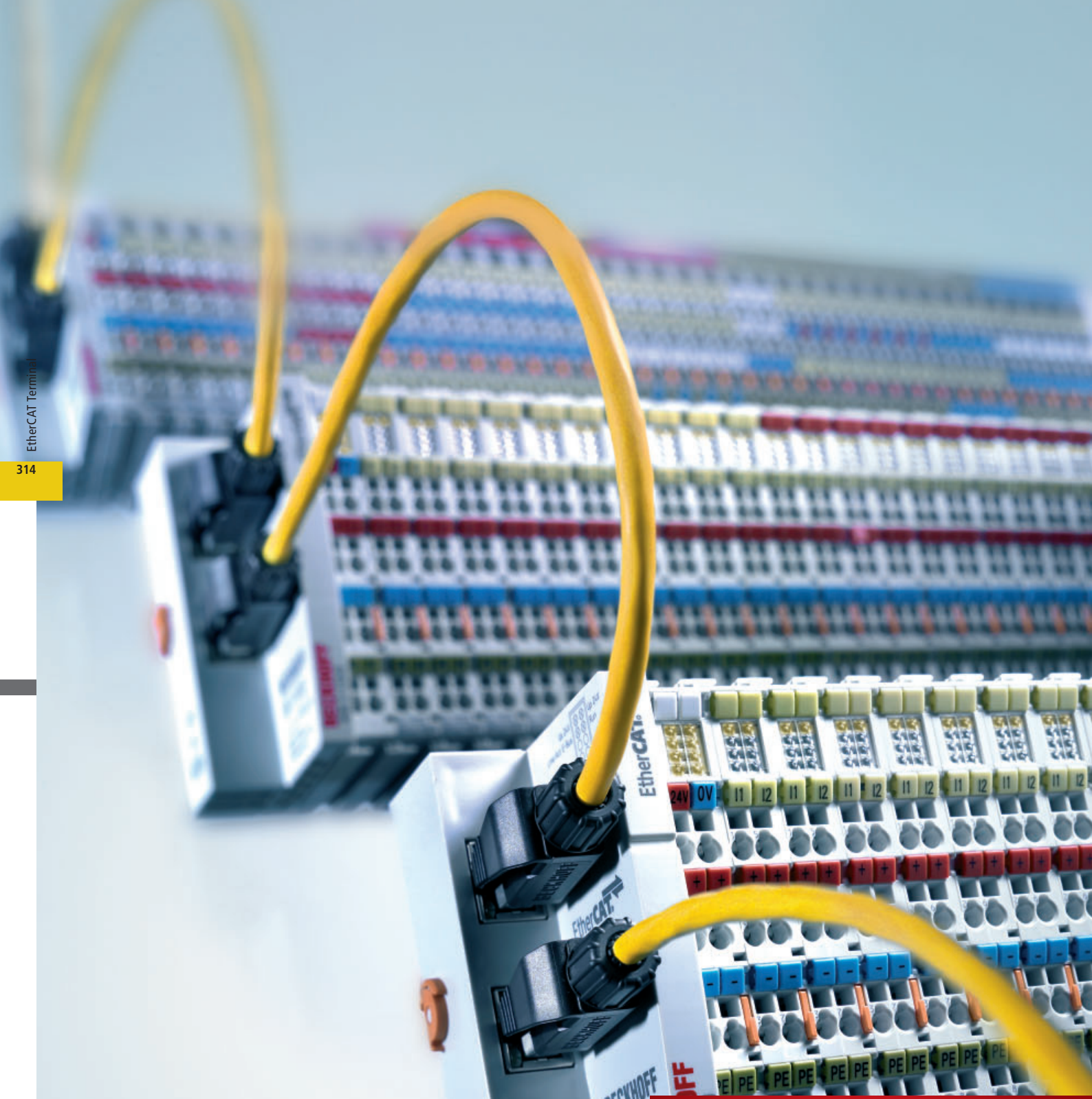


EtherCAT®

Highlights

- IP 20 EtherCAT I/O system
- Real-time Ethernet down to the terminal
- Integration of highly precise measurement technology, drive technology and safety terminals
- Gateways for subordinate fieldbus systems

EtherCAT Terminal

Ultra high-speed communication

▸ **www.beckhoff.com/EtherCAT-Terminal**

Product overview EtherCAT Terminals

EtherCAT Couplers

EtherCAT Couplers E-bus	**EK1100** 332	**EK1300** 338 EtherCAT P Coupler	**EK1101** 332 ID switch	**EK1101-0080** 332 ID switch, Fast Hot Connect	**EK1100-0008** 332 M8 connection
	EK1501 334 ID switch, multimode fibre optic	**EK1501-0010** 335 ID switch, singlemode fibre optic	**EK1501-0100** 335 media converter (multimode fibre optic to RJ45), ID switch	**EK1541** 335 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 4 in- + 4 outputs, 332 2 safe inputs + 2 safe outputs	**EK1960** TwinSAFE Compact Controller, 1053 20 safe digital inputs, 10 safe digital outputs			
EtherCAT Couplers K-bus	**BK1120** 339	**BK1150** 339 "Compact"	**BK1250** 339 between E-bus and K-bus terminals		
Bus Couplers (for ELxxxx)	**EK3100** 340 PROFIBUS	**EK9000** 340 Ethernet	**EK9160** 340 IoT	**EK9300** 341 PROFINET RT	**EK9500** 341 EtherNet/IP
	EK9700 341 SERCOS III				
Extension system and junctions	**EK1110** 337 extension end terminal	**EK1310** 338 extension end terminal, EtherCAT P	**EK1122** 337 2-port junction	**EK1322** 338 2-port junction, EtherCAT P	**EK1122-0008** 337 2-port junction, M8
	EK1122-0080 337 2-port junction, Fast Hot Connect	**EK1521** 336 multimode fibre optic junction	**EK1521-0010** 336 singlemode fibre optic junction	**EK1561** 336 POF junction	

Embedded PCs with E-bus interface see page 188, Infrastructure Components see page 738

EtherCAT Terminal | Digital input: EL1xxx/ES1xxx

Signal	2-channel	4-channel		8-channel	16-channel
5/12/24 V DC	**EL1382** 347 24 V DC, thermistor	**EL1124** 351 5 V DC	**EL1144** 351 12 V DC		
24 V DC (filter 3.0 ms)	**EL1002** type 3 346	**EL1004** type 3 345	**EL1004-0020** > 2500 V 345	**EL1008** type 3 344	**EL1809** type 3 345
		EL1104 347 with sensor supply, type 3	**EL1804** 347 8 x 24 V, 4 x 0 V, type 3	**EL1808** 345 8 x 24 V DC, type 3	**EL1862** 347 flat-ribbon cable, type 3
		EL1084 350 negative switching	**EL1024** 346 type 2	**EL1859** type 3, 345 8 inputs, 8 outputs, I_{MAX} = 0.5 A	**EL1862-0010** 350 flat-ribbon cable, negative switching
				EL1088 negative switching 350	**EL1889** negative switching 350
24 V DC (filter 10 µs)	**EL1012** 346 type 3	**EL1014** 345 type 3	**EL1034** 346 potential-free inputs, type 1	**EL1018** 344 type 3	**EL1819** 345 type 3
		EL1114 347 with sensor supply, type 3	**EL1814** 347 8 x 24 V, 4 x 0 V, type 3		**EL1872** 347 flat-ribbon cable, type 3
			EL1094 negative switching 350	**EL1098** negative switching 350	
24 V DC (XFC, T_{ON}/T_{OFF} 1 µs)	**EL1202** fast input, type 3 348			**EL1258** multi-timestamping 349	
	EL1252 timestamp, type 3 348			**EL1259** 8 multi-timestamping inputs and outputs 349	
	EL1262 oversampl., type 3 349				
24 V DC (safe inputs)		**EL1904** 353 TwinSAFE, 4 safe inputs			
48 V DC		**EL1134** filter 10 µs, type 1 351			
120 V AC/DC	**EL1712** power contacts 351				
230 V AC	**EL1702** power contacts 351				
	EL1722 no power contacts 351				
Counter	**EL1502** 352 100 kHz, 32 bit, type 1				
	EL1512 352 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 361 I_{MAX} = ±20 mA		
12 V DC			EL2024-0010 361 I_{MAX} = 2.0 A		
24 V DC	EL2042 357 2 x 4 A/1 x 8 A				
24 V DC (I_{MAX} = 0.5 A)	EL2002 354		EL2004 354	EL2008 355	EM2042 D-sub connection 356
			EL2014 with diagnostics 355		EL2872 flat-ribbon cable 355
				EL2808 8 x 0 V 355	EL2809 355
					EL2819 with diagnostics 356
			EL2084 360 negative switching	EL2088 360 negative switching	EL2889 360 negative switching
				EL1859 356 8 inputs, 8 outputs, filter 3.0 ms, type 3	EL2872-0010 360 flat-ribbon cable, negative switching
24 V DC (I_{MAX} = 2.0 A)	EL2022 356		EL2024 357	EL2828 357	
	EL2032 357 with diagnostic		EL2034 357 with diagnostic		
24 V DC (XFC, T_{ON}/T_{OFF} 1 µs)	EL2202 358 push-pull outputs	EL2212 358 overexcitation, multi-timestamping		EL1259 359 8 multi-timestamping inputs and outputs	
	EL2252 359 timestamp	EL2262 359 oversampling		EL2258 359 multi-timestamping	
24 V DC (safe outputs)	EL2901 371 TwinSAFE, 1 safe output	EL2902 371 TwinSAFE, 2 safe outputs	EL2904 371 TwinSAFE, 4 safe outputs		
30 V AC/DC (I_{MAX} = 2.0 A)			EL2784 362	EL2788 363	
			EL2794 363 potential-free	EL2798 363 potential-free	
Relay (up to 230 V AC)	EL2602 368 I_{MAX} = 5.0 A, make contact, power contacts	EL2622 369 I_{MAX} = 5.0 A, make contact, no power contacts	EL2624 369 I_{MAX} = 2.0 A, make contact, no power contacts		
	EL2612 369 I_{MAX} = 2.0 A, change-over, no power contacts	EL2652 369 I_{MAX} = 1.0 A, change-over, no power contacts			
Triac (12…230 V AC)	EL2712 370 I_{MAX} = 0.5 A, power contacts	EL2722 370 I_{MAX} = 1.0 A, mutually locked outputs			
	EL2732 370 I_{MAX} = 0.5 A, no power contacts				
PWM	EL2502 366 24 V DC, I_{MAX} = 0.5 A				
Frequency output	EL2521 365 1-channel AB, 0…500 kHz	EL2522 365 2-channel AB, 1-channel ABC, 0…4 MHz			
Current control	EL2595 367 1-channel, LED constant current terminal	EL2535 367 24 V DC, I_{MAX} = ±50 mA, ±1 A or ±2 A			
		EL2545 367 50 V DC, I_{MAX} = ±3.5 A			

EtherCAT Terminal | Analog input: EL3xxx/ES3xxx

Signal	1-channel	2-channel	4-channel	5-/8-channel
Multi-function	EL3751 387 24 bit, 10 ksps			
±10 V, ±20 mA, NAMUR NE43			EL3174 386 16 bit EL3174-0002 386 16 bit, electrically isolated	
±75 mV, 24 bit		EL3602-0010 375		
±200 mV		EL3602-0002 375		
0…10 V	EL3061 376 12 bit EL3161 377 16 bit	EL3062 376 12 bit EL3162 377 16 bit	EL3064 376 12 bit EL3164 377 16 bit	EL3068 376 12 bit
0…30 V, 12 bit		EL3062-0030 376		
±10 V	EL3001 372 single-ended, 12 bit	EL3002 373 single-ended, 12 bit	EL3004 373 single-ended, 12 bit	EL3008 373 single-ended, 12 bit
	EL3101 374 differential input, 16 bit	EL3102 374 differential input, 16 bit EL3602 375 differential input, 24 bit EL3702 375 differential input, 16 bit, oversampling	EL3104 374 differential input, 16 bit	
0…20 mA	EL3041 378 single-ended, 12 bit EL3141 380 single-ended, 16 bit	EL3042 378 single-ended, 12 bit EL3142 380 single-ended, 16 bit EL3742 381 differential input, 16 bit, oversampling	EL3044 378 single-ended, 12 bit EL3144 380 single-ended, 16 bit	EL3048 378 single-ended, 12 bit
	EL3011 379 differential input, 12 bit EL3111 381 differential input, 16 bit	EL3012 379 differential input, 12 bit EL3112 381 differential input, 16 bit EL3612 381 differential input, 24 bit	EL3014 379 differential input, 12 bit EL3114 381 differential input, 16 bit	
4…20 mA	EL3051 382 single-ended, 12 bit EL3151 384 single-ended, 16 bit	EL3052 382 single-ended, 12 bit EL3152 384 single-ended, 16 bit	EL3054 382 single-ended, 12 bit EL3154 384 single-ended, 16 bit	EL3058 382 single-ended, 12 bit
	EL3021 383 differential input, 12 bit EL3121 385 differential input, 16 bit	EL3022 383 differential input, 12 bit EL3122 385 differential input, 16 bit	EL3024 383 differential input, 12 bit EL3124 385 differential input, 16 bit	
			EL3124-0090 385 TwinSAFE SC, 16 bit	
±10 mA		EL3142-0010 380 single-ended, 16 bit		
Thermo-couple/mV	EL3311 392 16 bit	EL3312 392 16 bit	EL3314 393 16 bit EL3314-0090 393 TwinSAFE SC, 16 bit	EL3318 393 16 bit
Resistance thermometer (RTD)	EL3201 390 16 bit	EL3202 391 16 bit	EL3204 389 2-wire, 16 bit EL3214 389 3-wire, 16 bit	EL3208 389 16 bit
			EL3204-0200 389 16 bit, parameterisable EL3214-0090 389 TwinSAFE SC, 16 bit	
Resistor bridge	EL3351 396 EL3356 397 self-calibration			
3-phase power measurement		EL3403 398 500 V AC, 1 A EL3413 399 690 V AC, 5 A EL3433 399 500 V AC, 10 A		
Measurement technology/ Condition Monitoring	EL3681 400 digital multimeter terminal, 18 bit	EL3632 394 IEPE terminal, acceleration sensors EL3692 395 resistance measurement, 10 mΩ…10 MΩ EL3773 399 power monitoring		EL3255 401 potentiometer measurement, 5-channel
Pressure measuring	EM3701 402 differential pressure measuring, -100…+100 hPa	EM3702 403 relative pressure measuring, 7500 hPa EM3712 403 relative pressure measuring, -1000…+1000 hPa		

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

EtherCAT Terminal | Analog output: EL4xxx/ES4xxx

Signal	1-channel	2-channel	4-channel	8-channel
0…10 V	EL4001 406 12 bit	EL4002 406 12 bit EL4102 407 16 bit	EL4004 406 12 bit EL4104 407 16 bit	EL4008 406 12 bit
±10 V	EL4031 404 12 bit	EL4032 404 12 bit EL4132 405 16 bit EL4732 405 16 bit, oversampling	EL4034 405 12 bit EL4134 405 16 bit	EL4038 405 12 bit
0…20 mA	EL4011 408 12 bit	EL4012 408 12 bit EL4112 409 16 bit EL4712 409 16 bit, oversampling	EL4014 408 12 bit EL4114 409 16 bit	EL4018 408 12 bit
4…20 mA	EL4021 410 12 bit	EL4022 410 12 bit EL4122 411 16 bit	EL4024 410 12 bit EL4124 411 16 bit	EL4028 410 12 bit
±10 mA		EL4112-0010 409 16 bit		

EtherCAT Terminal | Position measurement: EL/ES5xxx

Signal	1-channel			2-channel
Position measurement	EL5001 412 SSI encoder interface	EL5101 414 differential inputs, RS485, incremental encoder interface	EL5021 415 SinCos encoder interface, 1 V_{PP}	EL5002 412 SSI encoder interface
	EL5001-0011 412 SSI monitor terminal	EL5101-0090 414 incremental encoder interface, TwinSAFE SC	EL5021-0090 415 SinCos encoder interface, 1 V_{PP}, TwinSAFE SC	EL5032 413 EnDat 2.2 interface
	EL5101-0010 414 differential inputs, RS485, incremental encoder interface	EL5101-0011 416 incremental encoder interface, RS422, oversampling	EL5151 415 24 V DC, incremental encoder interface	EL5152 415 24 V DC, incremental encoder interface

EtherCAT Terminal | Communication: EL/ES6xxx

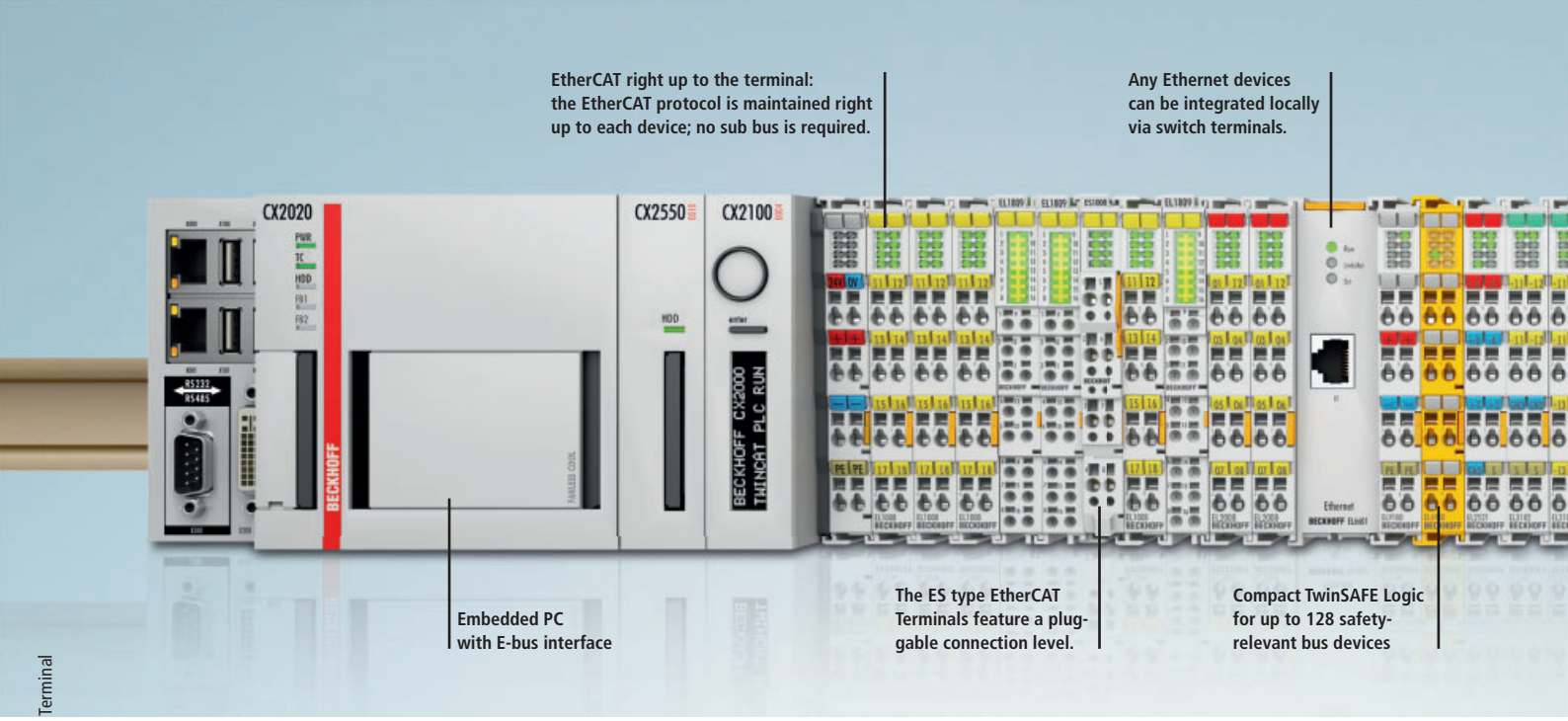
Signal	1-channel			2-channel	4-channel
Communication	**EL6001** 417 RS232, 115.2 kbaud	**EL6021** 417 RS422/RS485, 115.2 kbaud	**EL6080** 420 memory terminal 128 kbyte	**EL6002** 417 RS232, 115.2 kbaud, D-sub	**EL6224** 426 IO-Link master
	EL6090 421 display terminal	**EL6070** 419 license key terminal	**EL6688** 423 IEEE 1588 master/slave	**EL6022** 417 RS422/RS485, 115.2 kbaud, D-sub	**EL6224-0090** 426 IO-Link master, TwinSAFE SC
	EL6601 422 switch port			**EL6692** 424 EtherCAT bridge	**EL6614** 422 switch port
				EL6695 424 EtherCAT bridge, high performance	
Communication (master terminal)	**EL6201** 425 AS-Interface	**EL6631** 427 PROFINET RT	**EL6632** 427 PROFINET IRT		
	EL6652 428 EtherNet/IP	**EL6720** 432 Lightbus	**EL6731** 429 PROFIBUS		
	EL6751 430 CANopen	**EL6752** 431 DeviceNet	**EL6851** 433 DMX		
Communication (slave terminal ELxxxx-0010)	**EL6631-0010** 427 PROFINET RT	**EL6652-0010** 428 EtherNet/IP	**EL6731-0010** 429 PROFIBUS		
	EL6740-0010 432 Interbus	**EL6751-0010** 430 CANopen	**EL6752-0010** 431 DeviceNet		
	EL6851-0010 433 DMX				
Safety	**EL6900** 434 TwinSAFE Logic	**EL6910** 434 TwinSAFE Logic	**EL6930** 434 TwinSAFE/PROFIsafe logic and gateway		

EtherCAT Terminal | Motion: EL/ES7xxx, EM7xxx

Signal	< 3 A	3…5 A	≥ 5 A
Servomotor	**EL7201-9014** 438 I_{MAX} = 2.8 A_{RMS}, 50 V DC, OCT, STO	**EL7211-9014** 439 I_{MAX} = 4.5 A_{RMS}, 50 V DC, OCT, STO	
	EL7201 439 I_{MAX} = 2.8 A_{RMS}, 50 V DC, resolver	**EL7211** 439 I_{MAX} = 4.5 A_{RMS}, 50 V DC, resolver	
	EL7201-0010 438 I_{MAX} = 2.8 A_{RMS}, 50 V DC, OCT	**EL7211-0010** 439 I_{MAX} = 4.5 A_{RMS}, 50 V DC, OCT	
Stepper motor	**EL7037** 437 I_{MAX} = 1.5 A, 24 V DC, incremental encoder, vector control		**EL7047** 437 I_{MAX} = 5.0 A, 50 V DC, incremental encoder, vector control
	EL7031 437 I_{MAX} = 1.5 A, 24 V DC		**EL7041** 437 I_{MAX} = 5.0 A, 50 V DC, incremental encoder
DC motor output stage	**EL7332** 441 I_{MAX} = 1.0 A, 24 V DC	**EL7342** 441 I_{MAX} = 3.5 A, 50 V DC, incremental encoder	
4-axis interface	**EM7004** 435 4 incremental encoders, 32 digital I/Os 24 V DC, 4 analog outputs ±10 V		

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

Signal	System			
Components for system bus	**EL9011** 444 bus end cap	**EL9070** 443 shield terminal	**EL9080** 443 isolation terminal	**EL9195** 443 shield terminal
Potential distribution	**EL9180** 444 2 clamping units per power contact	**EL9181** 445 2 x 8 terminal points	**EL9182** 445 8 x 2 terminal points	**EL9183** 445 1 x 16 terminal points
	EL9184 445 8 x 24 V DC, 8 x 0 V DC	**EL9185** 444 4 clamping units at 2 power contacts	**EL9186** 444 8 x 24 V DC	**EL9187** 445 8 x 0 V DC
	EL9188 445 16 x 24 V DC	**EL9189** 445 16 x 0 V DC		
Potential supply, 24 V DC	**EL9100** 442	**EL9110** 442 diagnostic	**EL9200** 443 with fuse	**EL9210** 443 diagnostic, with fuse
	EL9520 446 AS-Interface potential supply with filter			
Potential supply, 120…230 V AC	**EL9150** 442 with LED	**EL9160** 442 diagnostic	**EL9190** 443	**EL9250** 443 with fuse, with LED
	EL9260 443 diagnostic, with fuse	**EL9290** 443 with fuse		
Power supply	**EL9410** 446 input 24 V DC, output 5 V DC/2 A	**EL9505** 447 input 24 V DC, output 5 V DC/0.5 A	**EL9508** 447 input 24 V DC, output 8 V DC/0.5 A	**EL9510** 447 input 24 V DC, output 10 V DC/0.5 A
	EL9512 447 input 24 V DC, output 12 V DC/0.5 A	**EL9515** 447 input 24 V DC, output 15 V DC/0.5 A	**EL9560** 447 input 24 V DC, output 24 V DC/0.1 A with electrical isolation	447
Filtering and smoothing	**EL9540** 448 surge filter terminal for field supply	**EL9550** 448 surge filter terminal for system/field supply	**EL9576** 449 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.

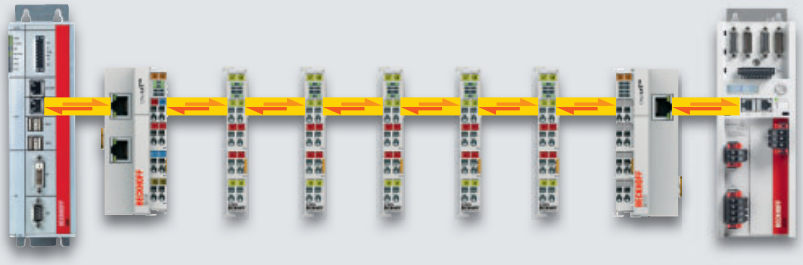
The electronic terminal blocks are attached to the EtherCAT Coupler. The contacts are made as the terminal clicks into place, without any other manipulation. This means that each electronic terminal block can be individually exchanged. It can be placed on a standard DIN rail.

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.

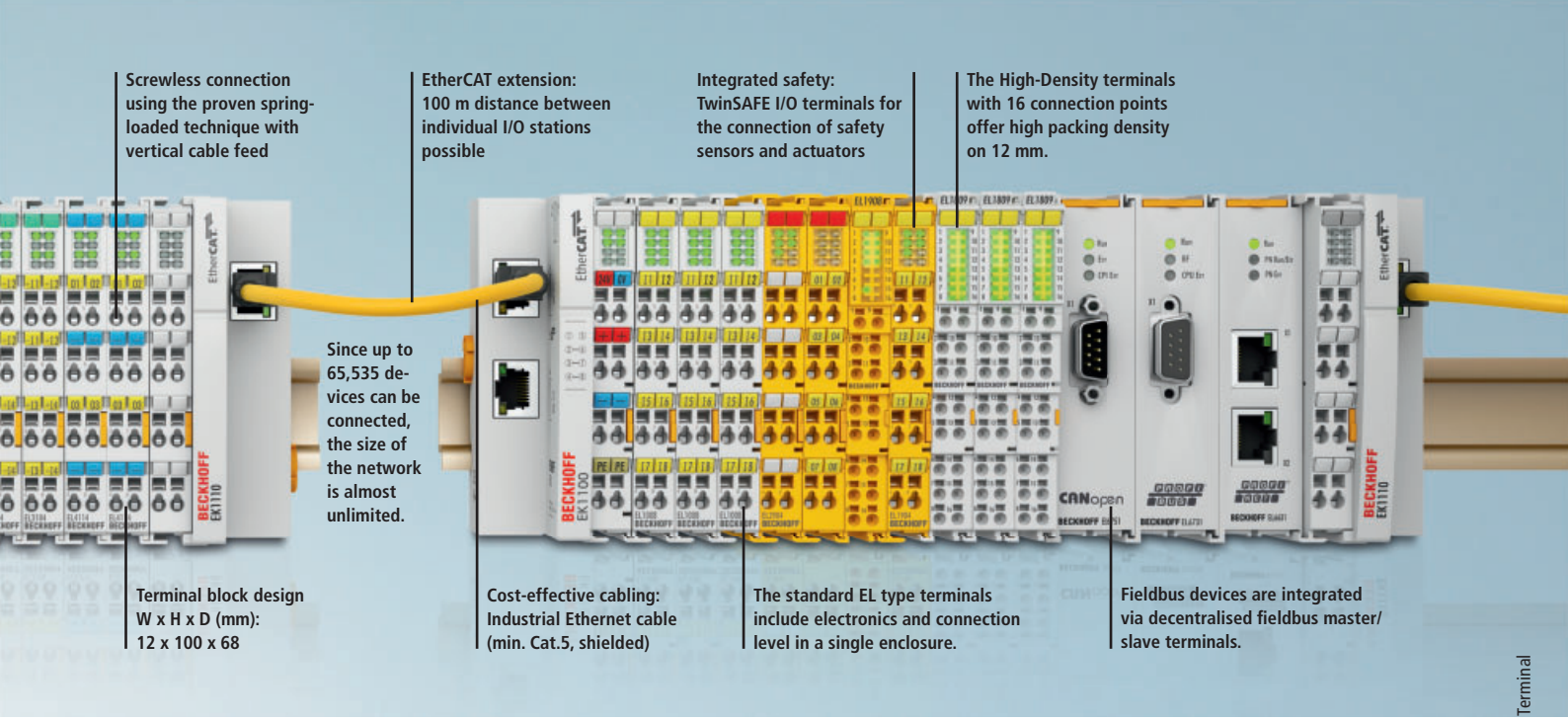
Free mix of signals

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.

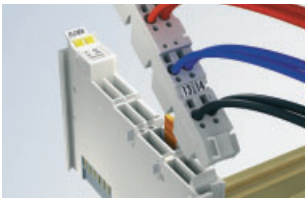
EtherCAT Coupler with integrated I/Os

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 282
TwinSAFE see page 1044

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.

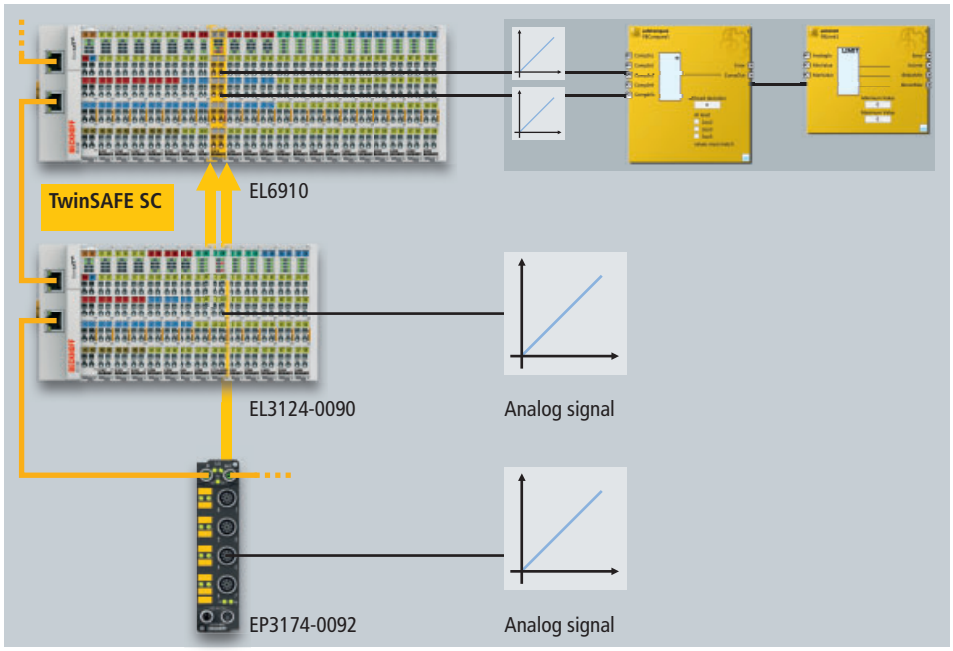
With the aid of the TwinSAFE SC technology it is typically possible to achieve a safety level equivalent to PL d/Cat. 3 in accordance with EN ISO 13849-1 or SIL 2 in accordance with EN 62061.

EP3174-0092 | TwinSAFE SC EtherCAT Box, IP 67, 4-channel analog input ±10 V or 0/4…20 mA, see page 491

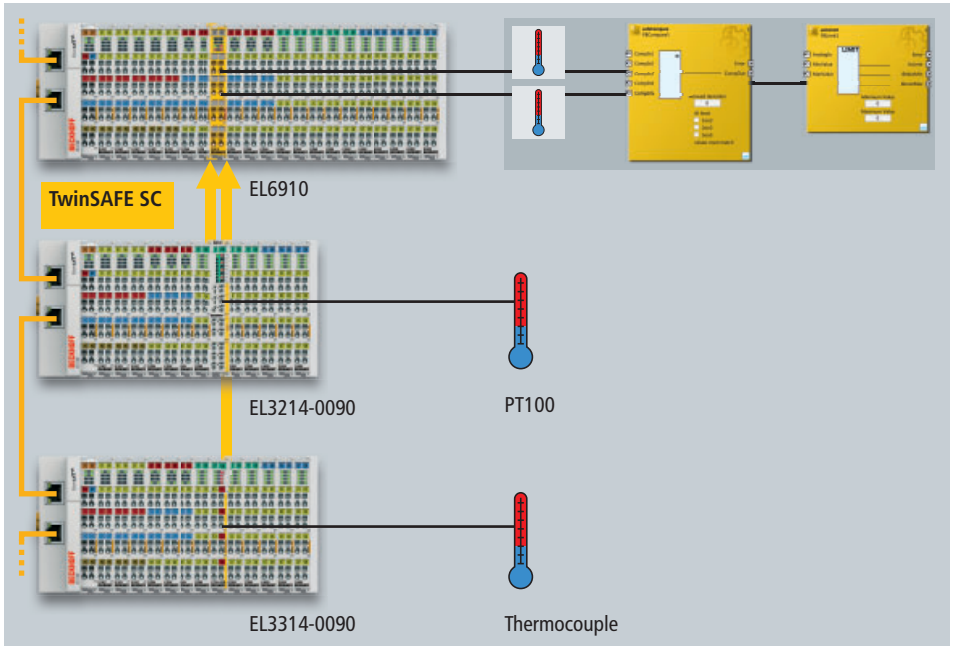
EL6910 | TwinSAFE Logic see page 434

EK1960 | TwinSAFE Compact Controller see page 1044

▶ **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	385
EL3214-0090	EtherCAT Terminal, 4-channel input terminal PT100 (RTD) for 3-wire connection, TwinSAFE SC	389
EL3314-0090	EtherCAT Terminal, 4-channel thermocouple input terminal with open-circuit recognition, TwinSAFE SC	393
EP3174-0092	EtherCAT Box, 4-channel analog input ±10 V or 0/4…20 mA, differential input, 16 bit, TwinSAFE SC	491
Position measurement		
EL5021-0090	EtherCAT Terminal, 1-channel SinCos encoder interface, 1 V_{PP}, TwinSAFE SC	415
EL5101-0090	EtherCAT Terminal, incremental encoder interface, TwinSAFE SC	414
Communication		
EL6224-0090	EtherCAT Terminal, IO-Link terminal, TwinSAFE SC	426

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

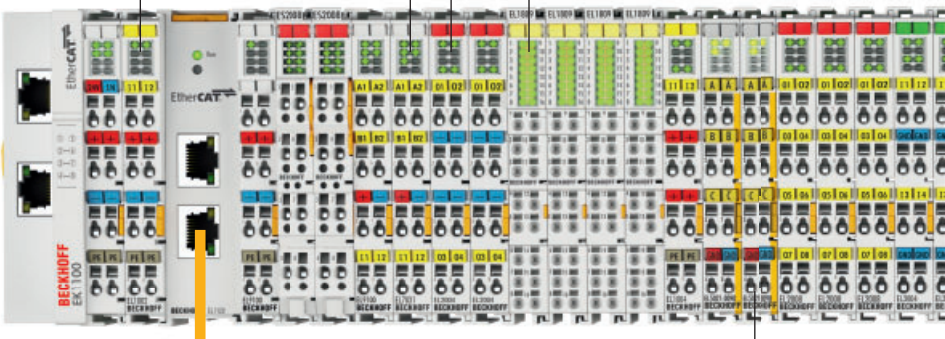
Embedded PC series CX,
further Embedded PCs see page 184

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

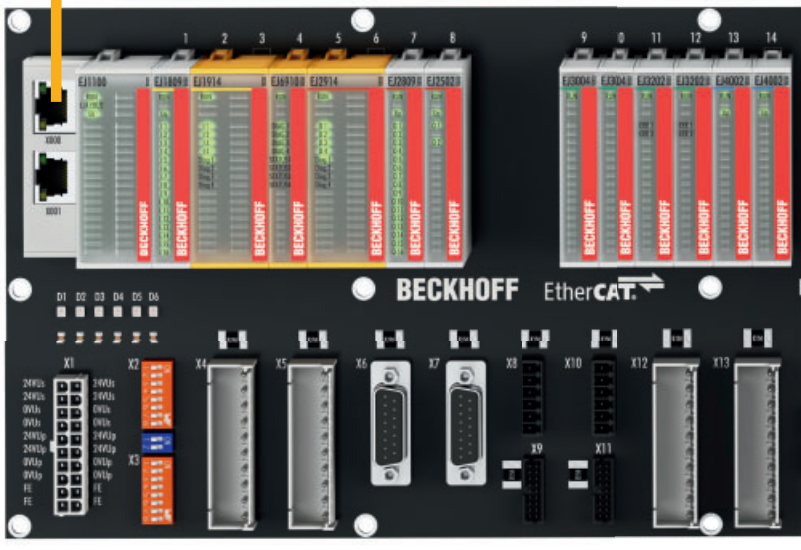
Motion terminals for stepper, servo or DC motors or hydraulic valves

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



100 m Industrial Ethernet cable (100BASE-TX)

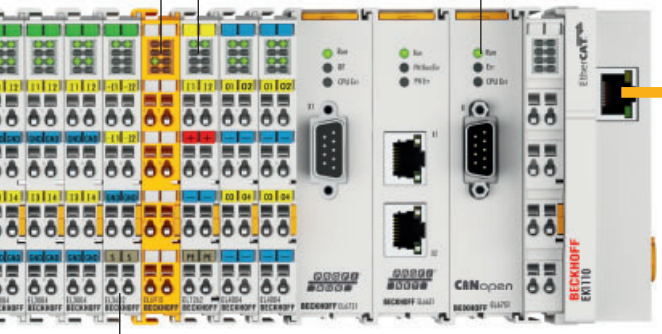
With the aid of the TwinSAFE SC technology it is possible to make use of standard signals for safety tasks in any network or fieldbus.



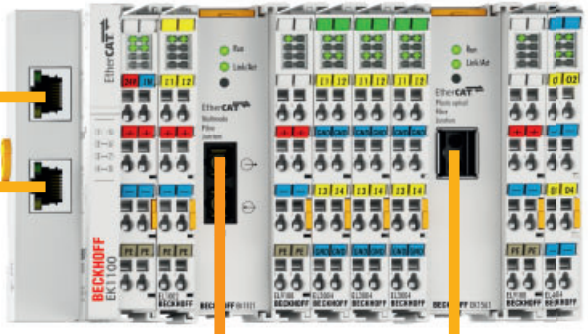
TwinSAFE: safety I/Os and compact Safety PLC for up to 128 safetyrelevant bus devices

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

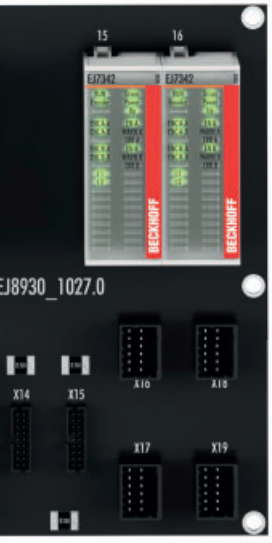


High-speed measurement, high-precision measurement, Condition Monitoring, energy monitoring



2000/20,000 m fibre optic (100BASE-FX)

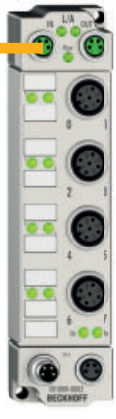
50 m Plastic Optical Fibre (100BASE-FX POF)



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 550

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

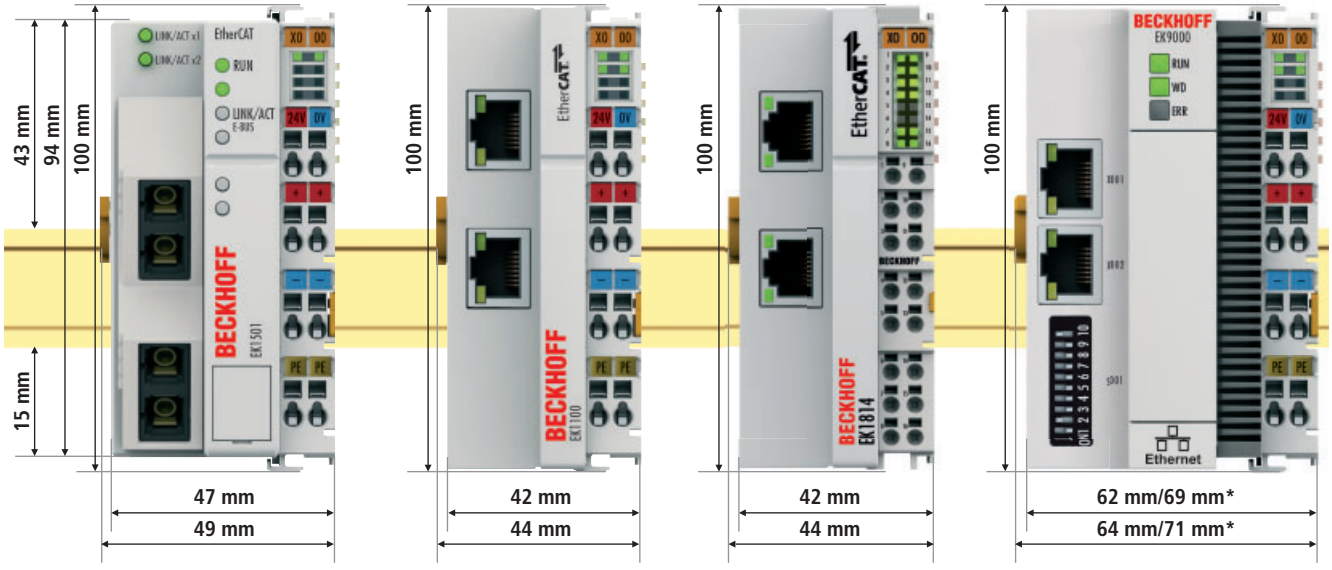
IP 69K EtherCAT Box (stainless steel)



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.

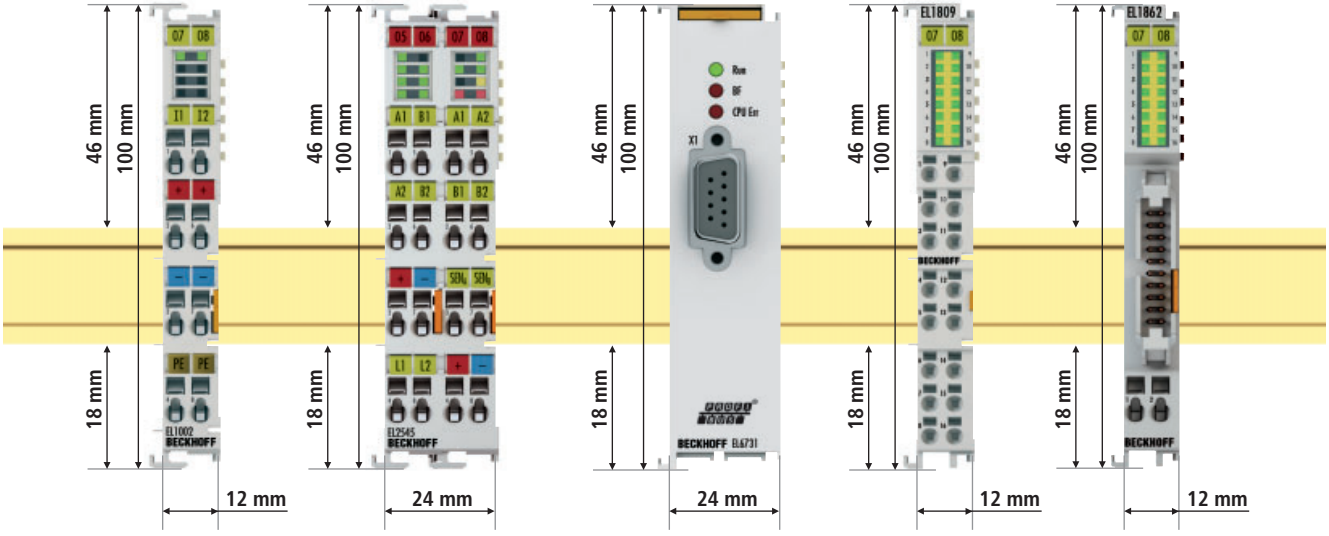


Mechanical data	EK1501, BK1120	EK11xx, EK18xx, EK1914	EK3100, EK9xxx	EK91xx
Design form	compact terminal housing with signal LED			
Material	polycarbonate			
Dimensions (W x H x D)	49 mm x 100 mm x 68 mm	44 mm x 100 mm x 68 mm	64 mm x 100 mm x 73 mm	71 mm x 100 mm x 73 mm
Installation	on 35 mm DIN rail, 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, EK91xx
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

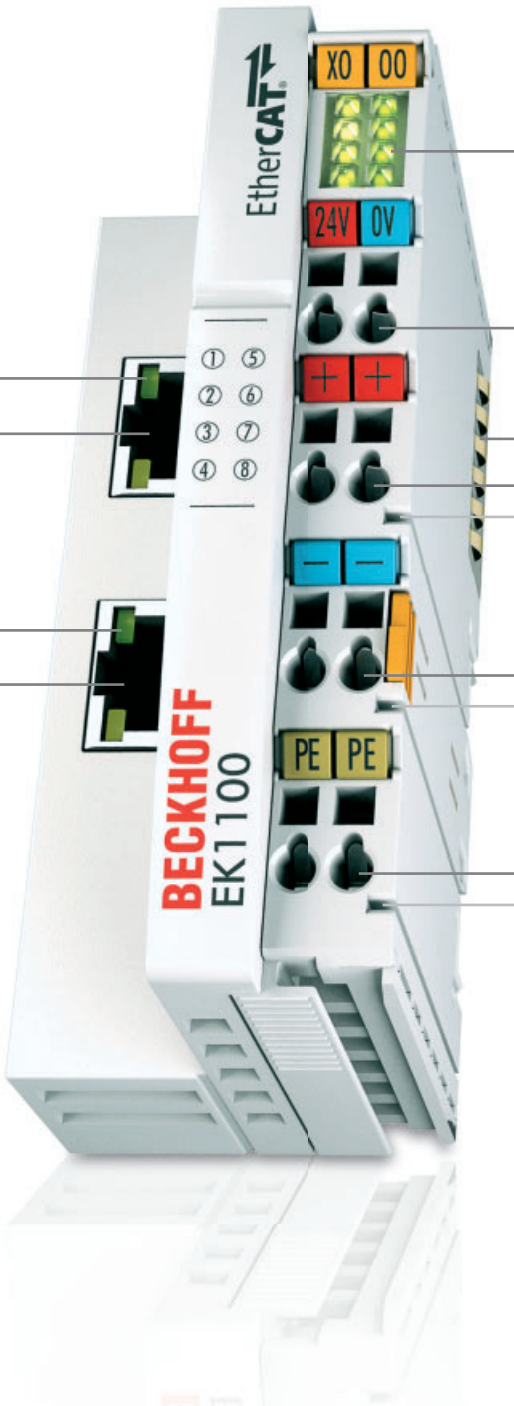
Mechanical data	ELxxxx, BK1250	EL66xx, EL67xx, EK1122, EK1521	ESxxxx	HD housing	EL1862, ELx872
Design form	compact terminal housing with signal LED	compact terminal housing with signal LED	terminal housing with pluggable wiring level	HD (High Density) housing with signal LED	compact terminal housing 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

▶ www.beckhoff.com/EtherCAT-Coupler



Power LEDs

Coupler supply

E-bus

Power contacts

Input for power contacts

Link/Act In

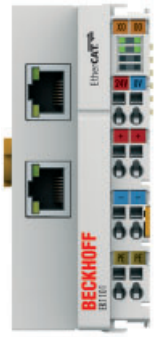
Fieldbus connection

Link/Act Out

Fieldbus connection

+60 °C
-25 °C
Extended operating/ storage temperature

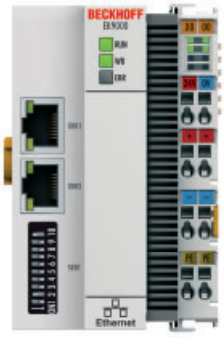
25 g
Extended mechanical load



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.

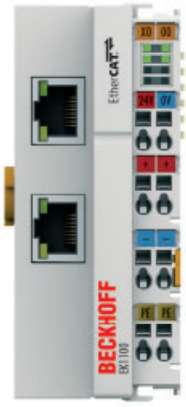
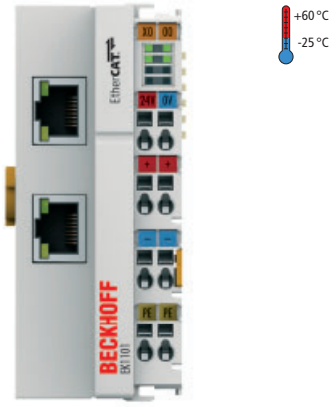
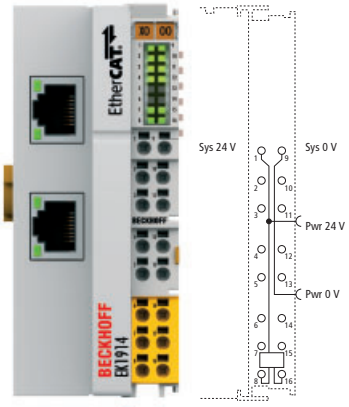
Some couplers support Hot Connect functionality. They have three hexadecimal ID switches on the side, which enable ID settings between 0 and 4095. The EtherCAT master detects a terminal station at this ID if it is connected to an EK1122 or EK1521 junction terminal at any point in the network during operation. 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.

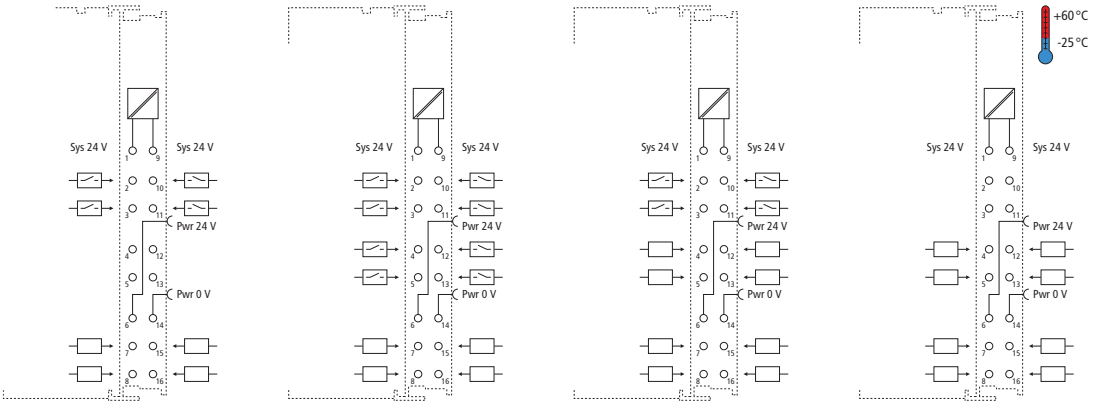
Technical data	EKxxxx
Electrical isolation	500 V
Operating/storage temperature	0…+55 °C/-25…+85 °C (extended temperature range: -25…+60 °C/-40…+85 °C)
Relative humidity	95 %, no condensation
Vibration resistance	conforms to EN 60068-2-6: 1 g (extended range: 5 g)
Shock resistance	conforms to EN 60068-2-27: 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

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 1054
Special couplers	**EK1100-0008**	**EK1101-0080**	
Distinguishing features	M8	Fast Hot Connect, CE	

Cordsets and connectors see page 800

	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

The EK1501, EK1501-0010, EK1501-0100 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 EK1501-0100 is a media converter from optical fibre to copper. It has an SC (IN) as well as an RJ45 socket (OUT).

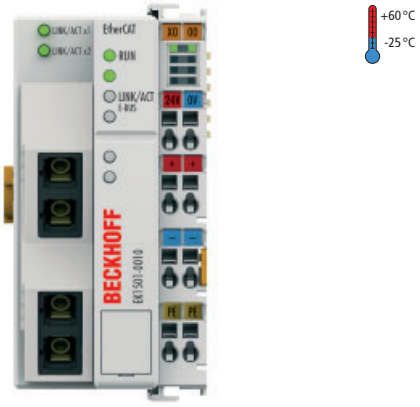
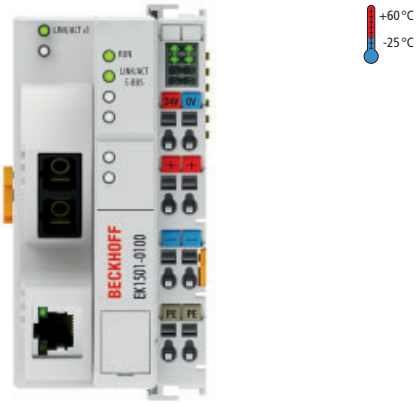
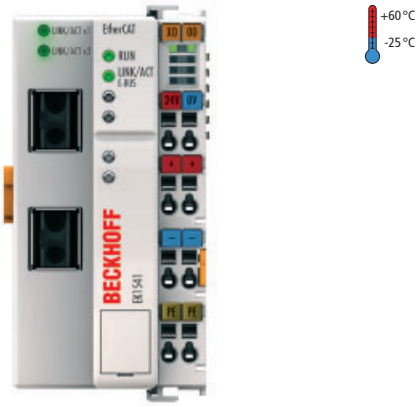
The couplers are connected to the network via the upper interface. The lower socket is used for the optional connection of further EtherCAT devices in the same strand. Distances of up to 2 km can be bridged with multimode fibre optics (EK1501, EK1501-0100) and up to 20 km with single-mode fibre optics (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.

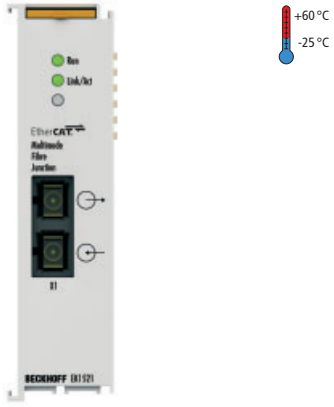
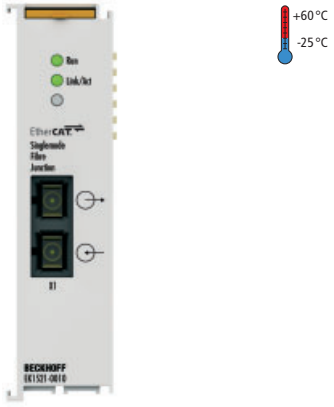
	EtherCAT Coupler with ID switch, multimode fibre optic connection, Hot Connect
Technical data	**EK1501**
Task within EtherCAT system	coupling of EtherCAT Terminals (ELxxxx) to 100BASE-FX EtherCAT networks, with identity verification
Number of EtherCAT Terminals	up to 65,534
Data transfer rates	100 Mbaud
Data transfer medium	multimode glass fibre 50/125 µm (MM)
	 
Bus interface	2 x SC Duplex
Type/number of peripheral signals	max. 4.2 GB addressable I/O points
Current consumption 24 V DC	typ. 70 mA
Distance between stations	max. 2000 m (100BASE-FX)
Delay	approx. 1 µs
Power supply	24 V DC (-15 %/+20 %)
Current consumption E-bus	–
Current supply E-bus	2000 mA
Weight	approx. 190 g
Operating temperature	-25…+60 °C
Approvals	CE, UL, Ex
Further information	www.beckhoff.com/EK1501

Cordsets and connectors see page 800

For availability status see Beckhoff website at: www.beckhoff.com/EK1501-0100

	EtherCAT Coupler with ID switch, singlemode fibre optic connection, Hot Connect	EtherCAT Coupler with ID switch, multimode fibre optic IN, RJ45 OUT	EtherCAT Coupler with ID switch, plastic optical fibre
	EK1501-0010	**i EK1501-0100**	**EK1541**
		media transition from multimode fibre optic to RJ45 copper physics and coupling of EtherCAT Terminals (ELxxxx)	coupling of EtherCAT Terminals (ELxxxx) to 100BASE-FX EtherCAT POF networks, with identity verification
	100 Mbaud	100 Mbaud	100 Mbaud
	singlemode glass fibre 9/125 µm (SM)	multimode glass fibre 50/125 µm; Ethernet/EtherCAT cable (min. Cat.5), shielded	plastic optical fibre (POF)
			
	2 x SC Duplex	1 x SC Duplex; 1 x RJ45	2 x ZS1090-0008 POF plug
	max. 4.2 GB addressable I/O points	max. 4.2 GB addressable I/O points	max. 4.2 GB addressable I/O points
	typ. 70 mA	typ. 70 mA	typ. 70 mA
	max. 20,000 m (100BASE-FX)	max. 2000 m (100BASE-FX); max. 100 m (100BASE-TX)	max. 50 m (100BASE-FX)
	approx. 1 µs	approx. 1 µs	approx. 1 µs
	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)
	–	–	–
	2000 mA	2000 mA	2000 mA
	approx. 190 g	approx. 190 g	approx. 190 g
	-25…+60 °C	-25…+60 °C	-25…+60 °C
	CE, UL, Ex	CE, UL	CE, UL
	www.beckhoff.com/EK1501	www.beckhoff.com/EK1501-0100	www.beckhoff.com/EK1541

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. 2000 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, UL
Further information	www.beckhoff.com/EK1521	www.beckhoff.com/EK1521	www.beckhoff.com/EK1561

Cordsets and connectors see page 800

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	**EK1122-0008**	**EK1122-0080**	**EK1110-0008**
Distinguishing features	M8	Fast Hot Connect, CE	M8

Cordsets and connectors see page 800

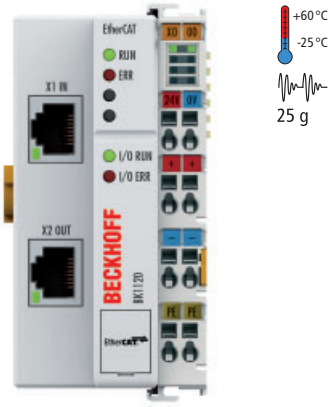
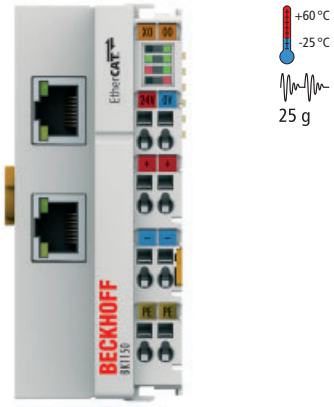
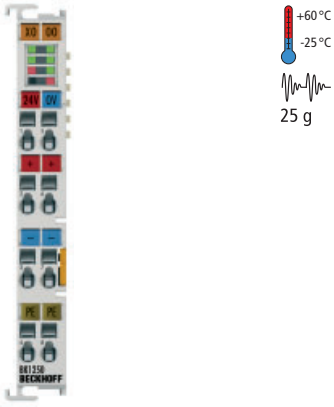
EtherCAT P Coupler, junction and extension

	EtherCAT P Coupler	EtherCAT P extension	2-port EtherCAT P junction
Technical data	**EK1300**	**EK1310**	**EK1322**
Task within EtherCAT system	coupling of EtherCAT Terminals (ELxxxx) to 100BASE-TX EtherCAT P networks	conversion of the E-bus signals to 100BASE-TX Ethernet for extension of the EtherCAT P network	coupling of EtherCAT P junctions
Number of EtherCAT Terminals	up to 65,534	–	
Data transfer rates	100 Mbaud	100 Mbaud	100 Mbaud
			
	– coupler connection to the network via upper EtherCAT P interface – optional continuation of the EtherCAT P topology via lower EtherCAT-P-coded M8 socket – additional power supply for the coupler via the terminal points no longer required	– conversion from EtherCAT to EtherCAT P or extension of an EtherCAT P network	– configuration of EtherCAT P star topologies – connection of individual EtherCAT P devices or whole EtherCAT P strands – installation at any point in an EtherCAT strand between the EtherCAT Terminals (ELxxxx)
Bus interface	2 x M8 socket, shielded, screw type, EtherCAT-P-coded	1 x M8 socket, shielded, screw type, EtherCAT-P-coded	2 x M8 socket, shielded, screw type, EtherCAT-P-coded
Data transfer medium	EtherCAT P cable, shielded, to 100BASE-TX EtherCAT P networks	EtherCAT P cable, shielded, to 100BASE-TX EtherCAT P networks	EtherCAT P cable, shielded, to 100BASE-TX EtherCAT P networks
Total current	from EtherCAT P, max. 3 A per U_S and U_P	max. 3 A per U_S and U_P	max. 3 A per U_S and U_P
Current consumpt. from U_S	70 mA + (∑ E-bus current/4)	typ. 4 mA	typ. 4 mA
Current consumpt. from U_P	–	–	–
Power supply	from EtherCAT P (24 V DC for U_S and U_P)	external feed-in: 24 V DC for U_S and U_P	external feed-in: 24 V DC for U_S and U_P
Current consumption E-bus	–	typ. 130 mA	typ. 220 mA
Current rating per port	max. 3 A per U_S and U_P	max. 3 A per U_S and U_P	max. 3 A per U_S and U_P
Weight	approx. 105 g	approx. 50 g	approx. 65 g
Operating temperature	0…+55 °C	0…+55 °C	0…+55 °C
Approvals	CE	CE	CE
Further information	www.beckhoff.com/EK1300	www.beckhoff.com/EK1310	www.beckhoff.com/EK1322

Cordsets and connectors see page 800

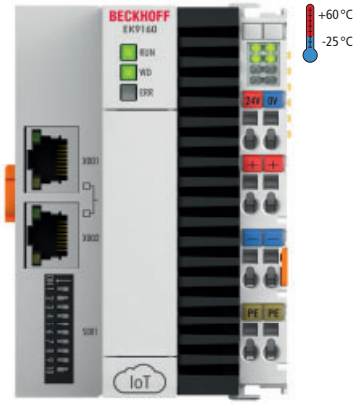
For availability status see Beckhoff website at: www.beckhoff.com

EtherCAT Couplers K-bus

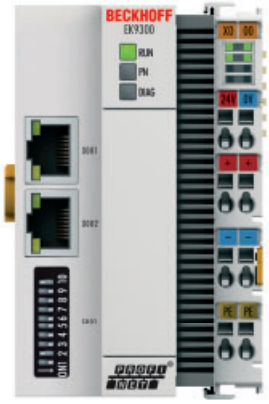
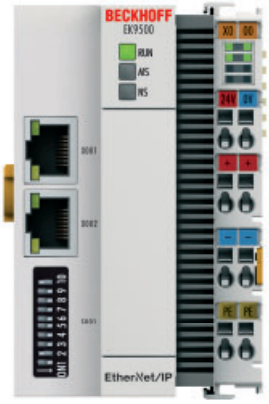
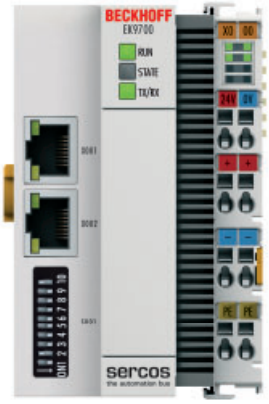
	EtherCAT "Economy plus" Bus Coupler for up to 64 Bus Terminals (255 with K-bus extension)	EtherCAT "Compact" Bus Coupler for up to 64 Bus Terminals (255 with K-bus extension)	EtherCAT "Compact" coupler between E-bus and K-bus terminals
Technical data	**BK1120**	**BK1150**	**BK1250**
Number of Bus Terminals	64 (255 with K-bus extension)		
Max. number of bytes fieldbus	1024 byte input and 1024 byte output		
Current supply K-bus	1750 mA	2000 mA	500 mA
	 +60 °C -25 °C 25 g	 +60 °C -25 °C 25 g	 +60 °C -25 °C 25 g
	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, UL, Ex	CE, UL, Ex
Further information	www.beckhoff.com/BK1120	www.beckhoff.com/BK1150	www.beckhoff.com/BK1250

Cordsets and connectors see page 800, Bus Terminals see page 570

Bus Couplers for EtherCAT Terminals

	PROFIBUS	Ethernet	IoT
	PROFIBUS Bus Coupler	Ethernet Bus Coupler	IoT Bus Coupler
Technical data	**EK3100**	**EK9000**	**EK9160**
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	coupling of standard digital and analog EtherCAT Terminals and EtherCAT Box modules to the IoT world
Number of EtherCAT Terminals	depending on the process data size		
Data transfer rates	up to 12 Mbaud (automatic detection)	100 Mbaud	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.	The EK9160 Bus Coupler enables the direct connection of EtherCAT I/Os from Beckhoff to the Internet of Things (IoT) by converting the E-bus signal representation to different IoT communication protocols.
Protocol	PROFIBUS DP	Modbus TCP, Modbus UDP	MQTT, AMQP (in preparation)
Bus interface	1 x D-sub 9-pin socket with shielding	2 x RJ45 (switched)	2 x RJ45 (switched)
Type/number of peripheral signals	depending on the process data size	depending on the process data size	depending on the process data size
Power supply	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)
Operating temperature	0…+55 °C	0…+55 °C	-25…+60 °C
Approvals	CE, UL, Ex	CE, UL, Ex	CE
Further information	www.beckhoff.com/EK3100	www.beckhoff.com/EK9000	www.beckhoff.com/EK9160
Accessories			
Cordsets and connectors	see page 800	see page 800	see page 800
PC Fieldbus Cards	FC310x 782	FC90xx 788	FC90xx 788

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

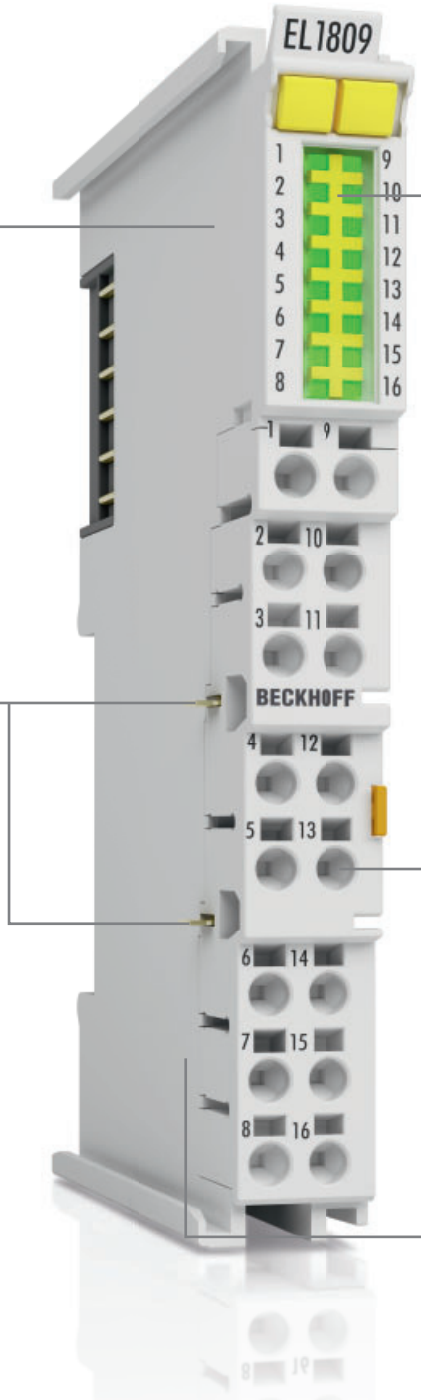
	PROFINET RT Bus Coupler	EtherNet/IP Bus Coupler	SERCOS III Bus Coupler
	EK9300	**i EK9500**	**i EK9700**
	coupling of standard digital and analog EtherCAT Terminals and EtherCAT Box modules to PROFINET RT networks	coupling of standard digital and analog EtherCAT Terminals and EtherCAT Box modules to EtherNet/IP networks	coupling of standard digital and analog EtherCAT Terminals and EtherCAT Box modules to SERCOS III networks
	100 Mbaud	100 Mbaud	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, UL, Ex	CE, UL, Ex	CE, UL, Ex
	www.beckhoff.com/EK9300	www.beckhoff.com/EK9500	www.beckhoff.com/EK9700
	see page 800	see page 800	see page 800
	FC90xx 788	FC90xx 788	FC750x 787

Embedded PC CX8000 see page 196

EtherCAT | I/O modules with 100 Mbit communication

▶ www.beckhoff.com/EtherCAT-IO

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.

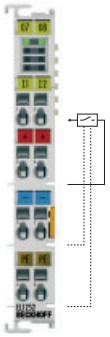
Different field level connection techniques can be used for EtherCAT Terminals:
- standard terminal point: 0.08…2.5 mm² spring-loaded technique
- HD EtherCAT Terminal: 0.08…0.75 mm² (with ferrule); 0.08…1.5 mm² (single-wire); spring-loaded technique; direct plug-in technique
- D-sub, 9-pin, common for 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.

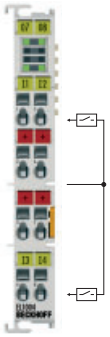
Some 2-channel EtherCAT Terminals have a PE power contact, which can be used for PE distribution by connecting it together with similar terminals. The EMC spring contact on the underside of the terminal only serves to remove interference and may not be used as a protective earth.

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

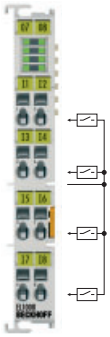
Technical data see page 329



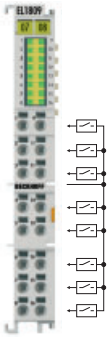
2-channel terminals
The 2-channel terminals provide additional power (+24 V DC), ground (0 V DC) and in many cases also PE for each channel. Connection is carried out with 3- or 4-wire connection.



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 to 10 V, ±10 V, 0 to 20 mA or 4 to 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.

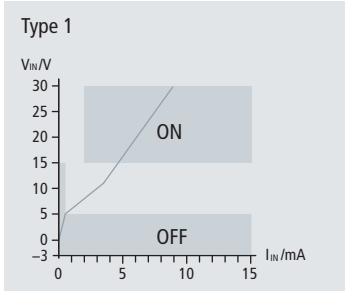
Technical data	**ELxxxx** | ESxxxx
Electrical isolation	500 V (E-bus/field potential), unless stated otherwise
Operating/storage temperature	0…+55 °C/-25…+85 °C (extended temperature range: -25…+60 °C/-40…+85 °C)
Relative humidity	95 %, no condensation
Vibration resistance	conforms to EN 60068-2-6: 1 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

Digital input | 24 V DC, positive switching

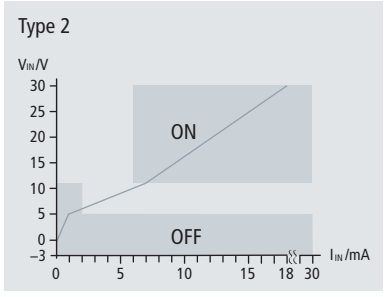
The digital inputs of a 24 V supply are among the most used signals. The EN 61131-2 standard describes the input characteristic and distinguishes three types. Type 1 has a small input current with low power dissipation. This input is optimised for mechanical switches and actively-switched electronic 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.

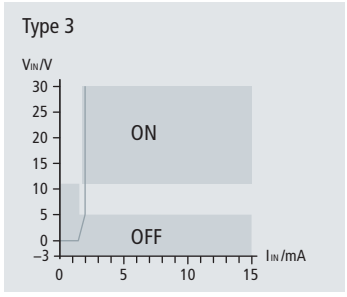
XFC terminals with a filter time of << 1 µs are available for particularly fast signals and exact edge identification.



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



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

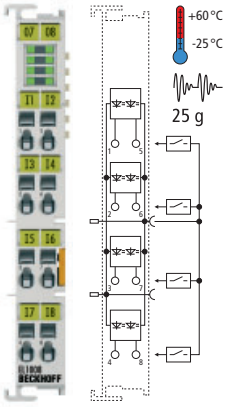


Signal voltage "0": -3…5 V DC
Signal voltage "1": 11…30 V DC

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

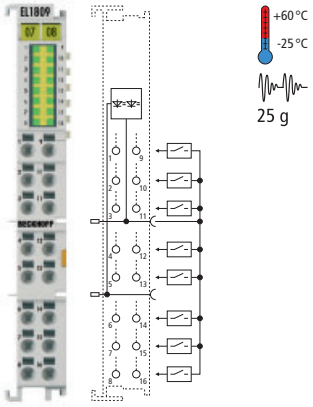
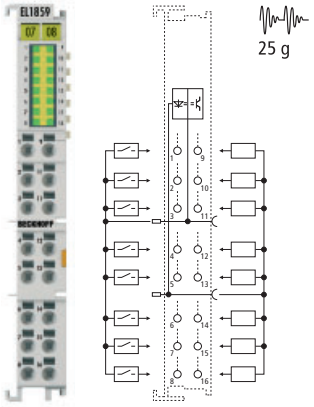
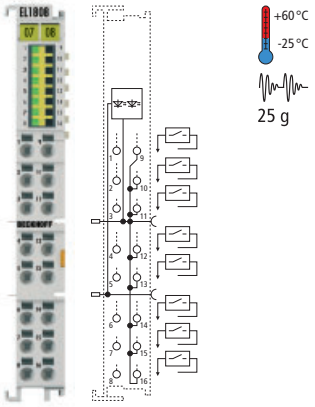
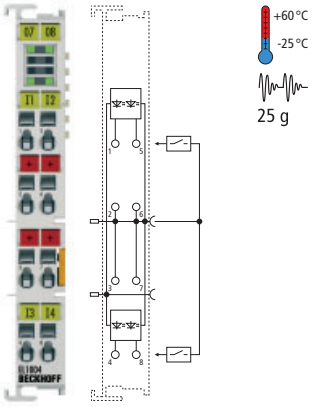
8-channel digital input terminal, 1-wire, 24 V DC, type 1/3

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	



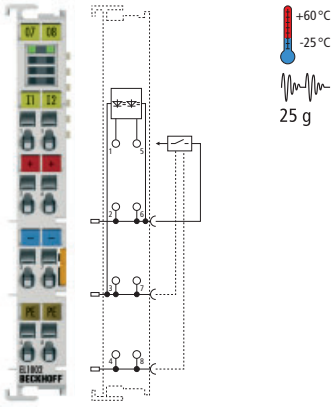
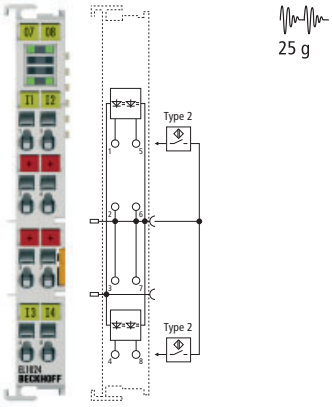
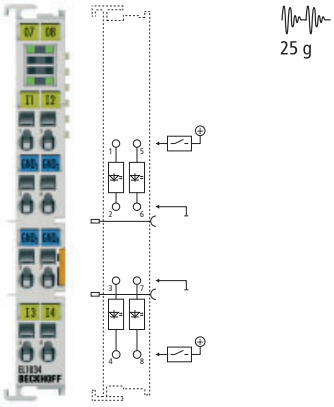
The EL1008 and EL1018 digital input terminals acquire the binary control signals from the process level and transmit them, in an electrically isolated form, to the higher-level automation unit.

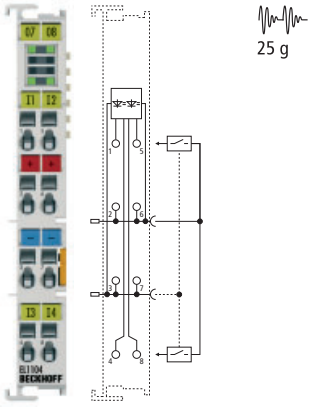
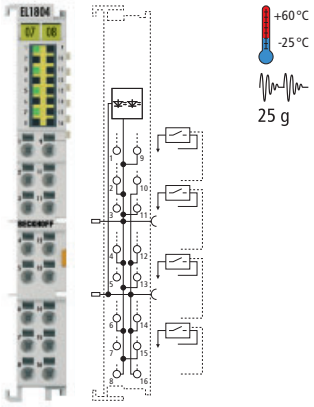
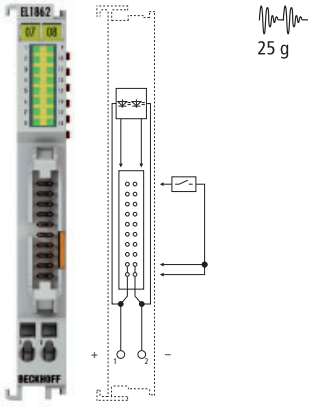
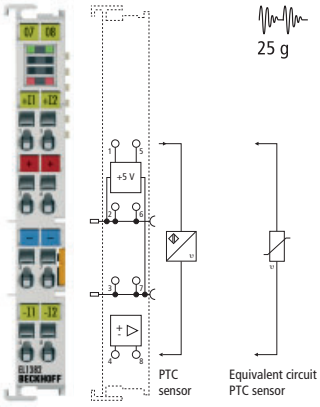
Nominal voltage	24 V DC (-15 %/+20 %)
Current consumption power contacts	typ. 2 mA + load
Current consumption E-bus	typ. 90 mA
Distributed clocks	–
Special features	standard input terminals for fast (filter 10 µs) or bouncing signals (filter 3 ms)
Operating temperature	-25…+60 °C
Approvals	CE, UL, Ex
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 > 2500 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, UL
	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 350		

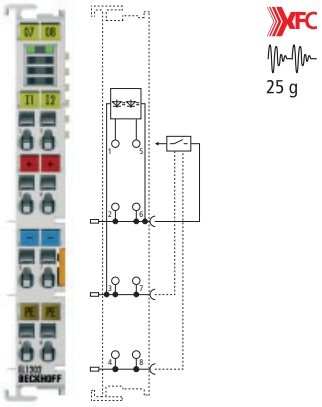
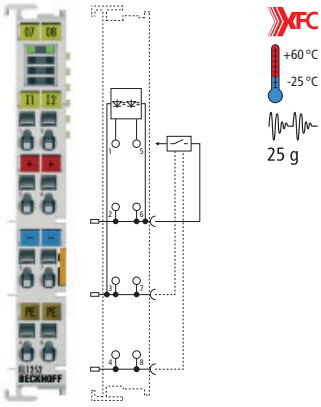
XFC digital input | 24 V DC, positive, fast inputs

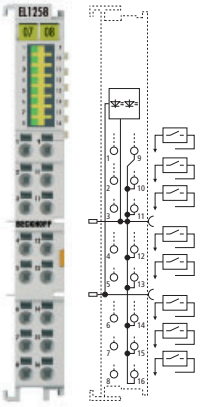
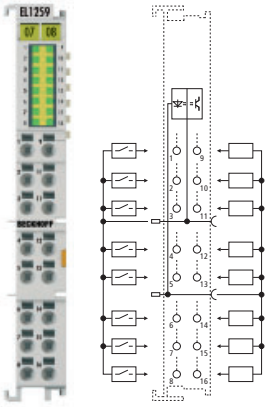
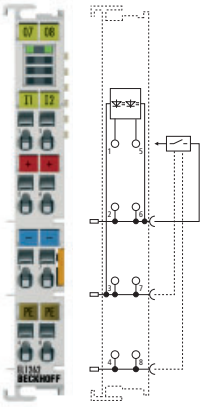
XFC – eXtreme Fast Control – comprises a fast controller, fast real-time capable communication and fast, high-precision input/output modules. Based on synchronisation through the distributed clocks principle, input modules read their inputs at exactly defined times. Outputs can be controlled with nanosecond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

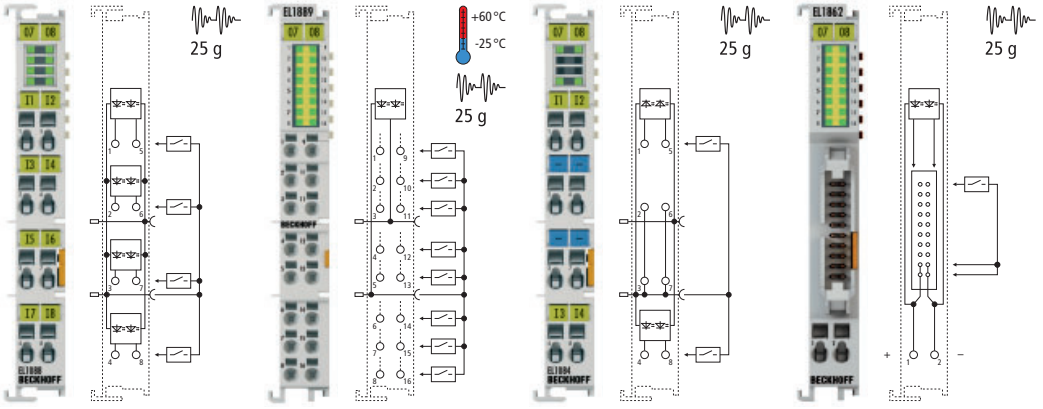
For further information on XFC see page 298

	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
	 XFC 25 g	 XFC 25 g	 XFC 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…1000, see documentation
	multi-timestamping	multi-timestamping, auto activation	oversampling
	0…+55 °C	0…+55 °C	0…+55 °C
	CE, UL	CE, UL	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

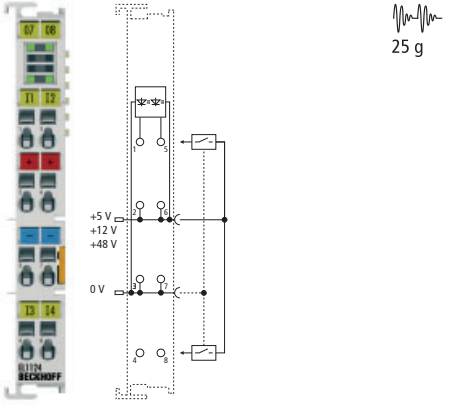
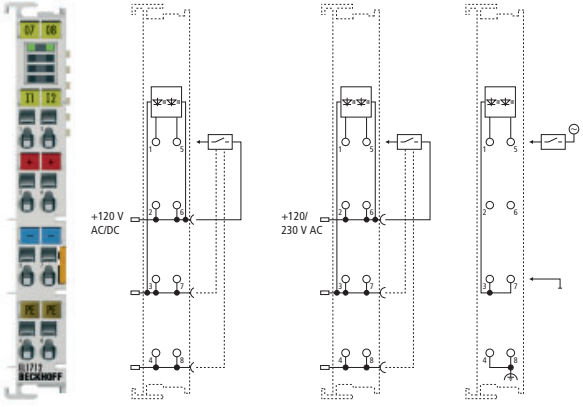


The EL terminals of the EL108x and EL109x series and the EL1889 and EL1862-0010 interpret input signals with negative logic: 0 V signal level means logic "1". The rated voltage level is read as logic "0". Versions with 10 µs input filter are available for sampling fast input edges. The slow 3 ms filter 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); 3750 V AC, 1 min.	500 V (E-bus/ mains voltage); 3750 V AC, 1 min.	500 V (E-bus/ mains voltage); 3750 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

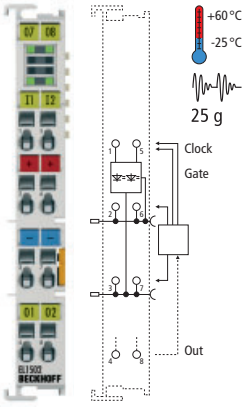
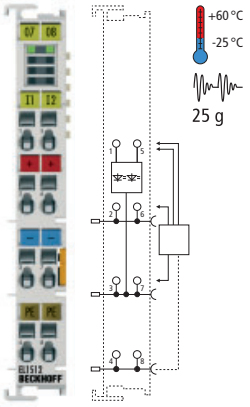
Pulses often need to be captured in technical control applications. This can be done with fast inputs such as EL1202 and a central pulse counter. If the pulse length is the order of magnitude of the control cycle time or less, the controller cannot record these signals correctly any more. Pre-processing 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.

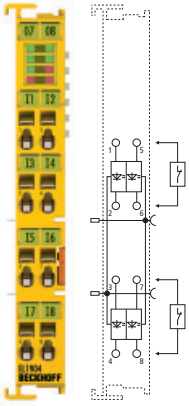
The EL1512 was developed for price-sensitive applications and has limitations in terms of speed and functionality.

	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

The EL1904 safety terminal is a digital input terminal for sensors with potential-free 24 V DC contacts. It has four fail-safe inputs. It conforms to the requirements of IEC 61508 SIL 3 and DIN EN ISO 13849-1:2008 PL e.

For further information on TwinSAFE and the TwinSAFE products see page 1044

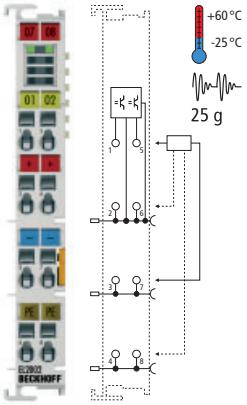
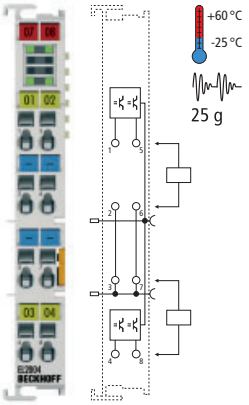
	4-channel digital input terminal, TwinSAFE, 24 V DC
Technical data	**EL1904**
Connection technology	1-/2-wire
Safety standard	DIN EN ISO 13849-1:2008 (Cat 4, PL e) and IEC 61508:2010 (SIL 3)
Number of inputs	4
	
Protocol	TwinSAFE/Safety over EtherCAT
Current consumption power contacts	see documentation
Current consumption E-bus	approx. 200 mA
Response time	typ. 4 ms (read input/write to E-bus)
Fault response time	≤ watchdog time (parameterisable)
Special features	4 safe inputs
Operating/storage temperature	-25…+55 °C/-40…+70 °C
Approvals	CE, UL, Ex, TÜV SÜD
Weight	approx. 50 g
Further information	www.beckhoff.com/EL1904

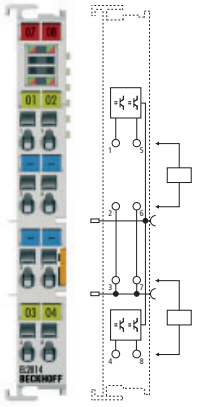
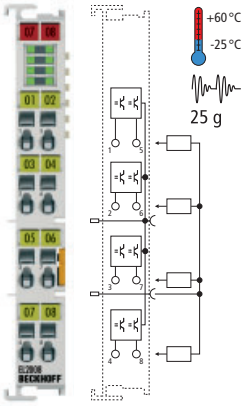
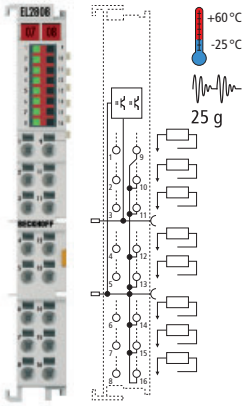
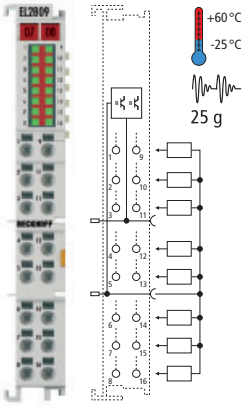
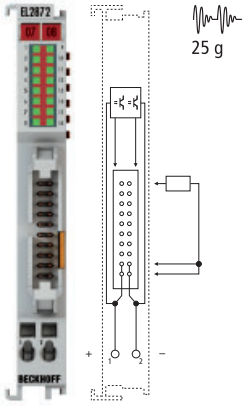
Digital output | 24 V DC, positive switching

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.

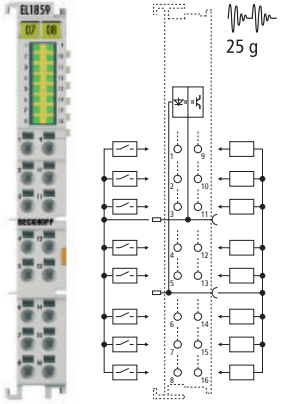
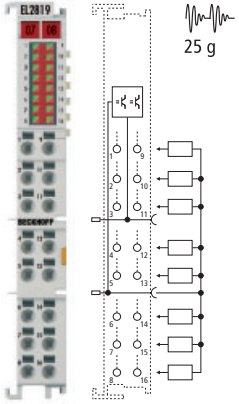
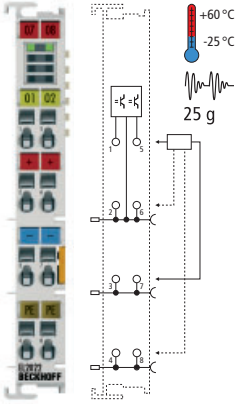
The most common output circuit delivers a maximum continuous current of 0.5 A. Special output terminals are available for higher currents. Any type of load (ohmic, capacitive, inductive) can be connected to an output terminal. As lamp and capacitive loads are critical due to their high starting currents, 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.

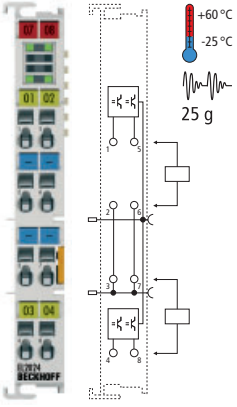
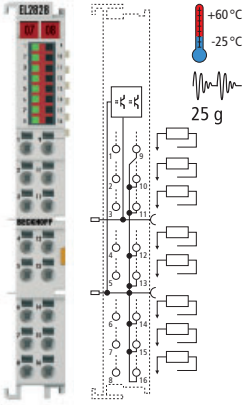
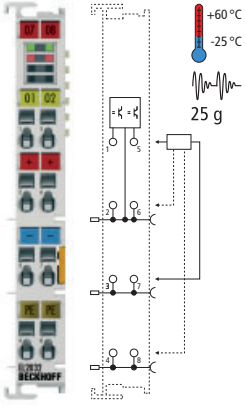
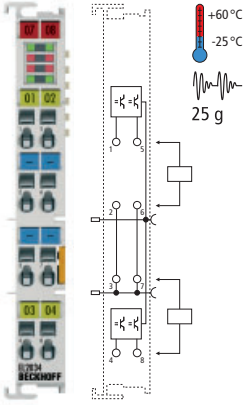
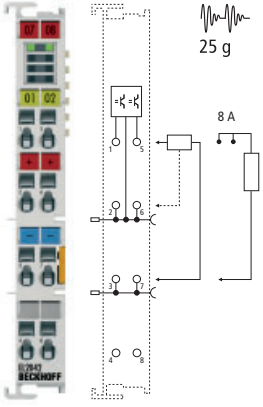
In the case of short-circuit, the output circuit limits the current and prevents the activation of the upstream circuit-breaker. The EtherCAT Terminal maintains this current until important self-heating and finally switches off. After the circuit has cooled, it switches back on. The output signal is 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** | ES2002	**EL2004** | ES2004
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
Special features	–	–
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

	4-channel digital output terminal, 1-wire, 24 V DC, 0.5 A, with diagnostics	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
	EL2014	**EL2008** | ES2008	**EL2808**	**EL2809**	**EL2872**
	1-wire		2-wire	1-wire	flat-ribbon cable
	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}: 50 µs, typ. T_{OFF}: 100 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
	4	8	8	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	
	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. 15 mA + load	typ. 35 mA + load	typ. 25 mA + load (no power contacts)
	typ. 60 mA	typ. 110 mA	typ. 110 mA	typ. 140 mA	typ. 130 mA
	–	–	–	–	–
	< 150 mJ/channel	< 150 mJ/channel	< 150 mJ/channel	< 150 mJ/channel	< 150 mJ/channel
	yes	yes	yes	yes	yes
	< typ. 1 A	typ. < 2 A	typ. < 2 A	typ. < 2 A	typ. < 2 A
	diagnostics via process data and LED: overtemperature, PowerFail, short circuit (per channel)	–	–	–	ideal for multi-pin connector valve terminals
	0…+55 °C	-25…+60 °C	-25…+60 °C	-25…+60 °C	0…+55 °C
	CE	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex
	approx. 70 g	approx. 55 g	approx. 65 g	approx. 70 g	approx. 55 g
	www.beckhoff.com/EL2014	www.beckhoff.com/EL2008	www.beckhoff.com/EL2808	www.beckhoff.com/EL2809	www.beckhoff.com/EL2872

Digital output | 24 V DC, positive switching

	16-channel digital output terminal, D-sub, 24 V DC	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)
Technical data	**EM2042**	**EL1859**	**EL2819**	**EL2022** | ES2022
Connection technology	D-sub	1-wire		4-wire
Load type	ohmic, inductive, lamp load			
Max. output current	0.5 A per channel, individually short-circuit-proof, ∑ 4 A	0.5 A (short-circuit-proof) per channel	0.5 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}: 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
Number of outputs	16	8 outputs + 8 inputs	16	2
				
	Plug X2 is included in the scope of supply.	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	
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.	X2: typ. 25 mA + load	typ. 15 mA + load	typ. 50 mA + load	typ. 9 mA + load
Current consumption E-bus	typ. 115 mA	typ. 110 mA	typ. 90 mA	typ. 100 mA
Distributed clocks	–	–	–	–
Breaking energy	< 150 mJ/channel	< 150 mJ/channel	< 150 mJ/channel	< 1.7 J/channel
Reverse voltage protection	yes	yes	yes	yes
Short circuit current	typ. < 2 A	typ. < 2 A	< typ. 1 A	typ. < 70 A
Special features	ideal for multi-pin connector valve terminals	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	0…+55 °C	-25…+60 °C
Approvals	CE	CE, UL, Ex	CE, UL	CE, UL, Ex
Weight	approx. 90 g	approx. 65 g	approx. 70 g	approx. 55 g
Further information	www.beckhoff.com/EM2042	www.beckhoff.com/EL1859	www.beckhoff.com/EL2819	www.beckhoff.com/EL2022
Special terminals				
Distinguishing features				

	4-channel digital output terminal, 2-wire, 24 V DC, 2 A	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
	EL2024 | ES2024	**EL2828**	**EL2032** | ES2032	**EL2034** | ES2034	**EL2042** | ES2042
	2-wire		4-wire	2-wire	3-wire
	2.0 A (short-circuit-proof) per channel	2 A per channel (∑ 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}: 40 µs, typ. T_{OFF}: 200 µs	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
	4	8	2	4	2
					
	Direct 2-wire connection of 4 actuators	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 %)	24 V DC (-15 %/+20 %)
	typ. 13 mA + load	typ. 15 mA + load	typ. 13 mA + load	typ. 14 mA + load	typ. 15 mA + load
	typ. 120 mA	typ. 110 mA	typ. 100 mA	typ. 120 mA	typ. 120 mA
	–	–	–	–	–
	< 1.7 J/channel	< 1.2 J/channel	< 1.7 J/channel	< 1.7 J/channel	< 1.7 J/channel
	yes	yes	yes	yes	yes
	typ. < 70 A	< 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	-25…+60 °C	0…+55 °C
	CE, UL, Ex	CE, UL	CE, UL, Ex	CE, UL, Ex	CE
	approx. 55 g	approx. 70 g	approx. 55 g	approx. 55 g	approx. 55 g
	www.beckhoff.com/EL2024	www.beckhoff.com/EL2828	www.beckhoff.com/EL2032	www.beckhoff.com/EL2034	www.beckhoff.com/EL2042
	EL2024-0010				
	nom. volt. 12 V DC 361				

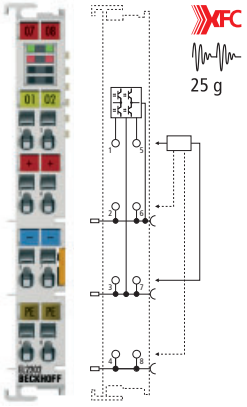
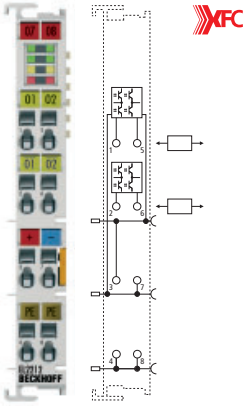
XFC digital output | 24 V DC, positive switching

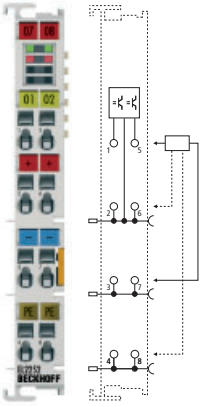
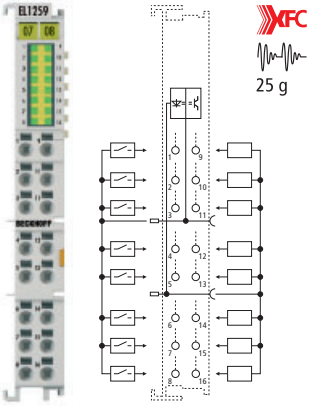
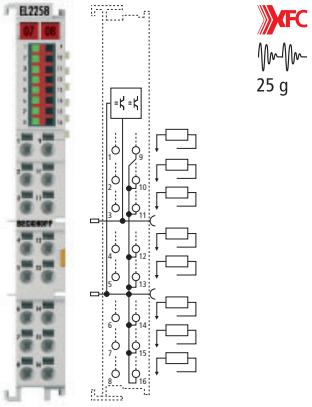
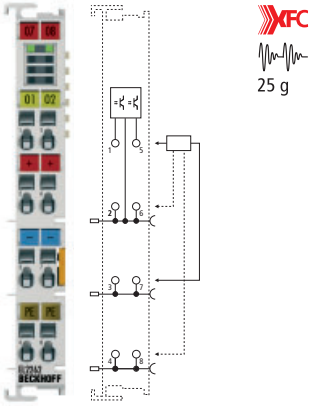
XFC – eXtreme Fast Control – comprises a fast controller, fast real-time capable communication and fast, high-precision input/output modules. Based on synchronisation through the distributed clocks principle, input modules read their inputs at exactly defined times. Outputs can be controlled with nanosecond precision, irrespective of restrictions through the bus cycle time or communication jitter. Further information on XFC see pages 298 and 348

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.

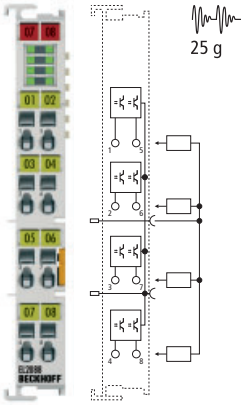
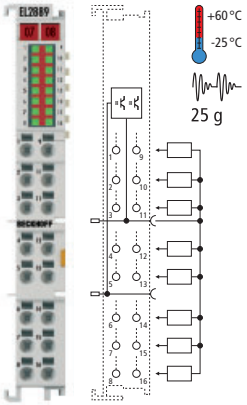
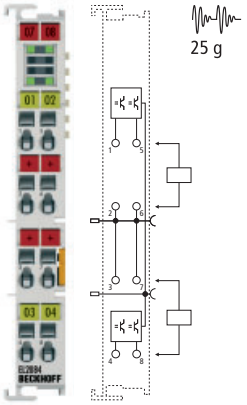
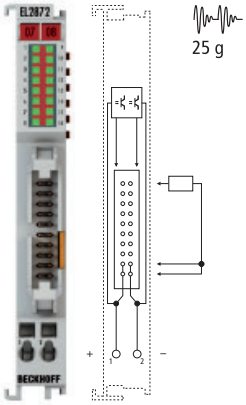
With overexcitation, the EL2212 supports the particularly fast switching of inductive loads, such as valves. A supply of 24 to 72 V is connected to the power contacts and passed through to the load when switched on. After an adjustable waiting period the terminal begins to control the current channel-wise 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 to 40 µs time interval. They can sample inputs or issue outputs at these intervals, synchronised through the distributed clocks.

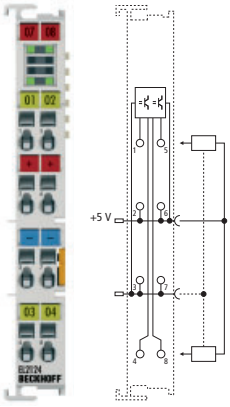
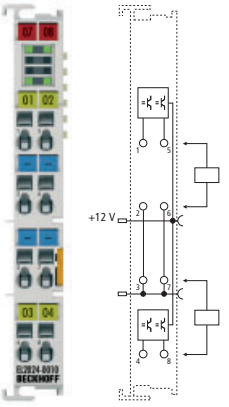
	2-channel digital output terminal, 4-wire, 24 V DC, T_{ON}/T_{OFF} 1 µs, push-pull outputs, tri-state	2-channel digital output terminal, 4-wire, 24…72 V DC, multi-time-stamping, overexcitation
Technical data	**EL2202** | ES2202	**EL2212** | ES2212
Connection technology	4-wire	
Load type	ohmic, inductive, 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, UL, 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, 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, multi-timestamping	2-channel digital output terminal, 4-wire, 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
	 XFC 25 g	 XFC 25 g	 XFC 25 g	 XFC 25 g
	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…1000
	< 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 349	up to 1000 x oversampling, max. 1 Msample/s, min. output cycle 1 µs
	0…+55 °C	0…+55 °C	0…+55 °C	0…+55 °C
	CE, Ex	CE, UL	CE, UL	CE, UL, 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, ∑ 3 A	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, Ex
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, UL, Ex
Weight	approx. 70 g	approx. 55 g
Further information	www.beckhoff.com/EL2124	www.beckhoff.com/EL2024

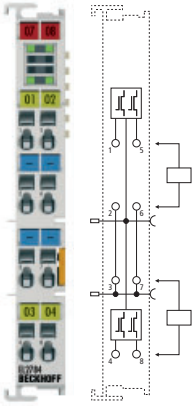
Digital output | 30 V AC/DC, positive switching

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.

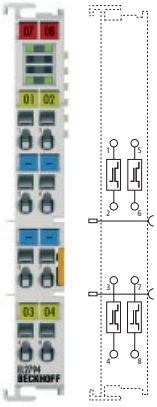
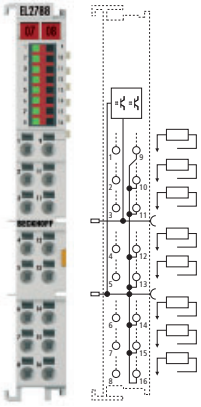
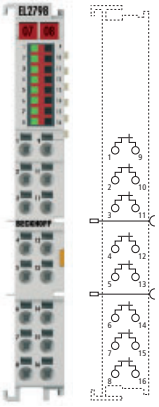
The electronic switch in the EtherCAT Terminal is implemented by efficient MOSFET transistors with a low switch-on resistance. The electronics are virtually wear-free. The switch itself is not short-circuit-proof, but can conduct a high current with its high pulse current capability long enough, until 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 per channel
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, UL
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
	EL2794	EL2788	EL2798
	2 A per channel	2 A per channel (∑ 10 A)	2 A per channel (∑ 10 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, UL	CE, UL	CE, UL
	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

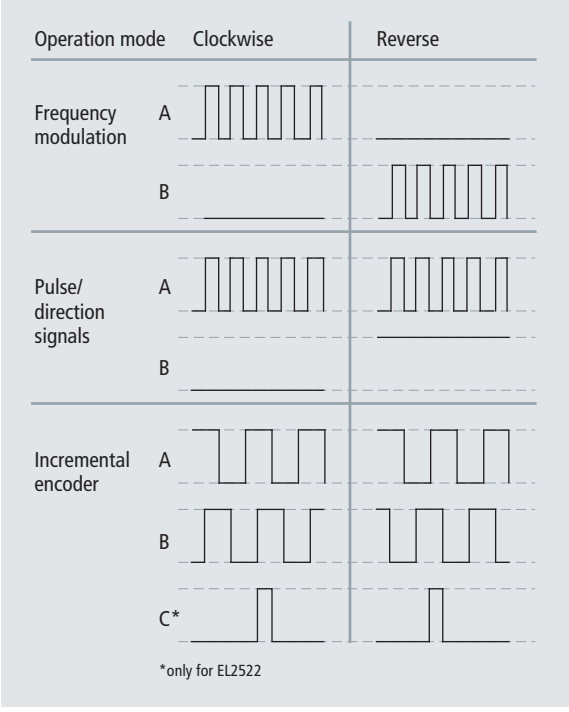
The output terminals of the series EL252x-xxxx issue a configurable pulse sequence via their outputs. The operating mode is individually configurable for each channel. These operating modes are available:

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

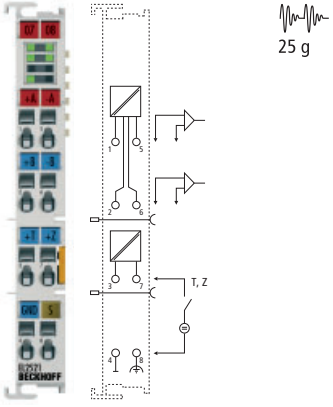
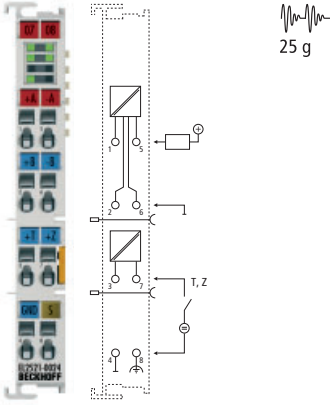
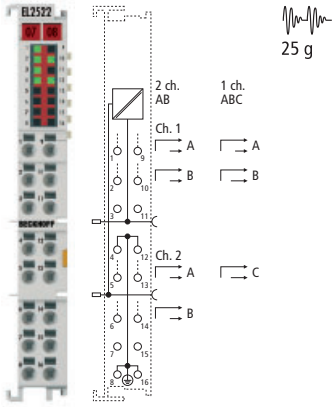
Pulse rate and frequency are specified by the controller via a 16-bit value. Distributed clock synchronisation enables the output to be synchronised with other EtherCAT slaves.

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, UL, Ex	CE, UL
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	

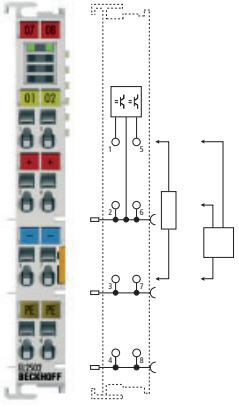
Digital output | **PWM up to 24/50 V DC, current control**

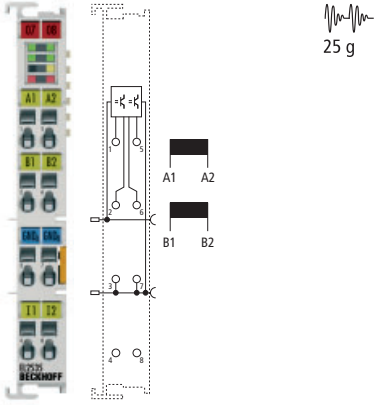
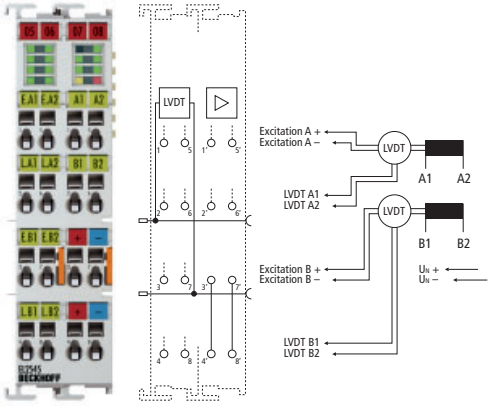
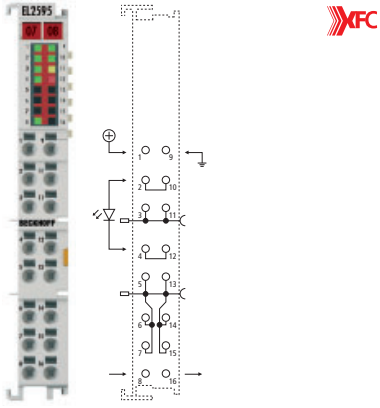
EtherCAT Terminals with PWM output are used to control variable actuators such as valves, solenoid coils, lamps, heating elements and rotary magnets. To this end, the base frequency can be set via the process data (EL2502) or through parameterisation. The EL25xx PWM terminals deal with determining switching 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 LVDT	1-channel LED constant current terminal, 2-wire, adjustable
	EL2535 | ES2535	**EL2545** | ES2545	**EL2595**
			2-wire
	inductive > 1 mH		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
	30 kHz default	32 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 LVDT feedback	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, ATEX	typ. ±2 A	

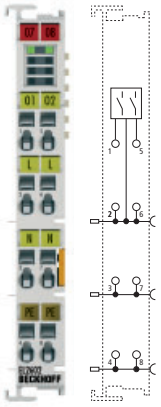
For availability status see Beckhoff website at: www.beckhoff.com/EL2545

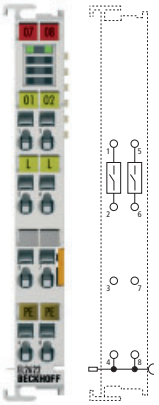
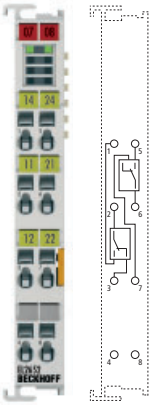
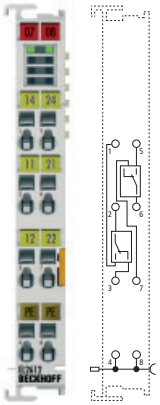
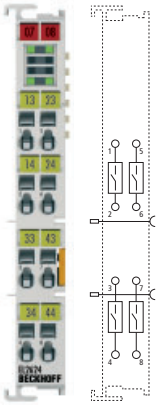
Digital output | **Relay outputs up to 230 V AC**

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 per channel
Inductive switching current	2 A AC/DC per channel
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

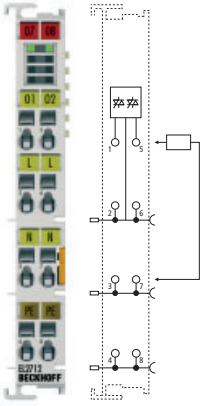
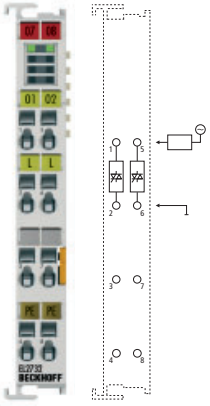
	2-channel relay output terminal, 230 V AC/30 V DC	2-channel relay output terminal, 230 V AC, 300 V DC	2-channel relay output terminal, 125 V AC/30 V DC	4-channel relay output terminal, 125 V AC/30 V DC
	EL2622 | ES2622	**EL2652** | ES2652	**EL2612** | ES2612	**EL2624** | ES2624
			ohmic	
	2 x make contacts	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 per channel	–	0.5 A AC/2 A DC per channel	0.5 A AC/2 A DC per channel
	2 A AC/DC per channel	–	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, UL	CE, UL	CE, UL
	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.

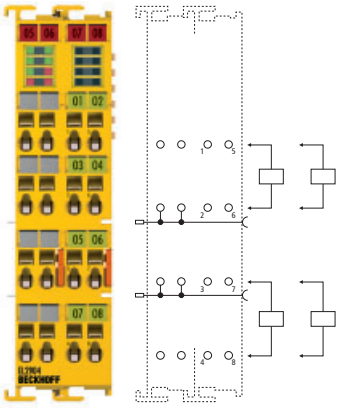
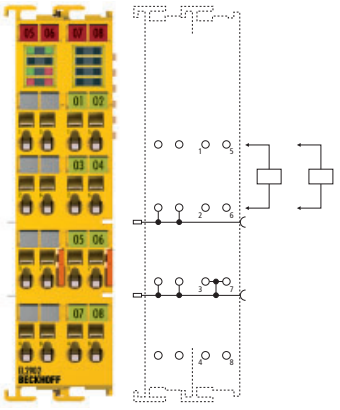
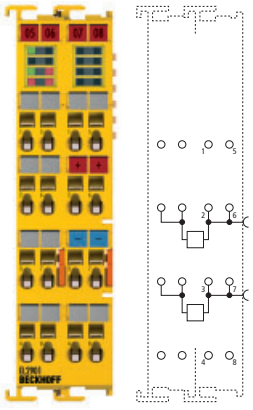
A triac is a robust switch and will only be used as a zero crossing switch in the EtherCAT Terminals. Switch-on only occurs in zero crossing voltage and switch-off only in zero crossing current. Inductive loads are therefore switched off without overvoltage. The disadvantage of a Triac is a relatively 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

i 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
			
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 consumption power contacts	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)
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
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
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 1044

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

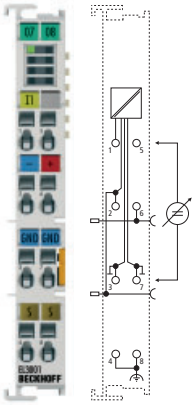
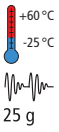
Analog input | -10…+10 V, 12 bit, single-ended

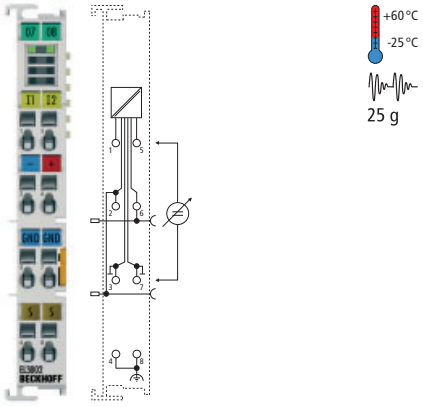
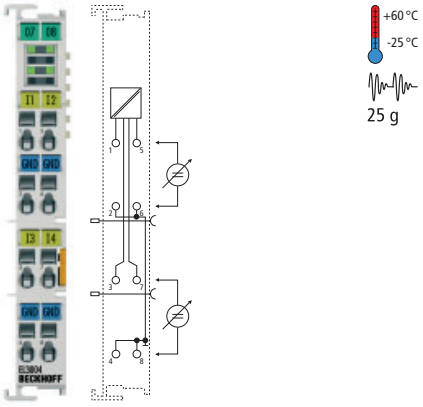
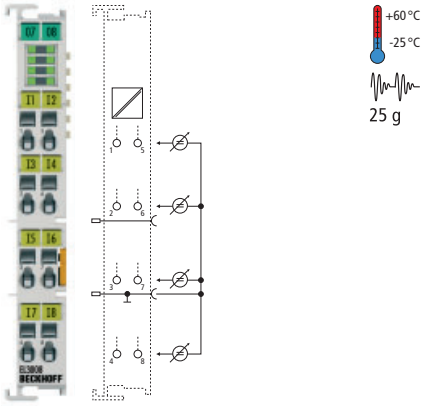
The EL3xxx EtherCAT Terminals read analog signal voltages in the common standard signal range of -10 to +10 V, 0 to 10 V, 0 to 20 mA and 4 to 20 mA. Within the EtherCAT Terminal the field side is electrically isolated from the E-bus and enables interconnection to form potential groups as required. The 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.

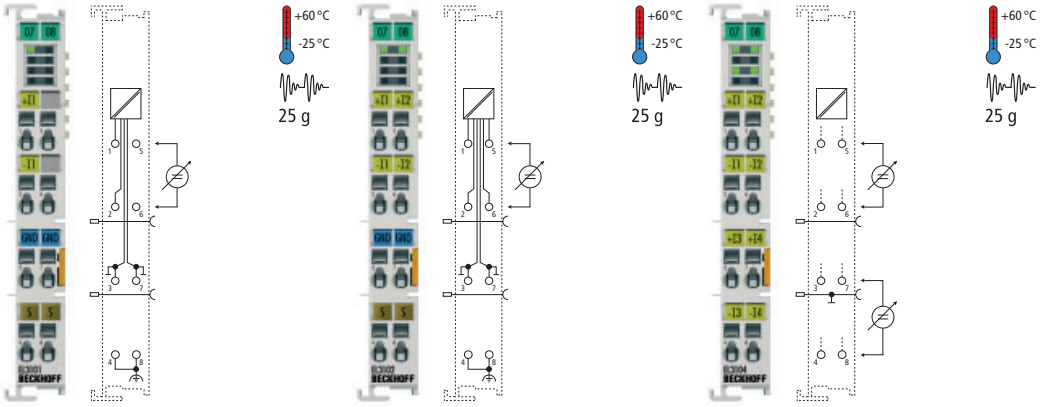
The product range is rounded off by further special input voltages and covers a wide field of application for the processing of analog signals. By the expansion of power supply terminals well-stabilised auxiliary voltages from 5 to 15 V can be generated.

	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

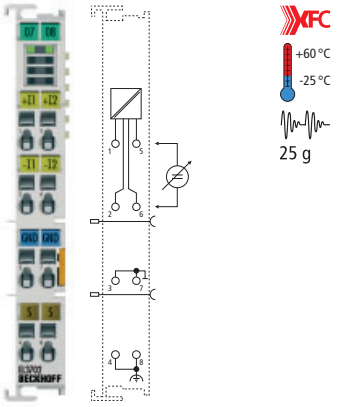
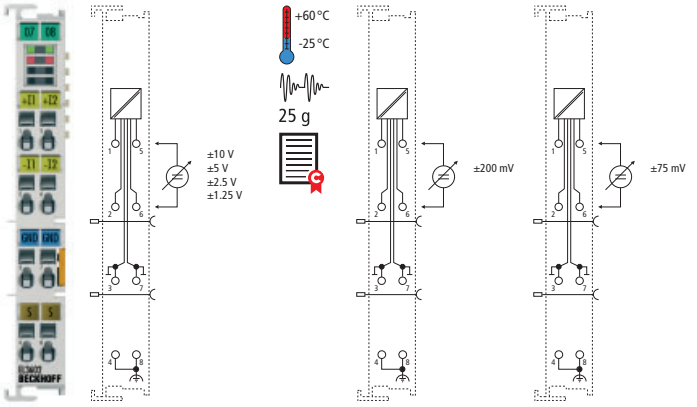
	1-channel analog input terminal, -10…+10 V, 16 bit, differential input	2-channel analog input terminal, -10…+10 V, 16 bit, differential input	4-channel analog input terminal, -10…+10 V, 16 bit, differential input
Technical data	**EL3101** | ES3101	**EL3102** | ES3102	**EL3104** | ES3104
Signal voltage	-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.

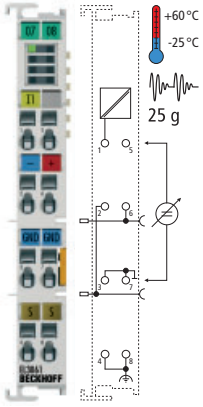
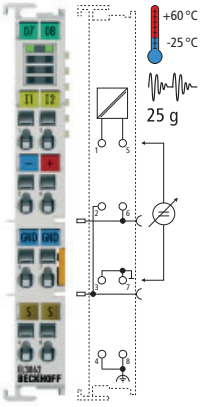
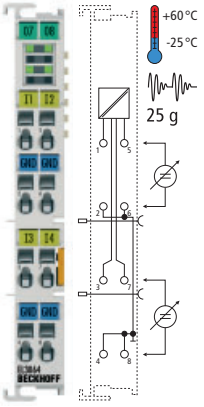
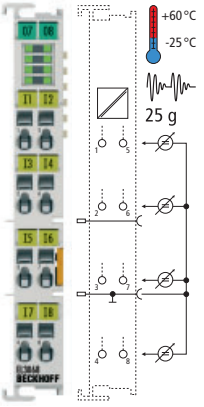
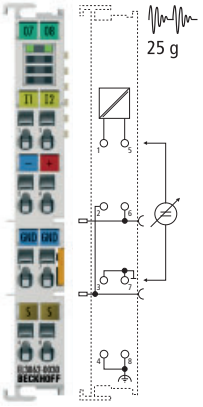
Common-mode voltage U_{CM}	35 V max. (relative to the internal GND)	35 V max. (relative to the internal GND)	35 V max. (relative to GND power contact)
Current consumption power contacts	–	–	–
Current consumption E-bus	typ. 130 mA	typ. 170 mA	typ. 130 mA
Distributed clocks	yes	yes	yes
Oversampling factor	–	–	–
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		

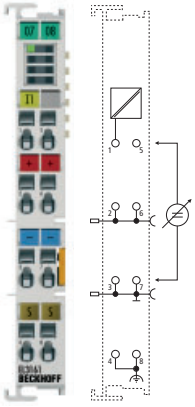
Further information on XFC see page 298

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

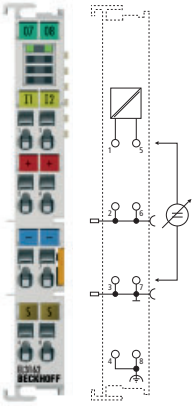
	1-channel analog input terminal, 0…10 V, 12 bit, single-ended	2-channel analog input terminal, 0…10 V, 12 bit, single-ended	4-channel analog input terminal, 0…10 V, 12 bit, single-ended	8-channel analog input terminal, 0…10 V, 12 bit, single-ended	2-channel analog input terminal, 0…30 V, 12 bit, single-ended
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, UL, 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

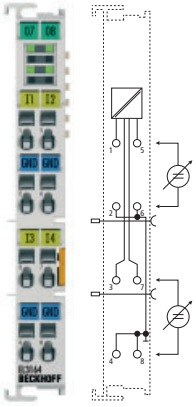
	1-channel analog input terminal, 0…10 V, 16 bit, single-ended	2-channel analog input terminal, 0…10 V, 16 bit, single-ended	4-channel analog input terminal, 0…10 V, 16 bit, single-ended
Technical data	**EL3161** | ES3161	**EL3162** | ES3162	**EL3164** | ES3164
Signal voltage	0…10 V		
Resolution	16 bit (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



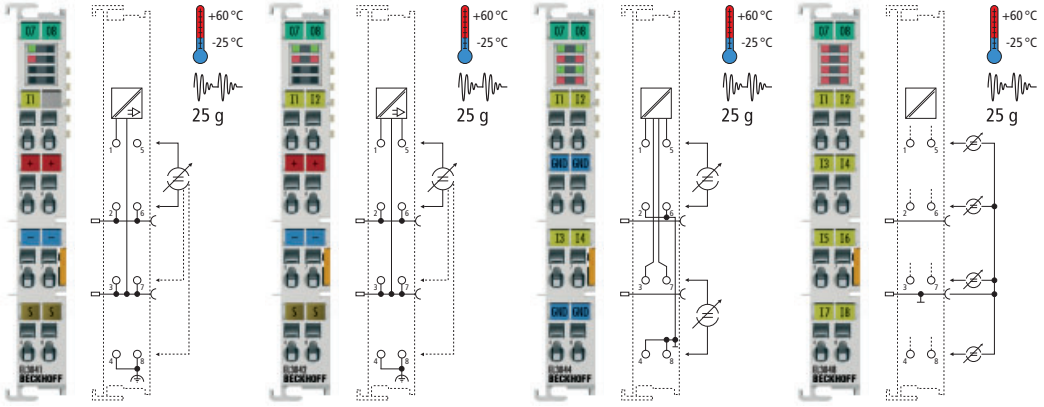
25 g

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

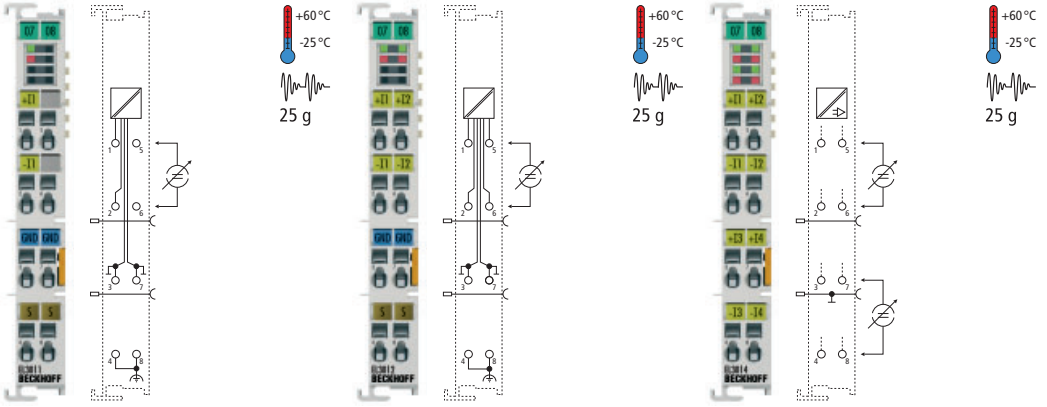
	1-channel analog input terminal, 0…20 mA, 12 bit, single-ended	2-channel analog input terminal, 0…20 mA, 12 bit, single-ended	4-channel analog input terminal, 0…20 mA, 12 bit, single-ended	8-channel analog input terminal, 0…20 mA, 12 bit, single-ended
Technical data	**EL3041** | ES3041	**EL3042** | ES3042	**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.

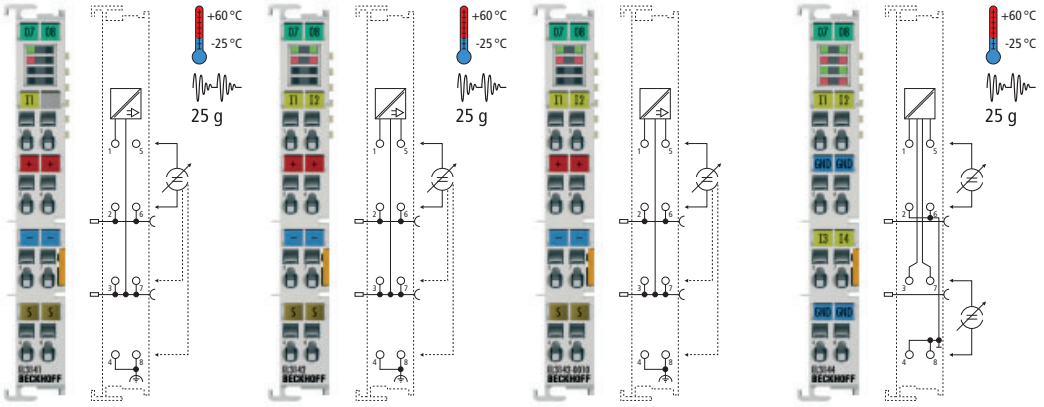
Dielectric strength	max. 30 V	max. 30 V	max. 30 V	max. 30 V
Current consumption power contacts	–	–	–	–
Current consumption E-bus	typ. 130 mA	typ. 130 mA	typ. 130 mA	typ. 130 mA
Distributed clocks	–	–	–	–
Internal resistance	85 Ω typ. + diode voltage	85 Ω typ. + diode voltage	85 Ω typ. + diode voltage	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

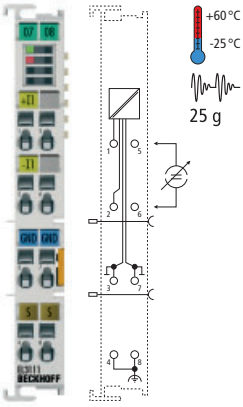
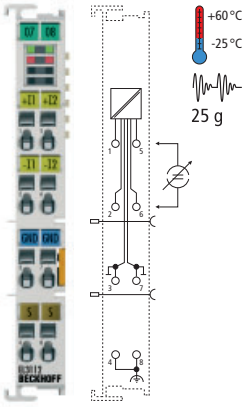
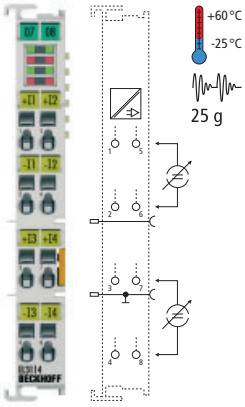
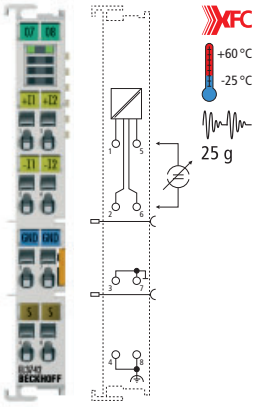
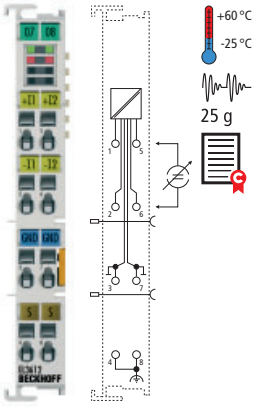
	1-channel analog input terminal, 0…20 mA, 16 bit, single-ended	2-channel analog input terminal, 0…20 mA, 16 bit, single-ended	2-channel analog input terminal, -10…+10 mA, 16 bit, single-ended	4-channel analog input terminal, 0…20 mA, 16 bit, single-ended
Technical data	**EL3141** | ES3141	**EL3142** | 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				

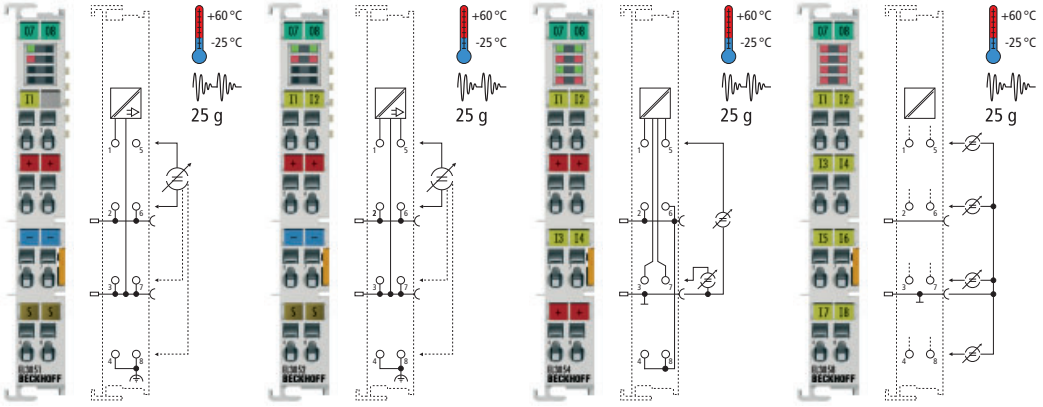
Analog input | 0…20 mA, 16/24 bit, differential input

	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 375	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

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

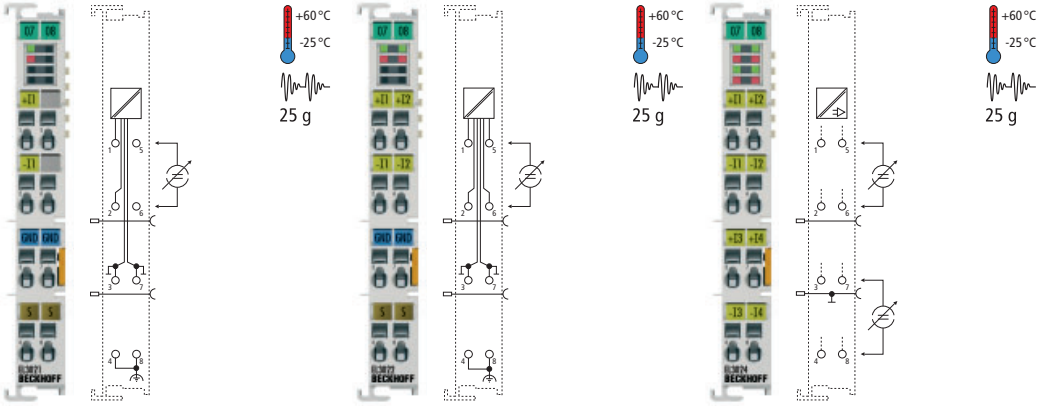
	1-channel analog input terminal, 4…20 mA, 12 bit, single-ended	2-channel analog input terminal, 4…20 mA, 12 bit, single-ended	4-channel analog input terminal, 4…20 mA, 12 bit, single-ended	8-channel analog input terminal, 4…20 mA, 12 bit, single-ended
Technical data	**EL3051** | ES3051	**EL3052** | ES3052	**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.

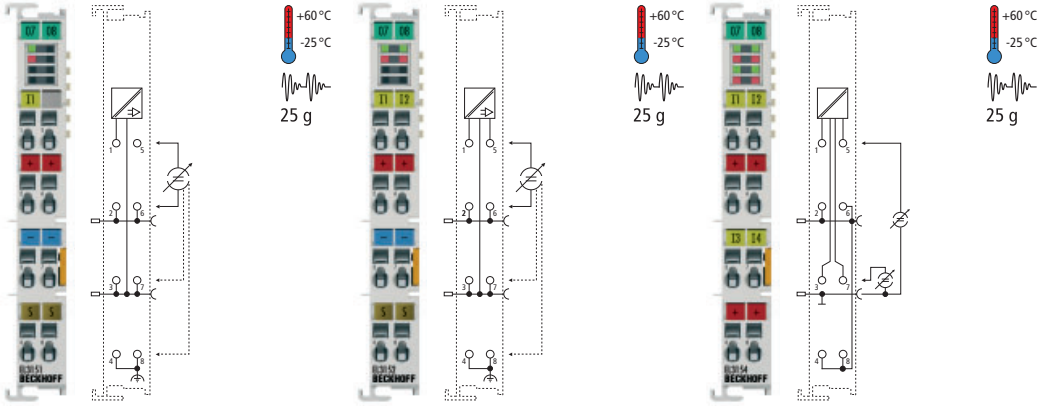
Dielectric strength	max. 30 V	max. 30 V	max. 30 V	max. 30 V
Current consumption power contacts	–	–	–	–
Current consumption E-bus	typ. 130 mA	typ. 130 mA	typ. 130 mA	typ. 130 mA
Distributed clocks	–	–	–	–
Internal resistance	85 Ω typ. + diode voltage	85 Ω typ. + diode voltage	85 Ω typ. + diode voltage	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

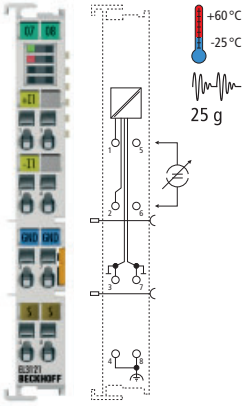
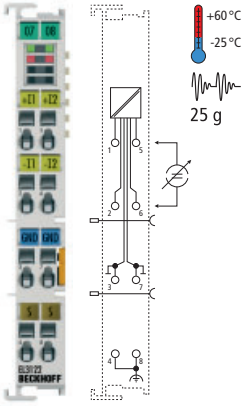
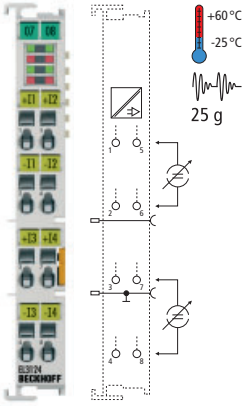
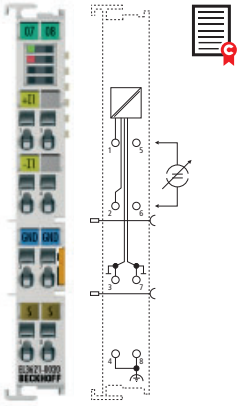
	1-channel analog input terminal, 4…20 mA, 16 bit, single-ended	2-channel analog input terminal, 4…20 mA, 16 bit, single-ended	4-channel analog input terminal, 4…20 mA, 16 bit, single-ended
Technical data	**EL3151** | ES3151	**EL3152** | ES3152	**EL3154** | ES3154
Signal voltage	4…20 mA		
Resolution	16 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, 16/24 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	1-channel analog input terminal, 4…20 mA, 24 bit, with calibration certificate
Technical data	**EL3121** | ES3121	**EL3122** | ES3122	**EL3124** | ES3124	**EL3621-0020**
Signal voltage	4…20 mA			
Resolution	16 bit (incl. sign)			24 bit (incl. sign)
Technology	differential input	differential input	differential input	differential input
Conversion time	~ 40 µs	~ 50 µs (fast mode ~ 35 µs)	~ 100 µs	1…400 ms configurable
Number of inputs	1 (differential)	2 (differential)	4 (differential)	1 (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.			The EL3621-0020 is a precise measuring device with 24-bit resolution.
Common-mode voltage U_{CM}	10 V max.	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	typ. 190 mA
Distributed clocks	yes	yes	yes	–
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	3 kHz
Measuring error	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)	< ±0.01 % at 25 °C (relative to full scale value, 50 Hz filter)
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	various filter times, limit evaluation, high precision, with calibration certificate
Operating temperature	-25…+60 °C	-25…+60 °C	-25…+60 °C	0…+55 °C
Approvals	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex	CE
Weight	approx. 55 g	approx. 55 g	approx. 60 g	approx. 60 g
Further information	www.beckhoff.com/EL3121	www.beckhoff.com/EL3122	www.beckhoff.com/EL3124	www.beckhoff.com/EL3621-0020
Special terminals			i EL3124-0090	
Distinguishing features			TwinSAFE SC 324	

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

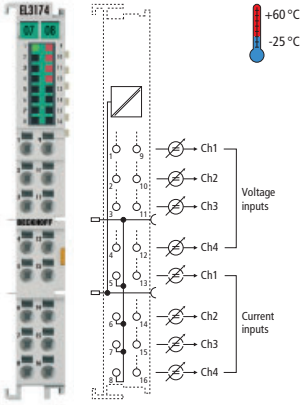
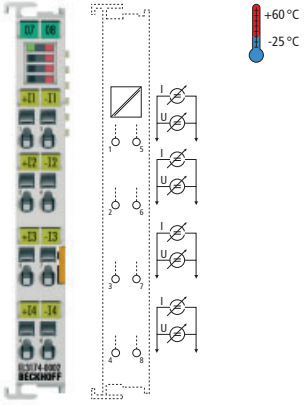
Analog input | -10/0…+10 V, -20/0/+4…+20 mA, 16 bit

The EL3174 and EL3174-0002 analog input terminals have four individually parameterisable inputs. Signals in the range from -10/0 to +10 V or -20/0/+4 to +20 mA can be processed via each channel.

Physically, the voltage and current signals of the EL3174 should be connected to different terminal points. Each channel should then be set by the controller/TwinCAT to U or I mode via CoE. The voltage inputs operate differentially; the current inputs are single-ended. All inputs are digitised with a resolution of 16 bits and transmitted, electrically isolated, to the higher-level automation device.

Each channel of the EL3174-0002 should be set by the controller to U or I mode via CoE. The input voltage or current is digitised with a resolution of 16 bits, and is transmitted, electrically isolated, to the higher-level automation device. The four differential inputs are electrically isolated against each other and against the fieldbus (2500 V DC).

With a technical measuring range of ±107 % of the nominal range, the terminals also support commissioning with sensor values in the limit range and diagnostics according to NAMUR NE43.

	4-channel analog input, parameterisable, -10/0…+10 V, -20/0/+4…+20 mA, differential, 16 bit	4-channel analog input, -10/0…+10 V, -20/0/+4…+20 mA, electrically isolated, 16 bit
Technical data	**EL3174**	**EL3174-0002**
Measuring range, nominal	-10/0…+10 V | -20/0/+4…+20 mA	
Resolution	16 bit (incl. sign)	
Technology	U differential, I single-ended	differential input, channels electrically isolated
Conversion time	min. 150 µs	min. 150 µs
Number of inputs	4	4
		
Measuring range, technical	-10.73…+10.73 V | -21.47…+21.47 mA	-10.73…+10.73 V | -21.47…+21.47 mA
Dielectric strength	max. 30 V (current measurement)	see eletrical isolation
Common-mode voltage U_{CM}	35 V max. (voltage measurement)	see electrical isolation
Distributed clocks	yes	yes
Oversampling factor	–	–
Distributed clock precision	<< 1 µs	<< 1 µs
Input signal bandwidth	–	–
Internal resistance	> 200 kΩ | 85 Ω typ	> 200 kΩ | 85 Ω typ
Electrical isolation	500 V (E-bus/signal voltage)	2500 V functional isolation (test voltage channel/channel and channel/fieldbus, production test)
Input filter limit frequency	5 kHz	5 kHz
Measuring error	< ±0.3 % (relative to full scale value)	< ±0.2 % (at 25 °C ±5 °C, or else < ±0.3 %, relative to full scale value)
Special features	U/I parameterisable, ExtendedRange,standard and compact process image, activatable FIR/IIR filters	U/I parameterisable, ExtendedRange,standard and compact process image, activatable FIR/IIR filters
Operating temperature	-25…+60 °C	-25…+60 °C
Approvals	CE	CE
Weight	approx. 65 g	approx. 65 g
Further information	www.beckhoff.com/EL3174	www.beckhoff.com/EL3174-0002

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

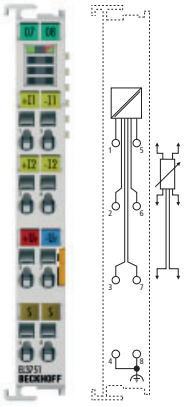
XFC analog input | **Multi-functional input, 24 bit**

The EL3751 analog input terminal is part of the new generation of analog EtherCAT measurement terminals. The nominal measuring range of the input channel can be comprehensively parameterised, both electrically and on the software side. The measuring ranges generally reach accuracy class 0.01 %. For further information please refer to the documentation. Through the feature "ExtendedRange" the user has the full technical measuring range available, up to 107 % of the specified nominal measuring range, depending on the measuring range. This feature can be disabled, in order to ensure compatibility with the "LegacyRange" of the EL30xx/EL31xx series.

To suppress aliasing effects, the input channel features two configurable numeric software filters up to 39th order FIR/6th order IIR. The filters can be preselected or freely described, so that a band stop or a band pass can be realised. The measurement at the differential input channel is digitised with a resolution of 24 bit and 10 ksps and is transmitted to the higher-level automation device electrically isolated and optionally with oversampling. The data rate can be internally reduced, in which case the filters have to be adjusted accordingly. Non-linear characteristic sensor curves can be corrected flexibly through an integrated sampling points table. Simple mathematical operations are also possible.

The integrated supply and the switchable auxiliary resistors enable direct connection of a resistor bridge (strain gauge) or a load cell, a fixed ohmic resistor, a PTC or a potentiometer. The signal state of the EtherCAT Terminal is indicated by light emitting diodes. Each terminal has a unique ID number.

XFC	1-channel analog input, high-precision, parameterisable, 24 bit, 10 ksps, differential, oversampling

Technical data	EL3751
Measuring range, nominal	±30/10/5/2.5/1.25 V, ±640/320/160/80/40/20/10/5 mV, 0…5/10 V, ±20 mA, 0/4…20 mA, NAMUR NE43, 0…5 kΩ, RTD, PT100/PT1000, Ni, KTY, ¼ bridge (350 Ω + 120 Ω), ½ bridge (±16 mV/V), full bridge (±32 mV/V), potentiometer ≥ 1 kΩ
Resolution	24 bit (incl. sign)
Technology	differential input, 2-/3-/4-/5-/6-wire connection
Conversion time	100 µs/10 ksps
Number of inputs	1
	
Measuring range, technical	generally 107 % of the nominal measuring range, see documentation
Dielectric strength	max. 36 V
Distributed clocks	yes
Oversampling factor	n = 1…64
Distributed clock precision	<< 1 µs
Internal resistance	> 500 kΩ (30 V); > 4 MΩ (others); 150 Ω (current)
Input filter limit frequency	3 kHz
Measuring error	typ. ±0.01 % relative to the respective full scale value @ 23 °C in some measuring ranges, see documentation
Special features	integr. power supply for strain gauge 0.5…5 V, parameterisable, ExtendedRange 107 %, free numeric filter, TrueRMS, integrator/differentiator, non-linear scaling, PeakHold
Operating temperature	0…+55 °C
Approvals	CE, UL
Weight	approx. 65 g
Further information	www.beckhoff.com/EL3751
Special terminals	EL3751-0020
Distinguishing features	with calibration certificate

Further information on XFC see page 298

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 1047 Ω: 1/64 Ω (approx. 15 mΩ)
– in the measuring range 10 to 4095 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.

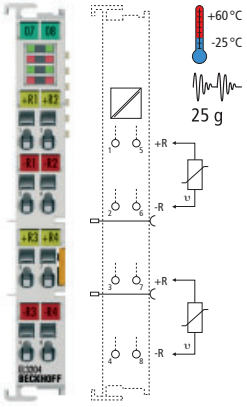
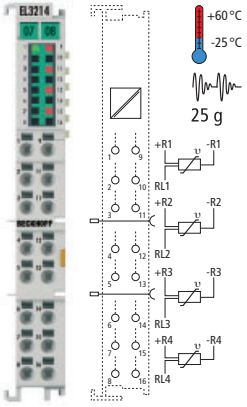
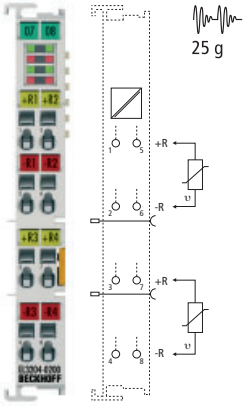
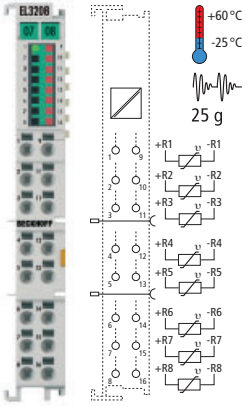
To achieve maximum measurement accuracy, the 4-wire system should be used (in conjunction with highly precise sensors, e.g. PT100).

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.

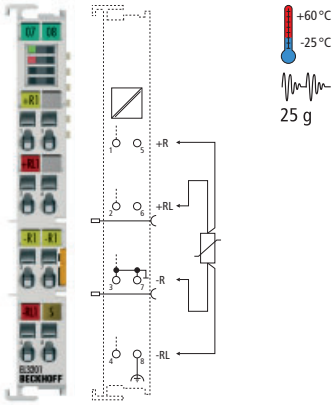
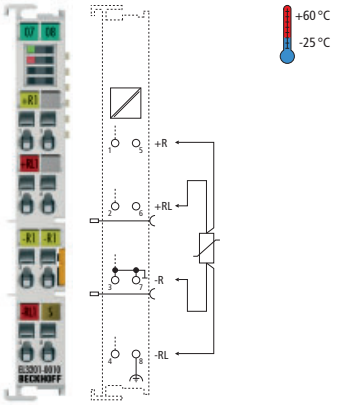
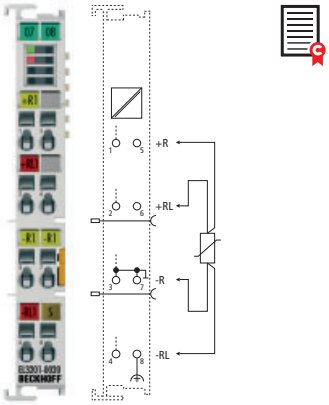
For 2-wire measurements, PT sensors/ Ni1000 sensors are recommended. Whereas the EL3204 was designed for the connection of four sensors in 2-wire technology, using the EL3208 as many as eight sensors in 2-wire technology can be connected. In addition, the EL3214 and the EL3202 offer the possibility to 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.

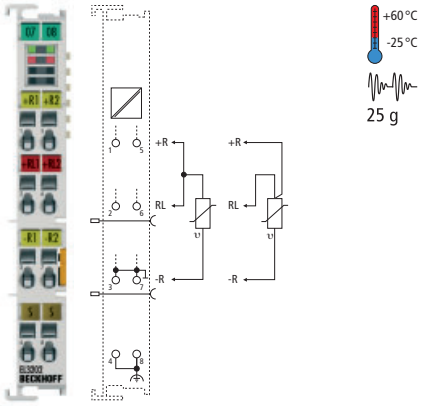
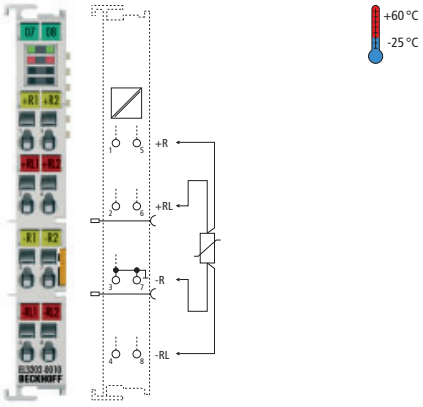
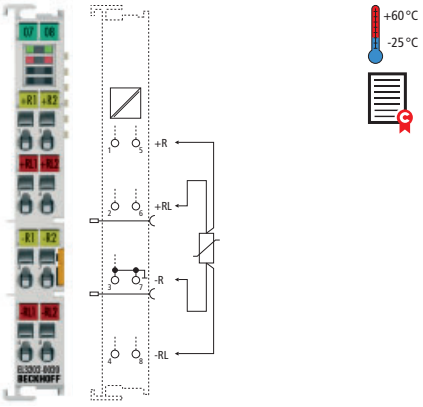
The analog EL3204-0200 input terminal enables direct connection of four resistance sensors for up to 240 kΩ, so that the usable measuring range is significantly larger compared with the EL3204. As a result, NTC sensors can also be used in addition to PT100 to 1000 and Ni100 to 1000 sensors. In addition, 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, 4 x 3-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, UL	CE, UL, Ex	CE, UL
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	-25…+60 °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

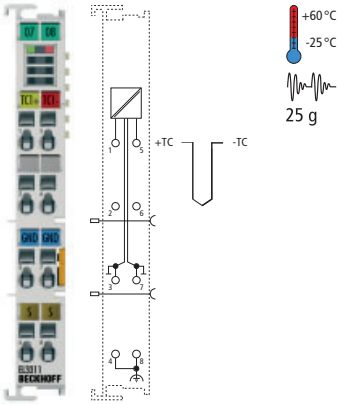
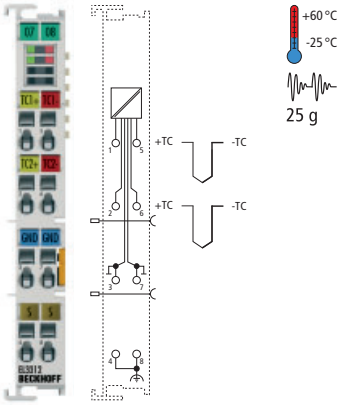
	2-channel analog input terminal, PT100 (RTD), 16 bit	2-channel analog input terminal, PT100 (RTD), 16 bit, high-precision	2-channel analog input terminal, PT100 (RTD), 16 bit, high-precision, with calibration certificate
	EL3202 | ES3202	**EL3202-0010**	**EL3202-0020**
	2-, 3-wire (default setting: 3-wire)	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	-25…+60 °C	-25…+60 °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

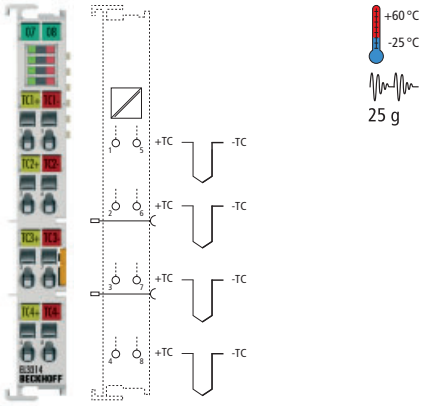
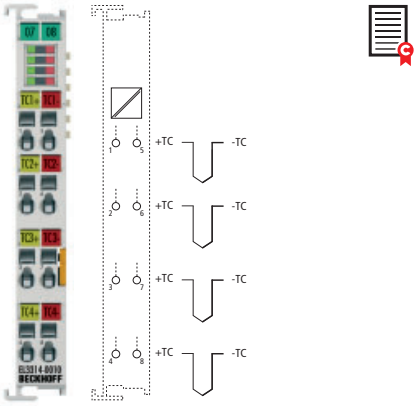
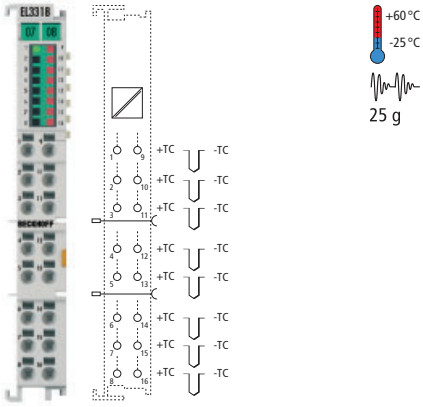
Analog input | **Thermocouple/mV measurement**

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 +2300 °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…+1370 °C); voltage measurement: ±30 mV…±75 mV	in the range defined in each case for the sensor (default setting: type K; -200…+1370 °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…+1370 °C); voltage measurement: ±30 mV…±75 mV	in the range defined in each case for the sensor (default setting: type K; -200…+1370 °C); voltage measurement: ±78 mV in 10 nV resolution	in the range defined in each case for the sensor (default setting: type K; -200…+1370 °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, UL, Ex
	approx. 60 g	approx. 60 g	approx. 70 g
	www.beckhoff.com/EL3314	www.beckhoff.com/EL3314-0010	www.beckhoff.com/EL3318
	i EL3314-0090	**i EL3314-0020**	
	TwinSAFE SC 324	with calibration certificate	

i 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.

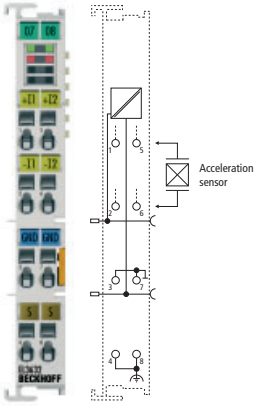
Many manufacturers offer suitable sensors, usually under their brand names or the standardised IEPE interface name.

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.

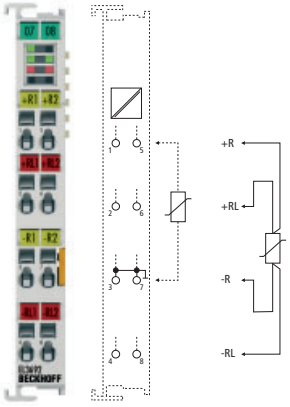
XFC	2-channel analog input terminal for Condition Monitoring (IEPE), 16 bit
Technical data	**EL3632**
Signal voltage	IEPE constant current supply and recording of modulated AC voltage
Technology	Condition Monitoring (IEPE), oversampling recording
Resolution	16 bit (incl. sign)
Conversion time	20 µs (max. 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/EL3632-0020

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	1500 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, Ex
Weight	approx. 55 g
Further information	www.beckhoff.com/EL3692
Special terminals	i EL3692-0020
Distinguishing features	with calibration certificate

i For availability status see Beckhoff website at: www.beckhoff.com/EL3692-0020

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.

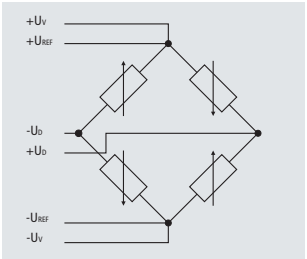
Thanks to the high measuring resolution of U_D with 16 bits (EL3351 and EL3356) or 24 bits (EL3356-0010), the detuning of the bridge can be evaluated with high accuracy. The simultaneous measurement of U_{REF} and U_D eliminates long-term and temperature drift; in the EL3356 and EL3356-0010 the integrated 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.

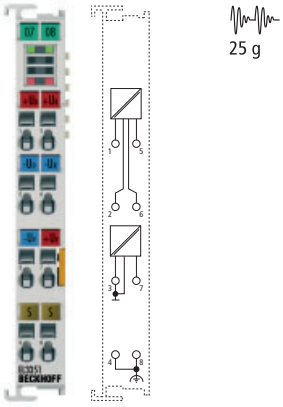
Sensors with measuring bridges are used, for example, for:

- 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

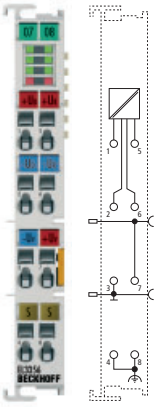
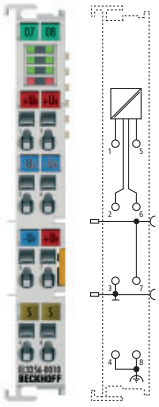


Full bridge

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, Ex	CE, UL, Ex
	approx. 60 g	approx. 60 g
	www.beckhoff.com/EL3356	www.beckhoff.com/EL3356-0010
		EL3356-0020
		with calibration certificate

For availability status see Beckhoff website at: www.beckhoff.com/EL3356-0020

Analog input | **Power measurement**

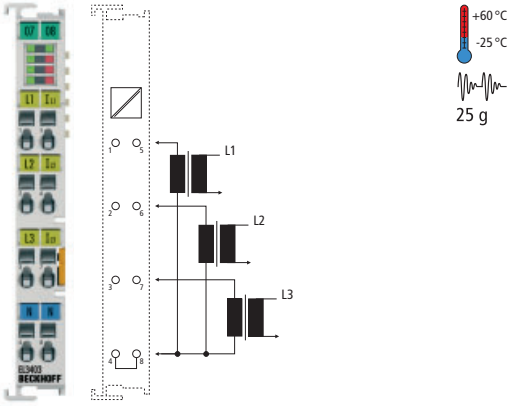
The EL34x3 and EL3773 EtherCAT power measurement terminals enable analysis of the energy consumption of the connected plant or building segment or, quite specifically, the key energy data of individual consumers directly via the fieldbus.

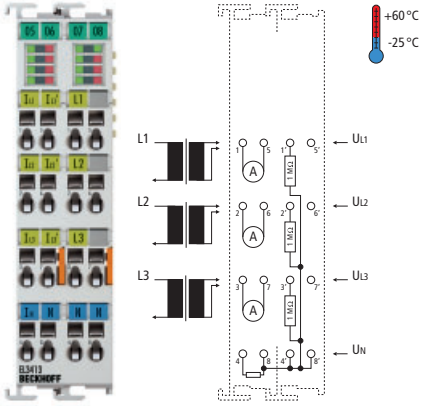
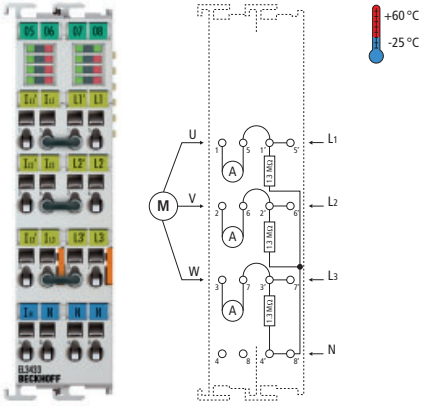
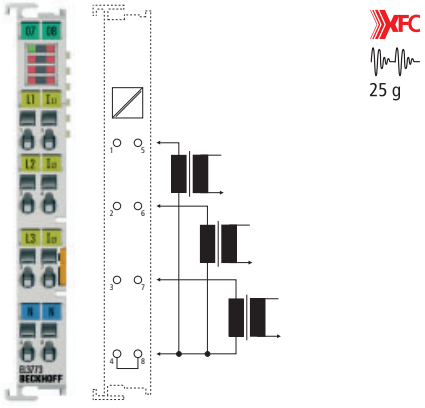
The EL34x3 terminals are suitable for measurements in 50/60 Hz power networks; the three phases plus neutral can be wired directly to the terminal for voltage measurement. For current measurement the three phases L1, L2 and L3 are fed in via simple current transformers. The measured current and voltage 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	1500 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
	4500 V	4500 V	2500 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, UL
	approx. 100 g	approx. 100 g	approx. 75 g
	www.beckhoff.com/EL3413	www.beckhoff.com/EL3433	www.beckhoff.com/EL3773
	EL3413-0001	**EL3413-0120**	
	max. 600 V AC, UL approval	max. 210 V AC 3~ (ULx-N: max. 120 V AC)	

Further information on XFC see page 298

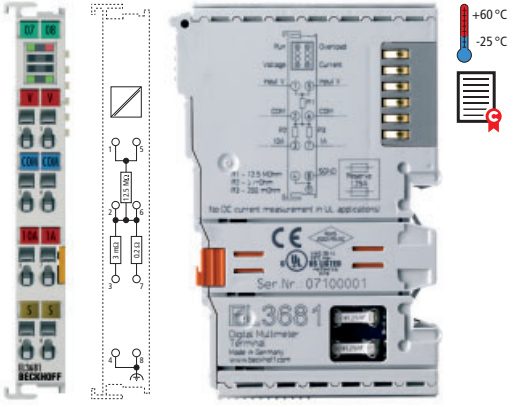
Analog input | **Measurement technology, multimeter terminal**

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.

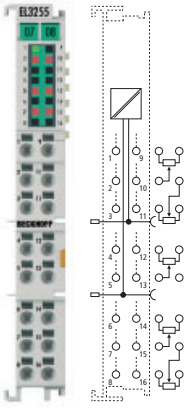
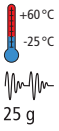
	Digital multimeter terminal, 18 bit
Technical data	**EL3681** | ES3681
Signal voltage	max. 300 V AC/DC, 10 A
Resolution	18 bit + sign in each measurement range
Conversion time	0.5 s (1 s during measuring range switching) preset, min. 65 ms
Number of inputs	1 voltage or 1 current (10 A/1 A)
	
Measuring 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	1500 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 844

i For availability status see Beckhoff website at: www.beckhoff.com/EL3681-0020

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, UL, Ex
Weight	approx. 70 g
Further information	www.beckhoff.com/EL3255

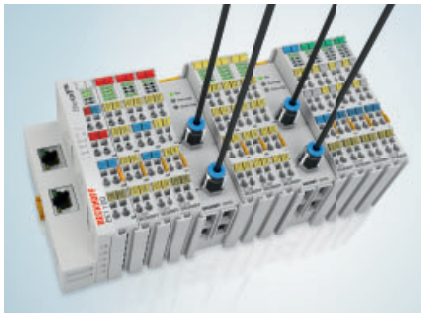
Analog input | **Pressure measuring**

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, the EM3702 and EM3712 enable direct measurement of the pressure value relative to the environment (relative pressure measurement). In contrast to the EM3702, with the EM3712 negative pressure values, as differential values relative to ambient, are also permitted.

The measured values are available as 16-bit values. 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.



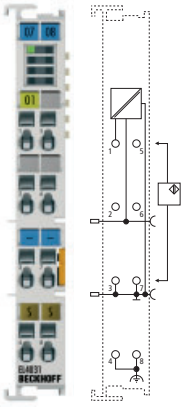
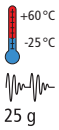
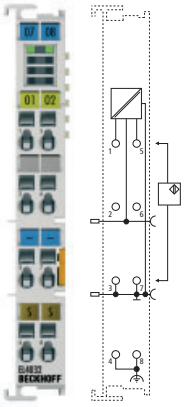
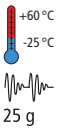
	1-channel differential pressure measuring terminal -100…+100 hPa
Technical data	**EM3701**
Technology	differential pressure measurement
	
	The EM3701 pressure measuring terminal enables direct measurement of pressure differences between two hose connections. The pressure difference is available as a 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.
Measuring error	3 % (relative to full scale value)
Measuring range	-100…+100 hPa (-100…+100 mbar)
Current consumption power contacts	– (no power contacts)
Max. overload	500 hPa (500 mbar) differential
Medium	non-aggressive gases
Operating temperature	0…+55 °C
Approvals	CE, UL
Weight	approx. 95 g
Further information	www.beckhoff.com/EM3701

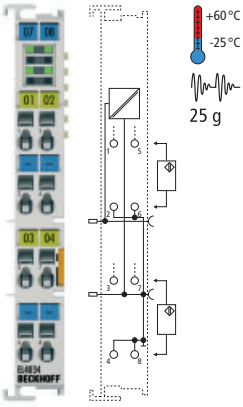
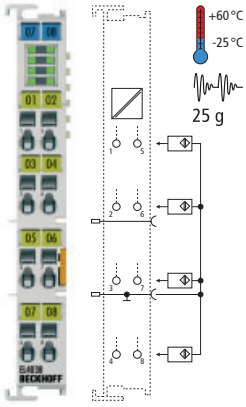
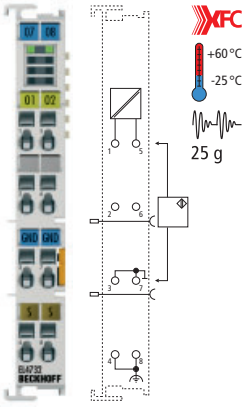
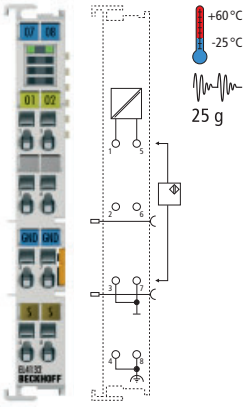
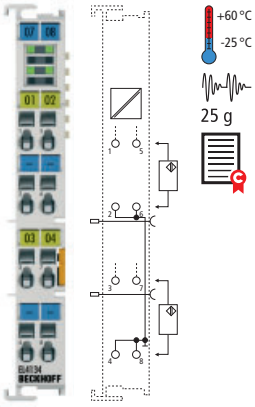
	2-channel relative pressure measuring terminal 7500 hPa	2-channel relative pressure measuring terminal -1000…+1000 hPa
	EM3702	**EM3712**
	relative pressure measurement	
		
	The EM3702 pressure measuring terminal enables direct measurement of two pressure values at the hose connections. The pressure 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.	The EM3712 pressure measuring terminal enables direct measurement of two negative pressure values at the hose connections. The pressure is determined as a pressure difference to the ambiance of the KM3712 and is available as a 16 bit value. The status LEDs indicate proper function or errors such as over-range.
	3 % (relative to full scale value)	3 % (relative to full scale value)
	0…7500 hPa (7.5 bar)	-1000…+1000 hPa (-1…+1 bar)
	– (no power contacts)	– (no power contacts)
	10,000 hPa (10 bar)	5000 hPa (5 bar)
	non-aggressive gases	non-aggressive gases
	0…+55 °C	0…+55 °C
	CE, UL	CE, UL
	approx. 95 g	approx. 95 g
	www.beckhoff.com/EM3702	www.beckhoff.com/EM3712

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 to +10 V, 0 to 10 V, 0 to 20 mA and 4 to 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		

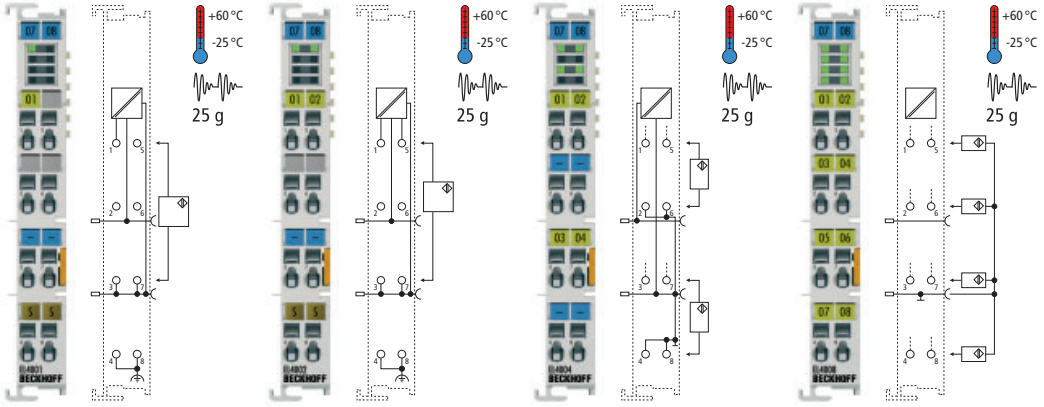
	4-channel analog output terminal, -10…+10 V, 12 bit	8-channel analog output terminal, -10…+10 V, 12 bit	2-channel analog output terminal, -10…+10 V, 16 bit, oversampling	2-channel analog output terminal, -10…+10 V, 16 bit	4-channel analog output terminal, -10…+10 V, 16 bit
	EL4034 | ES4034	**EL4038** | 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

Further information on XFC see page 298

i For availability status see Beckhoff website at: www.beckhoff.com/EL4134-0020

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

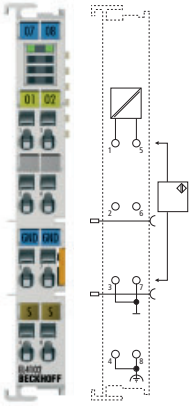


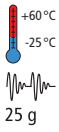
The EL4001, EL4002, EL4004 and EL4008 EtherCAT Terminals are analog output terminals with average conversion times and 12-bit resolution. The channels use the 0 V power contact as common reference potential. The EL4008 is designed for single-wire connection. The other terminals are designed for 2-wire connection. User scaling can be set in the terminal.

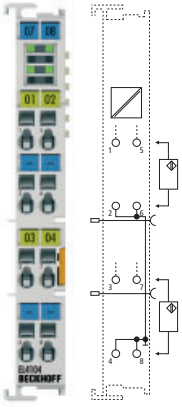
Load	> 5 kΩ (short-circuit-proof)	> 5 kΩ (short-circuit-proof)	> 5 kΩ (short-circuit-proof)	> 5 kΩ (short-circuit-proof)
Current consumption E-bus	typ. 140 mA	typ. 140 mA	typ. 140 mA	typ. 100 mA
Distributed clocks	yes	yes	yes	yes
Distributed clock precision	<< 1 µs	<< 1 µs	<< 1 µs	<< 1 µs
Current consumption 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

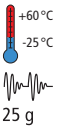
Analog output | 0…10 V, 16 bit

	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







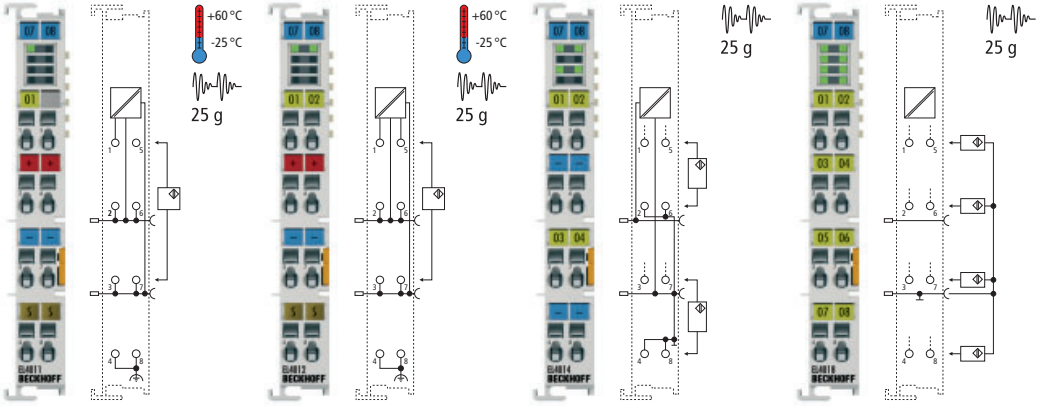


The EL4102 and EL4104 EtherCAT Terminals are analog output terminals with short conversion times and 16-bit resolution and are suitable for fast control tasks. Both terminals are designed for 2-wire connection. The channels have a common reference ground. User scaling can be set in the terminal.

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

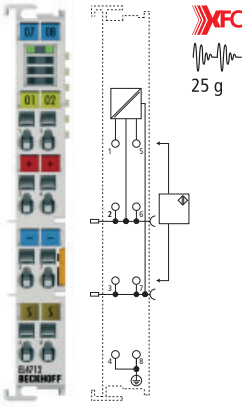
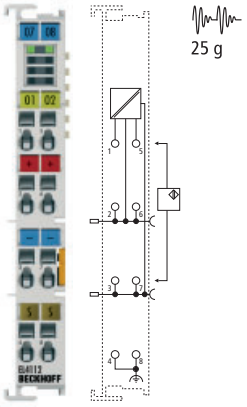
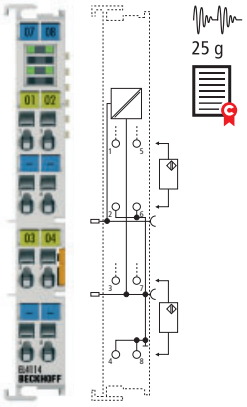
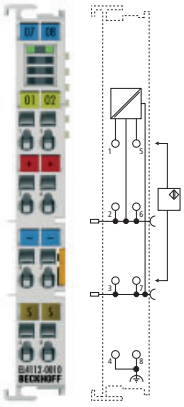
	1-channel analog output terminal, 0…20 mA, 12 bit	2-channel analog output terminal, 0…20 mA, 12 bit	4-channel analog output terminal, 0…20 mA, 12 bit	8-channel analog output terminal, 0…20 mA, 12 bit
Technical data	**EL4011** | ES4011	**EL4012** | ES4012	**EL4014** | ES4014	**EL4018** | ES4018
Signal 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

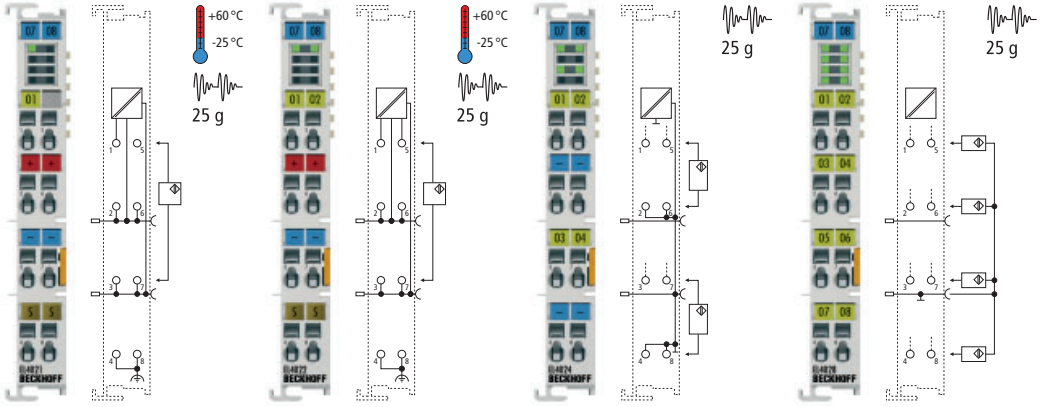
	2-channel analog output terminal, 0…20 mA, 16 bit, oversampling	2-channel analog output terminal, 0…20 mA, 16 bit	4-channel analog output terminal, 0…20 mA, 16 bit	2-channel analog output terminal, -10…+10 mA, 16 bit
Technical data	**EL4712** | ES4712	**EL4112** | ES4112	**EL4114** | ES4114	**EL4112-0010**
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/EL4114-0020

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

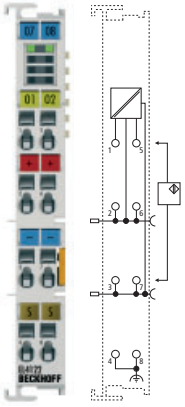


The EtherCAT Terminals of the EL402x series are analog output terminals with average conversion times and 12-bit resolution. The channels use the 0 V power contact as common reference potential. Apart from the 8-channel version EL4028, the terminals of the EL402x series are designed for 2-wire connection. User scaling can be set in the terminal.

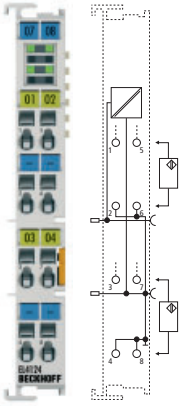
Load	< 500 Ω (short-circuit-proof)	< 500 Ω (short-circuit-proof)	< 350 Ω (short-circuit-proof)	< 150 Ω
Current consumption E-bus	typ. 140 mA	typ. 140 mA	typ. 140 mA	typ. 100 mA
Distributed clocks	yes	yes	yes	yes
Distributed clock precision	<< 1 µs	<< 1 µs	<< 1 µs	<< 1 µs
Current consumption power contacts	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**

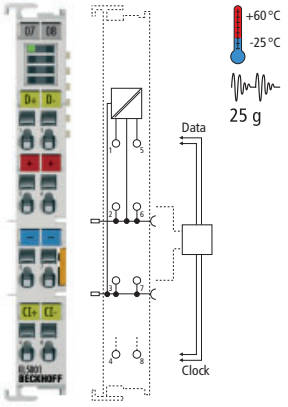
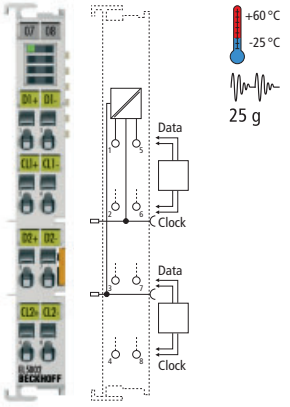
The EL5001 SSI interface EtherCAT Terminal enables the direct connection of an SSI encoder; two SSI encoders can be connected to the 2-channel EL5002 version.

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.

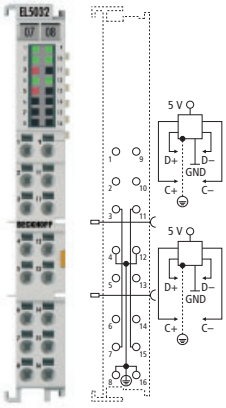
The EL5001 and EL5002 feature the distributed clocks function. Cyclic reading of the SSI encoder can thus be started with high precision, enabling detailed dynamic analysis of the axis in the control system. If the distributed clocks function is deactivated, the EL500x clocks the data synchronously with 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)	

Position measurement | **EnDat 2.2 interface**

The EL5032 EnDat 2.2 EtherCAT Terminal is used for direct connection of two encoders with EnDat 2.2 interface. The EL5032 enables reading of position values, diagnosis encoder data, internal and external temperature values and the electronic identification plate. With the electronic identification plate all measuring device-specific information is directly available. In addition, user-defined data can be stored in the encoder. This enables cost-effective and quicker commissioning. The position value is output with up to 48 bits, depending on the resolution of the connected measuring device. In addition to the position value, further information such as status information, addresses and data can be transferred. A list of additional information supported by the encoder is stored in the parameters. The EL5032 features distributed clocks, which means that the position value can be read in exact synchrony with the system. If the distributed clock function is deactivated, the EL5032 cycles synchronous with the EtherCAT cycle.

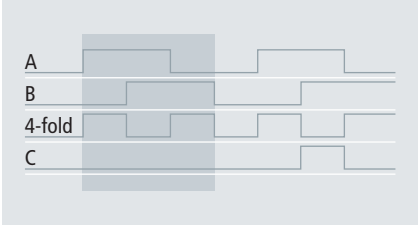
	2-channel EnDat 2.2 interface
Technical data	**EL5032**
Technology	EnDat 2.2 interface
Number of channels	2
	 25 g
Nominal voltage	24 V at power contact, built in encoder supply, max. 0.5 A
Encoder supply	optionally 5 V DC or 9 V DC
Current consumption power contacts	typ. 150 mA
Current consumption E-bus	typ. 120 mA
Commands	reading position values including additional information available for selection via MRS code (Memory Range Select), reading and writing parameters, reset functions
Distributed clocks	yes
Encoder connection	D+, D-, C+, C-
Resolution	max. 48 bit for position
Special features	saving the zero offset shift, electronic type plate, diagnostics, warning, including cable length compensation up to 100 m, reading the encoder temperature values
Operating temperature	0…+55 °C
Approvals	CE, UL
Weight	approx. 50 g
Further information	www.beckhoff.com/EL5032

Position measurement | **Incremental/SinCos encoder interfaces**

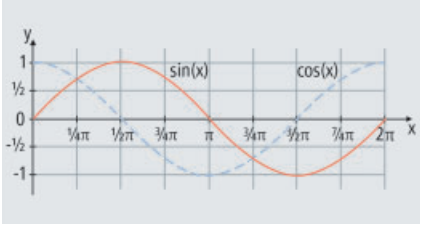
As opposed to absolute value encoders, incremental encoders do not provide a direct position, but rather two changing/pulsed signals that are phase-shifted by 90°, which can be used to calculate back to a position. To this end, digital position encoders subdivide a 360° rotation of the encoder axis into individual steps (increments). For position encoders with analog sin/cos interface it is subdivided into periods, with a period corresponding to a full revolution of the sine/cosine signal. A full revolution of the encoder axis is indicated by a special marker/zero pulse. The number of increments determines both the resolution of an encoder and the accuracy of the position.

The EL51xx terminals support micro-increment mode: By interpolating the signal voltages, the resolution is increased 256-fold and can be used for refining the positioning.

Using the EL5021, an n-times more precise position determination is achieved within one period through interpolation of the two 90° phase-shifted sine signals. Depending on the setting (8 to 13 bit), a micro-resolution of the period of 256 to 8192 times can be achieved.



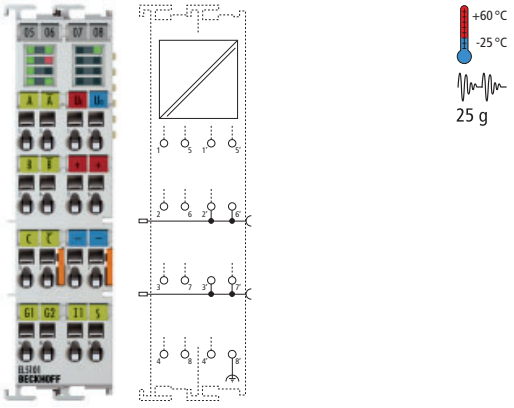
The quadruple evaluation of the signals A and B (quadrature encoder) produces a fine positional resolution and enables detection of the direction.



SinCos signal depending on the encoder position

1-channel incremental encoder interface, differential input (RS485)

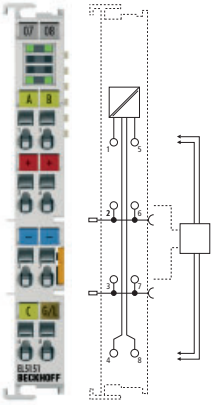
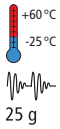
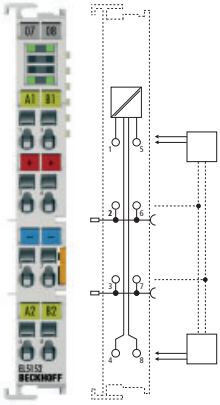
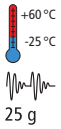
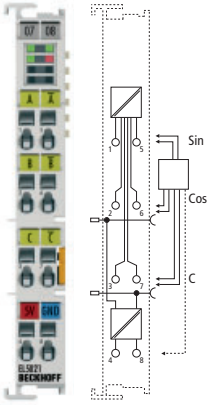
Technical data	**EL5101** | ES5101	
Technology	incremental encoder interface RS485	
Number of channels	1	



The EL5101 is an interface for the direct connection of incremental encoders with differential (RS485) or single-ended inputs. It supplies 5 V for the encoder supply.

Nominal voltage	24 V DC at power contact	
Current consum. pow. cont.	typ. 100 mA + load	
Current consumption E-bus	typ. 130 mA	
Distributed clocks	yes	
Input signal	difference signal (RS485), single-ended possible	
Encoder connection	A, A (inv), B, B (inv), C,C (inv), differential inputs (RS485); status input 5 V DC; gate/latch input 24 V DC	
Encoder operating voltage	5 V DC/max. 0.5 A	
Input frequency	max. 4 million increments/s (with 4-fold evaluation)	
Resolution	1/256 bit microincrements	
Counter	1 x 16/32 bit switchable	
Special features	wire breakage detection, latch and gate function, period duration and frequency measurement, microincrements, timestamping of edges, filters	
Operating temperature	-25…+60 °C	
Approvals	CE, UL, Ex	
Weight	approx. 100 g	
Further information	www.beckhoff.com/EL5101	
Special terminals	**EL5101-0010**	**EL5101-0090**
Distinguishing features	20 million increments/s (with 4-fold evaluation), no single-ended operation	TwinSAFE SC 324

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

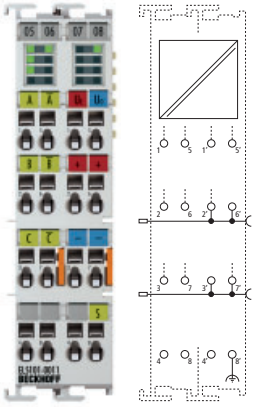
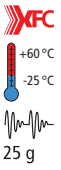
	1-channel incremental encoder interface, single-ended, 24 V DC	2-channel incremental encoder interface, single-ended, 24 V DC	1-channel SinCos encoder interface, 1 V_{PP}
	EL5151 | ES5151	**EL5152** | ES5152	**EL5021** | ES5021
	incremental encoder interface 24 V DC, EN 61131-2, type 1, "0": < 5 V DC, "1": > 15 V DC, typ. 5 mA		SinCos encoder interface for differential 1 V_{PP} signal
		2	1
	   		 
	The EL5151 and EL5152 are interfaces with 24 V inputs for the direct connection of incremental encoders. For each channel a 32-bit counter with quadrature decoder can be read and set. In addition, the EL5151 offers a 32-bit latch for the zero pulse. Alternatively, both terminals can be used as forward/backward counters. Due to their support of distributed clocks, the EL515x terminals can detect the axis positions together with other slaves synchronously and with high temporal accuracy.		The EL5021 is an interface for the direct connection of a measuring sensor with sinusoidal voltage output 1 V_{PP}. The measuring signal is provided as a 32 bit value. The maximum resolution of the counter value is 24 bit, the maximum resolution of the signal period is 13 bit. The reference mark is stored in a 32 bit value.
	24 V DC at power contact		24 V DC at power contact
	typ. 100 mA + load		typ. 50 mA + load
	typ. 130 mA		typ. 120 mA
	yes		yes
	24 V DC		1 V_{PP}
	A, B, C, gate/latch input 24 V DC, 24 V/0 V	A1, B1, A2, B2, 24 V/0 V	A, A (inv), B, B (inv), C,C (inv)
	24 V DC		5 V DC/max. 0.5 A
	max. 400,000 increments/s (with 4-fold evaluation)		250 kHz @ 10 bit (sampling frequency 70 MHz)
	1/256 bit microincrements		max. 13 bit, 8192 steps per period
	1 x 16/32 bit switchable	2 x 32 bit	max. 24 bit
	gate or latch function, microincrements, timestamping of edges, period duration and frequency measurement, up/down counters	microincrements, period duration and frequency measurement, up/down counters	latch, reset, amplitude and frequency error recognition, frequency-dependent period resolution, frequency counter max. 24 bit
	-25…+60 °C		0…+55 °C
	CE, UL, Ex		CE, UL, Ex
	approx. 50 g		approx. 55 g
	www.beckhoff.com/EL5151	www.beckhoff.com/EL5152	www.beckhoff.com/EL5021
	EL5151-0021		**i EL5021-0090**
	with parameterisable 24 V DC output and workpiece measurement		TwinSAFE SC 324

Position measurement | **Incremental encoder interface**

The EL5101-0011 EtherCAT Terminal is an interface for direct connection of incremental encoders with differential inputs (RS422) and it processes the signals for a finer resolution of position values according to the oversampling principle.

A conventional incremental encoder reads a counter value with each bus cycle and passes it on to the higher-level controller in the next fieldbus cycle. The EL5101-0011 reads the current counter value at several configurable and equidistant times between two fieldbus communication cycles with an adjustable whole number multiple (oversampling factor: n) of the bus cycle time. A packet of n position values of 32 bits each is then transmitted to the higher-level controller in the next fieldbus communication cycle. The minimum sampling time is 10 µs (100 ksps). The EL5101-0011 terminal is especially suitable for applications where high-resolution position detection is required.

The EL5101-0011 supports distributed clocks, i.e. input data can be synchronously acquired with data from other I/Os that, similarly distributed, are also connected to distributed slave clocks. A system accuracy of about < 100 ns can be achieved.

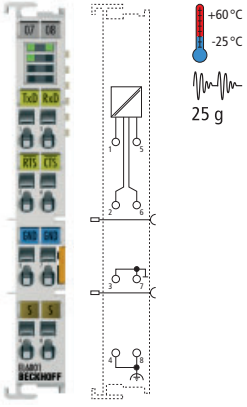
	1-channel incremental encoder interface (RS422), oversampling
Technical data	**EL5101-0011**
Technology	incremental encoder interface RS422
Number of channels	1
	 
Nominal voltage	24 V at power contact
Current consumption power contacts	typ. 100 mA + load
Current consumption E-bus	typ. 130 mA
Distributed clocks	yes
Oversampling factor	n = 1…100 selectable
Input signal	difference signal (RS422)
Encoder connection	A, A (inv), B, B (inv), C,C (inv) (RS422, differential inputs)
Encoder operating voltage	5 V DC/max. 0.5 A
Input frequency	max. 20 million increments/s (with 4-fold evaluation)
Conversion time	10 µs/100 ksps
Counter	1 x 32 bit
Special features	oversampling, wire breakage detection
Operating temperature	-25…+60 °C
Approvals	CE, UL, Ex
Weight	approx. 100 g
Further information	www.beckhoff.com/EL5101-0011

Communication | **Serial interfaces RS232/RS485**

The EL60xx serial interfaces enable the connection of devices with RS232 or RS422/RS485 interfaces to the control level. The devices connected to the EtherCAT Terminal communicate via the EtherCAT network with the automation device. The active communication channel works independently of the cycle of the higher-level EtherCAT system in full duplex mode at up to 115.2 kbaud. This way, any desired number of serial interfaces can be used in the application without having to consider structural restrictions in the control device. The serial interface can be positioned close to the place of use, this way reducing the necessary cable lengths.

The RS232 interface allows for high immunity to interference through electrically isolated signals. In the EL6021 this is additionally supported by differential signal transmission according to RS422. The EL6022 can make 2 x 5 V/20 mA from the E-bus supply available for powering external devices.

The EL60xx can be used as a normal Windows COM interface in conjunction with the TwinCAT Virtual Serial COM Driver (see page 1041).

	1 x serial interface RS232/RS422/RS485		2 x serial interface RS232/RS422/RS485	
Technical data	**EL6001** | ES6001	**EL6021** | ES6021	**EL6002**	**EL6022**
Data transfer rates	2400…115,200 baud; default: 9600 baud, 8 data bits, no parity and one stop bit		300…115,200 baud; default: 9600 baud, 8 data bits, no parity and one stop bit	
Interfaces	1 x RS232	1 x RS422/ RS485	2 x RS232	2 x RS422/ RS485
Technology	terminal contact		D-sub, 9-pin	
				
Data buffer	864 bytes receive buffer, 128 bytes transmit buffer		864 bytes receive buffer, 128 bytes transmit buffer	
Current consumption power contacts	–		–	
Current consumption E-bus	typ. 120 mA	typ. 170 mA	typ. 170 mA	typ. 270 mA
Distributed clocks	–		–	
Cable length	max. 15 m	approx. 1000 m twisted pair	max. 15 m	approx. 1000 m twisted pair
Line impedance	–	120 Ω	–	120 Ω
Special features	–		–	2 x 5 V/ 20 mA for external supply
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/EL6001		www.beckhoff.com/EL6002	

Communication | License key terminal for TwinCAT 3.1

With few exceptions, TwinCAT 3 Engineering is free of charge. The chargeable engineering products are licensed in the same way as chargeable runtime licenses. TwinCAT 3.1 offers the option of using a TwinCAT 3 license key (license dongle) for licensing.

License keys make exchange of a PC easy, since the TwinCAT 3 license is no longer tied to the PC hardware itself and the TwinCAT 3 license file can be directly stored on the TwinCAT 3 license key.

Beckhoff offers two types of TwinCAT 3 license key devices: the EL6070 EtherCAT license key terminal or the C9900-L100 license key USB stick.

The EL6070 EtherCAT Terminal enables direct integration into the EtherCAT I/O system and is available in two variants. The EL6070-0000 is an "empty" version for which users can activate any desired licenses themselves. The EL6070-0033 is delivered with pre-activated TwinCAT 3 licenses that have been specified by the user. Of course, users can also activate any additional desired licenses if desired.

An alternative is available in the C9900-L100 license key USB stick, likewise in the C9900-L100-0000 and C9900-L100-0033 variants.

For specifying in the order whether and how TwinCAT 3 licenses should be pre-activated, the TwinCAT 3 article number offers a corresponding option in the third-to-last digit:

0 = pre-activation for IPC
1 = pre-activation for license key (EL6070-0033 or C9900-L100-0033)
2 = no pre-activation (activation carried out by the user)

Examples of orders for a TC1200-0050 TwinCAT 3 PLC license:

Single, not pre-activated TwinCAT 3 license + empty license key:

– license key: EL6070-0000 or C9900-L100-0000
– not pre-activated TwinCAT license: TC1200-0250

Pre-activated TwinCAT 3 license with delivery on the associated license key:

– license key: EL6070-0033 or C9900-L100-0033
– pre-activated TwinCAT license: TC1200-0150

Pre-activated licenses can only be ordered in combination with the associated license key. When re-ordering licenses for an already existing license key, not pre-activated licenses must be ordered, which have to be activated by the user later.

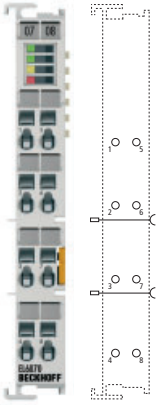
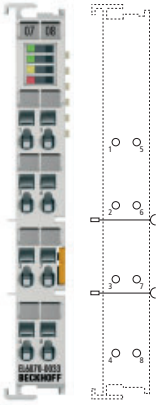
Prerequisite for the use of a TwinCAT 3 license key and the memory function for the license files on the hardware memory of the license key is the current TwinCAT 3.1 version.

TwinCAT 3 see page 974

C9900-L100 | License key USB stick for TwinCAT 3.1

i C9900-L100-0033 | License key USB stick for TwinCAT 3.1, programmed according to customer specifications

TwinCAT 3 standard licenses are chargeable and are tied to a unique system ID (of the IPC or the license key) as well as to the performance level of the IPC hardware to be used.

	License key terminal for TwinCAT 3.1	License key terminal for TwinCAT 3.1 (programmed according to customer specifications)
Technical data	**EL6070**	**EL6070-0033**
Technology	EtherCAT license key terminal	
	 	 
Current consumption power contacts	–	–
Current consumption E-bus	typ. 130 mA	typ. 130 mA
Distributed clocks	–	–
Operating temperature	-25…+60 °C	-25…+60 °C
Approvals	CE, UL	CE
Weight	approx. 50 g	approx. 50 g
Further information	www.beckhoff.com/EL6070	www.beckhoff.com/EL6070-0033

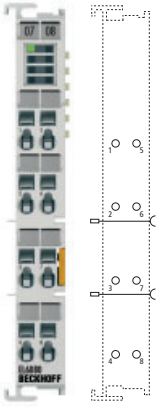
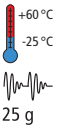
For availability status see Beckhoff website at: www.beckhoff.com

Communication | **EtherCAT memory terminal 128 kbyte**

The EL6080 EtherCAT memory terminal has 128 KB of non-volatile memory (NOVRAM). The terminal can be used to store and read out parameters and recipes. Part of the memory can also be used for the cyclic storage of machine data such as operating hour meters or production numbers. The EtherCAT Terminal is used, for example, for storing module-related data in the machine module in modular machine concepts with a central controller.

Data is only stored in the RAM in the live terminal and is therefore not stored permanently. However, this allows unlimited access for reading and writing. In the event of a power failure, an internal buffer supplies the NOVRAM block until the entire contents of the RAM have been stored in a non-volatile memory.

The EL6080 supports memory access with cyclic process data or via acyclic SDO/CoE. The access time depends in both cases on the size of the data. For cyclic access, the user must create a set of process data with an arbitrary structure, which is then written to or read from the terminal in its entirety. This process takes several task cycles, depending upon the size of the data and the cycle time, and is controlled by a handshake.

	EtherCAT memory terminal 128 kbyte, NOVRAM
Technical data	**EL6080**
Technology	EtherCAT memory terminal
Memory	128 kbyte NOVRAM
	 
Number of write/read	arbitrary
Current consumption power contacts	–
Current consumption E-bus	typ. 130 mA
Distributed clocks	–
Operating temperature	-25…+60 °C
Approvals	CE, UL, Ex
Weight	approx. 50 g
Further information	www.beckhoff.com/EL6080

Communication | **Display terminal – operating hours counter**

The display terminal has an illuminated, low-reflection LC display with two lines of 16 characters. It can be used, for example, for displaying status messages or diagnostic information. A non-resettable operating hours counter is integrated and can be displayed and also read out via the controller.

Via the user program dynamic and static application-specific texts can be displayed, e.g. "Production counter: (count value)". If the output text is longer than 16 characters, the terminal automatically switches to scrolling text mode. Two special characters can be defined via a 5 x 8 pixel matrix.

The statuses of the navigation switch – up, down, left, right and enter – are transmitted to the controller as binary variables and can be used, for example, to control the display.

	Display terminal with navigation switch and operating hours counter
Technical data	**EL6090**
Technology	EtherCAT display terminal
Switch inputs	navigation switch: up, down, left, right, enter
	
Display	LC display, 2 x 16 characters (> 16 characters = scrolling text mode), switchable backlight
Special characters	2 characters (5 x 8 pixel matrix)
Operating hours counter	32 bit overflow after 136 years (no reset possible), secure data storage > 100 years (@15 minutes writing interval), accuracy: ±50 ppm
Time measuring	4 x 32 bit second counter (reset possible)
Counter	4 x 32 bit counter (reset possible)
Storage interval	manual/automatic every 15 minutes
Current consumption power contacts	–
Current consumption E-bus	typ. 80 mA
Distributed clocks	–
Operating temperature	0…+55 °C
Approvals	CE, UL
Weight	approx. 70 g
Further information	www.beckhoff.com/EL6090

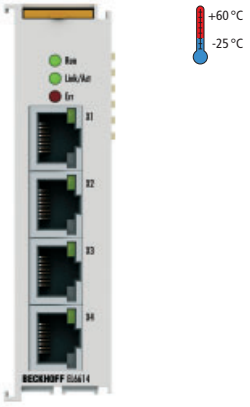
Communication | **Ethernet switch port terminals**

The EL6601 and EL6614 Ethernet switchport terminals serve the local connection of arbitrary Ethernet devices to the EtherCAT system. The EtherCAT system relays the Ethernet communication of the connected devices fully transparent and collision-free.

The EL6614 Ethernet switchport terminal has an integrated 5-port switch. It manages the data from the EtherCAT system and the four RJ45 ports. In full-duplex mode, the terminal enables the collision-free communication of the connected devices with one another.

The EL6601 and EL6614 are suitable for transmitting and receiving "normal" non-real-time-critical Ethernet frames, e.g. with TCP/IP contents. The throughput specified in the documentation must be observed. TwinCAT, as a "virtual switch", manages these frames at the IPC Ethernet port, which is configured as an EtherCAT device.

In addition, the EL6601 and EL6614 can appear as a publisher/subscriber like a real-time Ethernet device and can be configured as such in TwinCAT. Real-time data are preferred by the terminal and processed synchronously with the EtherCAT cycle. In this way, several hundred bytes of process data can be transmitted and received cyclically, up to < 1 ms.

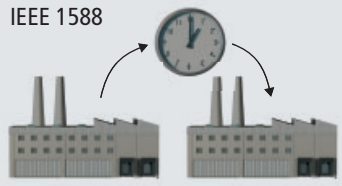
Ethernet	Ethernet switch port terminal, 1 port	Ethernet switch port terminal, 4 ports, internal switch
Technical data	**EL6601**	**EL6614**
Ethernet interface	10BASE-T/100BASE-TX Ethernet with 1 x RJ45	10BASE-T/100BASE-TX Ethernet with 4 x RJ45
Data transfer rates	10/100 Mbit/s, IEEE 802.3u auto-negotiation, half or full duplex at 10 and 100 Mbit/s possible, automatic settings	
Cable length	up to 100 m twisted pair	up to 100 m twisted pair
		
Protocol	all Ethernet (IEEE 802.3)-based protocols, store and forward switching mode	all Ethernet (IEEE 802.3)-based protocols, store and forward switching mode
Current consumption power contacts	–	–
Current consumption E-bus	typ. 310 mA	typ. 450 mA
Distributed clocks	–	–
Special features	support of RT Ethernet, publisher/subscriber, DHCP/BootP address allovation (1 device)	support of RT Ethernet, publisher/subscriber, DHCP/BootP address allovation (1 device)
Operating temperature	-25…+60 °C	-25…+60 °C
Approvals	CE, UL, Ex	CE, UL, Ex
Weight	approx. 75 g	approx. 95 g
Further information	www.beckhoff.com/EL6601	www.beckhoff.com/EL6614

Communication | IEEE 1588 external synchronisation

The Precision Time Protocol can be used in order to generate an identical time base within an application, i.e. over several networks. PTP is a protocol that secures the synchronicity of the time settings of several devices in a network and which is defined in IEEE 1588 standard as the protocol standard for the synchronisation of distributed clocks in networks. As opposed to the NTP (Network Time Protocol), the emphasis in PTP is on higher accuracy. The applicational synchronisation can be implemented using TwinCAT and the EL6688 IEEE 1588 External Synchronisation Interface.

If the PTP Ethernet frames are routed by switches in a larger network, then PTP-compatible switches should to be used in order to attain the highest possible synchronisation accuracy. These enter the self-caused data delays into the correction values provided in the PTP data. In this way, the accuracy of the synchronisation of the master to the slave is not affected negatively by the transmission delays.

The EL6688 is the simplest way to synchronise an EtherCAT system with appropriate interface devices to the global world time via GPS or radio transmitters such as DFC77. If more than two EtherCAT systems are to be synchronised with one another, the EtherCAT Terminal is likewise the means of choice.



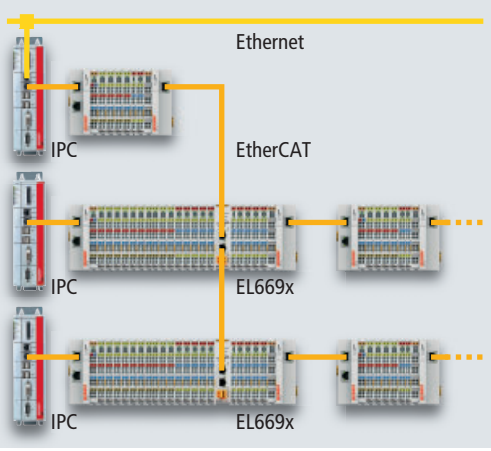
Applicational synchronicity in the network thanks to distributed clocks according to IEEE 1588

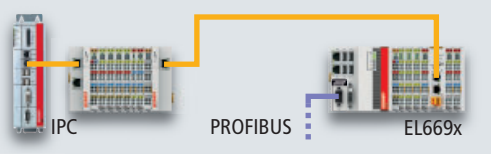
	IEEE 1588 external synchronisation interface
Technical data	**EL6688**
Ethernet interface	10BASE-T/100BASE-TX Ethernet with 1 x RJ45
Data transfer rates	10/100 Mbit/s, IEEE 802.3u auto-negotiation, half or full duplex at 10 and 100 Mbit/s possible, automatic settings
Cable length	up to 100 m twisted pair
	
	The EL6688 EtherCAT Terminal is a device in the IEEE 1588 synchronisation system that supports the Ethernet-based precision time protocols PTPv1 (IEEE 1588-2002) and PTPv2 (IEEE 1588-2008). On the one hand, the EL6688 is an IEEE 1588 clock (master or slave), which is synchronised within the scope of the protocol accuracy. On the other hand, it is synchronised by the EtherCAT master as an EtherCAT Terminal in the distributed clocks system, or it provides the reference clock for the EtherCAT system. To do this, it only needs to be selected as the "reference clock" in the TwinCAT System Manager. This way, a consistent timebase can be created across applications for any number of spatially separated TwinCAT EtherCAT systems and machine sections, e.g. for applications with axes or measurement technology. The compact EtherCAT Terminal enables flexible deployment depending on the application requirements.
Protocol	PTPv1 (IEEE 1588-2002), PTPv2 (IEEE 1588-2008)
Current consumption power contacts	–
Current consumption E-bus	typ. 310 mA
Distributed clocks	yes
Cable length	up to 100 m twisted pair
Special features	usable in TwinCAT as a reference clock
Operating temperature	0…+55 °C
Approvals	CE, UL, Ex
Weight	approx. 75 g
Further information	www.beckhoff.com/EL6688

Communication | **EtherCAT bridge terminals**

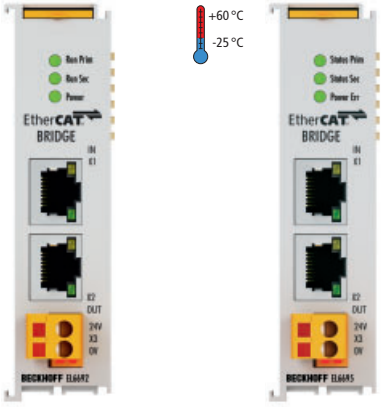
The slaves within an EtherCAT system are synchronised by the distributed clocks system. In each slave capable of doing so, a local clock triggers the reading in of inputs and the output of outputs synchronously with all other slaves. A slave represents the reference clock, according to which the EtherCAT master/TwinCAT synchronises all other slaves. For event logging and axis synchronisation, the synchronous operation of several EtherCAT systems is useful. The EL669x, which serves as a crossover point between two EtherCAT systems, can be used for interconnection: it is an EtherCAT Terminal on the so-called primary side and an EtherCAT slave with an RJ45 connection on the so-called secondary side. The direction of the time synchronisation is selectable. TwinCAT can use this terminal as the reference clock in the synchronised system; this way, the entire lower-level system is operated synchronously with the primary system. With the same cycle times, both real-time tasks then work synchronously in TwinCAT.

The power supply for the secondary side (RJ45) of the EL6695 is via an external connection, the primary side is supplied via the E-bus. The bridge terminal can also be used for integrating a subordinate PC system as an EtherCAT slave.





Example topologies EL669x

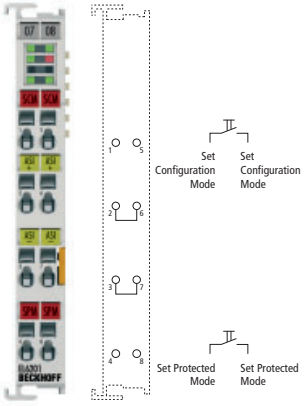
	EtherCAT bridge terminal	EtherCAT bridge terminal
Technical data	**EL6692**	**EL6695**
Technology	primary side: E-bus (terminal strand), secondary side: 2 x 100 Mbit/s Ethernet, RJ45, In/Out	
Function	EtherCAT distributed clock synchronisation, data exchange	
	 The EL6692 and EL6695 are EtherCAT bridge terminals with different performance levels for the synchronous and asynchronous data transmission between two EtherCAT systems. The EL6695 differs from the EL6692 in a flexible CoE configuration, the possibility for device emulation and significantly higher data throughput rates. Apart from that, a reconfigurable partial transmission of the PDO can be offered through selective PDO mapping. Especially with modular or changing machine concepts this is a helpful function.	
Nominal voltage	24 V DC (secondary side)	24 V DC (secondary side)
Current consumption power contacts	–	–
Current consumption E-bus	E-bus: 120 mA, external: 60 mA/24 V typ.	E-bus: typ. 400 mA, external: 80 mA/24 V typ.
Distributed clocks	yes	yes
Power supply	primary: via the E-bus, secondary: via connector	primary: via the E-bus, secondary: via connector, 24 V
Cyclic process data per direction	max. 480 byte	max. 1400 byte
Special features	usable in TwinCAT as a reference clock, supports ADS over EtherCAT (AoE)	usable in TwinCAT as a reference clock, synchronous data exchange, flexible PDO mapping, supports AoE, EoE, FoE, VoE
Operating temperature	-25…+60 °C	0…+55 °C
Approvals	CE, UL, Ex	CE, UL
Weight	approx. 85 g	approx. 85 g
Further information	www.beckhoff.com/EL6692	www.beckhoff.com/EL6695

Communication | **AS-Interface master terminal**

The AS-Interface (AS-i = Actuator Sensor interface) is a fieldbus communication method for actuators and sensors. The master cyclically transmits telegrams to the individual slaves via a 2-core yellow ribbon cable, which serves at the same time for the 24 V power supply. Up to 62 slaves with a total of 496 inputs and 496 outputs are supported, depending on the protocol.

AS-Interface potential feed terminal
EL9520 see page 446

AS-Interface master terminal

Technical data	**EL6201** | ES6201
Technology	AS-Interface master terminal (M3, M4)
Specification version	AS-Interface V 2.0, V 2.11, V 3.0 (Rev. 4)
AS-Interface slaves	31 for V 2.0, 62 for V 2.1
Number of channels	1 (AS-Interface channel)
	 The EL6201 AS-Interface master terminal enables the direct connection of AS-Interface slaves. The AS-Interface compliant interface supports digital and analog slaves, versions 3.0 (master profile M3, M4). The connected devices are supplied via the EL9520 AS-Interface potential feed terminal with integrated filter.
Slave types	standard: digital and analog, extended: type 1 (CTT1): S-7.3, S-7.4, type 2 (CTT2): S-7.5.5, S-7.A.5, S-B.A.5, type 3 (CTT3): S-7.A.7, S-7.A.A, type 4 (CTT4): S-7.A.8, S-7.A.9, type 5 (CTT5): S-6.0, safety at work: S-0.B, S-7.B
Cycle time	max. 5 ms (at 31 or 62 slaves)
Current consumption power contacts	–
Current consumption	120 mA (E-Bus), typ. 40 mA/max. 60 mA (AS-Interface)
Distributed clocks	–
AS-Interface certificate	yes, ZU-No. 97701
AS-Interface diagnostics	power failure, slave failure, parameterisation error
Operating temperature	0…+55 °C
Approvals	CE
Weight	approx. 55 g
Further information	www.beckhoff.com/EL6201

Communication | IO-Link terminal

The EL6224 IO-Link terminal enables connection of up to four IO-Link devices, e.g. actuators, sensors or combinations of both. A point-to-point connection is used between the terminal and the device. The terminal is parameterised via the EtherCAT master. IO-Link is designed as an intelligent link between the fieldbus level and the sensor, allowing parameterisation information to be exchanged bidirectionally via the IO-Link connection. The parameterisation of the IO-Link devices with service data can be done from TwinCAT via ADS or very conveniently via the integrated IO-Link configuration tool.

In the standard setting, the EL6224 functions as a 4-channel input terminal, 24 V DC, which communicates with connected IO-Link devices, parameterises them and, if necessary, changes their operating mode.

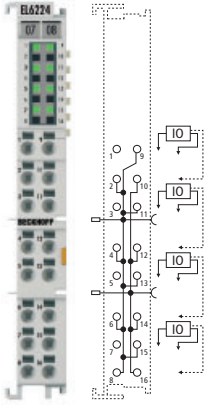
Integration into the HD housing with 16 connection points enables each IO-Link device to be operated in 3-wire connection mode.

Additional 24 V and 0 V connection points can be realised via the EL918x potential distributor terminal.

IO-Link

4-channel input/output,
IO-Link master terminal

Technical data	EL6224
Technology	IO-Link input/output
Specification version	IO-Link V1.1
Data transfer rates	4.8 kbaud, 38.4 kbaud and 230.4 kbaud
Number of channels	4 IO-Link interfaces



25 g

Supply current for devices	500 mA per device
Current consumption power contacts	typ. 20 mA + load
Current consumption E-bus	typ. 120 mA
Distributed clocks	–
Cable length	max. 20 m
Special features	each channel parameterisable in TwinCAT
Operating temperature	0…+55 °C
Approvals	CE, UL, Ex
Weight	approx. 60 g
Further information	www.beckhoff.com/EL6224
Special terminals	i EL6224-0090
Distinguishing features	TwinSAFE SC 324

i For availability status see Beckhoff website at: www.beckhoff.com/EL6224-0090

Communication | **PROFINET controller/device**

The EL6631 PROFINET RT controller (master) terminal supports the complete real-time function (RT) as well as extensive diagnostic possibilities. All services according to conformance class B are supported. Up to 15 PROFINET RT devices can be projected on the EL6631.

The EL6631-0010 PROFINET RT device (slave) terminal enables the simple exchange of data between EtherCAT and the PROFINET RT controllers. Within the EtherCAT strand it represents a slave that can consist of up to 65,535 devices. The EL6631-0010 contains a 3-port switch; two of these ports are fed externally to RJ45 sockets. This allows the construction of the I/O stations as a line topology, thus reducing wiring. The maximum distance between two devices is 100 m.

Protocols such as LLDP or SNMP can be used for network diagnostics.

The EL6632 PROFINET IRT Controller Terminal supports the complete RT (real-time) or IRT (isochronous real-time) function as well as providing extensive diagnostic options.

All services in accordance with Conformance Class C are supported. Depending on the cycle time, up to five PROFINET IRT or up to 15 PROFINET RT devices can be operated at the EL6632 in a line topology. The maximum distance between two devices is 100 m. Protocols such as LLDP or SNMP can be used for network diagnostics.

	PROFINET RT controller/device, 2 ports, internal switch	PROFINET IRT controller, 2 ports, internal switch
Technical data	**EL6631**	**i EL6632**
Technology	PROFINET RT	PROFINET IRT
Ethernet interface	100BASE-TX Ethernet with 2 x RJ45	
		
Protocol	RT	RT or IRT
Current consumption power contacts	–	–
Current consumption E-bus	typ. 400 mA	typ. 400 mA
Distributed clocks	–	–
Cable length	up to 100 m twisted pair	up to 100 m twisted pair
Special features	LLDP, SNMP, Conformance Class B, max. 15 RT devices, min. 1 ms RT cycle	Conformance Class C, max. 5 IRT devices, max. 15 RT devices, min. 500 µs IRT cycle, min. 1 ms RT cycle
Operating temperature	0…+55 °C (see documentation)	0…+55 °C (see documentation)
Approvals	CE, UL, Ex	CE, UL, Ex
Weight	approx. 75 g	approx. 75 g
Further information	www.beckhoff.com/EL6631	www.beckhoff.com/EL6632
Special terminals	**EL6631-0010**	
Distinguishing features	PROFINET RT device	

i For availability status see Beckhoff website at: www.beckhoff.com/EL6632

Communication | **EtherNet/IP master/slave terminal**

The EL6652 EtherNet/IP master terminal and the EL6652-0010 EtherNet/IP slave terminal have a switched 2-port Ethernet connection and can thus be operated in a line with further Ethernet/IP nodes. The process data are configured by an EtherCAT master, allowing different process data and different sizes.

The EL6652 and EL6652-0010 support both multicast and unicast connections. With the EL6652, up to 16 simple EtherNet/IP slave devices can be connected via one generic node. The EL6652-0010 is optionally available for connecting EtherCAT with an EtherNet/IP master.

EtherNet/IP

EtherNet/IP master/slave terminal,
2 x RJ45 switch

Technical data	EL6652	EL6652-0010
Technology	EtherNet/IP master terminal	EtherNet/IP slave terminal
Ethernet interface	100BASE-TX Ethernet with 2 x RJ45	

Protocol	EtherNet/IP	EtherNet/IP slave
Number of possible slave devices	max. 16 slave nodes	–
Current consumption power contacts	–	
Current consumption E-bus	typ. 400 mA	
Distributed clocks	–	
Cable length	up to 100 m twisted pair	
Special features	multicast/unicast connection	
Operating temperature	0…+55 °C (see documentation)	
Approvals	CE, UL	
Weight	approx. 75 g	
Further information	www.beckhoff.com/EL6652	

Communication | **PROFIBUS master/slave terminal**

The EL6731 PROFIBUS master terminal corresponds to the FC3101 PROFIBUS PCI card. Connection via EtherCAT allows PCI slots in the PC to be dispensed with; instead, any desired number of PROFIBUS master terminals (EL6731) or slave terminals (EL6731-0010) can be used in the field. This reduces cabling and facilitates the connection of existing fieldbus installations to the high-performance EtherCAT fieldbus.

The terminal can handle the PROFIBUS protocol with all features and enables the integration of arbitrary PROFIBUS devices in the EtherCAT Terminal network. The terminal has a PROFIBUS chip with the latest PROFIBUS technology – including a high-precision isochronous mode for axis control and advanced diagnostic options.

The EL6731 allows the operation of PROFIBUS slaves with different polling rates and is distinguished by the following characteristics:

- Cycle times from 200 µs are possible.
- PROFIBUS DP, PROFIBUS DP-V1, PROFIBUS DP-V2
- master and slave monitor up to 12 Mbit/s
- powerful parameter and diagnostics interfaces
- The error management for each bus user is freely configurable.
- It is possible to read the bus configuration and automatically assign the "GSD" files.

PROFIBUS master/slave terminal

Technical data	EL6731	EL6731-0010
Technology	PROFIBUS master terminal	PROFIBUS slave terminal
Data transfer rates	9.6 kbaud…12 Mbaud	
Interfaces	1 x D-sub socket, 9-pin, galvanically decoupled	
Number of channels	1	
	 	
Fieldbus	PROFIBUS DP (standard), PROFIBUS DP-V1 (Cl. 1+2: acyclic services, alarms), DP-V2, PROFIBUS MC (equidistant)	
Cycle time	differing DP cycle times per slave are possible using the CDL concept	
Current consumption power contacts	–	
Current consumption E-bus	typ. 350 mA	
Distributed clocks	yes	–
Bus device	max. 125 slaves with up to 244 bytes input, output, parameter, configuration or diagnostic data per slave	
Special features	status LEDs, total max. 7 kbyte input and output data	
Operating temperature	-25…+60 °C	
Approvals	CE, UL, Ex	
Weight	approx. 70 g	
Further information	www.beckhoff.com/EL6731	

Communication | CANopen master/slave terminal

The EL6751 CANopen master terminal corresponds to the FC5101 CANopen PCI card. Connection via EtherCAT allows PCI slots in the PC to be dispensed with; instead, any desired number of CANopen master or slave terminals can be used in the field.
The EL6751 enables the integration of arbitrary CANopen devices in the EtherCAT Terminal network. It is alternatively available as a master (EL6751) or slave (EL6751-0010). In addition, general CAN messages can be sent or received – without having to bother with CAN frames in the applications program. The terminal has a powerful protocol implementation with many features:

- support for all CANopen PDO communication modes: event-controlled, time-controlled (event timer), synchronous, polling
- synchronisation with the task cycle of the PC controller
- SYNC cycle with quartz precision for drive synchronisation, zero cumulative jitter
- parameter communication (SDO) at start-up and when running
- emergency message handling, guarding and heartbeat
- powerful parameter and diagnostics interfaces
- online bus load display

CANopen

CANopen master/slave terminal

Technical data	EL6751	EL6751-0010
Technology	CANopen master terminal	CANopen slave terminal
Data transfer rates	10, 20, 50, 100, 125, 250, 500, 800, 1000 kbaud	
Interfaces	D-sub connector, 9-pin according to CANopen specification, galvanically decoupled	
Number of channels	1	

Fieldbus	CANopen	
Current consumption power contacts	–	
Current consumption E-bus	typ. 300 mA	
Distributed clocks	–	
Bus device	max. 127 slaves	–
Special features	status LEDs, CANopen network master, CANopen Manager, supports RAW-CAN	status LEDs, CANopen slave
Operating temperature	-25…+60 °C	
Approvals	CE, UL, Ex	
Weight	approx. 70 g	
Further information	www.beckhoff.com/EL6751	

Communication | DeviceNet master/slave terminal

The EL6752 DeviceNet master terminal corresponds to the FC5201 DeviceNet PCI card. Connection via EtherCAT allows PCI slots in the PC to be dispensed with; instead, any desired number of DeviceNet master or slave terminals can be used in the field. The EL6752 allows the integration of arbitrary DeviceNet devices in the EtherCAT Terminal network. It is alternatively available as a master (EL6752) or slave (EL6752-0010). The DeviceNet terminal has a powerful protocol implementation with many features:

- support of all DeviceNet I/O modes: polling, change of state, cyclic, strobed
- Unconnected Message Manager (UCMM)
- offline connection set, Device Heartbeat Messages, Device Shutdown Messages
- Auto Device Replacement (ADR)
- powerful parameter and diagnostics interfaces
- The error management for each bus user is freely configurable.

DeviceNet

DeviceNet master/slave terminal

Technical data	EL6752	EL6752-0010
Technology	DeviceNet master terminal	DeviceNet slave terminal
Data transfer rates	125, 250, 500 kbaud	
Interfaces	open style connector, 5-pin, according to DeviceNet specification, galvanically decoupled (Connector is supplied.)	
Number of channels	1	

Fieldbus	DeviceNet
Current consumption power contacts	–
Current consumption E-bus	typ. 260 mA
Distributed clocks	–
Bus device	max. 63 slaves
Special features	DeviceNet scanner
Operating temperature	-25…+60 °C
Approvals	CE, UL, Ex
Weight	approx. 70 g
Further information	www.beckhoff.com/EL6752

Communication | Lightbus master/Interbus slave terminal

Lightbus
The EL6720 Lightbus master terminal enables the connection to Lightbus devices just as the Beckhoff FC2001 Lightbus PCI card. Due to the connection via EtherCAT, no PCI slots are required in the PC. The terminal controls the Lightbus protocol with all its features. Within an EtherCAT Terminal network, the EL6720 enables the integration of any Lightbus slaves. The terminal has a powerful protocol implementation with many features:

- Cycle times up to 100 µs are possible.
- Process data communication can either be free running or synchronised.
- powerful parameter and diagnostics interfaces (ADS)

Lightbus accessories see page 800

Interbus
Interbus is a ring system, i.e. all devices are actively integrated into a closed transmission path. Each device regenerates the incoming signal and passes it on. In the Interbus system, both the data line and the return line are fed through all devices inside one cable. This results in the physical appearance of a line or tree structure. The master-slave system allows the connection of a maximum of 512 devices, which form the structure of a spatially distributed shift register. Each device, with its registers of different lengths, is part of the shift register ring. The master pushes data through the ring serially. Due to the point-to-point connection method, termination resistors do not have to be installed.

The EL6740-0010 Interbus slave terminal enables data exchange between EtherCAT and Interbus. For both bus systems the terminal "mirrors" up to 32 word input and 32 word output to the respective other system. The outputs are written to the inputs of the other bus with minimum delay. The terminal can use the Interbus protocol up to a baud rate of 2 Mbits. Due to the connection via EtherCAT, no PCI slots are required in the PC.

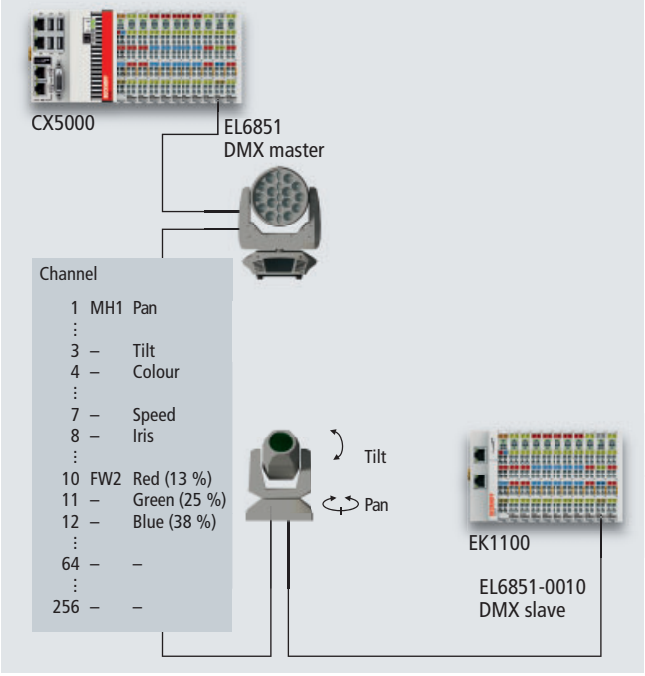
LIGHTBUS / INTERBUS	Lightbus master terminal	Interbus slave terminal
Technical data	**EL6720**	**EL6740-0010**
Technology	Lightbus master terminal	Interbus slave terminal
Data transfer rates	2.5 Mbaud	500 kbits, 2 Mbits (default)
Interfaces	2 x fibre optic standard connector Z1000 (plastic fibre), Z1010 (HCS fibre)	2 x D-sub plug, 9-pin, plug and socket with screening and vibration lock
Number of channels	1	1
		
Fieldbus	Lightbus	Interbus, max. 400 m between 2 stations at 500 kbit/s
Type of connection	fibre optic standard connector	only remote bus
Current consumption power contacts	–	–
Current consumption E-bus	typ. 240 mA	typ. 450 mA
Distributed clocks	–	–
Bus device	max. 254 nodes with a max. of 65,280 I/O points per fieldbus connection	–
Special features	3 priority-controlled logical communication channels	status LEDs
Operating temperature	0…+55 °C	0…+55 °C
Approvals	CE, UL, Ex	CE, UL, Ex
Weight	approx. 70 g	approx. 80 g
Further information	www.beckhoff.com/EL6720	www.beckhoff.com/EL6740

Communication | DMX master/slave terminal

DMX is the standard protocol for controlling professional stage and effect lighting equipment, which is used, for example, for the dynamic lighting of showrooms and salesrooms as well as for exclusive displays of light and colour in high-profile buildings, such as hotels and event centres. For static DMX light sources (e.g. spotlights), colour mixing and brightness values are transmitted, while moving DMX light sources (e.g. moving heads and scanners) receive additional spatial coordinates. The high data transfer rate of EtherCAT permits higher update rates of light settings, resulting in more harmonious changes of light and colour as perceived by the human eye.

The EL6851 DMX master terminal allows the direct connection of up to 32 DMX devices and supports the transmission of the full DMX protocol width of 512 bytes in just one control cycle using EtherCAT. This way, random devices, such as scanners, moving heads or spotlights can be controlled (see illustration below).

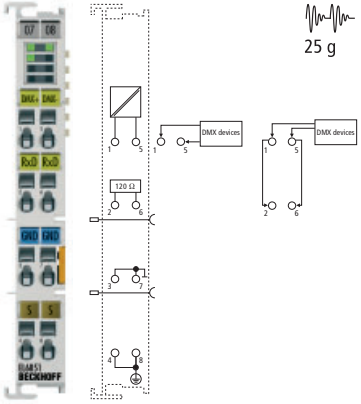
The EL6851-0010 DMX slave terminal acts as a link to the DMX world and enables professional stage and effect lighting to be implemented in conjunction with standard hardware. It takes on the information from the DMX master for the assigned automation equipment. This way, theatre and show stages can be constructed with standard hardware at reduced cost, but with full flexibility. The data from the DMX telegram are output on simple digital outputs, stepper motors or dimmer terminals. Furthermore, it is possible to transmit the DMX data to a DALI network and in this way to indirectly operate DALI ballasts with DMX.



DMX

DMX master/slave terminal

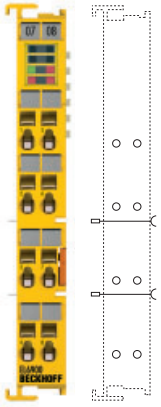
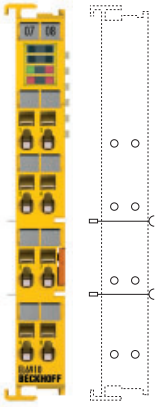
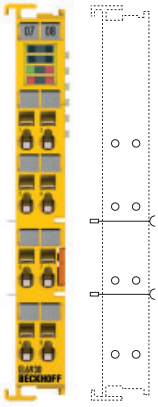
Technical data	EL6851	EL6851-0010
Technology	DMX master terminal	DMX slave terminal
Data transfer rates	250 kbit, one start bit, two stop bits	
Interfaces	RS485, termination resistor can be switched, half duplex	
Number of channels	1	



The EL6851 EtherCAT Terminal is a DMX master terminal and enables connection of up to 32 devices without repeater. The DMX master terminal can send up to 512 bytes of data. At 250 kbit/s a maximum data rate of 44 kHz is thus possible.

Data length	max. 512 bytes	
Protocol	DMX512	
Current consumption power contacts	–	
Current consumption E-bus	typ. 130 mA	
Distributed clocks	–	
Bus device	max. 32 without repeater	–
Line impedance	120 Ω	
Special features	supports RDM protocol, library available; electrically isolated	start address and data length can be set
Operating temperature	0…+55 °C	
Approvals	CE, UL, Ex	
Weight	approx. 55 g	
Further information	www.beckhoff.com/EL6851	

Communication | **TwinSAFE, PROFIsafe**

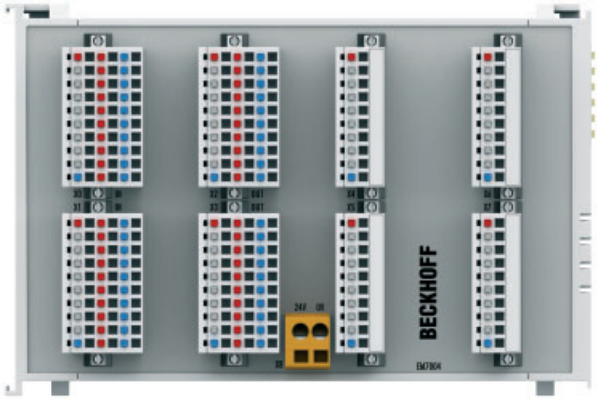
	TwinSAFE Logic	TwinSAFE Logic	TwinSAFE/PROFIsafe logic and gateway terminal
Technical data	**EL6900**	**i EL6910**	**EL6930**
Technology	TwinSAFE Logic		TwinSAFE/PROFIsafe logic and gateway terminal
Safety standard	DIN EN ISO 13849-1:2008 (Cat 4, PL e) and IEC 61508:2010 (SIL 3)		
	 The TwinSAFE Logic can establish 128 connections to other TwinSAFE devices.	 The TwinSAFE Logic can establish 212 connections to other TwinSAFE devices.	 The EL6930 logic terminal can establish 127 connections to other TwinSAFE/Safety over EtherCAT devices and one PROFIsafe slave connection to a PROFIsafe master.
Protocol	TwinSAFE/Safety over EtherCAT	TwinSAFE/Safety over EtherCAT	TwinSAFE/Safety over EtherCAT, PROFIsafe
Nominal voltage	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)
Current consumption power contacts	–	–	–
Current consumption E-bus	approx. 188 mA	approx. 160 mA	approx. 188 mA
Cycle time	500 µs…~25 ms	500 µs…~10 ms	500 µs…~25 ms
Fault response time	≤ watchdog time (parameterisable)	≤ watchdog time (parameterisable)	≤ watchdog time (parameterisable)
Special features	backup restore	backup restore	1 PROFIsafe slave connection
Operating/storage temperature	-25…+55 °C/-40…+70 °C	-25…+55 °C/-40…+70 °C	-25…+55 °C/-40…+70 °C
Approvals	CE, UL, Ex, TÜV SÜD	CE, UL	CE, TÜV SÜD
Weight	approx. 50 g	approx. 50 g	approx. 50 g
Further information	www.beckhoff.com/EL6900	www.beckhoff.com/EL6910	www.beckhoff.com/EL6930

For TwinSAFE products and further information on the TwinSAFE technology see page 1044

i For availability status see Beckhoff website at: www.beckhoff.com/EL6910

Motion | 4-axis interface

The EM7004 interface module is designed for direct connection of servo drives with ±10 V DC interface and incremental encoder output for position feedback and represents a cost-effective solution for drives in the lower and medium speed range. The individual servo interfaces are electrically isolated from each other. The analog I/Os and the incremental encoder connections have a common reference potential. Further digital inputs and outputs turn the compact module into a complete – and sole – link between the control and application level. Internal preprocessing of the signals enables users to modify outputs with short reaction times, depending on the position.

	4-axis interface
Technical data	**EM7004**
Technology	4-axis interface
Number of channels	4 encoder inputs, 4 analog outputs, 16 digital inputs and 16 digital outputs
Cycle time	min. 1 ms
	 The EM7004 module is available with different connectors: EM7004-0000 without connectors EM7004-0002 4 x ZS2001-0002 (1-wire, LED), 4 x ZS2001-0005 (1-wire, LED) EM7004-0004 4 x ZS2001-0005 (1-wire), 4 x ZS2001-0004 (3-wire, LED) Plug X8 is included in the scope of supply.
Nominal voltage	24 V DC (-15 %/+20 %)
Current consumption power contacts	– (no power contacts)
Current consumption E-bus	typ. 280 mA
Distributed clocks	–
Digital inputs	16 x 24 V DC
Digital outputs	16 (8 x 0.5 A, 8 x 1.5 A), 24 V DC
Analog outputs	4 x ±10 V (2 mA)
Encoder inputs	4 x (A, /A, B, /B, gate, latch, ground); A B – isolated RS485 inputs (RS422); 4 x 16 bit quadrature encoder; < 400 kHz
Special features	outputs switchable in relation to counter states, user scaling parameterisable, watchdog parameterisable
Operating temperature	0…+55 °C
Approvals	CE
Weight	approx. 260 g
Further information	www.beckhoff.com/EM7004

Motion | Stepper motor terminals

Stepper motors are often used in positioning drives. They allow, by the combination of single steps, a positioning process without feedback of the rotor positions. This "open control chain" mode of operation and the longevity of a stepper motor are particularly interesting for price-sensitive fields of application.

In contrast with a DC motor the control of a stepper motor is carried out by the different energisation of the individual motor windings following a defined pattern of pulses. The electromagnetic field of the stator is switched intermittently so that the shaft turns through the step angle α. The motor follows the impulse pattern of the control unit, until the coupled momentum exceeds its holding momentum or the impulse demand is too dynamic, which leads to standstill of the motor. The EL703x and EL704x EtherCAT stepper motor terminals, which are suitable for highly dynamic movement, solve this problem also in areas of higher speeds of rotation.

The EL703x and EL704x stepper motor terminals are designed for direct connection of medium capacity stepper motors. A high frequency clocked PWM output stage regulates the currents through the motor coils.

The stepper motor terminals are synchronised with the motor by parameterising. Unipolar as well as bipolar stepper motors can be driven. Additional inputs support functions like homing and final position monitoring. 64-fold micro stepping ensures particularly quiet and precise motor operation even with standard technology. Together with a stepper motor, the stepper motor terminals represent an inexpensive small servo axis. The EL7037 and EL704x also include an incremental encoder interface to read position data.

The stepper motor terminals can be controlled like a servo drive by a speed interface from a Motion Control software such as TwinCAT for example. In applications with a less complex and less powerful CPU the control is also possible via a position interface (travel distance control). The stepper motor terminals move the motor themselves to a desired position. Ramp steepness and maximum speed can be entered as parameters.

Irregular operation at certain speed ranges with standard technology, particularly without coupled load, indicates that the stepper motor is being run at its resonance frequency. Under certain circumstances the motor may even stop. Resonances in the lower frequency range essentially result from the mechanical motor parameters. Apart from their impact on smooth running, such resonances can lead to significant loss of torque, or even loss of step of the motor, and are therefore particularly undesirable. The EL7041-1000 special version is particularly well suited for such low-mass and therefore resonance-critical applications and it is compatible to the KL2541.

In combination with the Beckhoff stepper motor series ASxxxx, the EL7037 and EL7047 EtherCAT Terminals support vector control. The advantages of this operating mode are:

- low power consumption (almost entirely load-dependent)
- high efficiency
- consistent dynamics compared with standard mode
- Step losses are inherently eliminated.

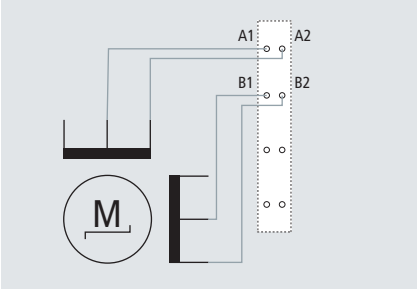
The EL703x stepper motor terminal is designed exclusively for 24 V supply voltage. The motor current can reach up to 1.5 A. The EL704x covers a supply voltage range from 8 V DC to 50 V DC and also needs a 24 V supply from the power contacts. The motor current can be set from 1 to 5 A.

The peak current may briefly significantly exceed the rated current and in this way makes the whole drive system very dynamic. In such dynamic applications, negative acceleration causes the feedback of energy, which leads to voltage peaks at the power supply unit. An EL9576 brake chopper terminal protects from the effects of overvoltage, in that it absorbs some of the energy. For voltage values exceeding the capacity of the terminal, an external resistor has to be connected to eliminate surplus energy.

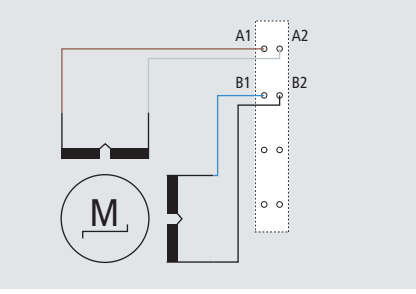
AS20xx | Stepper motors see page 933

AS10xx | Stepper motors see page 936

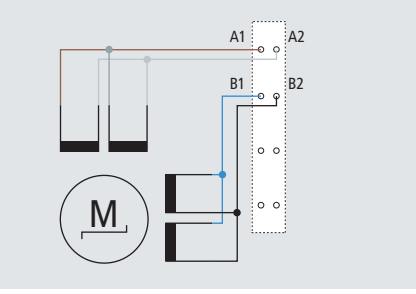
EL9576 | Brake chopper terminal see page 449



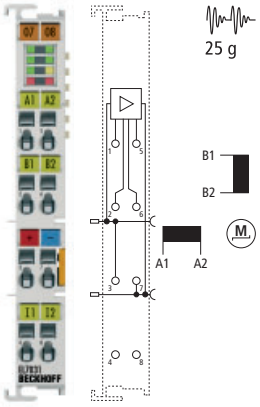
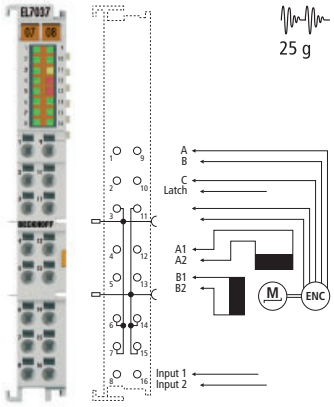
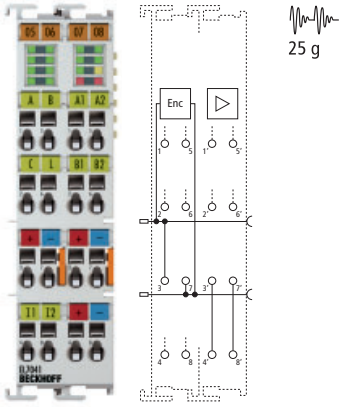
Connection of a unipolar stepper motor



Connection of a bipolar AS10xx stepper motor, serial



Connection of a bipolar AS10xx stepper motor, parallel

	Stepper motor terminal 24 V DC, 1.5 A	Stepper motor terminal 24 V DC, 1.5 A, with incremental encoder, vector control	Stepper motor terminal 50 V DC, 5 A, with incremental encoder	Stepper motor terminal 50 V DC, 5 A, with incremental encoder, vector control
Technical data	**EL7031** | ES7031	**EL7037**	**EL7041** | ES7041	**EL7047**
Technology	direct motor connection			
Load type	uni- or bipolar stepper motors			
Output current	max. 1.5 A (overload- and short-circuit-proof)		max. 5 A (overload- and short-circuit-proof)	
Number of channels	1 stepper motor, 2 digital inputs	1 stepper motor, encoder input, 2 digital inputs	1 stepper motor, encoder input, 2 digital inputs	
				
Nominal voltage	24 V DC (-15 %/+20 %)		8…50 V DC	
Current consumption power contacts	typ. 30 mA + motor current	typ. 50 mA	typ. 50 mA	
Current consumption E-bus	typ. 120 mA	typ. 100 mA	typ. 140 mA	typ. 100 mA
Distributed clocks	yes		yes	
Maximum step frequency	1000, 2000, 4000 or 8000 full steps/s (configurable)	1000, 2000, 4000, 8000 or 16,000 full steps/s (configurable)	1000, 2000, 4000 or 8000 full steps/s (configurable)	1000, 2000, 4000, 8000 or 16,000 full steps/s (configurable)
Step pattern	64-fold micro stepping		64-fold micro stepping	
Current controller frequency	approx. 25 kHz	approx. 30 kHz	approx. 30 kHz	
Control resolution	approx. 5000 positions in typ. applications (per revolution)		approx. 5000 positions in typ. applications (per revolution)	
Encoder input signal	–	5…24 V DC, 5 mA, single-ended	5…24 V DC, 5 mA, single-ended	
Pulse frequency	–	max. 400,000 increments/s (with 4-fold evaluation)	max. 400,000 increments/s (with 4-fold evaluation)	
Special features	travel distance control	travel distance control, encoder input, vector control	travel distance control, encoder input	travel distance control, encoder input, vector control
Weight	approx. 50 g		approx. 90 g	
Operating temperature	0…+55 °C		0…+55 °C	
Approvals	CE		CE, UL	CE
Further information	www.beckhoff.com/EL7031	www.beckhoff.com/EL7037	www.beckhoff.com/EL7041	www.beckhoff.com/EL7047
Special terminals			**EL7041-1000**	
Distinguishing features			for resonance-critical applications	

Motion | Servomotor terminals

The EL72xx servomotor terminals are complete servo drives for the direct control of servomotors in a standard HD (High Density) terminal housing. The fast control technology, based on field-oriented current and PI speed control, supports highly dynamic and frequently changing positioning tasks. The monitoring of important load criteria, which are derived from the calculation of an I^2T model, ensures maximum operational reliability.

For the feedback system there is a choice of either resolver feedback or else absolute feedback integrated in the motor cable by OCT (One Cable Technology). With OCT, the encoder signals are digitally transmitted via the existing motor cable, thus eliminating the need for an encoder cable.

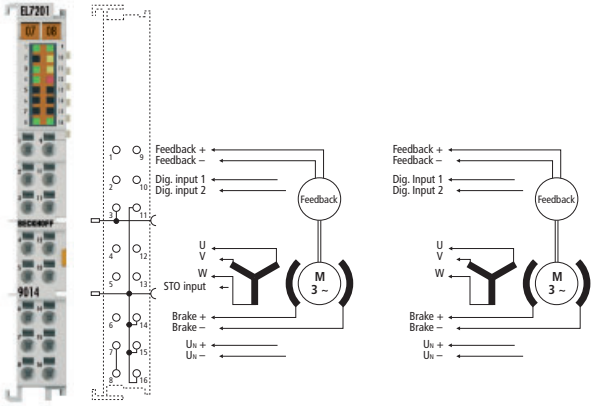
Since the servomotor terminals are completely integrated into the EtherCAT Terminal network, there is no wiring to the controller required; space requirements are significantly reduced. For highly dynamic applications and for supplying several servomotors from one power supply unit, the additional use of an EL9576 brake chopper terminal is recommended. It protects against overvoltage by absorbing part of the energy. The EL72xx terminals are tested and pre-parameterised for use with the AM81xx and AM31xx servomotor series. In combination with these motors, they enable highly dynamic, precise and compact drive applications.

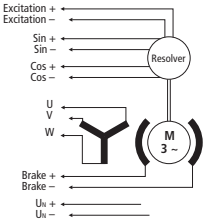
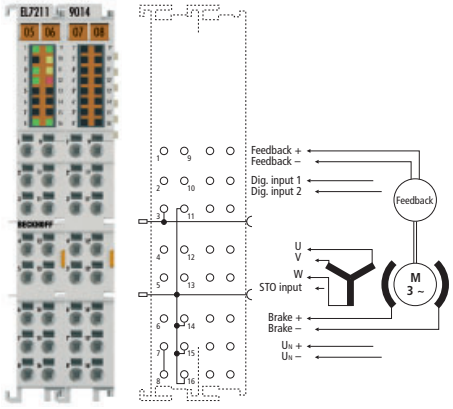
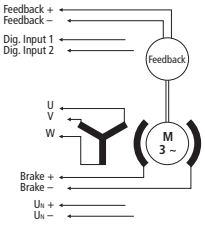
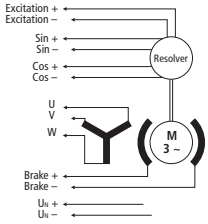
Moreover, the EL721x-9014 enable the user to implement STO (Safe Torque Off) safety functions corresponding to a Cat 3/PL d safety level according to DIN EN ISO 13849-1:2015.

AM81xx | Servomotors with OCT
see page 928

EL9576 | Brake chopper terminal
see page 449

ZB85xx | Shielding connection system
see page 846

	Servomotor terminal for OCT, with STO, 50 V DC, 2.8 A_{RMS}	Servomotor terminal for OCT, 50 V DC, 2.8 A_{RMS}
Technical data	**EL7201-9014**	**EL7201-0010**
Connection method	direct motor connection	
Load type	permanent-magnet synchronous motors	
Number of channels	1 servomotor, absolute feedback, motor brake, 2 digital inputs, 1 STO input	1 servomotor, absolute feedback, motor brake, 2 digital inputs
		
Nominal voltage	8…50 V DC	
Current consumption power contacts	typ. 50 mA + holding current motor brake	
Current consumption E-bus	120 mA	
Current controller frequency	32 kHz	
Output current I_N	2.8 A (rms)	
Peak current I_N	5.7 A (rms) for 1 s	
Frequency range	0…599 Hz	
PWM clock frequency	16 kHz	
Rated speed controller frequency	16 kHz	
Output voltage motor brake	24 V DC (+6 %/-10 %)	
Output current motor brake	max. 0.5 A	
Special features	compact (only 12 mm wide), system-integrated, absolute feedback, One Cable Technology (OCT), plug-and-play, STO (Safe Torque Off)	compact (only 12 mm wide), system-integrated, absolute feedback, One Cable Technology (OCT), plug-and-play
Weight	approx. 60 g	
Operating temperature	0…+55 °C	
Approvals	CE, TÜV SÜD	CE
Further information	www.beckhoff.com/EL7201-9014	www.beckhoff.com/EL7201-0010

	Servomotor terminal for resolver, 50 V DC, 2.8 A_{RMS}	Servomotor terminal for OCT, with STO, 50 V DC, 4.5 A_{RMS}	Servomotor terminal for OCT, 50 V DC, 4.5 A_{RMS}	Servomotor terminal for resolver, 50 V DC, 4.5 A_{RMS}
	EL7201	**EL7211-9014**	**EL7211-0010**	**EL7211**
	1 servomotor, resolver, motor brake	1 servomotor, absolute feedback, motor brake, 2 digital inputs, 1 STO input	1 servomotor, absolute feedback, motor brake, 2 digital inputs	1 servomotor, resolver, motor brake
	25 g 			25 g 
		8…50 V DC		
		typ. 50 mA + holding current motor brake		
		typ. 120 mA		
		32 kHz		
		4.5 A (rms)		
		9.0 A (rms) for 1 s		
		0…599 Hz		
		16 kHz		
		16 kHz		
		24 V DC (+6 %/-10 %)		
		max. 0.5 A		
	compact (only 12 mm wide), system-integrated	compact and system-integrated, absolute feedback, One Cable Technology (OCT), plug-and-play, STO (Safe Torque Off)	compact and system-integrated, absolute feedback, One Cable Technology (OCT), plug-and-play	compact and system-integrated
		approx. 95 g		
		0…+55 °C		
	CE	CE, TÜV SÜD	CE	CE
	www.beckhoff.com/EL7201	www.beckhoff.com/EL7211-9014	www.beckhoff.com/EL7211-0010	www.beckhoff.com/EL7211

Motion | 2-channel DC motor output stages

DC motors can replace the servomotors in many applications if they are operated with an intelligent controller. A DC motor can be integrated very simply into the control system using the EL7332 and EL7342 EtherCAT Terminals. All parameters are adjustable via the fieldbus. The small, compact design and DIN rail mounting make the EtherCAT DC motor output stages suitable for a wide range of applications. The output stages are protected against overload and short circuit and offer an integrated feedback system for incremental encoders on a case-by-case basis. Two DC motors can be controlled by one terminal.

Two areas of application are particularly well supported by the output stages:

– Simple controller for low demands on the cycle time at inexpensive processor power: by the use of the integrated travel distance control, the EL73x2 EtherCAT Terminal can perform positioning travels independently without the use of NC. Nothing further is required apart from a DC motor and a terminal.
– High-end positioning by means of integration in TwinCAT NC: in conjunction with the EtherCAT DC motor output stage, the DC motor is used with TwinCAT for the application without further changes – analogous to a servo-axis.

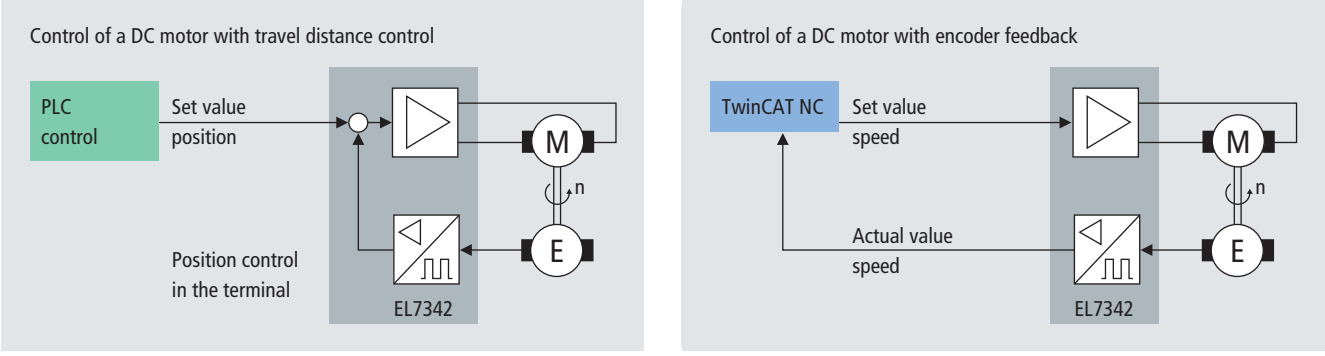
The control of a DC motor is simple to implement in comparison with other motors, since the speed of rotation is proportional to the voltage. It can be adjusted directly via the process data with the EL7332 and EL7342 EtherCAT Terminals. The integrated compensation of the internal resistance keeps the motor at the desired speed for load changes. Thus a simple drive task can be solved using a simple controller.

The EL7332 EtherCAT Terminal enables direct operation of two DC motors. It is electrically isolated from the E-bus. The speed is preset by a 16 bit value from the automation unit. The EtherCAT Terminal contains two channels whose signal state is indicated by LEDs. The LEDs enable quick local diagnosis.

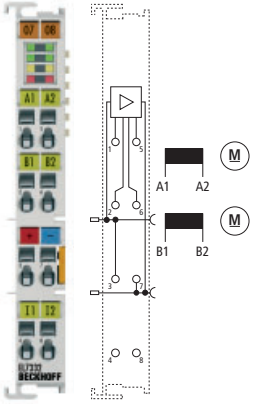
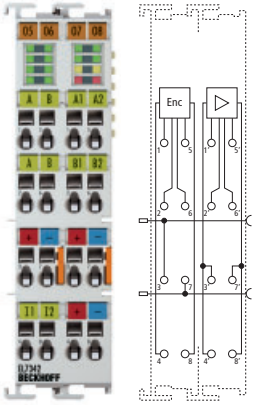
For demanding positioning tasks a closed speed control loop with a feedback system is needed. Apart from the operation of two DC motors, the EL7342 EtherCAT Terminal enables the connection of an incremental encoder. The control loop can be closed either by the EtherCAT Terminal itself or by higher-level controller (see illustration).

The peak current may briefly significantly exceed the rated current and in this way makes the whole drive system very dynamic. In such dynamic applications, negative acceleration causes the feedback of energy, which leads to voltage peaks at the power supply unit. The EL9576 brake chopper terminal protects from the effects of overvoltage, in that it absorbs some of the energy. If the voltage exceeds the capacity of the terminal, it gets rid of the excess energy via an external resistance.

EL9576 | Brake chopper terminal
see page 449



Realisation possibilities for position control loops

	2-channel DC motor output stage 24 V DC, 1.5 A	2-channel DC motor output stage 50 V DC, 3.5 A
Technical data	**EL7332** | ES7332	**EL7342** | ES7342
Technology	direct motor connection	
Load type	DC brush motors, inductive	
Output current	per channel max. 1 A	per channel max. 3,5 A
Number of channels	2 DC motors, 2 digital inputs	2 DC motors, 2 digital inputs, encoder input
	 25 g	
Nominal voltage	24 V DC (-15 %/+20 %)	8…50 V DC
Current consumption power contacts	typ. 40 mA + motor current	typ. 70 mA
Current consumption E-bus	typ. 140 mA	typ. 140 mA
Distributed clocks	yes	yes
PWM clock frequency	32 kHz with 180° phase shift each	32 kHz with 180° phase shift each
Duty factor	0…100 % (voltage-controlled)	0…100 % (voltage-controlled)
Control resolution	max. 10 bits current, 16 bits speed	max. 10 bits current, 16 bits speed
Encoder input signal	–	5…24 V, 5 mA, single-ended
Pulse frequency	–	max. 400,000 increments/s (with 4-fold evaluation)
Current consumption sensor supply	–	typ. 20 mA
Special features	travel distance control	travel distance control, encoder input
Operating temperature	0…+55 °C	0…+55 °C
Approvals	CE	CE, UL
Weight	approx. 50 g	approx. 90 g
Further information	www.beckhoff.com/EL7332	www.beckhoff.com/EL7342

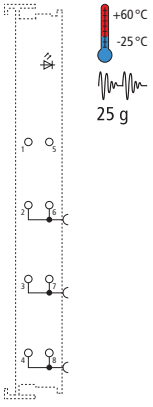
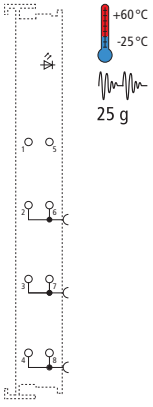
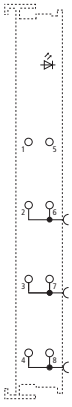
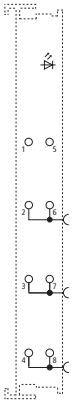
System terminals | **Function terminals**

The power feed terminals make it possible to set up various potential groups with any desired voltages (EL9190) or with the standard voltages of 24 V DC or 230 V AC (120 V AC). They are available with or without fine-wire fuse. In order to monitor the supply voltage, the terminals with diagnostics function report the status of the power feed terminal to the EtherCAT Coupler through two input bits. It is thus possible for the controller to check the distributed peripheral voltage over the fieldbus. The operating point performance conforms to the input terminals EL1002 (24 V) and EL1702 (230 V).

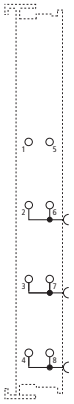
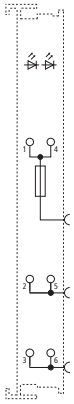
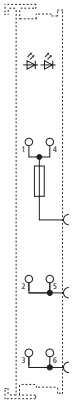
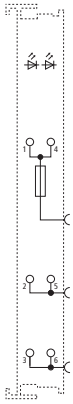
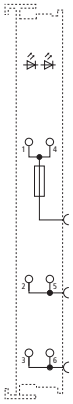
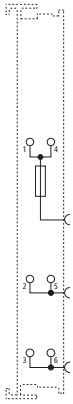
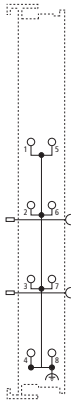
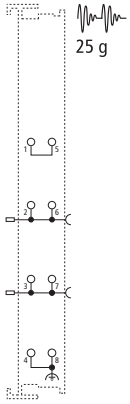
The EL9180, EL9185 and EL9195 EtherCAT Terminals allow the supply voltage to be accessed a number of times via spring force terminals. They make it unnecessary to use additional terminal blocks on the terminal strip.

The EL9195 or EL9070 EtherCAT Terminal can be used for the connection of screens. It connects the spring force contacts directly to the DIN rail and can optimally ground incoming electromagnetic radiation. The two power contacts are looped through by the EL9195, allowing two wires to be connected to each.

The EL9080 is used to identify potential groups (e.g. 230 V AC/ 24 V DC). It is inserted between two potential groups, and indicates the separation through an orange coloured cover.

	Potential supply terminal, 24 V DC	Potential supply terminal, 24 V DC, with diagnostics	Potential supply terminal, 120…230 V AC	Potential supply terminal, 120…230 V AC, with diagnostics
Technical data	**EL9100** | ES9100	**EL9110** | ES9110	**EL9150** | ES9150	**EL9160** | ES9160
Technology	potential supply terminal	potential supply terminal with diagnostics	potential supply terminal	potential supply terminal with diagnostics
Diagnostics in the process image	–	yes	–	yes
				
Nominal voltage	24 V DC	24 V DC	120 V AC/ 230 V AC	120 V AC/ 230 V AC
Integrated fine-wire fuse	–	–	–	–
Current load	≤ 10 A	≤ 10 A	≤ 10 A	≤ 10 A
Power LED	green	green	green	green
Defect LED	–	–	–	–
PE contact	yes	yes	yes	yes
Shield connection	–	–	–	–
Current consumption E-bus	–	typ. 90 mA	–	typ. 90 mA
Connection to DIN rail	–	–	–	–
Electrical isolation	yes	yes	yes	yes
Special features	–	–	–	–
Operating temperature	-25…+60 °C	-25…+60 °C	0…+55 °C	0…+55 °C
Approvals	CE, UL, Ex	CE, UL, Ex	CE, UL	CE, UL
Weight	approx. 50 g	approx. 50 g	approx. 50 g	approx. 50 g
Further information	www.beckhoff.com/EL9100	www.beckhoff.com/EL9110	www.beckhoff.com/EL9150	www.beckhoff.com/EL9160

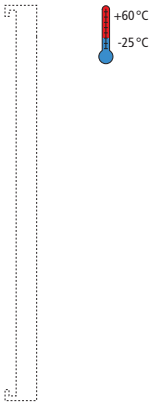
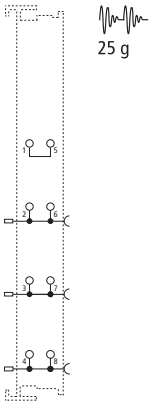
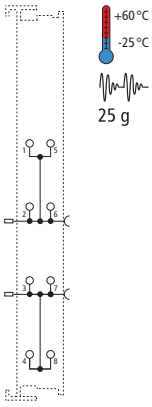
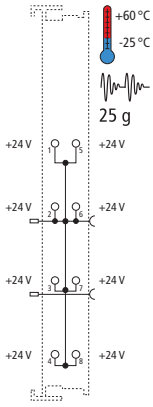
For availability status see Beckhoff website at: www.beckhoff.com

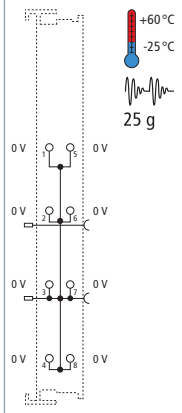
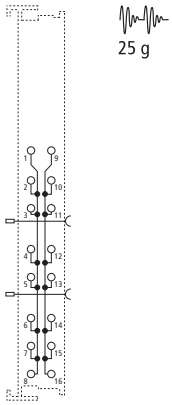
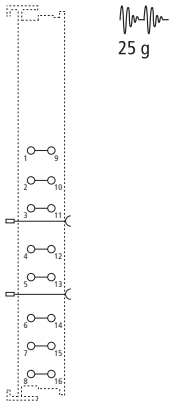
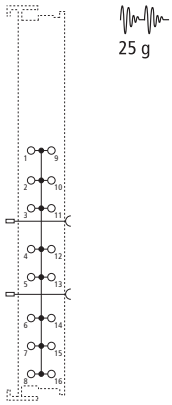
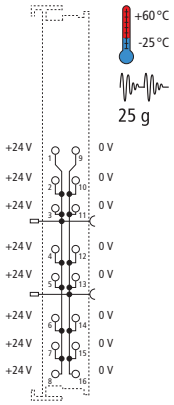
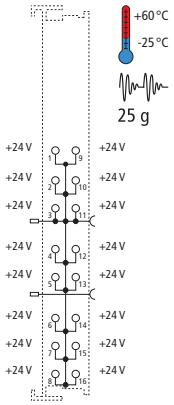
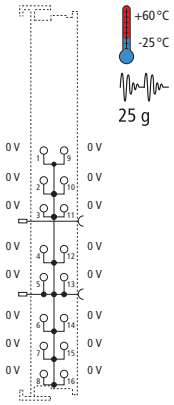
	Potential supply terminal, any voltage up to 230 V AC	Potential supply terminal, 24 V DC, with fuse	Potential supply terminal, 24 V DC, with diagnostics and fuse	Potential supply terminal, 120…230 V AC, with fuse	Potential supply terminal, 120…230 V AC, with diagnostics and fuse	Potential supply terminal, arbitrary, with fuse	Shield terminal	Shield terminal	Separation terminal
	EL9190 | ES9190	**EL9200**	**EL9210**	**i EL9250**	**i EL9260**	**i EL9290**	**EL9070**	**EL9195 | ES9195**	**EL9080**
	potential supply terminal	potential supply terminal with fuse	potential supply terminal with diagnostics and fuse	potential supply terminal with fuse	potential supply terminal with diagnostics and fuse	potential supply terminal with fuse	shield terminal		separation terminal
	–		yes	–	yes	–			
									
	arbitrary up to 230 V AC/DC	24 V DC	24 V DC	120 V AC/ 230 V AC	120 V AC/ 230 V AC	arbitrary up to 230 V AC/DC	arbitrary up to 230 V AC	arbitrary up to 230 V AC/DC	separation terminal
	–	…6.3 A	…6.3 A	…6.3 A	…6.3 A	…6.3 A	–	–	–
	≤ 10 A	≤ 10 A	≤ 10 A	≤ 10 A	≤ 10 A	≤ 10 A	≤ 10 A	≤ 10 A	≤ 10 A
	–	green	green	green	green	–	–	–	–
	–	red	red	red	red	–	–	–	–
	yes	yes	yes	yes	yes	yes	–	–	–
	–	–	–	–	–	–	8 x	2 x	–
	–	–	typ. 90 mA	–	typ. 90 mA	–	–	–	–
	–	–	–	–	–	–	yes	yes	–
	yes	yes	yes	yes	yes	yes	–	–	yes
	–	–	–	–	–	–	dissipation of EMC interference via large copper surfaces on the DIN rail	dissipation of EMC interference	placeholder terminal with E-bus transmission
	0…+55 °C	0…+55 °C	0…+55 °C	0…+55 °C	0…+55 °C	0…+55 °C	0…+55 °C	0…+55 °C	-25…+60 °C
	CE, UL	CE, UL, Ex	CE, UL, Ex	CE	CE	CE	CE, UL	CE, UL, Ex	CE, UL, Ex
	approx. 50 g	approx. 50 g	approx. 55 g	approx. 55 g	approx. 55 g	approx. 50 g	approx. 50 g	approx. 50 g	approx. 50 g
	www.beckhoff.com/EL9190	www.beckhoff.com/EL9200	www.beckhoff.com/EL9210	www.beckhoff.com/EL9250	www.beckhoff.com/EL9260	www.beckhoff.com/EL9290	www.beckhoff.com/EL9070	www.beckhoff.com/EL9195	www.beckhoff.com/EL9080

System terminals | **Function terminals**

The EL918x potential distribution terminals enable – depending upon the type – the distribution of ground or supply potentials to external devices. Wiring work and separate potential distributors are saved. Eight ground points are required for the ground connection of 8-channel output terminals in 2-wire operating mode, e.g. EL2008, for which the EL9187 can be used. The EL9184 and EL9188 HD EtherCAT Terminals (High Density) even make 16 connection points available in a compact housing.

Each assembly must be terminated at the right hand end with an EL9011 bus end cap.

	End cap	Potential distribution terminal, 2 terminal points per power contact	Potential distribution terminal, 4 terminal points at 2 power contacts	Potential distribution terminal, 8 x 24 V
Technical data	**EL9011**	**EL9180 |** ES9180	**EL9185 |** ES9185	**EL9186 |** ES9186
Technology	end cap	potential distribution terminal		
Diagnostics in the process image	–			
				
Nominal voltage	end cap	arbitrary up to 230 V AC/DC	arbitrary up to 230 V AC/DC	≤ 60 V
Integrated fine-wire fuse	–	–	–	–
Current load	≤ 10 A	≤ 10 A	≤ 10 A	≤ 10 A
Power LED	–	–	–	–
Defect LED	–	–	–	–
PE contact	–	yes	–	–
Shield connection	–	–	–	–
Current consumption E-bus	–	–	–	–
Electrical connection to DIN rail	–	–	–	–
Electrical isolation	yes	–	–	–
Special features	cover for the E-bus contacts	–	–	–
Operating temperature	-25…+60 °C	0…+55 °C	-25…+60 °C	-25…+60 °C
Approvals	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex
Weight	approx. 10 g	approx. 50 g	approx. 50 g	approx. 50 g
Further information	www.beckhoff.com/EL9011	www.beckhoff.com/EL9180	www.beckhoff.com/EL9185	www.beckhoff.com/EL9186

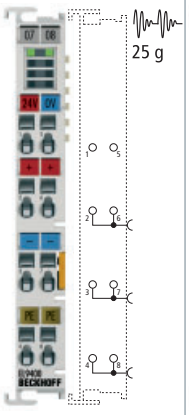
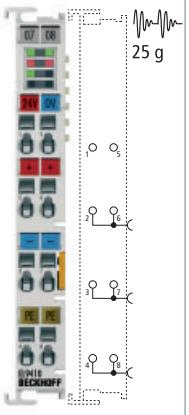
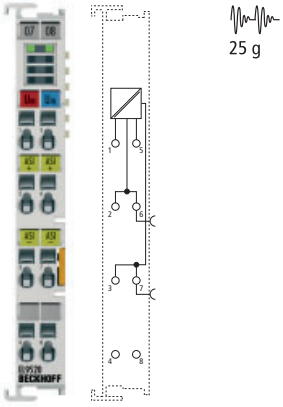
	Potential distribution terminal, 8 x 0 V	Potential distribution terminal, 2 x 8 terminal points	Potential distribution terminal, 8 x 2 terminal points	Potential distribution terminal, 1 x 16 terminal points	Potential distribution terminal, 8 x 24 V, 8 x 0 V	Potential distribution terminal, 16 x 24 V	Potential distribution terminal, 16 x 0 V
	EL9187 | ES9187	**EL9181**	**EL9182**	**EL9183**	**EL9184**	**EL9188**	**EL9189**
							
	≤ 60 V	≤ 60 V AC/DC	≤ 60 V AC/DC	≤ 60 V AC/DC	≤ 60 V	≤ 60 V	≤ 60 V
	–	–	–	–	–	–	–
	≤ 10 A	max. 10 A (per terminal point)	max. 10 A (per terminal point)	max. 10 A (per terminal point)	≤ 10 A	≤ 10 A	≤ 10 A
	–	–	–	–	–	–	–
	–	–	–	–	–	–	–
	–	–	–	–	–	–	–
	–	–	–	–	–	–	–
	–	–	–	–	–	–	–
	–	–	–	–	–	–	–
	–	500 V (E-bus/ field potential)	500 V (E-bus/ field potential)	500 V (E-bus/ field potential)	–	–	–
	–	2 x 8-way bridge	8 x 2-way bridge	16-way bridge	direct plug-in technique	direct plug-in technique	direct plug-in technique
	-25…+60 °C	0…+55 °C	0…+55 °C	0…+55 °C	-25…+60 °C	-25…+60 °C	-25…+60 °C
	CE, UL, Ex	CE, UL	CE, UL	CE, UL	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex
	approx. 50 g	approx. 60 g	approx. 60 g	approx. 60 g	approx. 60 g	approx. 60 g	approx. 60 g
	www.beckhoff.com/ EL9187	www.beckhoff.com/ EL9181	www.beckhoff.com/ EL9182	www.beckhoff.com/ EL9183	www.beckhoff.com/ EL9184	www.beckhoff.com/ EL9188	www.beckhoff.com/ EL9189

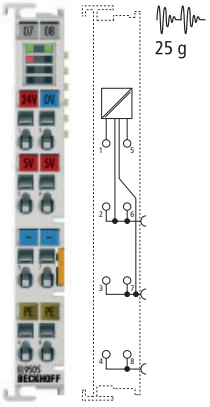
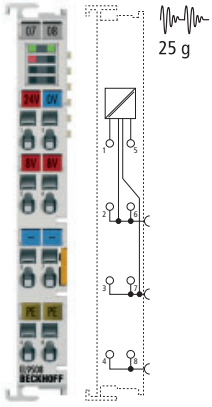
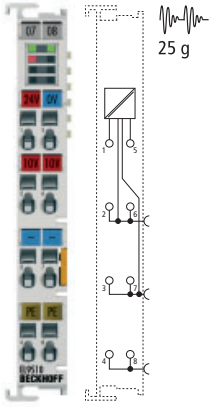
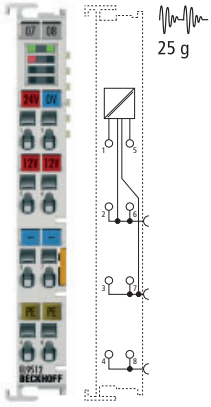
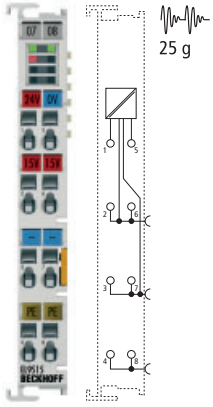
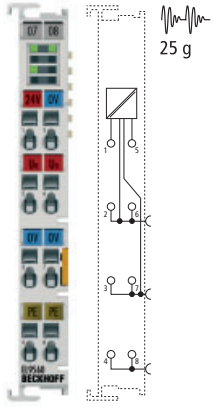
System terminals | **Power supply terminals**

The EL94xx and EL95xx terminal series are designed for the modified feeding of the operating voltage into the terminal strand. The EL9400 ane EL9410 power supply terminals enable the refreshment of the E-bus, via which data exchange takes place between the EtherCAT Coupler and the EtherCAT Terminals. Each EtherCAT Terminal requires a certain amount of current from the E-bus (see technical data: "Current consumption E-bus"). This current is fed into the E-bus by the relevant EtherCAT Coupler's power supply unit. When configuring a large number of EtherCAT Terminals, the 5 V power supply to the E-bus can be increased by 2 A via the EL9400/EL9410. As opposed to the EL9400, the EL9410 has a diagnostic function which is displayed by LED and on the process image.

The EL9520 potential feed terminal uncouples the input and output signal through an integrated filter and enables the supply of AS-Interface networks from standard power supply units or another AS-Interface network.

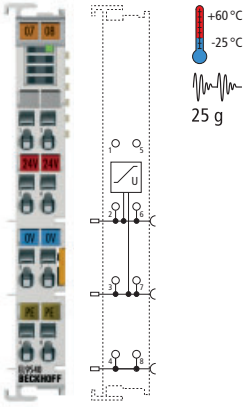
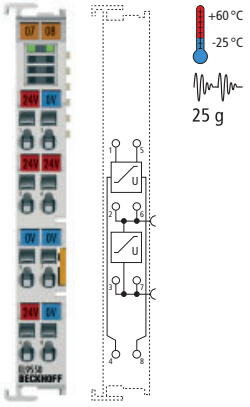
The EL95xx power supply terminals produce different output voltages from the input voltage (24 V DC) that can be accessed at the terminals. The following EtherCAT Terminals are also supplied with this voltage via the power contacts. The power LEDs indicate the operating states of the terminals; short-circuits or overloads are indicated by the overcurrent LEDs. There is no electrical isolation of the input and output voltage.

	Power supply terminal for refreshing the E-bus	Power supply terminal for refreshing the E-bus, with diagnostics	AS-Interface potential feed terminal, with filter
Technical data	**EL9400** | ES9400	**EL9410** | ES9410	**EL9520** | ES9520
Technology	power supply terminal		AS-Interface potential feed terminal
Diagnostics in the process image	–	yes	–
			
Input voltage	24 V DC	24 V DC	up to 35 V
Output voltage	5 V for E-bus supply	5 V for E-bus supply	up to 35 V
Input current	approx. 70 mA + (E-bus/4)	approx. 70 mA + (E-bus/4)	load-dependent
Output current	2 A	2 A	2 A
Short-circuit-proof	–	yes	–
Residual ripple	–	–	–
Current consumption E-bus	–	–	typ. 100 mA
Electrical isolation	–	–	–
Insulation voltage input/output	–	–	–
Special features	for new projects: please use EL9410	standard EL supply	no electrical isolation
Operating temperature	0…+55 °C	0…+55 °C	0…+55 °C
Approvals	CE, UL, Ex	CE, UL, Ex	CE
Weight	approx. 65 g	approx. 65 g	approx. 90 g
Further information	www.beckhoff.com/EL9400	www.beckhoff.com/EL9410	www.beckhoff.com/EL9520

	Power supply terminal, 5 V DC, with diagnostics	Power supply terminal, 8 V DC, with diagnostics	Power supply terminal, 10 V DC, with diagnostics	Power supply terminal, 12 V DC, with diagnostics	Power supply terminal, 15 V DC, with diagnostics	Power supply terminal, 24 V DC, electrical isolation
	EL9505 | ES9505	**EL9508** | ES9508	**EL9510** | ES9510	**EL9512** | ES9512	**EL9515** | ES9515	**EL9560** | ES9560
	power supply terminal with diagnostics and overcurrent LED					power supply terminal
	yes					
						
	The EL9505 generates 5 V from the fed-in 24 V without electrical isolation.	The EL9508 generates 8 V from the fed-in 24 V without electrical isolation.	The EL9510 generates 10 V from the fed-in 24 V without electrical isolation.	The EL9512 generates 12 V from the fed-in 24 V without electrical isolation.	The EL9515 generates 15 V from the fed-in 24 V without electrical isolation.	24 V generation from the 24 V fed-in with electrical isolation, potential-free
	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 %)	24 V DC (-15 %/+20 %)
	5 V DC ±1 %	8 V DC ±1 %	10 V DC ±1 %	12 V DC ±1 %	15 V DC ±1 %	24 V DC (-15 %/+5 %)
	load-dependent	load-dependent	load-dependent	load-dependent	load-dependent	load-dependent
	0.5 A	0.5 A	0.5 A	0.5 A	0.5 A	≤ 0.1 A
	yes	yes	yes	yes	yes	yes
	< 5 mV	< 5 mV	< 5 mV	< 5 mV	< 5 mV	–
	90 mA	90 mA	90 mA	90 mA	90 mA	90 mA
	–	–	–	–	–	1500 V AC constant load field side/E-bus
	–	–	–	–	–	500 V AC permanent load (field side)
	stabilised output voltage	stabilised output voltage	stabilised output voltage	stabilised output voltage	stabilised output voltage	automatic restart after short-circuit, diagnostics U_{IN}/U_{OUT}
	0…+55 °C	0…+55 °C	0…+55 °C	0…+55 °C	0…+55 °C	0…+55 °C
	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex	CE, UL
	approx. 65 g	approx. 65 g	approx. 65 g	approx. 65 g	approx. 65 g	approx. 65 g
	www.beckhoff.com/EL9505	www.beckhoff.com/EL9508	www.beckhoff.com/EL9510	www.beckhoff.com/EL9512	www.beckhoff.com/EL9515	www.beckhoff.com/EL9560

System terminals | **Surge filter system and field supply**

The EL9540 system terminal contains an overvoltage filter for the 24 V field supply, the EL9550 for the 24 V field and system supply. The filter protects the EtherCAT Terminals from line-bound surge voltages that can occur due to high-energy disturbances such as switching overvoltages at inductive consumers or lightning strikes at the supply lines. The EtherCAT Terminals EL9540 or EL9550 protect the terminal station from damage in particularly harsh environments. The ship classification organisations require the use in shipbuilding applications and in the onshore/offshore sector.

	Surge filter field supply	Surge filter system and field supply
Technical data	**EL9540** | ES9540	**EL9550** | ES9550
Technology	surge filter field supply	surge filter system and field supply
Diagnostics	–	
		
Nominal voltage	24 V (-15 %/+20 %)	24 V (-15 %/+20 %)
Surge filter field supply	yes	yes
Surge filter system supply	–	yes
Rated current field supply	≤ 10 A	≤ 10 A
Rated current system supply	–	≤ 1.5 A
PE connection	yes	–
Operating temperature	-25…+60 °C	-25…+60 °C
Approvals	CE, UL, Ex	CE, UL, Ex
Weight	approx. 50 g	approx. 50 g
Further information	www.beckhoff.com/EL9540	www.beckhoff.com/EL9550

System terminals | **Brake chopper terminal**

The EL9576 EtherCAT Terminal contains high-performance capacitors for stabilising supply voltages. It can be used in connection with the motion terminals (EL7xxx), e.g. the EL70xx stepper motor terminals, the EL73xx DC motor terminals or the EL72xx servomotor terminals.

Low internal resistance and high pulsed current capability enable good buffering in parallel with a power supply unit. Return currents are stored, particularly in the context of drive applications, thereby preventing overvoltages. If the fed back energy exceeds the capacity of the capacitors, the EL9576 switches the load voltage through to the terminal points 1 and 5. The energy is dissipated by the connection of the ZB8110 external ballast resistor (10 Ω, 100 W).

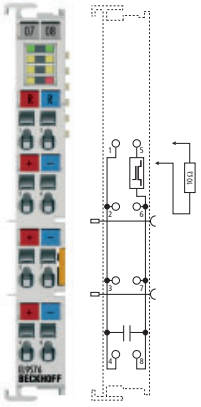
The EL9576 is characterised in particular by adjustable threshold values and various diagnostic possibilities.

EL7xxx | Motion terminals
see page 437

ZB8110 | External ballast resistor
see page 848

Brake chopper terminal,
72 V, 155 µF

Technical data	**EL9576** | ES9576
Technology	brake chopper
Diagnostics	temperature on board, over-/undervoltage



25 g

The EL9576 buffers the connected voltage via its integrated capacitors and connects the external brake resistor if the preset threshold of the internal voltage is exceeded.

Nominal voltage	arbitrary up to 72 V
Capacity	155 µF
Ripple current (max.)	10 A
Internal resistance	< 5 mΩ
Chopper voltage	adjustable
Recommended ballast resistor	10 Ω, typ. 100 W (dependent on application)
Overvoltage control range	typ. 1 V, parametrisable by CoE data
Ballast resistor clock rate	load-dependent, max. 100 µs, 2-point control
Electrical isolation	1500 V (E-bus/field potential)
Special features	adjustabel threshold
Operating temperature	0…+55 °C
Approvals	CE, UL
Weight	approx. 90 g
Further information	www.beckhoff.com/EL9576