and junctions	**EK1110** 336 extension end terminal	**EK1122** 336 2-port junction	**EK1122-0080** 336 2-port junction, Fast Hot Connect	**EK1521** 335 multimode fibre optic junction
	EK1521-0010 335 singlemode fibre optic junction	**EK1561** 335 POF junction		

Embedded PCs with E-bus interface see page 198, Infrastructure Components see page 766

EtherCAT Terminal | Digital input: EL1xxx/ES1xxx

Signal	2-channel	4-channel		8-channel	16-channel
5/12/24 V DC	**EL1382** 345 24 V DC, thermistor	**EL1124** 349 5 V DC	**EL1144** 349 12 V DC		
24 V DC (filter 3.0 ms)	**EL1002** type 3 344	**EL1004** type 3 343	**EL1004-0020** > 2,500 V 343	**EL1008** type 3 342	**EL1809** type 3 343
		EL1104 345 with sensor supply, type 3	**EL1804** 345 8 x 24 V, 4 x 0 V, type 3	**EL1808** 343 8 x 24 V DC, type 3	**EL1862** 345 flat-ribbon cable, type 3
		EL1084 348 negative switching	**EL1024** 344 type 2	**EL1859** type 3, 343 8 inputs, 8 outputs, I_{MAX} = 0.5 A	**EL1862-0010** 348 flat-ribbon cable, negative switching
				EL1088 negative switching 348	**EL1889** negative switching 348
24 V DC (filter 10 µs)	**EL1012** 344 type 3	**EL1014** 343 type 3	**EL1034** 344 potential-free inputs, type 1	**EL1018** 342 type 3	**EL1819** 343 type 3
		EL1114 345 with sensor supply, type 3	**EL1814** 345 8 x 24 V, 4 x 0 V, type 3		**EL1872** 345 flat-ribbon cable, type 3
			EL1094 negative switching 348	**EL1098** negative switching 348	
24 V DC (XFC, T_{ON}/T_{OFF} 1 µs)	**EL1202** fast input, type 3 346			**EL1258** multi-timestamping 347	
	EL1252 timestamp, type 3 346			**EL1259** 8 multi- 347 timestamping inputs and outputs	
	EL1262 oversampl., type 3 347				
24 V DC (safe inputs)		**EL1904** 351 TwinSAFE, 4 safe inputs		**EL1908** 351 TwinSAFE, 8 safe inputs	
48 V DC		**EL1134** filter 10 µs, type 1 349			
120 V AC/DC	**EL1712** power contacts 349				
230 V AC	**EL1702** power contacts 349				
	EL1722 no power contacts 349				
Counter	**EL1502** 350 100 kHz, 32 bit, type 1				
	EL1512 350 1 kHz, 16 bit, type 1				

The standard EtherCAT Terminals (ELxxxx) can be optionally ordered as ESxxxx with pluggable wiring level.
EN 61131-2 specification ▶ **www.beckhoff.com/EN61131-2**

EtherCAT Terminal | Digital output: EL2xxx/ES2xxx, EM2xxx

Signal	2-channel		4-channel	8-channel	16-channel
5 V DC			**EL2124** 359 I_{MAX} = ±20 mA		
12 V DC			**EL2024-0010** 359 I_{MAX} = 2.0 A		
24 V DC	**EL2042** 355 2 x 4 A/1 x 8 A				
24 V DC (I_{MAX} = 0.5 A)	**EL2002** 352		**EL2004** 352	**EL2008** 353	**EM2042** D-sub connection 353
					EL2872 flat-ribbon cable 353
				EL2808 8 x 0 V 353	**EL2809** 353
					EL2819 with diagnostics 354
			EL2084 358 negative switching	**EL2088** 358 negative switching	**EL2889** 358 negative switching
				EL1859 354 8 inputs, 8 outputs, filter 3.0 ms, type 3	**EL2872-0010** 358 flat-ribbon cable, negative switching
24 V DC (I_{MAX} = 2.0 A)	**EL2022** 354		**EL2024** 354	**EL2828** 355	
	EL2032 355 with diagnostic		**EL2034** 355 with diagnostic		
24 V DC (XFC, T_{ON}/T_{OFF} 1 µs)	**EL2202** 356 push-pull outputs	**EL2212** 356 overexcitation, multi-timestamping		**EL1259** 357 8 multi-timestamping inputs and outputs	
	EL2252 357 timestamp	**EL2262** 357 oversampling		**EL2258** 357 multi-timestamping	
24 V DC (safe outputs)	**EL2901** 369 TwinSAFE, 1 safe output	**EL2902** 369 TwinSAFE, 2 safe outputs	**EL2904** 369 TwinSAFE, 4 safe outputs		
30 V AC/DC			**EL2784** 360	**EL2788** 361	
			EL2794 361 potential-free	**EL2798** 361 potential-free	
Relay (up to 230 V AC)	**EL2602** 366 I_{MAX} = 5.0 A, make contact, power contacts	**EL2622** 367 I_{MAX} = 5.0 A, make contact, no power contacts	**EL2624** 367 I_{MAX} = 2.0 A, make contact, no power contacts		
	EL2612 367 I_{MAX} = 2.0 A, change-over, no power contacts	**EL2652** 367 I_{MAX} = 1.0 A, change-over, no power contacts			
Triac (12…230 V AC)	**EL2712** 368 0.5 A, power contacts	**EL2722** 368 1.0 A, mutually locked outputs			
	EL2732 368 0.5 A, no power contacts				
PWM	**EL2502** 364 24 V DC, 1.0 A				
Frequency output	**EL2521** 363 1-channel AB, 0…500 kHz	**EL2522** 363 2-channel AB, 1-channel ABC, 0…4 MHz			
Current control	**EL2595** 1-channel, 365 LED constant current terminal	**EL2535** 365 24 V DC, 50 mA, 1 A or 2 A			
		EL2545 365 50 V DC, 3.5 A			

EtherCAT Terminal | Analog input: EL3xxx/ES3xxx

Signal	1-channel	2-channel	4-channel	5-/8-channel
±75 mV, 24 bit		EL3602-0010 373		
±200 mV		EL3602-0002 373		
0…10 V	EL3061 374 12 bit EL3161 375 16 bit	EL3062 374 12 bit EL3162 375 16 bit	EL3064 374 12 bit EL3164 375 16 bit	EL3068 374 12 bit
0…30 V, 12 bit		EL3062-0030 374		
±10 V	EL3001 370 single-ended, 12 bit EL3101 372 differential input, 16 bit	EL3002 371 single-ended, 12 bit EL3102 372 differential input, 16 bit EL3602 373 differential input, 24 bit EL3702 373 differential input, 16 bit, oversampling	EL3004 371 single-ended, 12 bit EL3104 372 differential input, 16 bit	EL3008 371 single-ended, 12 bit
0…20 mA	EL3041 376 single-ended, 12 bit EL3141 378 single-ended, 16 bit EL3011 377 differential inp., 12 bit EL3111 379 differential inp., 16 bit	EL3042 376 single-ended, 12 bit EL3142 378 single-ended, 16 bit EL3742 379 differential input, 16 bit, oversampling EL3012 377 differential inp., 12 bit EL3112 379 differential inp., 16 bit EL3612 379 differential inp., 24 bit	EL3044 376 single-ended, 12 bit EL3144 378 single-ended, 16 bit EL3014 377 differential inp., 12 bit EL3114 379 differential inp., 16 bit	EL3048 376 single-ended, 12 bit
4…20 mA	EL3051 380 single-ended, 12 bit EL3151 382 single-ended, 16 bit EL3021 381 differential inp., 12 bit EL3121 383 differential inp., 16 bit	EL3052 380 single-ended, 12 bit EL3152 382 single-ended, 16 bit EL3022 381 differential inp., 12 bit EL3122 383 differential inp., 16 bit	EL3054 380 single-ended, 12 bit EL3154 382 single-ended, 16 bit EL3024 381 differential inp., 12 bit EL3124 383 differential inp., 16 bit EL3124-0090 383 TwinSAFE SC, 16 bit	EL3058 380 single-ended, 12 bit
±10 mA		EL3142-0010 378 single-ended, 16 bit		
Thermo-couple/mV	EL3311 388 16 bit	EL3312 388 16 bit	EL3314 389 16 bit EL3314-0090 389 TwinSAFE SC, 16 bit	EL3318 389 16 bit
Resistance thermometer (RTD)	EL3201 386 16 bit	EL3202 387 16 bit	EL3204 385 2-wire, 16 bit EL3214 385 3-wire, 16 bit EL3204-0200 385 16 bit, parameterisable EL3214-0090 385 TwinSAFE SC, 16 bit	EL3208 385 16 bit
Resistor bridge	EL3351 392 EL3356 393 self-calibration			
3-phase power measurement		EL3403 394 500 V AC, 1 A EL3413 395 690 V AC, 5 A EL3433 395 500 V AC, 10 A		
Measurement technology/ Condition Monitoring	EL3681 396 digital multimeter terminal, 18 bit	EL3632 390 IEPE terminal, acceleration sensors EL3692 391 resistance measurement, 10 mΩ…10 MΩ EL3773 395 power monitoring		EL3255 397 potentiometer measurement, 5-channel
Pressure measuring	EM3701 398 differential pressure measuring, -100…+100 hPa	EM3702 398 relative pressure measuring, 7,500 hPa		

EtherCAT Terminal | Analog output: EL4xxx/ES4xxx

Signal	1-channel	2-channel	4-channel	8-channel
0…10 V	EL4001 12 bit 402	EL4002 12 bit 402 EL4102 16 bit 403	EL4004 12 bit 402 EL4104 16 bit 403	EL4008 12 bit 402
±10 V	EL4031 12 bit 400	EL4032 12 bit 400 EL4132 16 bit 401 EL4732 16 bit, oversampling 401	EL4034 12 bit 401 EL4134 16 bit 401	EL4038 12 bit 401
0…20 mA	EL4011 12 bit 404	EL4012 12 bit 404 EL4112 16 bit 405 EL4712 16 bit, oversampling 405	EL4014 12 bit 404 EL4114 16 bit 405	EL4018 12 bit 404
4…20 mA	EL4021 12 bit 406	EL4022 12 bit 406 EL4122 16 bit 407	EL4024 12 bit 406 EL4124 16 bit 407	EL4028 12 bit 406
±10 mA		EL4112-0010 16 bit 405		

The standard EtherCAT Terminals (ELxxxx) can be optionally ordered as ESxxxx with pluggable wiring level.

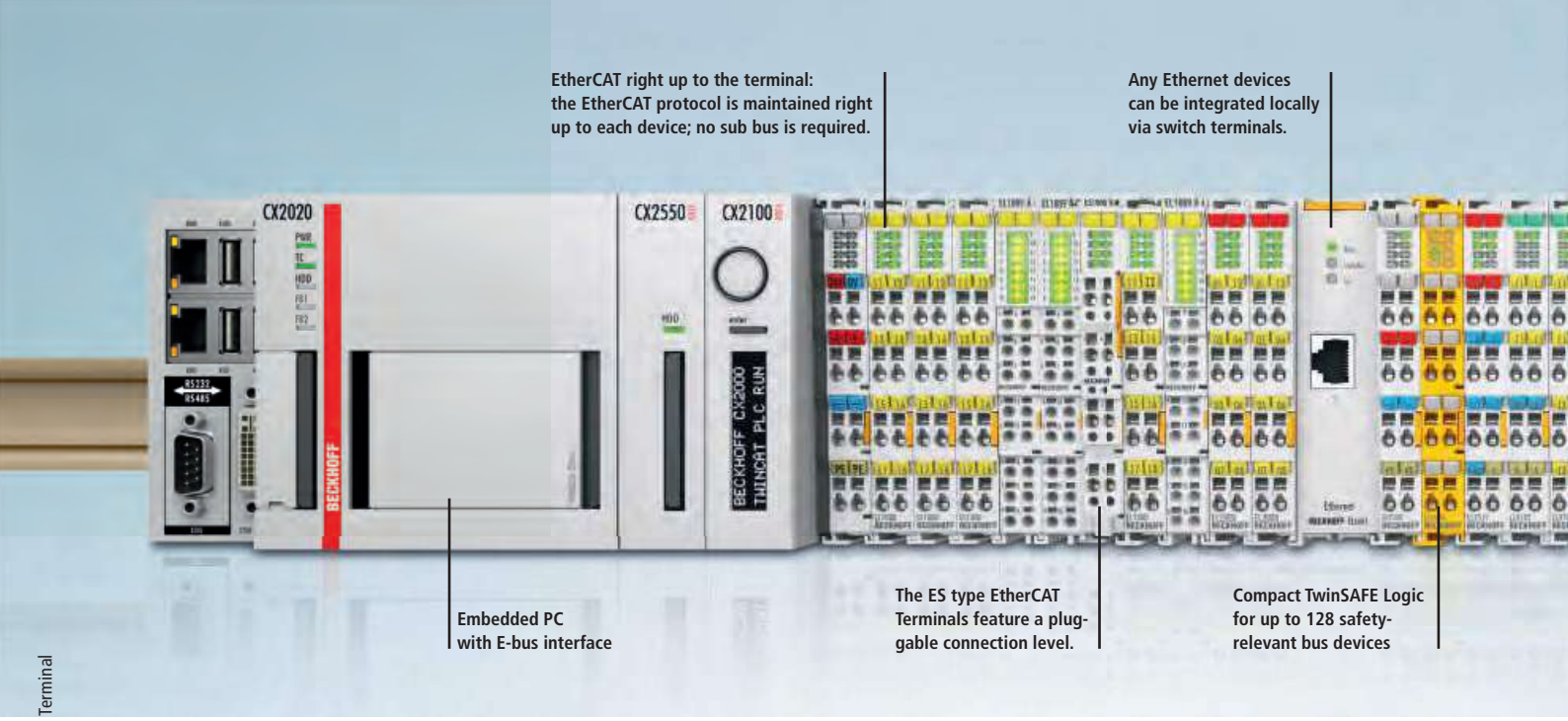
EtherCAT Terminal | Special functions: EL/ES5xxx, EL/ES6xxx, EL/ES7xxx, EM7xxx

Signal	1-channel			2-channel	4-channel
Position measurement	**EL5001** 408 SSI encoder interface	**EL5021** 411 SinCos encoder interface, 1 V_{PP}	**EL5021-0090** SinCos 411 encoder interface, TwinSAFE SC	**EL5002** 408 SSI encoder interface	
	EL5001-0011 408 SSI monitor terminal	**EL5101** 410 differential inputs, RS485, incremental encoder interface	**EL5101-0090** 410 incremental encoder interface, TwinSAFE SC	**EL5032** 409 EnDat 2.2 interface	
		EL5151 24 V DC, 411 incremental encoder interface		**EL5152** 24 V DC, 411 incremental encoder interface	
Communication	**EL6001** 412 RS232, 115.2 kbaud	**EL6021** 412 RS422/RS485, 115.2 kbaud	**EL6080** 414 memory terminal 128 kbyte	**EL6002** 412 RS232, 115.2 kbaud, D-sub	**EL6224** 420 IO-Link master
	EL6090 415 display terminal	**EL6070** 413 license key terminal	**EL6688** 417 IEEE 1588 master/slave	**EL6022** 412 RS422/RS485, 115.2 kbaud, D-sub	**EL6224-0090** 420 IO-Link master, TwinSAFE SC
	EL6601 switch port 416			**EL6692** EtherCAT bridge 418	**EL6614** switch port 416
				EL6695 418 EtherCAT bridge, high performance	
Communication (master terminal)	**EL6201** AS-Interface 419	**EL6631** PROFINET RT 421	**EL6632** PROFINET IRT 421	**EL6652** EtherNet/IP 422	
	EL6720 Lightbus 426	**EL6731** PROFIBUS 423	**EL6751** CANopen 424		
	EL6752 DeviceNet 425	**EL6851** DMX 427			
Communication (slave terminal ELxxxx-0010)	**EL6631** PROFINET RT 421	**EL6731** PROFIBUS 423	**EL6740** Interbus 426	**EL6652** EtherNet/IP 422	
	EL6751 CANopen 424	**EL6752** DeviceNet 425	**EL6851** DMX 427		
Safety	**EL6900** 428 TwinSAFE Logic	**EL6910** 428 TwinSAFE Logic	**EL6930** TwinSAFE/ 428 PROFIsafe logic and gateway		
Motion	**EL7031** 431 stepper motor terminal, I_{MAX} = 1.5 A, 24 V DC	**EL7037** 431 stepper motor terminal, I_{MAX} = 1.5 A, 24 V DC, incremental encoder, vector control	**EL7047** 431 stepper motor terminal, I_{MAX} = 5.0 A, 50 V DC, incremental encoder, vector control	**EL7342** 435 DC motor output stage, 50 V DC, 3.5 A, incremental encoder	**EM7004** 429 4 incremental encoders, 32 digital I/O 24 V DC, 4 analog outputs ±10 V
	EL7041 431 stepper motor terminal, I_{MAX} = 5.0 A, 50 V DC, incremental encoder	**EL7201-0010** 433 servomotor terminal, 50 V DC, 2.8 A_{RMS}, OCT	**EL7211-0010** 433 servomotor terminal, 50 V DC, 4.5 A_{RMS}, OCT	**EL7332** 435 DC motor output stage, 24 V DC, 1.0 A	
		EL7201 servomotor 433 terminal, 50 V DC, 2.8 A_{RMS}	**EL7211** servomotor 433 terminal, 50 V DC, 4.5 A_{RMS}		

EtherCAT Terminal | System terminals: EL9xxx/ES9xxx

Signal	System
System	**EL9011** bus end cap 438
	EL9070 shield terminal 437
	EL9080 isolation terminal 437
	EL9195 shield terminal 437
Potential distribution terminal	**EL9180** 438 2 clamping units per power contact
	EL9181 439 2 x 8 terminal points
	EL9182 439 8 x 2 terminal points
	EL9183 439 1 x 16 terminal points
	EL9184 439 8 x 24 V DC, 8 x 0 V DC
	EL9185 4 clamping units 438 at 2 power contacts
	EL9186 8 x 24 V DC 438
	EL9187 8 x 0 V DC 439
	EL9188 16 x 24 V DC 439
	EL9189 16 x 0 V DC 439

Signal	Potential supply	Power supply and accessories	
24 V DC	**EL9100** 436	**EL9410** 440 input 24 V DC, output 5 V DC/2 A	**EL9505** 441 input 24 V DC, output 5 V DC, 0.5 A
	EL9110 436 diagnostic	**EL9508** 441 input 24 V DC, output 8 V DC, 0.5 A	**EL9510** 441 input 24 V DC, output 10 V DC, 0.5 A
	EL9200 437 with fuse	**EL9512** 441 input 24 V DC, output 12 V DC, 0.5 A	**EL9515** 441 input 24 V DC, output 15 V DC, 0.5 A
	EL9210 437 diagnostic, with fuse	**EL9540** 442 surge filter terminal for field supply	**EL9550** surge filter 442 terminal for system/field supply
	EL9520 440 AS-Interface potential supply with filter	**EL9560** 441 input 24 V DC, output 24 V DC, 0.1 A with electrical isolation	
120… 230 V AC	**EL9150** with LED 436		
	EL9160 diagnostic 436		
	EL9190 437		
	EL9250 with fuse, with LED 437		
	EL9260 diagnostic, with fuse 437		
	EL9290 with fuse 437		
µF		**EL9576** 443 brake chopper terminal, up to 72 V DC, 155 µF	



Beckhoff EtherCAT Terminals

In analogy to the Beckhoff Bus Terminals, the EtherCAT Terminal system is a modular I/O system consisting of electronic terminal blocks. In contrast to Bus Terminals, where the fieldbus signal is implemented within the Bus Coupler on the internal, fieldbus-independent terminal bus, the EtherCAT protocol remains fully intact down to the individual terminal. In addition to EtherCAT Terminals with E-bus connection, the standard Bus Terminals with K-bus connection can also be connected via the BK1120 or BK1150 EtherCAT Bus Coupler. This ensures compatibility and continuity with the existing system. Existing and future investments are protected.

Structure

The robust housing, secure contacts and the solidly built electronics are prominent features of Beckhoff components. An I/O station consists of an EtherCAT Coupler and almost any number of terminals. Since up to 65,535 devices can be connected, the size of the network is almost unlimited.

The electronic terminal blocks are attached to the EtherCAT Coupler. The contacts are made as the terminal clicks into place, without any other manipulation. This means that each electronic terminal block can be individually exchanged. It can be placed on a standard DIN rail.

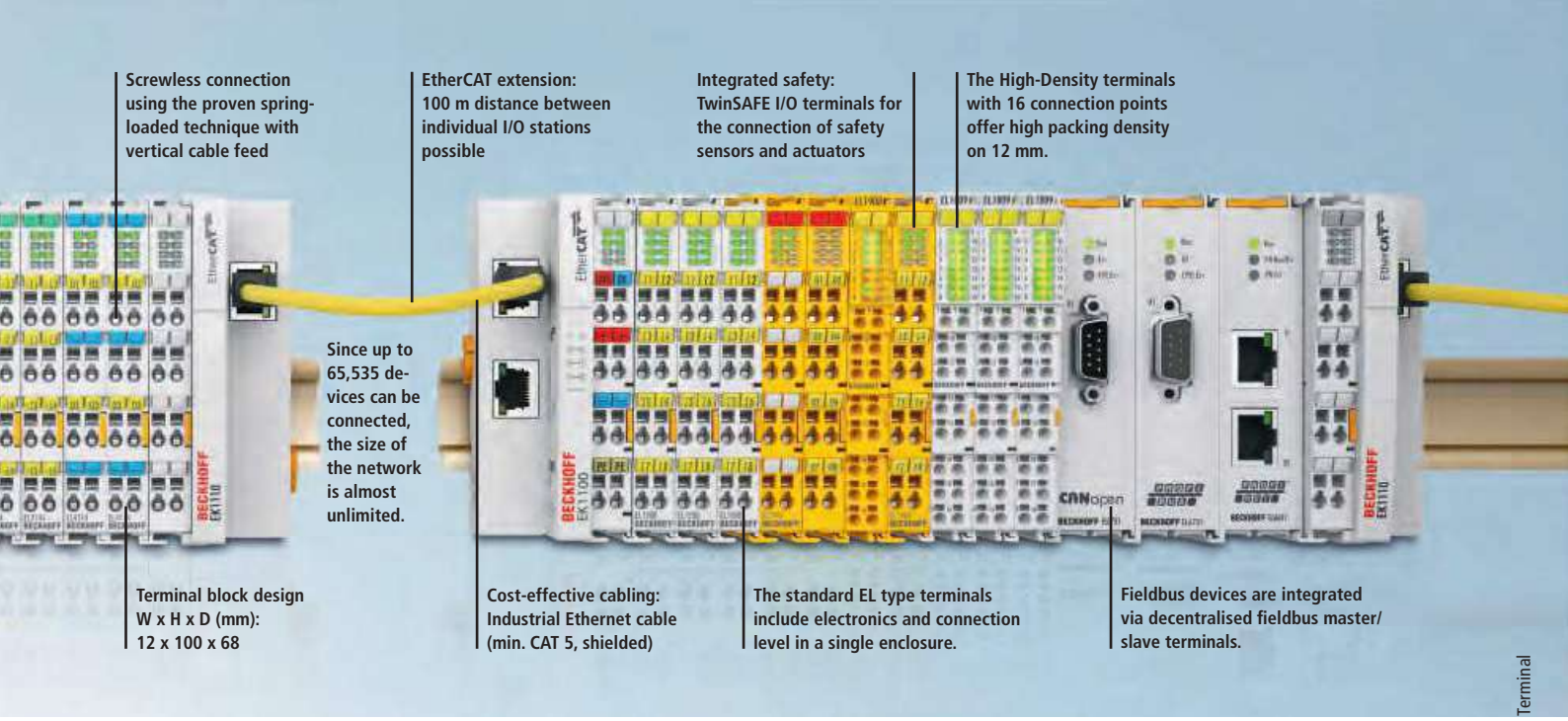
Like the Beckhoff Bus Terminals, the outer contour of the EtherCAT Terminals perfectly adapts to the dimensions of terminal boxes. A clearly arranged connection panel with LEDs for status display and push-in contact labels ensures clarity in the field.

Free mix of signals

Suitable EtherCAT Terminals are available for all common digital and analog signal types encountered in the world of automation. Fieldbus devices, e.g. for PROFIBUS, PROFINET, CANopen, DeviceNet, Interbus, IO-Link or Lightbus, are integrated via local fieldbus master/slave terminals. Removal of the fieldbus master saves PCI slots in the PC. Any Ethernet devices can be integrated locally via switch port terminals.

The fine granularity of the EtherCAT Terminals enables bit-precise composition of the required I/O channels. The digital EtherCAT Terminals are designed as 2-, 4-, 8- or 16-channel terminals. In the 16-channel variant, digital input and output signals are arranged in an ultra-compact way within a standard terminal housing across a width of only 12 mm. The standard analog signals of ±10 V, 0 to 10 V, 0 to 20 mA and 4 to 20 mA are all available as 1-, 2-, 4- and 8-channel variants within a standard housing.

Ethernet down to the terminal | Full duplex Ethernet in the ring, one telegram for many devices, connection directly at the standard Ethernet port.



Flexible connection system

The EtherCAT Terminal system offers different connection options for optimum adaptation to the respective application. The ELxxxx EtherCAT Terminals include electronics and connection level in a single enclosure. The ESxxxx type EtherCAT Terminals feature a pluggable connection level. The ES series Bus Terminals enable the complete wiring to be removed as a plug connector from the top of the housing for servicing.

Bus Coupler for the EtherCAT Terminal system

The Bus Couplers from the EKxxxx series connect conventional fieldbus systems to EtherCAT. The ultra-fast, powerful I/O system with its large choice of terminals is now available for other fieldbus and Industrial Ethernet systems. EtherCAT makes a very flexible topology configuration possible. Thanks to the Ethernet physics, long distances can also be bridged without the bus speed being affected. When changing to the field level – without a control cabinet – the IP 67 EtherCAT Box modules (EPxxxx) can also be connected to the EKxxxx. The EKxxxx Bus Couplers are fieldbus slaves and contain an EtherCAT master for the EtherCAT Terminals. The EKxxxx is integrated in exactly the same way as the Bus Couplers from the BKxxxx series via the corresponding fieldbus system configuration tools and the associated configuration files, such as GSD, ESD or GSDML. The TwinCAT-programmable variant is the CX8000 Embedded PC series.

EtherCAT Coupler with integrated I/Os

Beckhoff is consistently continuing the path towards miniaturisation of designs and cost optimisation: tailored to applications with a small number of I/O points and cramped space conditions, the EK18xx and EK19xx EtherCAT Couplers with integrated digital I/Os offer users a precisely dimensioned compact solution.

The EK18xx series includes combinations of digital inputs and outputs. Further digital, analog and Motion EtherCAT Terminals can be attached to the EK18xx Couplers, taking into account the E-bus current consumption. The EK19xx series includes combinations of safe digital inputs and outputs. In conjunction with TwinSAFE – the safety solution from Beckhoff – users have an ultra-compact, space-saving solution available for direct connection of safety-relevant sensors and actuators.

EtherCAT Terminal with standard wiring

HD EtherCAT Terminal (High Density) with 16 terminal points

EtherCAT Terminal with pluggable wiring

EtherCAT topology and system description see page 284
TwinSAFE see page 966

TwinSAFE SC (TwinSAFE Single Channel)

With the aid of the TwinSAFE SC technology it is possible to make use of standard signals for safety tasks in any network or fieldbus. To do this, EtherCAT Terminals from the areas of analog input, postition measurement or communication (4…20 mA, incremental encoder, IO-Link, etc.) are extended by the TwinSAFE SC function. The data from these extended EtherCAT Terminals is fed to the TwinSAFE Logic, where they undergo safety-related multi-channel processing.

In the Safety Logic the data originating from different sources is analysed, checked for plausibility and submitted to a "voting". This is done by certified function blocks such as Scale, Compare/Voting (1oo2, 2oo3, 3oo5), Limit, etc. For safety reasons, however, at least one of the data sources must be a TwinSAFE SC component. The remainder of the data can originate from other standard Bus Terminals, drive controllers or measuring transducers. In this way, it is possible to use all the process data existing in the system for the safety technology. The TwinSAFE SC technology thus opens up completely new possibilities in the Beckhoff system world and offers a simple, efficient and inexpensive possibility to fully integrate the safety tasks into the existing infrastructure.

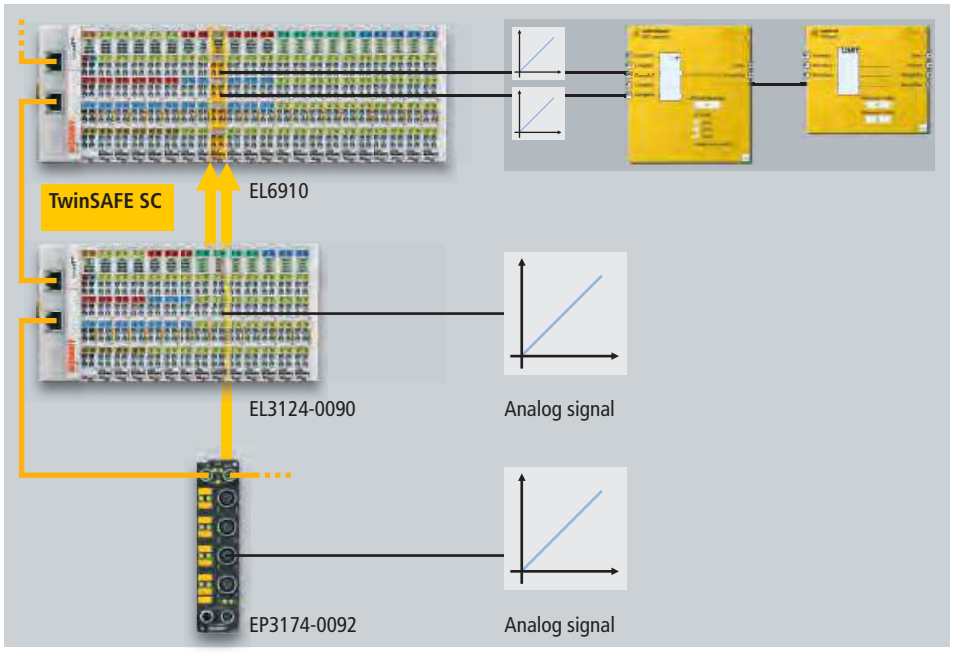
With the aid of the TwinSAFE SC technology it is typically possible to achieve a safety level equivalent to PL d/Cat. 3 in accordance with EN ISO 13849-1 or SIL 2 in accordance with EN 62061.

EP3174-0092 | TwinSAFE SC EtherCAT Box, IP 67, 4-channel analog input ±10 V or 0/4…20 mA, see page 487

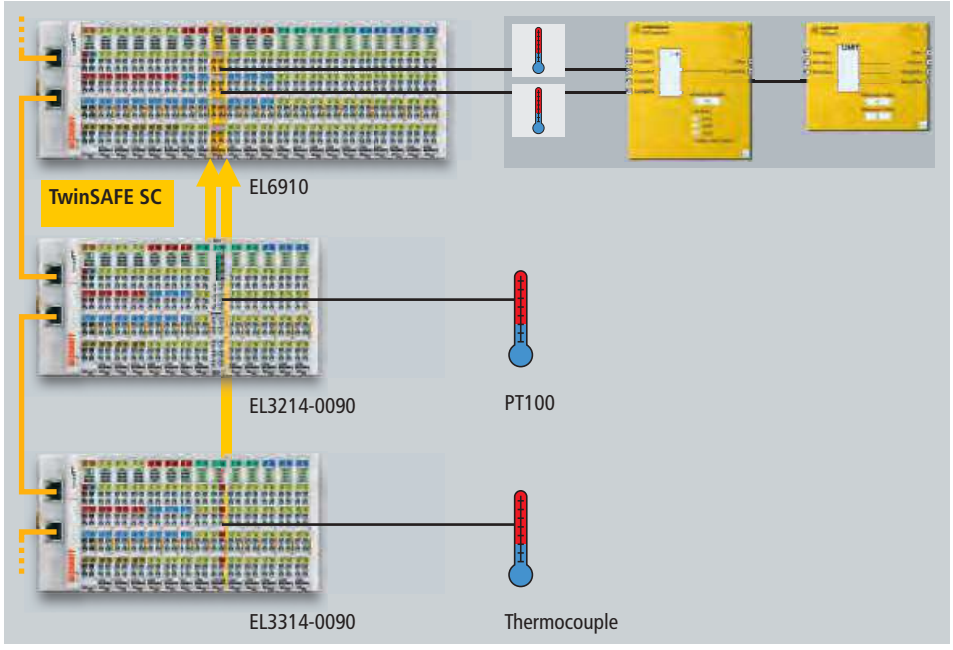
EL6910 | TwinSAFE Logic see page 979

EK1960 | TwinSAFE Compact Controller see page 977

▶ **www.beckhoff.com/TwinSAFE-SC**



Safe analog value processing with TwinSAFE SC



Safe temperature monitoring with TwinSAFE SC

Ordering information		
Analog input		
EL3124-0090	EtherCAT Terminal, 4-channel analog input terminal 4…20 mA, differential input, 16 bit, TwinSAFE SC	383
EL3214-0090	EtherCAT Terminal, 4-channel input terminal PT100 (RTD) for 3-wire connection, TwinSAFE SC	385
EL3314-0090	EtherCAT Terminal, 4-channel thermocouple input terminal with open-circuit recognition, TwinSAFE SC	389
EP3174-0092	EtherCAT Box, 4-channel analog input ±10 V or 0/4…20 mA, differential input, 16 bit, TwinSAFE SC	487
Position measurement		
EL5021-0090	EtherCAT Terminal, 1-channel SinCos encoder interface, 1 V_{PP}, TwinSAFE SC	411
EL5101-0090	EtherCAT Terminal, incremental encoder interface, TwinSAFE SC	410
Communication		
EL6224-0090	EtherCAT Terminal, IO-Link terminal, TwinSAFE SC	420

For availability status see Beckhoff website at: www.beckhoff.com

System overview EtherCAT I/O

EK EtherCAT Coupler series

EtherCAT Coupler with integrated digital I/Os

Bus Coupler (e.g. PROFIBUS) for EtherCAT Terminals

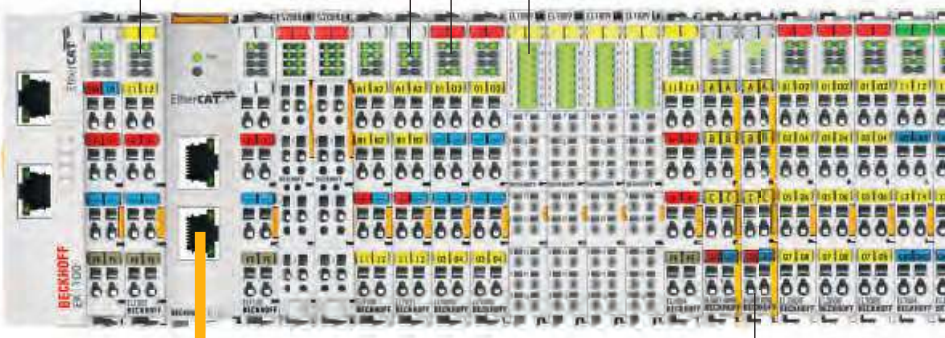
Embedded PC series CX,
further Embedded PCs see page 184

Free mix of signals: more than 200 different EtherCAT Terminals enable connection of all common sensors and actuators.

EtherCAT Terminals in 1-, 2-, 4-, 8- and 16-channel modularity

Motion terminals for stepper, servo or DC motors or hydraulic valves

HD EtherCAT Terminals (high-density) with 16 connection points offer high packing density on 12 mm.



100 m Industrial Ethernet cable (100BASE-TX)

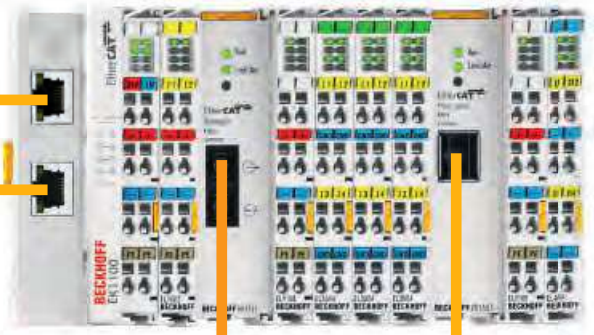
With the aid of the TwinSAFE SC technology it is possible to make use of standard signals for safety tasks in any network or fieldbus.

TwinSAFE: safety I/Os and compact Safety PLC for up to 128 safetyrelevant bus devices

Ultra-fast I/O terminals for I/O response times < 100 µs for fast I/O, oversampling and timestamp

Optional fieldbus integration via decentralised field-bus master/slave terminals

High-speed measurement, high-precision measurement, Condition Monitoring, energy monitoring



2,000/20,000 m fibre optic (100BASE-FX)

50 m Plastic Optical Fibre (100BASE-FX POF)

EtherCAT plug-in modules: very compact EtherCAT I/O system in IP 20 for plug-in into a circuit board (signal distribution board)
see page 526

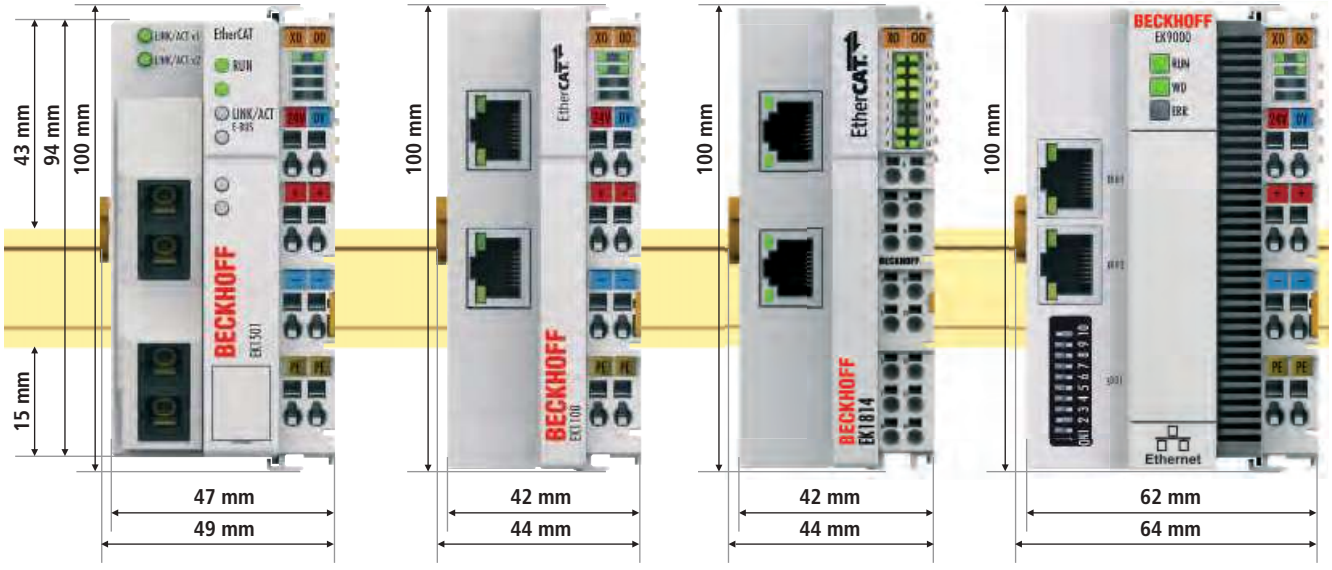
IP 67 EtherCAT Box, further EtherCAT Box modules see page 450

IP 69K EtherCAT Box (stainless steel)

IP 67 EtherCAT Box (die-cast zinc)

Technical data – EtherCAT Coupler housing

The EtherCAT Coupler electronics can be mounted in a variety of housings. A housing has three power contacts, which, if the application requires, automatically implement a continued connection, carrying the potential of the power circuit to the next EtherCAT Terminal. The supply voltage that is connected to the coupler spring-loaded terminals is 24 V DC. If a different voltage is required for the power contacts, the appropriate power feed terminal must be inserted after the coupler.

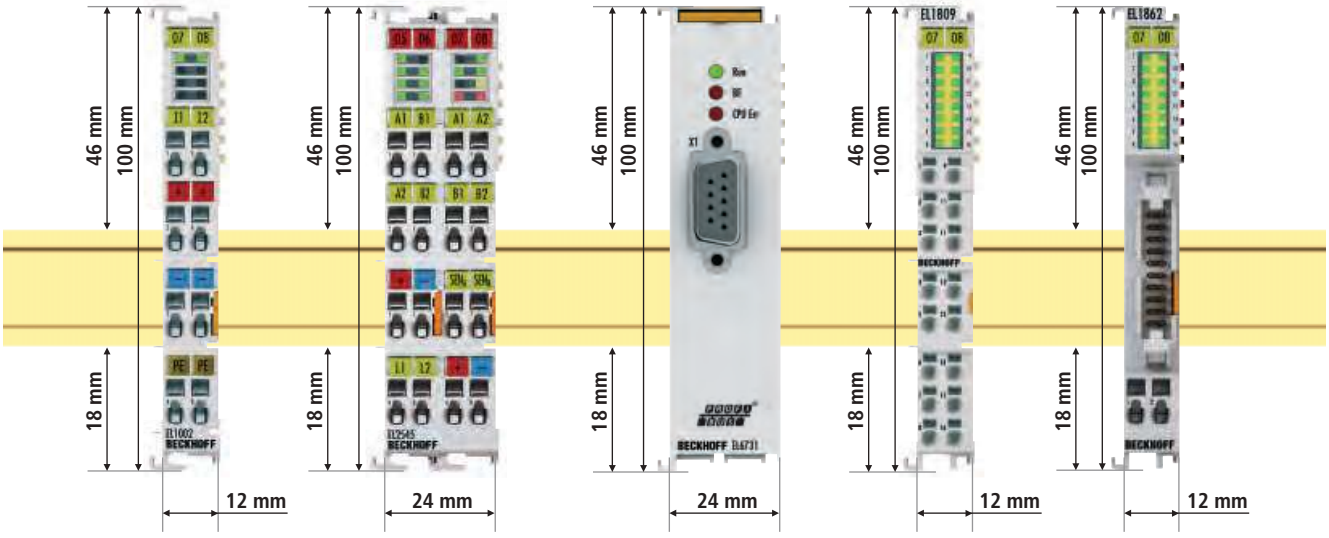


Mechanical data	EK1501, BK1120	EK11xx, EK18xx, EK1914	EK3100, EK9xxx
Design form	compact terminal housing with signal LED		
Material	polycarbonate		
Dimensions (W x H x D)	49 mm x 100 mm x 68 mm	44 mm x 100 mm x 68 mm	64 mm x 100 mm x 80 mm
Installation	on 35 mm DIN rail, conforming to EN 60715 with lock		
Side by side mounting by means of	double slot and key connection		
Marking	standard terminal block marking and plain language slides (8 mm x 47 mm)		
Vibration resistance	conforms to EN 60068-2-6: 1 g (extended range: 5 g)		
Shock resistance	conforms to EN 60068-2-27: 15 g, 11 ms (extended range: 25 g, 6 ms); 1000 shocks per direction, 3 axes		
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4		

Connection	EK1501, BK1120, EK11xx, EK18xx, EK1914, EK3100, EK9xxx
Wiring	spring-loaded technique
Connection cross-section	0.08…2.5 mm², AWG 28-14, stranded wire, solid wire
Stripping length	8…9 mm
Fieldbus connection	depending on fieldbus
Power contacts	3 spring contacts
Current load	I_{MAX}: 10 A (125 A short-circuit)
Nominal voltage	24 V DC

Technical data – EtherCAT Terminal housing

The EtherCAT Terminals have different housings. They are available with up to three power contacts and can have a variety of voltages. Care should be taken to ensure that a change in voltage always starts with a power feed terminal.



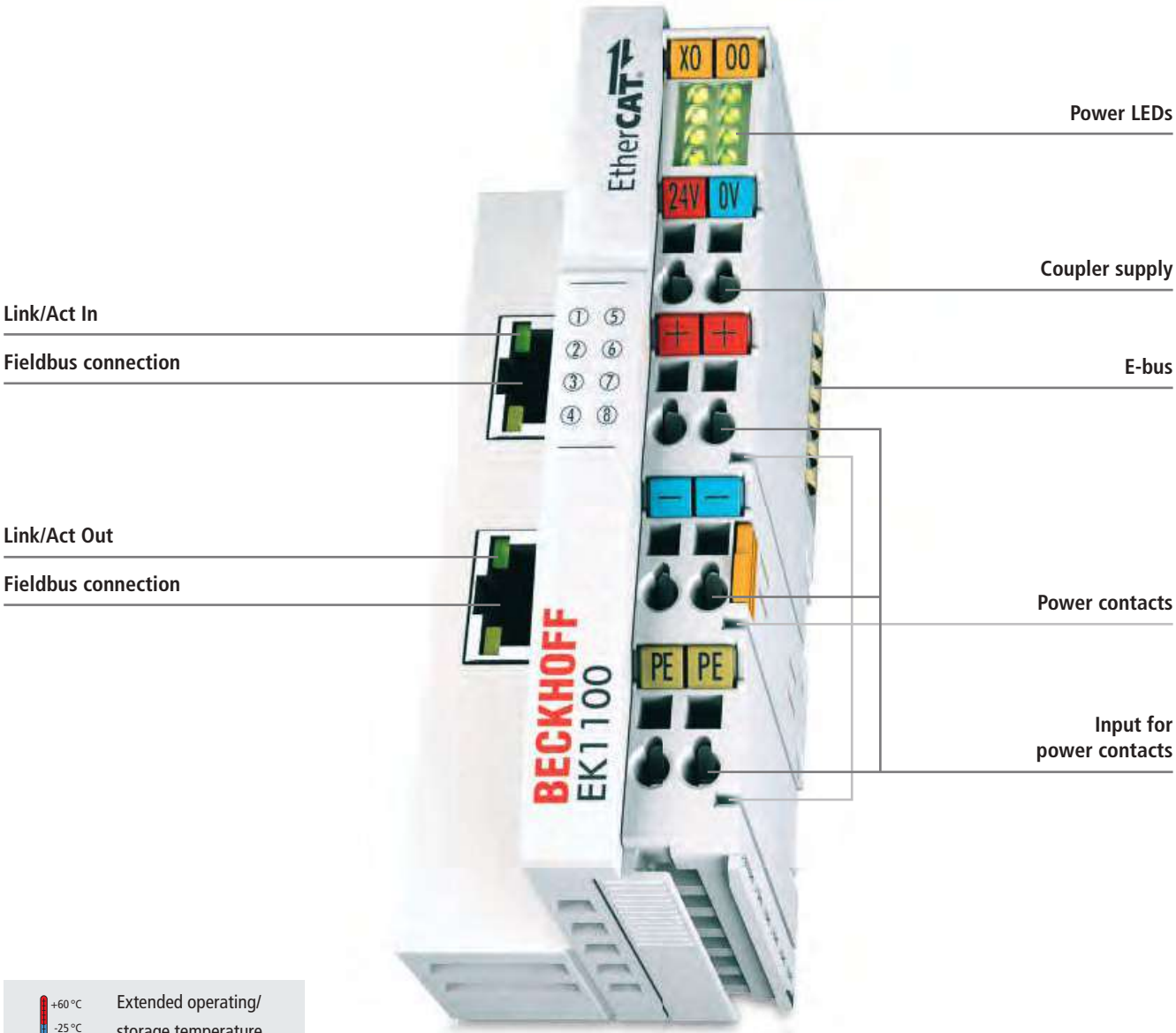
ELxxxx, ESxxxx, BK1250 | ELxxxx, ESxxxx | EL66xx, EL67xx, EK1122, EK1521 | HD housing | EL1862, ELx872

Mechanical data	ELxxxx, BK1250	EL66xx, EL67xx, EK1122, EK1521	ESxxxx	HD housing	EL1862, ELx872
Design form	compact terminal housing with signal LED	compact terminal housing with signal LED	terminal housing with pluggable wiring level	HD (High Density) housing with signal LED	compact terminal housing with signal LED
Material	polycarbonate				
Dimensions (W x H x D)	12/24 mm x 100 mm x 68 mm	24 mm x 100 mm x 52 mm	12/24 mm x 100 mm x 71 mm	12 mm x 100 mm x 68 mm	12 mm x 100 mm x 68 mm
Installation	on 35 mm DIN rail, conforming to EN 60715 with lock				
Side by side mounting by means of	double slot and key connection				
Marking	standard terminal block marking	–	standard terminal block marking	–	standard terminal block marking
Vibration resistance	conforms to EN 60068-2-6: 1 g (extended range: 5 g)				
Shock resistance	conforms to EN 60068-2-27: 15 g, 11 ms (extended range: 25 g, 6 ms); 1000 shocks per direction, 3 axes				
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4				

Connection	ELxxxx, BK1250	EL66xx, EL67xx, EK1122, EK1521	ESxxxx	HD housing	EL1862, ELx872
Wiring	spring-loaded technique	specific push-in connection	spring-loaded technique	direct plug-in technique	flat-ribbon cable connection
Connection cross-section	s, st*: 0.08…2.5 mm², AWG 28-14, f: 0.14…1.5 mm²	–	s, st*: 0.08…1.5 mm², f: 0.14…1.5 mm²	s*: 0.08…1.5 mm²; st: 0.25…1.5 mm²; f: 0.14…0.75 mm²	common flat-ribbon cables, AWG 28, spacing 1.27 mm
Stripping length	8…9 mm	–	9…10 mm	8…9 mm	–
Fieldbus connection	depending on fieldbus				
Power contacts	3 spring contacts				
Current load	I_{MAX}: 10 A (125 A short-circuit)				
Nominal voltage	24 V DC				

*s: solid wire; st: stranded wire; f: ferrule

EKxxxx | EtherCAT Couplers



+60 °C -25 °C	Extended operating/ storage temperature
25 g	Extended mechanical load

E-bus EtherCAT Couplers
An I/O station consists of an EtherCAT Coupler and almost any number of terminals. The EtherCAT protocol is maintained right down into the individual terminal.

K-bus EtherCAT Couplers
EtherCAT Couplers with K-bus connection can also be used to connect Beckhoff Bus Terminals. This way, compatibility and consistency with existing system are guaranteed.

EtherCAT Couplers with optical fibre connection
For linking devices over large distances with plastic optical fibre (up to 50 m), multimode glass fibre (up to 2 km) or singlemode glass fibre (up to 20 km).

E-bus Bus Couplers
The Bus Couplers for EtherCAT Terminals are used to connect conventional fieldbus systems with EtherCAT.

The EtherCAT Couplers are the link between the EtherCAT protocol at the fieldbus level and E-bus-based EL/ES/EM terminals. Different versions are available, depending on:

– which physical layer is used "on the left", i.e. on the fieldbus side,
– whether the coupler supports Hot Connect functionality,
– and whether it has a dedicated, local PLC/small controller.

In a conventional fieldbus the coupler can be the most complex and most expensive element, since it has to translate between the fieldbus protocol level and the terminal bus I/O level, which can be complex and time-consuming. This often results in delays and inconsistent access to parameters and diagnostic data in the individual downstream devices.

In EtherCAT systems the coupler is one of the simplest devices. It has almost no dedicated intelligence, but merely transforms the electrical physical layer without changing the data structure: EtherCAT means integrated communication down to the last terminal. The EtherCAT Couplers of the EK1xxx series are currently available with copper-based RJ45 connectors or optical fibre connectors. The number of downstream terminals is almost unlimited and is subject to only two conditions. In an EtherCAT network a maximum of 65,535 slaves are permitted. If necessary, the E-bus current has to be supplemented with an EL9410 E-bus power supply unit.

Some couplers support Hot Connect functionality. They have three hexadecimal ID switches on the side, which enable ID settings between 0 and 4,095. The EtherCAT master detects a terminal station at this ID if it is connected to an EK1122 or EK1521 junction terminal at any point in the network during operation. In the TwinCAT System Manager the corresponding terminal station (coupler and terminals) has to be defined as a Hot Connect group.

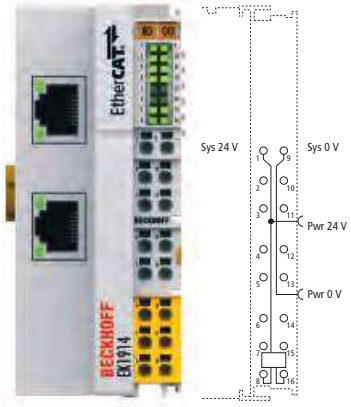
Couplers from the EK3xxx or EK9xxx series are available for integrating the EtherCAT Terminals in a fieldbus other than EtherCAT. They feature a microcontroller that deals with the data management and the data transfer between the different bus systems: EtherCAT on the right-hand terminal side and the fieldbus protocol on the left.

For applications with a small number of I/O points and cramped space conditions, the EK18xx and EK19xx EtherCAT Couplers with integrated digital I/Os offer users a precisely dimensioned compact solution. The EK18xx series includes combinations of digital inputs and outputs. The EK19xx series includes combinations of safe digital inputs and outputs. In conjunction with TwinSAFE, users have an ultra-compact, space-saving solution available for direct connection of safety-relevant sensors and actuators.

Technical data	EKxxxx
Electrical isolation	500 V
Operating/storage temperature	0…+55 °C/-25…+85 °C (extended temperature range: -25…+60 °C/-40…+85 °C)
Relative humidity	95 %, no condensation
Vibration resistance	conforms to EN 60068-2-6: 1 g (extended range: 5 g)
Shock resistance	conforms to EN 60068-2-27: 15 g, 11 ms (extended range: 25 g, 6 ms); 1000 shocks per direction, 3 axes
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4
Protect. class/installation pos.	IP 20/see documentation

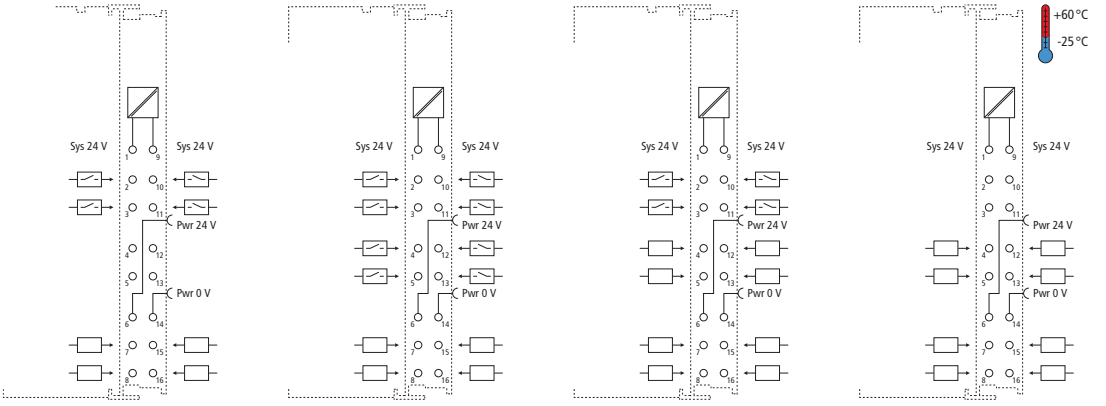
▶ **www.beckhoff.com/EtherCAT-Coupler**

EtherCAT Couplers E-bus

	EtherCAT Coupler	EtherCAT Coupler with ID switch, Hot Connect	EtherCAT Coupler with 4 inputs and 4 outputs as well as 2 safe inputs and 2 safe outputs
Technical data	**EK1100**	**EK1101**	**EK1914**
Task within EtherCAT system	coupling of EtherCAT Terminals (ELxxxx) to 100BASE-TX EtherCAT networks	coupling of EtherCAT Terminals (ELxxxx) to 100BASE-TX EtherCAT networks, with identity verification	coupling of EtherCAT Terminals (ELxxxx) to 100BASE-TX EtherCAT networks
No. of EtherCAT Terminals	up to 65,534		
Data transfer rates	100 Mbaud	100 Mbaud	100 Mbaud
			
	The EK110x EtherCAT Couplers connect 100BASE-TX EtherCAT with the EtherCAT Terminals and convert the passing telegrams from Ethernet 100BASE-TX to E-bus signal representation. The coupler is connected to the network via the upper RJ45 Ethernet interface; further EtherCAT devices can be connected in the same strand via the lower RJ45 socket. The couplers do not need to be parameterised and are treated as EtherCAT slaves without process data. The EK1101 has three hexadecimal ID switches, with which an ID can be assigned to the coupler station. This group can be located at any position within the EtherCAT network. Variable topologies can therefore be easily implemented.		The EK1914 has four digital inputs and four digital outputs as well as two fail-safe inputs and two fail-safe outputs. The safe outputs switch 24 V DC actuators with up to 0.5 A current per channel. The EK1914 meets the requirements of DIN EN ISO 13849-1:2008 (Cat 4, PL e).
Bus interface	2 x RJ45	2 x RJ45	2 x RJ45
Type/number of peripheral signals	max. 4.2 GB addressable I/O points	max. 4.2 GB addressable I/O points	max. 4.2 GB addressable I/O points
Data transfer medium	Ethernet/EtherCAT cable (min. CAT 5), shielded	Ethernet/EtherCAT cable (min. CAT 5), shielded	Ethernet/EtherCAT cable (min. CAT 5), shielded
Current consumpt. from U_S	70 mA + (∑ E-bus current/4)	70 mA + (∑ E-bus current/4)	72 mA + (∑ E-bus current/4)
Current consumpt. from U_P	load	load	load
Distance between stations	max. 100 m (100BASE-TX)	max. 100 m (100BASE-TX)	max. 100 m (100BASE-TX)
Delay	approx. 1 µs	approx. 1 µs	approx. 1 µs
Power supply	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %) (PELV)
Current supply E-bus	2000 mA	2000 mA	max. 500 mA
Weight	approx. 105 g	approx. 105 g	approx. 123 g
Operating temperature	-25…+60 °C	-25…+60 °C	-25…+55 °C
Approvals	CE, UL, Ex	CE, UL, Ex	CE, UL, TÜV SÜD
Further information	www.beckhoff.com/EK1100	www.beckhoff.com/EK1101	www.beckhoff.com/EK1914 or see page 978
Special couplers		**EK1101-0080**	
Distinguishing features		Fast Hot Connect, CE	

Cordsets and connectors see page 444

	EtherCAT Coupler with 4 digital inputs and 4 digital outputs	EtherCAT Coupler with 8 digital inputs and 4 digital outputs	EtherCAT Coupler with 4 digital inputs and 8 digital outputs	EtherCAT Coupler with 8 digital outputs
	EK1814	**EK1818**	**EK1828**	**EK1828-0010**
	coupling of EtherCAT Terminals (ELxxxx) to 100BASE-TX EtherCAT networks			
	100 Mbaud	100 Mbaud	100 Mbaud	100 Mbaud



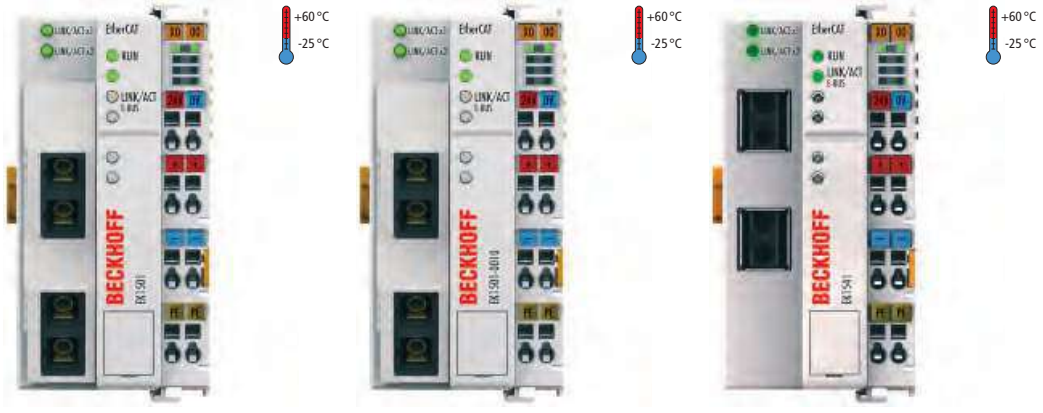
The EtherCAT Couplers from the EK18xx series combine the functionalities of the EK1100 EtherCAT Coupler with standard digital I/Os in one housing. This results in a compact design that is especially suitable for applications with a low number of I/Os. Like the EK1100, the EK18xx coupler can be extended by all EL/ES terminals. The digital I/Os are implemented with a 1-wire technique. The wiring can be implemented without tools using a direct plug-in technique with solid wire conductors or ferrules.

– EK1814: 4 digital inputs (3.0 ms), 4 digital outputs (0.5 A)
– EK1818: 8 digital inputs (3.0 ms), 4 digital outputs (0.5 A)
– EK1828: 4 digital inputs (3.0 ms), 8 digital outputs (0.5 A)
– EK1828-0010: 8 digital outputs (0.5 A)

	2 x RJ45	2 x RJ45	2 x RJ45	2 x RJ45
	max. 4.2 GB addressable I/O points	max. 4.2 GB addressable I/O points	max. 4.2 GB addressable I/O points	max. 4.2 GB addressable I/O points
	Ethernet/EtherCAT cable (min. CAT 5), shielded	Ethernet/EtherCAT cable (min. CAT 5), shielded	Ethernet/EtherCAT cable (min. CAT 5), shielded	Ethernet/EtherCAT cable (min. CAT 5), shielded
	100 mA + (∑ E-bus current/4)	100 mA + (∑ E-bus current/4)	100 mA + (∑ E-bus current/4)	100 mA + (∑ E-bus current/4)
	40 mA + load	40 mA + load	40 mA + load	40 mA + load
	max. 100 m (100BASE-TX)	max. 100 m (100BASE-TX)	max. 100 m (100BASE-TX)	max. 100 m (100BASE-TX)
	approx. 1 µs	approx. 1 µs	approx. 1 µs	approx. 1 µs
	24 V (-15 %/+20 %)	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)
	1000 mA	1000 mA	1000 mA	1000 mA
	approx. 95 g	approx. 95 g	approx. 95 g	approx. 95 g
	-25…+60 °C	-25…+60 °C	-25…+60 °C	-25…+60 °C
	CE, UL	CE, UL	CE, UL	CE, UL
	www.beckhoff.com/EK1814	www.beckhoff.com/EK1818	www.beckhoff.com/EK1828	www.beckhoff.com/EK1828-0010

EtherCAT Couplers with fibre optic connection

	EtherCAT Coupler with ID switch, multimode fibre optic connection, Hot Connect	EtherCAT Coupler with ID switch, singlemode fibre optic connection, Hot Connect	EtherCAT Coupler with ID switch, plastic optical fibre
Technical data	**EK1501**	**EK1501-0010**	**EK1541**
Task within EtherCAT system	coupling of EtherCAT Terminals (ELxxxx) to 100BASE-FX EtherCAT networks, with identity verification		coupling of EtherCAT Terminals (ELxxxx) to 100BASE-FX EtherCAT POF networks, with identity verification
Number of EtherCAT Terminals	up to 65,534		
Data transfer medium	multimode glass fibre 50/125 µm (MM)	singlemode glass fibre 9/125 µm (SM)	plastic optical fibre (POF)
Data transfer rates	100 Mbaud	100 Mbaud	100 Mbaud



The EK1501, EK1501-0010 and EK1541 EtherCAT Couplers connect fibre optic-based EtherCAT with the EtherCAT Terminals by converting the telegrams on the fly from Ethernet 100BASE FX or FX POF to the E-bus signal representation. The EK1501 and EK1501-0010 EtherCAT Couplers are equipped with SC sockets, while the EK1541 is equipped with a POF plug.

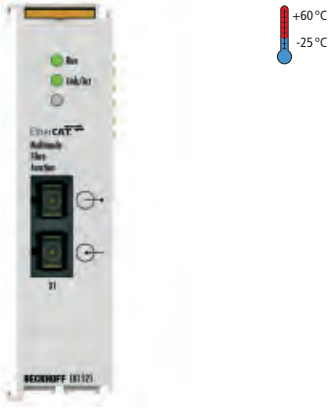
The couplers are connected to the network via the upper interface. The lower socket is used for the optional connection of further EtherCAT devices in the same strand. Distances of up to 2 km can be bridged with multimode fibre optics (EK1501) and up to 20 km with single-mode fibre optics (EK1501-0010). Distances of up to 50 m can be bridged using the Plastic Optical Fibre (EK1541); the POF is simple to assemble in the field.

The couplers do not need to be parameterised and are treated as EtherCAT slaves without process data. They have three hexadecimal ID switches, with which an ID can be assigned to the coupler station. This group can be located at any position within the EtherCAT network.

Bus interface	2 x SC Duplex	2 x SC Duplex	2 x ZS1090-0008 POF plug
Type/number of peripheral signals	max. 4.2 GB addressable I/O points	max. 4.2 GB addressable I/O points	max. 4.2 GB addressable I/O points
Current consumption 24 V DC	typ. 70 mA	typ. 70 mA	typ. 70 mA
Distance between stations	max. 2,000 m (100BASE-FX)	max. 20,000 m (100BASE-FX)	max. 50 m (100BASE-FX)
Delay	approx. 1 µs	approx. 1 µs	approx. 1 µs
Power supply	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)
Current supply E-bus	2000 mA	2000 mA	2000 mA
Weight	approx. 190 g	approx. 190 g	approx. 190 g
Operating temperature	-25…+60 °C	-25…+60 °C	-25…+60 °C
Approvals	CE, UL, Ex	CE, UL, Ex	CE
Further information	www.beckhoff.com/EK1501	www.beckhoff.com/EK1501	www.beckhoff.com/EK1541

Cordsets and connectors see page 444

EtherCAT junctions with fibre optic connection

	1-port EtherCAT multimode fibre optic junction, Hot Connect	1-port EtherCAT singlemode fibre optic junction, Hot Connect	1-port EtherCAT plastic optical fibre junction
Technical data	**EK1521**	**EK1521-0010**	**EK1561**
Task within EtherCAT system	coupling of EtherCAT junctions via multimode glass fibre	coupling of EtherCAT junctions via singlemode glass fibre	coupling of EtherCAT junctions via POF
Data transfer medium	multimode glass fibre 50/125 µm (MM)	singlemode glass fibre 9/125 µm (SM)	plastic optical fibre (POF)
Data transfer rates	100 Mbaud	100 Mbaud	100 Mbaud
			
	In conjunction with an EK1100 EtherCAT Coupler, the EK1521(-0010) 1-port EtherCAT fibre optic junction enables conversion from 100BASE-TX to 100BASE-FX physics (glass fibre). Distances of up to 2 km can be bridged with the EK1521 and the EK1501 EtherCAT Coupler for multimode fibre optics. EK1521-0010 and EK1501-0010 for singlemode fibre optics permit distances up to 20 km. Even cable redundant systems with fibre optic can be realised using the 1-port EtherCAT fibre optic junction.		In connection with an EK1100 EtherCAT coupler, the EK1561 single-port POF branch makes it possible to convert from 100BASE-TX physics to 100BASE-FX physics (POF – Plastic Optical Fibre). Distances of up to 50 m between two couplers can be bridged using the EK1561 and the EK1541 EtherCAT Coupler for POF. Unlike the glass fibre, the POF fibre is easily wireable in the field. The Run LED indicates the status of the EK1561.
Bus interface	1 x SC Duplex	1 x SC Duplex	1 x ZS1090-0008 POF plug
Type/number of peripheral signals	–	–	–
Current consumption 24 V DC	–	–	–
Distance between stations	max. 2,000 m (100BASE-FX)	max. 20,000 m (100BASE-FX)	max. 50 m (100BASE-FX)
Delay	approx. 1 µs	approx. 1 µs	approx. 1 µs
Power supply	from E-bus	from E-bus	from E-bus
Current consumption E-bus	typ. 350 mA	typ. 350 mA	typ. 200 mA
Weight	approx. 65 g	approx. 65 g	approx. 65 g
Operating temperature	-25…+60 °C	-25…+60 °C	-25…+60 °C
Approvals	CE, UL, Ex	CE, UL, Ex	CE
Further information	www.beckhoff.com/EK1521	www.beckhoff.com/EK1521	www.beckhoff.com/EK1561

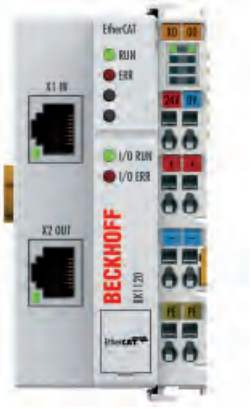
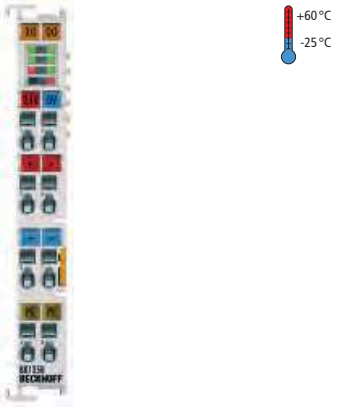
Cordsets and connectors see page 444

EtherCAT junctions and extensions

	2-port EtherCAT junction	EtherCAT extension
Technical data	**EK1122**	**EK1110**
Task within EtherCAT system	coupling of EtherCAT junctions	conversion of the E-bus signals to 100BASE-TX Ethernet for extension of the EtherCAT network
Data transfer rates	100 Mbaud	
	 +60 °C -25 °C	 +60 °C -25 °C 25 g
	The 2-port EtherCAT junction enables configuration of EtherCAT star topologies. A modular EtherCAT star can be realised by using several EK1122 units in a station. Individual devices or complete EtherCAT strands can be connected at the junction ports. The EtherCAT junctions are connected via RJ45 sockets with direct display of link and activity status.	Like the E-bus end cap, the EK1110 EtherCAT extension is connected to the end of the EtherCAT Terminal block. The terminal offers the option of connecting an Ethernet cable with RJ45 connector, thereby extending the EtherCAT strand electrically isolated by up to 100 m. In the EK1110 terminal, the E-bus signals are converted on the fly to 100BASE-TX Ethernet signal representation. Power supply to the EK1110 electronics is via the E-bus. No parameterisation or configuration tasks are required.
Bus interface	2 x RJ45	1 x RJ45
Data transfer medium	Ethernet/EtherCAT cable (min. CAT 5), shielded	Ethernet/EtherCAT cable (min. CAT 5), shielded
Distance between stations	100 m (100BASE-TX)	100 m (100BASE-TX)
Delay	approx. 1 µs	approx. 1 µs
Power supply	from E-bus	from E-bus
Current consumption E-bus	typ. 220 mA	typ. 130 mA
Weight	approx. 65 g	approx. 50 g
Operating temperature	-25…+60 °C	-25…+60 °C
Approvals	CE, UL, Ex	CE, UL, Ex
Further information	www.beckhoff.com/EK1122	www.beckhoff.com/EK1110
Special couplers	**EK1122-0080**	
Distinguishing features	Fast Hot Connect, CE	

Cordsets and connectors see page 444

EtherCAT Couplers K-bus

	EtherCAT "Economy plus" Bus Coupler for up to 64 Bus Terminals (255 with K-bus extension)	EtherCAT "Compact" Bus Coupler for up to 64 Bus Terminals (255 with K-bus extension)	EtherCAT "Compact" coupler between E-bus and K-bus terminals
Technical data	**BK1120**	**BK1150**	**BK1250**
Number of Bus Terminals	64 (255 with K-bus extension)		
Max. number of bytes fieldbus	1,024 byte input and 1,024 byte output		
Current supply K-bus	1,750 mA	2,000 mA	500 mA
			
	The BK1120 Bus Coupler connects EtherCAT, the real-time Ethernet system, with the modular, extendable electronic terminal blocks. A unit consists of a Bus Coupler, any number (between 1 and 64) of terminals (255 with K-bus extension) and one end terminal.	The BK1150 Bus Coupler connects EtherCAT to the modular extendable Bus Terminals (K-bus). A unit consists of a Bus Coupler, any number of terminals from 1 to 64 (with K-bus extension: 255) and a bus end terminal. The "Compact" Bus Coupler offers a cost-optimised alternative to the BK1120 EtherCAT Bus Coupler.	The BK1250 is a "Bus Coupler in terminal housing" for mixed application of EtherCAT Terminals (ELxxxx) and standard Bus Terminals (KLxxxx) in a bus station. It enables implementation of compact and cost-effective control solutions. The wide range of Bus Terminals can thus be optimally combined with the communication speed and large bandwidth of EtherCAT Terminals. Up to 64 Bus Terminals (with K-bus extension up to 255) can be connected to a BK1250. The Bus Coupler recognises the connected Bus Terminals and automatically allocates them into the EtherCAT process image.
Bus interface	2 x RJ45	2 x RJ45	via E-bus contacts
Data transfer rates	100 Mbaud	100 Mbaud	100 Mbaud E-bus
Distance between stations	100 m (100BASE-TX)	100 m (100BASE-TX)	–
Weight	approx. 150 g	approx. 110 g	approx. 55 g
Operating temperature	-25…+60 °C	-25…+60 °C	-25…+60 °C
Approvals	CE, UL, Ex	CE, Ex	CE, UL, Ex
Further information	www.beckhoff.com/BK1120	www.beckhoff.com/BK1150	www.beckhoff.com/BK1250

Cordsets and connectors see page 444, Bus Terminals see page 542

Bus Couplers for EtherCAT Terminals

	PROFIBUS	Ethernet
	PROFIBUS Bus Coupler	Ethernet Bus Coupler
Technical data	**EK3100**	**EK9000**
Task within EtherCAT system	coupling of standard digital and analog EtherCAT Terminals and EtherCAT Box modules to PROFIBUS networks	coupling of standard digital and analog EtherCAT Terminals and EtherCAT Box modules to Ethernet networks
Number of EtherCAT Terminals	depending on the process data size	
Data transfer rates	up to 12 Mbaud (automatic detection)	10/100 Mbaud
		
	The EK3100 Bus Coupler converts the telegrams from PROFIBUS to the E-bus signal representation. The coupler supports the PROFIBUS profile and fits seamlessly into PROFIBUS networks.	The EK9000 Bus Coupler converts the telegrams from Ethernet to the E-bus signal representation. The coupler supports the Modbus TCP protocol and fits seamlessly into Ethernet networks.
Protocol	PROFIBUS DP	Modbus TCP, Modbus UDP
Bus interface	1 x D-sub 9-pin socket with shielding	2 x RJ45 (switched)
Type/number of peripheral signals	depending on the process data size	depending on the process data size
Power supply	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)
Operating temperature	0…+55 °C	0…+55 °C
Approvals	CE, Ex	CE, Ex
Further information	www.beckhoff.com/EK3100	www.beckhoff.com/EK9000
Accessories		
Cordsets and connectors	see page 444	see page 444
PC Fieldbus Cards	FC310x 772	FC90xx 778

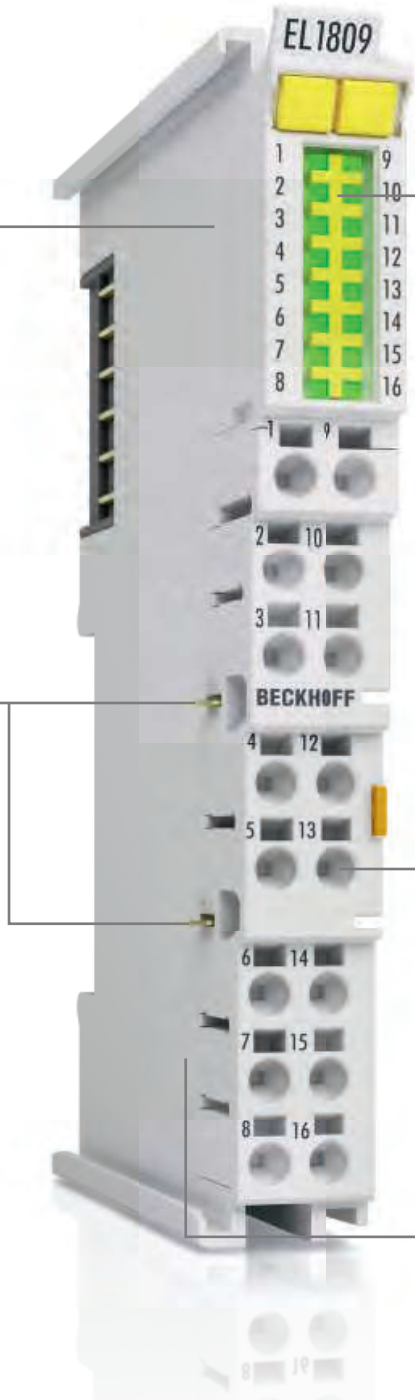
For availability status see Beckhoff website at: www.beckhoff.com

	PROFINET RT Bus Coupler	EtherNet/IP Bus Coupler	SERCOS III Bus Coupler
	EK9300	**i EK9500**	**i EK9700**
	coupling of standard digital and analog EtherCAT Terminals and EtherCAT Box modules to PROFINET RT networks	coupling of standard digital and analog EtherCAT Terminals and EtherCAT Box modules to EtherNet/IP networks	coupling of standard digital and analog EtherCAT Terminals and EtherCAT Box modules to SERCOS III networks
	10/100 Mbaud	10/100 Mbaud	10/100 Mbaud
			
	The EK9300 Bus Coupler converts the telegrams from PROFINET RT to the E-bus signal representation. The coupler supports the PROFINET RT profile and fits seamlessly into PROFINET RT networks.	The EK9500 Bus Coupler converts the telegrams from EtherNet/IP to the E-bus signal representation. The coupler supports the EtherNet/IP profile and fits seamlessly into EtherNet/IP networks.	The EK9700 Bus Coupler converts the telegrams from SERCOS III to the E-bus signal representation. The coupler supports the SERCOS III profile and fits seamlessly into SERCOS III networks.
	PROFINET RT	EtherNet/IP	SERCOS III I/O profile
	2 x RJ45 (switched)	2 x RJ45 (switched)	2 x RJ45 (switched)
	depending on the process data size	depending on the process data size	depending on the process data size
	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)
	0…+55 °C	0…+55 °C	0…+55 °C
	CE, Ex	CE, Ex	CE, Ex
	www.beckhoff.com/EK9300	www.beckhoff.com/EK9500	www.beckhoff.com/EK9700
	see page 444	see page 444	see page 444
	FC90xx 778	FC90xx 778	FC750x 777

Embedded PC CX8000 see page 198

EtherCAT | I/O modules with 100 Mbit communication

The EtherCAT Terminals have a galvanic isolation between the field level and the communication level (E-bus). A terminal is equipped with 1…n input or output channels. The channels within a terminal are usually not electrically isolated from each other.



Beckhoff EtherCAT HD Terminals feature function-dependant colour-coded LED frames: yellow for digital inputs, red for digital outputs, green for analog inputs, blue for analog outputs.

Different field level connection techniques can be used for EtherCAT Terminals:

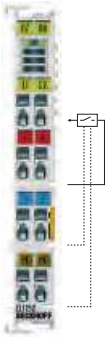
- standard terminal point: 0.08…2.5 mm² spring-loaded technique
- HD EtherCAT Terminal: 0.08…0.75 mm² (with ferrule); 0.08…1.5 mm² (single-wire); spring-loaded technique; direct plug-in technique
- D-sub, 9-pin, common for serial communication or fieldbus master terminals
- ribbon: especially used in Asia for digital input/output channels
- plug-in wiring level: ES terminals

The power contacts on the left hand side (if available) supply the terminals with field voltage. Depending on the terminals 24 V DC, 230 V AC or other voltages are transferred. The supply power required is listed in the technical data. The maximum load of the power contacts is 10 A.

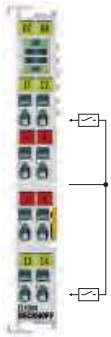
Some 2-channel EtherCAT Terminals have a PE power contact, which can be used for PE distribution by connecting it together with similar terminals. The EMC spring contact on the underside of the terminal only serves to remove interference and may not be used as a protective earth.

XFC	eXtreme Fast Control Technology
+60 °C -25 °C	Extended operating/ storage temperature
25 g	Extended mechanical load
	Terminals with calibration certificate

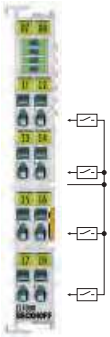
Technical data see page 329



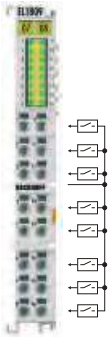
2-channel terminals
The 2-channel terminals provide additional power (+24 V DC), ground (0 V DC) and in many cases also PE for each channel. Connection is carried out with 3- or 4-wire connection.



4-channel terminals
Along with four channels the 4-channel terminals have another four connection points available. These can provide 24 V DC or ground. Connection is carried out with 2-wire connection.



8-channel terminals
The 8-channel terminals have one channel per connection point due to a high packing density. The power contact of the terminal will be used as the common reference potential. Connection is carried out with 1-wire connection.



16-channel terminals
The HD (High Density) housing allows 16 channels to be accommodated on a unit that is only 12 mm wide. The power contact of the terminal will be used as the common reference potential. Connection is carried out with 1-wire connection.

The EtherCAT Terminals offer the possibility to directly connect many different signals. No signal converter or additional evaluation device is needed. The direct connection reduces the costs and simplifies the control technology. Each EtherCAT Terminal separates the internal electronics from the connection level and thus simplifies the creation of voltage groups with different voltages. In addition, interfering voltages on the signal connector lose their adverse effects.

The EL1xxx and EL2xxx EtherCAT Terminals are designed for the processing of digital or binary signals. Unless otherwise noted, the High level corresponds to the supply voltage, the Low level corresponds to ground. For negative switching logic it is the other way around. For both types of logic various supply voltages are available. 1-, 2-, 3- and 4-wire connections allow the use of EtherCAT Terminals in almost all applications without further wiring work.

The EL3xxx and EL4xxx EtherCAT Terminals process analogue signals with 0…10 V, ±10 V, 0…20 mA or 4…20 mA. Also many other industry-standard voltage and current signals are supported and pre-processed.

In the EL5xxx and EL6xxx EtherCAT Terminals other complex signals, such as encoders, position values and digital interfaces, are supported. Some EtherCAT Terminals act as fieldbus masters for subordinate bus systems. turning the station into a universal gateway between different systems.

The EL7xxx EtherCAT Terminals offer compact drive solutions for stepper, DC and servomotors.

The EL9xxx system terminals round off the application of EtherCAT Terminals with filters, power feed and power supply units.

The XFC terminals are particularly suitable for fast, precise sensor detection or actuator control in the ns range in conjunction with TwinCAT as real-time environment and PC-based high-performance control technology.

Technical data	**ELxxxx** | ESxxxx
Electrical isolation	500 V (E-bus/field potential), unless stated otherwise
Operating/storage temperature	0…+55 °C/-25…+85 °C (extended temperature range: -25…+60 °C/-40…+85 °C)
Relative humidity	95 %, no condensation
Vibration resistance	conforms to EN 60068-2-6: 1 g (extended range: 5 g)
Shock resistance	conforms to EN 60068-2-27: 15 g, 11 ms (extended range: 25 g, 6 ms); 1000 shocks per direction, 3 axes
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4
Protect. class/installation pos.	IP 20/variable conforms to EN 60529 (see documentation)
Pluggable wiring	for all ESxxxx terminals

▶ **www.beckhoff.com/EtherCAT-IO**

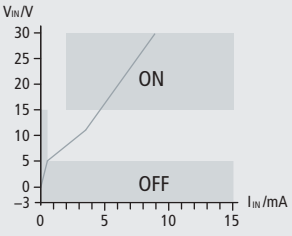
Digital input | 24 V DC, positive switching

The digital inputs of a 24 V supply are among the most used signals. The EN 61131-2 standard describes the input characteristic and distinguishes three types. Type 1 has a small input current with low power dissipation. This input is optimised for mechanical switches and actively-switched electronic outputs. Type 2 has a significantly larger input current and is optimised for 2-wire sensors with a high quiescent current consumption. In switched-on state the current consumption of this input is high. The related power dissipation is generally not acceptable. Type 3 is a combination between type 1, with low current in switched-on state, and a satisfactorily high quiescent current for the majority of modern 2-wire sensors. The type 3 input can be used in almost all applications as a replacement for type 1. The diagram shows the typical current/voltage curves of the EtherCAT Terminal inputs and the allowable range of conformity in accordance with the standard.

The input circuits differ in their filtering functions. The filtering has the task of suppressing electromagnetic interference. However, this does have the drawback of signal deceleration. The filter time of 3 ms is comparatively slow, but it can suppress the bouncing of a mechanical switch and delivers a stable signal for simple PLC applications. Filter times of 10 µs are suitable for applications with shortest possible reaction times and should be used for mechanical switches only in a restricted manner.

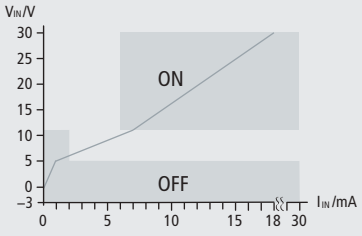
XFC terminals with a filter time of << 1 µs are available for particularly fast signals and exact edge identification.

Type 1



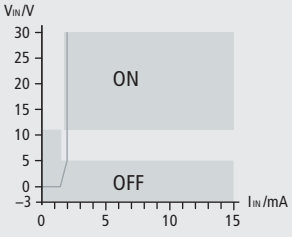
Signal voltage "0": -3…5 V DC
Signal voltage "1": 15…30 V DC

Type 2



Signal voltage "0" -3…5 V DC
Signal voltage "1": 11…30 V DC

Type 3

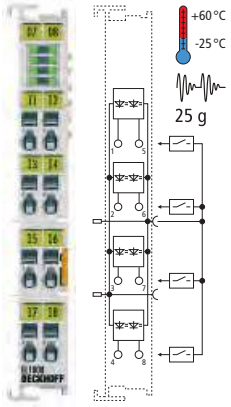


Signal voltage "0": -3…5 V DC
Signal voltage "1": 11…30 V DC

Characteristics of the 3 input types according to EN 61131-2 (24 V DC)

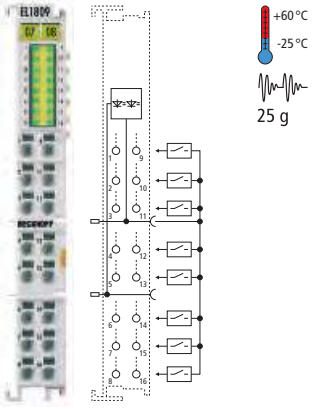
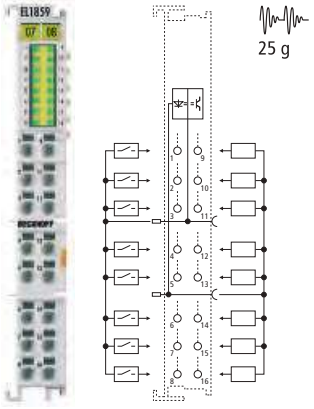
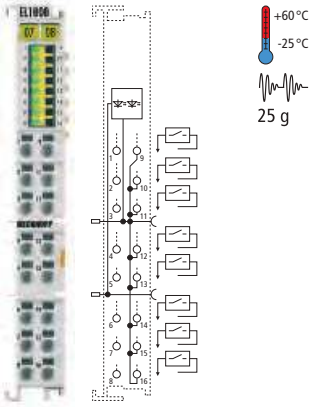
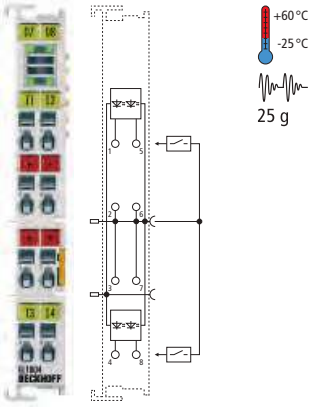
8-channel digital input terminal, 1-wire, 24 V DC, type 1/3

Technical data	EL1008 | ES1008	EL1018 | ES1018
Connection technology	1-wire	
Specification	EN 61131-2, type 1/3	
Input filter	typ. 3.0 ms	typ. 10 µs
Number of inputs	8	



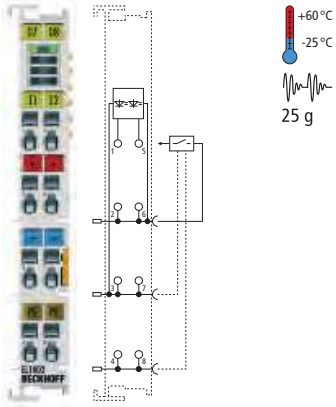
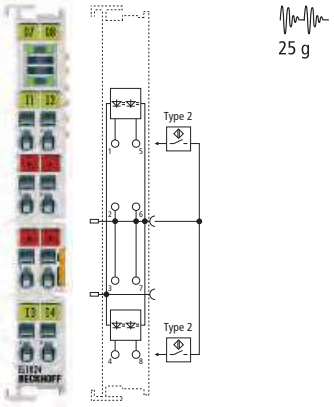
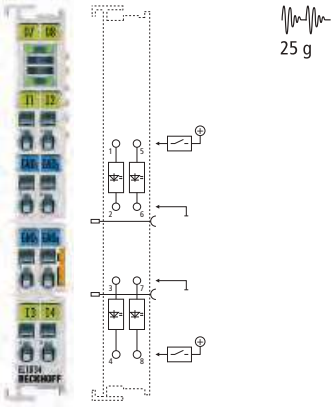
The EL1008 and EL1018 digital input terminals acquire the binary control signals from the process level and transmit them, in an electrically isolated form, to the higher-level automation unit.

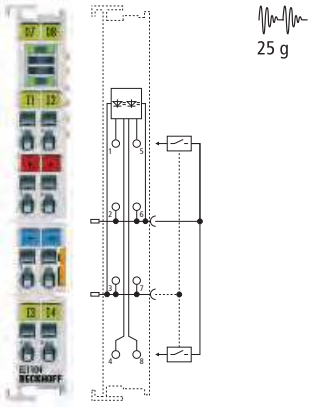
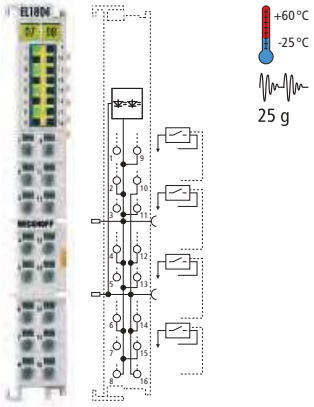
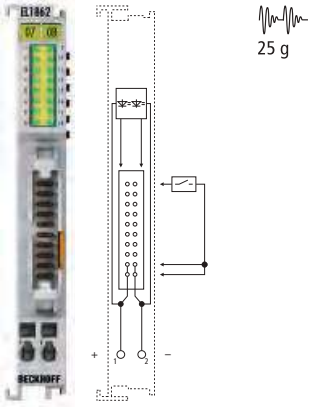
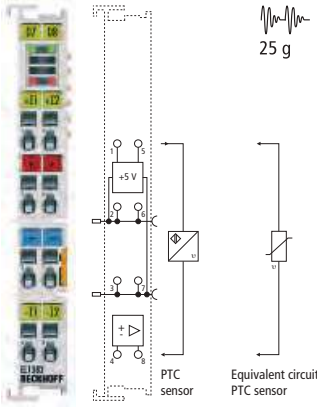
Nominal voltage	24 V DC (-15 %/+20 %)
Current consumption power contacts	typ. 2 mA + load
Current consumption E-bus	typ. 90 mA
Distributed clocks	–
Special features	standard input terminals for fast (filter 10 µs) or bouncing signals (filter 3 ms)
Operating temperature	-25…+60 °C
Approvals	CE, UL, Ex
Weight	approx. 55 g
Further information	www.beckhoff.com/EL1008
Special terminals	
Distinguishing features	

	16-channel digital input terminal, 1-wire, 24 V DC, type 1/3		8-channel digital input + 8-channel digital output, 1-wire, 24 V DC, type 1/3	8-channel digital input terminal, 2-wire, 24 V DC, type 1/3	4-channel digital input terminal, 2-wire, 24 V DC, type 1/3	
	EL1809	**EL1819**	**EL1859**	**EL1808**	**EL1004** | ES1004	**EL1014** | ES1014
				2-wire		
	typ. 3.0 ms	typ. 10 µs	typ. 3.0 ms	typ. 3.0 ms	typ. 3.0 ms	typ. 10 µs
	16		8 inputs + 8 outputs	8	4	
						
	With 16 input channels and only 12 mm width the EL1809 and EL1819 digital input terminals are suitable for space-saving control cabinet installation. Reference ground for all terminal points is the 0 V power contact. Single wires can be connected directly without tools. A screwdriver is required for disconnection.		The digital EL1859 EtherCAT Terminal combines eight digital inputs and eight digital outputs in one device.	The EL1808 digital input terminal acquires the binary control signals from the process level and transmits them, in an electrically isolated form, to the higher-level automation device. With its 3 ms input filter it is suitable for identifying slow edges or bouncing signals, for which multiple detection is undesirable.	With its 3 ms input filter the EL1004 is suitable for identifying slow edges or bouncing signals, for which multiple detection is undesirable. The EL1014 is suitable for identifying fast signal edges in the µs range. There is no electrical isolation between the channels.	
	24 V DC (-15 %/+20 %)		24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)	
	typ. 4 mA + load		typ. 15 mA + load	typ. 2 mA + load	typ. 2 mA + load	
	typ. 100 mA		typ. 130 mA	typ. 100 mA	typ. 90 mA	
	–		–	–	–	
	standard input terminal with high number of channels for slow or fast 24 V DC edges, direct plug-in technique		combi EtherCAT Terminal, 8 x output 24 V DC, max. output current 0.5 A, load type: ohmic, inductive, lamp load, reverse voltage protection	direct plug-in technique, 2-wire connection	standard input terminals for 2-wire connection	
	-25…+60 °C		0…+55 °C	-25…+60 °C	-25…+60 °C	
	CE, UL, Ex		CE, UL, Ex	CE, UL, Ex	CE, UL, Ex	
	approx. 65 g		approx. 65 g	approx. 60 g	approx. 50 g	
	www.beckhoff.com/EL1809		www.beckhoff.com/EL1859	www.beckhoff.com/EL1808	www.beckhoff.com/EL1004	
					EL1004-0020	
					isolation voltage > 2,500 V, CE	

For availability status see Beckhoff website at: www.beckhoff.com/EL1004

Digital input | 24 V DC, positive switching

	2-channel digital input terminal, 4-wire, 24 V DC, type 1/3		4-channel digital input terminal, 2-wire, 24 V DC, type 2	4-channel digital input terminal, 2-wire, 24 V DC, type 1
Technical data	**EL1002** | ES1002	**EL1012** | ES1012	**EL1024** | ES1024	**EL1034** | ES1034
Connection technology	4-wire		2-wire	
Specification	EN 61131-2, type 1/3		EN 61131-2, type 2	EN 61131-2, type 1
Input filter	typ. 3.0 ms	typ. 10 µs	typ. 3.0 ms	typ. 10 µs
Number of inputs	2		4	4
				
	The EL1002 and EL1012 digital input terminals acquire the binary control signals from the process level and transmit them, in an electrically isolated form, to the higher-level automation unit.		The EL1024 enables the connection of up to four type 2 24 V sensors with high quiescent current consumption. 2-wire connection is possible through the four 24 V connection points. The input filter is 3 ms, e.g. for bouncing signals.	The EL1034 enables electrically isolated and potential-free connection of four digital 24 V signals. A filter time of 10 µs enables sampling of fast signal edges.
Nominal voltage	24 V DC (-15 %/+20 %)		24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)
Current consumption power contacts	typ. 2 mA + load		typ. 30 mA + load	–
Current consumption E-bus	typ. 90 mA		typ. 90 mA	typ. 90 mA
Distributed clocks	–		–	–
Special features	4-wire connection		type 2	4 electrically isolated fast inputs, potential-free
Operating temperature	-25…+60 °C		0…+55 °C	0…+55 °C
Approvals	CE, UL, Ex		CE, UL, Ex	CE, UL, Ex
Weight	approx. 50 g		approx. 50 g	approx. 50 g
Further information	www.beckhoff.com/EL1002		www.beckhoff.com/EL1024	www.beckhoff.com/EL1034
Special terminals				
Distinguishing features				

	4-channel digital input terminal, 2-/3-wire, 24 V DC, type 1/3		4-channel digital input terminal, 3-wire, 24 V DC, type 1/3		16-channel digital input terminal, flat-ribbon cable connection, 24 V DC, type 1/3		2-channel digital input terminal, 24 V DC, thermistor
	EL1104 | ES1104	**EL1114** | ES1114	**EL1804**	**EL1814**	**EL1862**	**EL1872**	**EL1382** | ES1382
	2-/3-wire		3-wire		flat-ribbon cable		2-wire
	EN 61131-2, type 1/3						thermistor PTC
	typ. 3.0 ms	typ. 10 µs	typ. 3.0 ms	typ. 10 µs	typ. 3.0 ms	typ. 10 µs	30 ms
	4		4		16		2
							
	With 2- or 3-wire connections the EL1104/EL1114 enables reading of up to four digital signals. The EL1114 with a 10 µs filter time is a good choice for fast signal changes with short cycle times. Reference ground for all terminal points is the 0 V power contact.		The EL1804 and EL1814 digital input terminals acquire the binary control signals from the process level and transmit them, in an electrically isolated form, to the higher-level automation device. The EtherCAT Terminals each contain four channels, consisting of a signal input, 24 V DC and 0 V. The power contacts are looped through.		A 20-pin plug connector with 2.54 mm contact spacing enables the secure connection of plug connectors using insulation displacement contact, as is usual for ribbon cables and special round cables. The required 24 V DC voltage supply must be input by the ribbon cable or the terminal points.		The digital EL1382 input terminal analyses the input signal of thermistor sensors with the aid of a current loop and a voltage of less than 5 V. It is a monitoring device for the thermal machine protection of PTC sensors, suitable for the direct monitoring of motors, bearings and equipment. In the process image, the state of the sensor is indicated by one bit each. A further bit reports short circuits or line interruptions. – sensor voltage: ≤ 5 V – diagnostics: open-circuit: > 8 kΩ short-circuit: < 25 Ω
	24 V DC (-15 %/+20 %)		24 V DC (-15 %/+20 %)		24 V DC (-15 %/+20 %)		24 V (-15 %/+20 %)
	typ. 2 mA + load		typ. 2 mA + load		4 mA from the 24 V supply (no power contacts)		–
	typ. 90 mA		typ. 90 mA		typ. 100 mA		typ. 120 mA
	–		–		–		–
	4 inputs for 2- and 3-wire connection		–		also available as negative switching		monitoring device for thermal machine protection
	-25…+60 °C	0…+55 °C	-25…+60 °C		0…+55 °C		0…+55 °C
	CE, UL, Ex		CE, UL, Ex		CE, UL, Ex		CE
	approx. 55 g		approx. 60 g		approx. 50 g		approx. 55 g
	www.beckhoff.com/EL1104		www.beckhoff.com/EL1804		www.beckhoff.com/EL1862		www.beckhoff.com/EL1382
					EL1862-0010		
					negative switching, see page 348		

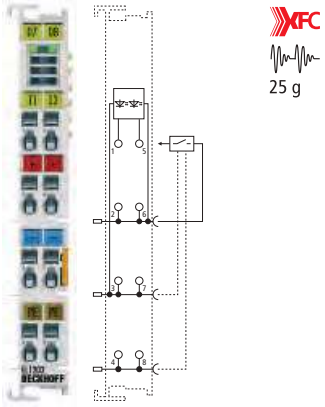
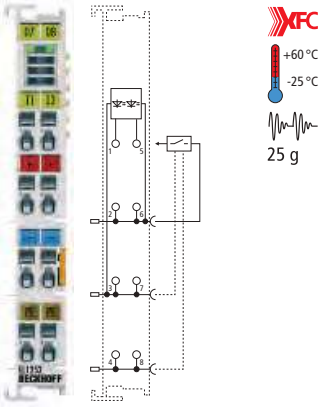
XFC digital input | 24 V DC, positive, fast inputs

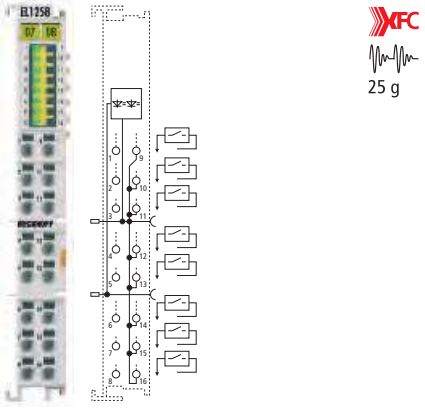
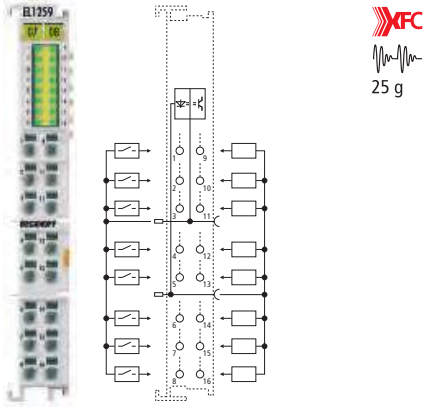
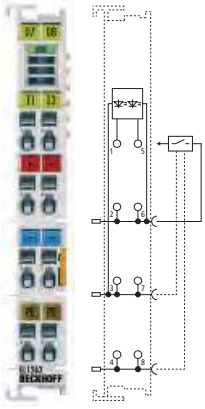
XFC – eXtreme Fast Control – comprises a fast controller, fast real-time capable communication and fast, high-precision input/output modules. Based on synchronisation through the distributed clocks principle, input modules read their inputs at exactly defined times. Outputs can be controlled with nanosecond precision, irrespective of restrictions through the bus cycle time or communication jitter.

The DC devices trigger the reading of inputs or the activation of outputs through their local clocks. This way, a uniform, application-wide timebase is formed in the modules, which makes parallel hardware wiring unnecessary. Responses with equidistant time intervals are possible largely independent of the bus cycle time.

EtherCAT components with DC support, such as shaft encoders, drives or I/O modules, enable synchronised, time-based operation for exact control of the mechanical components. All EL12xx terminals feature a fast input circuit, which enables the signal information from the field to be transferred to the communication level without delay.

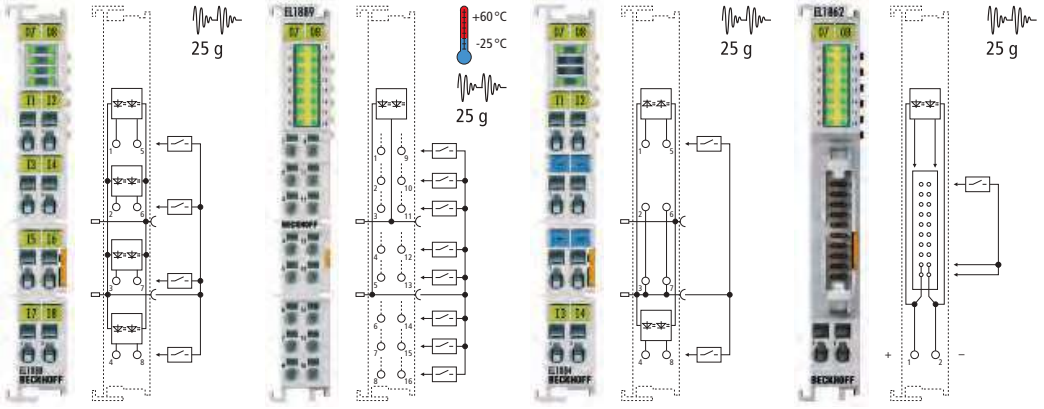
For further information on XFC see page 298

	2-channel digital input terminal, 24 V DC, 4-wire, fast input	2-channel digital input terminal, 24 V DC, 4-wire, timestamping
Technical data	**EL1202** | ES1202	**EL1252** | ES1252
Connection technology	4-wire	
Specification	similar to EN 61131-2, type 3, "0": -3…5 V DC, "1": 11…30 V DC, typ. 3 mA input current	
Input filter	typ. < 1 µs	typ. < 1 µs
Number of inputs	2	2
		
	The very fast input circuit enables sampling of short input pulses, even with very short EtherCAT cycle times.	The EL1252 allocates a 64-bit timestamp (1 ns triggering) to each edge change as a process data.
Nominal voltage	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)
Current consum. pow. cont.	typ. 6 mA + load	typ. 6 mA + load
Current consumption E-bus	typ. 110 mA	typ. 110 mA
Distributed clocks	yes	yes
Internal sampling/ execution	10 ns (+ input delay)	10 ns (+ input delay)
Distributed clock precision	<< 1 µs	<< 1 µs
Oversampling/multi-timestamping factor	–	–
Special features	DC can be activated, see documentation	timestamping, latch last edge
Operating temperature	0…+55 °C	-25…+60 °C
Approvals	CE, UL, Ex	CE, UL, Ex
Weight	approx. 55 g	approx. 55 g
Further information	www.beckhoff.com/EL1202	www.beckhoff.com/EL1252
Special terminals		**EL1252-0050**
Distinguishing features		5 V inputs

	8-channel digital input terminal, 24 V DC, 2-wire, multi-timestamping	8-channel digital input + 8-channel digital output, 24 V DC, 1-wire, multi-timestamping	2-channel digital input terminal, 24 V DC, 4-wire, oversampling
	EL1258	**EL1259**	**EL1262** | ES1262
	2-wire	1-wire	4-wire
	typ. < 1 µs	typ. < 1 µs	typ. < 1 µs
	8	8 inputs + 8 outputs	2
	 25 g	 25 g	 25 g
	The ELx258 EtherCAT HD terminals with timestamp technology offer optimised sensor/actuator control with high channel density and compact design. In contrast to the ELx252 series with a timestamp interval of 1 ns, the EL1258, EL1259 and EL2258 operate with a 10…40 µs interval. They can sample inputs or issue outputs at these intervals, synchronised through the distributed clocks. The 16-channel digital EL1259 EtherCAT Terminal combines the functions of the EL1258 – eight timestamp inputs – with those of the EL2258 – eight timestamp outputs. Multi-timestamping enables up to 10 events per channel to be sampled or output in each EtherCAT cycle. The outputs feature auto-activation, i.e. they can be re-activated in each cycle. The EL1259, as a combination of DC-controlled inputs and outputs within a terminal, is particularly suitable for local switching tasks.		The EL1262 oversamples both channels with up to 1 Msample/s and transfers the state of the inputs as a bit datastream collectively to the controller. This way, even the fastest signals can be acquired.
	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)
	typ. 6 mA + load	typ. 6 mA + load	typ. 20 mA + load
	typ. 110 mA	typ. 90 mA	typ. 70 mA
	yes	yes	yes
	< 10…40 µs, corresponds to 100…25 k detectable edges/s, dependent on configuration	< 10…40 µs, corresponds to 100…25 k detectable edges/s, dependent on configuration	10 ns (+ input delay)
	<< 1 µs	<< 1 µs	<< 1 µs
	n = integer multiple of the cycle time, 1…10	n = integer multiple of the cycle time, 1…10	n = integer multiple of the cycle time, 1…1,000, see documentation
	multi-timestamping	multi-timestamping, auto activation	oversampling
	0…+55 °C	0…+55 °C	0…+55 °C
	CE	CE	CE, UL, Ex
	approx. 55 g	approx. 55 g	approx. 60 g
	www.beckhoff.com/EL1258	www.beckhoff.com/EL1259	www.beckhoff.com/EL1262
			EL1262-0050
			5 V inputs

Digital input | 24 V DC, negative switching

	8-channel digital input terminal, 1-wire, 24 V DC, negative switching		16-channel digital input terminal, 1-wire, 24 V DC, negative switching	4-channel digital input terminal, 2-wire, 24 V DC, negative switching		16-channel digital input terminal, flat-ribbon, 24 V DC, negative switching
Technical data	**EL1088** | ES1088	**EL1098** | ES1098	**EL1889**	**EL1084** | ES1084	**EL1094** | ES1094	**EL1862-0010**
Connection technology	1-wire			2-wire		flat-ribbon cable
Specification	negative switching "0": 18…30 V DC, "1": 0…7 V DC, typ. 3 mA input current					
Input filter	typ. 3.0 ms	typ. 10 µs	typ. 3.0 ms	typ. 3.0 ms	typ. 10 µs	typ. 3.0 ms
Number of inputs	8		16	4		16

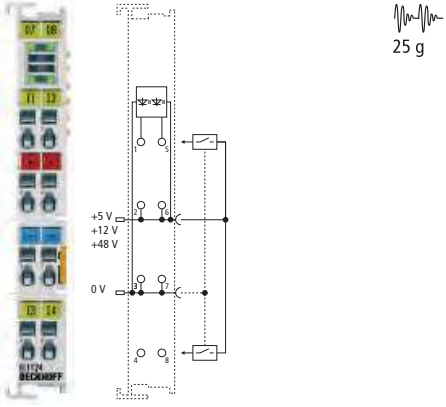
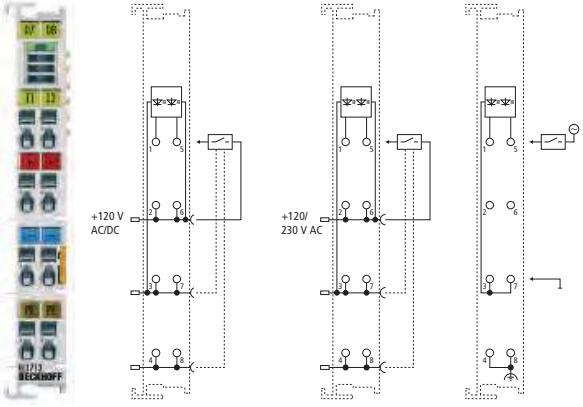


The EL terminals of the EL108x and EL109x series and the EL1889 and EL1862-0010 interpret input signals with negative logic: 0 V signal level means logic "1". The rated voltage level is read as logic "0". Versions with 10 µs input filter are available for sampling fast input edges. The slow 3 ms filter enables logging of bouncing contacts or slowly rising signal edges. The 4-channel versions enable 2-wire connection. In the ribbon version the 0 V and 24 V rails are available for 3-wire connection. In all cases, a power supply with 24 V DC rated voltage is required for operation.

In the EL1862-0010 a 20-pole pin contact strip with a 2.54 mm contact spacing with locking enables safe connection of plug connectors with insulation displacement.

Nominal voltage	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)
Current consumption power contacts	typ. 25 mA	typ. 35 mA	typ. 20 mA	typ. 35 mA
Current consumption E-bus	typ. 90 mA	typ. 110 mA	typ. 90 mA	typ. 100 mA
Distributed clocks	–	–	–	–
Special features	–	–	2-wire connection	–
Operating temperature	0…+55 °C	-25…+60 °C	0…+55 °C	0…+55 °C
Approvals	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex
Weight	approx. 50 g	approx. 55 g	approx. 50 g	approx. 50 g
Further information	www.beckhoff.com/EL1088	www.beckhoff.com/EL1889	www.beckhoff.com/EL1084	www.beckhoff.com/EL1862

Digital input | 5 V…230 V

	4-channel digital input terminal, 2-/3-wire, 5 V DC	4-channel digital input terminal, 2-/3-wire, 12 V DC	4-channel digital input terminal, 2-/3-wire, type 1, 48 V DC	2-channel digital input terminal, 4-wire, type 1, 120 V AC/DC	2-channel digital input terminal, 4-wire, type 1, 120/230 V AC	2-channel digital input terminal, 2-wire, type 1, 120/230 V AC
Technical data	**EL1124** | ES1124	**EL1144** | ES1144	**EL1134** | ES1134	**EL1712** | ES1712	**EL1702** | ES1702	**EL1722** | ES1722
Connection technology	2-/3-wire			4-wire		2-wire
Specification	"0": < 0.8 V DC, "1": > 2.4 V DC, typ. 50 µA	"0": < 2.4 V DC, "1": > 8.5 V DC, input current "1": typ. 3 mA	EN 61131-2, type 1	"0": < 40 V, "1": 80…140 V, input current "1": > 3 mA, typ. 6 mA	"0": < 40 V, "1": 79…260 V, input current "1": > 3 mA, typ. 6 mA	
Input filter	typ. 0.05 µs	typ. 10 µs	typ. 10 µs	typ. 10 ms	typ. 10 ms	typ. 10 ms
Number of inputs	4	4	4	2	2	2
	 The digital EL11x4 input terminals are suitable for reading logical signals based on direct current: EL1124 (5 V DC), EL1144 (12 V DC) and EL1134 (48 V DC). The EL9505 power supply terminals (5 V DC, for EL1124) and EL9512 (12 V DC, for EL1144) are available for feeding in the supply voltage at the power contacts. The EL9190 potential supply terminal in conjunction with an external 48 V DC power supply unit can be used for supplying the EL1134.			 The EL17x2 digital input terminals are suitable for recording logic signals ≥ 120 V. The EL1712 is suitable for both DC and AC voltages and can therefore be used in the voltage range 120 V AC/DC. Using the EL1702 and EL1722, logic signals can be recorded on a 120 or 230 V AC basis. The EL1722 is suitable for the construction of individual potential groups, since it has no power contacts.		
Nominal voltage	5 V DC	12 V DC	48 V DC	120 V AC/DC	120/230 V AC	120/230 V AC
Current consumption power contacts	typ. 14 mA + load	typ. 14 mA + load	typ. 10 mA + load	–	–	–
Current consumption E-bus	typ. 90 mA	typ. 90 mA	typ. 90 mA	typ. 110 mA	typ. 110 mA	typ. 110 mA
Distributed clocks	–	–	–	–	–	–
Electrical isolation	500 V (E-bus/ field potential)	500 V (E-bus/ field potential)	500 V (E-bus/ field potential)	500 V (E-bus/ mains voltage); 3,750 V AC, 1 min.	500 V (E-bus/ mains voltage); 3,750 V AC, 1 min.	500 V (E-bus/ mains voltage); 3,750 V AC, 1 min.
Special features	fast CMOS input	–	–	also suitable for 120 V DC	–	no power contacts
Operating temperature	0…+55 °C	0…+55 °C	0…+55 °C	0…+55 °C	0…+55 °C	0…+55 °C
Approvals	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex	CE	CE	CE
Weight	approx. 55 g	approx. 55 g	approx. 55 g	approx. 60 g	approx. 60 g	approx. 60 g
Further information	www.beckhoff.com/EL1124	www.beckhoff.com/EL1144	www.beckhoff.com/EL1134	www.beckhoff.com/EL1712	www.beckhoff.com/EL1702	www.beckhoff.com/EL1722

i For availability status see Beckhoff website at: www.beckhoff.com/EL1712

Digital input | 24 V DC, counter

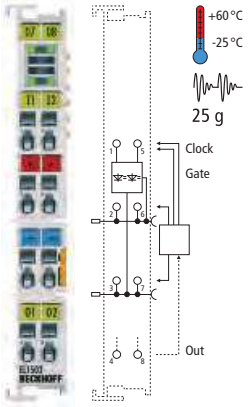
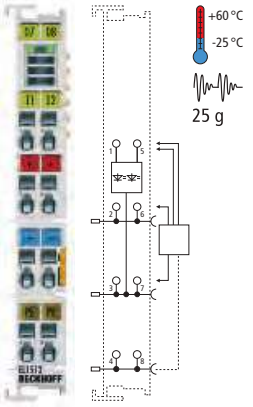
Pulses often need to be captured in technical control applications. This can be done with fast inputs such as EL1202 and a central pulse counter. If the pulse length is the order of magnitude of the control cycle time or less, the controller cannot record these signals correctly any more. Pre-processing counter terminals can then be used to count the number and direction of the pulses, which enables the controller to determine reliable values. The counter is adapted to the individual requirements, such as up/down counter or Gate/Latch-controlled, by fieldbus parameterisation. With a counting depth of 32 bit any overflow can be controlled reliably, even at high frequencies.

As a multi-functional EtherCAT Terminal the EL1502 supports the following operating modes:

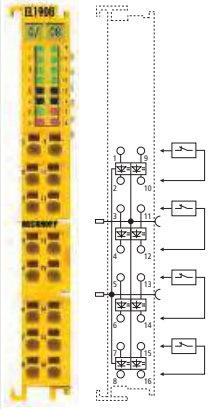
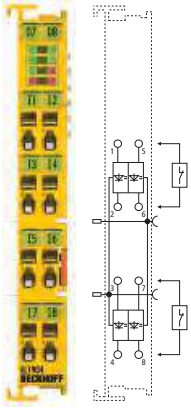
– 1 x 32 bit up/down counter (the counting direction is specified via the input)
– 1 x 32 bit gated counter (the counter is enabled via the input)
– 2 x 32 bit up or down counter (no direction detection)

The EtherCAT Terminal can switch its outputs depending on the counter values. The EL1502 device supports the distributed clocks function. This enables the counter value to be read at highly constant intervals.

The EL1512 was developed for price-sensitive applications and has limitations in terms of speed and functionality.

	2-channel digital input terminal, 24 V DC, 100 kHz, counter	2-channel digital input terminal, 24 V DC, 1 kHz, counter
Technical data	**EL1502** | ES1502	**EL1512** | ES1512
Connection technology	1 x up/down counter, 2 x up or down counter	2 up counters
Specification	EN 61131-2, type 1, "0": < 5 V DC, "1": > 15 V DC, typ. 5 mA	
		
	The EL1502 supports numerous functions for demanding counting tasks such as distributed clocks, fast counting frequency and switchable outputs.	The EL1512 is suitable for slow, simple and unidirectional counting tasks with two channels.
Nominal voltage	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)
Current consumption power contacts	typ. 14 mA + load	typ. 14 mA + load
Current consumption E-bus	typ. 130 mA	typ. 130 mA
Distributed clocks	yes	–
Electrical isolation	500 V (E-bus/field potential)	500 V (E-bus/field potential)
Counting frequency	max. 100 kHz	max. 1 kHz
Max. output current	24 V/0.5 A (short-circuit-proof) per channel	–
Counter depth	32 bit	32 bit
Special features	set counters, switch outputs	10 µs input filter
Operating temperature	-25…+60 °C	-25…+60 °C
Approvals	CE, UL, Ex	CE, UL, Ex
Weight	approx. 50 g	approx. 55 g
Further information	www.beckhoff.com/EL1502	www.beckhoff.com/EL1512

Digital input | 24 V DC, TwinSAFE

	8-channel digital input terminal, TwinSAFE, 24 V DC	4-channel digital input terminal, TwinSAFE, 24 V DC
Technical data	**EL1908**	**EL1904**
Connection technology	1-/2-wire	
Safety standard	DIN EN ISO 13849-1:2008 (Cat 4, PL e) and IEC 61508:2010 (SIL 3)	
Number of inputs	8	4
	 The EL1908 Safety EtherCAT Terminal has eight fail-safe inputs.	 The EL1904 Safety EtherCAT Terminal has four fail-safe inputs.
Protocol	TwinSAFE/Safety over EtherCAT	TwinSAFE/Safety over EtherCAT
Nominal voltage	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)
Current consumption power contacts	see documentation	see documentation
Current consumption E-bus	approx. 200 mA	approx. 200 mA
Response time	typ. 4 ms (read input/write to E-bus)	typ. 4 ms (read input/write to E-bus)
Fault response time	≤ watchdog time (parameterisable)	≤ watchdog time (parameterisable)
Permitted degree of contamination	2	2
Climate class EN 60721-3-3	3K3	3K3
Installation position	horizontal	horizontal
Special features	8 safe inputs	4 safe inputs
Operating/storage temperature	0…+55 °C/-40…+70 °C	-25…+55 °C/-40…+70 °C
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4	conforms to EN 61000-6-2/EN 61000-6-4
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27	conforms to EN 60068-2-6/EN 60068-2-27
Approvals	in preparation (CE, UL, Ex, TÜV SÜD)	CE, UL, Ex, TÜV SÜD
Weight	approx. 50 g	approx. 50 g
Protection class	IP 20	IP 20
Further information	www.beckhoff.com/EL1908	www.beckhoff.com/EL1904

For TwinSAFE products and further information on the TwinSAFE technology see page 966

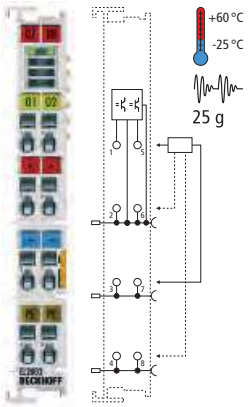
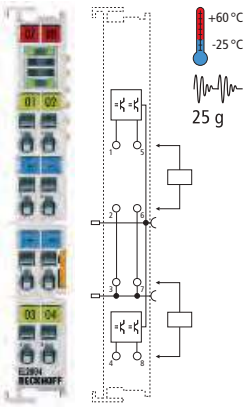
For availability status see Beckhoff website at: www.beckhoff.com/EL1908

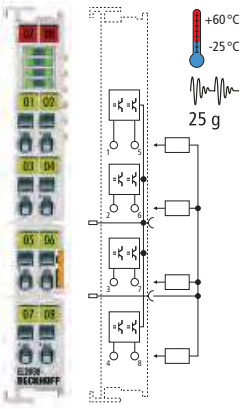
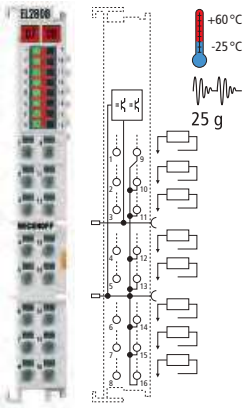
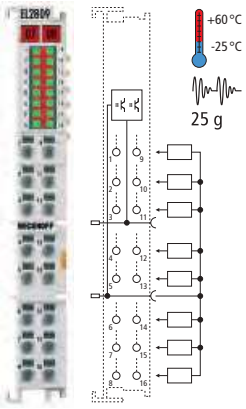
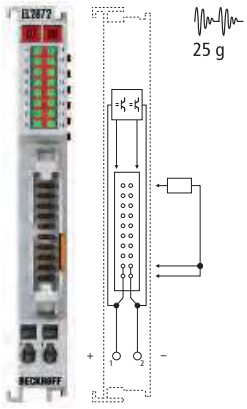
Digital output | 24 V DC, positive switching

Many actuators are driven or controlled with 24 V DC. The EtherCAT Terminals of the "positive switching" category switch all output channels to 24 V DC, so all connected actuators are hard-wired to ground (0 V). The output of an EtherCAT Terminal can be considered as a functional 24 V DC relay contact. The output circuit offers further functions such as short-circuit-current limitation, short-circuit switch-off and the rapid depletion of inductive energy from the coil.

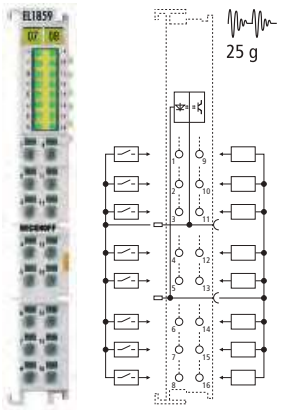
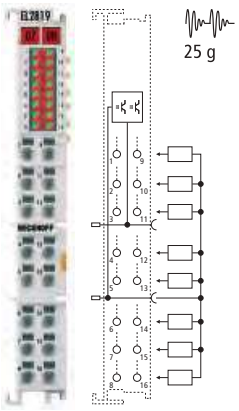
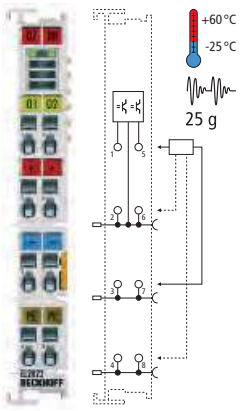
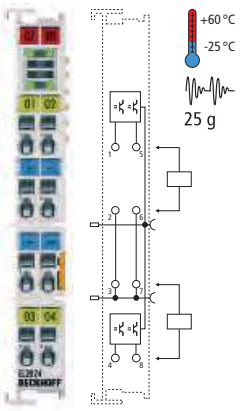
The most common output circuit delivers a maximum continuous current of 0.5 A. Special output terminals are available for higher currents. Any type of load (ohmic, capacitive, inductive) can be connected to an output terminal. As lamp and capacitive loads are critical due to their high starting currents, they are limited by the output circuits of the EtherCAT Terminals. This ensures that the upstream circuit-breaker is not triggered. Inductive loads are problematic at switch-off, as high induction voltages develop if the current is interrupted too fast. An integrated freewheeling diode prevents this voltage peak. However, the current is reduced so slowly that it leads to faults in many technical control applications. For example, a valve remains open for many milliseconds. The EtherCAT Terminals represent a compromise between prevention of overvoltage and rapid switch-off. They suppress the induction voltage to about 24 V DC and realise switch-off times which approximately correspond to the switch-on time of the coil.

In the case of short-circuit, the output circuit limits the current and prevents the activation of the upstream circuit-breaker. The EtherCAT Terminal maintains this current until important self-heating and finally switches off. After the circuit has cooled, it switches back on. The output signal is driven in time until the output of the controller is switched off or the short-circuit is rectified. The clock frequency depends on the ambient temperature and the load of the other terminal channels. The overload protection of the output is also realised by thermal switch-off.

	2-channel digital output terminal, 4-wire, 24 V DC, 0.5 A	4-channel digital output terminal, 2-wire, 24 V DC, 0.5 A
Technical data	**EL2002**	**EL2004**
Connection technology	4-wire	2-wire
Load type	ohmic, inductive, lamp load	
Max. output current	0.5 A (short-circuit-proof) per channel	0.5 A (short-circuit-proof) per channel
Switching times	typ. T_{ON}: 60 µs, typ. T_{OFF}: 300 µs	typ. T_{ON}: 60 µs, typ. T_{OFF}: 300 µs
Number of outputs	2	4
		 The digital EL2004 EtherCAT Terminal is suitable for the connection of four 2-wire actuators.
Nominal voltage	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)
Current consumption power contacts	typ. 15 mA + load	typ. 15 mA + load
Current consumption E-bus	typ. 100 mA	typ. 100 mA
Distributed clocks	–	–
Breaking energy	< 150 mJ/channel	< 150 mJ/channel
Reverse voltage protection	yes	yes
Short circuit current	–	typ. < 2 A
Operating temperature	-25…+60 °C	-25…+60 °C
Approvals	CE, UL, Ex	CE, UL, Ex
Weight	approx. 55 g	approx. 55 g
Further information	www.beckhoff.com/EL2002	www.beckhoff.com/EL2004

	8-channel digital output terminal, 1-wire, 24 V DC, 0.5 A	8-channel digital output terminal, 2-wire, 24 V DC, 0.5 A	16-channel digital output terminal, 1-wire, 24 V DC, 0.5 A	16-channel digital output terminal, flat-ribbon cable connection, 24 V DC	16-channel digital output terminal, D-sub, 24 V DC
	EL2008	**EL2808**	**EL2809**	**EL2872**	**EM2042**
	1-wire	2-wire	1-wire	flat-ribbon cable	D-sub
	0.5 A (short-circuit-proof) per channel	0.5 A (short-circuit-proof) per channel	0.5 A (short-circuit-proof) per channel	0.5 A (short-circuit-proof) per channel	0.5 A (short-circuit-proof) per channel
	typ. T_{ON}: 60 µs, typ. T_{OFF}: 300 µs	typ. T_{ON}: 60 µs, typ. T_{OFF}: 300 µs	typ. T_{ON}: 60 µs, typ. T_{OFF}: 300 µs	typ. T_{ON}: 60 µs, typ. T_{OFF}: 300 µs	typ. T_{ON}: 60 µs, typ. T_{OFF}: 300 µs
	8	8	16	16	16
					
	8-channel standard output terminal for 1-wire connection; output signalling through LED	The EL2808 High Density EtherCAT Terminal contains eight outputs for the connection of 2-wire actuators and thus allows a very high packing density.	16-channel standard output terminal for 1-wire connection; output signalling through LED		Plug X2 is included in the scope of supply.
	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)
	typ. 15 mA + load	typ. 15 mA + load	typ. 35 mA + load	typ. 25 mA + load (no power contacts)	X2: typ. 25 mA + load
	typ. 110 mA	typ. 110 mA	typ. 140 mA	typ. 130 mA	typ. 115 mA
	–	–	–	–	–
	< 150 mJ/channel	< 150 mJ/channel	< 150 mJ/channel	< 150 mJ/channel	< 150 mJ/channel
	yes	yes	yes	yes	yes
	typ. < 2 A	typ. < 2 A	typ. < 2 A	typ. < 2 A	typ. < 2 A
	-25…+60 °C	-25…+60 °C	-25…+60 °C	0…+55 °C	0…+55 °C
	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex	CE, UL	CE
	approx. 55 g	approx. 65 g	approx. 70 g	approx. 55 g	approx. 90 g
	www.beckhoff.com/EL2008	www.beckhoff.com/EL2808	www.beckhoff.com/EL2809	www.beckhoff.com/EL2872	www.beckhoff.com/EM2042

Digital output | 24 V DC, positive switching

	8-channel digital input + 8-channel digital output, 1-wire, 24 V DC, 0.5 A	16-channel digital output terminal, 1-wire, 24 V DC, 0.5 A, with diagnostics	2-channel digital output terminal, 4-wire, 24 V DC, 2 A (+ diagnostics)	4-channel digital output terminal, 2-wire, 24 V DC, 2 A
Technical data	**EL1859**	**EL2819**	**EL2022** | ES2022	**EL2024** | ES2024
Connection technology	1-wire		4-wire	2-wire
Load type	ohmic, inductive, lamp load			
Max. output current	0.5 A (short-circuit-proof) per channel	0.5 A (short-circuit-proof) per channel	2.0 A (short-circuit-proof) per channel	2.0 A (short-circuit-proof) per channel
Switching times	typ. T_{ON}: 60 µs, typ. T_{OFF}: 300 µs	typ. T_{ON}: 50 µs, typ. T_{OFF}: 100 µs	typ. T_{ON}: 40 µs, typ. T_{OFF}: 200 µs	typ. T_{ON}: 40 µs, typ. T_{OFF}: 200 µs
Number of outputs	8 outputs + 8 inputs	16	2	4
	 Combi EtherCAT Terminal with 8 digital inputs and outputs in HD direct plug-in technique and 1-wire connection	 16-channel output terminal with diagnostics		 Direct 2-wire connection of 4 actuators
Nominal voltage	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)
Current consum. pow. cont.	typ. 15 mA + load	typ. 50 mA + load	typ. 9 mA + load	typ. 13 mA + load
Current consumption E-bus	typ. 110 mA	typ. 90 mA	typ. 100 mA	typ. 120 mA
Distributed clocks	–	–	–	–
Breaking energy	< 150 mJ/channel	< 150 mJ/channel	< 1.7 J/channel	< 1.7 J/channel
Reverse voltage protection	yes	yes	yes	yes
Short circuit current	typ. < 2 A	< typ. 1 A	typ. < 70 A	typ. < 70 A
Special features	combi EtherCAT Terminal, 8 x input 24 V DC – input filter: 3 ms – type: 1/3	diagnostics via process data and LED: overtemperature, PowerFail, short circuit (per channel)	–	–
Operating temperature	0…+55 °C	0…+55 °C	-25…+60 °C	-25…+60 °C
Approvals	CE, UL, Ex	CE	CE, UL, Ex	CE, UL, Ex
Weight	approx. 65 g	approx. 70 g	approx. 55 g	approx. 55 g
Further information	www.beckhoff.com/EL1859	www.beckhoff.com/EL2819	www.beckhoff.com/EL2022	www.beckhoff.com/EL2024
Special terminals				EL2024-0010
Distinguishing features				nominal volt. 12 V DC

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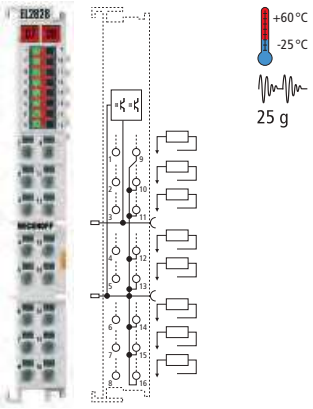
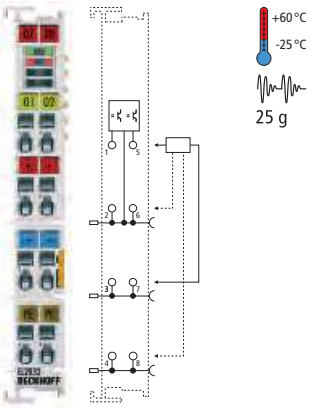
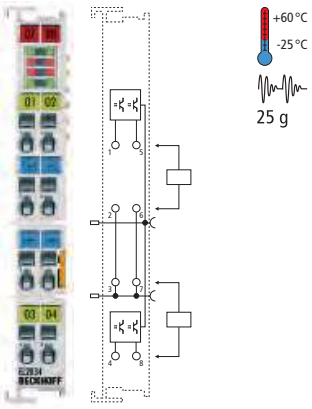
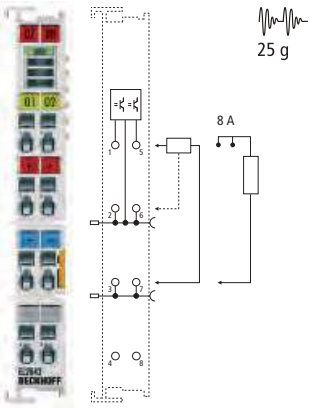
	8-channel digital output terminal, 2-wire, 24 V DC, 2 A	2-channel digital output terminal, 4-wire, 24 V DC, 2 A (+ diagnostics)	4-channel digital output terminal, 2-wire, 24 V DC, 2 A, with diagnostics	2-channel digital output terminal, 3-wire, 24 V DC, 2 x 4 A/1 x 8 A
	EL2828	**EL2032** | ES2032	**EL2034** | ES2034	**EL2042** | ES2042
		4-wire	2-wire	3-wire
	2 A (∑ 10 A)	2.0 A (short-circuit-proof) per channel	2.0 A (short-circuit-proof) per channel, with diagnostics	4.0 A (short-circuit-proof) per channel, 8 A for parallel connection
	typ. T_{ON}: 60 µs, typ. T_{OFF}: 250 µs	typ. T_{ON}: 40 µs, typ. T_{OFF}: 200 µs	typ. T_{ON}: 40 µs, typ. T_{OFF}: 200 µs	typ. T_{ON}: 40 µs, typ. T_{OFF}: 200 µs
	8	2	4	2
				
	The EL2828 High Density EtherCAT Terminal contains eight outputs for the connection of 2-wire actuators and thus allows a very high packing density.	The EL2032 has diagnostics for short circuit and open circuit.	Direct 2-wire connection of 4 actuators with diagnostics over EtherCAT	The EL2042 can supply up to 8 A output current if the outputs are connected in parallel.
	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)
	typ. 15 mA + load	typ. 13 mA + load	typ. 14 mA + load	typ. 15 mA + load
	typ. 110 mA	typ. 100 mA	typ. 120 mA	typ. 120 mA
	–	–	–	–
	< 1.2 J/channel	< 1.7 J/channel	< 1.7 J/channel	< 1.7 J/channel
	yes	yes	yes	yes
	< 40 A typ.	typ. < 70 A	typ. < 70 A	typ. < 70 A
	–	especially suitable for loads with high input current	diagnostics: short circuit and open circuit	–
	-25…+60 °C	-25…+60 °C	-25…+60 °C	0…+55 °C
	CE	CE, UL, Ex	CE, UL, Ex	CE
	approx. 70 g	approx. 55 g	approx. 55 g	approx. 55 g
	www.beckhoff.com/EL2828	www.beckhoff.com/EL2032	www.beckhoff.com/EL2034	www.beckhoff.com/EL2042

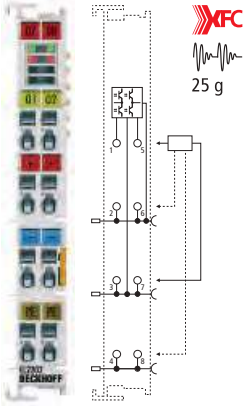
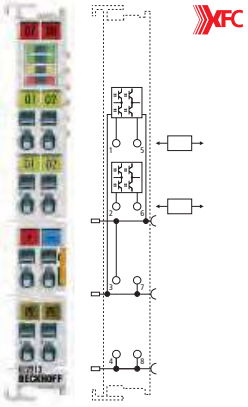
XFC digital output | 24 V DC, positive switching

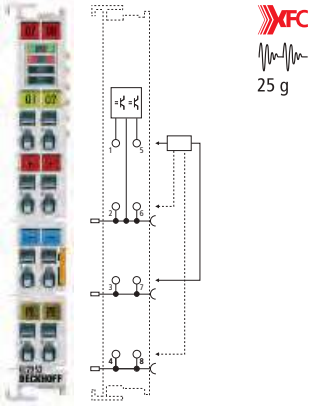
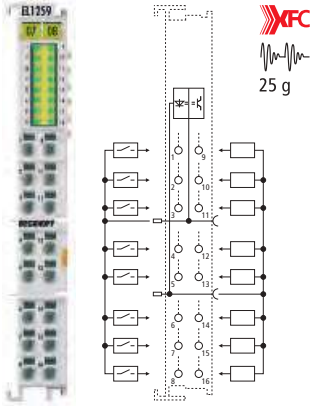
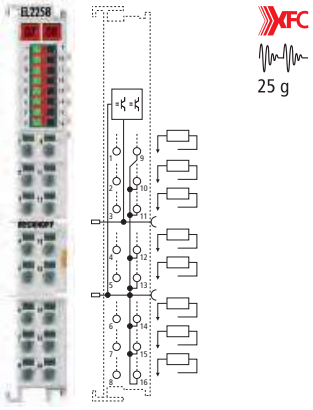
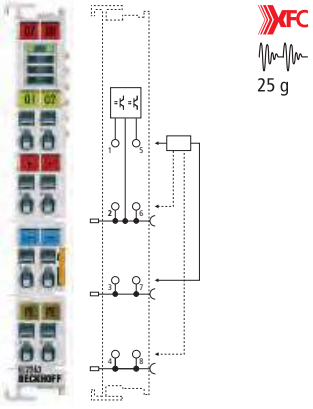
XFC – eXtreme Fast Control – comprises a fast controller, fast real-time capable communication and fast, high-precision input/output modules. Based on synchronisation through the distributed clocks principle, input modules read their inputs at exactly defined times. Outputs can be controlled with nanosecond precision, irrespective of restrictions through the bus cycle time or communication jitter. Further information on XFC see pages 298 and 346

EtherCAT components with DC support, such as shaft encoders, drives or I/O modules, enable synchronised, time-based operation for exact control of the mechanical components. All EL12xx terminals feature a fast input circuit, which enables the signal information from the field to be transferred to the communication level without delay. The EL22xx XFC output terminals connect their outputs correspondingly fast and with distributed clock accuracy.

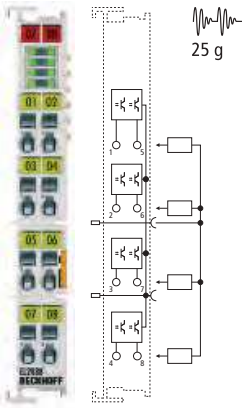
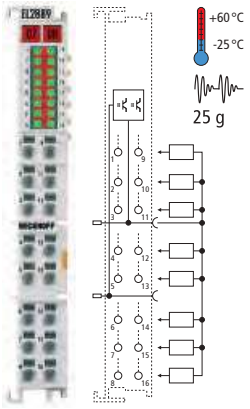
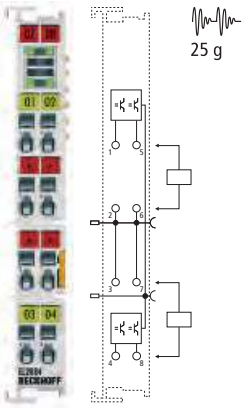
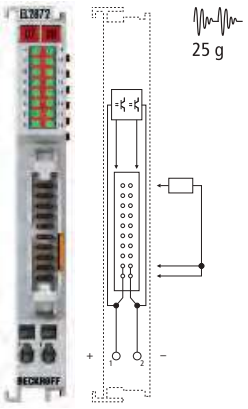
With overexcitation, the EL2212 supports the particularly fast switching of inductive loads, such as valves. A supply of 24…72 V is connected to the power contacts and passed through to the load when switched on. After an adjustable waiting period the terminal begins to control the current channel-wise in order to protect the load. The switching event is precisely positionable by the timestamping functionality. The switch-off process is also accelerated considerably by the pole reversal of the voltage.

The ELx258 and EL1259 EtherCAT HD terminals with multi-timestamping technology offer optimised sensor/actuator control with high channel density and compact design. In contrast to the ELx252 series with a timestamp per PLC cycle and a time resolution of 1 ns, the EL1258, EL1259 and EL2258 operate with up to 10 timestamps per PLC cycle and thus a 10…40 µs time interval. They can sample inputs or issue outputs at these intervals, synchronised through the distributed clocks.

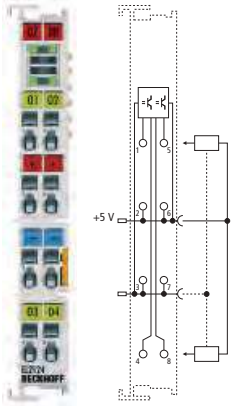
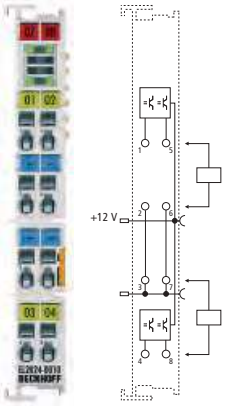
	2-channel digital output terminal, 4-wire, 24 V DC, T_{ON}/T_{OFF} 1 µs, push-pull outputs, tri-state	2-channel digital output terminal, 4-wire, 24…72 V DC, with multi-timestamping, overexcitation
Technical data	**EL2202** | ES2202	**EL2212** | ES2212
Connection technology	4-wire	
Load type	ohmic, inductive, lamp load	inductive > 1 mH
Max. output current	0.5 A (short-circuit-proof in push operation) per channel	peak current: max. 10 A per channel, holding current: 0.2…2.5 A per channel
Switching times	typ. T_{ON}: < 1 µs, typ. T_{OFF}: < 1 µs	without distributed clocks: T_{ON}/T_{OFF} typ. 20 µs, with distributed clocks: T_{ON}/T_{OFF} typ. < 1 µs via internal compensation
Number of outputs	2	2
		
Nominal voltage	24 V DC (-15 %/+20 %)	24…72 V DC (-15 %/+0 %)
Current consum. pow. cont.	typ. 30 mA + load	load-dependent
Current consumption E-bus	typ. 130 mA	typ. 120 mA
Distributed clocks	– (EL2202-0100 yes)	yes
Output stage	push-pull, high-ohmic	full bridge (push-pull)
Internal sampling/ execution	–	10 ns
Distributed clock precision	<< 1 µs	<< 1 µs
Oversampling/multi-timestamping factor	–	–
Breaking energy	< 150 mJ/channel	load-dependent
Reverse voltage protection	yes	–
Short circuit current	typ. < 1.5 A	12 A typ.
Special features	can be converted to DC version EL2202-0100, outputs connectable in high-resistance mode	Multi-timestamping, current-controlled outputs can be connected in high-resistance mode.
Operating temperature	0…+55 °C	0…+55 °C
Approvals	CE, Ex	CE
Weight	approx. 55 g	approx. 50 g
Further information	www.beckhoff.com/EL2202	www.beckhoff.com/EL2212

	2-channel digital output terminal, 4-wire, with timestamping, push-pull outputs, tri-state	8-channel digital input + 8-channel digital output, 1-wire, 24 V DC, multi-timestamping	8-channel digital output terminal, 2-wire, with multi-timestamping	2-channel digital output terminal, 4-wire, with oversampling, push-pull outputs
	EL2252 | ES2252	**EL1259**	**EL2258**	**EL2262** | ES2262
		1-wire	2-wire	4-wire
	ohmic, inductive, lamp load			
	0.5 A (short-circuit-proof) per channel	0.5 A (short-circuit-proof) per channel	0.5 A (short-circuit-proof) per channel	0.5 A (short-circuit-proof in push operation) per channel
	typ. T_{ON}: < 1 µs, typ. T_{OFF}: < 1 µs	typ. T_{ON}: < 1 µs, typ. T_{OFF}: < 1 µs	typ. T_{ON}: < 1 µs, typ. T_{OFF}: < 1 µs	typ. T_{ON}: < 1 µs, typ. T_{OFF}: < 1 µs
	2	8 outputs + 8 inputs	8	2
				
	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)
	typ. 30 mA + load	typ. 6 mA + load	typ. 30 mA + load	typ. 35 mA + load
	typ. 130 mA	typ. 90 mA	typ. 130 mA	typ. 70 mA
	yes	yes	yes	yes
	push-pull	push	push	push-pull
	10 ns	< 10…40 µs, corresponds to 100…25 k detectable edges/s, dependent on configuration	< 10…40 µs, corresponds to 100…25 k detectable edges/s, dependent on configuration	10 ns
	<< 1 µs	<< 1 µs	<< 1 µs	<< 1 µs
	–	n = integer multiple of the cycle time, 1…10	n = integer multiple of the cycle time, 1…10	n = integer multiple of the cycle time, 1…1,000
	< 150 mJ/channel	< 150 mJ/channel	< 150 mJ/channel	< 150 mJ/channel
	yes	yes	yes	yes
	typ. < 1.5 A	< typ. 1 A	< typ. 1 A	typ. < 1.5 A
	Timestamping, outputs can be connected in high-resistance mode, short-circuit-proof.	multi-timestamping, auto activation	multi-timestamping, auto activation, further information see page 347	up to 1,000 x oversampling
	0…+55 °C	0…+55 °C	0…+55 °C	0…+55 °C
	CE, Ex	CE	CE	CE, Ex
	approx. 60 g	approx. 55 g	approx. 55 g	approx. 60 g
	www.beckhoff.com/EL2252	www.beckhoff.com/EL1259	www.beckhoff.com/EL2258	www.beckhoff.com/EL2262

Digital output | 24 V DC, negative switching

	8-channel digital output terminal, 1-wire, 24 V DC, 0.5 A	16-channel digital output terminal, 1-wire, 24 V DC, 0.5 A	4-channel digital output terminal, 2-wire, 24 V DC, 0.5 A	16-channel digital output terminal, flat-ribbon cable connection, 24 V DC, 0.5 A
Technical data	**EL2088** | ES2088	**EL2889**	**EL2084** | ES2084	**EL2872-0010**
Connection technology	1-wire		2-wire	flat-ribbon cable
Load type	ohmic, inductive, lamp load			
Max. output current	0.5 A (short-circuit-proof) per channel	0.5 A (short-circuit-proof) per channel	0.5 A (short-circuit-proof) per channel	0.5 A (short-circuit-proof) per channel
Switching times	T_{ON}: 50 µs, T_{OFF}: 200 µs	T_{ON}: 50 µs, T_{OFF}: 200 µs	T_{ON}: 50 µs, T_{OFF}: 200 µs	T_{ON}: 50 µs, T_{OFF}: 200 µs
Number of outputs	8	16	4	16
				
	The negative switching EL2088 digital output terminal is suitable for the connection of eight actuators using 1-wire connection technology.	The negative switching EL2889 digital output terminal offers terminal points for 16 actuators using 1-wire connection technology and thus a very high packing density.	The negative switching EL2084 digital output terminal offers four outputs and additionally provides 24 V DC for each channel.	A 20-pin plug connector with 2.54 mm contact spacing enables the secure connection of plug connectors using insulation displacement contact, as is usual for ribbon cables and special round cables. The required 24 V DC voltage supply must be input by the ribbon cable or the terminal points 1 and 2.
Nominal voltage	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)
Current consumption power contacts	typ. 30 mA + load	typ. 30 mA + load	typ. 30 mA + load	typ. 30 mA + load
Current consumption E-bus	typ. 110 mA	typ. 140 mA	typ. 100 mA	typ. 130 mA
Distributed clocks	–	–	–	–
Breaking energy	< 100 mJ/channel	< 100 mJ/channel	< 100 mJ/channel	< 150 mJ/channel
Reverse voltage protection	yes	yes	yes	yes
Short circuit current	typ. < 7 A	typ. < 7 A	typ. < 7 A	typ. < 7 A
Operating temperature	0…+55 °C	-25…+60 °C	0…+55 °C	0…+55 °C
Approvals	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex	CE, UL
Weight	approx. 70 g	approx. 70 g	approx. 70 g	approx. 55 g
Further information	www.beckhoff.com/EL2088	www.beckhoff.com/EL2889	www.beckhoff.com/EL2084	www.beckhoff.com/EL2872

Digital output | 5/12 V DC, positive switching

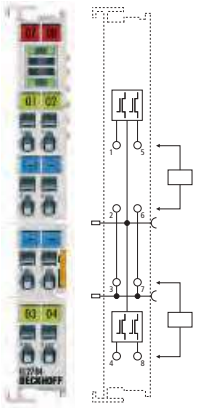
	4-channel digital output terminal, 2-/3-wire, 5 V DC, 20 mA	4-channel digital output terminal, 2-wire, 12 V DC, 2 A
Technical data	**EL2124** | ES2124	**EL2024-0010**
Connection technology	2-/3-wire	2-wire
Load type	ohmic, lamp load	ohmic, inductive, lamp load
Max. output current	±20 mA (short-circuit-proof) per channel, type CMOS output/push-pull	2.0 A (short-circuit-proof) per channel
Switching times	typ. T_{ON}: < 1 µs, typ. T_{OFF}: < 1 µs	typ. T_{ON}: 40 µs, typ. T_{OFF}: 200 µs
Number of outputs	4	4
	 25 g	 25 g
	The EL2124 is suitable for particularly fast switching of 5 V signals in push-pull mode. A 5 V supply is required via the power contacts, e.g. via a EL9505 power supply terminal.	The 12 V EL2024-0010 version is particularly suitable for automotive and building applications.
Nominal voltage	5 V DC	12 V DC (-15 %/+20 %)
Current consumption power contacts	typ. 12 mA + load	typ. 13 mA + load
Current consumption E-bus	typ. 130 mA	typ. 120 mA
Distributed clocks	–	–
Peak current	–	–
Isolation voltage (channel/channel)	no data	no data
On-resistance	no data	no data
Breaking energy	–	< 1.7 J/channel
Reverse voltage protection	–	yes
Short circuit current	typ. < 50 A	typ. < 70 A
Special features	fast 5 V output	for automotive applications
Operating temperature	0…+55 °C	0…+55 °C
Approvals	CE, UL, Ex	CE
Weight	approx. 70 g	approx. 55 g
Further information	www.beckhoff.com/EL2124	www.beckhoff.com/EL2024

Digital output | 30 V AC/DC, positive switching

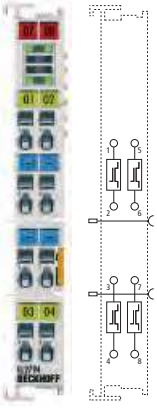
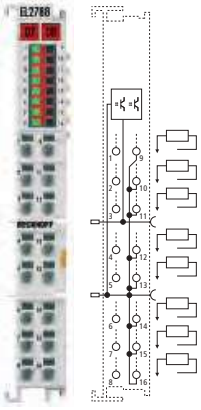
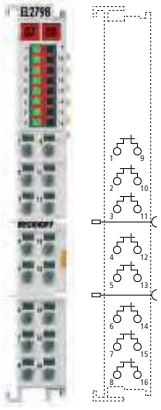
The EL2784, EL2788, EL2794 and EL2798 digital output terminals each provide four (EL27x4) or eight (EL27x8) switches, which can be used like a relay contact for AC/DC voltages. The EL2784 and EL2788 use power contacts as a common potential. In the KL2794 and KL2798, the power contacts are passed directly to the circuit without connection.

The electronic switch in the EtherCAT Terminal is implemented by efficient MOSFET transistors with a low switch-on resistance. The electronics are virtually wear-free. The switch itself is not short-circuit-proof, but can conduct a high current with its high pulse current capability long enough, until the circuit-breaker switches off. It behaves like a robust relay contact.

Inductive loads can be switched directly, without further safety measures. The circuit switches relatively slowly and prevents high peak voltages. No break sparks are created in the terminal and thus no electromagnetic interference pulse.

	4-channel digital output terminal, 2-wire, 30 V AC/DC, 2 A
Technical data	**EL2784**
Connection technology	2-wire
Load type	AC/DC loads
Max. output current	2 A
Switching times	T_{ON}: typ. 1.8 ms, T_{OFF}: typ. 30 ms
Number of outputs	4 x make contacts
	 25 g 4 electronic switches on the power contact
Nominal voltage	0…30 V AC/DC (only ohmic load: 0…48 V DC)
Current consumption power contacts	–
Current consumption E-bus	typ. 140 mA
Distributed clocks	–
Peak current	5 A (100 ms), < 50 A (10 ms)
Isolation voltage (channel/channel)	–
On-resistance	typ. 0.03 Ω
Breaking energy	no data
Reverse voltage protection	–
Short circuit current	not short-circuit-proof, see peak current
Special features	substitute for relay contacts
Operating temperature	0…+55 °C
Approvals	CE
Weight	approx. 70 g
Further information	www.beckhoff.com/EL2784

For availability status see Beckhoff website at: www.beckhoff.com

	4-channel digital output terminal, 2-wire, 30 V AC/DC, 2 A, potential-free	8-channel digital output terminal, 2-wire, 30 V AC/DC, 2 A	8-channel digital output terminal, 2-wire, 30 V AC/DC, 2 A, potential-free
	i EL2794	i EL2788	EL2798
	2 A	2 A	2 A
	T_{ON}: typ. 1.8 ms, T_{OFF}: typ. 30 ms	T_{ON}: typ. 1.8 ms, T_{OFF}: typ. 30 ms	T_{ON}: typ. 1.8 ms, T_{OFF}: typ. 30 ms
	4 x make contacts	8 x make contacts	8 x make contacts
	 25 g	 25 g	 25 g
	4 potential-free electronic switches	8 electronic switches on the power contact	8 potential-free electronic switches
	0…30 V AC/DC (only ohmic load: 0…48 V DC)	0…30 V AC/DC (only ohmic load: 0…48 V DC)	0…30 V AC/DC (only ohmic load: 0…48 V DC)
	–	–	–
	typ. 140 mA	typ. 140 mA	typ. 140 mA
	–	–	–
	5 A (100 ms), < 50 A (10 ms)	5 A (100 ms), < 50 A (10 ms)	5 A (100 ms), < 50 A (10 ms)
	< 200 V	–	< 200 V
	typ. 0.03 Ω	typ. 0.03 Ω	typ. 0.03 Ω
	no data	no data	no data
	–	–	–
	not short-circuit-proof, see peak current	not short-circuit-proof, see peak current	not short-circuit-proof, see peak current
	substitute for relay contacts, potential-free	substitute for relay contacts	substitute for relay contacts; potential-free
	0…+55 °C	0…+55 °C	0…+55 °C
	CE	CE	CE
	approx. 70 g	approx. 70 g	approx. 70 g
	www.beckhoff.com/EL2794	www.beckhoff.com/EL2788	www.beckhoff.com/EL2798

Digital output | 24 V DC, pulse train/frequency output

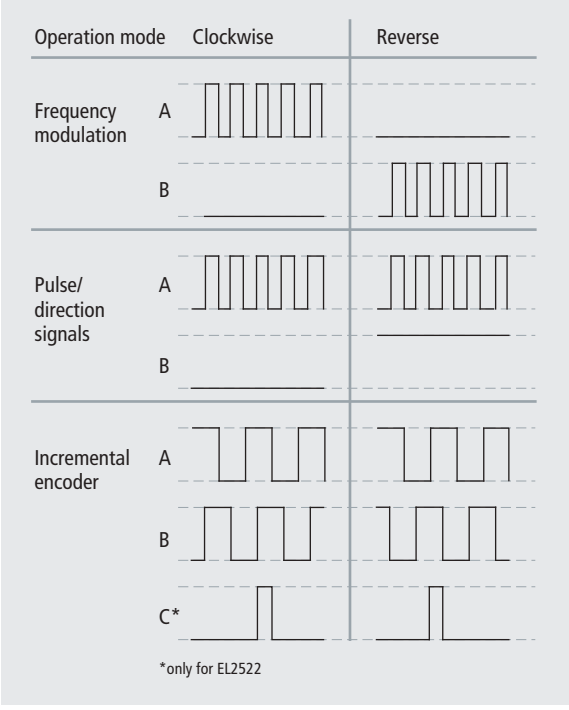
The output terminals of the series EL252x-xxxx issue a configurable pulse sequence via their outputs. The operating mode is individually configurable for each channel. These operating modes are available:

– frequency modulation on the individual channels (A- and B-channel)
– pulse direction setting
– incremental encoders

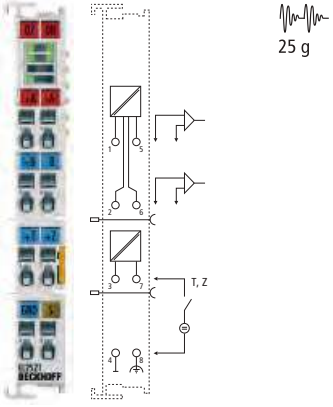
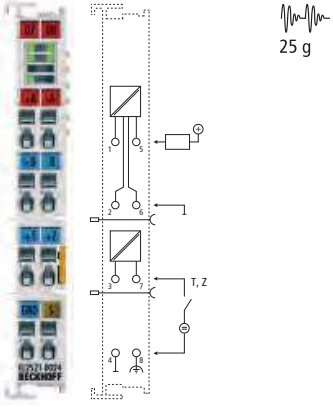
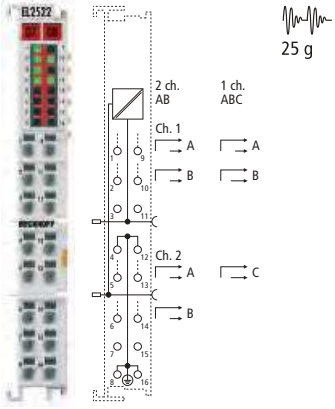
Pulse rate and frequency are specified by the controller via a 16-bit value. Distributed clock synchronisation enables the output to be synchronised with other EtherCAT slaves.

The EL2521-xxxx is a single-channel output terminal with two differential outputs and two digital inputs that are transferred into the process image. The two RS422-compatible differential outputs of the EL2521-0000 are supplied (electrically isolated) from the E-bus. In contrast, in the EL2521-0024 and EL2521-0025 the two output channels are designed as potential-free FET switches and have to be supplied externally. Moreover, in the EL2521-0025 the outputs switch to negative potential. Another available version is the EL2521-0124 with a 24 V latch input and an automatically switching 24 V output (Capture/Compare). In this way, the EtherCAT Terminal can automatically switch the output at a specifiable step number, for example for controlling an external device at a required position, independent of the bus cycle. The 100 mA switch output is short-circuit-proof.

The EL2522 is the two-channel version of the EL2521-0000 with the same functionality. In addition, in single-channel mode it offers the option to control three output channels in an ABC encoder simulation.



Frequency pulse patterns

	1-channel pulse train output terminal, 2 x RS422	1-channel pulse train output terminal, 2 x 24 V DC	Incremental encoder simulation terminal (pulse train)
Technical data	**EL2521 | ES2521**	**EL2521-0024**	**EL2522**
Connection technology	pulse train (frequency output)		
Load type	ohmic, min. 220 Ω	ohmic, inductive	ohmic, min. 220 Ω
Max. output current	RS422 specification, 50 mA	5…24 V DC, 1 A	RS422 specification, 50 mA
Number of outputs	1 channel (2 differential outputs A, B)	1 channel (2 outputs A, B)	2 channel A/B, 1 channel A/B/C (4 differential outputs)
			
Current consum. pow. cont.	–	load	typ. 50 mA (load-dependent)
Current consumption E-bus	typ. 280 mA (load-dependent)	typ. 280 mA (load-dependent)	typ. 120 mA
Distributed clocks	yes	yes	yes
Input specification	24 V DC	24 V DC	–
Output specification	RS422, differential	5…24 V DC	RS422, differential, 50 mA, min. 220 Ω load
Base frequency	0…500 kHz, 50 kHz default	0…500 kHz, 50 kHz default	0…4 MHz, 50 kHz default
Resolution	max. 15 bit (16 bit + sign)	max. 15 bit (16 bit + sign)	16 bit (incl. sign, scaled via the set frequency range)
Step size	10 mHz	10 mHz	min. 10 ns (internal)
Short circuit current	short-circuit-proof	–	short-circuit-proof
Special features	different modes, ramp function, travel distance control	different modes, ramp function, travel distance control	operating modes as with EL2521, ABC incremental encoder simulation including interfacing with TwinCAT NC
Operating temperature	0…+55 °C	0…+55 °C	0…+55 °C
Approvals	CE, UL, Ex	CE, Ex	CE
Weight	approx. 50 g	approx. 50 g	approx. 50 g
Further information	www.beckhoff.com/EL2521	www.beckhoff.com/EL2521	www.beckhoff.com/EL2522
Special terminals	**EL2521-0025**	**EL2521-0124**	
Distinguishing features	pulse train output, 24 V version, negative switching	24 V version with Capture/Compare input/output	

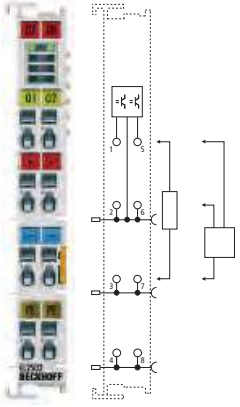
Digital output | **PWM up to 24/50 V DC, current control**

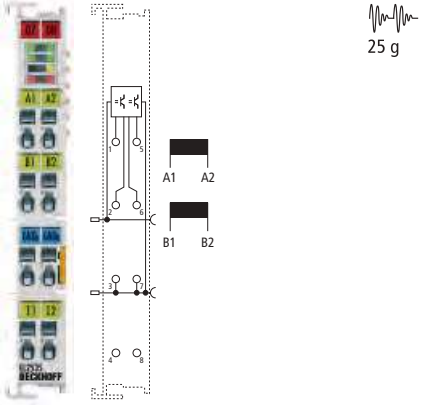
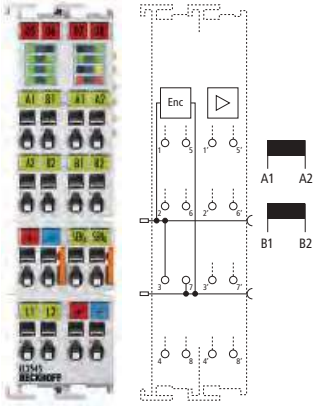
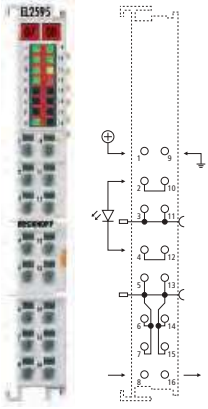
EtherCAT Terminals with PWM output are used to control variable actuators such as valves, solenoid coils, lamps, heating elements and rotary magnets. To this end, the base frequency can be set via the process data (EL2502) or through parameterisation. The EL25xx PWM terminals deal with determining switching times, thus taking a load off the central controller.

The EL2502 modulates its 24 V outputs independently in terms of frequency and pulse width based on the process data specification. The output stage is protected against overload and short circuit.

In contrast to the EL2502, which is an uncontrolled actuator and operates based on a specified duty factor, the EL2535 and EL2545 measure the actual current at an inductive load and regulate it through the duty factor based on the actual rated current specification. They also monitor overload and short circuit. Moreover, stored characteristic valve curves can be retrieved. The PWM frequency can be set separately for the two channels. Two digital 24 V inputs can be read via the process data. The EL2545 has a larger output stage and a 24 V incremental encoder unit. It can be used as a single- or two-encoder unit with up to 400,000 increments/second. In addition, a latch function and a reset function are available via the two digital inputs.

The EL2595 also enables connection of non-inductive loads and is particularly suitable for precisely timed pulse operation of LEDs, e.g. for camera lighting. In addition, the EL2595 enables continuous lighting with real-time diagnostics. Internally the EL2595 features a PWM stage, which is smoothed and filtered towards the output. This means that in practice almost a DC output voltage is available.

	2-channel pulse width output terminal, 24 V DC, 0.5 A
Technical data	**EL2502** | ES2502
Connection technology	PWM output, push-pull outputs
Load type	ohmic, inductive, lamp load
Max. output current	0.5 A (short-circuit-proof) per channel
Number of outputs	2
	 25 g
Nominal voltage	24 V DC (-15 %/+20 %)
Current consumption power contacts	typ. 30 mA + load
Current consumption E-bus	typ. 150 mA
Distributed clocks	–
PWM clock frequency	20 Hz…20 kHz, 250 Hz default
Duty factor	0…100 % (T_{ON} > 750 ns, T_{OFF} > 500 ns)
Resolution	10 bit
Reverse voltage protection	yes
Short circuit current	typ. < 1.5 A
Special features	separate frequency can be set for each channel
Operating temperature	0…+55 °C
Approvals	CE, UL, Ex
Weight	approx. 50 g
Further information	www.beckhoff.com/EL2502
Special terminals	
Distinguishing features	

	2-channel pulse width current terminal, 24 V DC, 1 A, current-controlled	2-channel pulse width current terminal, 50 V DC, 3.5 A, current-controlled, with incremental encoder	1-channel LED constant current terminal, 2-wire, adjustable
	EL2535 | ES2535	**EL2545** | ES2545	**EL2595**
			2-wire
	ohmic, inductive > 1 mH	inductive	ohmic
	1 A	3.5 A (short-circuit-proof, thermal overload-proof) per channel	700 mA steady load (short-circuit-proof)
	2	2	1
			
	24 V DC (-15 %/+20 %)	8…50 V DC	2…48 V DC (controlled automatically)
	typ. 30 mA + load	typ. 50 mA + load	typ. 20 mA + load
	typ. 110 mA	typ. 180 mA	typ. 130 mA
	–	yes	yes
	25 kHz default	25 kHz default	–
	0…100 % (current-controlled)	0…100 % (current-controlled)	typ. T_{ON}: < 1 µs, typ. T_{OFF}: < 1 µs
	10 bit	12 bit	–
	yes	yes	–
	typ. < 2 A	typ. < 5 A	–
	2 digital 24 V inputs	with encoder 5…24 V, 5 mA, single-ended, max. 100 kHz (400,000 increments/s)	optional automatic operation in case of communication interruption, extensive real-time diagnostics, external trigger input
	0…+55 °C	0…+55 °C	0…+55 °C
	CE	CE	CE
	approx. 50 g	approx. 50 g	approx. 55 g
	www.beckhoff.com/EL2535	www.beckhoff.com/EL2545	www.beckhoff.com/EL2595
	EL2535-0050 | **EL2535-0002**		
	output 50 mA | typ. 2 A		

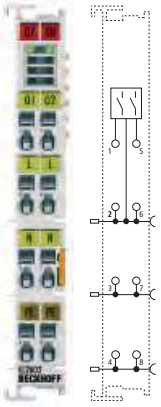
For availability status see Beckhoff website at: www.beckhoff.com/EL2545

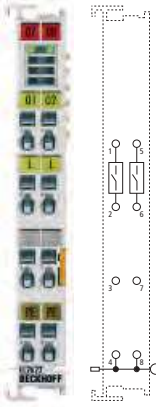
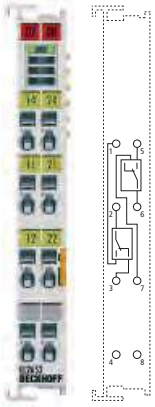
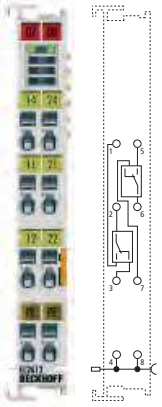
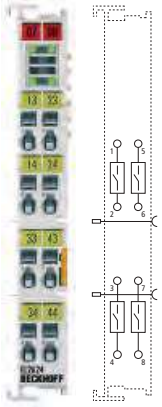
Digital output | **Relay outputs up to 230 V AC**

The EtherCAT Terminals switch a relay as a function of a bit in the process image. The relays completely isolate the current flow by a mechanical contact; there is no residual current through the open contact. The EtherCAT Terminals are not equipped with a protective circuit, so as not to allow for residual current by parallel switched components. The relay contacts differ in their contact material. Signal contacts also switch small voltages and currents; large current here leads to a change in the contact characteristics. Power contacts can also switch large loads. However, an oxide layer on the power contacts prevents safe contact for small voltages below 1 V DC. The contacts of the small-signal relays in the EL2612 and EL2614 are specially coated, so that they can switch small loads reliably. Should this coating become damaged through overload caused by high switching currents, only larger loads can be handled thereafter.

Switching on is accompanied by a bouncing: the electrical connection is initially switched on and off briefly, until the contact is securely in its closed location. With an inductive load (coil) this behaviour leads to a spark and to corresponding electromagnetic radiation. Capacitive loads create a short-circuit for a brief period of time. This can – particularly with alternating voltages – lead to such high switch-on currents at switch-on under peak value that the bouncing contact is burned shut. A capacitive load can also be electronic devices, which are typically equipped with a rectifier in the input and a relatively large smoothing capacitor. Electronic ballast is especially critical for fluorescent lamps. The maximum switch-on currents of the devices are generally specified in the technical data.

The relay is switched off through opening of a mechanical contact. An arc burns for a short moment and warms the contact. For an inductive load (coil) a large part of the magnetic energy stored in the coil is additionally released as heat at the contact. This load on the contact determines the service life of the relay and is called the electrical service life. The mechanical service life is defined as the number of switching operations without current flow through the contact.

	2-channel relay output terminal, 230 V AC/30 V DC
Technical data	**EL2602** | ES2602
Connection technology	relay output
Load type	ohmic, inductive, lamp load
Number of outputs	2 x make contacts for power contact
	
Nominal voltage	230 V AC/30 V DC
Current consumption power contacts	–
Current consumption E-bus	typ. 170 mA
Distributed clocks	–
Ohmic switching current	5 A AC/DC
Inductive switching current	2 A AC/DC
Switching current max.	–
Operat. cycles mech. (min.)	2 x 10^7
Operat. cycles electr. (min.)	1 x 10^5 (5 A/30 V DC)
Switching frequency max.	–
Lamp test, electronic ballast	4 x 58 W
Minimum permitted load	10 mA at 5 V DC
Special features	1-wire connection possible
Operating temperature	0…+55 °C
Approvals	CE, UL
Weight	approx. 50 g
Further information	www.beckhoff.com/EL2602

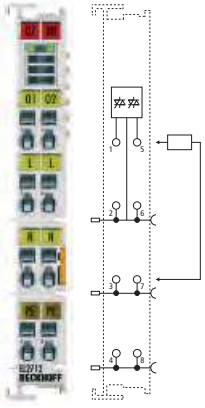
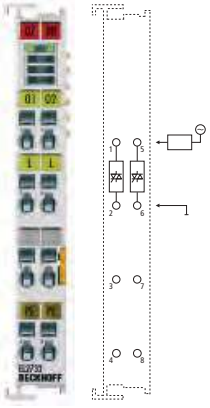
	2-channel relay output terminal, 230 V AC/30 V DC	2-channel relay output terminal, 230 V AC, 300 V DC	2-channel relay output terminal, 125 V AC/30 V DC	4-channel relay output terminal, 125 V AC/30 V DC
	EL2622 | ES2622	**EL2652** | ES2652	**EL2612** | ES2612	**EL2624** | ES2624
			ohmic	
	2 x make contacts	2 x change-over	2 x change-over	4 x make contacts
				
	230 V AC/30 V DC	230 V AC (max. switching voltage 250 V AC/300 V DC)	125 V AC/30 V DC	125 V AC/30 V DC
	–	– (no power contacts)	–	–
	typ. 170 mA	180 mA	typ. 150 mA	typ. 200 mA
	–	–	–	–
	5 A AC/DC	–	0.5 A AC/2 A DC	0.5 A AC/2 A DC
	2 A AC/DC	–	no data	no data
	–	1 A AC/1 A DC at 40 V DC; 0.15 A at 300 V DC (UL: max. 230 V AC, 1 A)	–	–
	2×10^7	5×10^6 (180 switching cycles/minute)	1×10^8	1×10^8
	1×10^5 (5 A/30 V DC)	1×10^6 (1 A/250 V AC ohmic load)	2×10^5 (1 A/30 V DC)	2×10^5 (1 A/30 V DC)
	–	6/min. (at rated load)	–	–
	4 x 58 W	–	–	–
	10 mA at 5 V DC	100 mA (12 V DC)	10 µA at 10 mV DC with intact contact coating	10 µA at 10 mV DC with intact contact coating
	–	reverse switching realisable	signal relay	–
	0…+55 °C	0…+55 °C	0…+55 °C	0…+55 °C
	CE, UL	CE	CE, UL	CE
	approx. 50 g	approx. 55 g	approx. 50 g	approx. 50 g
	www.beckhoff.com/EL2622	www.beckhoff.com/EL2652	www.beckhoff.com/EL2612	www.beckhoff.com/EL2624

Digital output | **Triac outputs up to 230 V AC**

In applications with particularly frequent switching operations the service life of a mechanical relay is potentially very short. An electronic switch in the form of triacs and Mosfet transistors is an almost wear-free replacement.

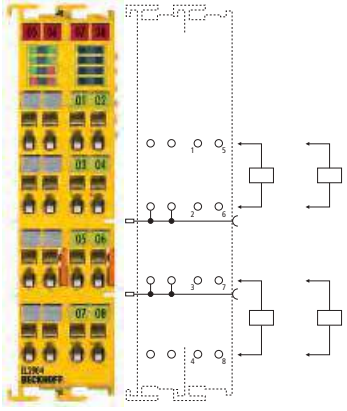
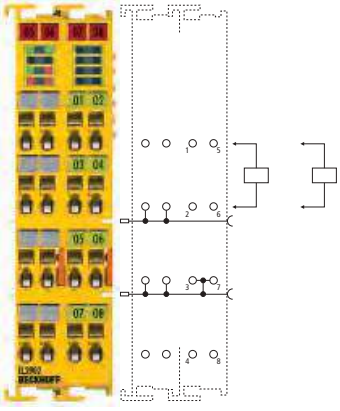
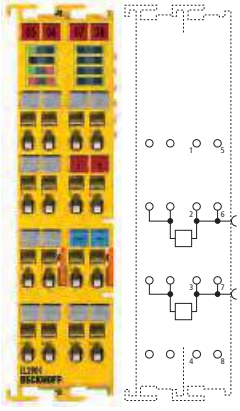
A triac is a robust switch and will only be used as a zero crossing switch in the EtherCAT Terminals. Switch-on only occurs in zero crossing voltage and switch-off only in zero crossing current. Inductive loads are therefore switched off without overvoltage. The disadvantage of a Triac is a relatively high voltage drop in switched-on state, which leads to a higher power dissipation compared to a relay contact. An essential protective circuit leads to a leakage current in switched-off state. The output is not safely isolated from the mains. Triacs need a minimum load so that they remain switched-on, and a minimum voltage for error-free zero crossing detection.

When fusing EtherCAT Terminals from the triac family it should be noted that electronic switches cannot withstand high short-circuit currents. The fuses which are used should at least be fast-acting (characteristic: F) with low rated/reference current.

	2-channel triac output terminal, up to 230 V AC		2-channel triac output terminal, up to 230 V AC, no power contacts
Technical data	**EL2712 | ES2712**	**EL2722 | ES2722**	**EL2732 | ES2732**
Connection technology	triac output, 2-wire		
Load type	ohmic, inductive		
Max. output current	0.5 A	1 A (0.5 A if both outputs are on)	0.5 A
Switching times	in zero crossing, 0.1…10 ms		in zero crossing, 0.1…10 ms
Number of outputs	2 x make contacts	2 x make contacts, mutually locked	2 x make contacts (without power contacts), mutually locked
			
Nominal voltage	12…230 V AC		12…230 V AC
Current consum. pow. cont.	–		–
Current consumption E-bus	typ. 120 mA		typ. 120 mA
Distributed clocks	–		–
Frequency range	47…63 Hz		47…63 Hz
Surge voltage protection	> 275 V		> 275 V
Peak current	40 A (16 ms), 1.5 A (30 s)		40 A (16 ms), 1.5 A (30 s)
Leakage current	typ. 0.8 mA, max. 1.5 mA (OFF state)		typ. 0.8 mA, max. 1.5 mA (OFF state)
Switch-off time	T/2		T/2
Maximum residual voltage	1.5 V (60 mA…1 A), 150 Ω (< 60 mA)		1.5 V (60 mA…1 A), 150 Ω (< 60 mA)
Special features	suitable for conventional blind motors		suitable for conventional blind motors
Operating temperature	0…+55 °C		0…+55 °C
Approvals	CE		CE
Weight	approx. 55 g		approx. 55 g
Further information	www.beckhoff.com/EL2712	www.beckhoff.com/EL2722	www.beckhoff.com/EL2732

For availability status see Beckhoff website at: www.beckhoff.com/EL2712

Digital output | 24 V DC, TwinSAFE

	4-channel digital output terminal, TwinSAFE, 24 V DC	2-channel digital output terminal, TwinSAFE, 24 V DC	Potential power supply terminal, TwinSAFE, 24 V DC, 10 A
Technical data	**EL2904**	**EL2902**	**EL2901**
Connection technology	1-/2-wire	1-wire	1-/2-wire and/or via power contacts
Safety standard	DIN EN ISO 13849-1:2008 (Cat 4, PL e) and IEC 61508:2010 (SIL 3)		
Max. output current	0.5 A (per channel), min. 20 mA (with active current measurement)	2.3 A (per channel)	10 A
Number of outputs	4	2	1
	 The EL2904 Safety EtherCAT Terminal has four outputs.	 The EL2902 Safety EtherCAT Terminal has two outputs.	 The EL2901 Safety EtherCAT Terminal switches the power contacts on two channels.
Protocol	TwinSAFE/Safety over EtherCAT	TwinSAFE/Safety over EtherCAT	TwinSAFE/Safety over EtherCAT
Nominal voltage	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)
Current consum. pow. cont.	load-dependent	load-dependent	load-dependent
Current consumption E-bus	approx. 221 mA	approx. 221 mA	approx. 221 mA
Fault response time	≤ watchdog time (parameterisable)	≤ watchdog time (parameterisable)	≤ watchdog time (parameterisable)
Permitted degree of contamination	2	2	2
Climate class EN 60721-3-3	3K3	3K3	3K3
Installation position	horizontal	horizontal	horizontal
Special features	4 safe outputs	2 safe outputs	safe power supply
Operating/storage temperature	-25…+55 °C/-40…+70 °C	0…+55 °C/-40…+70 °C	0…+55 °C/-40…+70 °C
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4	conforms to EN 61000-6-2/EN 61000-6-4	conforms to EN 61000-6-2/EN 61000-6-4
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27	conforms to EN 60068-2-6/EN 60068-2-27	conforms to EN 60068-2-6/EN 60068-2-27
Approvals	CE, UL, Ex, TÜV SÜD	in preparation (CE, UL, Ex, TÜV SÜD)	in preparation (CE, UL, Ex, TÜV SÜD)
Weight	approx. 90 g	approx. 90 g	approx. 90 g
Protection class	IP 20	IP 20	IP 20
Further information	www.beckhoff.com/EL2904	www.beckhoff.com/EL2902	www.beckhoff.com/EL2901

For TwinSAFE products and further information on the TwinSAFE technology see page 966

For availability status see Beckhoff website at: www.beckhoff.com

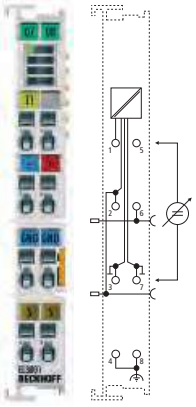
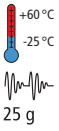
Analog input | -10…+10 V, 12 bit, single-ended

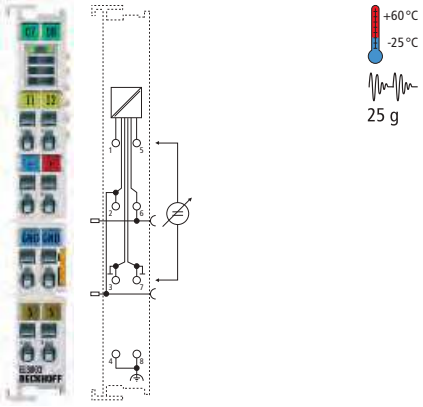
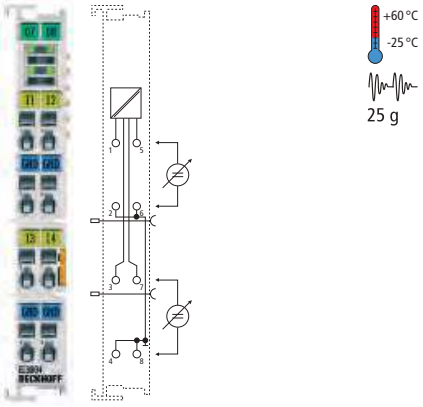
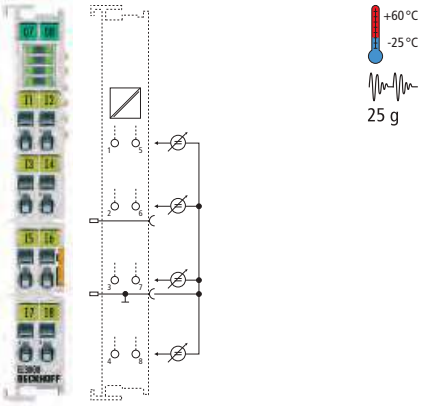
The EL3xxx EtherCAT Terminals read analog signal voltages in the common standard signal range of -10…+10 V, 0…10 V, 0…20 mA and 4…20 mA. Within the EtherCAT Terminal the field side is electrically isolated from the E-bus and enables interconnection to form potential groups as required. The 1-channel terminals are available for applications in which each signal must be completely electrically isolated. An additional electrically isolated 24 V DC supply can be created by the application of the EL9560 power supply terminal (24 V DC/24 V DC).

The analog input EtherCAT Terminals differ in their different resolutions of the analog/digital conversion, conversion speed and accuracy. For 1- and 2-channel terminals 1-, 2-, 3- and 4-wire connections are available for the sensors. 4-channel EtherCAT Terminals can only be used with 1- and 2-wire connections.

The input circuit of the EtherCAT Terminals differs between single-ended and differential inputs. A single-ended input expects a signal with a fixed reference to ground. In practice, single-ended is easily to be wired using single-wire connection. The differential input measures the difference between both inputs +I and -I. A superposition within the common-mode area (common-mode voltage) has no effect on the measuring result. For measurement two conductors should always be connected; in the case of single-wire connection input -I can be connected to ground.

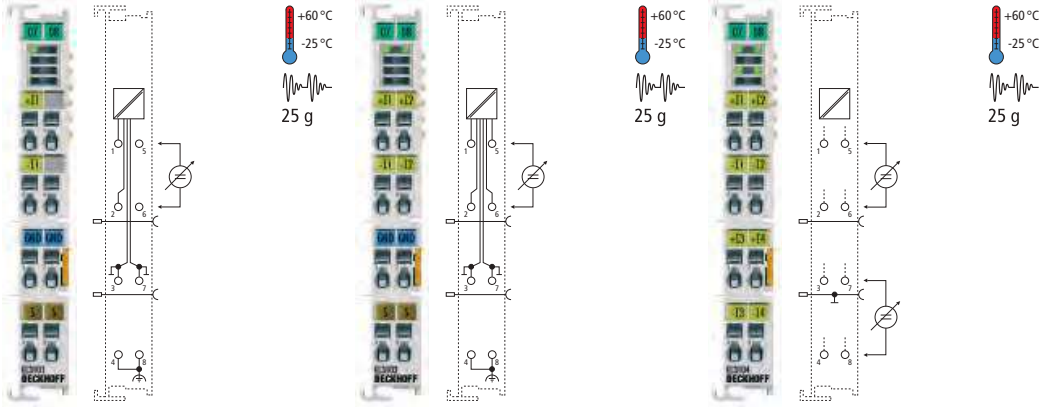
The product range is rounded off by further special input voltages and covers a wide field of application for the processing of analog signals. By the expansion of power supply terminals well-stabilised auxiliary voltages from 5 to 15 V can be generated.

	1-channel analog input terminal, -10…+10 V, 12 bit, single-ended
Technical data	**EL3001** | ES3001
Signal voltage	-10…+10 V
Resolution	12 bit (16 bit presentation, incl. sign)
Technology	single-ended
Conversion time	0.625 ms default setting, configurable
Number of inputs	1 (single-ended)
	  The EL3001 analog input terminal is characterised by its fine granularity and electrical isolation.
Dielectric strength	max. 30 V
Current consumption power contacts	–
Current consumption E-bus	typ. 130 mA
Distributed clocks	–
Internal resistance	> 130 kΩ
Input filter limit frequency	1 kHz
Measuring error	< ±0.3 % (relative to full scale value)
Special features	standard and compact process image, switchable measuring data representation, activatable FIR/IIR filters, limit value monitoring, overload display in the process data
Operating temperature	-25…+60 °C
Approvals	CE, UL, Ex
Weight	approx. 70 g
Further information	www.beckhoff.com/EL3001

	2-channel analog input terminal, -10…+10 V, 12 bit, single-ended	4-channel analog input terminal, -10…+10 V, 12 bit, single-ended	8-channel analog input terminal, -10…+10 V, 12 bit, single-ended
	EL3002 | ES3002	**EL3004** | ES3004	**EL3008** | ES3008
	single-ended	single-ended	single-ended
	0.625 ms default setting, configurable	0.625 ms default setting, configurable	1.25 ms default setting, configurable
	2 (single-ended)	4 (single-ended)	8 (single-ended)
			
	The EL3002 analog input terminal combines two analog inputs with a common internal ground potential in one housing.	The four single-ended inputs of the EL3004 have a common reference ground that is fed out. A 2-wire connection is thus possible.	With eight input channels, the EL3008 is particularly suitable for space-saving installation in the control cabinet. The common reference ground is the 0 V power contact. A 0 V distribution terminal, e.g. EL9187 or EL9189, must be added for a 2-wire connection.
	max. 30 V	max. 30 V	max. 30 V
	–	–	–
	typ. 130 mA	typ. 130 mA	typ. 130 mA
	–	–	–
	> 130 kΩ	> 130 kΩ	> 130 kΩ
	1 kHz	1 kHz	1 kHz
	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)
	standard and compact process image, switchable measuring data representation, activatable FIR/IIR filters, limit value monitoring, overload display in the process data	standard and compact process image, switchable measuring data representation, activatable FIR/IIR filters, limit value monitoring, overload display in the process data	standard and compact process image, switchable measuring data representation, activatable FIR/IIR filters, limit value monitoring, overload display in the process data
	-25…+60 °C	-25…+60 °C	-25…+60 °C
	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex
	approx. 70 g	approx. 70 g	approx. 70 g
	www.beckhoff.com/EL3002	www.beckhoff.com/EL3004	www.beckhoff.com/EL3008

Analog input | -10…+10 V, 16 bit, differential input

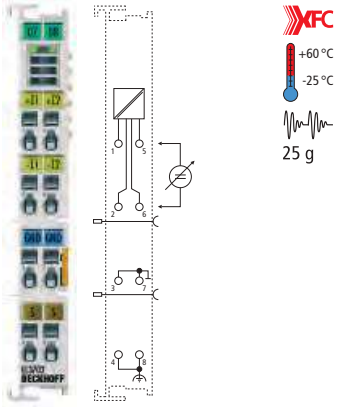
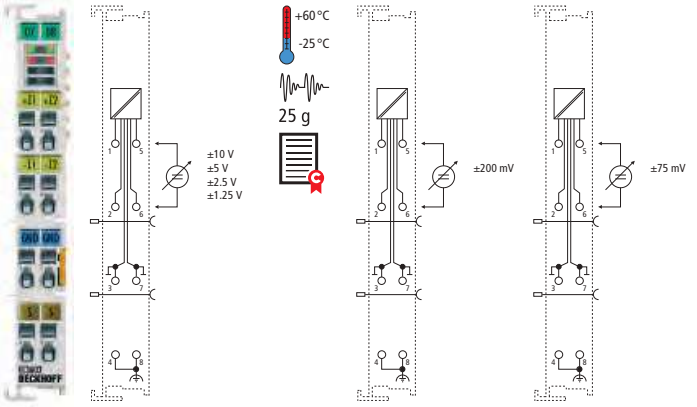
	1-channel analog input terminal, -10…+10 V, 16 bit, differential input	2-channel analog input terminal, -10…+10 V, 16 bit, differential input	4-channel analog input terminal, -10…+10 V, 16 bit, differential input
Technical data	**EL3101** | ES3101	**EL3102** | ES3102	**EL3104** | ES3104
Signal voltage	-10…+10 V		
Resolution	16 bit (incl. sign)		
Technology	differential input	differential input	differential input
Conversion time	~ 40 µs	~ 60 µs (fast mode ~ 40 µs)	~ 100 µs
Number of inputs	1 (differential)	2 (differential)	4 (differential)



The EL310x analog input terminals measure input voltages from -10 to +10 V with 16-bit resolution. The significantly faster conversion time and support for distributed clocks enable use in time-critical applications and set them apart from the EL30xx series. The differential inputs of the EL3102/EL3104 have the same reference ground.

Common-mode voltage U_{CM}	35 V max.	35 V max.	35 V max.
Current consumption power contacts	–	–	–
Current consumption E-bus	typ. 130 mA	typ. 170 mA	typ. 130 mA
Distributed clocks	yes	yes	yes
Oversampling factor	–	–	–
Distributed clock precision	<< 1 µs	<< 1 µs	<< 1 µs
Input signal bandwidth	–	–	–
Internal resistance	> 200 kΩ	> 200 kΩ	> 200 kΩ
Input filter limit frequency	5 kHz	5 kHz	5 kHz
Measuring error	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)
Special features	standard and compact process image, switchable measuring data representation, activatable FIR/IIR filters, limit value monitoring	standard and compact process image, switchable measuring data representation, activatable FIR/IIR filters, limit value monitoring	standard and compact process image, switchable measuring data representation, activatable FIR/IIR filters, limit value monitoring
Operating temperature	-25…+60 °C	-25…+60 °C	-25…+60 °C
Approvals	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex
Weight	approx. 60 g	approx. 60 g	approx. 65 g
Further information	www.beckhoff.com/EL3101	www.beckhoff.com/EL3102	www.beckhoff.com/EL3104

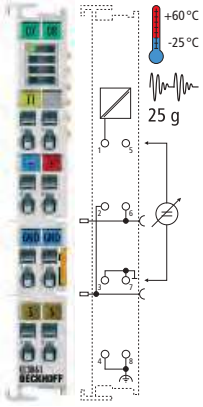
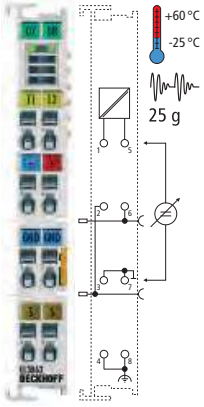
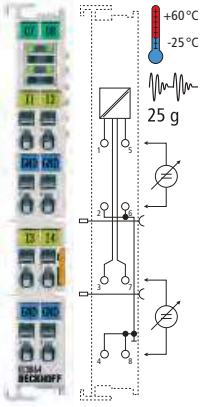
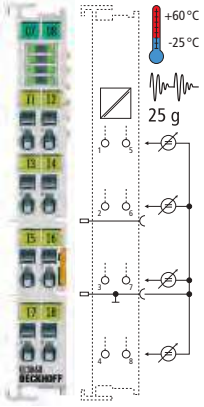
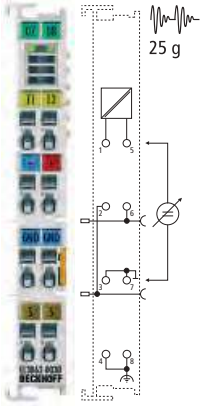
Analog input | **Oversampling, precision measurement**

	2-channel analog input terminal, -10…+10 V, 16 bit, oversampling, differential input	2-channel analog input terminal, -10…+10 V, 24 bit, differential input	2-channel analog input terminal, ±200 mV, differential input, 24 bit	2-channel analog input term., -75…+75 mV, 24 bit, differential input
Technical data	**EL3702** | ES3702	**EL3602** | ES3602	**EL3602-0002**	**EL3602-0010**
Signal voltage	-10…+10 V	-10…+10 V, -5…+5 V, -2.5…+2.5 V, -1.25…+1.25 V (parameterisable)	-200…+200 mV	-75…+75 mV
Resolution	16 bit (incl. sign)	24 bit (incl. sign)		
Technology	differential input, oversampling	differential input		
Conversion time	~ 10 µs per sample	20 ms default setting, 1…400 ms configurable		
Number of inputs	2 (differential)	2 (differential)		
				
	The ±10 V signals are sampled with an adjustable integral multiple (oversampling factor: n) of the bus cycle time (n microcycles for each bus cycle). For each microcycle a process data block is generated and transferred collectively during the next bus cycle.	The EL3602 terminal is a precise measuring device with 24-bit resolution and a common ground potential for both differential inputs. Shielded connecting cables, secure shield and earth connections and a controlled ambient temperature are necessary in order to obtain precise results. The EL9195 shield terminal is to be placed adjacently if necessary.		
Common-mode voltage U_{CM}	35 V max.	35 V max.		
Current consum. pow. cont.	–	–		
Current consumption E-bus	typ. 200 mA	typ. 190 mA		
Distributed clocks	yes	–		
Oversampling factor	n = 1…100 select. (max. 100 ksamples/s)	–		
Distributed clock precision	<< 1 µs	–		
Input signal bandwidth	0…30 kHz recommended	–		
Internal resistance	> 200 kΩ	> 200 kΩ		
Input filter limit frequency	30 kHz	3 kHz	3 kHz	10 kHz
Measuring error	< ±0.3 % up to 10 Hz (relative to full scale value)	< ±0.01 % at 25 °C, 50 Hz filter (relative to full scale value)	< ±0.05 % at 25 °C, 50 Hz filter (relative to full scale value)	
Special features	oversampling	various filter times, limit value monitoring, high precision		
Operating temperature	-25…+60 °C	-25…+60 °C	0…+55 °C	0…+55 °C
Approvals	CE, UL, Ex	CE, UL, Ex		
Weight	approx. 60 g	approx. 60 g		
Further information	www.beckhoff.com/EL3702	www.beckhoff.com/EL3602		
Special terminals		EL3602-0020		
Distinguishing features		with calibration certificate		

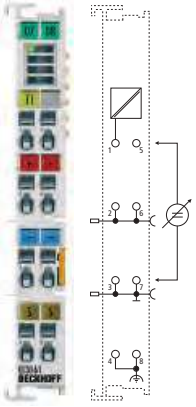
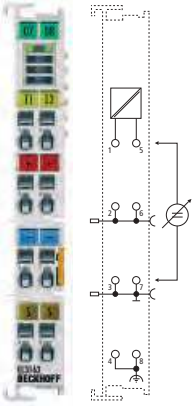
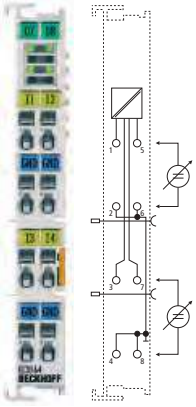
Further information on XFC see page 298

For availability status see Beckhoff website at: www.beckhoff.com/EL3602

Analog input | 0…10 V/30 V, 12 bit, single-ended

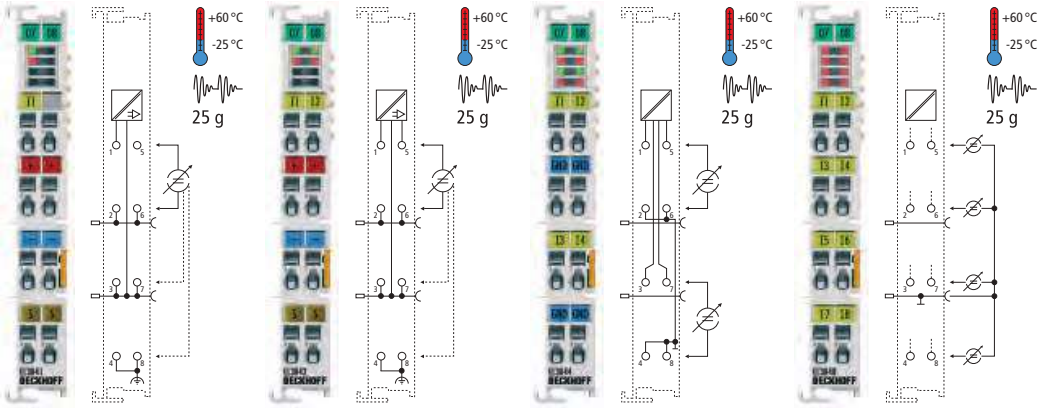
	1-channel analog input terminal, 0…10 V, 12 bit, single-ended	2-channel analog input terminal, 0…10 V, 12 bit, single-ended	4-channel analog input terminal, 0…10 V, 12 bit, single-ended	8-channel analog input terminal, 0…10 V, 12 bit, single-ended	2-channel analog input terminal, 0…30 V, 12 bit, single-ended
Technical data	**EL3061** | ES3061	**EL3062** | ES3062	**EL3064** | ES3064	**EL3068** | ES3068	**EL3062-0030**
Signal voltage	0…10 V				0…30 V
Resolution	12 bit (16 bit presentation, incl. sign)				
Technology	single-ended	single-ended	single-ended	single-ended	single-ended
Conversion time	0.625 ms default setting, configurable	0.625 ms default setting, configurable	0.625 ms default setting, configurable	1.25 ms default setting, configurable	0.625 ms default setting, configurable
Number of inputs	1 (single-ended)	2 (single-ended)	4 (single-ended)	8 (single-ended)	2 (single-ended)
					
Dielectric strength	max. 30 V	max. 30 V	max. 30 V	max. 30 V	max. 30 V
Current consumption power contacts	–	–	–	–	–
Current consumption E-bus	typ. 130 mA	typ. 130 mA	typ. 130 mA	typ. 130 mA	typ. 130 mA
Distributed clocks	–	–	–	–	–
Internal resistance	> 130 kΩ	> 130 kΩ	> 130 kΩ	> 130 kΩ	> 130 kΩ
Input filter limit frequency	1 kHz	1 kHz	1 kHz	1 kHz	1 kHz
Measuring error	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)
Special features	activatable FIR/IIR filters, limit value monitoring	activatable FIR/IIR filters, limit value monitoring	activatable FIR/IIR filters, limit value monitoring	activatable FIR/IIR filters, limit value monitoring	activatable FIR/IIR filters, limit value monitoring
Operating temperature	-25…+60 °C	-25…+60 °C	-25…+60 °C	-25…+60 °C	0…+55 °C
Approvals	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex	CE, Ex
Weight	approx. 60 g	approx. 60 g	approx. 60 g	approx. 60 g	approx. 60 g
Further information	www.beckhoff.com/EL3061	www.beckhoff.com/EL3062	www.beckhoff.com/EL3064	www.beckhoff.com/EL3068	www.beckhoff.com/EL3062

Analog input | 0…10 V, 16 bit, single-ended

	1-channel analog input terminal, 0…10 V, 16 bit, single-ended	2-channel analog input terminal, 0…10 V, 16 bit, single-ended	4-channel analog input terminal, 0…10 V, 16 bit, single-ended
Technical data	**EL3161** | ES3161	**EL3162** | ES3162	**EL3164** | ES3164
Signal voltage	0…10 V		
Resolution	16 bit (incl. sign)		
Technology	single-ended	single-ended	single-ended
Conversion time	~ 35 µs	~ 50 µs	~ 100 µs
Number of inputs	1 (single-ended)	2 (single-ended)	4 (single-ended)
	 25 g	 25 g	 25 g
	The EL316x analog input terminals measure input voltages from 0 to 10 V with 16-bit resolution. The significantly faster conversion time and support for distributed clocks enable use in time-critical applications and set them apart from the EL30xx series. The inputs have a common reference potential and display overrange and limit evaluation via the process data.		
Dielectric strength	max. 30 V	max. 30 V	max. 30 V
Current consumption power contacts	–	–	–
Current consumption E-bus	typ. 130 mA	typ. 130 mA	typ. 130 mA
Distributed clocks	yes	yes	yes
Internal resistance	> 200 kΩ	> 200 kΩ	> 200 kΩ
Input filter limit frequency	5 kHz	5 kHz	5 kHz
Measuring error	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)
Special features	standard and compact process image, activatable FIR/IIR filters, limit value monitoring	standard and compact process image, activatable FIR/IIR filters, limit value monitoring	standard and compact process image, activatable FIR/IIR filters, limit value monitoring
Operating temperature	0…+55 °C	0…+55 °C	0…+55 °C
Approvals	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex
Weight	approx. 60 g	approx. 60 g	approx. 65 g
Further information	www.beckhoff.com/EL3161	www.beckhoff.com/EL3162	www.beckhoff.com/EL3164

Analog input | 0…20 mA, 12 bit, single-ended

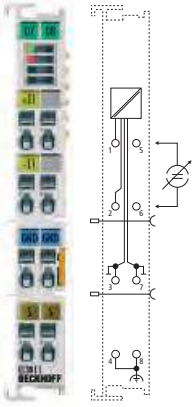
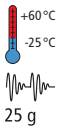
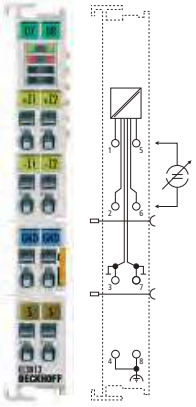
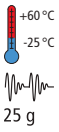
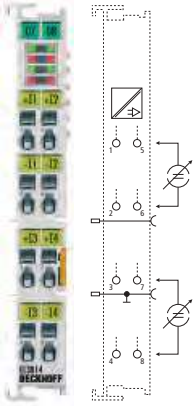
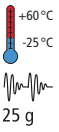
	1-channel analog input terminal, 0…20 mA, 12 bit, single-ended	2-channel analog input terminal, 0…20 mA, 12 bit, single-ended	4-channel analog input terminal, 0…20 mA, 12 bit, single-ended	8-channel analog input terminal, 0…20 mA, 12 bit, single-ended
Technical data	**EL3041** | ES3041	**EL3042** | ES3042	**EL3044** | ES3044	**EL3048** | ES3048
Signal voltage	0…20 mA			
Resolution	12 bit (16 bit presentation, incl. sign)			
Technology	single-ended	single-ended	single-ended	single-ended
Conversion time	0.625 ms default setting, configurable	0.625 ms default setting, configurable	0.625 ms default setting, configurable	1.25 ms default setting, configurable
Number of inputs	1 (single-ended)	2 (single-ended)	4 (single-ended)	8 (single-ended)



The EL304x analog input terminals have a common reference potential. This reference potential is connected to the 0 V power contact in the EL3041, EL3042 and EL3048. Overcurrent is displayed not only in the process image, but also by an error LED for each channel.

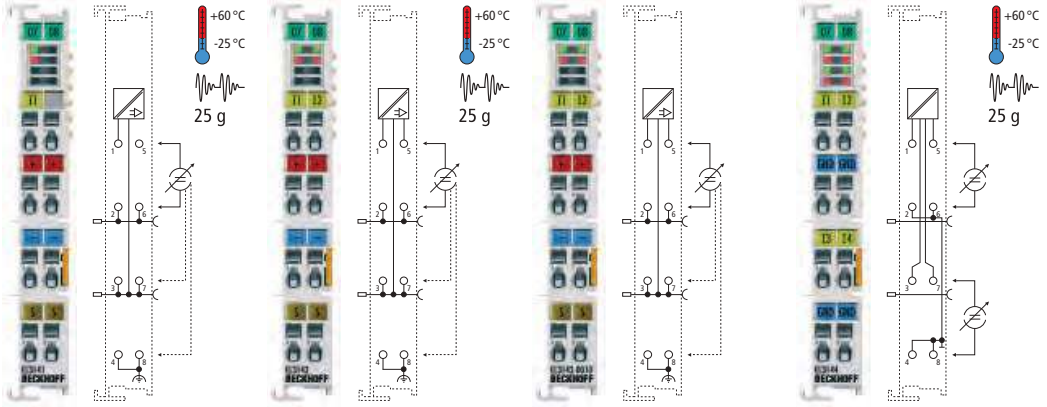
Dielectric strength	max. 30 V	max. 30 V	max. 30 V	max. 30 V
Current consumption power contacts	–	–	–	–
Current consumption E-bus	typ. 130 mA	typ. 130 mA	typ. 130 mA	typ. 130 mA
Distributed clocks	–	–	–	–
Internal resistance	85 Ω typ. + diode voltage	85 Ω typ. + diode voltage	85 Ω typ. + diode voltage	85 Ω typ. + diode voltage
Input filter limit frequency	1 kHz	1 kHz	1 kHz	1 kHz
Measuring error	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)
Special features	standard and compact process image, activatable FIR/IIR filters, limit value monitoring	standard and compact process image, activatable FIR/IIR filters, limit value monitoring	standard and compact process image, activatable FIR/IIR filters, limit value monitoring	standard and compact process image, activatable FIR/IIR filters, limit value monitoring
Operating temperature	-25…+60 °C	-25…+60 °C	-25…+60 °C	-25…+60 °C
Approvals	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex
Weight	approx. 60 g	approx. 60 g	approx. 60 g	approx. 60 g
Further information	www.beckhoff.com/EL3041	www.beckhoff.com/EL3042	www.beckhoff.com/EL3044	www.beckhoff.com/EL3048

Analog input | 0…20 mA, 12 bit, differential input

	1-channel analog input terminal, 0…20 mA, 12 bit, differential input	2-channel analog input terminal, 0…20 mA, 12 bit, differential input	4-channel analog input terminal, 0…20 mA, 12 bit, differential input
Technical data	**EL3011** | ES3011	**EL3012** | ES3012	**EL3014** | ES3014
Signal voltage	0…20 mA		
Resolution	12 bit (16 bit presentation, incl. sign)		
Technology	differential input	differential input	differential input
Conversion time	0.625 ms default setting, configurable	0.625 ms default setting, configurable	0.625 ms default setting, configurable
Number of inputs	1 (differential)	2 (differential)	4 (differential)
	      The differential inputs of the EL301x series measure the current between input and output as a floating current measurement. Overcurrent is displayed not only in the process image, but also by an error LED for each channel.		
Common-mode voltage U_{CM}	10 V max.	10 V max.	10 V max.
Current consumption power contacts	–	–	–
Current consumption E-bus	typ. 130 mA	typ. 130 mA	typ. 130 mA
Distributed clocks	–	–	–
Internal resistance	85 Ω typ. + diode voltage	85 Ω typ. + diode voltage	85 Ω typ. + diode voltage
Input filter limit frequency	1 kHz	1 kHz	1 kHz
Measuring error	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)
Special features	activatable FIR/IIR filters, limit value monitoring	activatable FIR/IIR filters, limit value monitoring	activatable FIR/IIR filters, limit value monitoring
Operating temperature	-25…+60 °C	-25…+60 °C	-25…+60 °C
Approvals	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex
Weight	approx. 55 g	approx. 55 g	approx. 55 g
Further information	www.beckhoff.com/EL3011	www.beckhoff.com/EL3012	www.beckhoff.com/EL3014

Analog input | 0…20 mA, 16 bit, single-ended

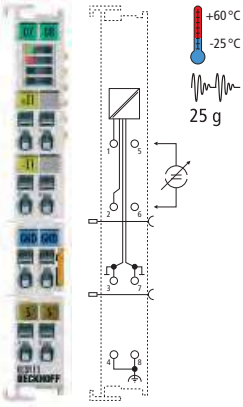
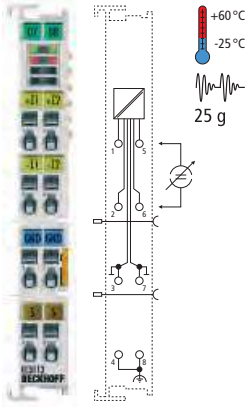
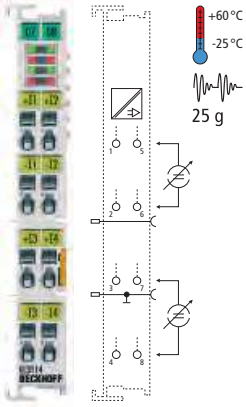
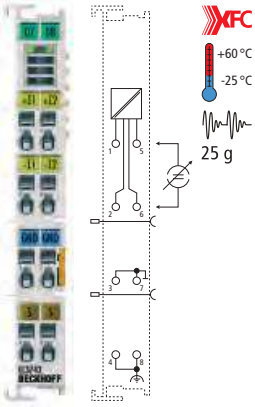
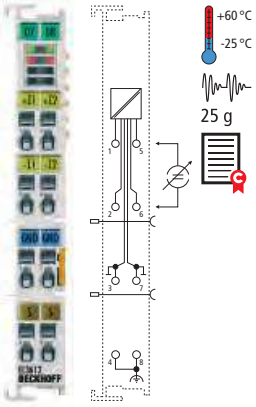
	1-channel analog input terminal, 0…20 mA, 16 bit, single-ended	2-channel analog input terminal, 0…20 mA, 16 bit, single-ended	2-channel analog input terminal, -10…+10 mA, 16 bit, single-ended	4-channel analog input terminal, 0…20 mA, 16 bit, single-ended
Technical data	**EL3141** | ES3141	**EL3142** | ES3142	**EL3142-0010**	**EL3144** | ES3144
Signal voltage	0…20 mA		-10…+10 mA	0…20 mA
Resolution	16 bit (incl. sign)			
Technology	single-ended	single-ended	single-ended	single-ended
Conversion time	~ 40 µs	~ 60 µs (fast mode ~ 40 µs)	~ 60 µs (fast mode ~ 40 µs)	~ 40 µs
Number of inputs	1 (single-ended)	2 (single-ended)	2 (single-ended)	4 (single-ended)



The EL314x analog input terminals measure input currents from 0 to 20 mA. The significantly faster conversion time and support for distributed clocks enable use in time-critical applications and set them apart from the EL30xx series. Overcurrent is displayed not only in the process image, but also by an error LED for each channel.

Dielectric strength	max. 30 V	max. 30 V	max. 30 V	max. 30 V
Current consum. pow. cont.	–	–	–	–
Current consumption E-bus	typ. 130 mA	typ. 170 mA	typ. 170 mA	typ. 130 mA
Distributed clocks	yes	yes	yes	yes
Oversampling factor	–	–	–	–
Distributed clock precision	<< 1 µs	<< 1 µs	<< 1 µs	<< 1 µs
Input signal bandwidth	see input filter	see input filter	see input filter	see input filter
Internal resistance	85 Ω typ. + diode voltage	85 Ω typ. + diode voltage	85 Ω typ. + diode voltage	85 Ω typ. + diode voltage
Input filter limit frequency	5 kHz	5 kHz	5 kHz	5 kHz
Measuring error	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)
Special features	standard and compact process image, switchable measuring data representation in the EL3142-0010, activatable FIR/IIR filters, limit value monitoring			
Operating temperature	-25…+60 °C	-25…+60 °C	0…+55 °C	-25…+60 °C
Approvals	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex
Weight	approx. 60 g	approx. 60 g	approx. 60 g	approx. 60 g
Further information	www.beckhoff.com/EL3141	www.beckhoff.com/EL3142	www.beckhoff.com/EL3142	www.beckhoff.com/EL3144
Special terminals				
Distinguishing features				

Analog input | 0…20 mA, 16/24 bit, differential input

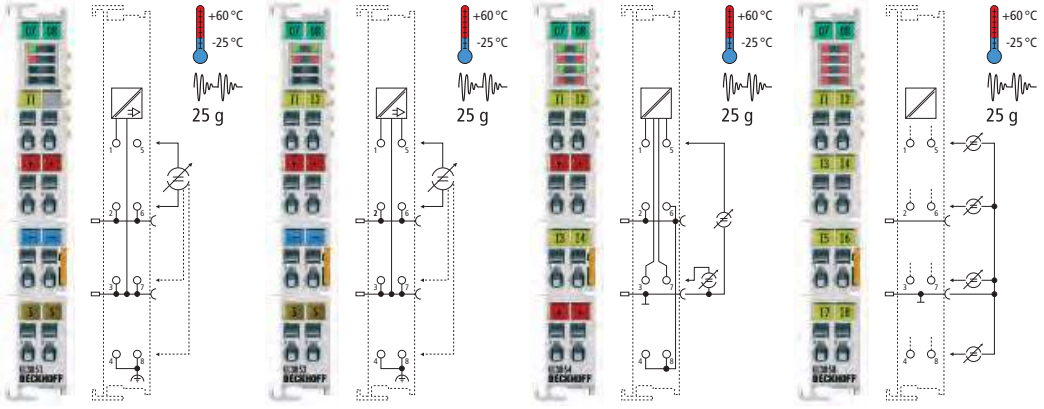
1-channel analog input terminal, 0…20 mA, 16 bit, differential input	2-channel analog input terminal, 0…20 mA, 16 bit, differential input	4-channel analog input terminal, 0…20 mA, 16 bit, differential input	2-channel analog input terminal, 0…20 mA, 16 bit, differential input, oversampling	2-channel analog input terminal, 0…20 mA, 24 bit, differential input
EL3111 | ES3111	**EL3112** | ES3112	**EL3114** | ES3114	**EL3742** | ES3742	**EL3612** | ES3612
				24 bit (incl. sign)
differential input	differential input	differential input	differential input, oversampling	differential input
~ 40 µs	~ 50 µs (fast mode ~ 35 µs)	~ 100 µs	min. 10 µs	1…400 ms configurable
1 (differential)	2 (differential)	4 (differential)	2 (differential)	2 (differential)
				
The EL311x analog input terminals measure input currents from 0 to 20 mA. The significantly faster conversion time and support for distributed clocks enable use in time-critical applications and set them apart from the EL30xx series. Overcurrent is displayed not only in the process image, but also by an error LED for each channel.			The EL3742 is an oversampling terminal like the EL3702, see description on page 373	The EL3612 terminal is a precise measuring device with 24-bit resolution.
max. 10 V common-mode voltage	max. 10 V common-mode voltage	max. 10 V common-mode voltage	max. 35 V common-mode voltage	max. 10 V common-mode voltage
–	–	–	–	–
typ. 130 mA	typ. 170 mA	typ. 130 mA	typ. 200 mA	typ. 190 mA
yes	yes	yes	yes	–
–	–	–	n = 1…100 selectable	–
<< 1 µs	<< 1 µs	<< 1 µs	<< 1 µs	–
see input filter	see input filter	see input filter	0…30 kHz recommended	see input filter
85 Ω typ. + diode voltage	85 Ω typ. + diode voltage	85 Ω typ. + diode voltage	85 Ω typ. + diode voltage	85 Ω typ. + diode voltage
5 kHz	5 kHz	5 kHz	30 kHz	3 kHz
< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value) up to 10 Hz input signal	< ±0.01 % at 25 °C (relative to full scale value, 50 Hz filter)
standard and compact process image, activatable FIR/IIR filters, limit value monitoring			oversampling	various filter times, limit evaluation, high precision
-25…+60 °C	-25…+60 °C	-25…+60 °C	-25…+60 °C	-25…+60 °C
CE, UL, Ex	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex
approx. 55 g	approx. 55 g	approx. 55 g	approx. 60 g	approx. 60 g
www.beckhoff.com/EL3111	www.beckhoff.com/EL3112	www.beckhoff.com/EL3114	www.beckhoff.com/EL3742	www.beckhoff.com/EL3612
				EL3612-0020
				with calibration certificate

Further information on XFC see page 298

For availability status see Beckhoff website at: www.beckhoff.com/EL3612

Analog input | 4…20 mA, 12 bit, single-ended

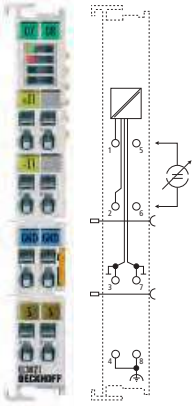
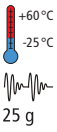
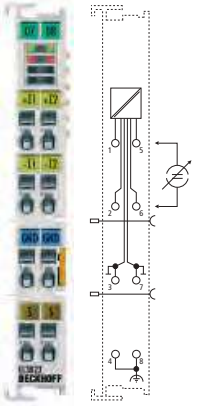
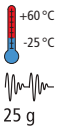
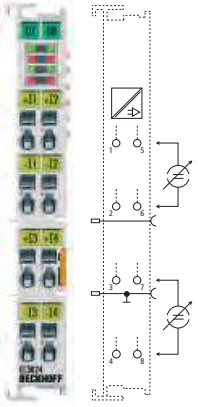
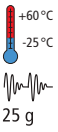
	1-channel analog input terminal, 4…20 mA, 12 bit, single-ended	2-channel analog input terminal, 4…20 mA, 12 bit, single-ended	4-channel analog input terminal, 4…20 mA, 12 bit, single-ended	8-channel analog input terminal, 4…20 mA, 12 bit, single-ended
Technical data	**EL3051** | ES3051	**EL3052** | ES3052	**EL3054** | ES3054	**EL3058** | ES3058
Signal voltage	4…20 mA			
Resolution	12 bit (16 bit presentation, incl. sign)			
Technology	single-ended	single-ended	single-ended	single-ended
Conversion time	0.625 ms default setting, configurable	0.625 ms default setting, configurable	0.625 ms default setting, configurable	1.25 ms default setting, configurable
Number of inputs	1 (single-ended)	2 (single-ended)	4 (single-ended)	8 (single-ended)



In the EL305x series (4 to 20 mA), overcurrent and undercurrent are displayed not only in the process image, but also by an error LED for each channel. The EL3054 is particularly suitable for the connection of 2-wire sensors.

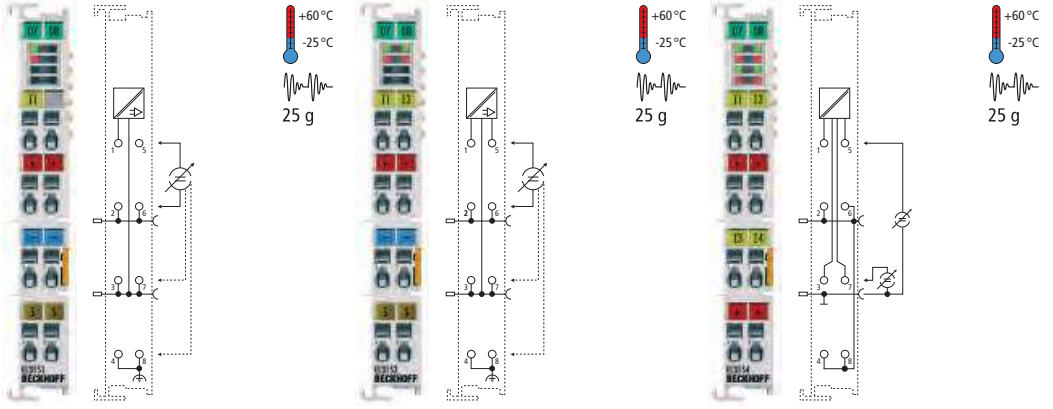
Dielectric strength	max. 30 V	max. 30 V	max. 30 V	max. 30 V
Current consumption power contacts	–	–	–	–
Current consumption E-bus	typ. 130 mA	typ. 130 mA	typ. 130 mA	typ. 130 mA
Distributed clocks	–	–	–	–
Internal resistance	85 Ω typ. + diode voltage	85 Ω typ. + diode voltage	85 Ω typ. + diode voltage	85 Ω typ. + diode voltage
Input filter limit frequency	1 kHz	1 kHz	1 kHz	1 kHz
Measuring error	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)
Special features	standard and compact process image, activatable FIR/IIR filters, limit value monitoring	standard and compact process image, activatable FIR/IIR filters, limit value monitoring	standard and compact process image, activatable FIR/IIR filters, limit value monitoring	standard and compact process image, activatable FIR/IIR filters, limit value monitoring
Operating temperature	-25…+60 °C	-25…+60 °C	-25…+60 °C	-25…+60 °C
Approvals	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex
Weight	approx. 60 g	approx. 60 g	approx. 60 g	approx. 60 g
Further information	www.beckhoff.com/EL3051	www.beckhoff.com/EL3052	www.beckhoff.com/EL3054	www.beckhoff.com/EL3058

Analog input | 4…20 mA, 12 bit, differential input

	1-channel analog input terminal, 4…20 mA, 12 bit, differential input	2-channel analog input terminal, 4…20 mA, 12 bit, differential input	4-channel analog input terminal, 4…20 mA, 12 bit, differential input
Technical data	**EL3021** | ES3021	**EL3022** | ES3022	**EL3024** | ES3024
Signal voltage	4…20 mA		
Resolution	12 bit (16 bit presentation, incl. sign)		
Technology	differential input	differential input	differential input
Conversion time	0.625 ms default setting, configurable	0.625 ms default setting, configurable	0.625 ms default setting, configurable
Number of inputs	1 (differential)	2 (differential)	4 (differential)
	      In the EL302x series (4 to 20 mA), overcurrent and undercurrent are displayed not only in the process image, but also by an error LED for each channel.		
Common-mode voltage U_{CM}	10 V max.	10 V max.	10 V max.
Current consumption power contacts	–	–	–
Current consumption E-bus	typ. 130 mA	typ. 130 mA	typ. 130 mA
Distributed clocks	–	–	–
Internal resistance	85 Ω typ. + diode voltage	85 Ω typ. + diode voltage	85 Ω typ. + diode voltage
Input filter limit frequency	1 kHz	1 kHz	1 kHz
Measuring error	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)
Special features	standard and compact process image, activatable FIR/IIR filters, limit value monitoring	standard and compact process image, activatable FIR/IIR filters, limit value monitoring	standard and compact process image, activatable FIR/IIR filters, limit value monitoring
Operating temperature	-25…+60 °C	-25…+60 °C	-25…+60 °C
Approvals	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex
Weight	approx. 55 g	approx. 55 g	approx. 60 g
Further information	www.beckhoff.com/EL3021	www.beckhoff.com/EL3022	www.beckhoff.com/EL3024

Analog input | 4…20 mA, 16 bit, single-ended

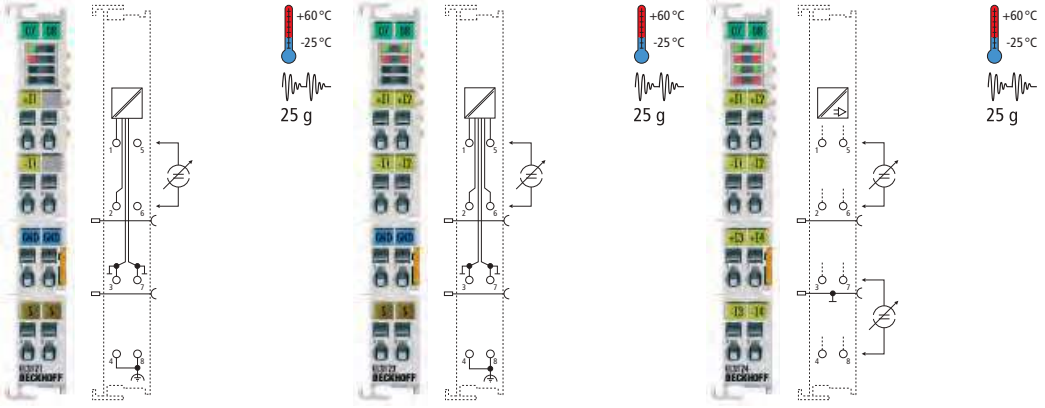
	1-channel analog input terminal, 4…20 mA, 16 bit, single-ended	2-channel analog input terminal, 4…20 mA, 16 bit, single-ended	4-channel analog input terminal, 4…20 mA, 16 bit, single-ended
Technical data	**EL3151** | ES3151	**EL3152** | ES3152	**EL3154** | ES3154
Signal voltage	4…20 mA		
Resolution	16 bit (incl. sign)		
Technology	single-ended	single-ended	single-ended
Conversion time	~ 40 µs	~ 60 µs (fast mode ~ 40 µs)	~ 100 µs
Number of inputs	1 (single-ended)	2 (single-ended)	4 (single-ended)



The EL315x analog input terminals measure input currents from 4 to 20 mA. The significantly faster conversion time and support for distributed clocks enable use in time-critical applications and set them apart from the EL30xx series. Overcurrent and undercurrent are displayed not only in the process image, but also by an error LED for each channel.

Dielectric strength	max. 30 V	max. 30 V	max. 30 V
Current consumption power contacts	–	–	–
Current consumption E-bus	typ. 130 mA	typ. 170 mA	typ. 130 mA
Distributed clocks	yes	yes	yes
Internal resistance	85 Ω typ. + diode voltage	85 Ω typ. + diode voltage	85 Ω typ. + diode voltage
Input filter limit frequency	5 kHz	5 kHz	5 kHz
Measuring error	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)
Special features	standard and compact process image, activatable FIR/IIR filters, limit value monitoring	standard and compact process image, activatable FIR/IIR filters, limit value monitoring	standard and compact process image, activatable FIR/IIR filters, limit value monitoring
Operating temperature	-25…+60 °C	-25…+60 °C	-25…+60 °C
Approvals	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex
Weight	approx. 60 g	approx. 60 g	approx. 60 g
Further information	www.beckhoff.com/EL3151	www.beckhoff.com/EL3152	www.beckhoff.com/EL3154

Analog input | 4…20 mA, 16 bit, differential input

	1-channel analog input terminal, 4…20 mA, 16 bit, differential input	2-channel analog input terminal, 4…20 mA, 16 bit, differential input	4-channel analog input terminal, 4…20 mA, 16 bit, differential input
Technical data	**EL3121** | ES3121	**EL3122** | ES3122	**EL3124** | ES3124
Signal voltage	4…20 mA		
Resolution	16 bit (incl. sign)		
Technology	differential input	differential input	differential input
Conversion time	~ 40 µs	~ 50 µs (fast mode ~ 35 µs)	~ 100 µs
Number of inputs	1 (differential)	2 (differential)	4 (differential)
			
	The EL312x analog input terminals measure input currents from 4 to 20 mA. The significantly faster conversion time and support for distributed clocks enable use in time-critical applications and set them apart from the EL30xx series. Overcurrent and undercurrent are displayed not only in the process image, but also by an error LED for each channel.		
Common-mode voltage U_{CM}	10 V max.	10 V max.	10 V max.
Current consumption power contacts	–	–	–
Current consumption E-bus	typ. 130 mA	typ. 170 mA	typ. 130 mA
Distributed clocks	yes	yes	yes
Internal resistance	85 Ω typ. + diode voltage	85 Ω typ. + diode voltage	85 Ω typ. + diode voltage
Input filter limit frequency	5 kHz	5 kHz	5 kHz
Measuring error	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)
Special features	standard and compact process image, activatable FIR/IIR filters, limit value monitoring	standard and compact process image, activatable FIR/IIR filters, limit value monitoring	standard and compact process image, activatable FIR/IIR filters, limit value monitoring
Operating temperature	-25…+60 °C	-25…+60 °C	-25…+60 °C
Approvals	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex
Weight	approx. 55 g	approx. 55 g	approx. 60 g
Further information	www.beckhoff.com/EL3121	www.beckhoff.com/EL3122	www.beckhoff.com/EL3124
Special terminals			i EL3124-0090
Distinguishing features			TwinSAFE SC

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i For availability status see Beckhoff website at: www.beckhoff.com/EL3124-0090

Analog input | **Resistance thermometer (RTD, PT100, PT1000)**

EL32xx analog input terminals enable the direct connection of resistance sensors. Depending on the terminal type, sensors in 2-, 3- or 4-wire technology can be connected. Apart from resistance measurement, temperatures can also be directly output; various sensor characteristics are supported (PT100, PT1000, Ni100, Ni1000 and KTY types, among others).

For temperature measurement, the conversion of the resistance into a temperature value and its linearisation are performed by a microprocessor within the terminal, depending on the preset characteristics.

The following measurement scaling is used:

– for temperature: 1/10 °C (1 digit = 0.1 °C)
– in the measuring range 10 to 1,047 Ω: 1/64 Ω (approx. 15 mΩ)
– in the measuring range 10 to 4,095 Ω: 1/16 Ω (approx. 62 mΩ)

In addition, a broken wire is reported to the controller and indicated by an error LED.

With resistance sensors, different characteristic curves are implemented over their entire measuring range in order to enable temperature measurements between -200 and +850 °C. The terminals are fully configurable via fieldbus communication. This way, for example, various sensor characteristics, the required connection technology and different filters can be selected; automatic temperature conversion can be switched off, and upper or lower limit values can be set for a temperature.

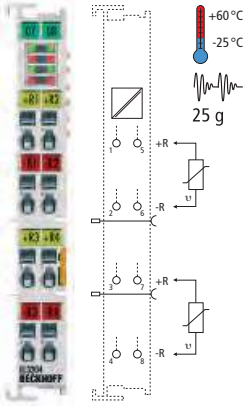
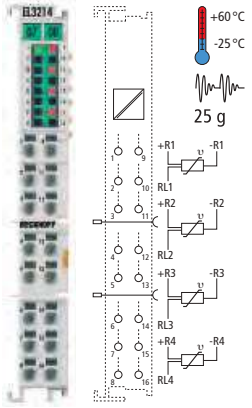
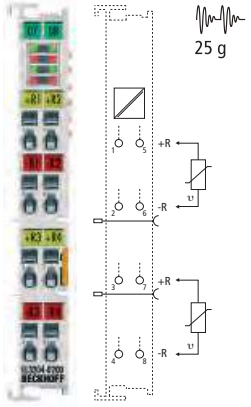
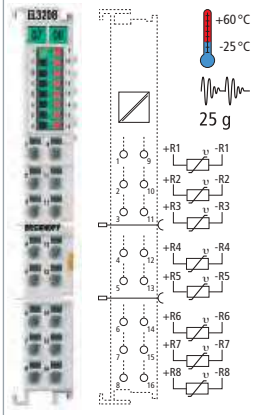
To achieve maximum measurement accuracy, the 4-wire system should be used (in conjunction with highly precise sensors, e.g. PT100).

Apart from 4-wire connection, the EL320x-0010 variants offer higher accuracy with a resolution of 0.01 °C/digit.

The calibration result for the EL3201-0020 and EL3202-0020 terminals is confirmed by a calibration certificate. Like the EL320x-0010 series, these terminals operate in the 4-wire system and therefore also offer a higher accuracy.

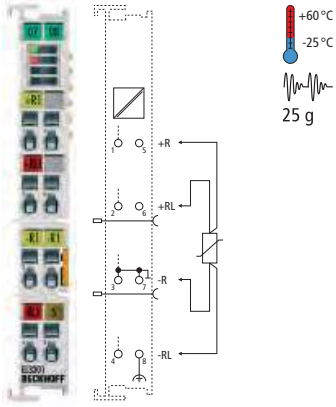
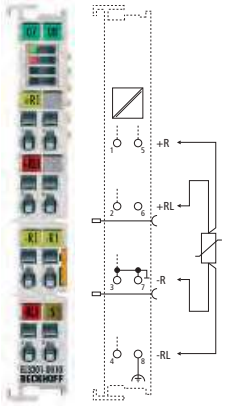
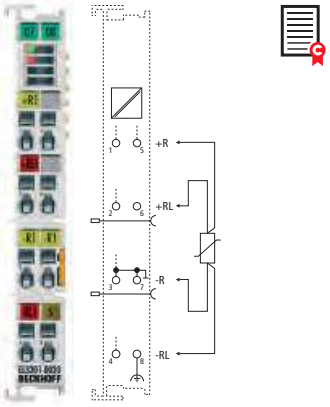
For 2-wire measurements, PT sensors/ Ni1000 sensors are recommended. Whereas the EL3204 was designed for the connection of four sensors in 2-wire technology, using the EL3208 as many as eight sensors in 2-wire technology can be connected. In addition, the EL3214 and the EL3202 offer the possibility to connect four or two sensors in 3-wire technology respectively. Terminals with 4 or 3-wire connection can also be operated in 2-wire mode by setting an external bridge.

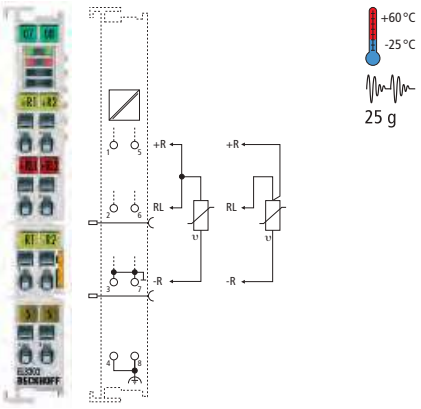
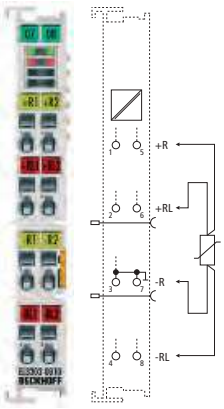
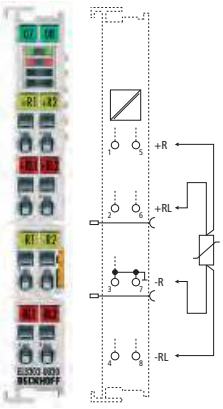
The analog EL3204-0200 input terminal enables direct connection of four resistance sensors for up to 240 kΩ, so that the usable measuring range is significantly larger compared with the EL3204. As a result, NTC sensors can also be used in addition to PT100 to 1000 and Ni100 to 1000 sensors. In addition, the resistance values can be converted (linearisation) in the terminal either based on preset characteristics, conversion formulas with specific material parameters (e.g. according to IEC 60751, Steinhart-Hart equation, B-parameter equation), or according to freely programmable conversion tables. Due to this flexibility the EL3204-0200 is especially suitable for applications where customer-specific sensors are used.

	4-channel analog input terminal, PT100 (RTD), 16 bit	4-channel analog input terminal, PT100 (RTD), 3-wire, 16 bit	4-channel universal input terminal for RTD up to 240 kΩ, NTC 20 k, 16 bit	8-channel analog input terminal, PT100 (RTD), 16 bit
Technical data	**EL3204** | ES3204	**EL3214**	**EL3204-0200**	**EL3208**
Sensor types	PT100, PT200, PT500, PT1000, Ni100, Ni120, Ni1000 resistance measurement (e.g. potentiometer, 10 Ω…1.2/4 kΩ), KTY sensors	PT100, PT200, PT500, PT1000, Ni100, Ni120, Ni1000 resistance measurement (e.g. potentiometer, 10 Ω…1.2/4 kΩ), KTY sensors	Ni/PT, any RTD in the range of 100 Ω…240 kΩ, calculation possible on the basis of a table or material constant, resistance measurement	PT100, PT200, PT500, PT1000, Ni100, Ni120, Ni1000 resistance measurement (e.g. potentiometer, 10 Ω…1.2/4 kΩ), KTY sensors
Technology	2-wire	2-/3-wire	2-wire	
Resolution	0.1 °C per digit	0.1 °C per digit	0.1 °C per digit	0.1 °C per digit
Conversion time	approx. 85 ms default setting, 2…800 ms configurable	approx. 170 ms default setting	approx. 24 ms default setting, 4…500 ms configurable	approx. 170 ms default setting, 3…1600 ms configurable
Number of inputs	4	4	4	8
				
Temperature range	-200…+850 °C (PT sensors); -60…+250 °C (Ni sensors)	-200…+850 °C (PT sensors); -60…+250 °C (Ni sensors)	dependent on the sensor (e.g. PT sensors -200…+850 °C, Ni sensors -60…+250 °C)	-200…+850 °C (PT sensors); -60…+250 °C (Ni sensors)
Current consum. pow. cont.	–	–	–	–
Current consumption E-bus	typ. 190 mA	typ. 140 mA	typ. 150 mA	typ. 140 mA
Distributed clocks	–	–	–	–
Measuring current	< 0.5 mA (load-dependent)	< 0.5 mA (load-dependent)	< 0.03 mA typ.	< 0.5 mA (load-dependent)
Input filter limit frequency	typ. 1 kHz	typ. 1 kHz	–	typ. 1 kHz
Measuring error	< ±0.5 °C for PT sensors	< ±0.5 °C for PT sensors, 4x3-wire connection	< ±0.3 % relative to full scale value (6 kΩ, 65 kΩ, 240 kΩ)	< ±0.5 °C for PT sensors
Special features	integrated digital filter, limit value monitoring	integrated digital filter, limit value monitoring, variable connection technology	temperature calculation on the basis of Steinhart-Hart, B parameters, IEC 60751, free table, predefined sensors	integrated digital filter, limit value monitoring
Operating temperature	-25…+60 °C	-25…+60 °C	0…+55 °C	-25…+60 °C
Approvals	CE, UL, Ex	CE	CE, UL, Ex	CE
Weight	approx. 60 g	approx. 60 g	approx. 60 g	approx. 60 g
Further information	www.beckhoff.com/EL3204	www.beckhoff.com/EL3214	www.beckhoff.com/EL3204	www.beckhoff.com/EL3208
Special terminals		i EL3214-0090		
Distinguishing features		TwinSAFE SC 324		

i For availability status see Beckhoff website at: www.beckhoff.com/EL3214-0090

Analog input | **Resistance thermometer (RTD, PT100, PT1000)**

	1-channel analog input terminal, PT100 (RTD), 16 bit	1-channel analog input terminal, PT100 (RTD), 16 bit, high-precision	1-channel analog input terminal, PT100 (RTD), 16 bit, high-precision, with calibration certificate
Technical data	**EL3201** | ES3201	**EL3201-0010**	**EL3201-0020**
Sensor types	PT100, PT200, PT500, PT1000, Ni100, Ni120, Ni1000 resistance measurement (e.g. potentiometer, 10 Ω…1.2/4 kΩ), KTY sensors (types see documentation)		
Technology	2-, 3-, 4-wire	4-wire	
Resolution	0.1 °C per digit	0.01 °C per digit	0.01 °C per digit
Conversion time	approx. 24 ms default setting, 4…500 ms configurable	approx. 24 ms default setting, 4…500 ms configurable	approx. 24 ms default setting, 4…500 ms configurable
Number of inputs	1	1	1
			
Temperature range	-200…+850 °C (PT sensors); -60…+250 °C (Ni sensors)	-200…+320 °C (PT sensors)	-200…+320 °C (PT sensors)
Current consumption power contacts	–	–	–
Current consumption E-bus	typ. 190 mA	typ. 190 mA	typ. 190 mA
Distributed clocks	–	–	–
Measuring current	< 0.5 mA (load-dependent)	< 0.5 mA (load-dependent)	< 0.5 mA (load-dependent)
Input filter limit frequency	typ. 1 kHz	typ. 1 kHz	typ. 1 kHz
Measuring error	< ±0.5 °C for PT sensors	< ±0.1 °C at 40 °C ambient temperature, 4-wire connection, PT100 sensors (measuring range: -200…+320 °C) and 50 Hz filter	< ±0.1 °C at 40 °C ambient temperature, 4-wire connection, PT100 sensors (measuring range: -200…+320 °C) and 50 Hz filter
Special features	integrated digital filter, limit value monitoring, variable connection technology	integrated digital filter, limit value monitoring, variable connection technology	integrated digital filter, limit value monitoring, variable connection technology, with calibration certificate
Operating temperature	-25…+60 °C	0…+55 °C	0…+55 °C
Approvals	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex
Weight	approx. 60 g	approx. 60 g	approx. 60 g
Further information	www.beckhoff.com/EL3201	www.beckhoff.com/EL3201-0010	www.beckhoff.com/EL3201-0020

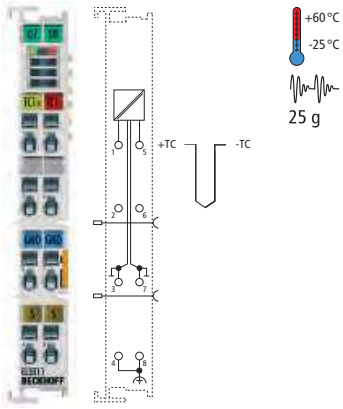
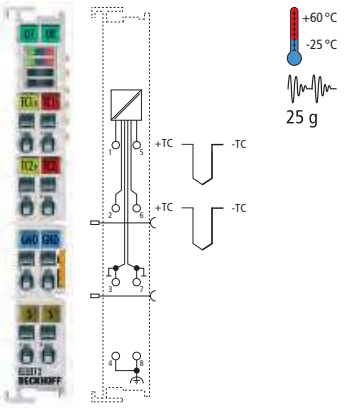
	2-channel analog input terminal, PT100 (RTD), 16 bit	2-channel analog input terminal, PT100 (RTD), 16 bit, high-precision	2-channel analog input terminal, PT100 (RTD), 16 bit, high-precision, with calibration certificate
	EL3202 | ES3202	**EL3202-0010**	**EL3202-0020**
	2-, 3-wire (default setting: 3-wire)	4-wire	
	0.1 °C per digit	0.01 °C per digit	0.01 °C per digit
	approx. 85 ms default setting, 2…800 ms configurable	approx. 85 ms default setting, 2…800 ms configurable	approx. 85 ms default setting, 2…800 ms configurable
	2	2	2
			 
	-200…+850 °C (PT sensors); -60…+250 °C (Ni sensors)	-200…+320 °C (PT sensors)	-200…+320 °C (PT sensors)
	–	–	–
	typ. 190 mA	typ. 190 mA	typ. 190 mA
	–	–	–
	< 0.5 mA (load-dependent)	< 0.5 mA (load-dependent)	< 0.5 mA (load-dependent)
	typ. 1 kHz	typ. 1 kHz	typ. 1 kHz
	< ±0.5 °C for PT sensors	< ±0.1 °C at 40 °C ambient temperature, 4-wire connection, PT100 sensors (measuring range: -200…+320 °C) and 50 Hz filter	< ±0.1 °C at 40 °C ambient temperature, 4-wire connection, PT100 sensors (measuring range: -200…+320 °C) and 50 Hz filter
	integrated digital filter, limit value monitoring, variable connection technology	integrated digital filter, limit value monitoring, variable connection technology	integrated digital filter, limit value monitoring, variable connection technology, with calibration certificate
	-25…+60 °C	0…+55 °C	0…+55 °C
	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex
	approx. 60 g	approx. 60 g	approx. 60 g
	www.beckhoff.com/EL3202	www.beckhoff.com/EL3202-0010	www.beckhoff.com/EL3202-0020

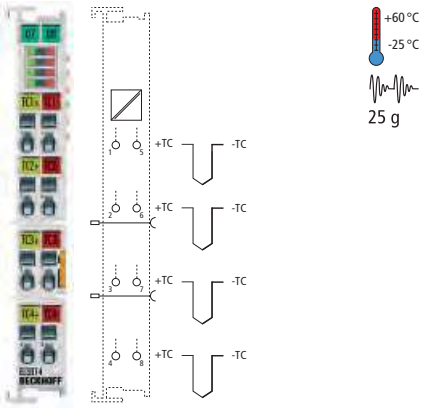
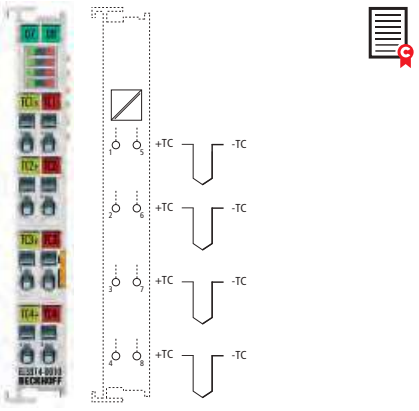
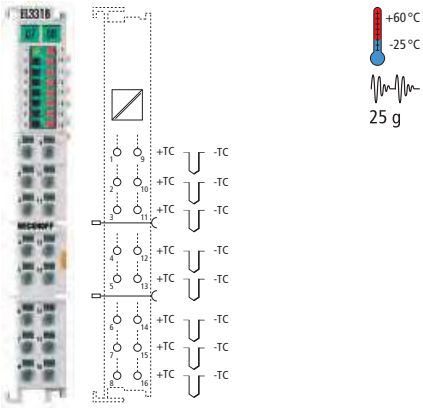
Analog input | **Thermocouple/mV measurement**

Thermocouples can be classified as active transducers. They exploit the thermo-electric effect (Seebeck, Peltier, Thomson). Where two electrical conductors of different materials (e.g. iron and constantan) make contact, a contact voltage occurs, which is clearly a function of temperature and thus is called thermovoltage. The material change associated with thermocouples will always result in at least two such material combinations. One is placed at the measurement location, the other is the so-called comparison point, which is normally located in the measurement device.
In order to compensate for the reference point effect, the temperature at the reference point must be known. For the EL331x this is the connection point of the thermocouple to the terminal contacts, which is why the terminal contact temperature is specially measured here.

Thermocouples represent cost-effective and easy to install sensors for temperature measurement with reduced need for accuracy.

Depending on the type of thermocouple temperatures from -200 to +2,300 °C can be measured. The linearisation and cold junction compensation is carried out by a characteristic curve on a microprocessor. The directions in the documentation, concerning earthing and thermocouples which are not potential-free, must be observed. An error LED indicates any broken wire.

	1-channel analog input terminal, thermocouple with open-circuit recognition	2-channel analog input terminal, thermocouple with open-circuit recognition
Technical data	**EL3311**	**EL3312**
Thermocouple sensor types	types J, K, L, B, E, N, R, S, T, U (default setting type K), mV measurement	
Technology	2-wire	
Resolution	0.1 °C per digit	0.1 °C per digit
Conversion time	approx. 750 ms up to 20 ms, depending on configuration and filter setting, default: approx. 75 ms	approx. 1.2 s up to 20 ms, depending on configuration and filter setting, default: approx. 125 ms
Number of inputs	1	2
		
Temperature range	in the range defined in each case for the sensor (default setting: type K; -200…+1,370 °C); voltage measurement: ±30 mV…±75 mV	in the range defined in each case for the sensor (default setting: type K; -200…+1,370 °C); voltage measurement: ±30 mV…±75 mV
Current consum. pow. cont.	–	–
Current consumption E-bus	200 mA	200 mA
Distributed clocks	–	–
Input filter limit frequency	typ. 1 kHz; dependent on sensor length, conversion time, sensor type	typ. 1 kHz; dependent on sensor length, conversion time, sensor type
Measuring error	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)
Special features	open-circuit recognition	open-circuit recognition
Operating temperature	-25…+60 °C	-25…+60 °C
Approvals	CE, UL, Ex	CE, UL, Ex
Weight	approx. 60 g	approx. 60 g
Further information	www.beckhoff.com/EL3311	www.beckhoff.com/EL3312
Special terminals		
Distinguishing features		

	4-channel analog input terminal, thermocouple with open-circuit recognition	4-channel analog input terminal, high-precision, thermocouple with open-circuit recognition	8-channel analog input terminal, thermocouple with open-circuit recognition
	EL3314	**EL3314-0010**	**EL3318**
	0.1 °C per digit	24 bit, presentation adjustable: 0.1/0.01/0.001 °C per digit or 10 nV per digit	0.1 °C per digit
	approx. 2.5 s up to 20 ms, depending on configuration and filter setting, default: approx. 250 ms	approx. 2.5 s up to 20 ms, depending on configuration and filter setting, default: approx. 250 ms	approx. 5 s up to 40 ms, depending on configuration and filter setting, default: approx. 500 ms
	4	4	8
			
		The internal high-precision measurement of the temperature of the cold junction in the terminal allows exact temperature measurement in calibrated mode even with thermocouples.	The 16-pin HD housing enables the connection of up to eight thermocouples on a terminal width of 12 mm. Errors are displayed for each channel by LED and process data.
	in the range defined in each case for the sensor (default setting: type K; -200…+1,370 °C); voltage measurement: ±30 mV…±75 mV	in the range defined in each case for the sensor (default setting: type K; -200…+1,370 °C); voltage measurement: ±78 mV in 10 nV resolution	in the range defined in each case for the sensor (default setting: type K; -200…+1,370 °C); voltage measurement: ±30 mV…±75 mV
	–	–	–
	typ. 200 mA	typ. 200 mA	typ. 210 mA
	–	–	–
	typ. 1 kHz; dependent on sensor length, conversion time, sensor type	typ. 1 kHz; dependent on sensor length, conversion time, sensor type	typ. 1 kHz; dependent on sensor length, conversion time, sensor type
	< ±0.3 % (relative to full scale value)	voltage measurement < ±25 µV, e.g. type K: < ±1.8 °C, others see documentation	< ±0.3 % (relative to full scale value)
	open-circuit recognition	open-circuit recognition	open-circuit recognition
	-25…+60 °C	0…+55 °C	-25…+60 °C
	CE, UL, Ex	CE, UL, Ex	CE, Ex
	approx. 60 g	approx. 60 g	approx. 70 g
	www.beckhoff.com/EL3314	www.beckhoff.com/EL3314-0010	www.beckhoff.com/EL3318
	EL3314-0090	**EL3314-0020**	
	TwinSAFE SC 324	with calibration certificate	

For availability status see Beckhoff website at: www.beckhoff.com

XFC analog input | **Oscillation measurement**

The EL3632 EtherCAT Terminal is a 2-channel oversampling input terminal, which is able to sample up to 50 ksamples per channel and second. As a minimum every 20 µs an analog input value is sampled and stored in a buffer for retrieval by the EtherCAT master. The master cyclically retrieves not only a single measured value, but a package consisting of n measurement readings that were sampled at equidistant intervals. System-wide distributed clock synchronisation enables the measurement readings to be related to other system components. This is used for correlation with axis positions, for example.

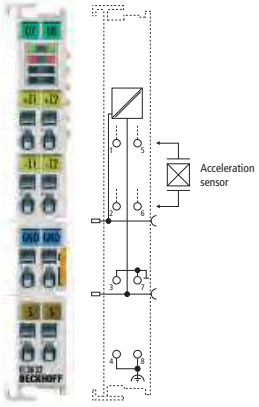
Many manufacturers offer suitable sensors, usually under their brand names or the standardised IEPE interface name.

Up to two IEPE sensors can be connected to the EL3632 in 2-wire mode. IEPE sensors are dynamic vibration sensors that are supplied with a constant current and respond to mechanical deflection with a variable resistance. The constant current source integrated in the EL3632 continues to stabilise the constant current rapidly, so that the change in resistance results in a change in voltage on the feed line, which is measured by the EL3632. The constant current can be set separately between 4 and 10 mA for each channel, depending on the sensor and the cable length. It is generated from the 24 V voltage available at the power contacts. An electrically isolated measurement configuration can be achieved using the EL9560 power supply terminal.

Except for filtering no preprocessing of the vibration amplitude values takes place in the EL3632. This is handled by the retrieving controller.

Please note that such dynamic sensors can only be used for vibrations up to a lower limit frequency, but not for static position without dynamic movement.

A TwinCAT library with mathematical functions is available for evaluating the signals on the controller. This enables all benefits of the PC platform, such as performance and flexibility, to be fully utilised.

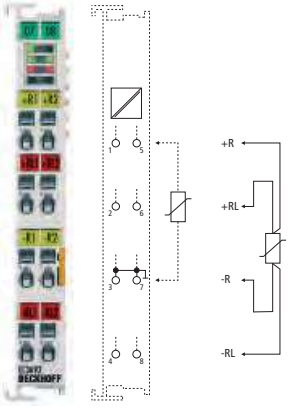
XFC	2-channel analog input terminal for Condition Monitoring (IEPE), 16 bit
Technical data	**EL3632**
Signal voltage	IEPE constant current supply and recording of modulated AC voltage
Technology	Condition Monitoring (IEPE), oversampling recording
Resolution	16 bit (incl. sign)
Conversion time	20 µs (max. 50 ksamples/s)
Number of inputs	2
	 
Measuring range	default ±5 V up to 25 kHz, ±250 mV up to 10 Hz
Sensor voltage	max. power contact voltage less 1 V
Supply current I_{EXCITE}	typ. 2/4/8 mA (separately configurable for both channels)
Current consumption power contacts	24 V, typ. 20 mA + load
Current consumption E-bus	typ. 220 mA
Distributed clocks	yes
Input filter limit frequency	analog parameterisable 5th order low-pass filter up to 25 kHz, typically 0.05 Hz high-pass filter
Measuring error	< ±0.5 % (DC; relative to full scale value)
Special features	automatic anti-aliasing function, wire breakage detection
Operating temperature	0…+55 °C
Approvals	CE, UL, Ex
Weight	approx. 60 g
Further information	www.beckhoff.com/EL3632
Special terminals	i EL3632-0020
Distinguishing features	with calibration certificate

Further information on XFC see page 298

i For availability status see Beckhoff website at: www.beckhoff.com/EL3632

Analog input | **Resistance measurement**

The EL3692 2-channel resistance measurement terminal is designed for slow sampling of ohmic resistors over a wide range from 10 mΩ to 10 MΩ. The circuitry of the EtherCAT Terminal enables measurement in 2- or 4-wire versions. Due to the electrical isolation of 1.5 kV between the field side and the E-bus, in single-channel mode measurements can be carried out at live points (within the permissible range). Contact resistance values of contacts can be sampled both in closed and open state. The measurement is parameterisable for continuous measurement (single-channel) or alternate measurement in pulsed mode.

	2-channel analog resistance measurement terminal, 10 mΩ…10 MΩ, 24 bit, high-precision
Technical data	**EL3692**
Measuring range	10 mΩ, 1 Ω, 10 Ω, 100 Ω, 1 kΩ, 10 kΩ, 100 kΩ, 1 MΩ, 10 MΩ
Technology	2- or 4-wire, resistance measurement
Resolution	24 bit
Conversion time	typ. 10…400 ms, dependent on measuring range and settings
Number of inputs	2
	 25 g
Measuring error	< ±0.5 % (relative to the respective full scale value with 4-wire connection)
Current consumption power contacts	–
Current consumption E-bus	typ. 220 mA
Distributed clocks	–
Internal resistance	> 100 MΩ
Electrical isolation	1,500 V (E-bus/signal voltage)
Input filter limit frequency	100 Hz
Special features	automatic range selection, pulse and continuous measurement
Operating temperature	0…+55 °C
Approvals	CE, UL
Weight	approx. 55 g
Further information	www.beckhoff.com/EL3692
Special terminals	EL3692-0020
Distinguishing features	with calibration certificate

For availability status see Beckhoff website at: www.beckhoff.com/EL3692

Analog input | **Measurement technology, strain gauge**

The analog input terminals EL3351, EL3356 and EL3356-0010 are suitable for connection of full resistor bridges such as strain gauges, for example. Like 2-channel analog input terminals, they measure the two voltages U_{REF} (power supply of the bridge) and U_D (bridge voltage or variable sensor voltage depending on the detuning of the bridge). The respective measuring range is adapted to the levels: The bridge is usually operated with a high supply voltage, U_{REF} ±12 V DC; the measurable bridge voltage U_D, conversely, lies in the mV range.

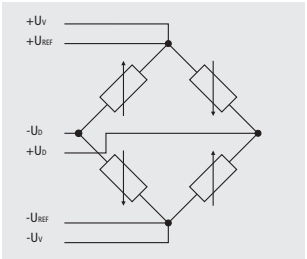
Thanks to the high measuring resolution of U_D with 16 bits (EL3351 and EL3356) or 24 bits (EL3356-0010), the detuning of the bridge can be evaluated with high accuracy. The simultaneous measurement of U_{REF} and U_D eliminates long-term and temperature drift; in the EL3356 and EL3356-0010 the integrated self-calibration additionally increases the measuring accuracy. Beyond that the EL335x has adaptive filter functions, by means of which it is possible to map the static condition of the sensor with high accuracy, or a dynamic load with the minimum delay.

The EL3351 supplies the bridge internally with ±5 V DC from the E-bus supply; alternatively an external bridge supply with up to ±12 V DC can also be connected. Any number of sensors can be connected in parallel to the EL3356 and EL3356-0010, therefore an external supply is required in any case. The EL9512 power supply terminal is suitable for the direct supply of 12 V DC via the power contacts.

Depending on the type of sensor and the required accuracy/sensitivity, resistance bridges are designed as quarter, half or full bridges. If the EL335x is to be operated with a quarter or half-bridge, external supplementary bridge resistors must be provided.

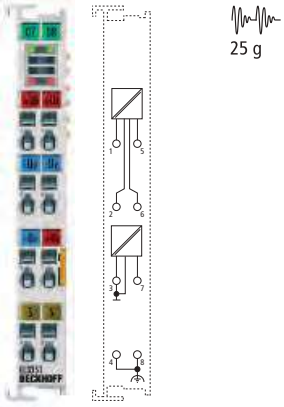
Sensors with measuring bridges are used, for example, for:

- Weighing tasks such as slow silo measurement or fast bag filling by load cells, where strain gauges are glued onto an elastic mechanical carrier, e.g. double-cantilever beam spring elements, and additionally covered to protect against environmental influences.
- vibration measurement for moving components
- deformation measurement under static load and deformation warning
- pressure measurement through sensor deformation measurement

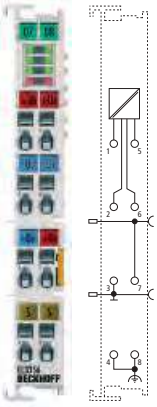
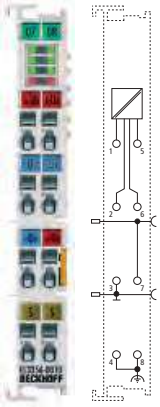


Full bridge

1-channel analog input terminal, resistor bridge analysis, 16 bit

Technical data	EL3351 | ES3351
Resolution	16 bit, 32 bit presentation
Technology	resistor bridge, strain gauge
Number of inputs	2, for 1 resistor bridge in full bridge technology
Conversion time	2.5…800 ms, configurable, max. 400 samples/s
	 25 g The EL3351 analog input terminal is suitable for slow measuring tasks.
Power supply U_V	5 V, max. 20 mA
Current consum. pow. cont.	–
Current consumption E-bus	typ. 170 mA
Distributed clocks	–
Measuring range U_D	max. -20…+20 mV
Measuring range U_{REF}	max. -12…+12 V
Internal resistance	> 200 kΩ (U_{REF}), > 1 MΩ (U_D)
Input filter limit frequency	50 Hz default setting, parameterisable
Measuring error	< ±0.1 % (relative to full scale value, 50 Hz filter)
Supported nominal sensitivity	calculated in PLC, freely selectable
Special features	integrated ±5 V DC bridge supply
Operating temperature	0…+55 °C
Approvals	CE, UL, Ex
Weight	approx. 60 g
Further information	www.beckhoff.com/EL3351
Special terminals	
Distinguishing features	

Further information on XFC see page 298

	1-channel precise load cell analysis (resistor bridge), 16 bit	1-channel precise load cell analysis (resistor bridge), 24 bit
	EL3356 | ES3356	**EL3356-0010**
		24 bit, 32 bit presentation
	2, for 1 resistor bridge in full bridge technology	2, for 1 resistor bridge in full bridge technology
	10…250 ms, configurable, max. 100 samples/s	0.1…250 ms, configurable, max. 10,000 samples/s
	 XFC 25 g	 XFC
	The EL3356 analog input terminal is suitable for high-precision measurements with high demands on the prefiltering of the measured values in the terminal.	The EL3356-0010 analog input terminal with measuring cycles of 100 µs and a resolution of 24 bits can be used for fast and precise monitoring of torque or vibration sensors.
	up to 12 V from power contacts, dependent on sensor	up to 12 V from power contacts, dependent on sensor
	depends on strain gauge supply, min. 1 mA	depends on strain gauge supply, min. 1 mA
	typ. 210 mA	typ. 210 mA
	–	yes
	max. -25…+25 mV rated voltage	max. -25…+25 mV rated voltage
	max. -12…+12 V rated voltage	max. -12…+12 V rated voltage
	> 200 kΩ (U_{REF}), > 1 MΩ (U_D)	> 200 kΩ (U_{REF}), > 1 MΩ (U_D)
	10 kHz low pass (-3 dB)	10 kHz low pass (-3 dB)
	< ±0,01 % for the calculated load value in relation to the final load value with a 12 V feed and 24 mV bridge voltage (hence nominal strain gauge characteristic value of 2 mV/V), self-calibration active, 50 Hz filter active	< ±0,01 % for the calculated load value in relation to the final load value with a 12 V feed and 24 mV bridge voltage (hence nominal strain gauge characteristic value of 2 mV/V), self-calibration active, 50 Hz filter active
	all, resolution of parameter: 0.01 µV/V recommended: 0.5…4 mV/V	all, resolution of parameter: 0.01 µV/V recommended: 0.5…4 mV/V
	self-calibration, quadruple averager, dynamic filters	self-calibration, quadruple averager, dynamic filters, fast data sampling
	0…+55 °C	0…+55 °C
	CE, UL	CE, UL
	approx. 60 g	approx. 60 g
	www.beckhoff.com/EL3356	www.beckhoff.com/EL3356-0010
		i EL3356-0020
		with calibration certificate

i For availability status see Beckhoff website at: www.beckhoff.com/EL3356-0010

Analog input | **Power measurement**

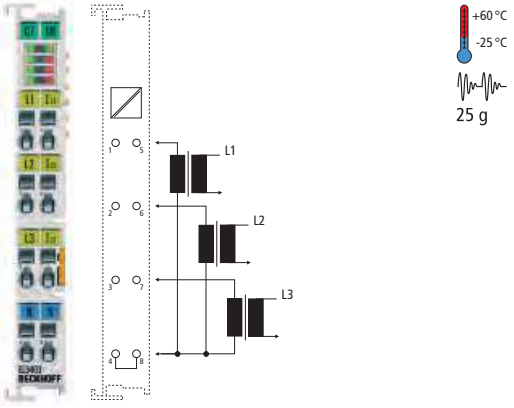
The EL34x3 and EL3773 EtherCAT power measurement terminals enable analysis of the energy consumption of the connected plant or building segment or, quite specifically, the key energy data of individual consumers directly via the fieldbus.

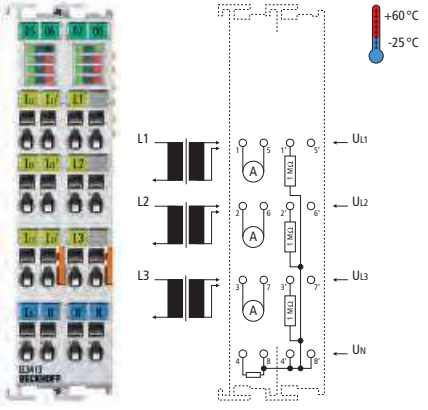
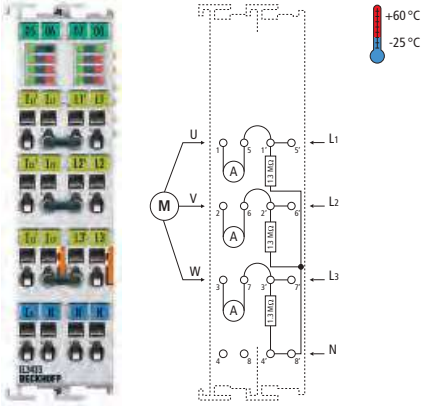
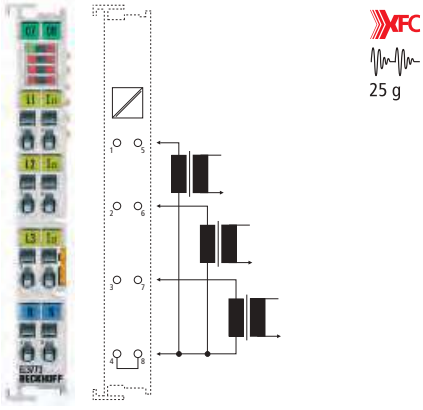
The EL34x3 terminals are suitable for measurements in 50/60 Hz power networks; the three phases plus neutral can be wired directly to the terminal for voltage measurement. For current measurement the three phases L1, L2 and L3 are fed in via simple current transformers. The measured current and voltage values are output as RMS values. From the RMS values for voltage (U) and current (I), the EL34x3 calculates the effective power (P), the energy consumption (W) and the power factor (cos φ) for each phase. From these values the terminals calculate the apparent power (S) and the phase shift angle (φ). Simple net analyses up to the 21st harmonic component as well as measurements of the neutral conductor current can additionally be performed using the EL3413 and EL3433.

With up to 690 V AC the voltage inputs of the EL3413 are optimised for direct monitoring of high-performance generators, as used in the wind power industry, for example. The current inputs are electrically isolated from one another.

The EL3773 is designed to detect the state of a 3-phase AC voltage system. For each phase voltages up to 288 V_{eff} and currents up to 1 A_{eff} are sampled as instantaneous values with a resolution of 16 bit.

The EL3773 further enables the measurement of direct current voltage up to 410 V DC and direct current up to 1.5 A DC. Based on the EtherCAT oversampling principle, the measured values are measured simultaneously with a temporal resolution of up to 100 µs and passed on to the controller. The controller has sufficient computing power for true RMS or performance calculation and complex custom algorithms based on the measured voltages and currents. The EL3773 supports distributed clocks and can therefore measure synchronous with other EtherCAT devices, but can also operate without distributed clocks.

	3-phase power measurement terminal, 500 V AC	
Technical data	**EL3403** | ES3403	
Technology	3-phase power measurement for alternating voltages	
Measuring voltage	max. 500 V AC 3~ (UL_x-N: max. 288 V AC)	
Resolution	1 µA, 0.1 mV, 10 mW	
Conversion time	mains-synchronous	
Number of inputs	3 x current, 3 x voltage	
		
Measured values	current (I1, I2, I3), voltage, effective power, reactive power, apparent power, energy, cos φ, frequency	
Current consum. pow. cont.	–	
Current consumption E-bus	typ. 120 mA	
Distributed clocks	–	
Oversampling factor	–	
Measuring current	max. 1 A (AC), via measuring transformers x A/1 A	
Electrical isolation	1,500 V	
Measurement frequency range	45…65 Hz	
Measuring error	0.5 % relative to full scale value (U/I), 1 % calculated value	
Special features	true RMS value calculation, single-phase operation also possible	
Operating temperature	-25…+60 °C	
Approvals	CE, UL	
Weight	approx. 75 g	
Further information	www.beckhoff.com/EL3403	
Special terminals	**EL3403-0010**	**EL3403-0xxx**
Distinguishing features	500 V AC, 5 A	further special terminals see www.beckhoff.com/EL3403

	3-phase power measurement terminal, 690 V AC	3-phase power measurement terminal 500 V AC, 10 A	Power monitoring oversampling terminal, 500 V AC
	EL3413	**EL3433**	**EL3773**
			3-phase power monitoring for alternating/direct voltages
	max. 690 V AC 3~ (UL_x-N: max. 400 V AC)	max. 500 V AC 3~ (UL_x-N: max. 288 V AC)	max. 500 V AC 3~ (UL_x-N: max. 288 V AC), max. 410 V DC
	1 µA, 0.1 mV, 10 mW	1 µA, 0.1 mV, 10 mW	16 bit (incl. sign)
	mains-synchronous	mains-synchronous	min. 100 µs, all channels simultaneously
	4 x current, 3 x voltage	4 x current, 3 x voltage	3 x current, 3 x voltage
			
	current (I1, I2, I3, In), voltage, effective power, reactive power, apparent power, energy, cos φ, frequency, harmonic	current (I1, I2, I3, In), voltage, effective power, reactive power, apparent power, energy, cos φ, frequency, harmonic	current (I1, I2, I3), voltage as instantaneous values (oversampling)
	–	–	–
	typ. 160 mA	typ. 120 mA	typ. 215 mA
	–	–	yes
	–	–	n = 1…100 selectable
	adjustable, 100 mA, 1 A (default), 5 A; potential-free	max. 10 A (AC)	max. 1 A (AC)/1.5 A (DC), via measuring transformers x A AC/1 A AC
	4,500 V	4,500 V	2,500 V
	45…65 Hz	45…65 Hz	0…5 kHz
	0.5 % relative to full scale value (U/I), 1 % calculated value	0.5 % relative to full scale value (U/I), 1 % calculated value	0.5 % relative to full scale value
	galvanically isolated current inputs, harmonic analysis, single-phase operation also possible	direct current measurement, harmonic analysis, single-phase operation also possible	oversampling, AC/DC measurement, single-phase operation also possible, adjustable hardware filters
	-25…+60 °C	-25…+60 °C	0…+55 °C
	CE, UL	CE, UL	CE
	approx. 100 g	approx. 100 g	approx. 75 g
	www.beckhoff.com/EL3413	www.beckhoff.com/EL3433	www.beckhoff.com/EL3773
	EL3413-0001	**EL3413-0xxx**	
	max. 600 V AC, UL approval	further special terminals see www.beckhoff.com/EL3413	

Further information on XFC see page 298

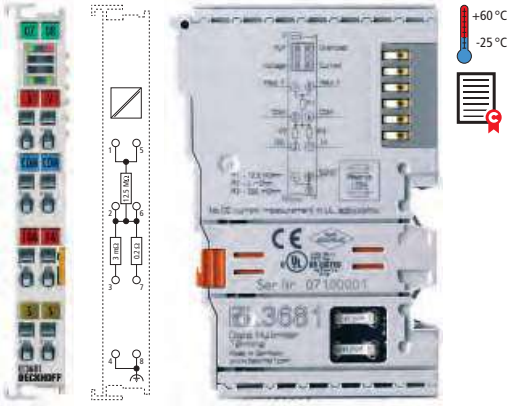
Analog input | **Measurement technology, multimeter terminal**

The EL3681 EtherCAT Terminal enables measurement of currents and voltages in a wide input range. The measuring ranges are switched automatically, as usual in advanced digital multimeters. There are two current paths available for current measurement: for small currents protected with 1 A and a high-current path for up to 10 A. The current and the high-resistance voltage measurement can be used for DC and AC. The alternating parameters are issued as true RMS values, the direct parameters with arithmetic averaging. The measured data are read via EtherCAT and processed further in the controller. At the same time, the EL3681 enables the measuring type and range to be set via the bus.

Excellent interference immunity is achieved through the fully electrically isolated design of the electronic measuring system and the dual slope conversion system. High precision and simple, high-impedance measurement from 300 mV to 300 V allow the EtherCAT Terminals to be used like a modern digital multimeter.

For voltages greater than 25 V AC (42 V peak) or 60 V DC the fuse opening must be covered by an additional terminal or the EL9011 end terminal.

In measuring applications in particular, the voltage to be expected is often not yet known during the planning phase. Automatic adjustment of the measurement range simplifies use and reduces stock levels.

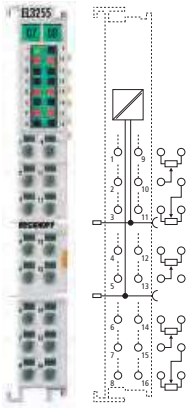
	Digital multimeter terminal, 18 bit
Technical data	**EL3681** | ES3681
Signal voltage	max. 300 V AC/DC, 10 A
Resolution	18 bit + sign in each measurement range
Conversion time	0.5 s (1 s during measuring range switching) preset, min. 65 ms
Number of inputs	1 voltage or 1 current (10 A/1 A)
	
Measuring voltage	300 mV, 3 V, 30 V, 300 V
Current consumption power contacts	–
Current consumption E-bus	150 mA
Distributed clocks	–
Measuring current	100 mA, 1 A and 10 A via high-current path
Internal resistance	3 mΩ/0.2 Ω/12.5 MΩ
Electrical isolation	1,500 V (E-bus/field potential)
Measuring error	0.01 % DC voltage measurement at 25 °C
Special features	automatic or manual range selection, 1.25 A fuse installed + spare fuse, filter deactivatable
Operating temperature	-25…+60 °C
Approvals	CE
Weight	approx. 70 g
Further information	www.beckhoff.com/EL3681
Special terminals	i EL3681-0020
Distinguishing features	with calibration certificate
Accessories	ZB8000-0001
Spare fuse	10 pieces, 1.25 A

i For availability status see Beckhoff website at: www.beckhoff.com/EL3681

Analog input | **Potentiometer measurement**

The EL3255 EtherCAT Terminal enables direct connection of up to five resistive voltage dividers. It is possible to connect potentiometers, e.g. for manual operation of a system, or path or pressure sensors, whose value can be determined through resistance comparison.

The EL3255 generates the 10 V supply voltage for the sensors internally and measures this voltage as well as the voltages fed back by the five sensors. Since all voltages are subject to the same influences, the potentiometer analysis is based on determination of the individual voltage components.

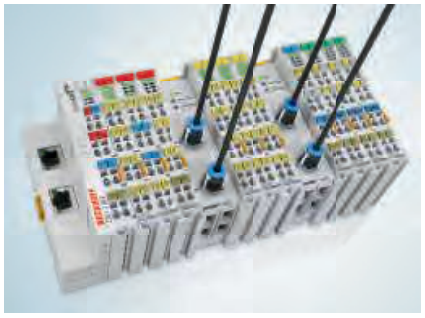
	5-channel input, potentiometer measurement with sensor supply, 10 V
Technical data	**EL3255**
Sensor types	potentiometer 300 Ω…50 kΩ
Technology	ratiometric potentiometer evaluation with own supply, 3-wire connection
Resolution	16 bit (incl. sign)
Number of inputs	5
	   25 g
Conversion time	typ. 300…700 µs, dependent on settings, default setting: approx. 500 µs (5 channels, filter deactivated)
Current consumption power contacts	dependent on the potentiometers, max. 70 mA
Current consumption E-bus	typ. 80 mA
Distributed clocks	yes
Feed voltage potentiometer	typ. 10 V ±10 %
Internal resistance	>> 100 kΩ to wiper connection
Measuring error	< ±0.5 % (relative to full scale value)
Special features	open-circuit recognition, supply monitoring, activatable filters, simultaneous measurement of the channels
Operating temperature	-25…+60 °C
Approvals	CE, Ex
Weight	approx. 70 g
Further information	www.beckhoff.com/EL3255

Analog input | **Pressure measuring**

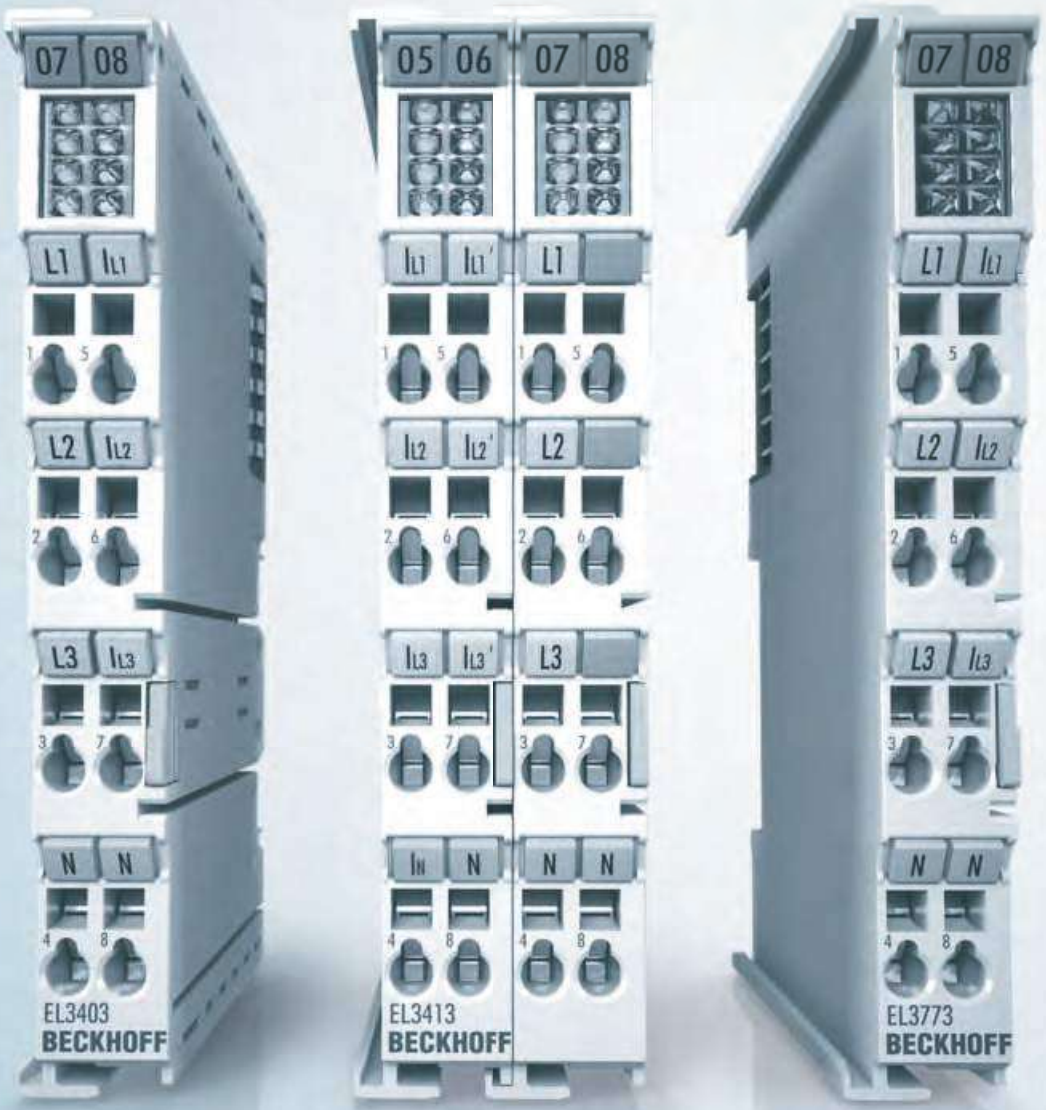
The EtherCAT Terminal system is extended with pressure measuring terminals for recording differential and relative pressures. In a similar way to electrical signal acquisition, an EtherCAT Terminal with 24 mm width is used for pressure measurement. The compact design and simple connection system supports space-saving and quick installation. Additional measuring instruments are unnecessary.

The pressure measuring terminals of the EM37xx series are divided into two groups: differential pressure measurement (measurement between two terminals) and relative pressure measurement (measurement relative to the environment). The EtherCAT Terminals can be used for measuring the pressure or as a substitute for a pressure switch. The pressure value in the controller makes it possible to store the switching threshold as a parameter for a logic link. Manual setting at the pressure switch in the application is therefore no longer required.

While the EM3701 measures the pressure difference between two hose connections in the range between -100 and +100 hPa and provides the result as a 16-bit value, the EM3702 enables direct measurement of the pressure value relative to the environment. The status LEDs indicate proper function or errors such as over-range. The pressure measurement terminals are not suitable for the measurement of aggressive gases.



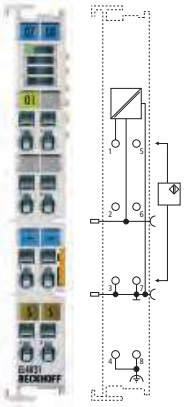
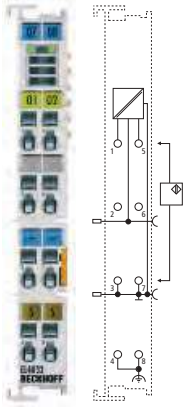
	1-channel differential pressure measuring terminal -100…+100 hPa	2-channel relative pressure measuring terminal 7,500 hPa
Technical data	**EM3701**	**EM3702**
Technology	differential pressure measurement	relative pressure measurement
		
	The EM3701 pressure measuring terminal enables direct measurement of pressure differences between two hose connections. The pressure difference is available as a 16 bit value and can be measured between any points up to an ambient pressure of 10 bar. The status LEDs indicate proper function or errors such as over-range.	The EM3702 pressure measuring terminal enables direct measurement of two pressure values at the hose connections. The pressure is determined as a pressure difference to the ambiance of the EM3702 and is available as a 16 bit value. The status LEDs indicate proper function or errors such as over-range.
Measuring error	3 % (relative to full scale value)	3 % (relative to full scale value)
Measuring range	-100…+100 hPa (-100…+100 mbar)	0…7,500 hPa (7.5 bar)
Current consumption power contacts	– (no power contacts)	– (no power contacts)
Max. overload	500 hPa (500 mbar) differential	10,000 hPa (10 bar)
Medium	non-aggressive gases	non-aggressive gases
Operating temperature	0…+55 °C	0…+55 °C
Approvals	CE	CE
Weight	approx. 95 g	approx. 95 g
Further information	www.beckhoff.com/EM3701	www.beckhoff.com/EM3702


07 08
L1
L2
L3
N N
EL3403
BECKHOFF
05 06 07 08
EL3413
BECKHOFF
07 08
EL3773
BECKHOFF

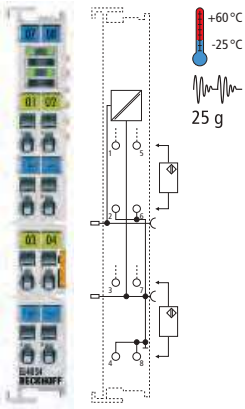
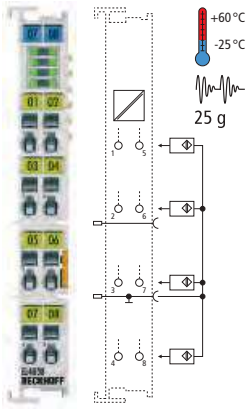
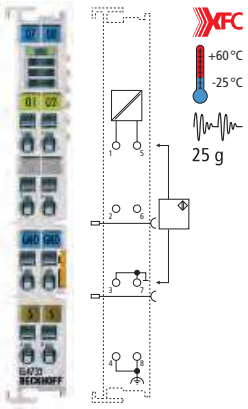
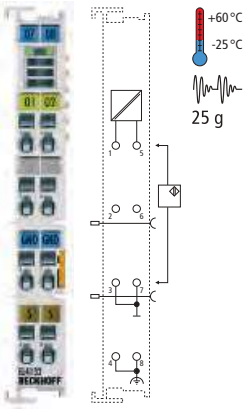
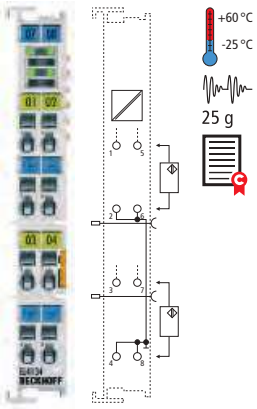
Analog output | -10…+10 V, 12 bit/16 bit

The output from the EL4xxx EtherCAT Terminals is an analog voltage or current parameter, depending on the controller specification: Terminals with 1 to 8 output channels on a 12 mm wide terminal are available for the ranges -10…+10 V, 0…10 V, 0…20 mA and 4…20 mA. All terminals feature a watchdog which, in the event of a communication failure, issues a stored value (default: 0) or even moves to it via a ramp. All EL4xxx units feature distributed clocks, which means that, if activated, they issue their output values reproducibly and synchronous with the other distributed clock devices in the system. The fewer channels a terminal has, the faster it can update its channels. The EL47xx is even able to generate new output values every 10 µs and can therefore output up to 100,000 samples per second.

The EL4732 and EL4712 oversampling terminals are particularly suitable for high-precision responses in DC systems, e.g. in conjunction with input terminals (EL37xx, EL31xx) or servo controllers.

	1-channel analog output terminal, -10…+10 V, 12 bit	2-channel analog output terminal, -10…+10 V, 12 bit
Technical data	**EL4031** | ES4031	**EL4032** | ES4032
Signal voltage	-10…+10 V	
Resolution	12 bit	
Connection technology	2-wire, single-ended	2-wire, single-ended
Conversion time	~ 100 µs	~ 150 µs
Number of outputs	1	2
		
	The EL4031 and EL4032 EtherCAT Terminals are analog output terminals with average conversion times and 12-bit resolution. Both use the 0 V power contact as common reference potential and are designed for 2-wire connection. User scaling can be set in the terminal.	
Load	> 5 kΩ (short-circuit-proof)	> 5 kΩ (short-circuit-proof)
Current consumption E-bus	typ. 140 mA	typ. 140 mA
Distributed clocks	yes	yes
Distributed clock precision	<< 1 µs	<< 1 µs
Oversampling factor	–	–
Output rate	–	–
Current consum. pow. cont.	typ. 25 mA	typ. 25 mA
Output error	< 0.1 % (relative to end value)	< 0.1 % (relative to end value)
Special features	Optional watchdog: user-specific output value with ramp; user synchronisation can be activated.	Optional watchdog: user-specific output value with ramp; user synchronisation can be activated.
Operating temperature	-25…+60 °C	-25…+60 °C
Approvals	CE, UL, Ex	CE, UL, Ex
Weight	approx. 55 g	approx. 55 g
Further information	www.beckhoff.com/EL4031	www.beckhoff.com/EL4032
Special terminals		
Distinguishing features		

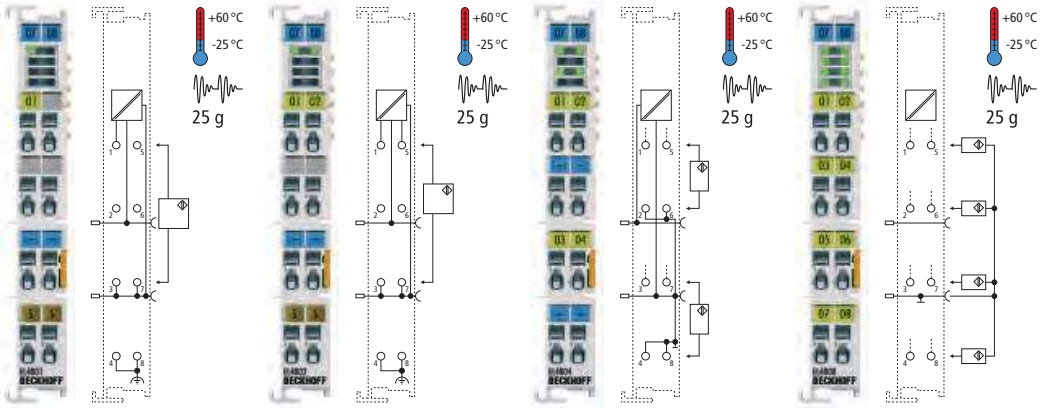
Further information on XFC see page 298

	4-channel analog output terminal, -10…+10 V, 12 bit	8-channel analog output terminal, -10…+10 V, 12 bit	2-channel analog output terminal, -10…+10 V, 16 bit, oversampling	2-channel analog output terminal, -10…+10 V, 16 bit	4-channel analog output terminal, -10…+10 V, 16 bit
	EL4034 | ES4034	**EL4038** | ES4038	**EL4732** | ES4732	**EL4132** | ES4132	**EL4134** | ES4134
			16 bit (incl. sign)		
	2-wire, single-ended	1-wire, single-ended	2-wire, single-ended	2-wire, single-ended	2-wire, single-ended
	~ 250 µs	~ 400 µs	~ 10 µs	~ 40 µs	~ 290 µs
	4	8	2	2	4
					
	The EL4034 and EL4038 EtherCAT Terminals are analog output terminals with average conversion times and 12-bit resolution. The EL4034 is designed for 2-wire connection. The channels have a common reference ground. The EL4038 uses the 0 V power contact as reference potential and is designed for single-wire connection. User scaling can be set in the terminal.		The EL4732 EtherCAT Terminal can output up to 100 sequential output values (which have previously been supplied as a package) per EtherCAT cycle. The oversampling factor must be an integer multiple of the cycle time.	The EL4132 and EL4134 EtherCAT Terminals are analog output terminals with short conversion times and 16-bit resolution and are suitable for fast control tasks. Both terminals are designed for 2-wire connection. The channels have a common reference ground. The EL4134 uses the 0 V power contact as reference potential. User scaling can be set in the terminal.	
	> 5 kΩ (short-circuit-proof)	> 5 kΩ (short-circuit-proof)	> 5 kΩ (short-circuit-proof)	> 5 kΩ (short-circuit-proof)	> 5 kΩ (short-circuit-proof)
	typ. 140 mA	typ. 100 mA	typ. 180 mA	typ. 210 mA	typ. 265 mA
	yes	yes	yes	yes	yes
	<< 1 µs	<< 1 µs	<< 1 µs	<< 1 µs	<< 1 µs
	–	–	n = 1…100 selectable	–	–
	–	–	max. 100 ksamples/s	–	–
	typ. 25 mA	typ. 25 mA	–	–	–
	< 0.1 % (relative to end value)	< 0.1 % (relative to end value)	< 0.1 % (relative to end value)	< 0.1 % (relative to end value)	< 0.1 % (relative to end value)
	Optional watchdog: user-specific output value with ramp; user synchronisation can be activated.	Optional watchdog: user-specific output value with ramp; user synchronisation can be activated.	oversampling	Watchdog parameterisable; user synchronisation can be activated.	Watchdog parameterisable; user synchronisation can be activated.
	-25…+60 °C	-25…+60 °C	-25…+60 °C	-25…+60 °C	-25…+60 °C
	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex
	approx. 85 g	approx. 85 g	approx. 50 g	approx. 55 g	approx. 65 g
	www.beckhoff.com/EL4034	www.beckhoff.com/EL4038	www.beckhoff.com/EL4732	www.beckhoff.com/EL4132	www.beckhoff.com/EL4134
					i EL4134-0020
					with calibration certificate

i For availability status see Beckhoff website at: www.beckhoff.com/EL4134

Analog output | 0…10 V, 12 bit

	1-channel analog output terminal, 0…10 V, 12 bit	2-channel analog output terminal, 0…10 V, 12 bit	4-channel analog output terminal, 0…10 V, 12 bit	8-channel analog output terminal, 0…10 V, 12 bit
Technical data	**EL4001** | ES4001	**EL4002** | ES4002	**EL4004** | ES4004	**EL4008** | ES4008
Signal voltage	0…10 V			
Resolution	12 bit			
Connection technology	2-wire, single-ended	2-wire, single-ended	2-wire, single-ended	1-wire, single-ended
Conversion time	~ 100 µs	~ 150 µs	~ 250 µs	~ 400 µs
Number of outputs	1	2	4	8

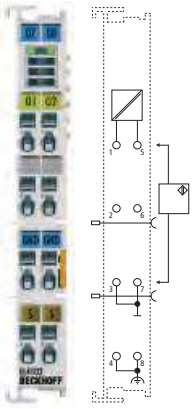


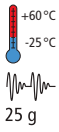
The EL4001, EL4002, EL4004 and EL4008 EtherCAT Terminals are analog output terminals with average conversion times and 12-bit resolution. The channels use the 0 V power contact as common reference potential. The EL4008 is designed for single-wire connection. The other terminals are designed for 2-wire connection. User scaling can be set in the terminal.

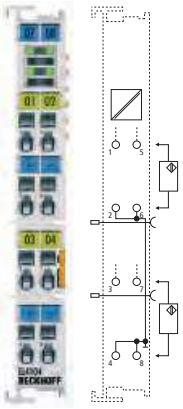
Load	> 5 kΩ (short-circuit-proof)	> 5 kΩ (short-circuit-proof)	> 5 kΩ (short-circuit-proof)	> 5 kΩ (short-circuit-proof)
Current consumption E-bus	typ. 140 mA	typ. 140 mA	typ. 140 mA	typ. 100 mA
Distributed clocks	yes	yes	yes	yes
Distributed clock precision	<< 1 µs	<< 1 µs	<< 1 µs	<< 1 µs
Current consumption power contacts	typ. 25 mA	typ. 25 mA	typ. 25 mA	typ. 25 mA
Output error	< 0.1 % (relative to end value)	< 0.1 % (relative to end value)	< 0.1 % (relative to end value)	< 0.1 % (relative to end value)
Special features	Optional watchdog: user-specific output value with ramp; user synchronisation can be activated.	Optional watchdog: user-specific output value with ramp; user synchronisation can be activated.	Optional watchdog: user-specific output value with ramp; user synchronisation can be activated.	Optional watchdog: user-specific output value with ramp; user synchronisation can be activated.
Operating temperature	-25…+60 °C	-25…+60 °C	-25…+60 °C	-25…+60 °C
Approvals	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex
Weight	approx. 60 g	approx. 60 g	approx. 85 g	approx. 85 g
Further information	www.beckhoff.com/EL4001	www.beckhoff.com/EL4002	www.beckhoff.com/EL4004	www.beckhoff.com/EL4008

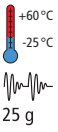
Analog output | 0…10 V, 16 bit

	2-channel analog output terminal, 0…10 V, 16 bit	4-channel analog output terminal, 0…10 V, 16 bit
Technical data	**EL4102** | ES4102	**EL4104** | ES4104
Signal voltage	0…10 V	
Resolution	16 bit (incl. sign)	
Connection technology	2-wire, single-ended	2-wire, single-ended
Conversion time	~ 40 µs	~ 290 µs
Number of outputs	2	4







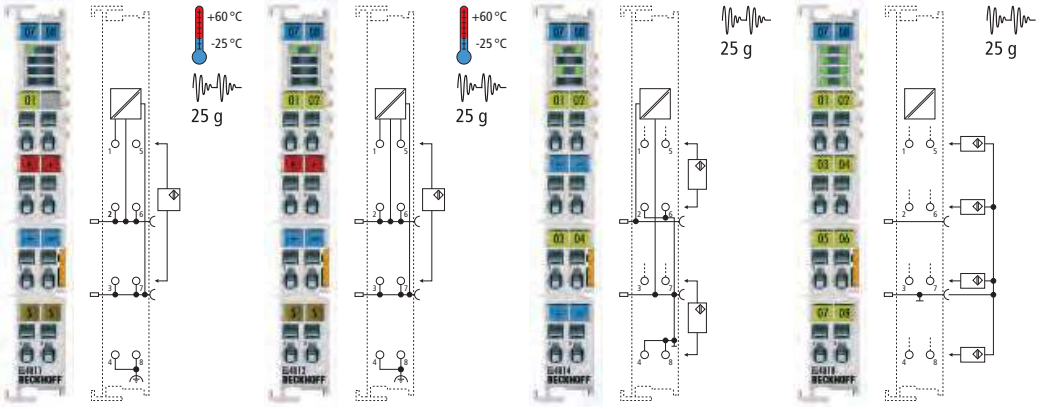


The EL4102 and EL4104 EtherCAT Terminals are analog output terminals with short conversion times and 16-bit resolution and are suitable for fast control tasks. Both terminals are designed for 2-wire connection. The channels have a common reference ground. User scaling can be set in the terminal.

Load	> 5 kΩ (short-circuit-proof)	> 5 kΩ (short-circuit-proof)
Current consumption E-bus	typ. 210 mA	typ. 190 mA
Distributed clocks	yes	yes
Distributed clock precision	<< 1 µs	<< 1 µs
Current consumption power contacts	–	–
Output error	< 0.1 % (relative to end value)	< 0.1 % (relative to end value)
Special features	Watchdog parameterisable; user synchronisation can be activated.	Watchdog parameterisable; user synchronisation can be activated.
Operating temperature	-25…+60 °C	-25…+60 °C
Approvals	CE, UL, Ex	CE, UL, Ex
Weight	approx. 60 g	approx. 65 g
Further information	www.beckhoff.com/EL4102	www.beckhoff.com/EL4104

Analog output | 0…20 mA, 12 bit

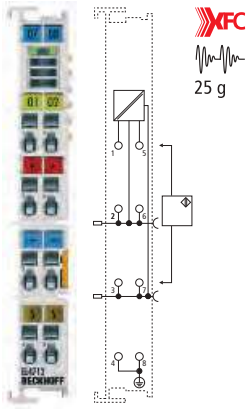
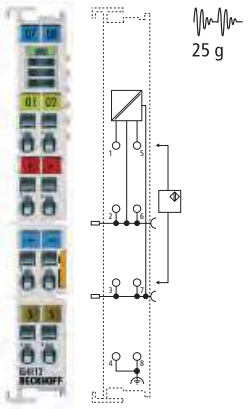
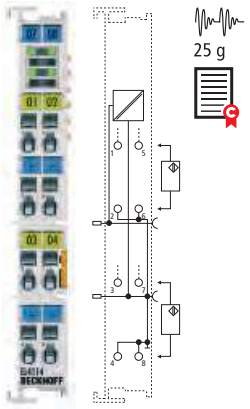
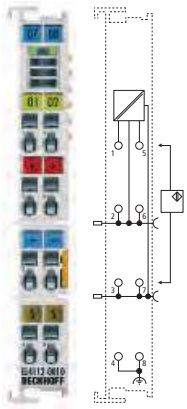
	1-channel analog output terminal, 0…20 mA, 12 bit	2-channel analog output terminal, 0…20 mA, 12 bit	4-channel analog output terminal, 0…20 mA, 12 bit	8-channel analog output terminal, 0…20 mA, 12 bit
Technical data	**EL4011** | ES4011	**EL4012** | ES4012	**EL4014** | ES4014	**EL4018** | ES4018
Signal voltage	0…20 mA			
Resolution	12 bit			
Connection technology	3-wire, single-ended	3-wire, single-ended	2-wire, single-ended	1-wire, single-ended
Conversion time	~ 100 µs	~ 150 µs	~ 250 µs	~ 400 µs
Number of outputs	1	2	4	8



The EtherCAT Terminals of the EL401x series are analog output terminals with average conversion times and 12-bit resolution. The channels use the 0 V power contact as common reference potential. Apart from the 8-channel version EL4018, the terminals of the EL401x series are designed for 2-wire connection. User scaling can be set in the terminal.

Load	< 500 Ω (short-circuit-proof)	< 500 Ω (short-circuit-proof)	< 350 Ω (short-circuit-proof)	< 150 Ω
Current consumption E-bus	typ. 140 mA	typ. 140 mA	typ. 140 mA	typ. 100 mA
Distributed clocks	yes	yes	yes	yes
Distributed clock precision	<< 1 µs	<< 1 µs	<< 1 µs	<< 1 µs
Oversampling factor	–	–	–	–
Output rate	–	–	–	–
Current consumption power contacts	typ. 25 mA	typ. 25 mA	typ. 25 mA	typ. 60 mA
Output error	< 0.1 % (relative to end value)	< 0.1 % (relative to end value)	< 0.1 % (relative to end value)	< 0.1 % (relative to end value)
Special features	Optional watchdog: user-specific output value with ramp; user synchronisation can be activated.	Optional watchdog: user-specific output value with ramp; user synchronisation can be activated.	Optional watchdog: user-specific output value with ramp; user synchronisation can be activated.	Optional watchdog: user-specific output value with ramp; user synchronisation can be activated.
Operating temperature	-25…+60 °C	-25…+60 °C	0…+55 °C	0…+55 °C
Approvals	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex
Weight	approx. 60 g	approx. 60 g	approx. 65 g	approx. 65 g
Further information	www.beckhoff.com/EL4011	www.beckhoff.com/EL4012	www.beckhoff.com/EL4014	www.beckhoff.com/EL4018

Analog output | 0…20 mA/-10…+10 mA, 16 bit

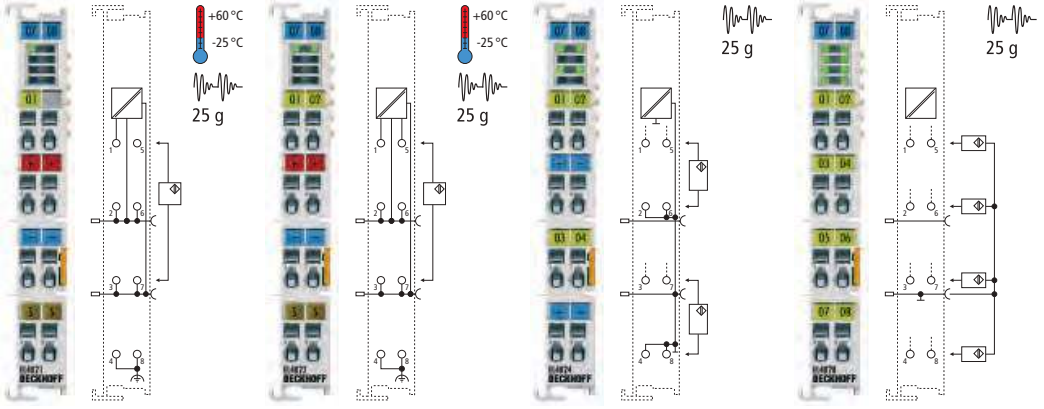
	2-channel analog output terminal, 0…20 mA, 16 bit, oversampling	2-channel analog output terminal, 0…20 mA, 16 bit	4-channel analog output terminal, 0…20 mA, 16 bit	2-channel analog output terminal, -10…+10 mA, 16 bit
Technical data	**EL4712** | ES4712	**EL4112** | ES4112	**EL4114** | ES4114	**EL4112-0010**
Signal voltage	0…20 mA			-10…+10 mA
Resolution	16 bit (incl. sign)			
Connection technology	3-wire, single-ended	3-wire, single-ended	2-wire, single-ended	3-wire, single-ended
Conversion time	~ 10 µs	~ 40 µs	~ 290 µs	~ 40 µs
Number of outputs	2	2	4	2
				
	The EL4712 EtherCAT Terminal can output up to 100 sequential output values (which have previously been supplied as a package) per EtherCAT cycle. The oversampling factor must be an integer multiple of the cycle time.	The EtherCAT Terminals of the EL411x series are analog output terminals with short conversion times and 16-bit resolution and are suitable for fast control tasks. The terminals are designed for 2-wire connection. The channels use the 0 V power contact as common reference potential. User scaling can be set in the terminal.		
Load	< 500 Ω (short-circuit-proof)	< 500 Ω (short-circuit-proof)	< 350 Ω (short-circuit-proof)	< 500 Ω (short-circuit-proof)
Current consumption E-bus	typ. 100 mA	typ. 160 mA	typ. 160 mA	typ. 160 mA
Distributed clocks	yes	yes	yes	yes
Distributed clock precision	<< 1 µs	<< 1 µs	<< 1 µs	<< 1 µs
Oversampling factor	n = integer multiple of the cycle time, 1…100 selectable	–	–	–
Output rate	max. 100 ksamples/s	–	–	–
Current consum. pow. cont.	typ. 15 mA	typ. 15 mA	typ. 15 mA	typ. 15 mA
Output error	< 0.1 % (relative to end value)	< 0.1 % (relative to end value)	< 0.1 % (relative to end value)	< 0.1 % (relative to end value)
Special features	oversampling	Watchdog parameterisable; user synchronisation can be activated.	Watchdog parameterisable; user synchronisation can be activated.	Watchdog parameterisable; user synchronisation can be activated.
Operating temperature	0…+55 °C	0…+55 °C	0…+55 °C	0…+55 °C
Approvals	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex
Weight	approx. 65 g	approx. 60 g	approx. 65 g	approx. 65 g
Further information	www.beckhoff.com/EL4712	www.beckhoff.com/EL4112	www.beckhoff.com/EL4114	www.beckhoff.com/EL4112
Special terminals			i EL4114-0020	
Distinguishing features			with calibration certificate	

Further information on XFC see page 298

i For availability status see Beckhoff website at: www.beckhoff.com/EL4114

Analog output | 4…20 mA, 12 bit

	1-channel analog output terminal, 4…20 mA, 12 bit	2-channel analog output terminal, 4…20 mA, 12 bit	4-channel analog output terminal, 4…20 mA, 12 bit	8-channel analog output terminal, 4…20 mA, 12 bit
Technical data	**EL4021** | ES4021	**EL4022** | ES4022	**EL4024** | ES4024	**EL4028** | ES4028
Signal voltage	4…20 mA			
Resolution	12 bit			
Connection technology	3-wire, single-ended	3-wire, single-ended	2-wire, single-ended	1-wire, single-ended
Conversion time	~ 100 µs	~ 150 µs	~ 250 µs	~ 400 µs
Number of outputs	1	2	4	8

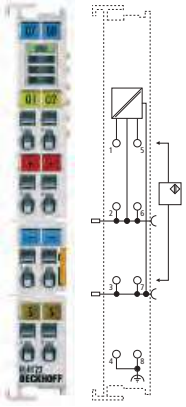


The EtherCAT Terminals of the EL402x series are analog output terminals with average conversion times and 12-bit resolution. The channels use the 0 V power contact as common reference potential. Apart from the 8-channel version EL4028, the terminals of the EL402x series are designed for 2-wire connection. User scaling can be set in the terminal.

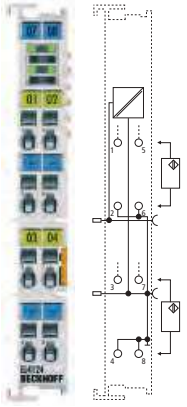
Load	< 500 Ω (short-circuit-proof)	< 500 Ω (short-circuit-proof)	< 350 Ω (short-circuit-proof)	< 150 Ω
Current consumption E-bus	typ. 140 mA	typ. 140 mA	typ. 140 mA	typ. 100 mA
Distributed clocks	yes	yes	yes	yes
Distributed clock precision	<< 1 µs	<< 1 µs	<< 1 µs	<< 1 µs
Current consumption power contacts	typ. 25 mA	typ. 25 mA	typ. 25 mA	typ. 60 mA
Output error	< 0.1 % (relative to end value)	< 0.1 % (relative to end value)	< 0.1 % (relative to end value)	< 0.1 % (relative to end value)
Special features	Optional watchdog: user-specific output value with ramp; user synchronisation can be activated.	Optional watchdog: user-specific output value with ramp; user synchronisation can be activated.	Optional watchdog: user-specific output value with ramp; user synchronisation can be activated.	Optional watchdog: user-specific output value with ramp; user synchronisation can be activated.
Operating temperature	-25…+60 °C	-25…+60 °C	0…+55 °C	0…+55 °C
Approvals	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex
Weight	approx. 60 g	approx. 60 g	approx. 60 g	approx. 60 g
Further information	www.beckhoff.com/EL4021	www.beckhoff.com/EL4022	www.beckhoff.com/EL4024	www.beckhoff.com/EL4028

Analog output | 4…20 mA, 16 bit

	2-channel analog output terminal, 4…20 mA, 16 bit	4-channel analog output terminal, 4…20 mA, 16 bit
Technical data	**EL4122** | ES4122	**EL4124** | ES4124
Signal voltage	4…20 mA	
Resolution	16 bit (incl. sign)	
Connection technology	3-wire, single-ended	2-wire, single-ended
Conversion time	~ 40 µs	~ 290 µs
Number of outputs	2	4



25 g



25 g

The EL4122 and EL4124 EtherCAT Terminals are analog output terminals with short conversion times and 16-bit resolution and are suitable for fast control tasks. The terminals are designed for 2-wire connection. The channels have a common reference ground. The EL4122 uses the 0 V power contact as reference potential. User scaling can be set in the terminal.

Load	< 500 Ω (short-circuit-proof)	< 350 Ω (short-circuit-proof)
Current consumption E-bus	typ. 160 mA	typ. 190 mA
Distributed clocks	yes	yes
Distributed clock precision	<< 1 µs	<< 1 µs
Current consumption power contacts	typ. 15 mA	typ. 15 mA
Output error	< 0.1 % (relative to end value)	< 0.1 % (relative to end value)
Special features	Watchdog parameterisable; user synchronisation can be activated.	Watchdog parameterisable; user synchronisation can be activated.
Operating temperature	0…+55 °C	0…+55 °C
Approvals	CE, UL, Ex	CE, UL, Ex
Weight	approx. 60 g	approx. 65 g
Further information	www.beckhoff.com/EL4122	www.beckhoff.com/EL4124

Position measurement | **SSI encoder interfaces**

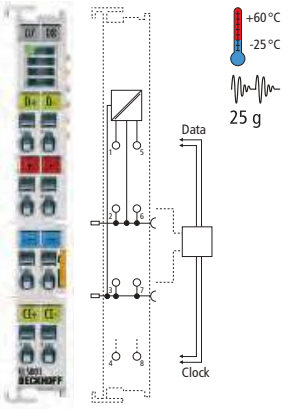
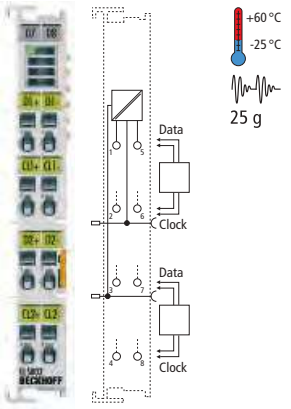
The EL5001 SSI interface EtherCAT Terminal enables the direct connection of an SSI encoder; two SSI encoders can be connected to the 2-channel EL5002 version.

SSI communication is normal for the connection of position encoders and needs two differential wire pairs as the clock and data line. Via the clock line, the master specifies the speed with which the SSI slave on the data line returns its position, e.g. with 24-bit length.

The interface circuit of the EL500x generates a pulse for reading the encoder, and makes the incoming data stream available to the controller as a data word in the process image. Various operating modes, transmission frequencies and bit widths can be permanently stored in a control register.

The EL5001 and EL5002 feature the distributed clocks function. Cyclic reading of the SSI encoder can thus be started with high precision, enabling detailed dynamic analysis of the axis in the control system. If the distributed clocks function is deactivated, the EL500x clocks the data synchronously with the EtherCAT cycle from the position encoder.

If the transmitted position data are also to be read by a second controller while an SSI master-slave connection already exists, the EL5001-0011 can be used as an SSI monitor, which passively and jointly reads the SSI data on the data lines.

	SSI encoder interface	SSI encoder interface
Technical data	**EL5001** | ES5001	**EL5002** | ES5002
Technology	SSI encoder interface	
Number of channels	1	2
		
Encoder supply	24 V DC via power contacts	external e.g. EL91xx
Current consumption power contacts	typ. 20 mA	typ. 20 mA
Current consumption E-bus	typ. 120 mA	typ. 130 mA
Distributed clocks	yes	yes
Signal output (pulse)	difference signal (RS422)	difference signal (RS422)
Signal input (data)	difference signal (RS422)	difference signal (RS422)
Encoder connection	binary input: D+, D-, binary output: Cl+, Cl-	binary input: D+, D-, binary output: Cl+, Cl-
Data transfer rates	variable up to 1 MHz, 250 kHz default	variable up to 1 MHz, 250 kHz default
Special features	adjustable baud rate, coding and data length	adjustable baud rate, coding and data length
Operating temperature	-25…+60 °C	-25…+60 °C
Approvals	CE, UL, Ex	CE, UL, Ex
Weight	approx. 55 g	approx. 55 g
Further information	www.beckhoff.com/EL5001	www.beckhoff.com/EL5002
Special terminals	**EL5001-0011**	
Distinguishing features	SSI monitor terminal, no clock output (simply listening)	

Каталог Beckhoff

Автоматизация