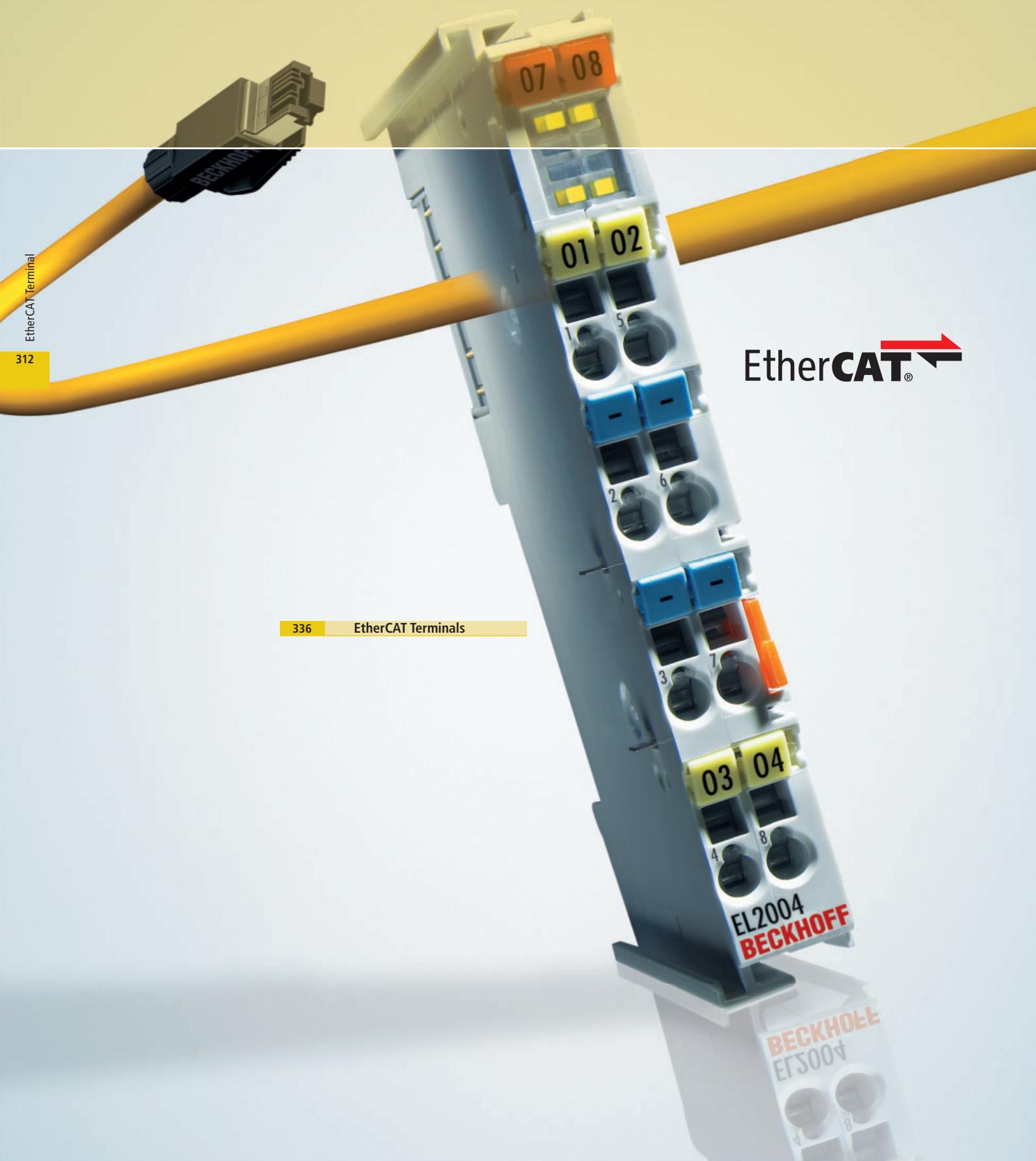


EtherCAT®

# EtherCAT Terminal

Ultra high-speed communication



EtherCAT®

# EtherCAT Terminal

Ethernet for Control Automation Technology

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# Product overview EtherCAT Terminals

## EtherCAT Couplers

<b>EtherCAT Couplers E-bus</b>	<b>EK1100</b>  ID switch, multimode fibre optic	<b>328</b>	<b>EK1501</b>  ID switch, multimode fibre optic	<b>330</b>
	<b>EK1101</b>  ID switch	<b>328</b>	<b>EK1501-0010</b>  ID switch, singlemode fibre optic	<b>330</b>
	<b>EK1101-0080</b>  ID switch, Fast Hot Connect	<b>328</b>	<b>EK1541</b>  ID switch, POF	<b>330</b>
<b>EtherCAT Couplers E-bus with integrated digital I/Os</b>	<b>EK1814</b>  4 inputs + 4 outputs	<b>329</b>	<b>EK1818</b>  8 inputs + 4 outputs	<b>329</b>
	<b>EK1828</b>  4 inputs + 8 outputs	<b>329</b>	<b>EK1828-0010</b>  8 outputs	<b>329</b>
	<b>EK1914</b>  EtherCAT Coupler with integrated digital I/Os: 4 inputs + 4 outputs, 2 safe inputs + 2 safe outputs	<b>328</b>		
<b>EtherCAT Couplers K-bus</b>	<b>BK1120</b>  "Compact"	<b>333</b>	<b>BK1150</b>  between E-bus and K-bus terminals	<b>333</b>
			<b>BK1250</b>  between E-bus and K-bus terminals	<b>333</b>
<b>Bus Couplers (for ELxxxx)</b>	<b>EK3100</b>  PROFIBUS	<b>334</b>	<b>EK9300</b>  PROFINET IO	<b>335</b>
	<b>EK5100</b>  CANopen	<b>334</b>	<b>EK9500</b>  EtherNet/IP	<b>335</b>
	<b>EK5200</b>  DeviceNet	<b>334</b>	<b>EK9700</b>  Sercos III	<b>335</b>
	<b>EK9000</b>  Ethernet	<b>335</b>		
<b>Extension system and junctions</b>	<b>EK1110</b>  extension end terminal	<b>332</b>	<b>EK1521</b>  multimode fibre optic junction	<b>331</b>
	<b>EK1122</b>  2-port junction	<b>332</b>	<b>EK1521-0010</b>  singlemode fibre optic junction	<b>331</b>
	<b>EK1122-0080</b>  2-port junction, Fast Hot Connect	<b>332</b>	<b>EK1561</b>  POF junction	<b>331</b>
	<b>EK1132</b>  2-port Power over EtherCAT junction	<b>332</b>		

## Embedded PCs, Infrastructure Components

<b>Embedded PCs with E-bus interface</b>	<b>CX80xx</b>  with directly integrated E-bus interface	<b>192</b>
	<b>CX9000, CX9010, CX9020</b>  with directly integrated E-bus interface	<b>198</b>
	<b>CX1010</b>  EtherCAT Terminal integration via power supply CX1100-0004	<b>208</b>
	<b>CX5010, CX5020</b>  with directly integrated E-bus interface	<b>214</b>
	<b>CX1020, CX1030</b>  EtherCAT Terminal integration via power supply CX1100-00x4	<b>218</b>
	<b>CX2020, CX2030, CX2040</b>  EtherCAT Terminal integration via power supply CX2100-0xx	<b>232</b>
<b>Infrastructure Components</b>	<b>CU1128</b>  EtherCAT junction	<b>741</b>
	<b>CU1521-0000</b>  EtherCAT media converter fibre optic (multimode)	<b>742</b>
	<b>CU1521-0010</b>  EtherCAT media converter fibre optic (singlemode)	<b>742</b>
	<b>CU1561</b>  EtherCAT media converter plastic optical fibre	<b>742</b>

## EtherCAT Terminal | Digital input: EL1xxx/ES1xxx

Signal	2-channel	4-channel		8-channel		16-channel
5/12 V DC		EL1124 5 V DC 345	EL1144 12 V DC 345			
24 V DC (filter 3.0 ms)	EL1002 type 3 341	EL1004 type 3 339	EL1004-0020 >2,500 V 339	EL1008 type 3 338	EL1809 type 3 339	
		EL1804 8 x 24 V, 4 x 0 V, type 3	EL1104 with sensor supply 341	EL1808 8 x 24 V DC, type 3 340	EL1862 flat-ribbon cable, type 3 341	
		EL1084 negative switching	EL1024 type 2 344	EL1859 type 3, 8 inputs, 8 outputs, I <sub>MAX</sub> = 0.5 A 340	EL1862-0010 flat-ribbon cable, negative switching 344	
				EL1088 negative switching 344	EL1889 negative switching 344	
24 V DC (filter 10 µs)	EL1012 type 3 341	EL1014 type 3 339	EL1034 potential-free 340	EL1018 type 3 338	EL1819 type 3 339	
		EL1114 with sensor supply	EL1814 8 x 24 V, 4 x 0 V, type 3 340		EL1872 flat-ribbon cable, type 3 341	
			EL1094 negative switching 344	EL1098 negative switching 344		
24 V DC (XFC, T <sub>ON</sub> /T <sub>OFF</sub> 1 µs)	EL1202 fast input 342			EL1258 time stamp 343		
	EL1252 time stamp 342			EL1259 8 in- + 8 outputs, I <sub>MAX</sub> = 0.5 A, time stamp 343		
	EL1262 oversampling 343					
24 V DC (safe inputs)		EL1904 TwinSAFE	347	EL1934 PROFIsafe	347	EL1908 TwinSAFE 347
48 V DC		EL1134 filter 10 µs 345				
120 V AC/DC	EL1712 power contacts 345					
230 V AC	EL1702 power contacts 345					
	EL1722 no power contacts 345					
Counter	EL1502 100 kHz, 32 bit 346					
	EL1512 1 kHz, 16 bit 346					

## EtherCAT Terminal | Digital output: EL2xxx/ES2xxx, EM2xxx

Signal	2-channel	4-channel		8-channel		16-channel
5 V DC		EL2124 I <sub>MAX</sub> = ±20 mA 354				
12 V DC		EL2024-0010 I <sub>MAX</sub> = 2.0 A 354				
24 V DC	EL2042 2 x 4 A/1 x 8 A 352					
24 V DC (I <sub>MAX</sub> = 0.5 A)	EL2002 352	EL2004 349	EL2008 348	EM2042 D-sub connection 352		
				EL2872 flat-ribbon cable 352		
		EL2084 negative switching 353	EL2088 negative switching 353	EL2809 348	EL2889 negative switching 353	
			EL1859 filter 3.0 ms, 8 inputs, 8 outputs, type 3 349	EL2872-0010 352	flat-ribbon cable, negative switching	
24 V DC (I <sub>MAX</sub> = 2.0 A)	EL2022 352	EL2024 349				
	EL2032 with diagnostic 352	EL2034 with diagnostic 349				
24 V DC (XFC, T <sub>ON</sub> /T <sub>OFF</sub> 1 µs)	EL2202 350	EL2212 350		EL1259 8 in- + 8 outputs, I <sub>MAX</sub> = 0.5 A, time stamp 351		
	push-pull outputs	overexcitation, time stamp		I <sub>MAX</sub> = 0.5 A, time stamp		
	EL2252 time stamp 351	EL2262 oversampling 351		EL2258 time stamp 351		
24 V DC (safe outputs)	EL2901 361	EL2902 361	EL2904 TwinSAFE 361			
	TwinSAFE, 1 safe output	TwinSAFE, 2 safe outputs	EL2934 PROFIsafe 931			
24 V AC/DC				EL2798 357		
Relay (up to 230 V AC)	EL2602 I <sub>MAX</sub> = 2.0 A, make contact, power contacts 358	EL2622 I <sub>MAX</sub> = 2.0 A, make contact, no power contacts 359	EL2624 359			
	EL2612 I <sub>MAX</sub> = 1.0 A, change-over, no power contacts 359					
Triac (up to 230 V AC)	EL2712 12...230 V AC, 0.5 A, power contacts 360	EL2722 12...230 V AC, 1.0 A, mutually locked outputs 360				
	EL2732 12...230 V AC, 0.5 A, no power contacts 360					
PWM	EL2502 356	EL2535 356				
	24 V DC, 1.0 A 24 V DC, 50 mA, 1 A or 2 A					
	EL2545 50 V DC, 3.5 A 356					
Frequency outp.	EL2521 1...500 kHz 355					

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

EN 61131-2 specification ► [www.beckhoff.com/EN61131-2](http://www.beckhoff.com/EN61131-2)

## EtherCAT Terminal | Analog input: EL3xxx/ES3xxx

Signal	1-channel		2-channel				4-channel				8-channel		
$\pm 75 \text{ mV}, 24 \text{ bit}$					EL3602-0010 365								
0...10 V	EL3061 366	EL3161 367	EL3062 366	EL3162 367	EL3064 366	EL3164 367	EL3068 366						
	12 bit	16 bit	12 bit	16 bit	12 bit	16 bit	12 bit						
0...30 V, 12 bit	EL3062-0030 366												
$\pm 10 \text{ V}$	EL3001 362		EL3002 363		EL3004 363		EL3008 363						
	single-ended, 12 bit		single-ended, 12 bit		single-ended, 12 bit		single-ended, 12 bit						
	EL3101 364		EL3102 364	EL3602 365	EL3702 365	EL3104 364							
	differential input,		differential input,	differential input,	differential input,	differential input,							
	16 bit		16 bit	24 bit	16 bit, oversampling	16 bit							
0...20 mA	EL3041 368	EL3141 370	EL3042 368	EL3142 370	EL3742 371	EL3044 368	EL3144 370	EL3048 368					
	single-ended, 12 bit	single-ended, 16 bit	single-ended, 12 bit	single-ended, 16 bit	differential input,	single-ended, 12 bit	single-ended, 16 bit	single-ended, 12 bit					
	EL3011 369	EL3111 371	EL3012 369	EL3112 371	EL3612 371	EL3014 369	EL3114 371						
	differential input,	differential input,	differential input,	differential input,	differential input,	differential input,	differential input,						
	12 bit	16 bit	12 bit	16 bit	24 bit	12 bit	16 bit	12 bit					
4...20 mA	EL3051 372	EL3151 374	EL3052 372	EL3152 374		EL3054 372	EL3154 374	EL3058 372					
	single-ended, 12 bit	single-ended, 16 bit	single-ended, 12 bit	single-ended, 16 bit		single-ended, 12 bit	single-ended, 16 bit	single-ended, 12 bit					
	EL3021 373	EL3121 375	EL3022 373	EL3122 375		EL3024 373	EL3124 375						
	differential input,	differential input,	differential input,	differential input,		differential input,	differential input,						
	12 bit	16 bit	12 bit	16 bit		12 bit	16 bit	12 bit					
$\pm 10 \text{ mA}$	EL3142-0010 370												
	single-ended, 16 bit												
Thermo-couples/mV	EL3311 378		EL3312 378		EL3314 379	EL3314-0010 379	EL3318 379						
	16 bit		16 bit		16 bit	24 bit	16 bit						
Resistance thermometer (RTD)	EL3201 376		EL3202 377		EL3204 377	EL3204-0200 377							
Potentiometer									EL3255 387				
Resistor bridge	EL3351 382	EL3356 383									5-channel		
	self-calibration												
3-phase power measurement					EL3403 384	EL3413 385	EL3433 385						
	500 V AC, 1 A				690 V AC, 5 A	500 V AC, 10 A							
Measurement	EL3681 386					EL3692 381	EL3773 385						
	digital multimeter terminal, 18 bit				resistance measurement, 10 mΩ...10 MΩ								
Condition Monitoring					EL3632 380								
	IEPE terminal, acceleration sensors												

## EtherCAT Terminal | Analog output: EL4xxx/ES4xxx

Signal	1-channel		2-channel		4-channel		8-channel	
0...10 V	EL4001 12 bit	390	EL4002 12 bit	390	EL4004 12 bit	390	EL4008 12 bit	390
			EL4102 16 bit		391	EL4104 16 bit	391	
$\pm 10 \text{ V}$	EL4031 12 bit	388	EL4032 12 bit	388	EL4034 12 bit	389	EL4038 12 bit	389
			EL4132 16 bit		389	EL4134 16 bit	389	
			EL4732 16 bit, oversampling		389			
0...20 mA	EL4011 12 bit	392	EL4012 12 bit	392	EL4014 12 bit	392	EL4018 12 bit	392
			EL4112 16 bit		393	EL4114 16 bit	393	
			EL4712 16 bit, oversampling		393			
4...20 mA	EL4021 12 bit	394	EL4022 12 bit	394	EL4024 12 bit	394	EL4028 12 bit	394
			EL4122 16 bit		395	EL4124 16 bit	395	
$\pm 10 \text{ mA}$	EL4112-0010 16 bit				393			

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

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

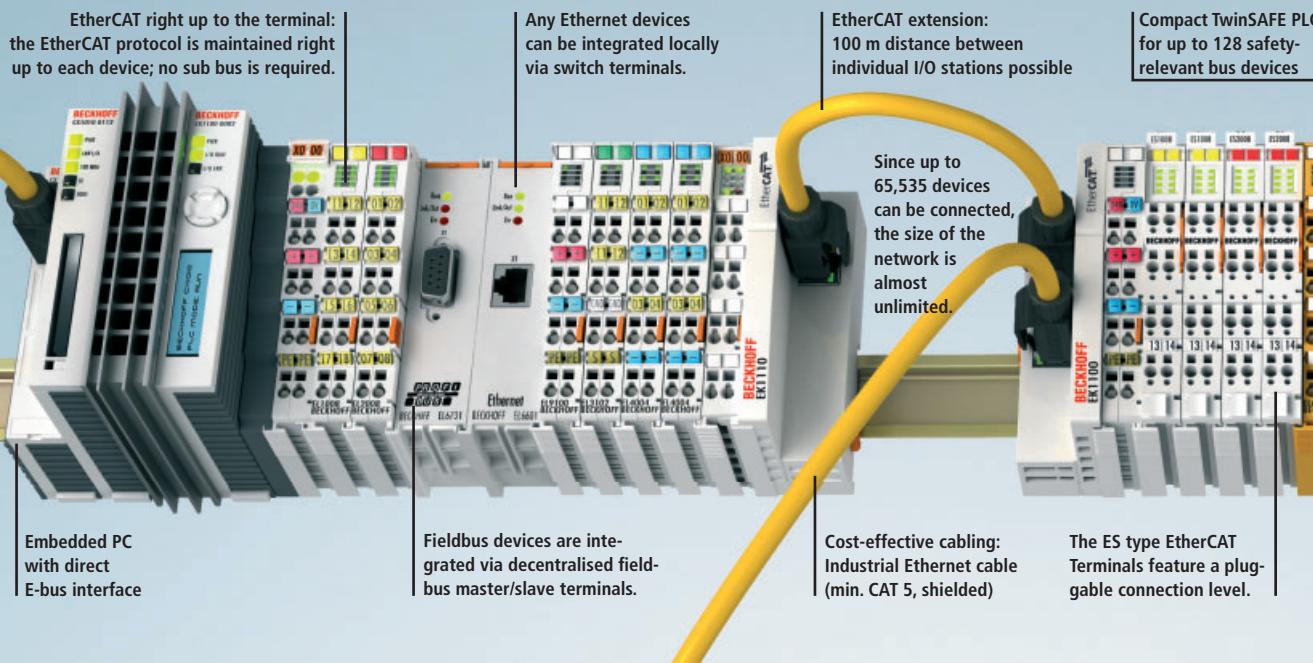
## Safety EtherCAT Terminals

Signal	1-channel		2-channel		4-channel	
<b>Position measurement</b>	<b>EL5001</b> 396	<b>EL5021</b> 1 V <sub>PP</sub> , SSI encoder interface	<b>397</b>	<b>EL5002</b>	<b>396</b>	
		SinCos encoder interface		SSI encoder interface		
<b>EL5001-0011</b>	<b>396</b>	<b>EL5101</b> differential inputs, RS485, incremental encoder interface	<b>398</b>			
<b>Position measur. (32 bit)</b>		SSI monitor terminal				
<b>Communication</b>	<b>EL6001</b> 400	<b>EL6021</b> 400	<b>EL6002</b> 400			
	RS232, 115.2 kbaud	RS422/RS485, 115.2 kbaud	RS232, 115.2 kbaud, D-sub			
	<b>EL6080</b> 401		<b>EL6022</b> D-sub, 400	<b>EL6224</b> 406		
	memory terminal 128 kbyte		RS422/RS485, 115.2 kbaud	IO-Link master		
	<b>EL6601</b> 402	<b>EL6688</b> 403	<b>EL6692</b> 404	<b>EL6614</b> 402		
	switch port	IEEE 1588 master/slave	EtherCAT bridge terminal	switch port		
<b>Communication (master terminal)</b>	<b>EL6201</b> AS-Interface 405	<b>EL6631</b> PROFINET IO 407				
	<b>EL6632</b> PROFINET IRT 407	<b>EL6720</b> Lightbus 408				
	<b>EL6731</b> PROFIBUS 409	<b>EL6751</b> CANopen 411				
	<b>EL6752</b> DeviceNet 412	<b>EL6851</b> DMX 413				
<b>Communication (slave terminal)</b>	<b>EL6631</b> PROFINET IO 407	<b>EL6731</b> PROFIBUS 409				
	<b>EL6740</b> Interbus 410	<b>EL6751</b> CANopen 411				
	<b>EL6752</b> DeviceNet 412	<b>EL6851</b> DMX 413				
<b>Motion</b>	<b>EL7031</b> 24 V DC, 417	<b>EL7201</b> 419	<b>EL7332</b> 24 V DC, 421			
	stepper motor ter., I <sub>MAX</sub> = 1.5 A	servomotor terminal, 50 V, 4 A	DC motor output stage, 1 A			
	<b>EL7041</b> 417	<b>EL7051</b> 417	<b>EL7342</b> 421	<b>EM7004</b> 415		
	stepper motor terminal, I <sub>MAX</sub> = 5.0 A, 50 V, incremental encoder interface	stepper motor terminal, I <sub>MAX</sub> = 8.0 A, 80 V, incremental encoder interface	DC motor output stage, 3 incremental encoders, 50 V DC, 3.5 A, incremental encoder	3 digital inputs 24 V DC, 16 digital outputs 24 V DC, 4 analog inputs ±10 V		

Signal	24 V DC	
<b>EK1914</b> 328	EtherCAT Coupler with integrated digital I/Os: 4 inputs + 4 outputs, 2 safe inputs + 2 safe outputs	
<b>EL1904</b> 347	TwinSAFE, 4 safe inputs	
<b>EL1908</b> 347	TwinSAFE, 8 safe inputs	
<b>EL1934</b> 347	PROFIsafe, 4 safe inputs	
<b>EL2901</b> 361	TwinSAFE, 1 safe output	
<b>EL2902</b> 361	TwinSAFE, 2 safe outputs	
<b>EL2934</b> 361	PROFIsafe, 4 safe outputs	
<b>EL6900</b> 414	TwinSAFE PLC	
<b>EL6930</b> 414	TwinSAFE/PROFIsafe logic and gateway terminal	

## EtherCAT Terminal | System terminals: EL9xxx/ES9xxx

Signal	System	Signal	Potential supply	Power supply and accessories
<b>System</b>	<b>EL9011</b> bus end cap 424	<b>24 V DC</b>	<b>EL9100</b> 422	<b>EL9400</b> input 24 V DC, E-bus power supply, 2 A 426 <b>EL9410</b> input 24 V DC, output 5 V/2 A 426
	<b>EL9070</b> shield terminal 423			
	<b>EL9080</b> isolation terminal 423		<b>EL9110</b> 422	<b>EL9505</b> input 24 V DC, output 5 V DC, 0.5 A 427
	<b>EL9195</b> shield terminal 423		<b>EL9200</b> 423	<b>EL9508</b> input 24 V DC, output 8 V DC, 0.5 A 427
<b>Potential distribution terminal</b>	<b>EL9180</b> 424			
	2 clamping units per power contact		<b>EL9210</b> 423	<b>EL9510</b> input 24 V DC, output 10 V DC, 0.5 A 427 <b>EL9512</b> input 24 V DC, output 12 V DC, 0.5 A 427
	<b>EL9181</b> 425		<b>EL9520</b> AS-Interface potential supply with filter 426	<b>EL9515</b> input 24 V DC, output 15 V DC, 0.5 A 427
	2 x 8 terminal points			<b>EL9540</b> surge filter terminal for field supply 428 <b>EL9550</b> surge filter terminal for system/field supply 428
	<b>EL9182</b> 425			
	8 x 2 terminal points			<b>EL9560</b> 427 input 24 V DC, output 24 V DC, 0.1 A with electrical isolation
	<b>EL9183</b> 425			
	1 x 16 terminal points			
	<b>EL9184</b> 425			
	8 x 24 V DC, 8 x 0 V DC			
<b>50 V DC</b>			<b>EL9570</b> 50 V DC, buffer capacitor terminal, 500 µF 429	
<b>120...</b>	<b>EL9150</b> with LED 422			
	<b>230 V AC</b>	<b>EL9160</b> diagnostic 422		
	<b>EL9190</b> 423			
	<b>EL9250</b> with fuse, with LED 423			
	<b>EL9260</b> diagnostic, with fuse 423			
	<b>EL9290</b> with fuse 423			



## 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 proven 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.

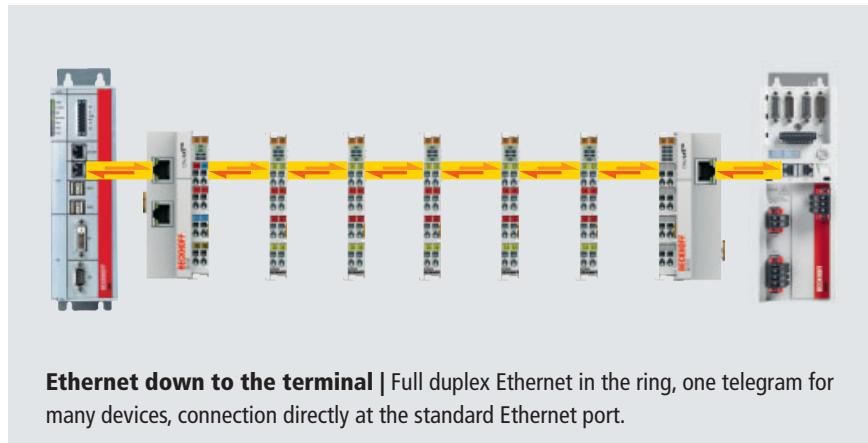
Like the Beckhoff Bus Terminals, the outer contour of the EtherCAT Terminals perfectly adapts to the dimensions of terminal boxes. A clearly arranged connection panel with LEDs for status display and push-in contact labels ensures clarity in the field.

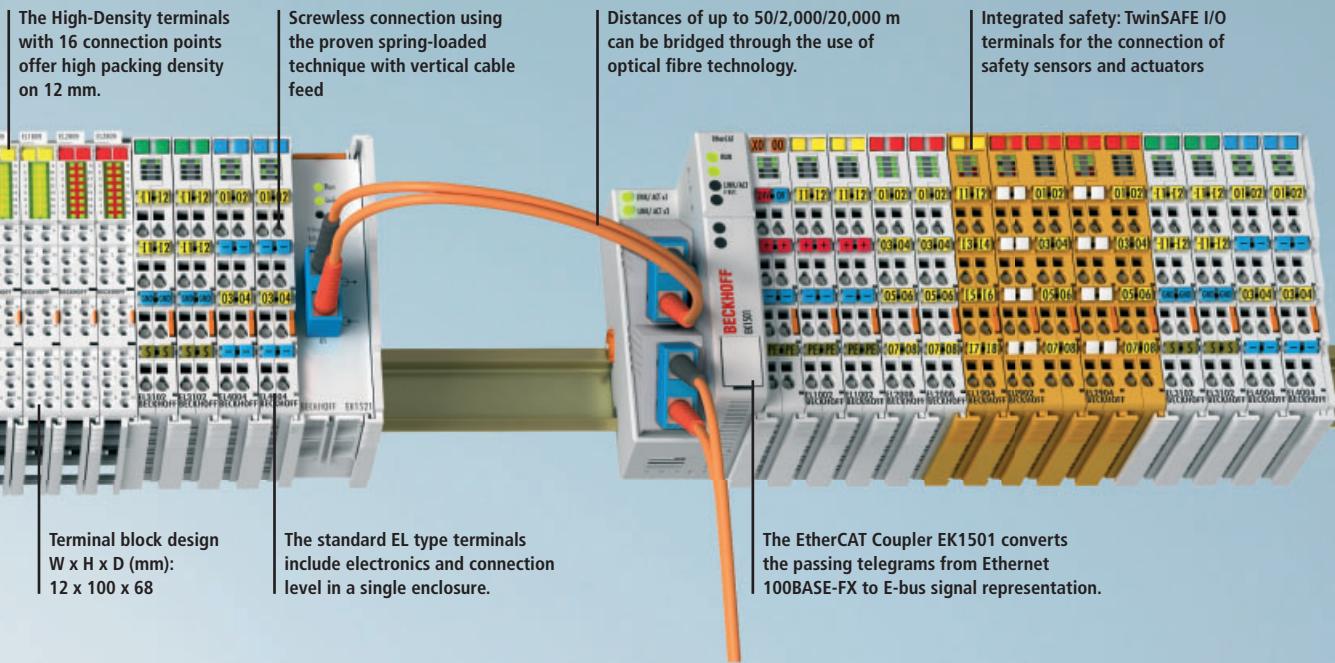
### Free mix of signals

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  $\pm 10\text{ V}$ ,  $0\ldots10\text{ V}$ ,  $0\ldots20\text{ mA}$  and  $4\ldots20\text{ mA}$  are all available as 1-, 2-, 4- and 8-channel variants within a standard housing.





### 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.

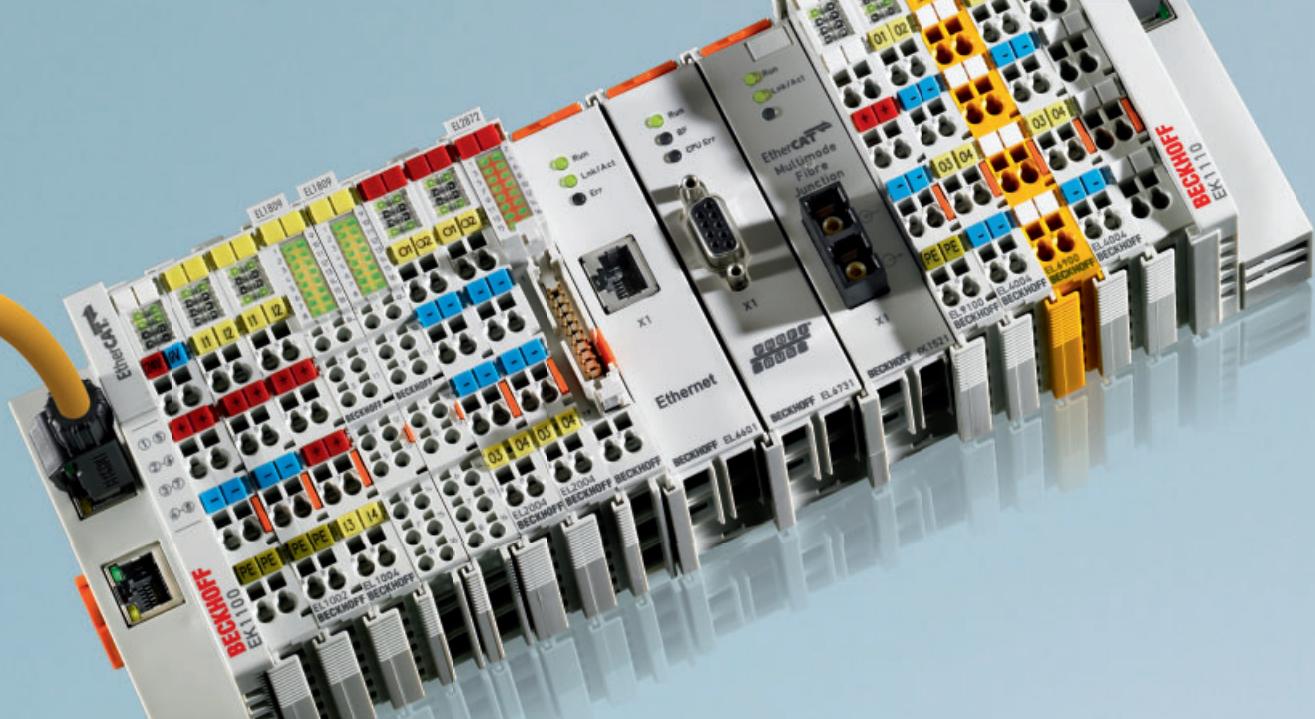
### EtherCAT Coupler with integrated I/Os

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.

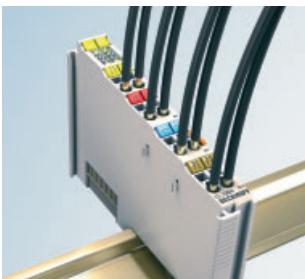
The EK19xx series includes combinations of safe digital inputs and outputs. In conjunction with TwinSAFE – the safety solution from Beckhoff – users have an ultra-compact, space-saving solution available for direct connection of safety-relevant sensors and actuators.

EtherCAT topology and system description see page 280



## **Flexible connection system**

# ELxxxx | Standard wiring



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. All terminal types are bus-neutral and can be combined as required.

The standard EL EtherCAT Terminals have been tried and tested for years. They feature integrated screwless spring-loaded technique for fast and simple assembly.

# ESxxxx | Pluggable wiring



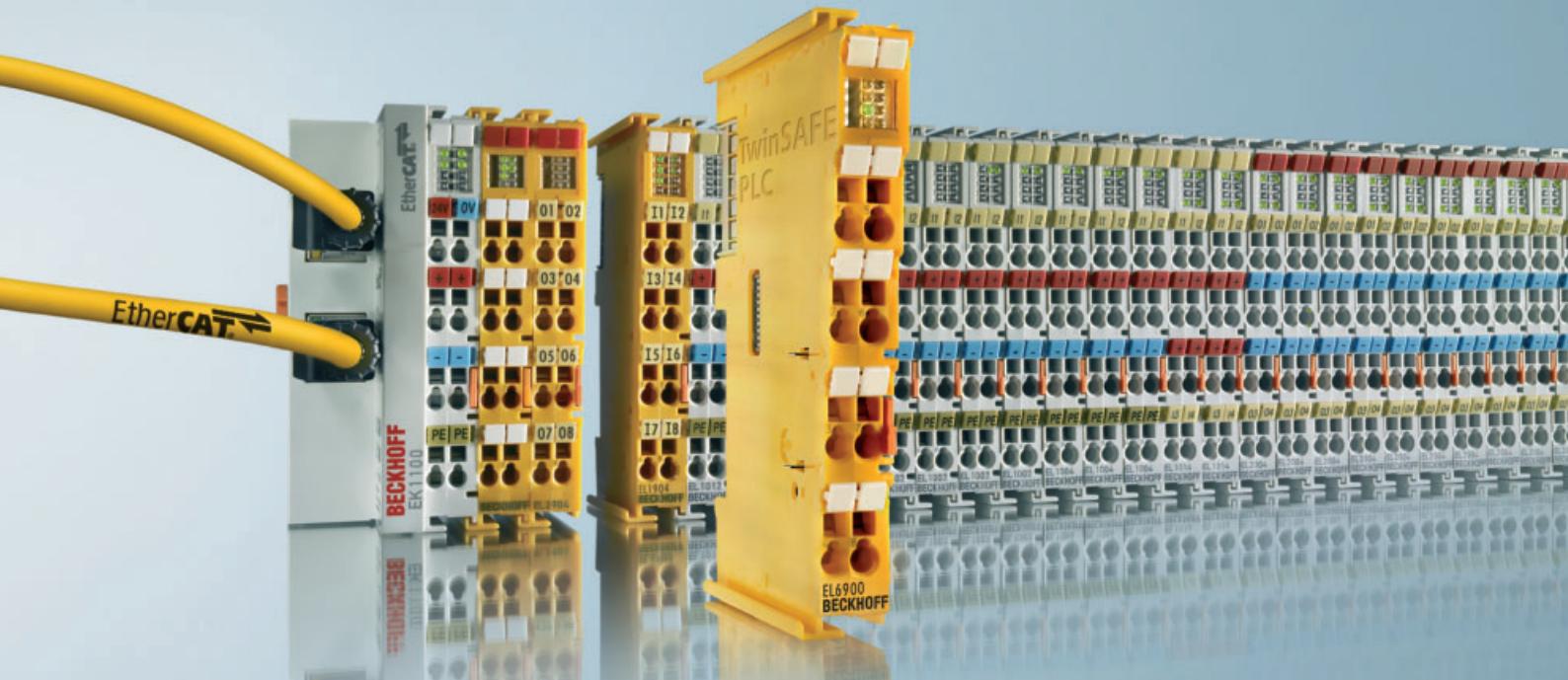
The ES type EtherCAT Terminals feature a pluggable connection level. The assembly and wiring procedure for the ES series is the same as for the EL series. The ES series EtherCAT Terminals enable the complete wiring to be removed as a plug connector from the top of the housing for servicing. The lower section can be removed from the EtherCAT Terminal assembly by pulling the unlocking tab. Insert the new component and plug in the connector with the wiring. This reduces the installation time and eliminates the risk of wires being mixed up.

The familiar dimensions of the EtherCAT Terminal only had to be changed slightly. The new connector adds about 3 mm. The maximum height of the EtherCAT Terminal remains unchanged.

The overview and nomenclature of the product names has been retained: The plug connector variant is identified in the part number by an additional letter.

Conductor cross sections between  $0.08 \text{ mm}^2$  and  $2.5 \text{ mm}^2$  can continue to be used with the proven spring-loaded technique.

A tab for strain relief of the cable simplifies assembly in many applications and prevents tangling of individual connection wires when the connector is removed.



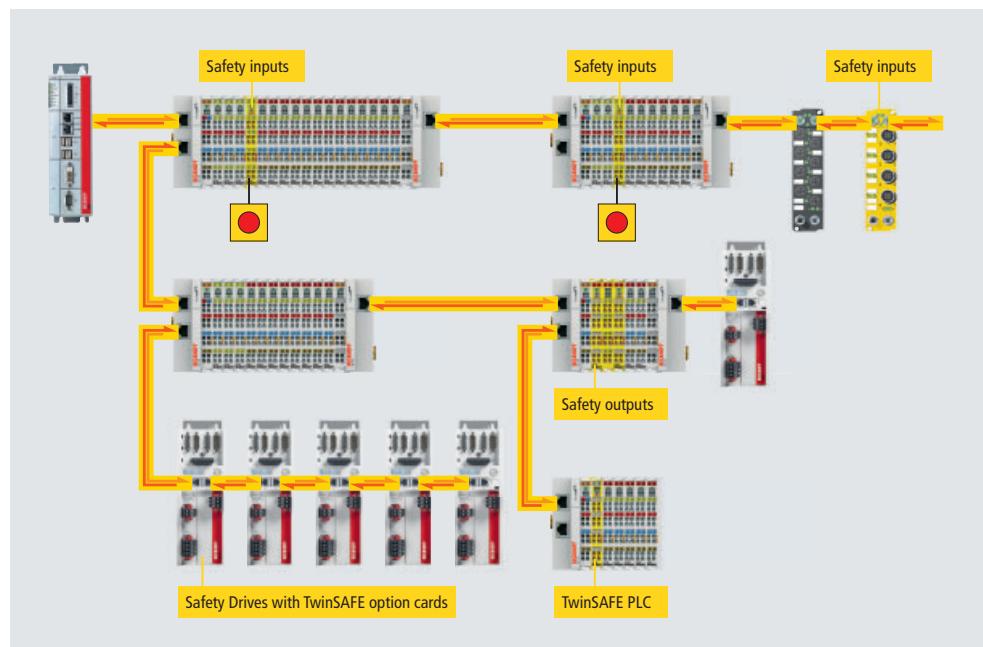
## TwinSAFE | Safety and I/O technology in one system

TwinSAFE – the safety solution from Beckhoff – integrates safety functionalities into the existing control architecture. TwinSAFE from Beckhoff provides a consistent hardware and software technology for achieving integrated and simplified handling, ranging from safe input and output terminals and safe miniature controllers for the EtherCAT Terminal system and the AX5000 Servo Drives to the PC-based Safety PLC.

The following TwinSAFE EtherCAT Terminals are available:

- EK1914 | EtherCAT Coupler with integrated I/O
  - EL1904 | 4-channel digital input
  - EL1908 | 8-channel digital input
  - EL1934 | 4-channel digital input, PROFIsafe
  - EL2901 | 1-channel digital output
  - EL2902 | 2-channel digital output
  - EL2904 | 4-channel digital output
- In addition, TwinSAFE is available in IP 67:
- EP1908 | 8-channel digital input

For further information on TwinSAFE and the TwinSAFE products see page **914**



Open control technology for safety integration: the TwinSAFE protocol enables transfer of safety-relevant data via any medium.

# System overview EtherCAT I/O

EtherCAT Terminal

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EK EtherCAT Coupler series



EtherCAT Coupler with integrated digital I/Os

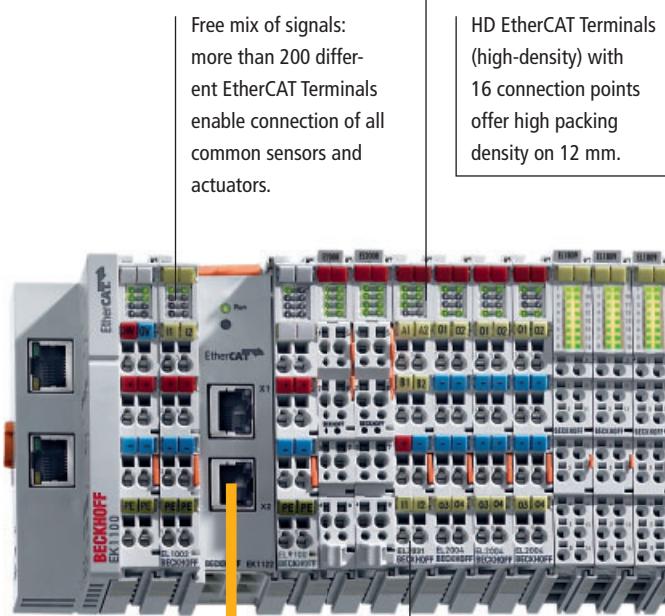


Bus Coupler (e.g. PROFIBUS) for EtherCAT Terminals



Embedded PC series CX,  
further Embedded PCs see page

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

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

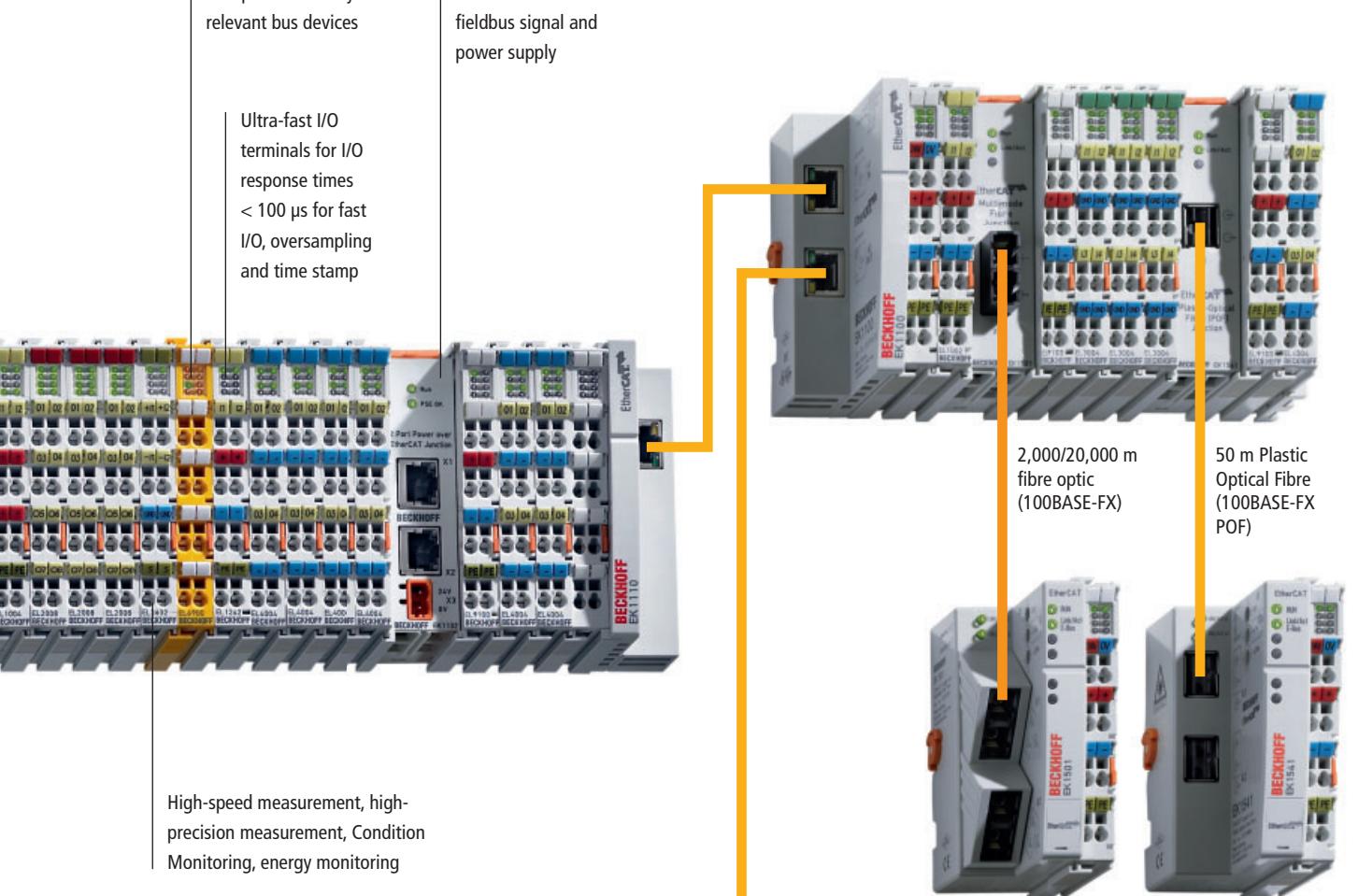
Free mix of signals:  
more than 200 different  
EtherCAT Terminals  
enable connection of all  
common sensors and  
actuators.

100 m  
Industrial  
Ethernet  
cable  
(100BASE-TX)

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

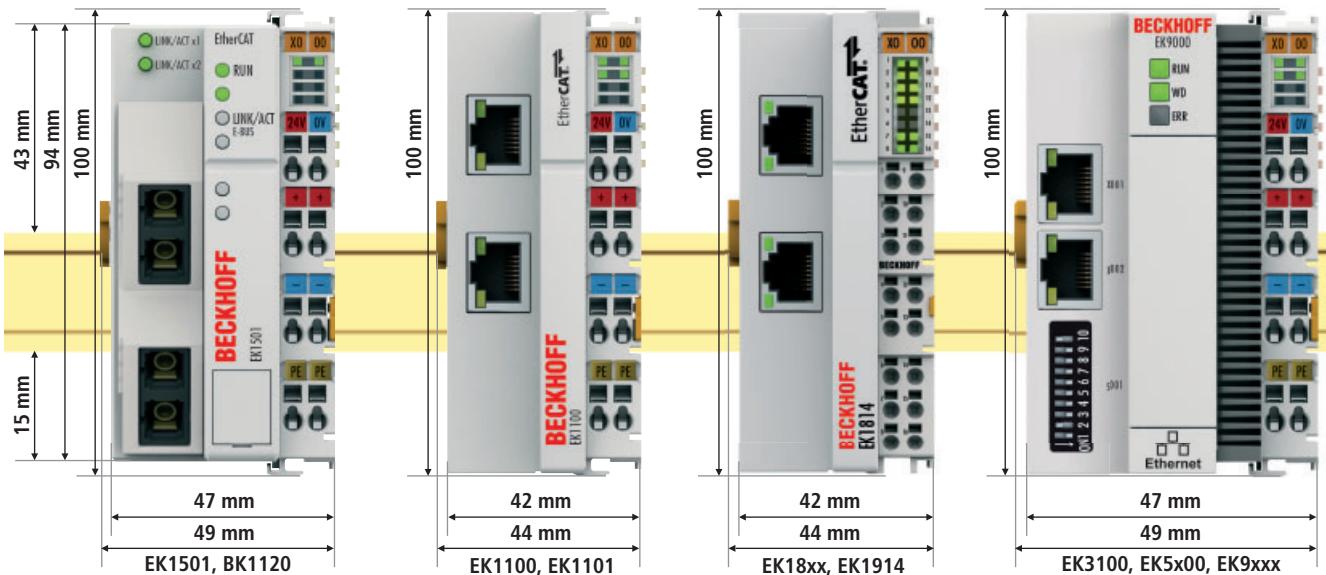
Optional fieldbus integration  
via decentralised fieldbus  
master/slave terminals





IP 67 EtherCAT Box, further EtherCAT Box modules see page 434



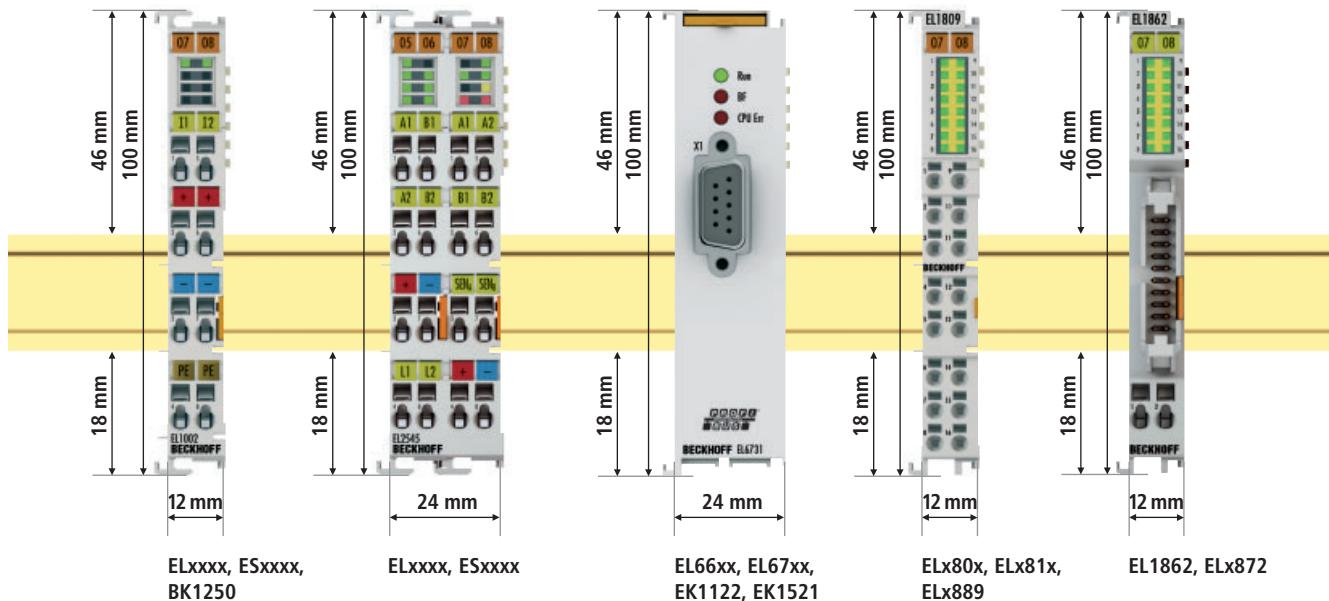


## Technical data – EtherCAT Coupler housing

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, EK5x00, EK9xxx
Design form	compact terminal housing with signal LED		
Material	polycarbonate		
Dimensions (W x H x D)	49 mm x 100 mm x 68 mm	44 mm x 100 mm x 68 mm	65 mm x 100 mm x 80 mm
Installation	on 35 mm DIN rail, conforming to EN 50022 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/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27		
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4		

Connection	EK1501, BK1120, EK11xx, EK18xx, EK1914, EK3100, EK5x00, EK9xxx
Wiring	spring-loaded technique
Connection cross-section	0.08...2.5 mm <sup>2</sup> , 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 <sub>MAX</sub> : 10 A (125 A short-circuit)
Nominal voltage	24 V DC



## Technical data – EtherCAT Terminal housing

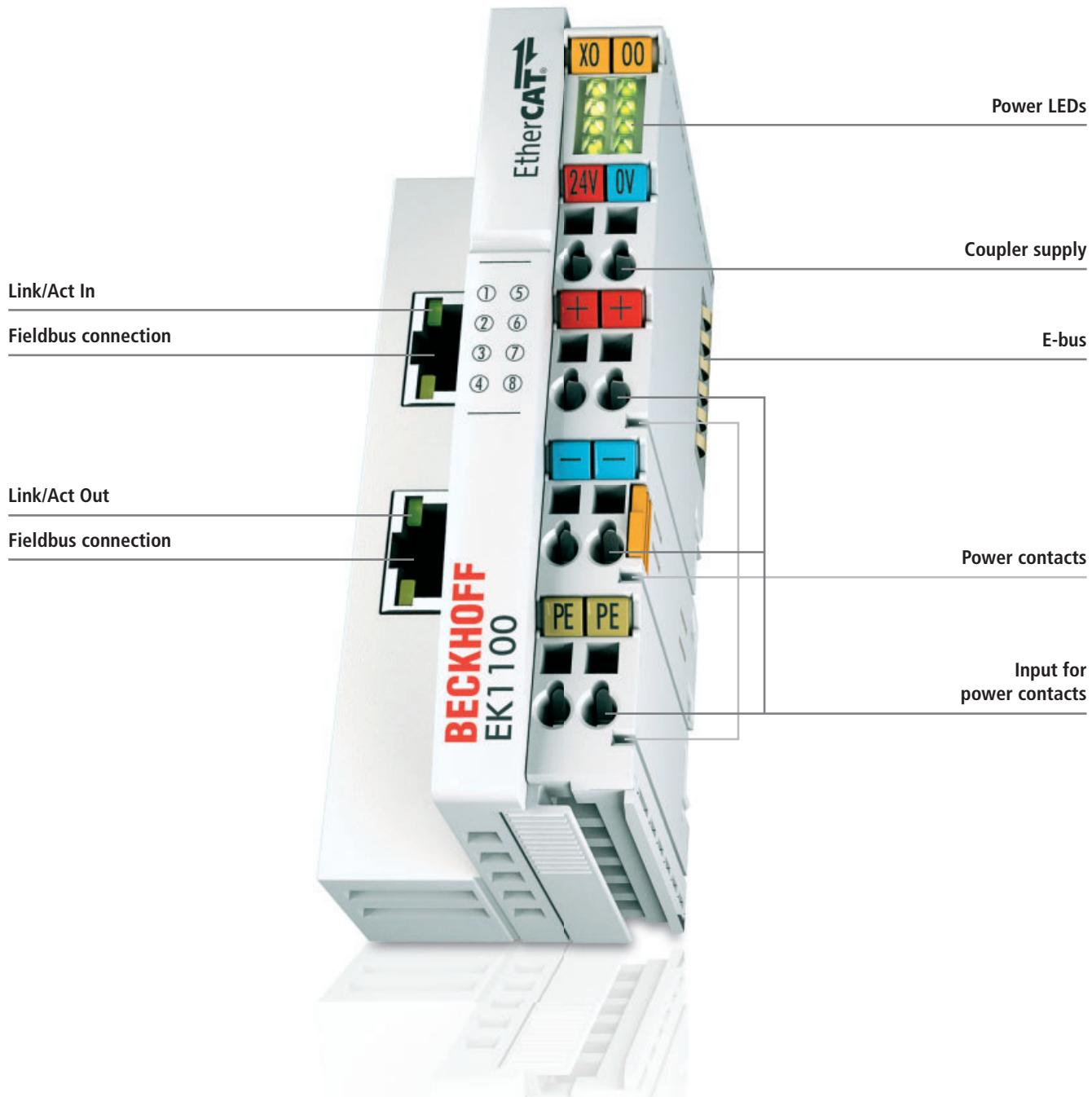
The EtherCAT Terminals have different housings. They are available with up to three power contacts and can have a variety of voltages. Care should be taken to ensure that a change in voltage always starts with a power feed terminal.

Mechanical data	ELxxxx, BK1250	EL66xx, EL67xx, EK1122, EK1521	ESxxxx	ELx80x, ELx81x, ELx889	EL1862, ELx872
Design form	compact terminal housing with signal LED	compact terminal housing with signal LED	terminal housing with pluggable wiring level	compact terminal 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 50022 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/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27				
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4				

Connection	ELxxxx, BK1250	EL66xx, EL67xx, EK1122, EK1521	ESxxxx	ELx80x, ELx81x, ELx889	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 mm <sup>2</sup> , AWG 28-14	–	s, st*: 0.08...1.5 mm <sup>2</sup>	s*: 0.08...1.5 mm <sup>2</sup> ; st: 0.25...1.5 mm <sup>2</sup> ; f: 0.14...0.75 mm <sup>2</sup>	common flat-ribbon cables
Stripping length	8...9 mm	–	9...10 mm	8...9 mm	–
Fieldbus connection	depending on fieldbus				
Power contacts	3 spring contacts				
Current load	I <sub>MAX</sub> : 10 A (125 A short-circuit)				
Nominal voltage	24 V DC				

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

# EKxxxx | EtherCAT Couplers





#### 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 RJ 45 connectors or optical fibre connectors. The number of downstream terminals is almost unlimited and is subject to only two conditions. In an EtherCAT network a maximum of 65,535 slaves are permitted. If necessary, the E-bus current has to be supplemented with an EL9410 E-bus power supply unit.

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

(coupler and terminals) has to be defined as a Hot Connect group.

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

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

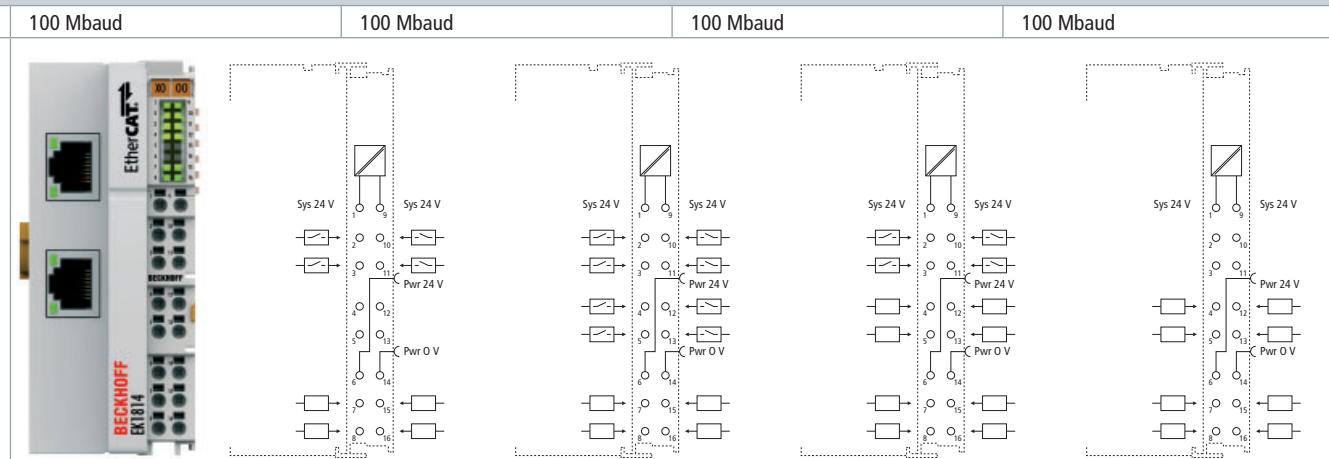
Technical data	EKxxxx
Electrical isolation	500 V
Operating/storage temperature	0...+55 °C/-25...+85 °C
Relative humidity	95 %, no condensation
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4
Protect. class/installation pos.	IP 20/see documentation

► [www.beckhoff.com/EtherCAT-Coupler](http://www.beckhoff.com/EtherCAT-Coupler)

# EtherCAT Couplers E-bus

	EtherCAT Coupler	EtherCAT Coupler with ID switch, Hot Connect	EtherCAT Coupler with 4 inputs and 4 outputs as well as 2 safe inputs and 2 safe outputs			
Technical data	EK1100	EK1101	EK1914			
Task within EtherCAT system	coupling of EtherCAT Terminals (ELxxxx) to 100BASE-TX EtherCAT networks	coupling of EtherCAT Terminals (ELxxxx) to 100BASE-TX EtherCAT networks, with identity verification	coupling of EtherCAT Terminals (ELxxxx) to 100BASE-TX EtherCAT networks			
Number of EtherCAT Terminals	up to 65,534					
Data transfer rates	100 Mbaud	100 Mbaud	100 Mbaud			
						
	<p>The EK1100 and EK1101 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 Couplers are equipped with two RJ 45 sockets. The coupler is connected to the network via the upper Ethernet interface; further EtherCAT devices can be connected in the same strand via the lower RJ 45 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.</p>					
Bus interface	2 x RJ 45	2 x RJ 45	2 x RJ 45			
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. 24 V DC	70 mA + ( $\sum$ E-bus current/4)	70 mA + ( $\sum$ E-bus current/4)	70 mA + ( $\sum$ E-bus current/4)			
Distance between stations	max. 100 m (100BASE-TX)	max. 100 m (100BASE-TX)	max. 100 m (100BASE-TX)			
Delay	approx. 1 $\mu$ s	approx. 1 $\mu$ s	approx. 1 $\mu$ s			
Power supply	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)			
Current supply E-bus	2000 mA	2000 mA	1000 mA			
Weight	approx. 105 g	approx. 105 g	approx. 95 g			
Approvals	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex, TÜV Süd			
Further information	<a href="http://www.beckhoff.com/EK1100">www.beckhoff.com/EK1100</a>	<a href="http://www.beckhoff.com/EK1101">www.beckhoff.com/EK1101</a>	<a href="http://www.beckhoff.com/EK1914">www.beckhoff.com/EK1914</a>			
Special couplers	<b>EK1101-0080</b>					
Distinguishing features	Fast Hot Connect					
Accessories						
Cordsets and connectors	see page	430	see page	430	see page	430

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			



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 RJ 45  |
|--|--|--|--|
| max. 4.2 GB addressable I/O points   |
| Ethernet/EtherCAT cable<br>(min. CAT 5), shielded                              |
| 100 mA + ( $\sum$ E-bus current/4)   |
| max. 100 m (100BASE-TX)  |
| approx. 1 $\mu$ s  |
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
CE, UL	CE, UL	CE, UL	CE
<a href="http://www.beckhoff.com/EK1814">www.beckhoff.com/EK1814</a>	<a href="http://www.beckhoff.com/EK1818">www.beckhoff.com/EK1818</a>	<a href="http://www.beckhoff.com/EK1828">www.beckhoff.com/EK1828</a>	<a href="http://www.beckhoff.com/EK1828-0010">www.beckhoff.com/EK1828-0010</a>
see page	430	see page	430
see page	430	see page	430

# EtherCAT Couplers with fibre optic connection

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



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

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

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

Bus interface	2 x SC Duplex	2 x SC Duplex	2 x ZS1090-0008 POF plug			
Type/number of peripheral signals	max. 4.2 GB addressable I/O points	max. 4.2 GB addressable I/O points	max. 4.2 GB addressable I/O points			
Current consumption 24 V DC	typ. 70 mA	typ. 70 mA	typ. 70 mA			
Distance between stations	max. 2,000 m (100BASE-FX)	max. 20,000 m (100BASE-FX)	max. 50 m (100BASE-FX)			
Delay	approx. 1 µs	approx. 1 µs	approx. 1 µs			
Power supply	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)			
Current supply E-bus	2000 mA	2000 mA	2000 mA			
Weight	approx. 190 g	approx. 190 g	approx. 190 g			
Approvals	CE, UL, Ex	CE, UL, Ex	CE			
Further information	<a href="http://www.beckhoff.com/EK1501">www.beckhoff.com/EK1501</a>	<a href="http://www.beckhoff.com/EK1501">www.beckhoff.com/EK1501</a>	<a href="http://www.beckhoff.com/EK1541">www.beckhoff.com/EK1541</a>			
Accessories						
Cordsets and connectors	Cordsets	430	Cordsets	430	Cordsets	430

# 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
<b>Technical data</b>	<b>EK1521</b>	<b>EK1521-0010</b>	<b>EK1561</b>
<b>Task within EtherCAT system</b>	coupling of EtherCAT junctions via multimode glass fibre	coupling of EtherCAT junctions via singlemode glass fibre	coupling of EtherCAT junctions via POF
<b>Data transfer medium</b>	multimode glass fibre 50/125 µm (MM)	singlemode glass fibre 9/125 µm (SM)	plastic optical fibre (POF)
<b>Data transfer rates</b>	100 Mbaud	100 Mbaud	100 Mbaud
	 <p>The EK1521 Multimode Fiber Junction module is a vertical metal enclosure. It features two circular ports at the bottom, each with a central fiber connector and a small circular indicator light above it. Above the ports, there are three green status LEDs labeled 'Run', 'Link/Act', and 'EtherCAT'. The top edge has a yellow RJ45 port. The model number 'BECKHOFF EK1521' is printed at the bottom.</p>	 <p>The EK1521-0010 Singlemode Fiber Junction module is similar in design to the EK1521, featuring two circular ports at the bottom, three green status LEDs, and a yellow RJ45 port at the top. The top edge has a yellow RJ45 port. The model number 'BECKHOFF EK1521-0010' is printed at the bottom.</p>	 <p>The EK1561 Plastic Optical Fiber Junction module is a vertical metal enclosure. It features a single large circular port at the bottom with a central fiber connector and a small circular indicator light above it. Above the port, there are three green status LEDs labeled 'Run', 'Link/Act', and 'EtherCAT'. The top edge has a yellow RJ45 port. The model number 'BECKHOFF EK1561' is printed at the bottom.</p>
	<p>In conjunction with an EK1100 EtherCAT Coupler, the 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.</p>	<p>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.</p>	
<b>Bus interface</b>	1 x SC Duplex	1 x SC Duplex	1 x ZS1090-0008 POF plug
<b>Type/number of peripheral signals</b>	–	–	–
<b>Current consumption 24 V DC</b>	–	–	–
<b>Distance between stations</b>	max. 2,000 m (100BASE-FX)	max. 20,000 m (100BASE-FX)	max. 50 m (100BASE-FX)
<b>Delay</b>	approx. 1 µs	approx. 1 µs	approx. 1 µs
<b>Power supply</b>	from E-bus	from E-bus	from E-bus
<b>Current consumption E-bus</b>	typ. 350 mA	typ. 350 mA	typ. 200 mA
<b>Weight</b>	approx. 65 g	approx. 65 g	approx. 65 g
<b>Approvals</b>	CE, UL, Ex	CE, UL, Ex	CE
<b>Further information</b>	<a href="http://www.beckhoff.com/EK1521">www.beckhoff.com/EK1521</a>	<a href="http://www.beckhoff.com/EK1521">www.beckhoff.com/EK1521</a>	<a href="http://www.beckhoff.com/EK1561">www.beckhoff.com/EK1561</a>
<b>Accessories</b>			
<b>Cordsets and connectors</b>	see page	430	see page
		430	see page
		430	430

# EtherCAT junctions and extensions

	2-port EtherCAT junction	2-port Power over EtherCAT junction	EtherCAT extension			
Technical data	EK1122	 EK1132	EK1110			
Task within EtherCAT system	coupling of EtherCAT junctions	coupling of EtherCAT junctions incl. power supply	conversion of the E-bus signals to 100BASE-TX Ethernet for extension of the EtherCAT network			
Data transfer rates	100 Mbaud					
	 <b>BECKHOFF EK1122</b>	 <b>BECKHOFF EK1132</b>	 <b>BECKHOFF EK1110</b>			
	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 RJ 45 sockets with direct display of link and activity status.	The EK1132 is based on IEEE standard 802.3af and supports power sourcing equipment (PSE), in order to ensure the supply of connected consumers (power devices, PD) via the 4-wire standard EtherCAT/Ethernet cable. The signal and energy transfer takes place on the same wires, so that 4-wire cables can be used. The Power over EtherCAT sensors are connected via a 4-pin connector, e.g. M12. Plug X3 is included in the scope of supply.	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 RJ 45 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 RJ 45	2 x RJ 45	1 x RJ 45			
Data transfer medium	Ethernet/EtherCAT cable (min. CAT 5), shielded	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)	100 m (100BASE-TX)			
Delay	approx. 1 µs	approx. 1 µs	approx. 1 µs			
Power supply	from E-bus	from E-bus and external power supply	from E-bus			
Current consumption E-bus	typ. 220 mA	typ. 220 mA	typ. 130 mA			
Weight	approx. 65 g	approx. 85 g	approx. 50 g			
Approvals	CE, UL, Ex	CE	CE, UL, Ex			
Further information	<a href="http://www.beckhoff.com/EK1122">www.beckhoff.com/EK1122</a>	<a href="http://www.beckhoff.com/EK1132">www.beckhoff.com/EK1132</a>	<a href="http://www.beckhoff.com/EK1110">www.beckhoff.com/EK1110</a>			
Special couplers	<b>EK1122-0080</b>					
Distinguishing features	Fast Hot Connect					
Accessories						
Cordsets and connectors	see page	430	see page	430	see page	430

 For availability status see Beckhoff website at: [www.beckhoff.com/EK1132](http://www.beckhoff.com/EK1132)

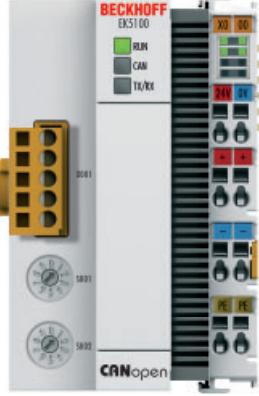
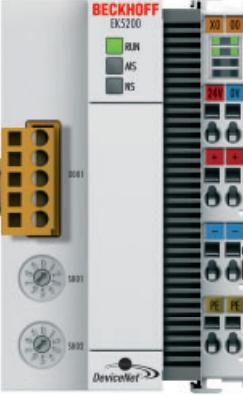
# EtherCAT Couplers K-bus

	EtherCAT "Economy plus" Bus Coupler for up to 64 Bus Terminals (255 with K-bus extension)	EtherCAT "Compact" Bus Coupler for up to 64 Bus Terminals (255 with K-bus extension)	EtherCAT "Compact" coupler between E-bus and K-bus Terminals	
Technical data	BK1120	BK1150	BK1250	
Number of Bus Terminals	64 (255 with K-bus extension)			
Max. number of bytes fieldbus	1,024 byte input and 1,024 byte output			
Current supply K-bus	1,750 mA	2,000 mA	500 mA	
	 <p>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.</p>	 <p>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.</p>	 <p>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.</p>	
Bus interface	2 x RJ 45	2 x RJ 45	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	0...+55 °C	0...+55 °C	
Approvals	CE, UL, Ex	CE	CE, UL, Ex	
Further information	<a href="http://www.beckhoff.com/BK1120">www.beckhoff.com/BK1120</a>	<a href="http://www.beckhoff.com/BK1150">www.beckhoff.com/BK1150</a>	<a href="http://www.beckhoff.com/BK1250">www.beckhoff.com/BK1250</a>	
Accessories				
Cordsets and connectors	see page	430	see page	430

Bus Terminals see page **498**

# Bus Couplers for EtherCAT Terminals



	PROFIBUS Bus Coupler	CANopen Bus Coupler	DeviceNet Bus Coupler
Technical data	<a href="#">EK3100</a>	<a href="#">EK5100</a>	<a href="#">EK5200</a>
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 CANopen networks	coupling of standard digital and analog EtherCAT Terminals and EtherCAT Box modules to DeviceNet networks
Number of EtherCAT Terminals	depending on the process data size		
Data transfer rates	up to 12 Mbaud (automatic detection)	up to 1 Mbaud (automatic detection)	up to 500 kbaud (automatic detection)
	 <p>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.</p>	 <p>The EK5100 Bus Coupler converts the telegrams from CANopen to the E-bus signal representation. The coupler supports the CANopen profile and fits seamlessly into CANopen networks.</p>	 <p>The EK5200 Bus Coupler converts the telegrams from DeviceNet to the E-bus signal representation. The coupler supports the DeviceNet profile and fits seamlessly into DeviceNet networks.</p>
Protocol	PROFIBUS DP	CANopen	DeviceNet
Bus interface	1 x D-sub 9-pin socket with shielding	1 x open style connector, 5-pin, included	1 x open style connector, 5-pin, included
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 %)
Approvals	CE	CE	CE
Further information	<a href="http://www.beckhoff.com/EK3100">www.beckhoff.com/EK3100</a>	<a href="http://www.beckhoff.com/EK5100">www.beckhoff.com/EK5100</a>	<a href="http://www.beckhoff.com/EK5200">www.beckhoff.com/EK5200</a>
Accessories			
Cordsets and connectors	see page <a href="#">430</a>	see page <a href="#">430</a>	see page <a href="#">430</a>
PC Fieldbus Cards	FC310x <a href="#">728</a>	FC510x <a href="#">730</a>	FC520x <a href="#">732</a>

**i** For availability status see Beckhoff website at: [www.beckhoff.com/EK3100](http://www.beckhoff.com/EK3100)

**Ethernet**

Ethernet Bus Coupler	PROFINET IO Bus Coupler	EtherNet/IP Bus Coupler	SERCOS III Bus Coupler
<b>i EK9000</b>	<b>i EK9300</b>	<b>i EK9500</b>	<b>i EK9700</b>
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 PROFINET IO networks	coupling of standard digital and analog EtherCAT Terminals and EtherCAT Box modules to EtherNet/IP networks	coupling of standard digital and analog EtherCAT Terminals and EtherCAT Box modules to SERCOS III networks

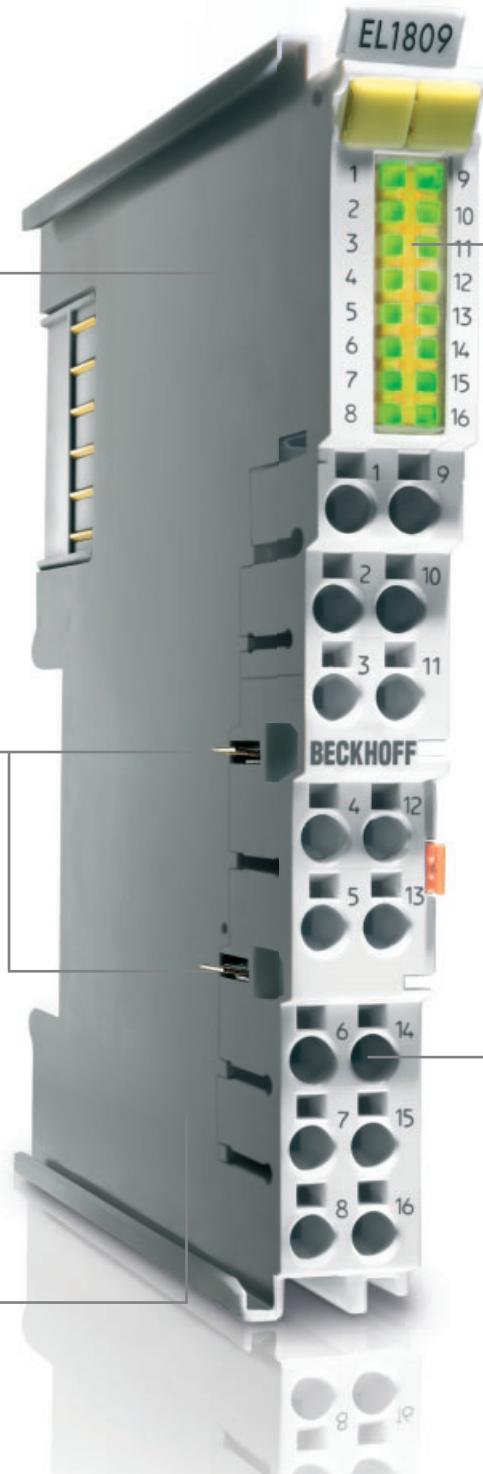
10/100 Mbaud	10/100 Mbaud	10/100 Mbaud	10/100 Mbaud
<p>The EK9000 Bus Coupler converts the telegrams from Ethernet to the E-bus signal representation. The coupler supports the EAP and Modbus TCP protocol and fits seamlessly into Ethernet networks.</p>	<p>The EK9300 Bus Coupler converts the telegrams from PROFINET IO to the E-bus signal representation. The coupler supports the PROFINET IO profile and fits seamlessly into PROFINET IO networks.</p>	<p>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.</p>	<p>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.</p>
EAP (EtherCAT Automation Protocol), Modbus TCP, ADS/TCP, ADS/UDP	PROFINET RT	EtherNet/IP	SERCOS III I/O profile
2 x RJ 45 (switched)	2 x RJ 45 (switched)	2 x RJ 45 (switched)	2 x RJ 45 (switched)
depending on the process data size	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 %)	24 V DC (-15 %/+20 %)
CE	CE	CE	CE
<a href="http://www.beckhoff.com/EK9000">www.beckhoff.com/EK9000</a>	<a href="http://www.beckhoff.com/EK9300">www.beckhoff.com/EK9300</a>	<a href="http://www.beckhoff.com/EK9500">www.beckhoff.com/EK9500</a>	<a href="http://www.beckhoff.com/EK9700">www.beckhoff.com/EK9700</a>
see page FC90xx	see page FC90xx	see page FC90xx	see page FC750x
430	430	430	430
734	734	734	733

# EtherCAT | I/O modules with 100 Mbit communication

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

The terminals are supplied with field voltage by the power contacts which are available on the left hand side, provided that the terminals have power contacts. Depending on the terminals 24 V DC, 230 V AC or other voltages are transferred by the power contacts. The supply power required for each terminal, which is provided through the power contacts, is listed in the technical data of each terminal. The maximum load of the power contacts is 10 A.

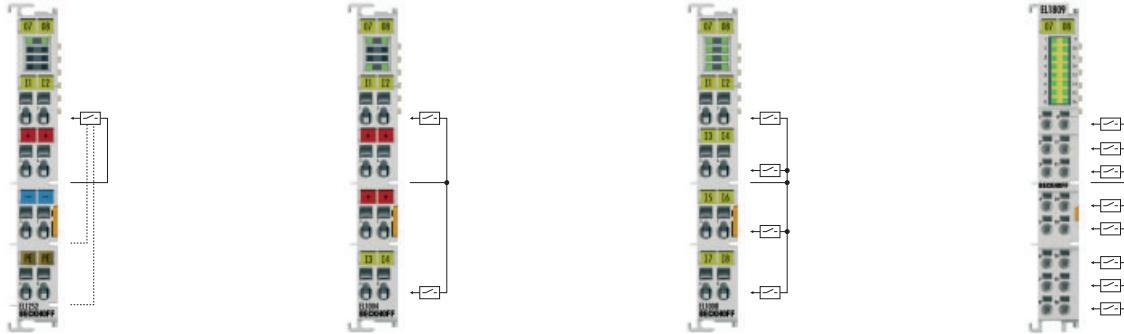
Some 2-channel EtherCAT Terminals have a PE power contact, which can be used for PE distribution by connecting it together with similar terminals. The EMC spring contact on the underside of the terminal only serves to remove interference  $\oplus$  and may not be used as a protective earth  $\ominus$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



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 mm<sup>2</sup> spring-loaded technique
- HD EtherCAT Terminal: 0.08...0.75 mm<sup>2</sup> (with ferrule); 0.08...1.5 mm<sup>2</sup> (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



#### 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, EL2xxx EtherCAT Terminal product family is designed for the processing of digital or binary signals. There are "High" and "Low" states. In the positive switching logic the High state corresponds to the level of the supply voltage, the Low state

corresponds to ground level. For negative switching logic it is the other way around. The EtherCAT Terminal product family supports both types of logic for various supply voltages. 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 Terminal product family processes analogue signals. The most commonly used are 0...10 V, ±10 V, 0...20 mA and 4...20 mA. Also many other industry-standard voltage and current signals are supported and pre-processed.

In the EL5xxx and EL6xxx EtherCAT Terminal product families other complex signals, such as position values and digital interfaces, are supported. Some EtherCAT Terminals

act as fieldbus masters for subordinate bus systems. The EtherCAT Terminal station thus becomes a universal gateway between different systems.

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

Some modules referred to as 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 voltage); if not indicated otherwise
Operating/storage temperature	0...+55 °C/-25...+85 °C
Relative humidity	95 %, no condensation
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4
Protect. class/installation pos.	IP 20/variable according to DIN EN 60529 (see documentation)
Pluggable wiring	for all ESxxxx terminals

► [www.beckhoff.com/EtherCAT-IO](http://www.beckhoff.com/EtherCAT-IO)

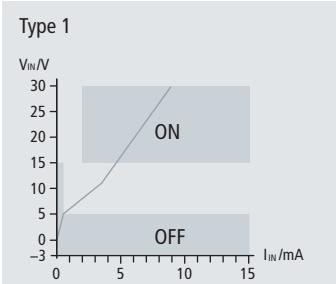
# Digital input | 24 V DC, positive switching

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

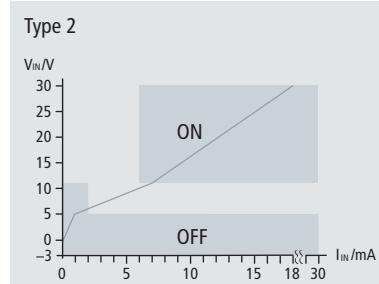
shows the typical current/voltage curves of the EtherCAT Terminal inputs and the allowable range of conformity in accordance with the standard.

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

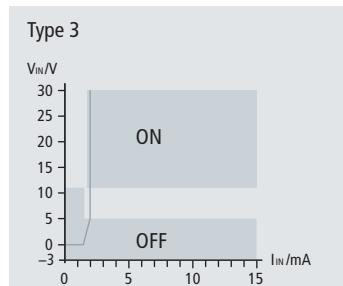
XFC terminals with a filter time of << 1 µs are available for particularly fast signals and exact edge identification.



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

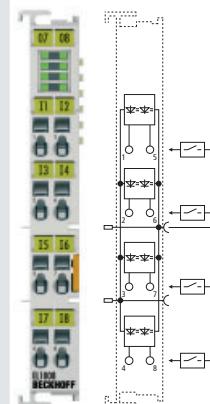


Signal voltage "0": -3...5 V DC  
Signal voltage "1": 11...30 V DC

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

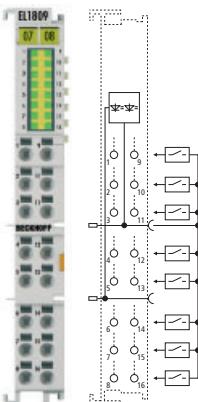
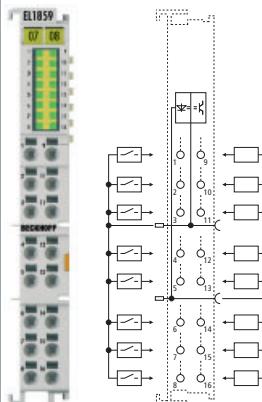
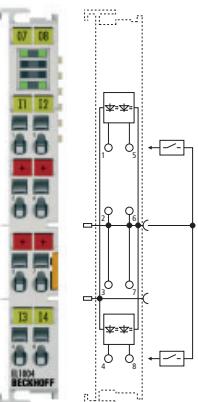
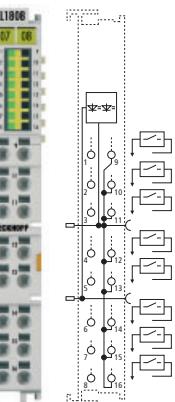
Technical data	EL1008   ES1008	EL1018   ES1018
Connection technology	1-wire	
Specification	EN 61131-2, type 1/3	
Input filter	typ. 3.0 ms	typ. 10 µs
Number of inputs	8	



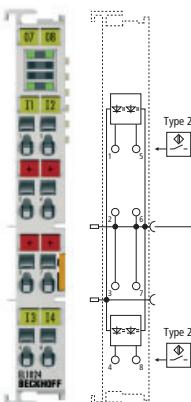
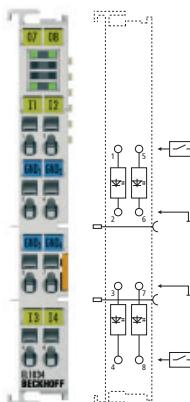
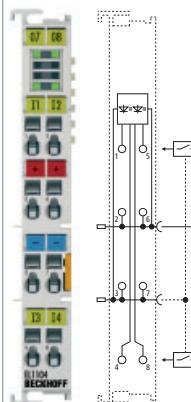
The EL1008 and EL1018 digital input terminals acquire the binary control signals from the process level and transmit them, in an electrically isolated form, to the higher-level automation unit.

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	0...+55 °C
Approvals	CE, UL, Ex
Weight	approx. 55 g
Further information	<a href="http://www.beckhoff.com/EL1008">www.beckhoff.com/EL1008</a>
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	4-channel digital input terminal, 2-wire, 24 V DC, type 1/3	8-channel digital input terminal, 2-wire, 24 V DC, type 1/3		
EL1809	EL1819	EL1859			
		2-wire			

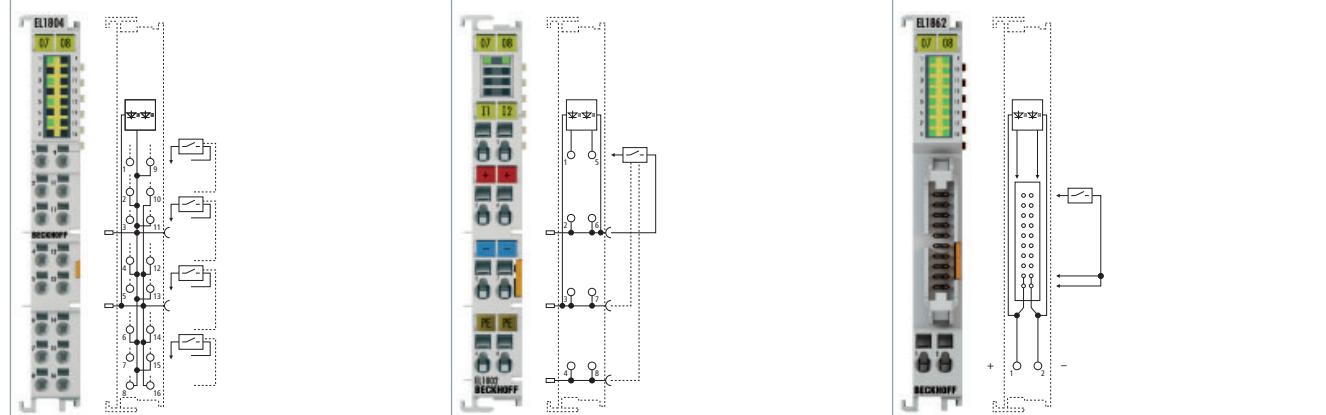
typ. 3.0 ms	typ. 10 µs	typ. 3.0 ms	typ. 3.0 ms	typ. 10 µs	typ. 3.0 ms
16		8 inputs + 8 outputs	4		8
					
With 16 input channels and only 12 mm width the EL1809 and EL1819 digital input terminals are suitable for space-saving control cabinet installation. Reference ground for all terminal points is the 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. <ul style="list-style-type: none"> <li>– number of outputs: 8</li> <li>– max. output current: 0.5 A (per channel)</li> <li>– load type: ohmic, inductive, lamp load</li> <li>– reverse voltage protection: yes</li> </ul>	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.	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.		
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. 90 mA	typ. 100 mA		
–	–	–	–		
standard input terminal with high number of channels for slow or fast 24 V DC edges, direct plug-in technique	direct plug-in technique, 8 x output 24 V DC/0.5 A	standard input terminals for 2-wire connection	direct plug-in technique, 2-wire connection		
0...+55 °C	0...+55 °C	0...+55 °C	0...+55 °C		
CE, UL, Ex	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex		
approx. 65 g	approx. 65 g	approx. 50 g	approx. 60 g		
www.beckhoff.com/EL1809	www.beckhoff.com/EL1859	www.beckhoff.com/EL1004	www.beckhoff.com/EL1808		
		EL1004-0020			
		isolation voltage > 2,500 V			

# Digital input | 24 V DC, positive switching

	4-channel digital input terminal, 2-wire, 24 V DC, type 2	4-channel digital input terminal, 2-wire, 24 V DC, type 1	4-channel digital input terminal, 2-/3-wire, 24 V DC, type 1/3	
<b>Technical data</b>	<b>EL1024   ES1024</b>	<b>EL1034   ES1034</b>	<b>EL1104   ES1104</b>	<b>EL1114   ES1114</b>
<b>Connection technology</b>	2-wire		2-/3-wire	
<b>Specification</b>	EN 61131-2, type 2		EN 61131-2, type 1	
<b>Input filter</b>	typ. 3.0 ms		typ. 3.0 ms	typ. 10 µs
<b>Number of inputs</b>	4		4	
				
	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.	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.	
<b>Nominal voltage</b>	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)	
<b>Current consumption power contacts</b>	typ. 30 mA + load	–	typ. 2 mA + load	
<b>Current consumption E-bus</b>	typ. 90 mA	typ. 90 mA	typ. 90 mA	
<b>Distributed clocks</b>	–	–	–	
<b>Special features</b>	type 2	4 electrically isolated fast inputs, potential-free	4 inputs for 2- and 3-wire connection	
<b>Operating temperature</b>	0...+55 °C	0...+55 °C	0...+55 °C	
<b>Approvals</b>	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex	
<b>Weight</b>	approx. 50 g	approx. 50 g	approx. 55 g	
<b>Further information</b>	<a href="http://www.beckhoff.com/EL1024">www.beckhoff.com/EL1024</a>	<a href="http://www.beckhoff.com/EL1034">www.beckhoff.com/EL1034</a>	<a href="http://www.beckhoff.com/EL1104">www.beckhoff.com/EL1104</a>	
<b>Special terminals</b>				
<b>Distinguishing features</b>				

4-channel digital input terminal, 3-wire, 24 V DC, type 1/3	2-channel digital input terminal, 4-wire, 24 V DC, type 1/3	16-channel digital input terminal, flat-ribbon cable connection, 24 V DC, type 1/3
EL1804	EL1814	EL1002   ES1002
3-wire	4-wire	flat-ribbon cable

typ. 3.0 ms	typ. 10 µs	typ. 3.0 ms	typ. 10 µs	typ. 3.0 ms	typ. 10 µs
4		2		16	



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.

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.

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.

24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)	24 V DC (-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
-	-	-
-	4-wire connection	also available as negative switching
0...+55 °C	0...+55 °C	0...+55 °C
CE, UL, Ex	CE, UL, Ex	CE, UL, Ex
approx. 60 g	approx. 50 g	approx. 50 g
www.beckhoff.com/EL1804	www.beckhoff.com/EL1002	www.beckhoff.com/EL1862
		<b>EL1862-0010</b>
		negative switching, see page

# 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 [294](#)

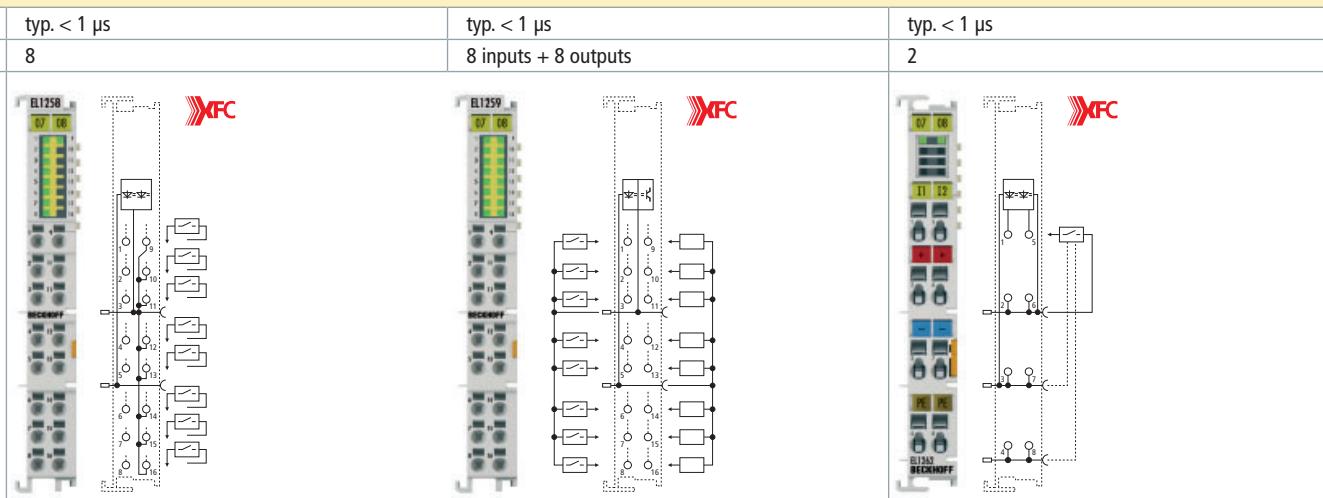


2-channel digital  
input terminal, 24 V DC,  
4-wire, fast input

2-channel digital  
input terminal, 24 V DC,  
4-wire, time stamp

Technical data	EL1202   ES1202	EL1252   ES1252
<b>Connection technology</b>	4-wire	
<b>Specification</b>	similar to EN 61131-2, type 3, "0": -3...5 V DC, "1": 11...30 V DC, typ. 3 mA input current	
<b>Input filter</b>	typ. < 1 µs	typ. < 1 µs
<b>Number of inputs</b>	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 time stamp (1 ns triggering) to each edge change as a process data.
<b>Nominal voltage</b>	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)
<b>Current consum. pow. cont.</b>	typ. 6 mA + load	typ. 6 mA + load
<b>Current consumption E-bus</b>	typ. 110 mA	typ. 110 mA
<b>Distributed clocks</b>	yes	yes
<b>Time resolution signal</b>	–	1 ns
<b>Precision of time stamp in the terminal</b>	10 ns (+ input delay)	10 ns (+ input delay)
<b>Distributed clock precision</b>	<< 1 µs	<< 1 µs
<b>Oversampling factor</b>	–	–
<b>Sampling rate</b>	–	–
<b>Special features</b>	DC can be activated, see documentation	time stamp, latch last edge
<b>Operating temperature</b>	0...+55 °C	0...+55 °C
<b>Approvals</b>	CE, UL, Ex	CE, UL, Ex
<b>Weight</b>	approx. 55 g	approx. 55 g
<b>Further information</b>	<a href="http://www.beckhoff.com/EL1202">www.beckhoff.com/EL1202</a>	<a href="http://www.beckhoff.com/EL1252">www.beckhoff.com/EL1252</a>
<b>Special terminals</b>	<b>EL1252-0050</b>	
<b>Distinguishing features</b>	5 V inputs	

8-channel digital input terminal, 24 V DC, 2-wire, time stamp	8-channel digital input + 8-channel digital output, 24 V DC, 1-wire, time stamp	2-channel digital input terminal, 24 V DC, 4-wire, oversampling
<b>EL1258</b>	<b>EL1259</b>	<b>EL1262   ES1262</b>
2-wire	1-wire	4-wire



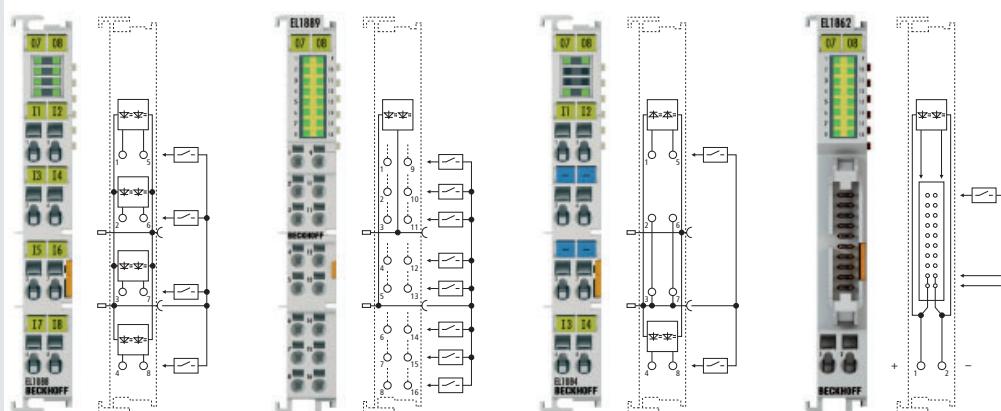
The ELx258 EtherCAT HD terminals with time stamp technology offer optimised sensor/actuator control with high channel density and compact design. In contrast to the ELx252 series with a time stamp interval of 1 ns, the EL1258, EL1259 and EL2258 operate with a 25 µs interval. They can sample inputs or issue outputs at these intervals, synchronised through the distributed clocks. The 16-channel digital EL1259 EtherCAT Terminal combines the functions of the EL1258 – eight time stamp inputs – with those of the EL2258 – eight time stamp outputs. Multi-time stamping 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. 110 mA	typ. 70 mA
yes	yes	yes
25 µs	25 µs	≥ 1 µs, adjustable
< 1 µs	< 1 µs	10 ns (+ input delay)
<< 1 µs	<< 1 µs	<< 1 µs
n = integer multiple of the cycle time, 1...10	n = integer multiple of the cycle time, 1...10	n = integer multiple of the cycle time, 1...1,000, see documentation
40 ksamples/s (25 µs)	40 ksamples/s (25 µs)	max. 1 Msample/s
multi-time stamping	multi-time stamping, auto activation	oversampling
0...+55 °C	0...+55 °C	0...+55 °C
CE	CE	CE, UL, Ex
approx. 55 g	approx. 55 g	approx. 60 g
<a href="http://www.beckhoff.com/EL1258">www.beckhoff.com/EL1258</a>	<a href="http://www.beckhoff.com/EL1259">www.beckhoff.com/EL1259</a>	<a href="http://www.beckhoff.com/EL1262">www.beckhoff.com/EL1262</a>
		<b>EL1262-0050</b>
		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		



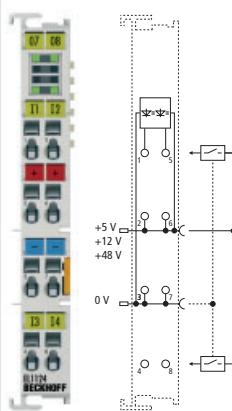
The EL terminals of the EL108x and EL109x series and the EL1862-0010 interpret input signals with negative logic: 0 V signal level means logic "1". The rated voltage level is read as logic "0". Versions with 10 µs input filter are available for sampling fast input edges. The slow 3 ms filter enables 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.

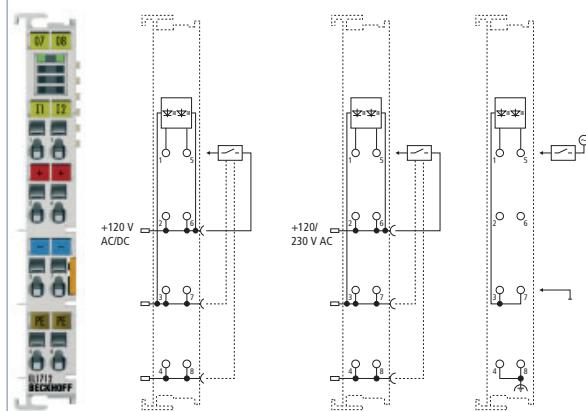
Nominal voltage	24 V DC (-15 %/+20 %)			
Current consumption power contacts	typ. 25 mA	typ. 35 mA	typ. 20 mA	typ. 35 mA
Current consumption E-bus	typ. 90 mA	typ. 110 mA	typ. 90 mA	typ. 100 mA
Distributed clocks	–	–	–	–
Special features	–	–	2-wire connection	–
Operating temperature	0...+55 °C	0...+55 °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	<a href="http://www.beckhoff.com/EL1088">www.beckhoff.com/EL1088</a>	<a href="http://www.beckhoff.com/EL1889">www.beckhoff.com/EL1889</a>	<a href="http://www.beckhoff.com/EL1084">www.beckhoff.com/EL1084</a>	<a href="http://www.beckhoff.com/EL1862">www.beckhoff.com/EL1862</a>

# 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, 4-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
<b>Technical data</b>	<b>EL1124   ES1124</b>	<b>EL1144   ES1144</b>	<b>EL1134   ES1134</b>	<b>EL1712   ES1712</b>	<b>EL1702   ES1702</b>	<b>EL1722   ES1722</b>
<b>Connection technology</b>	2-/3-wire		4-wire			
<b>Specification</b>	"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
<b>Input filter</b>	typ. 0.05 µs		typ. 10 µs	typ. 10 µs	typ. 10 ms	typ. 10 ms
<b>Number of inputs</b>	4		4	2	2	2



The digital EL11x4 input terminals are suitable for reading logical signals based on direct current: EL1124 (5 V DC), EL1144 (12 V DC) and EL1134 (48 V DC). The EL9505 power supply terminals (5 V DC, for EL1124) and EL9512 (12 V DC, for EL1144) are available for feeding in the supply voltage at the power contacts. The EL9190 potential supply terminal in conjunction with an external 48 V DC power supply unit can be used for supplying the EL1134.



The EL17x2 digital input terminals are suitable for recording logic signals ≥ 120 V. The EL1712 is suitable for both DC and AC voltages and can therefore be used in the voltage range 120 V AC/DC. Using the EL1702 and EL1722, logic signals can be recorded on a 120 or 230 V AC basis. The EL1722 is suitable for the construction of individual potential groups, since it has no power contacts.

Nominal voltage	5 V DC	12 V DC	48 V DC	120 V AC/DC	120/230 V AC	120/230 V AC
Current consumption power contacts	typ. 14 mA + load	typ. 14 mA + load	typ. 10 mA + load	–	–	–
Current consumption E-bus	typ. 90 mA	typ. 90 mA	typ. 90 mA	typ. 110 mA	typ. 110 mA	typ. 110 mA
Distributed clocks	–	–	–	–	–	–
Electrical isolation	500 V (E-bus/field potential)	500 V (E-bus/field potential)	500 V (E-bus/field potential)	500 V (E-bus/mains voltage); 3,750 V AC, 1 min.	500 V (E-bus/mains voltage); 3,750 V AC, 1 min.	500 V (E-bus/mains voltage); 3,750 V AC, 1 min.
Special features	fast CMOS input	–	–	also suitable for 120 V DC	–	no power contacts
Operating temperature	0...+55 °C	0...+55 °C	0...+55 °C	0...+55 °C	0...+55 °C	0...+55 °C
Approvals	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex	CE	CE	CE
Weight	approx. 55 g	approx. 55 g	approx. 55 g	approx. 60 g	approx. 60 g	approx. 60 g
Further information	www.beckhoff.com/EL1124	www.beckhoff.com/EL1144	www.beckhoff.com/EL1134	www.beckhoff.com/EL1712	www.beckhoff.com/EL1702	www.beckhoff.com/EL1722

**i** For availability status see Beckhoff website at: [www.beckhoff.com/EL1712](http://www.beckhoff.com/EL1712)

# Digital input | 24 V DC, counter

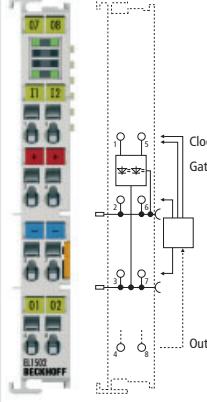
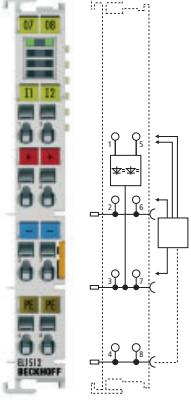
Pulses often need to be captured in technical control applications. This can be done with fast inputs such as EL1202 and a central pulse counter. If the pulse length is the order of magnitude of the control cycle time or less, the controller cannot record these signals correctly any more. Pre-processing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

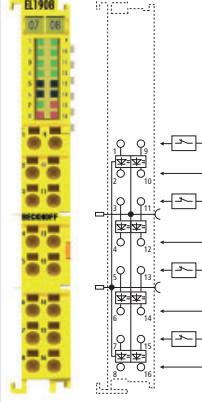
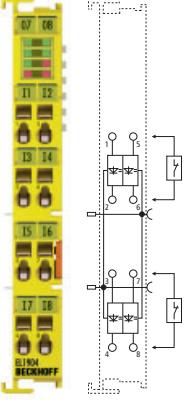
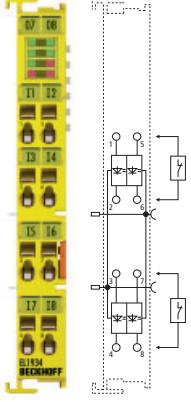
- 1 x 32 bit up/down counter (the counting direction is specified via the input)
- 1 x 32 bit gated counter (the counter is enabled via the input)
- 2 x 32 bit forward counter (no direction detection)

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

# Digital input | 24 V DC, TwinSAFE, PROFIsafe

	8-channel digital input terminal, TwinSAFE, 24 V DC	4-channel digital input terminal, TwinSAFE, 24 V DC	4-channel digital input terminal, PROFIsafe, 24 V DC
Technical data	<b>i</b> EL1908	EL1904	EL1934
Connection technology	1-/2-wire		
Safety standard	IEC 61508 SIL 3 and DIN EN ISO 13849-1:2008 PLe		
Number of inputs	8	4	4
	 <p>The EL1908 Safety EtherCAT Terminal has eight fail-safe inputs.</p>	 <p>The EL1904 Safety EtherCAT Terminal has four fail-safe inputs.</p>	 <p>The EL1934 PROFIsafe terminal has four fail-safe inputs.</p>
Protocol	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. 200 mA	approx. 200 mA	approx. 200 mA
Response time	typ. 4 ms (read input/write to E-bus)	typ. 4 ms (read input/write to E-bus)	typ. 4 ms (read input/write to E-bus)
Fault response time	≤ watchdog time (parameterisable)	≤ watchdog time (parameterisable)	≤ watchdog time (parameterisable)
Permiss. degree of contamination	2	2	2
Climate class EN 60721-3-3	3K3	3K3	3K3
Installation position	horizontal	horizontal	horizontal
Special features	8 safe inputs	4 safe inputs	4 safe inputs; may only be operated on PROFIBUS/PROFINET
Operating temperature	0...+55 °C	0...+55 °C	0...+55 °C
Electrical interference	EN 61000-6-2/EN 61000-6-4	EN 61000-6-2/EN 61000-6-4	EN 61000-6-2/EN 61000-6-4
Vibration/shock resistance	EN 60068-2-6/EN 60068-2-27	EN 60068-2-6/EN 60068-2-27	EN 60068-2-6/EN 60068-2-27
Approvals	CE, UL, Ex, TÜV Süd	CE, UL, Ex, TÜV Süd	CE, UL, Ex, TÜV Süd
Weight	approx. 50 g	approx. 50 g	approx. 50 g
Protection class	IP 20	IP 20	IP 20
Further information	<a href="http://www.beckhoff.com/EL1908">www.beckhoff.com/EL1908</a>	<a href="http://www.beckhoff.com/EL1904">www.beckhoff.com/EL1904</a>	<a href="http://www.beckhoff.com/EL1934">www.beckhoff.com/EL1934</a>

For TwinSAFE products and further information on the TwinSAFE technology see page **914**

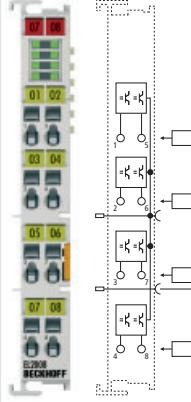
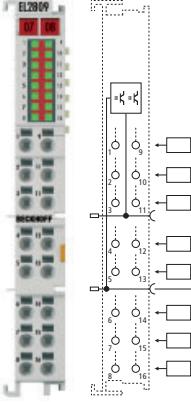
**i** For availability status see Beckhoff website at: [www.beckhoff.com/EL1908](http://www.beckhoff.com/EL1908)

# Digital output | 24 V DC, positive switching

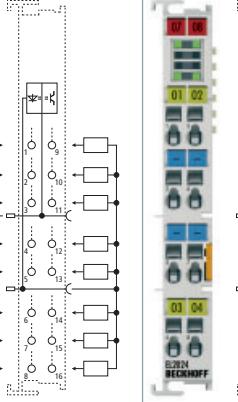
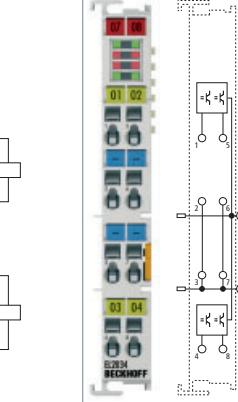
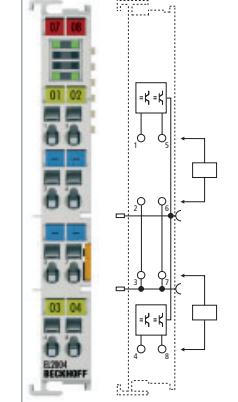
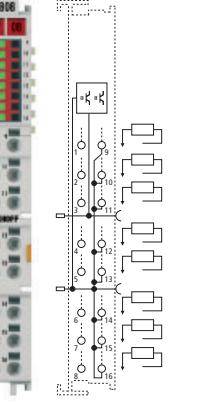
Many actuators are driven or controlled with 24 V DC. The EtherCAT Terminals of the "positive switching" category switch all output channels to 24 V DC, so all connected actuators are hard-wired to ground (0 V). The output of an EtherCAT Terminal can be considered as a functional 24 V DC relay contact.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

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

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

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	
<b>Technical data</b>	<b>EL2008   ES2008</b>	<b>EL2809</b>
<b>Connection technology</b>	1-wire	
<b>Load type</b>	ohmic, inductive, lamp load	
<b>Max. output current</b>	0.5 A (short-circuit-proof) per channel	0.5 A (short-circuit-proof) per channel
<b>Switching times</b>	typ. $T_{ON}$ : 60 $\mu$ s, typ. $T_{OFF}$ : 300 $\mu$ s	typ. $T_{ON}$ : 60 $\mu$ s, typ. $T_{OFF}$ : 300 $\mu$ s
<b>Number of outputs</b>	8	16
	 8-channel standard output terminal for 1-wire connection; output signalling through LED	 16-channel standard output terminal for 1-wire connection; output signalling through LED
<b>Nominal voltage</b>	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)
<b>Current consum. pow. cont.</b>	typ. 15 mA + load	typ. 35 mA + load
<b>Current consumption E-bus</b>	typ. 110 mA	typ. 140 mA
<b>Distributed clocks</b>	—	—
<b>Breaking energy</b>	< 150 mJ/channel	< 150 mJ/channel
<b>Reverse voltage protection</b>	yes	yes
<b>Short circuit current</b>	typ. < 2 A	typ. < 2 A
<b>Special features</b>	—	—
<b>Operating temperature</b>	0...+55 °C	0...+55 °C
<b>Approvals</b>	CE, UL, Ex	CE, UL, Ex
<b>Weight</b>	approx. 55 g	approx. 70 g
<b>Further information</b>	<a href="http://www.beckhoff.com/EL2008">www.beckhoff.com/EL2008</a>	<a href="http://www.beckhoff.com/EL2809">www.beckhoff.com/EL2809</a>
<b>Special terminals</b>		
<b>Distinguishing features</b>		

8-channel digital input + 8-channel digital output, 1-wire, 24 V DC, 0.5 A	4-channel digital output terminal, 2-wire, 24/12 V DC, 2 A	4-channel digital output terminal, 2-wire, 24 V DC, 2 A, with diagnostics	4-channel digital output terminal, 2-wire, 24 V DC, 0.5 A	8-channel digital output terminal, 2-wire, 24 V DC, 0.5 A
<b>EL1859</b>	<b>EL2024   ES2024</b>	<b>EL2034   ES2034</b>	<b>EL2004   ES2004</b>	<b>EL2808</b>
2-wire				

0.5 A (short-circuit-proof) per channel	2.0 A (short-circuit-proof) per channel	2.0 A (short-circuit-proof) per channel, with diagnostics	0.5 A (short-circuit-proof) per channel	0.5 A (short-circuit-proof) per channel
typ. $T_{ON}$ : 60 $\mu$ s, typ. $T_{OFF}$ : 300 $\mu$ s	typ. $T_{ON}$ : 40 $\mu$ s, typ. $T_{OFF}$ : 200 $\mu$ s	typ. $T_{ON}$ : 40 $\mu$ s, typ. $T_{OFF}$ : 200 $\mu$ s	typ. $T_{ON}$ : 60 $\mu$ s, typ. $T_{OFF}$ : 300 $\mu$ s	typ. $T_{ON}$ : 60 $\mu$ s, typ. $T_{OFF}$ : 300 $\mu$ s
8 outputs + 8 inputs	4	4	4	8
				
Combi EtherCAT Terminal with 8 digital inputs and outputs in HD direct plug-in technique and 1-wire connection – number of inputs: 8 – input filter: 3 ms – type: 1/3	Direct 2-wire connection of 4 actuators	Direct 2-wire connection of 4 actuators with diag- nostics over EtherCAT	The digital EL2004 EtherCAT Terminal is suitable for the con- nection of four 2-wire actuators.	The EL2808 High Density EtherCAT Terminal contains eight outputs for the connection of 2-wire actuators and thus allows a very high packing density.
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. 13 mA + load	typ. 14 mA + load	typ. 15 mA + load	typ. 15 mA + load
typ. 110 mA	typ. 120 mA	typ. 120 mA	typ. 100 mA	typ. 110 mA
–	–	–	–	–
< 150 mJ/channel	< 1.7 J/channel	< 1.7 J/channel	< 150 mJ/channel	< 150 mJ/channel
yes	yes	yes	yes	yes
typ. < 2 A	typ. < 70 A	typ. < 70 A	typ. < 2 A	typ. < 2 A
combi EtherCAT Terminal, 8 x input 24 V DC	–	diagnostics: short circuit and open circuit	–	–
0...+55 °C	0...+55 °C	0...+55 °C	0...+55 °C	0...+55 °C
CE, Ex	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex
approx. 65 g	approx. 55 g	approx. 55 g	approx. 55 g	approx. 65 g
<a href="http://www.beckhoff.com/EL1859">www.beckhoff.com/EL1859</a>	<a href="http://www.beckhoff.com/EL2024">www.beckhoff.com/EL2024</a>	<a href="http://www.beckhoff.com/EL2034">www.beckhoff.com/EL2034</a>	<a href="http://www.beckhoff.com/EL2004">www.beckhoff.com/EL2004</a>	<a href="http://www.beckhoff.com/EL2808">www.beckhoff.com/EL2808</a>
	<b>EL2024-0010</b>			
	nominal voltage 12 V DC			

# 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 time. 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. The EL2xx XFC output terminals connect their outputs correspondingly fast and with distributed clock accuracy.

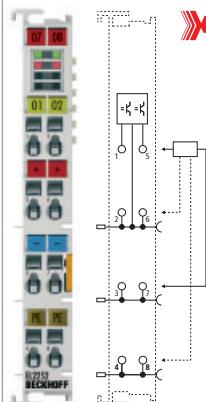
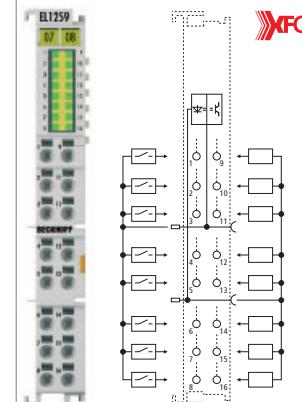
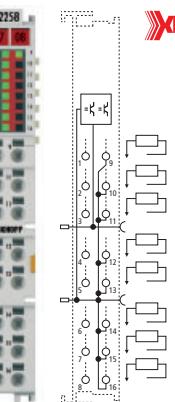
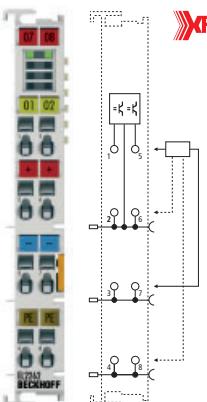
The EL2212 supports the particularly fast switching of inductive loads, such as valves. 24...72 V supplies are connected to the power contacts and passed through to the load when switched on. After an adjustable waiting period the terminal begins to control the current channel-wise in order to protect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

The ELx258 EtherCAT HD terminals with time stamp technology offer optimised sensor/actuator control with high channel density and compact design. In contrast to the ELx252 series with a time stamp interval of 1 ns, the EL1258, EL1259 and EL2258 operate with a 25 µs interval. They can sample inputs or issue outputs at these intervals, synchronised through the distributed clocks.

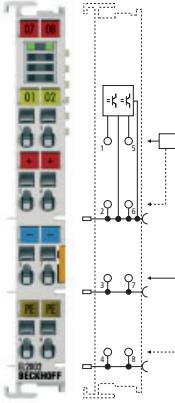
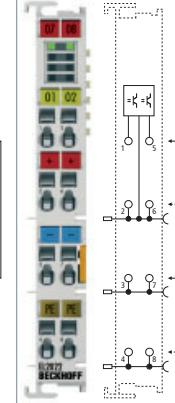
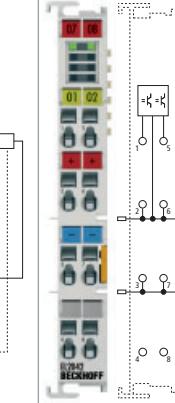
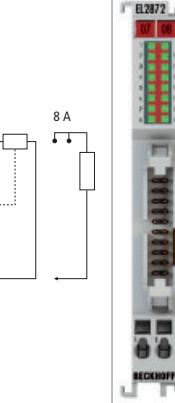
For further information on XFC  
see page **294**



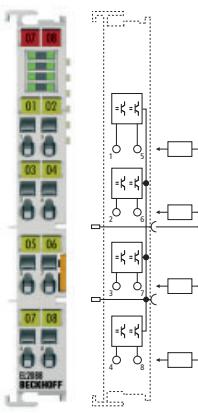
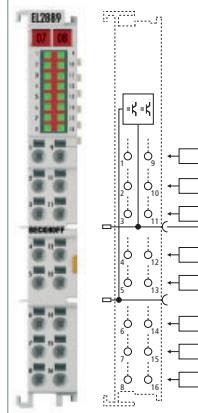
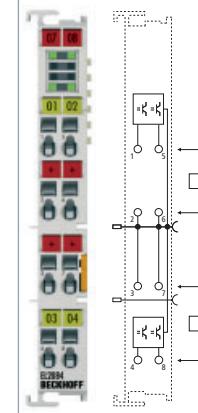
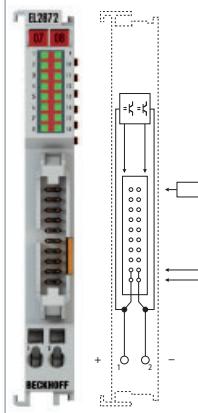
2-channel digital output terminal, 4-wire, 24 V DC, $T_{ON}/T_{OFF}$ 1 µs, push-pull outputs, tri-state	2-channel digital output terminal, 4-wire, 24...72 V DC, with time stamp, overexcitation	
<b>Technical data</b>	<b>EL2202   ES2202</b>	<b>EL2212   ES2212</b>
<b>Connection technology</b>	4-wire	
<b>Load type</b>	ohmic, inductive, lamp load	inductive > 1 mH
<b>Max. output current</b>	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
<b>Switching times</b>	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
<b>Number of outputs</b>	2	2
<b>Nominal voltage</b>	24 V DC (-15 %/+20 %)	24...72 V DC (-15 %/+20 %)
<b>Current consum. pow. cont.</b>	typ. 30 mA + load	load-dependent
<b>Current consumption E-bus</b>	typ. 130 mA	typ. 120 mA
<b>Distributed clocks</b>	– (EL2202-0100 yes)	yes
<b>Output stage</b>	push-pull, high-ohmic	full bridge (push-pull)
<b>Resolution time stamp</b>	–	1 ns
<b>Precision of time stamp in the terminal</b>	–	10 ns
<b>Distributed clock precision</b>	<< 1 µs	<< 1 µs
<b>Oversampling factor</b>	–	–
<b>Breaking energy</b>	< 150 mJ/channel	load-dependent
<b>Reverse voltage protection</b>	yes	–
<b>Short circuit current</b>	typ. < 1.5 A	12 A typ.
<b>Special features</b>	can be converted to DC version EL2202-0100, outputs connectable in high-resistance mode	Current-controlled outputs can be connected in high-resistance mode.
<b>Operating temperature</b>	0...+55 °C	0...+55 °C
<b>Approvals</b>	CE, Ex	CE
<b>Weight</b>	approx. 55 g	approx. 50 g
<b>Further information</b>	<a href="http://www.beckhoff.com/EL2202">www.beckhoff.com/EL2202</a>	<a href="http://www.beckhoff.com/EL2212">www.beckhoff.com/EL2212</a>

2-channel digital output terminal, 4-wire, with time stamp, push-pull outputs, tri-state	8-channel digital input + 8-channel digital output, 1-wire, 24 V DC, time stamp	8-channel digital output terminal, 2-wire, high-speed outputs with time stamp	2-channel digital output terminal, 4-wire, with oversampling, push-pull outputs
EL2252   ES2252	EL1259	EL2258	EL2262   ES2262
	1-wire	2-wire	4-wire
ohmic, inductive, lamp load			
0.5 A (short-circuit-proof) per channel	0.5 A (short-circuit-proof) per channel	0.5 A (short-circuit-proof) per channel	0.5 A (short-circuit-proof in push operation) per channel
typ. $T_{ON}$ : < 1 $\mu$ s, typ. $T_{OFF}$ : < 1 $\mu$ s	typ. $T_{ON}$ : < 1 $\mu$ s, typ. $T_{OFF}$ : < 1 $\mu$ s	typ. $T_{ON}$ : < 1 $\mu$ s, typ. $T_{OFF}$ : < 1 $\mu$ s	typ. $T_{ON}$ : < 1 $\mu$ s, typ. $T_{OFF}$ : < 1 $\mu$ s
2	8 outputs + 8 inputs	8	2
			
24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)
typ. 30 mA + load	typ. 6 mA + load	typ. 30 mA + load	typ. 35 mA + load
typ. 130 mA	typ. 110 mA	typ. 130 mA	typ. 70 mA
yes	yes	yes	yes
push-pull	push	push	push-pull
1 ns	25 $\mu$ s	25 $\mu$ s	–
10 ns	< 1 $\mu$ s	< 1 $\mu$ s	10 ns
<< 1 $\mu$ s	<< 1 $\mu$ s	<< 1 $\mu$ s	<< 1 $\mu$ s
–	–	–	n = integer multiple of the cycle time, 1...1,000
< 150 mJ/channel	< 150 mJ/channel	< 150 mJ/channel	< 150 mJ/channel
yes	yes	yes	yes
typ. < 1.5 A	< typ. 1 A	< typ. 1 A	typ. < 1.5 A
Outputs can be connected in high-resistance mode, short-circuit-proof.	multi-time stamping, auto activation	multi-time stamping, auto activation, further information see page 343	up to 1,000 x oversampling
0...+55 °C	0...+55 °C	0...+55 °C	0...+55 °C
CE, Ex	CE	CE	CE, Ex
approx. 60 g	approx. 55 g	approx. 55 g	approx. 60 g
<a href="http://www.beckhoff.com/EL2252">www.beckhoff.com/EL2252</a>	<a href="http://www.beckhoff.com/EL1259">www.beckhoff.com/EL1259</a>	<a href="http://www.beckhoff.com/EL2258">www.beckhoff.com/EL2258</a>	<a href="http://www.beckhoff.com/EL2262">www.beckhoff.com/EL2262</a>

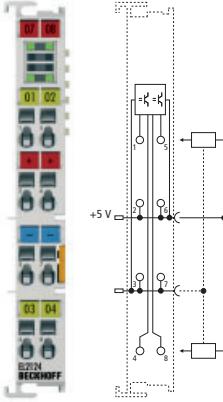
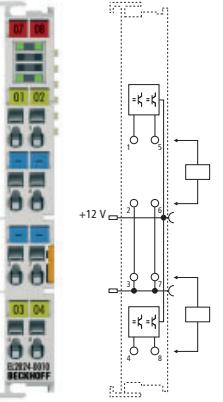
# Digital output | 24 V DC, positive switching

	2-channel digital output terminal, 4-wire, 24 V DC, 0.5 A	2-channel digital output terminal, 4-wire, 24 V DC, 2 A (+ diagnostics)	2-channel digital output terminal, 3-wire, 24 V DC, 2 x 4 A/1 x 8 A	16-channel digital output terminal, flat-ribbon cable connection, 24 V DC	16-channel digital output terminal, D-sub, 24 V DC
<b>Technical data</b>	EL2002   ES2002	EL2022   ES2022	EL2032   ES2032	EL2042   ES2042	EL2872
<b>Connection technology</b>	4-wire		3-wire		flat-ribbon cable
<b>Load type</b>	ohmic, inductive, lamp load		D-sub		
<b>Max. output current</b>	0.5 A (short-circuit-proof) per channel	2.0 A (short-circuit-proof) per channel	4.0 A (short-circuit-proof) per channel, 8 A for parallel connection	0.5 A (short-circuit-proof) per channel	0.5 A (short-circuit-proof) per channel
<b>Switching times</b>	typ. $T_{ON}$ : 60 $\mu$ s, typ. $T_{OFF}$ : 300 $\mu$ s	typ. $T_{ON}$ : 40 $\mu$ s, typ. $T_{OFF}$ : 200 $\mu$ s	typ. $T_{ON}$ : 40 $\mu$ s, typ. $T_{OFF}$ : 200 $\mu$ s	typ. $T_{ON}$ : 60 $\mu$ s, typ. $T_{OFF}$ : 300 $\mu$ s	typ. $T_{ON}$ : 60 $\mu$ s, typ. $T_{OFF}$ : 300 $\mu$ s
<b>Number of outputs</b>	2	2	2	16	16
	    	The EL2032 has diagnostics for short circuit and open circuit.	The EL2042 can supply up to 8 A output current if the outputs are connected in parallel.	Plug X2 included in the scope of supply.	
<b>Nominal voltage</b>	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 %)
<b>Current consumption power contacts</b>	typ. 15 mA + load	typ. 9 mA + load	typ. 15 mA + load	typ. 25 mA + load	typ. 25 mA + load
<b>Current consumption E-bus</b>	typ. 100 mA	typ. 100 mA	typ. 120 mA	typ. 130 mA	typ. 115 mA
<b>Distributed clocks</b>	–	–	–	–	–
<b>Breaking energy</b>	< 150 mJ/channel	< 1.7 J/channel	< 1.7 J/channel	< 150 mJ/channel	< 150 mJ/channel
<b>Reverse voltage protection</b>	yes	yes	yes	yes	yes
<b>Short circuit current</b>	–	typ. < 70 A	typ. < 70 A	typ. < 2 A	typ. < 2 A
<b>Operating temperature</b>	0...+55 °C	0...+55 °C	0...+55 °C	0...+55 °C	0...+55 °C
<b>Approvals</b>	CE, UL, Ex	CE, UL, Ex	CE	CE, UL	CE
<b>Weight</b>	approx. 55 g	approx. 55 g	approx. 55 g	approx. 55 g	approx. 90 g
<b>Further information</b>	www.beckhoff.com/ EL2002	www.beckhoff.com/ EL2022	www.beckhoff.com/ EL2042	www.beckhoff.com/ EL2872	www.beckhoff. com/EM2042
<b>Special terminals</b>			<b>EL2872-0010</b>		
<b>Distinguishing features</b>			negative switching		

# 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
<b>Technical data</b>	EL2088   ES2088	EL2889	EL2084   ES2084	EL2872-0010
<b>Connection technology</b>	1-wire		2-wire	flat-ribbon cable
<b>Load type</b>	ohmic, inductive, lamp load			
<b>Max. output current</b>	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
<b>Switching times</b>	T <sub>ON</sub> : 50 µs, T <sub>OFF</sub> : 200 µs	T <sub>ON</sub> : 50 µs, T <sub>OFF</sub> : 200 µs	T <sub>ON</sub> : 50 µs, T <sub>OFF</sub> : 200 µs	T <sub>ON</sub> : 50 µs, T <sub>OFF</sub> : 200 µs
<b>Number of outputs</b>	8	16	4	16
	 <p>The negative switching EL2088 digital output terminal is suitable for the connection of eight actuators using 1-wire connection technology.</p>	 <p>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.</p>	 <p>The negative switching EL2084 digital output terminal offers four outputs and additionally provides 24 V DC for each channel.</p>	 <p>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.</p>
<b>Nominal voltage</b>	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)
<b>Current consumption power contacts</b>	typ. 30 mA + load	typ. 30 mA + load	typ. 30 mA + load	typ. 30 mA + load
<b>Current consumption E-bus</b>	typ. 110 mA	typ. 140 mA	typ. 100 mA	typ. 130 mA
<b>Distributed clocks</b>	–	–	–	–
<b>Breaking energy</b>	< 100 mJ/channel	< 100 mJ/channel	< 100 mJ/channel	< 150 mJ/channel
<b>Reverse voltage protection</b>	yes	yes	yes	yes
<b>Short circuit current</b>	typ. < 7 A	typ. < 7 A	typ. < 7 A	typ. < 7 A
<b>Operating temperature</b>	0...+55 °C	0...+55 °C	0...+55 °C	0...+55 °C
<b>Approvals</b>	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex	CE, UL
<b>Weight</b>	approx. 70 g	approx. 70 g	approx. 70 g	approx. 55 g
<b>Further information</b>	<a href="http://www.beckhoff.com/EL2088">www.beckhoff.com/EL2088</a>	<a href="http://www.beckhoff.com/EL2889">www.beckhoff.com/EL2889</a>	<a href="http://www.beckhoff.com/EL2084">www.beckhoff.com/EL2084</a>	<a href="http://www.beckhoff.com/EL2872">www.beckhoff.com/EL2872</a>

# Digital output | 5 V DC/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
<b>Technical data</b>	<b>EL2124   ES2124</b>	<b>EL2024-0010</b>
<b>Connection technology</b>	2-/3-wire	2-wire
<b>Load type</b>	ohmic, lamp load	ohmic, inductive, lamp load
<b>Max. output current</b>	±20 mA (short-circuit-proof) per channel, type CMOS output/push-pull	2.0 A (short-circuit-proof) per channel
<b>Switching times</b>	typ. $T_{ON}$ : < 1 µs, typ. $T_{OFF}$ : < 1 µs	typ. $T_{ON}$ : 40 µs, typ. $T_{OFF}$ : 200 µs
<b>Number of outputs</b>	4	4
		
	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.
<b>Nominal voltage</b>	<b>5 V DC</b>	<b>12 V DC (-15 %/+20 %)</b>
<b>Current consumption power contacts</b>	typ. 12 mA + load	typ. 13 mA + load
<b>Current consumption E-bus</b>	typ. 130 mA	typ. 120 mA
<b>Distributed clocks</b>	–	–
<b>Breaking energy</b>	–	< 1.7 J/channel
<b>Reverse voltage protection</b>	–	yes
<b>Short circuit current</b>	typ. < 50 A	typ. < 70 A
<b>Special features</b>	fast 5 V output	for automotive applications
<b>Operating temperature</b>	0...+55 °C	0...+55 °C
<b>Approvals</b>	CE, UL, Ex	CE
<b>Weight</b>	approx. 70 g	approx. 55 g
<b>Further information</b>	<a href="http://www.beckhoff.com/EL2124">www.beckhoff.com/EL2124</a>	<a href="http://www.beckhoff.com/EL2024">www.beckhoff.com/EL2024</a>

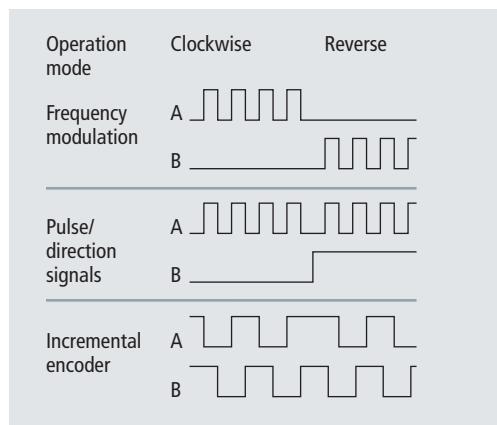
# Digital output | 24 V DC, pulse train/frequency output

The EL2521-xxxx output terminals provide a specifiable pulse sequence via their two outputs. The relationship between channel A and B is configurable, e.g. as encoder characteristics or for controlling of stepper motor power stages. The pulse rate and the frequency is specified by the controller via a 16-bit value. The LEDs are driven in time with the outputs and each displays an active output. The galvanic isolation from the E-bus is provided.

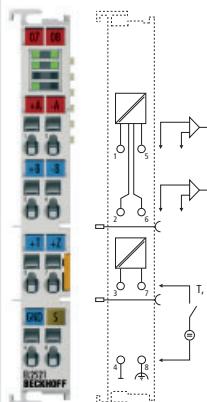
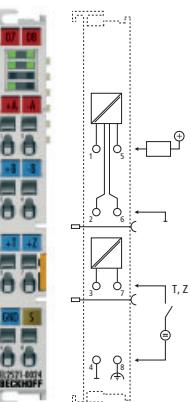
The EL2521 has two digital inputs, which are transferred to the process image. The EL2521-0124 has a special latch input. The two RS422-compatible differential outputs of the EL2521 are supplied (electrically isolated) from the E-bus. For the EL2521-0024 both output channels are implemented as potential-free FET switches and must be fed externally. In the EL2521-0025 the two output channels are negative switching, potential-free FET switches that also require an external supply.

Another version is the EL2521-0124 with a 24 V latch input and an automatically switching 24 V output ("capture-compare"). 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.

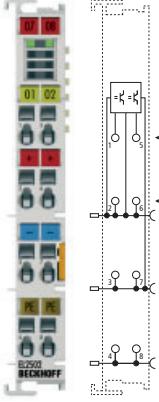
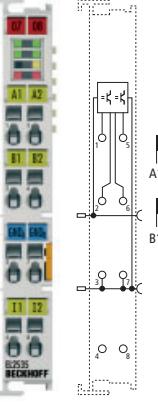
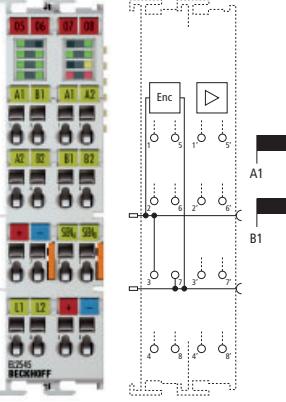
The EL2521 series offers different modes of operation: frequency modulation on the individual channels, incremental encoder or pulsed direction specification. A travel distance control can also be parameterised. Distributed clock synchronisation enables the output to be synchronised with other EtherCAT slaves.



Frequency pulse patterns

	1-channel pulse train output terminal, 2 x RS422	1-channel pulse train output terminal, 2 x 24 V DC
Technical data	EL2521   ES2521	EL2521-0024
Connection technology	pulse train (frequency output)	
Load type	ohmic, min. 220 Ω	ohmic, inductive
Max. output current	RS422 specification, 50 mA	5...24 V DC, 1 A
Number of outputs	1 channel (2 differential outputs A, B)	1 channel (2 outputs A, B)
		
Nominal voltage	–	24 V DC (-15 %/+20 %)
Current consum. pow. cont.	–	load
Current consumption	typ. 280 mA (load-dependent)	typ. 280 mA (load-dependent)
E-bus	yes	yes
Distributed clocks	yes	yes
Input specification	24 V DC	24 V DC
Output specification	RS422, differential	5...24 V DC
Base frequency	0...500 kHz, 50 kHz default	0...500 kHz, 50 kHz default
Duty factor	0...50 % (±10 %)	0...50 % (±10 %)
Resolution	max. 24 bits	max. 24 bits
Step size	10 mHz	10 mHz
Short circuit current	short-circuit-proof	–
Special features	different modes, ramp function, travel distance control	different modes, ramp function, travel distance control
Operating temperature	0...+55 °C	0...+55 °C
Approvals	CE, UL, Ex	CE, Ex
Weight	approx. 50 g	approx. 50 g
Further information	<a href="http://www.beckhoff.com/EL2521">www.beckhoff.com/EL2521</a>	<a href="http://www.beckhoff.com/EL2521">www.beckhoff.com/EL2521</a>
Special terminals	EL2521-0025	EL2521-0124
Distinguishing features	negative switching	24 V version, with "Capture & Compare" input/output

# Digital output | PWM outputs up to 24 V DC/50 V DC

	2-channel pulse width output terminal, 24 V DC, 0.5 A	2-channel pulse width current terminal, 24 V DC, 1 A, current-controlled	2-channel pulse width current terminal, 50 V DC, 3.5 A, current-controlled, with incremental encoder
Technical data	EL2502   ES2502	EL2535   ES2535	EL2545   ES2545
Connection technology	PWM output, push-pull outputs		
Load type	ohmic, inductive, lamp load	ohmic, inductive > 1 mH	inductive
Max. output current	0.5 A (short-circuit-proof) per channel	1 A (short-circuit-proof, thermal overload-proof) per channel	3.5 A (short-circuit-proof, thermal overload-proof) per channel
Number of outputs	2	2	2
			
	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. The EL2502 (as an uncontrolled actuator) operates based on a specified duty factor.	The EL2535 and EL2545 measure the actual current and control their two output channels through the duty factor based on the specified set current. They also monitor overload and short circuit. Stored valve characteristic 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 1- or 2-encoder unit up to 400,000 increments/s applicable and has a latch and reset function through the two digital inputs.	
Nominal voltage	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)	8...50 V DC
Current consum. pow. cont.	typ. 30 mA + load	typ. 30 mA + load	typ. 50 mA + load
Current consumption E-bus	typ. 150 mA	typ. 110 mA	typ. 180 mA
Distributed clocks	—	yes	yes
PWM clock frequency	20 Hz...20 kHz, 250 Hz default	25 kHz default	25 kHz default
Duty factor	0...100 % ( $T_{ON} > 750 \text{ ns}$ , $T_{OFF} > 500 \text{ ns}$ )	0...100 % (current-controlled)	0...100 % (current-controlled)
Resolution	10 bits	10 bits	10 bits
Reverse voltage protection	yes	yes	yes
Short circuit current	typ. < 1.5 A	typ. < 2 A	typ. < 5 A
Special features	separate frequency can be set for each channel	Stored valve characteristic curves can be retrieved; two 24 V digital inputs.	with encoder 5...24 V, 5 mA, single-ended, max. 100 kHz (400,000 increments/s)
Operating temperature	0...+55 °C	0...+55 °C	0...+55 °C
Approvals	CE, UL, Ex	CE	CE
Weight	approx. 50 g	approx. 50 g	approx. 50 g
Further information	<a href="http://www.beckhoff.com/EL2502">www.beckhoff.com/EL2502</a>	<a href="http://www.beckhoff.com/EL2535">www.beckhoff.com/EL2535</a>	<a href="http://www.beckhoff.com/EL2545">www.beckhoff.com/EL2545</a>
Special terminals	<b>EL2535-0050</b>	<b>EL2535-0002</b>	
Distinguishing features		output 50 mA	typ. 2 A

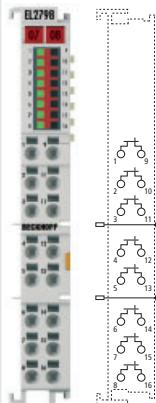
**i** For availability status see Beckhoff website at: [www.beckhoff.com/EL2545](http://www.beckhoff.com/EL2545)

# Digital output | 24 V AC/DC, positive switching

The digital EL2798 EtherCAT Terminal provides eight switches that can be used like a relay contact for AC/DC voltages. The electronic switch is realised through high-performance MOSFET transistors with low switch-on resistance. The switch itself is not short-circuit-proof, but due to its high pulse current capability it can cope with current until the fuse triggers a switch-off. Inductive loads can be switched directly, without further safety measures. High peak voltages and electromagnetic interference pulses are prevented.

8-channel digital output terminal, 2-wire, 24 V AC/DC, 2 A

Technical data	EL2798
Connection technology	2-wire
Load type	AC/DC loads
Max. output current	2 A
Number of outputs	8 x make contacts



Nominal voltage	0...24 V AC/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	< 200 V (channel/channel)
Switching on speed	typ. 1.8 ms, max. 5 ms
Switching off speed	typ. 30 ms, max. 50 ms
On-resistance	typ. 0.03 Ω
Breaking energy	no data
Reverse voltage protection	–
Short circuit current	50 A (10 ms), resistant
Special features	substitute for relay contacts; potential-free
Operating temperature	0...+55 °C
Approvals	CE
Weight	approx. 70 g
Further information	<a href="http://www.beckhoff.com/EL2798">www.beckhoff.com/EL2798</a>

# Digital output | Relay outputs up to 230 V AC

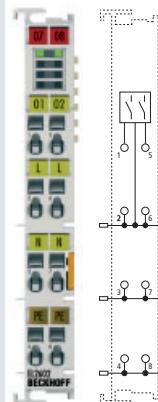
The EtherCAT Terminals switch a relay as a function of a bit in the process image. The relays completely isolate the current flow by a mechanical contact; there is no residual current through the open contact. The EtherCAT Terminals are not equipped with a protective circuit, so as not to allow for residual 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

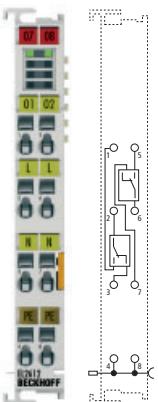
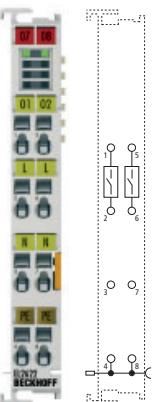
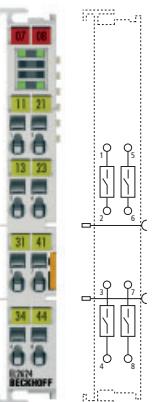
to corresponding electromagnetic radiation. Capacitive loads create a short-circuit for a brief period of time. This can – particularly with alternating voltages – lead to such high switch-on currents at switch-on under peak value that the bouncing contact is burned shut. A capacitive load can also be 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

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

2-channel relay output terminal, 125 V AC/30 V DC	2-channel relay output terminal, 230 V AC/30 V DC	4-channel relay output terminal, 125 V AC/30 V DC
EL2612   ES2612	EL2622   ES2622	EL2624   ES2624

ohmic	ohmic, inductive, lamp load	ohmic
2 x change-over	2 x make contacts	4 x make contacts
		

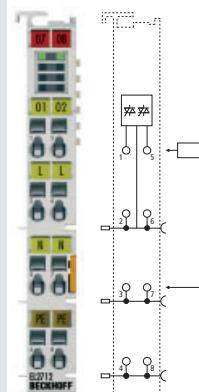
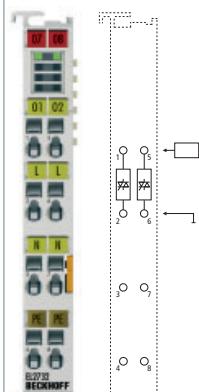
125 V AC/30 V DC	230 V AC/30 V DC	125 V AC/30 V DC
—	—	—
typ. 150 mA	typ. 170 mA	typ. 200 mA
—	—	—
0.5 A AC/2 A DC	5 A AC/DC	0.5 A AC/2 A DC
no data	2 A AC/DC	no data
$1 \times 10^8$	$2 \times 10^7$	$1 \times 10^8$
$2 \times 10^5$ (1 A/30 V DC)	$1 \times 10^5$ (5 A/30 V DC)	$2 \times 10^5$ (1 A/30 V DC)
—	4 x 58 W	—
10 µA at 10 mV DC with intact contact coating signal relay	10 mA at 5 V DC	10 µA at 10 mV DC with intact contact coating
0...+55 °C	0...+55 °C	0...+55 °C
CE, UL	CE, UL	CE
approx. 50 g	approx. 50 g	approx. 50 g
<a href="http://www.beckhoff.com/EL2612">www.beckhoff.com/EL2612</a>	<a href="http://www.beckhoff.com/EL2622">www.beckhoff.com/EL2622</a>	<a href="http://www.beckhoff.com/EL2624">www.beckhoff.com/EL2624</a>

# Digital output | Triac outputs up to 230 V AC

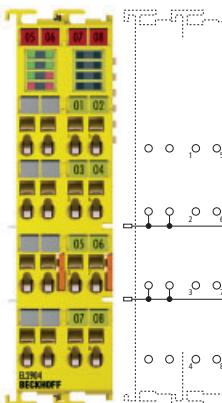
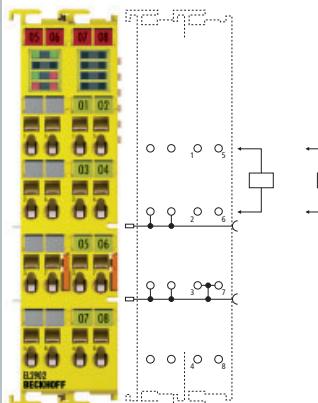
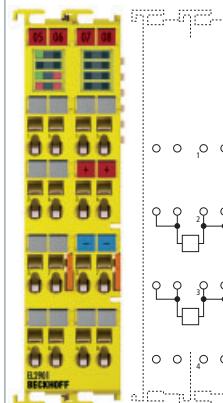
In applications with particularly frequent switching operations the service life of a mechanical relay is potentially very short. An electronic switch in the form of triacs and Mosfet transistors is an almost wear-free replacement.

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	
<b>Technical data</b>	<b>i EL2712   ES2712</b> <b>i EL2722   ES2722</b> <b>i EL2732   ES2732</b>	
<b>Connection technology</b>	triac output, 2-wire	
<b>Load type</b>	ohmic, inductive	
<b>Max. output current</b>	0.5 A	1 A (0.5 A if both outputs are on)
<b>Switching times</b>	in zero crossing, 0.1...10 ms	
<b>Number of outputs</b>	2 x make contacts	2 x make contacts, mutually locked
 		
<b>Nominal voltage</b>	12...230 V AC	
<b>Current consum. pow. cont.</b>	–	
<b>Current consumption E-bus</b>	typ. 120 mA	
<b>Distributed clocks</b>	–	
<b>Frequency range</b>	47...63 Hz	
<b>Surge voltage protection</b>	> 275 V	
<b>Peak current</b>	40 A (16 ms), 1.5 A (30 s)	
<b>Leakage current</b>	typ. 0.8 mA, max. 1.5 mA (OFF state)	
<b>Switch-off time</b>	T/2	
<b>Maximum residual voltage</b>	1.5 V (60 mA...1 A), 150 Ω (< 60 mA)	
<b>Special features</b>	suitable for conventional blind motors	
<b>Operating temperature</b>	0...+55 °C	
<b>Approvals</b>	CE	
<b>Weight</b>	approx. 55 g	
<b>Further information</b>	www.beckhoff.com/ EL2712	www.beckhoff.com/ EL2722
<b>i</b> For availability status see Beckhoff website at: <a href="http://www.beckhoff.com/EL2712">www.beckhoff.com/EL2712</a>		

# Digital output | 24 V DC, TwinSAFE

	4-channel digital output terminal, TwinSAFE, 24 V DC	2-channel digital output terminal, TwinSAFE, 24 V DC	1-channel digital output terminal, TwinSAFE, 24 V DC
Technical data	EL2904	EL2902	EL2901
Connection technology	1-/2-wire	1-wire	1-/2-wire and/or via power contacts
Safety standard	IEC 61508 SIL 3 and DIN EN ISO 13849-1:2008 PLe		
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
	 <p>The EL2904 Safety EtherCAT Terminal has four outputs.</p>	 <p>The EL2902 Safety EtherCAT Terminal has two outputs.</p>	 <p>The EL2901 Safety EtherCAT Terminal has one output.</p>
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)
Permiss. degree of contamination	2	2	2
Climate class EN 60721-3-3	3K3	3K3	3K3
Installation position	horizontal	horizontal	horizontal
Special features	4 safe outputs	2 safe outputs	safe power supply
Operating temperature	0...+55 °C	0...+55 °C	0...+55 °C
Electrical interference	EN 61000-6-2/EN 61000-6-4	EN 61000-6-2/EN 61000-6-4	EN 61000-6-2/EN 61000-6-4
Vibration/shock resistance	EN 60068-2-6/EN 60068-2-27	EN 60068-2-6/EN 60068-2-27	EN 60068-2-6/EN 60068-2-27
Approvals	CE, UL, Ex, TÜV Süd	CE, UL, Ex, TÜV Süd	CE, UL, Ex, TÜV Süd
Weight	approx. 90 g	approx. 90 g	approx. 90 g
Protection class	IP 20	IP 20	IP 20
Further information	<a href="http://www.beckhoff.com/EL2904">www.beckhoff.com/EL2904</a>	<a href="http://www.beckhoff.com/EL2902">www.beckhoff.com/EL2902</a>	<a href="http://www.beckhoff.com/EL2901">www.beckhoff.com/EL2901</a>

For TwinSAFE products and further information on the TwinSAFE technology see page **914**

**i** For availability status see Beckhoff website at: [www.beckhoff.com/EL2901](http://www.beckhoff.com/EL2901)

# Analog input | -10...+10 V, 12 bits, single-ended

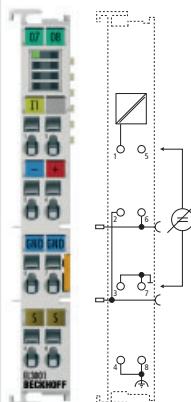
The EL3xxx EtherCAT Terminals read analog signal voltages in the common standard signal range of -10...+10 V, 0...10 V, 0...20 mA and 4...20 mA. Within the EtherCAT Terminal the field side is electrically isolated from the E-bus and enables interconnection to form potential groups as required. The 1-channel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

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

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

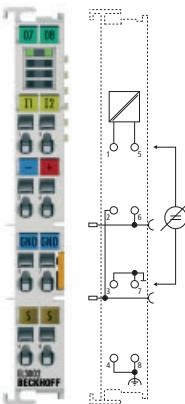
The product range is rounded off by further special input voltages and covers a wide field of application for the processing of analog signals. By the expansion of power supply terminals well-stabilised auxiliary voltages from 5 to 15 V can be generated.

1-channel analog  
input terminal,  
-10...+10 V, 12 bits,  
single-ended

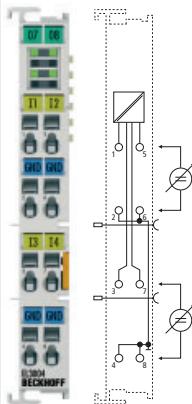
Technical data	EL3001   ES3001
Signal voltage	-10...+10 V
Resolution	12 bits (16 bits presentation, incl. sign)
Technology	single-ended
Conversion time	0.625 ms default setting, configurable
Number of inputs	1 (single-ended)
	
<p>The EL3001 analog input terminal is characterised by its fine granularity and electrical isolation.</p>	
Dielectric strength	max. 30 V
Current consum. pow. cont.	–
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	0...+55 °C
Approvals	CE, UL, Ex
Weight	approx. 70 g
Further information	<a href="http://www.beckhoff.com/EL3001">www.beckhoff.com/EL3001</a>

2-channel analog input terminal, -10...+10 V, 12 bits, single-ended	4-channel analog input terminal, -10...+10 V, 12 bits, single-ended	8-channel analog input terminal, -10...+10 V, 12 bits, single-ended
EL3002   ES3002	EL3004   ES3004	EL3008   ES3008

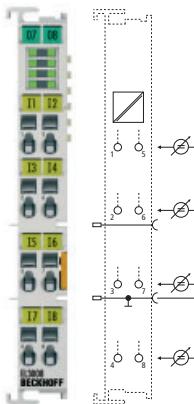
single-ended	single-ended	single-ended
0.625 ms default setting, configurable	0.625 ms default setting, configurable	1.25 ms default setting, configurable
2 (single-ended)	4 (single-ended)	8 (single-ended)



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.

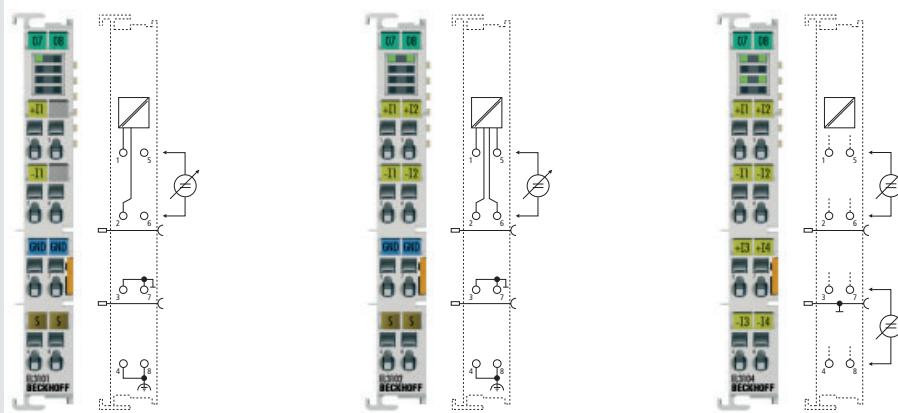


With eight input channels, the EL3008 is particularly suitable for space-saving installation in the control cabinet. The common reference ground is the 0 V power contact. A 0 V distribution terminal, e.g. EL9187 or EL9189, must be added for a 2-wire connection.

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
0...+55 °C	0...+55 °C	0...+55 °C
CE, UL, Ex	CE, UL, Ex	CE, UL, Ex
approx. 70 g	approx. 70 g	approx. 70 g
<a href="http://www.beckhoff.com/EL3002">www.beckhoff.com/EL3002</a>	<a href="http://www.beckhoff.com/EL3004">www.beckhoff.com/EL3004</a>	<a href="http://www.beckhoff.com/EL3008">www.beckhoff.com/EL3008</a>

# Analog input | -10...+10 V, 16 bits, differential input

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

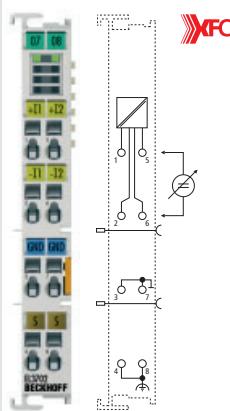


The EL310x analog input terminals measure input voltages from -10 to +10 V with 16-bit resolution. The significantly faster conversion time and support for distributed clocks enable use in time-critical applications and set them apart from the EL30xx series. The differential inputs of the EL3102/EL3104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

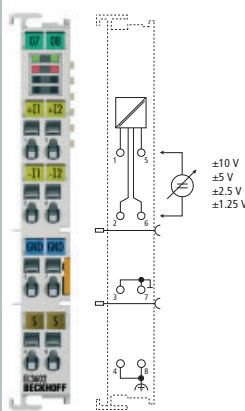
Common-mode voltage $U_{CM}$	35 V max.	35 V max.	35 V max.
Current consumption power contacts	–	–	–
Current consumption E-bus	typ. 130 mA	typ. 170 mA	typ. 130 mA
Distributed clocks	yes	yes	yes
Oversampling factor	–	–	–
Distributed clock precision	<< 1 µs	<< 1 µs	<< 1 µs
Input signal bandwidth	–	–	–
Internal resistance	> 200 kΩ	> 200 kΩ	> 200 kΩ
Input filter limit frequency	5 kHz	5 kHz	5 kHz
Measuring error	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)
Special features	standard and compact process image, switchable measuring data representation, activatable FIR/IIR filters, limit value monitoring	standard and compact process image, switchable measuring data representation, activatable FIR/IIR filters, limit value monitoring	standard and compact process image, switchable measuring data representation, activatable FIR/IIR filters, limit value monitoring
Operating temperature	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	<a href="http://www.beckhoff.com/EL3101">www.beckhoff.com/EL3101</a>	<a href="http://www.beckhoff.com/EL3102">www.beckhoff.com/EL3102</a>	<a href="http://www.beckhoff.com/EL3104">www.beckhoff.com/EL3104</a>

# Analog input | Oversampling, precision measurement

	2-channel analog input terminal, -10...+10 V, 16 bits, oversampling, differential input	2-channel analog input terminal, -10...+10 V, 24 bits, differential input	2-channel analog input terminal, -75...+75 mV, 24 bits, differential input
Technical data	EL3702   ES3702	EL3602   ES3602	EL3602-0010
Signal voltage	-10...+10 V	-10...+10 V, -5...+5 V, -2.5...+2.5 V, -1.25...+1.25 V (parameterisable)	-75...+75 mV
Resolution	16 bits (incl. sign)	24 bits (incl. sign)	
Technology	differential input, oversampling	differential input	differential input
Conversion time	~ 10 µs per sample	20 ms default setting, 1...400 ms configurable	
Number of inputs	2 (differential)	2 (differential)	2 (differential)



In the EL3702, the  $\pm 10\text{V}$  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, the EtherCAT Terminal generates a process data block that is transferred collectively during the next bus cycle. The maximum sampling frequency for each channel is 100 ksamples/s.

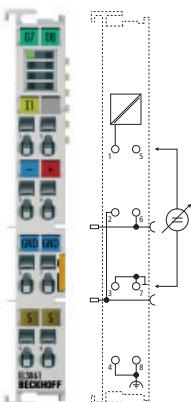
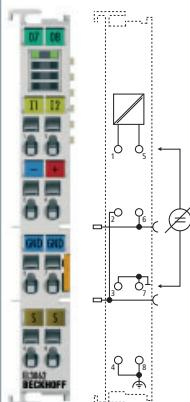
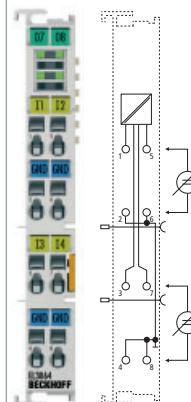
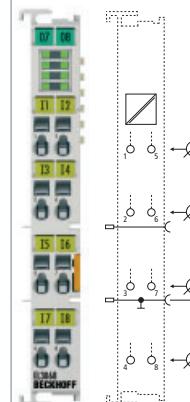
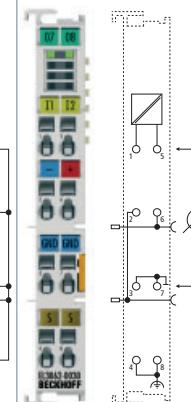


The EL3602 terminal is a precise measuring device with 24-bit resolution and a common ground potential for both differential inputs. Shielded connecting cables, secure shield and earth connections and a controlled ambient temperature are necessary in order to obtain precise results. The EL9195 shield terminal is to be placed adjacently if necessary.

Common-mode voltage $U_{cm}$	35 V max.	35 V max.	35 V max.
Current consum. pow. cont.	–	–	–
Current consumption E-bus	typ. 200 mA	typ. 190 mA	typ. 190 mA
Distributed clocks	yes	–	–
Oversampling factor	n = 1...100 selectable	–	–
Distributed clock precision	<< 1 µs	–	–
Input signal bandwidth	0...30 kHz recommended	–	–
Internal resistance	> 200 kΩ	> 200 kΩ	> 200 kΩ
Input filter limit frequency	30 kHz	3 kHz	3 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	0...+55 °C	0...+55 °C	0...+55 °C
Approvals	CE, UL, Ex	CE, UL, Ex	CE, Ex
Weight	approx. 60 g	approx. 60 g	approx. 60 g
Further information	<a href="http://www.beckhoff.com/EL3702">www.beckhoff.com/EL3702</a>	<a href="http://www.beckhoff.com/EL3602">www.beckhoff.com/EL3602</a>	<a href="http://www.beckhoff.com/EL3602">www.beckhoff.com/EL3602</a>

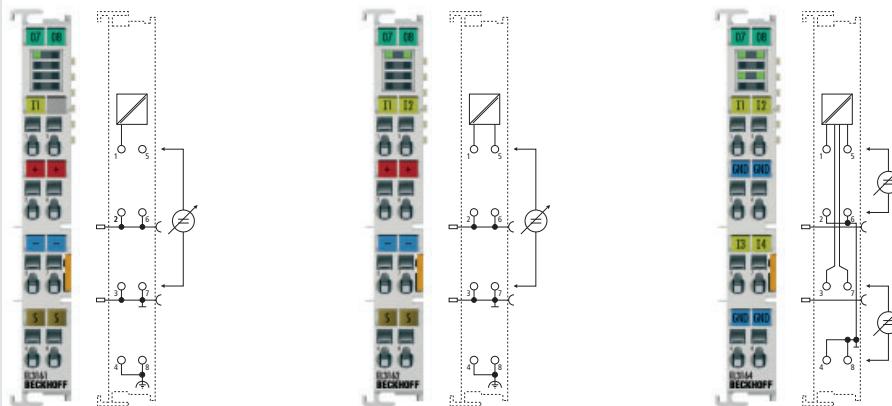
Further information on XFC see page **294**

# Analog input | 0...10 V/30 V, 12 bits, single-ended

	1-channel analog input terminal, 0...10 V, 12 bits, single-ended	2-channel analog input terminal, 0...10 V, 12 bits, single-ended	4-channel analog input terminal, 0...10 V, 12 bits, single-ended	8-channel analog input terminal, 0...10 V, 12 bits, single-ended	2-channel analog input terminal, 0...30 V, 12 bits, single-ended
Technical data	EL3061   ES3061	EL3062   ES3062	EL3064   ES3064	EL3068   ES3068	EL3062-0030
Signal voltage	0...10 V				0...30 V
Resolution	12 bits (16 bits 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	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, UL, Ex	CE, UL, Ex
Weight	approx. 60 g	approx. 60 g	approx. 60 g	approx. 60 g	approx. 60 g
Further information	<a href="http://www.beckhoff.com/EL3061">www.beckhoff.com/ EL3061</a>	<a href="http://www.beckhoff.com/EL3062">www.beckhoff.com/ EL3062</a>	<a href="http://www.beckhoff.com/EL3064">www.beckhoff.com/ EL3064</a>	<a href="http://www.beckhoff.com/EL3068">www.beckhoff.com/ EL3068</a>	<a href="http://www.beckhoff.com/EL3062">www.beckhoff.com/ EL3062</a>

# Analog input | 0...10 V, 16 bits, single-ended

	1-channel analog input terminal, 0...10 V, 16 bits, single-ended	2-channel analog input terminal, 0...10 V, 16 bits, single-ended	4-channel analog input terminal, 0...10 V, 16 bits, single-ended
Technical data	EL3161   ES3161	EL3162   ES3162	EL3164   ES3164
Signal voltage	0...10 V		
Resolution	16 bits (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)

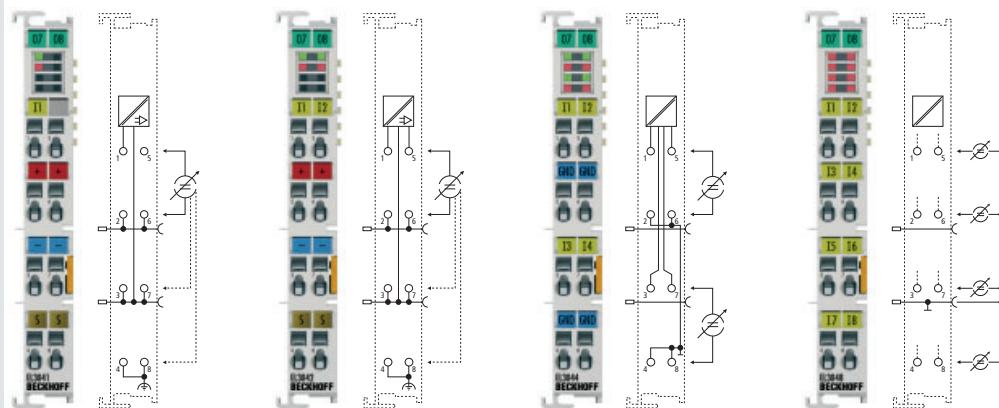


The EL316x analog input terminals measure input voltages from 0 to 10 V with 16-bit resolution. The significantly faster conversion time and support for distributed clocks enable use in time-critical applications and set them apart from the EL30xx series. The inputs have a common reference potential 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	<a href="http://www.beckhoff.com/EL3161">www.beckhoff.com/EL3161</a>	<a href="http://www.beckhoff.com/EL3162">www.beckhoff.com/EL3162</a>	<a href="http://www.beckhoff.com/EL3164">www.beckhoff.com/EL3164</a>

# Analog input | 0...20 mA, 12 bits, single-ended

	1-channel analog input terminal, 0...20 mA, 12 bits, single-ended	2-channel analog input terminal, 0...20 mA, 12 bits, single-ended	4-channel analog input terminal, 0...20 mA, 12 bits, single-ended	8-channel analog input terminal, 0...20 mA, 12 bits, single-ended
Technical data	EL3041   ES3041	EL3042   ES3042	EL3044   ES3044	EL3048   ES3048
Signal voltage	0...20 mA			
Resolution	12 bits (16 bits 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)

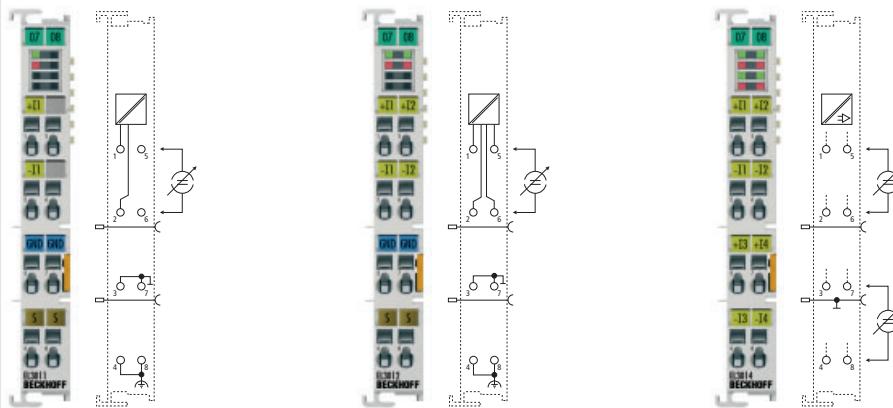


The EL304x analog input terminals have a common reference potential. This reference potential is connected to the 0 V power contact in the EL3041, EL3042 and EL3048. Overcurrent is displayed not only in the process image, but also by an error LED for each channel.

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			
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	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. 60 g	approx. 60 g	approx. 60 g	approx. 60 g
Further information	<a href="http://www.beckhoff.com/EL3041">www.beckhoff.com/EL3041</a>	<a href="http://www.beckhoff.com/EL3042">www.beckhoff.com/EL3042</a>	<a href="http://www.beckhoff.com/EL3044">www.beckhoff.com/EL3044</a>	<a href="http://www.beckhoff.com/EL3048">www.beckhoff.com/EL3048</a>

# Analog input | 0...20 mA, 12 bits, differential input

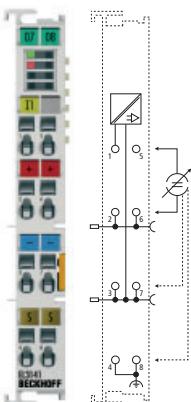
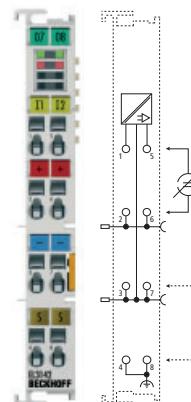
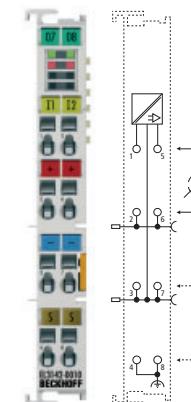
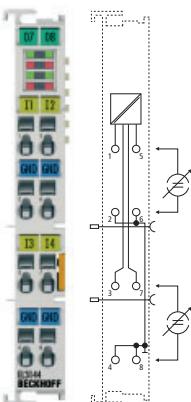
	1-channel analog input terminal, 0...20 mA, 12 bits, differential input	2-channel analog input terminal, 0...20 mA, 12 bits, differential input	4-channel analog input terminal, 0...20 mA, 12 bits, differential input
Technical data	EL3011   ES3011	EL3012   ES3012	EL3014   ES3014
Signal voltage	0...20 mA		
Resolution	12 bits (16 bits 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 $\Omega$ typ. + diode voltage	85 $\Omega$ typ. + diode voltage	85 $\Omega$ typ. + diode voltage
Input filter limit frequency	1 kHz	1 kHz	1 kHz
Measuring error	< $\pm 0.3\%$ (relative to full scale value)	< $\pm 0.3\%$ (relative to full scale value)	< $\pm 0.3\%$ (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	0...+55 °C	0...+55 °C	0...+55 °C
Approvals	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex
Weight	approx. 55 g	approx. 55 g	approx. 55 g
Further information	<a href="http://www.beckhoff.com/EL3011">www.beckhoff.com/EL3011</a>	<a href="http://www.beckhoff.com/EL3012">www.beckhoff.com/EL3012</a>	<a href="http://www.beckhoff.com/EL3014">www.beckhoff.com/EL3014</a>

# Analog input | 0...20 mA, 16 bits, single-ended

	1-channel analog input terminal, 0...20 mA, 16 bits, single-ended	2-channel analog input terminal, 0...20 mA, 16 bits, single-ended	2-channel analog input terminal, -10...+10 mA, 16 bits, single-ended	4-channel analog input terminal, 0...20 mA, 16 bits, 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 bits (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)
				
	<p>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.</p>			
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	0...+55 °C	0...+55 °C	0...+55 °C	0...+55 °C
Approvals	CE, UL, Ex	CE, UL, Ex	CE	CE, UL, Ex
Weight	approx. 60 g	approx. 60 g	approx. 60 g	approx. 60 g
Further information	<a href="http://www.beckhoff.com/EL3141">www.beckhoff.com/EL3141</a>	<a href="http://www.beckhoff.com/EL3142">www.beckhoff.com/EL3142</a>	<a href="http://www.beckhoff.com/EL3142-0010">www.beckhoff.com/EL3142-0010</a>	<a href="http://www.beckhoff.com/EL3144">www.beckhoff.com/EL3144</a>

# Analog input | 0...20 mA, 16/24 bits, differential input

1-channel analog input terminal, 0...20 mA, 16 bits, differential input	2-channel analog input terminal, 0...20 mA, 16 bits, differential input	4-channel analog input terminal, 0...20 mA, 16 bits, differential input	2-channel analog input terminal, 0...20 mA, 16 bits, differential input, with oversampling	2-channel analog input terminal, 0...20 mA, 24 bits, differential input
EL3111   ES3111	EL3112   ES3112	EL3114   ES3114	EL3742   ES3742	EL3612   ES3612

24 bits (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 <a href="#">365</a>	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
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
approx. 55 g	approx. 55 g	approx. 55 g	approx. 60 g	approx. 60 g
<a href="http://www.beckhoff.com/EL3111">www.beckhoff.com/EL3111</a>	<a href="http://www.beckhoff.com/EL3112">www.beckhoff.com/EL3112</a>	<a href="http://www.beckhoff.com/EL3114">www.beckhoff.com/EL3114</a>	<a href="http://www.beckhoff.com/EL3742">www.beckhoff.com/EL3742</a>	<a href="http://www.beckhoff.com/EL3612">www.beckhoff.com/EL3612</a>

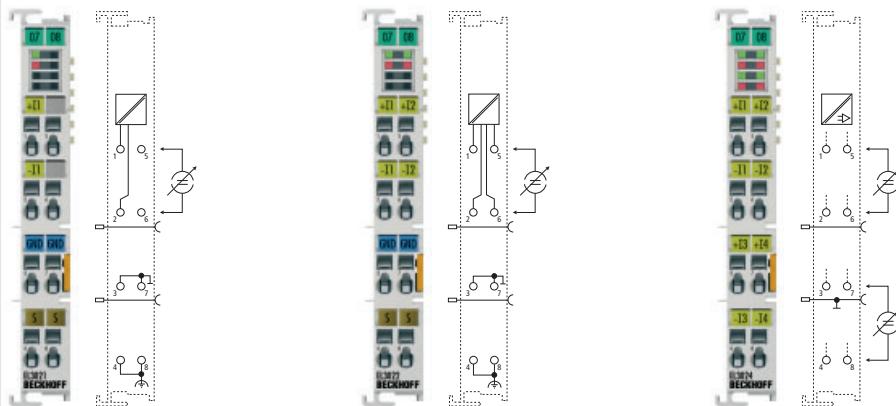
Further information on XFC see page [294](#)

# Analog input | 4...20 mA, 12 bits, single-ended

	1-channel analog input terminal, 4...20 mA, 12 bits, single-ended	2-channel analog input terminal, 4...20 mA, 12 bits, single-ended	4-channel analog input terminal, 4...20 mA, 12 bits, single-ended	8-channel analog input terminal, 4...20 mA, 12 bits, single-ended
Technical data	EL3051   ES3051	EL3052   ES3052	EL3054   ES3054	EL3058   ES3058
Signal voltage	4...20 mA			
Resolution	12 bits (16 bits 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)
	<p>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.</p>			
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	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. 60 g	approx. 60 g	approx. 60 g	approx. 60 g
Further information	<a href="http://www.beckhoff.com/EL3051">www.beckhoff.com/EL3051</a>	<a href="http://www.beckhoff.com/EL3052">www.beckhoff.com/EL3052</a>	<a href="http://www.beckhoff.com/EL3054">www.beckhoff.com/EL3054</a>	<a href="http://www.beckhoff.com/EL3058">www.beckhoff.com/EL3058</a>

# Analog input | 4...20 mA, 12 bits, differential input

	1-channel analog input terminal, 4...20 mA, 12 bits, differential input	2-channel analog input terminal, 4...20 mA, 12 bits, differential input	4-channel analog input terminal, 4...20 mA, 12 bits, differential input
Technical data	EL3021   ES3021	EL3022   ES3022	EL3024   ES3024
Signal voltage	4...20 mA		
Resolution	12 bits (16 bits 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)

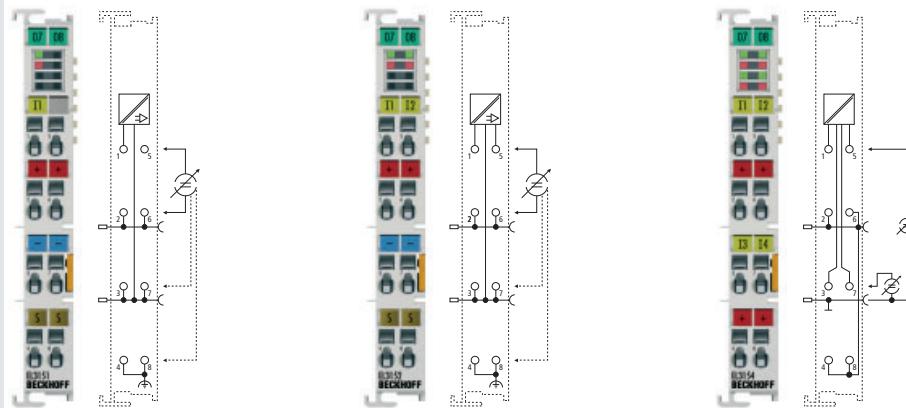


In the EL302x series (4 to 20 mA), overcurrent and undercurrent are displayed not only in the process image, but also by an error LED for each channel.

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 $\Omega$ typ. + diode voltage	85 $\Omega$ typ. + diode voltage	85 $\Omega$ typ. + diode voltage
Input filter limit frequency	1 kHz	1 kHz	1 kHz
Measuring error	< $\pm 0.3\%$ (relative to full scale value)	< $\pm 0.3\%$ (relative to full scale value)	< $\pm 0.3\%$ (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. 55 g	approx. 55 g	approx. 60 g
Further information	<a href="http://www.beckhoff.com/EL3021">www.beckhoff.com/EL3021</a>	<a href="http://www.beckhoff.com/EL3022">www.beckhoff.com/EL3022</a>	<a href="http://www.beckhoff.com/EL3024">www.beckhoff.com/EL3024</a>

# Analog input | 4...20 mA, 16 bits, single-ended

	1-channel analog input terminal, 4...20 mA, 16 bits, single-ended	2-channel analog input terminal, 4...20 mA, 16 bits, single-ended	4-channel analog input terminal, 4...20 mA, 16 bits, single-ended
Technical data	EL3151   ES3151	EL3152   ES3152	EL3154   ES3154
Signal voltage	4...20 mA		
Resolution	16 bits (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)

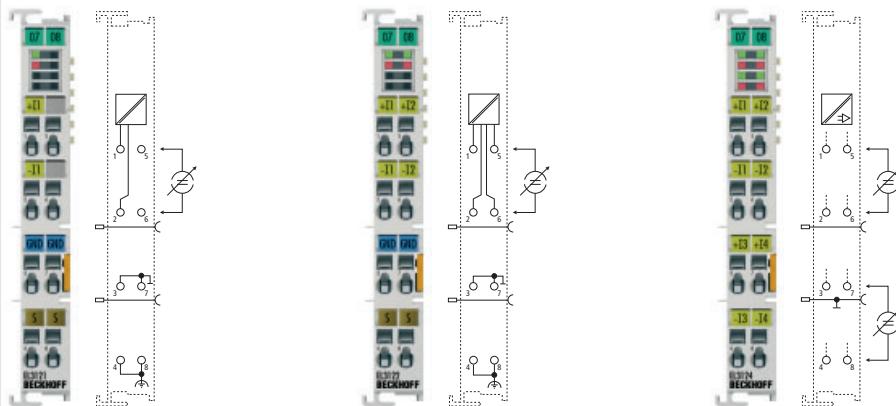


The EL315x analog input terminals measure input currents from 4 to 20 mA. The significantly faster conversion time and support for distributed clocks enable use in time-critical applications and set them apart from the EL30xx series. Overcurrent and undercurrent are displayed not only in the process 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	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. 60 g
Further information	<a href="http://www.beckhoff.com/EL3151">www.beckhoff.com/EL3151</a>	<a href="http://www.beckhoff.com/EL3152">www.beckhoff.com/EL3152</a>	<a href="http://www.beckhoff.com/EL3154">www.beckhoff.com/EL3154</a>

# Analog input | 4...20 mA, 16 bits, differential input

	1-channel analog input terminal, 4...20 mA, 16 bits, differential input	2-channel analog input terminal, 4...20 mA, 16 bits, differential input	4-channel analog input terminal, 4...20 mA, 16 bits, differential input
Technical data	EL3121   ES3121	EL3122   ES3122	EL3124   ES3124
Signal voltage	4...20 mA		
Resolution	16 bits (incl. sign)		
Technology	differential input	differential input	differential input
Conversion time	~ 40 µs	~ 50 µs (fast mode ~ 35 µs)	~ 100 µs
Number of inputs	1	2	4



The EL312x analog input terminals measure input currents from 4 to 20 mA. The significantly faster conversion time and support for distributed clocks enable use in time-critical applications and set them apart from the EL30xx series. Overcurrent and undercurrent are displayed not only in the process image, but also by an error LED for each channel.

Common-mode voltage $U_{CM}$	10 V max.	10 V max.	10 V max.
Current consumption power contacts	–	–	–
Current consumption E-bus	typ. 130 mA	typ. 170 mA	typ. 130 mA
Distributed clocks	yes	yes	yes
Internal resistance	85 Ω typ. + diode voltage	85 Ω typ. + diode voltage	85 Ω typ. + diode voltage
Input filter limit frequency	5 kHz	5 kHz	5 kHz
Measuring error	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)
Special features	standard and compact process image, activatable FIR/IIR filters, limit value monitoring	standard and compact process image, activatable FIR/IIR filters, limit value monitoring	standard and compact process image, activatable FIR/IIR filters, limit value monitoring
Operating temperature	0...+55 °C	0...+55 °C	0...+55 °C
Approvals	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex
Weight	approx. 55 g	approx. 55 g	approx. 60 g
Further information	<a href="http://www.beckhoff.com/EL3121">www.beckhoff.com/EL3121</a>	<a href="http://www.beckhoff.com/EL3122">www.beckhoff.com/EL3122</a>	<a href="http://www.beckhoff.com/EL3124">www.beckhoff.com/EL3124</a>

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

The EL320x analog input terminals enable resistance sensors to be connected directly. A microprocessor in the terminal converts the resistance value to temperature and linearises it, depending on the set characteristic curve.

The following measurement scaling is used:

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

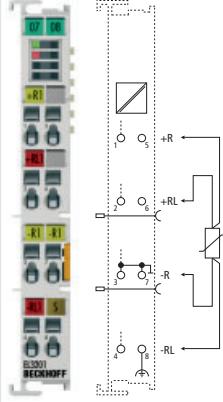
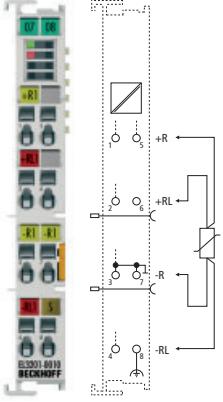
Besides that, a wire breakage is reported to the controller and indicated by the error LED. Resistance sensors with different characteristic curves are implemented over their entire measuring range, so that temperature measurements can be carried out between -200 and +850 °C. The terminal is fully configurable via the fieldbus, so that the temperature conversion can be switched off, for example.

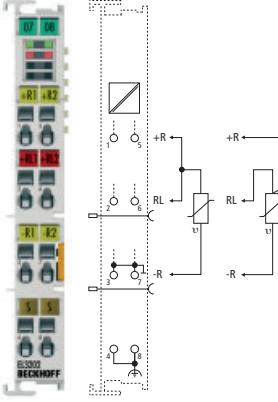
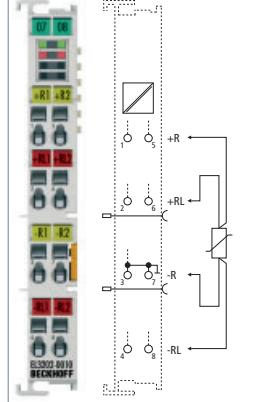
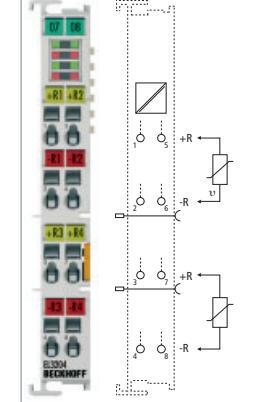
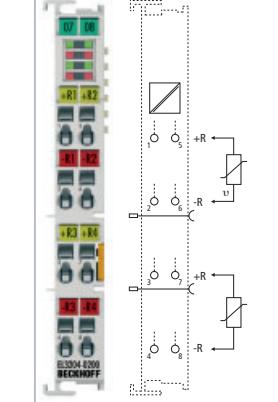
A 3- or 4-wire connection should be used for achieving maximum measuring accuracy (in conjunction with suitably precise sensors). For 2-wire measurements PT/Ni1000 sensors are recommended.

The EL320x-0010 versions offer increased accuracy at a resolution of 0.01 °C/digit and required 4-wire connection.

The synchronisation result provided by the EL3201-0020 and EL3202-0020 is confirmed with a calibration certificate.

The analog EL3204-0200 input terminal enables direct connection of four resistance sensors up to 220 kΩ, so that the usable measuring range is significantly larger compared with the EL3204. The resistance values are converted (linearisation) in the terminal either based on preset characteristic curves, conversion formulas with specific material parameters (e.g. according to IEC 60751, Steinhart-Hart equation, B-parameter equation), or a freely programmable conversion table.

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

2-channel analog input terminal, PT100 (RTD), 16 bits	2-channel analog input terminal, PT100 (RTD), 16 bits, high-precision	4-channel analog input terminal, PT100 (RTD), 16 bits	4-channel analog input terminal, PT1000 (RTD), 16 bits
EL3202   ES3202	EL3202-0010	EL3204   ES3204	EL3204-0200
		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...220 kΩ, calculation possible on the basis of a table or material constant, resistance measurement
2-, 3-wire (default setting: 3-wire)	4-wire	2-wire	
0.1 °C per digit	0.01 °C per digit	0.1 °C per digit	0.1 °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	approx. 85 ms default setting, 2...800 ms configurable
2	2	4	4
			
-200...+850 °C (PT sensors); -60...+250 °C (Ni sensors)	-200...+320 °C (PT 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)
–	–	–	–
typ. 190 mA	typ. 190 mA	typ. 190 mA	typ. 190 mA
–	–	–	–
< 0.5 mA (load-dependent)	< 0.5 mA (load-dependent)	< 0.5 mA (load-dependent)	< 0.5 mA (load-dependent)
typ. 1 kHz	typ. 1 kHz	typ. 1 kHz	typ. 1 kHz
< ±0.5 °C for PT sensors	< ±0.1 °C (for PT100 sensors, ambient temperature 40 °C, 4-wire connection, measuring range -200...+320 °C, 50 Hz filter)	< ±0.5 °C for PT sensors	dependent on measuring range (see documentation), occasionally < ±0.5 °C
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	temperature calculation on the basis of Steinhart-Hart, B parameters, IEC 60751, free table, predefined
0...+55 °C	0...+55 °C	0...+55 °C	0...+55 °C
CE, UL, Ex	CE, UL, Ex	CE, UL, Ex	CE
www.beckhoff.com/EL3202	www.beckhoff.com/EL3202-0010	www.beckhoff.com/EL3204	www.beckhoff.com/EL3204-0200
	EL3202-0020		
	with calibration certificate		

# Analog input | Thermocouple/mV measurement

Thermocouples can be classified as active transducers. They exploit the thermo-electric effect (Seebeck, Peltier, Thomson). Where two electrical conductors of different materials (e.g. iron and constantan) make contact, a contact voltage occurs, which is clearly a function of temperature and thus is called thermovoltage. The material change associated with thermocouples will always result in at least two such material combinations. One is placed at the measurement location, the other is the so-called comparison point, which is normally located in the measurement device.

In order to compensate for the reference point effect, the temperature at the reference point must be known. For the EL331x this is the connection point of the thermocouple to the terminal contacts, which is why the terminal contact temperature is specially measured here.

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

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

1-channel analog input terminal, thermocouple with open-circuit recognition

2-channel analog input terminal, thermocouple with open-circuit recognition

Technical data	EL3311	EL3312
<b>Thermocouple sensor types</b>	types J, K, L, B, E, N, R, S, T, U (default setting type K), mV measurement	
<b>Technology</b>	2-wire	
<b>Resolution</b>	0.1 °C per digit	0.1 °C per digit
<b>Conversion time</b>	approx. 750 ms up to 20 ms, depending on configuration and filter setting, default: approx. 75 ms approx. 75 ms	approx. 1.2 s up to 20 ms, depending on configuration and filter setting, default: approx. 125 ms
<b>Number of inputs</b>	1	2
<b>Temperature range</b>	in the range defined in each case for the sensor (default setting: type K; -200...+1,370 °C); voltage measurement: ±30 mV...±75 mV	in the range defined in each case for the sensor (default setting: type K; -200...+1,370 °C); voltage measurement: ±30 mV...±75 mV
<b>Current consumption power contacts</b>	–	–
<b>Current consumption E-bus</b>	200 mA	200 mA
<b>Distributed clocks</b>	–	–
<b>Input filter limit frequency</b>	typ. 1 kHz; dependent on sensor length, conversion time, sensor type	typ. 1 kHz; dependent on sensor length, conversion time, sensor type
<b>Measuring error</b>	< ±0.3 % (relative to full scale value)	< ±0.3 % (relative to full scale value)
<b>Special features</b>	open-circuit recognition	open-circuit recognition
<b>Operating temperature</b>	0...+55 °C	0...+55 °C
<b>Approvals</b>	CE, UL, Ex	CE, UL, Ex
<b>Weight</b>	approx. 60 g	approx. 60 g
<b>Further information</b>	<a href="http://www.beckhoff.com/EL3311">www.beckhoff.com/EL3311</a>	<a href="http://www.beckhoff.com/EL3312">www.beckhoff.com/EL3312</a>

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

# 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.

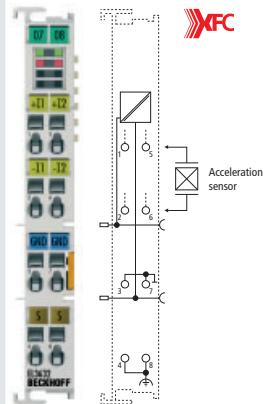
Except for filtering no preprocessing of the vibration amplitude values takes place in the EL3632. This is handled by the retrieving controller.

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.

2-channel analog  
input terminal for  
Condition Monitoring  
(IEPE), 16 bits

Technical data	EL3632
Signal voltage	IEPE constant current supply and recording of modulated AC voltage
Technology	Condition Monitoring (IEPE), oversampling recording
Resolution	16 bits (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	typ. 220 mA
E-bus	
Distributed clocks	yes
Input filter limit frequency	analog parameterisable 5 <sup>th</sup> 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	<a href="http://www.beckhoff.com/EL3632">www.beckhoff.com/EL3632</a>

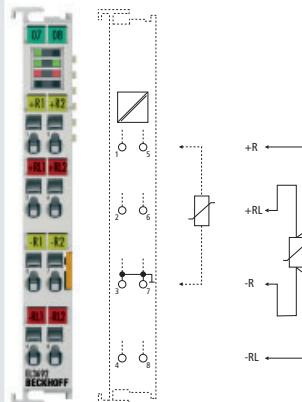
Further information on XFC see page 294

# Analog input | Resistance measurement

The EL3692 2-channel resistance measurement terminal is designed for slow sampling of ohmic resistors over a wide range from  $10\text{ m}\Omega$  to  $10\text{ M}\Omega$ . The circuitry of the EtherCAT Terminal enables measurement in 2- or 4-wire versions. Due to the electrical isolation of  $1.5\text{ kV}$  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,  
 $10\text{ m}\Omega\ldots10\text{ M}\Omega$ , 24 bits,  
high-precision

Technical data	EL3692
Measuring range	$10\text{ m}\Omega, 1\text{ }\Omega, 10\text{ }\Omega, 100\text{ }\Omega, 1\text{ k}\Omega, 10\text{ k}\Omega, 100\text{ k}\Omega, 1\text{ M}\Omega, 10\text{ M}\Omega$
Technology	2- or 4-wire, resistance measurement
Resolution	24 bits
Conversion time	typ. $10\ldots400\text{ ms}$ , dependent on measuring range and settings
Number of inputs	2



Measuring error	< $\pm 0.5\%$ (relative to the respective full scale value with 4-wire connection)
Current consumption power contacts	—
Current consumption E-bus	typ. $220\text{ mA}$
Distributed clocks	—
Internal resistance	> $100\text{ M}\Omega$
Electrical isolation	$1,500\text{ V}$ (E-bus/signal voltage)
Input filter limit frequency	100 Hz
Special features	automatic range selection, pulse and continuous measurement
Operating temperature	$0\ldots+55\text{ }^\circ\text{C}$
Approvals	CE, UL
Weight	approx. 55 g
Further information	<a href="http://www.beckhoff.com/EL3692">www.beckhoff.com/EL3692</a>

# 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,  $U_{REF} \pm 12$  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.

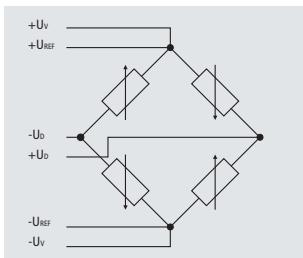
The EL3351 supplies the bridge internally with  $\pm 5$  V DC from the E-bus supply; alternatively an external bridge supply

with up to  $\pm 12$  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.

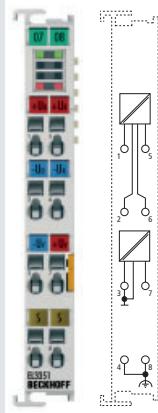
Sensors with measuring bridges are used, for example, for:

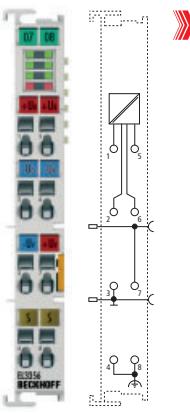
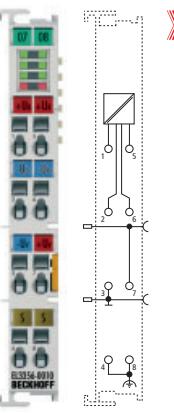
- Weighing tasks such as slow silo measurement or fast bag filling by load cells, where strain gauges are glued onto an elastic mechanical carrier, e.g. double-cantilever beam spring elements, and additionally covered to protect against environmental influences.
- vibration measurement for moving components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



Full bridge

2-channel analog input terminal, resistor bridge analysis, 16 bits

Technical data	EL3351   ES3351
Resolution	16 bits, 32 bits 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, default 82 ms, max. 400 samples/s
 The EL3351 analog input terminal is suitable for slow measuring tasks.	
Power supply $U_V$	5 V, max. 20 mA
Current consumption power contacts	–
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	<a href="http://www.beckhoff.com/EL3351">www.beckhoff.com/EL3351</a>

1-channel precise load cell analysis (resistor bridge), 16 bits	1-channel precise load cell analysis (resistor bridge), 24 bits
EL3356   ES3356	EL3356-0010
	24 bits, 32 bits 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
	
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 depends on strain gauge supply, min. 1 mA	up to 12 V from power contacts, dependent on sensor 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 <sub>REF</sub> ), > 1 MΩ (U <sub>D</sub> )	> 200 kΩ (U <sub>REF</sub> ), > 1 MΩ (U <sub>D</sub> )
10 kHz low pass (-3 dB)	10 kHz low pass (-3 dB)
< ±0,01 % for the calculated load value in relation to the final load value with a 12 V feed and 24 mV bridge voltage (hence nominal strain gauge characteristic value of 2 mV/V), self-calibration active, 50 Hz filter active	< ±0,01 % for the calculated load value in relation to the final load value with a 12 V feed and 24 mV bridge voltage (hence nominal strain gauge characteristic value of 2 mV/V), self-calibration active, 50 Hz filter active
all, resolution of parameter: 0.01 µV/V recommended: 0.5...4 mV/V	all, resolution of parameter: 0.01 µV/V recommended: 0.5...4 mV/V
self-calibration, quadruple averager, dynamic filters	self-calibration, quadruple averager, dynamic filters, fast data sampling
0...+55 °C	0...+55 °C
CE, UL	CE, UL
approx. 60 g	approx. 60 g
<a href="http://www.beckhoff.com/EL3356">www.beckhoff.com/EL3356</a>	<a href="http://www.beckhoff.com/EL3356-0010">www.beckhoff.com/EL3356-0010</a>

# 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.

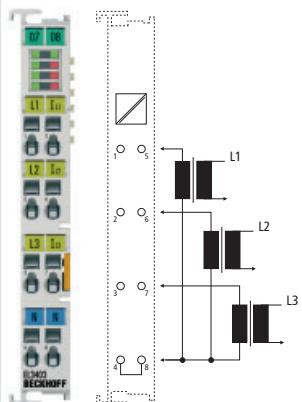
The EL34x3 terminals are suitable for measurements in 50/60 Hz power networks; the three phases plus neutral can be wired directly to the terminal for voltage measurement. For current measurement the three phases L1, L2 and L3 are fed in via simple current transformers. The measured current and voltage 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 ( $\cos \varphi$ ) for each phase. From these values the terminals calculate the apparent power (S) and the phase shift angle ( $\varphi$ ). Simple net analyses up to the 21<sup>st</sup> harmonic component 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<sub>eff</sub> and currents up to 1 A<sub>eff</sub> 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  $\mu$ s 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~ (ULx-N: max. 288 V AC)
Resolution	1 $\mu$ A, 0.1 mV, 10 mW
Conversion time	mains-synchronous
Number of inputs	3 x current, 3 x voltage
	
Measured values	current, voltage, effective power, reactive power, apparent power, energy, $\cos \varphi$ , frequency
Current consum. pow. cont.	–
Current consumption E-bus	typ. 120 mA
Distributed clocks	–
Oversampling factor	–
Measuring current	max. 1 A (AC), via measuring transformers x A/1 A
Electrical isolation	1,500 V
Measurement frequency range	45...65 Hz
Measuring error	0.5 % relative to full scale value (U/I), 1 % calculated value (P)
Special features	true RMS value calculation, single-phase operation also possible
Operating temperature	0...+55 °C
Approvals	CE, UL
Weight	approx. 75 g
Further information	<a href="http://www.beckhoff.com/EL3403">www.beckhoff.com/EL3403</a>
Special terminals	EL3403-0xxx
Distinguishing features	special terminals see <a href="http://www.beckhoff.com/EL3403">www.beckhoff.com/EL3403</a>

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~ (ULx-N: max. 400 V AC)	max. 500 V AC 3~ (ULx-N: max. 288 V AC)	max. 500 V AC 3~ (ULx-N: max. 288 V AC), max. 410 V DC
1 µA, 0.1 mV, 10 mW	1 µA, 0.1 mV, 10 mW	16 bits (incl. sign)
mains-synchronous	mains-synchronous	min. 100 µs, all channels simultaneously
3 x current, 3 x voltage	3 x current, 3 x voltage	3 x current, 3 x voltage
current, voltage, effective power, reactive power, apparent power, energy, cos φ, frequency, harmonic oscillation	current, voltage, effective power, reactive power, apparent power, energy, cos φ, frequency, harmonic oscillation	current, voltage
—	—	—
typ. 120 mA	typ. 120 mA	typ. 215 mA
—	—	yes
—	—	n = 1...100 selectable
adjustable, 100 mA, 1 A (default), 5 A; potential-free	max. 10 A (AC)	max. 1 A (AC)/1.5 A (DC), via measuring transformers x A AC/1 A AC
4,500 V	4,500 V	2,500 V
45...65 Hz	45...65 Hz	0...5 kHz
0.5 % relative to full scale value (U/I), 1 % calculated value	0.5 % relative to full scale value (U/I), 1 % calculated value	0.5 % relative to full scale value
galvanically isolated current inputs, harmonic analysis, single-phase operation also possible	direct current measurement, harmonic analysis, single-phase operation also possible	oversampling, AC/DC measurement, single-phase operation also possible, adjustable hardware filters
0...+55 °C	0...+55 °C	0...+55 °C
CE	CE	CE
approx. 100 g	approx. 100 g	approx. 75 g
<a href="http://www.beckhoff.com/EL3413">www.beckhoff.com/EL3413</a>	<a href="http://www.beckhoff.com/EL3433">www.beckhoff.com/EL3433</a>	<a href="http://www.beckhoff.com/EL3773">www.beckhoff.com/EL3773</a>

For availability status see Beckhoff website at: [www.beckhoff.com/EL3433](http://www.beckhoff.com/EL3433)

# 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.

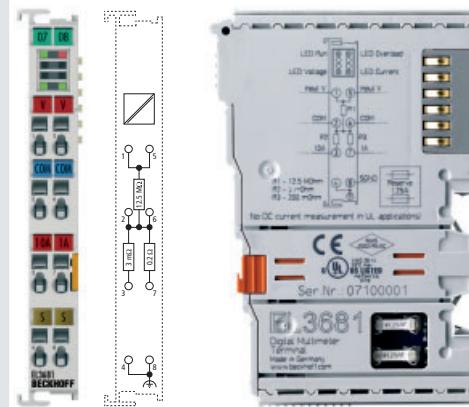
Excellent interference immunity is achieved through the fully electrically isolated design of the electronic measuring system and the dual slope conversion system. High precision and simple, high-impedance measurement from 300 mV to 300 V allow the EtherCAT Terminals to be used like a modern digital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

Technical data	EL3681   ES3681
Signal voltage	max. 300 V AC/DC, 10 A
Resolution	18 bits + 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



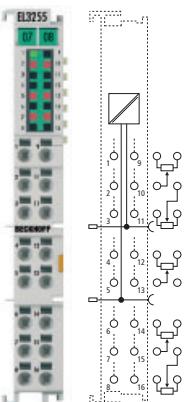
Measuring voltage	300 mV, 3 V, 30 V, 300 V
Current consumption power contacts	–
Current consumption E-bus	150 mA
Distributed clocks	–
Measuring current	100 mA, 1 A and 10 A via high-current path
Internal resistance	3 mΩ/0.2 Ω/12.5 MΩ
Electrical isolation	1,500 V (terminal/E-bus)
Measuring error	0.01 % DC voltage measurement at 25 °C
Special features	automatic or manual range selection, 1.25 A fuse installed + spare fuse, filter deactivatable
Operating temperature	0...+55 °C
Approvals	CE
Weight	approx. 70 g
Further information	<a href="http://www.beckhoff.com/EL3681">www.beckhoff.com/EL3681</a>
Accessories	ZB8000-0001
Spare fuse	10 pieces, 1.25 A

# 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.

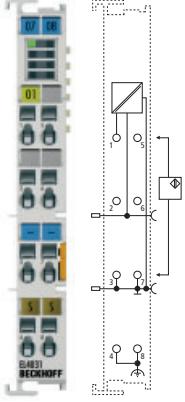
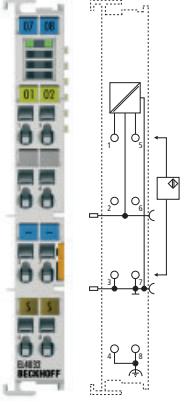
5-channel input,  
potentiometer measurement  
with sensor supply,  
10 V

Technical data	EL3255
Sensor types	potentiometer 300 $\Omega$ ...50 k $\Omega$
Technology	ratiometric potentiometer evaluation with own supply, 3-wire connection
Resolution	16 bits (incl. sign)
Number of inputs	5
	
Conversion time	typ. 300...700 $\mu$ s, dependent on settings, default setting: approx. 500 $\mu$ s (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 $\pm$ 10 %
Internal resistance	>> 100 k $\Omega$ to wiper connection
Measuring error	< $\pm$ 0.5 % (relative to full scale value)
Special features	open-circuit recognition, supply monitoring, activatable filters, simultaneous measurement of the channels
Operating temperature	0...+55 °C
Approvals	CE
Weight	approx. 70 g
Further information	<a href="http://www.beckhoff.com/EL3255">www.beckhoff.com/EL3255</a>

# Analog output | -10...+10 V, 12 bits/16 bits

The output from the EL4xxx EtherCAT Terminals is an analog voltage or current parameter, depending on the controller specification: Terminals with 1 to 8 output channels on a 12 mm wide terminal are available for the ranges -10...+10 V, 0...10 V, 0...20 mA and 4...20 mA. All terminals feature a watchdog which, in the event of a communication failure, issues a stored value (default: 0) or even moves to it via a ramp. All EL4xxx units feature distributed clocks, which means that, if activated, they issue their output values reproducibly and synchronous with the other distributed clock devices in the system. The fewer channels a terminal has, the faster it can update its channels. The EL47xx is even able to generate new output values every 10 µs and can therefore output up to 100,000 samples per second.

The EL4732 and EL4712 oversampling terminals are particularly suitable for high-precision responses in DC systems, e.g. in conjunction with input terminals (EL37xx, EL31xx) or servo controllers.

	1-channel analog output terminal, -10...+10 V, 12 bits	2-channel analog output terminal, -10...+10 V, 12 bits
<b>Technical data</b>	<b>EL4031   ES4031</b>	<b>EL4032   ES4032</b>
<b>Signal voltage</b>	-10...+10 V	
<b>Resolution</b>	12 bits	
<b>Connection technology</b>	2-wire, single-ended	2-wire, single-ended
<b>Conversion time</b>	~ 100 µs	~ 150 µs
<b>Number of outputs</b>	1	2
		
	<p>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.</p>	
<b>Load</b>	> 5 kΩ (short-circuit-proof)	> 5 kΩ (short-circuit-proof)
<b>Current consumption E-bus</b>	typ. 140 mA	typ. 140 mA
<b>Distributed clocks</b>	yes	yes
<b>Distributed clock precision</b>	<< 1 µs	<< 1 µs
<b>Oversampling factor</b>	–	–
<b>Output rate</b>	–	–
<b>Current consum. pow. cont.</b>	typ. 25 mA	typ. 25 mA
<b>Output error</b>	< 0.1 % (relative to end value)	< 0.1 % (relative to end value)
<b>Special features</b>	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.
<b>Operating temperature</b>	0...+55 °C	0...+55 °C
<b>Approvals</b>	CE, UL, Ex	CE, UL, Ex
<b>Weight</b>	approx. 55 g	approx. 55 g
<b>Further information</b>	<a href="http://www.beckhoff.com/EL4031">www.beckhoff.com/EL4031</a>	<a href="http://www.beckhoff.com/EL4032">www.beckhoff.com/EL4032</a>

4-channel analog output terminal, -10...+10 V, 12 bits	8-channel analog output terminal, -10...+10 V, 12 bits	2-channel analog output terminal, -10...+10 V, 16 bits, oversampling	2-channel analog output terminal, -10...+10 V, 16 bits	4-channel analog output terminal, -10...+10 V, 16 bits
EL4034   ES4034	EL4038   ES4038	EL4732   ES4732	EL4132   ES4132	EL4134   ES4134

16 bits (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.
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
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

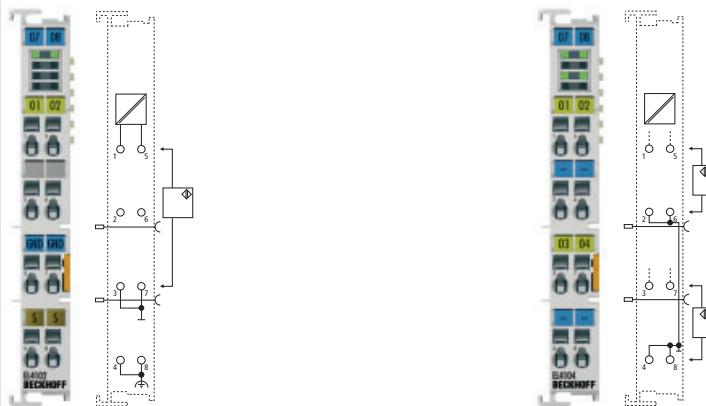
Further information on XFC see page [294](#)

# Analog output | 0...10 V, 12 bits

	1-channel analog output terminal, 0...10 V, 12 bits	2-channel analog output terminal, 0...10 V, 12 bits	4-channel analog output terminal, 0...10 V, 12 bits	8-channel analog output terminal, 0...10 V, 12 bits
Technical data	EL4001   ES4001	EL4002   ES4002	EL4004   ES4004	EL4008   ES4008
Signal voltage	0...10 V			
Resolution	12 bits			
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
<p>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.</p>				
Load	> 5 kΩ (short-circuit-proof)			
Current consumption	typ. 140 mA	typ. 140 mA	typ. 140 mA	typ. 100 mA
E-bus				
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)			
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	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. 60 g	approx. 60 g	approx. 85 g	approx. 85 g
Further information	<a href="http://www.beckhoff.com/EL4001">www.beckhoff.com/EL4001</a>	<a href="http://www.beckhoff.com/EL4002">www.beckhoff.com/EL4002</a>	<a href="http://www.beckhoff.com/EL4004">www.beckhoff.com/EL4004</a>	<a href="http://www.beckhoff.com/EL4008">www.beckhoff.com/EL4008</a>

# Analog output | 0...10 V, 16 bits

	2-channel analog output terminal, 0...10 V, 16 bits	4-channel analog output terminal, 0...10 V, 16 bits
<b>Technical data</b>	<b>EL4102   ES4102</b>	<b>EL4104   ES4104</b>
<b>Signal voltage</b>	0...10 V	
<b>Resolution</b>	16 bits (incl. sign)	
<b>Connection technology</b>	2-wire, single-ended	2-wire, single-ended
<b>Conversion time</b>	~ 40 µs	~ 290 µs
<b>Number of outputs</b>	2	4

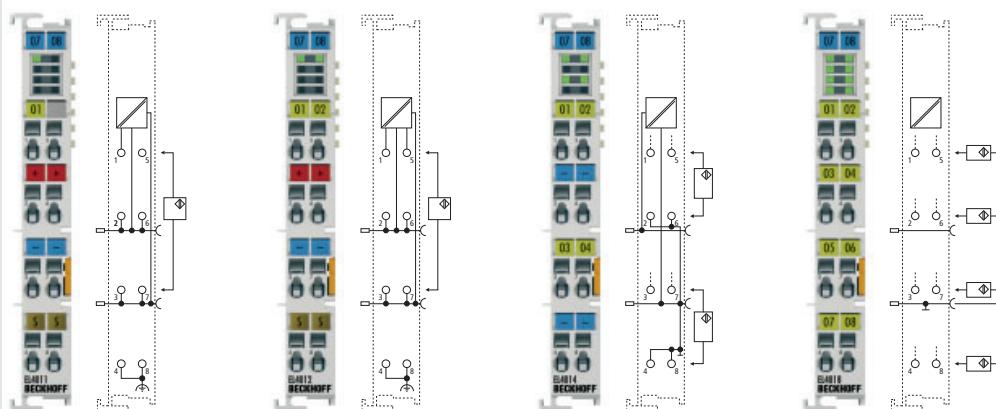


The EL4102 and EL4104 EtherCAT Terminals are analog output terminals with short conversion times and 16-bit resolution and are suitable for fast control tasks. Both terminals are designed for 2-wire connection. The channels have a common reference ground. User scaling can be set in the terminal.

<b>Load</b>	> 5 kΩ (short-circuit-proof)	> 5 kΩ (short-circuit-proof)
<b>Current consumption</b>	typ. 210 mA	typ. 190 mA
<b>E-bus</b>		
<b>Distributed clocks</b>	yes	yes
<b>Distributed clock precision</b>	<< 1 µs	<< 1 µs
<b>Current consumption power contacts</b>	–	–
<b>Output error</b>	< 0.1 % (relative to end value)	< 0.1 % (relative to end value)
<b>Special features</b>	Watchdog parameterisable; user synchronisation can be activated.	Watchdog parameterisable; user synchronisation can be activated.
<b>Operating temperature</b>	0...+55 °C	0...+55 °C
<b>Approvals</b>	CE, UL, Ex	CE, UL, Ex
<b>Weight</b>	approx. 60 g	approx. 65 g
<b>Further information</b>	<a href="http://www.beckhoff.com/EL4102">www.beckhoff.com/EL4102</a>	<a href="http://www.beckhoff.com/EL4104">www.beckhoff.com/EL4104</a>

# Analog output | 0...20 mA, 12 bits

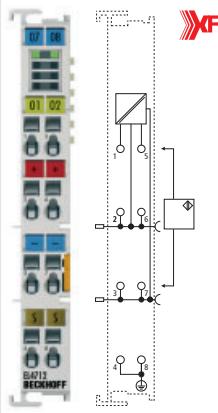
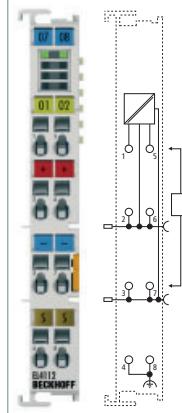
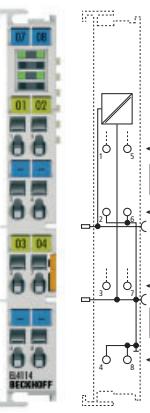
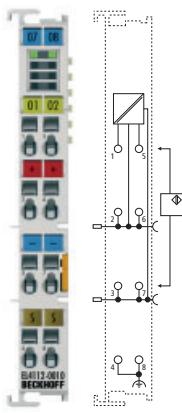
	1-channel analog output terminal, 0...20 mA, 12 bits	2-channel analog output terminal, 0...20 mA, 12 bits	4-channel analog output terminal, 0...20 mA, 12 bits	8-channel analog output terminal, 0...20 mA, 12 bits
Technical data	EL4011   ES4011	EL4012   ES4012	EL4014   ES4014	EL4018   ES4018
Signal voltage	0...20 mA			
Resolution	12 bits			
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)			
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	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. 60 g	approx. 60 g	approx. 65 g	approx. 65 g
Further information	<a href="http://www.beckhoff.com/EL4011">www.beckhoff.com/EL4011</a>	<a href="http://www.beckhoff.com/EL4012">www.beckhoff.com/EL4012</a>	<a href="http://www.beckhoff.com/EL4014">www.beckhoff.com/EL4014</a>	<a href="http://www.beckhoff.com/EL4018">www.beckhoff.com/EL4018</a>

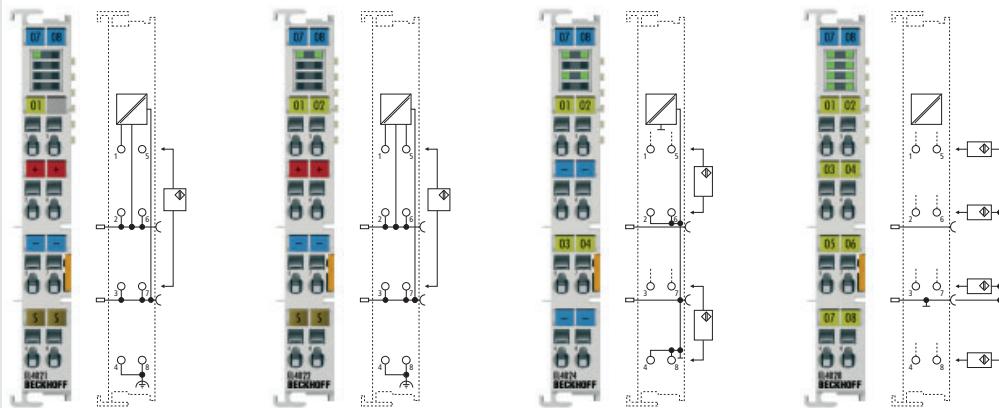
# Analog output | 0...20 mA/-10...+10 mA, 16 bits

	2-channel analog output terminal, 0...20 mA, 16 bits, oversampling	2-channel analog output terminal, 0...20 mA, 16 bits	4-channel analog output terminal, 0...20 mA, 16 bits	2-channel analog output terminal, -10...+10 mA, 16 bits
<b>Technical data</b>	<b>EL4712   ES4712</b>	<b>EL4112   ES4112</b>	<b>EL4114   ES4114</b>	<b>EL4112-0010</b>
<b>Signal voltage</b>	0...20 mA		-10...+10 mA	
<b>Resolution</b>	16 bits (incl. sign)			
<b>Connection technology</b>	3-wire, single-ended	3-wire, single-ended	2-wire, single-ended	3-wire, single-ended
<b>Conversion time</b>	~ 10 µs	~ 40 µs	~ 290 µs	~ 40 µs
<b>Number of outputs</b>	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.		
<b>Load</b>	< 500 Ω (short-circuit-proof)	< 500 Ω (short-circuit-proof)	< 350 Ω (short-circuit-proof)	< 500 Ω (short-circuit-proof)
<b>Current consumption E-bus</b>	typ. 100 mA	typ. 160 mA	typ. 160 mA	typ. 160 mA
<b>Distributed clocks</b>	yes	yes	yes	yes
<b>Distributed clock precision</b>	<< 1 µs	<< 1 µs	<< 1 µs	<< 1 µs
<b>Oversampling factor</b>	n = integer multiple of the cycle time, 1...100 selectable	–	–	–
<b>Output rate</b>	max. 100 ksamples/s	–	–	–
<b>Current consum. pow. cont.</b>	typ. 15 mA	typ. 15 mA	typ. 15 mA	typ. 15 mA
<b>Output error</b>	< 0.1 % (relative to end value)	< 0.1 % (relative to end value)	< 0.1 % (relative to end value)	< 0.1 % (relative to end value)
<b>Special features</b>	oversampling	Watchdog parameterisable; user synchronisation can be activated.	Watchdog parameterisable; user synchronisation can be activated.	Watchdog parameterisable; user synchronisation can be activated.
<b>Operating temperature</b>	0...+55 °C	0...+55 °C	0...+55 °C	0...+55 °C
<b>Approvals</b>	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex
<b>Weight</b>	approx. 65 g	approx. 60 g	approx. 65 g	approx. 65 g
<b>Further information</b>	<a href="http://www.beckhoff.com/EL4712">www.beckhoff.com/EL4712</a>	<a href="http://www.beckhoff.com/EL4112">www.beckhoff.com/EL4112</a>	<a href="http://www.beckhoff.com/EL4114">www.beckhoff.com/EL4114</a>	<a href="http://www.beckhoff.com/EL4112">www.beckhoff.com/EL4112</a>

Further information on XFC see page **294**

# Analog output | 4...20 mA, 12 bits

	1-channel analog output terminal, 4...20 mA, 12 bits	2-channel analog output terminal, 4...20 mA, 12 bits	4-channel analog output terminal, 4...20 mA, 12 bits	8-channel analog output terminal, 4...20 mA, 12 bits
Technical data	<b>EL4021   ES4021</b>	<b>EL4022   ES4022</b>	<b>EL4024   ES4024</b>	<b>EL4028   ES4028</b>
<b>Signal voltage</b>	4...20 mA			
<b>Resolution</b>	12 bits			
<b>Connection technology</b>	3-wire, single-ended	3-wire, single-ended	2-wire, single-ended	1-wire, single-ended
<b>Conversion time</b>	~ 100 µs	~ 150 µs	~ 250 µs	~ 400 µs
<b>Number of outputs</b>	1	2	4	8

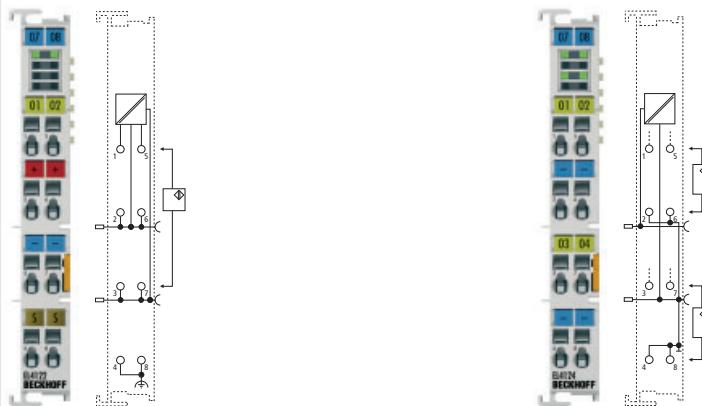


The EtherCAT Terminals of the EL402x series are analog output terminals with average conversion times and 12-bit resolution. The channels use the 0 V power contact as common reference potential. Apart from the 8-channel version EL4028, the terminals of the EL402x series are designed for 2-wire connection.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

<b>Load</b>	< 500 Ω (short-circuit-proof)	< 500 Ω (short-circuit-proof)	< 350 Ω (short-circuit-proof)	< 150 Ω
<b>Current consumption E-bus</b>	typ. 140 mA	typ. 140 mA	typ. 140 mA	typ. 100 mA
<b>Distributed clocks</b>	yes	yes	yes	yes
<b>Distributed clock precision</b>	<< 1 µs	<< 1 µs	<< 1 µs	<< 1 µs
<b>Current consumption power contacts</b>	typ. 25 mA	typ. 25 mA	typ. 25 mA	typ. 60 mA
<b>Output error</b>	< 0.1 % (relative to end value)			
<b>Special features</b>	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.
<b>Operating temperature</b>	0...+55 °C	0...+55 °C	0...+55 °C	0...+55 °C
<b>Approvals</b>	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex
<b>Weight</b>	approx. 60 g	approx. 60 g	approx. 80 g	approx. 80 g
<b>Further information</b>	<a href="http://www.beckhoff.com/EL4021">www.beckhoff.com/EL4021</a>	<a href="http://www.beckhoff.com/EL4022">www.beckhoff.com/EL4022</a>	<a href="http://www.beckhoff.com/EL4024">www.beckhoff.com/EL4024</a>	<a href="http://www.beckhoff.com/EL4028">www.beckhoff.com/EL4028</a>

# Analog output | 4...20 mA, 16 bits

	2-channel analog output terminal, 4...20 mA, 16 bits	4-channel analog output terminal, 4...20 mA, 16 bits
<b>Technical data</b>	<b>EL4122   ES4122</b>	<b>EL4124   ES4124</b>
<b>Signal voltage</b>	4...20 mA	
<b>Resolution</b>	16 bits (incl. sign)	
<b>Connection technology</b>	3-wire, single-ended	2-wire, single-ended
<b>Conversion time</b>	~ 40 µs	~ 290 µs
<b>Number of outputs</b>	2	4



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.

<b>Load</b>	< 500 Ω (short-circuit-proof)	< 350 Ω (short-circuit-proof)
<b>Current consumption</b>	typ. 160 mA	typ. 190 mA
<b>E-bus</b>		
<b>Distributed clocks</b>	yes	yes
<b>Distributed clock precision</b>	<< 1 µs	<< 1 µs
<b>Current consumption power contacts</b>	typ. 15 mA	typ. 15 mA
<b>Output error</b>	< 0.1 % (relative to end value)	< 0.1 % (relative to end value)
<b>Special features</b>	Watchdog parameterisable; user synchronisation can be activated.	Watchdog parameterisable; user synchronisation can be activated.
<b>Operating temperature</b>	0...+55 °C	0...+55 °C
<b>Approvals</b>	CE, UL, Ex	CE, UL, Ex
<b>Weight</b>	approx. 60 g	approx. 65 g
<b>Further information</b>	<a href="http://www.beckhoff.com/EL4122">www.beckhoff.com/EL4122</a>	

# Position measurement | SSI encoder interface

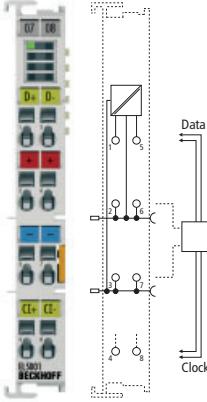
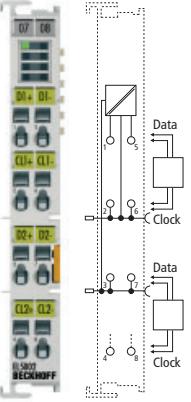
The EL5001 SSI interface EtherCAT Terminal enables the direct connection of an SSI encoder; two SSI encoders can be connected to the 2-channel EL5002 version.

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.

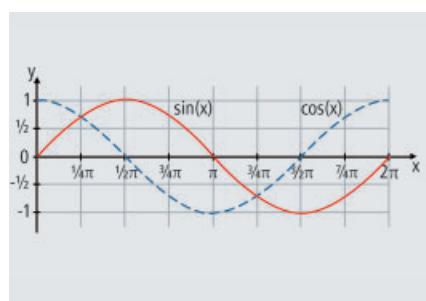
If the transmitted position data are also to be read by a second controller while an SSI master-slave connection already exists, the EL5001-0011 can be used as an SSI monitor, which passively and jointly reads the SSI data on the data lines.

	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	0...+55 °C	0...+55 °C
Approvals	CE, UL, Ex	CE, UL, Ex
Weight	approx. 55 g	approx. 55 g
Further information	<a href="http://www.beckhoff.com/EL5001">www.beckhoff.com/EL5001</a>	<a href="http://www.beckhoff.com/EL5002">www.beckhoff.com/EL5002</a>
Special terminals	EL5001-0011	
Distinguishing features	SSI monitor terminal, no clock output (simply listening)	

# Position measurement | 1-channel SinCos encoder interface

Position encoders with a 1 V<sub>PP</sub> sine/cosine interface output two sine signals phase-shifted by 90° as analog voltages. The two signals are each transmitted differentially as signal and counter-signal, so that the voltage difference between the two lines corresponds to the wanted signal in volts peak-to-peak (usual voltage level: 1 V<sub>PP</sub>). In the case of rotary encoders, a full mechanical revolution is divided into up to 10,000 periods, wherein one period corresponds to the full cycle of the sine/cosine signal in 1 V<sub>PP</sub> encoders. In order to refine the resolution, an n-thousandfold more exact determination of the position within one period is achieved by the interpolation of the two 90° phase-shifted sine signals. For the EL5021 SinCos EtherCAT Terminal, this resolution of the period by interpolation is 8 to 13 bits, depending upon the setting, and is equivalent to a 256 to 8,192-fold micro-resolution of the period.

Digital encoder evaluations mostly use only full steps to determine position, so that the reciprocal value of the number of periods of an encoder corresponds to the maximum resolution. The EL5101 encoder terminal, however, uses a time-based microincrement method to achieve 256-fold interpolation.



SinCos signal depending on the encoder position

1-channel SinCos encoder interface,  
1 V<sub>PP</sub>

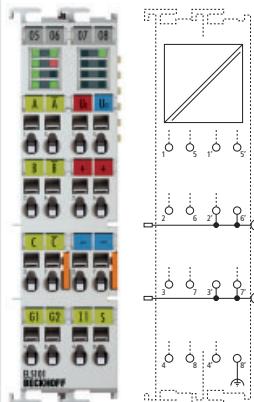
Technical data	EL5021   ES5021
Technology	SinCos encoder interface for differential 1 V <sub>PP</sub> signal
Number of channels	1
Nominal voltage	24 V at power contact, 5 V encoder supply built in
Current consumption power contacts	typ. 50 mA without connected sensor
Current consumption E-bus	typ. 120 mA
Distributed clocks	yes
Signal input	1 V <sub>PP</sub>
Encoder connection	A, A (inv), B, B (inv), C,C (inv)
Input frequency	250 kHz (scanning of the input signals with 70 MHz)
Resolution	max. 13 bits, 1,024 steps per period
Special features	latch, reset, amplitude and frequency error recognition, frequency-dependent period resolution, frequency counter max. 24 bit
Operating temperature	0...+55 °C
Approvals	CE, Ex
Weight	approx. 55 g
Further information	<a href="http://www.beckhoff.com/EL5021">www.beckhoff.com/EL5021</a>

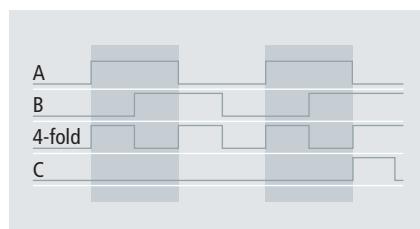
# Position measurement | Incremental encoder interface

As opposed to absolute value encoders, incremental encoders do not supply a direct position, but rather a changing/pulsed signal, which can be calculated back to a position. Incremental encoders divide a 360° rotation of the encoder axis into individual steps (increments) and mark a full revolution by means of a special mark (zero pulse).

The number of increments determines both the resolution of an encoder and the accuracy of the position. In order to refine the position determination or to increase the resolution, the Beckhoff encoder terminals support the microincrement mode. The interpolation of the signal voltages results in a 256-fold greater resolution, without which an encoder with a finer resolution would have to be used. Due to the functional principal, this time-based function requires a minimum speed in the case of dynamic axes; i.e. micro-increments cannot be evaluated at a (virtual) standstill.

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

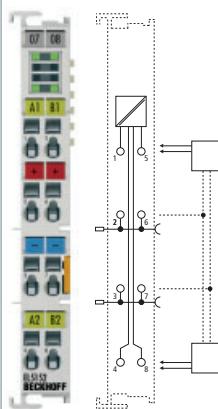
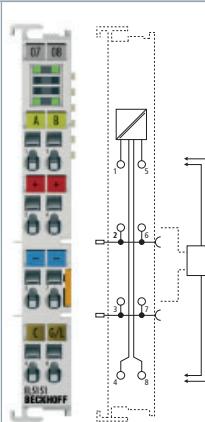
Technical data	EL5101   ES5101
Technology	incremental encoder interface RS485
Number of channels	1
	
	<p>The EL5101 EtherCAT Terminal is an interface for the direct connection of incremental encoders with differential (RS485) or single-ended inputs. It supplies 5 V for the encoder supply.</p>
Nominal 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, time-stamping of edges, filters
Operating temperature	0...+55 °C
Approvals	CE, UL, Ex
Weight	approx. 100 g
Further information	<a href="http://www.beckhoff.com/EL5101">www.beckhoff.com/EL5101</a>
Special terminals	EL5101-0010
Distinguishing features	20 million increments/s (with 4-fold evaluation), no single-ended operation



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

1-channel incremental encoder interface, single-ended, 24 V DC	2-channel incremental encoder interface, single-ended, 24 V DC
EL5151   ES5151	EL5152   ES5152
incremental encoder interface 24 V DC, EN 61131-2, type 1, "0": < 5 V DC, "1": > 15 V DC, typ. 5 mA	

2



The EL5151 EtherCAT Terminal is an interface with 24 V inputs for the direct connection of incremental encoders. A 32 bit counter with a quadrature decoder and a 32 bit latch for the zero pulse can be read, set or enabled. Alternatively, the EL5151 can be used as up/down counter terminal with gate.

Two 32-bit counters with quadrature encoder can be read and set in the EL5152 EtherCAT Terminal. Due to their support for distributed clocks, the EL51xx terminals can detect the axis positions synchronously and with high temporal accuracy together with other slaves. In the case of dynamic axes above a certain minimum speed, the microincrement function allows a 256-fold finer positional resolution than that provided by the encoder with its clock signals.

24 V DC at power contact	24 V DC at power contact
typ. 100 mA + load	typ. 100 mA + load
typ. 130 mA	typ. 130 mA
yes	yes
24 V DC	24 V DC
A, B, C, gate/latch input 24 V DC, 24 V/0 V	A1, B1, A2, B2, 24 V/0 V
24 V DC	24 V DC
max. 400,000 increments/s (with 4-fold evaluation)	max. 400,000 increments/s (with 4-fold evaluation)
1/256 bit microincrements	1/256 bit microincrements
1 x 16/32 bit switchable	2 x 32 bit
gate or latch function, microincrements, time stamping of edges, period duration and frequency measurement, up/down counters	gate or latch function, microincrements, time stamping of edges, period duration and frequency measurement, up/down counters
0...+55 °C	0...+55 °C
CE, UL, Ex	CE, UL, Ex
approx. 50 g	approx. 50 g
www.beckhoff.com/EL5151	www.beckhoff.com/EL5152

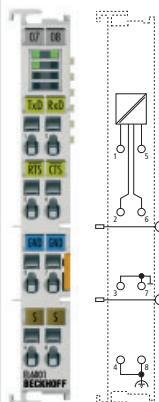
# Communication | Serial interfaces RS232/RS485

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 909).

1 x serial interface RS232/RS422/RS485	2 x serial interface RS232/RS422/RS485
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Technical data	EL6001   ES6001	EL6021   ES6021	EL6002	EL6022
<b>Data transfer rates</b>	2,400...115,200 baud; default: 9,600 baud, 8 data bits, no parity and one stop bit	300...115,200 baud; default: 9,600 baud, 8 data bits, no parity and one stop bit		
<b>Interfaces</b>	1 x RS232	1 x RS422/ RS485	2 x RS232	2 x RS422/ RS485
<b>Technology</b>	terminal contact		D-sub, 9-pin	
				
<b>Data buffer</b>	864 bytes receive buffer, 128 bytes transmit buffer	864 bytes receive buffer, 128 bytes transmit buffer		
<b>Current consumption power contacts</b>	–	–	–	–
<b>Current consumption E-bus</b>	typ. 120 mA	typ. 170 mA	typ. 170 mA	typ. 270 mA
<b>Distributed clocks</b>	–	–	–	–
<b>Cable length</b>	max. 15 m	approx. 1,000 m twisted pair	max. 15 m	approx. 1,000 m twisted pair
<b>Line impedance</b>	–	120 Ω	–	120 Ω
<b>Special features</b>	–	–	2 x 5 V/20 mA for external supply (EL6022)	
<b>Operating temperature</b>	0...+55 °C	0...+55 °C		
<b>Approvals</b>	CE, UL, Ex	CE, UL, Ex		
<b>Weight</b>	approx. 55 g	approx. 55 g		
<b>Further information</b>	<a href="http://www.beckhoff.com/EL6001">www.beckhoff.com/EL6001</a>	<a href="http://www.beckhoff.com/EL6002">www.beckhoff.com/EL6002</a>		

# Communication | EtherCAT memory terminal 128 kbyte

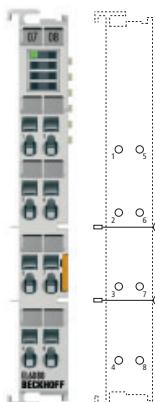
The EL6080 EtherCAT memory terminal has 128 KB of non-volatile memory (NOVRAM). The terminal can be used to store and read out parameters and recipes. Part of the memory can also be used for the cyclic storage of machine data such as operating hour meters or production numbers. The EtherCAT Terminal 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

<b>Technical data</b>	EL6080
<b>Technology</b>	EtherCAT memory terminal
<b>Memory</b>	128 kbyte NOVRAM



<b>Number of write/read</b>	arbitrary
<b>Current consumption power contacts</b>	–
<b>Current consumption E-bus</b>	typ. 130 mA
<b>Distributed clocks</b>	–
<b>Operating temperature</b>	0...+55 °C
<b>Approvals</b>	CE, UL, Ex
<b>Weight</b>	approx. 50 g
<b>Further information</b>	<a href="http://www.beckhoff.com/EL6080">www.beckhoff.com/EL6080</a>

# Communication | Ethernet switch port terminals

The EL6601 and EL6614 Ethernet switch-port 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 RJ 45 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

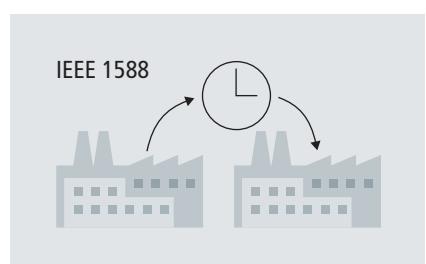
	Ethernet switch port terminal, 1 port	Ethernet switch port terminal, 4 ports, internal switch
Technical data	EL6601	EL6614
<b>Ethernet interface</b>	10BASE-T/100BASE-TX Ethernet with 1 x RJ 45	10BASE-T/100BASE-TX Ethernet with 4 x RJ 45
<b>Data transfer rates</b>	10/100 Mbit/s, IEEE 802.3u auto-negotiation, half or full duplex at 10 and 100 Mbit/s possible, automatic settings	
<b>Protocol</b>	all Ethernet (IEEE 802.3)-based protocols, store and forward switching mode	all Ethernet (IEEE 802.3)-based protocols, store and forward switching mode
<b>Cable length</b>	up to 100 m twisted pair	up to 100 m twisted pair
<b>Current consumption power contacts</b>	–	–
<b>Current consumption E-bus</b>	typ. 310 mA	typ. 450 mA
<b>Distributed clocks</b>	–	–
<b>Special features</b>	support of RT Ethernet, publisher/subscriber, DHCP/BootP address allocation (1 device)	support of RT Ethernet, publisher/subscriber, DHCP/BootP address allocation (1 device)
<b>Operating temperature</b>	0...+55 °C	0...+55 °C
<b>Approvals</b>	CE, UL, Ex	CE, UL, Ex
<b>Weight</b>	approx. 75 g	approx. 95 g
<b>Further information</b>	<a href="http://www.beckhoff.com/EL6601">www.beckhoff.com/EL6601</a>	<a href="http://www.beckhoff.com/EL6614">www.beckhoff.com/EL6614</a>

# 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 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 RJ 45
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
Protocol	PTPv1 (IEEE 1588-2002), PTPv2 (IEEE 1588-2008)
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.

Current consum. pow. cont.	–
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	<a href="http://www.beckhoff.com/EL6688">www.beckhoff.com/EL6688</a>

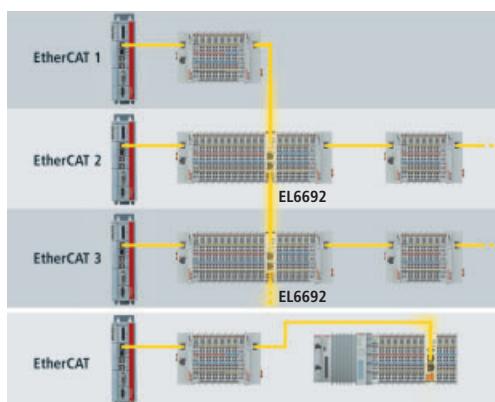
# Communication | EtherCAT bridge terminal

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 may be purposeful.

The EL6692, 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 RJ 45 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.

In addition, the EL6692 can transfer data up to 480 bytes in both directions and function as an ADS over EtherCAT gateway. The EL6601 can be used in real-time mode (publisher/subscriber) for synchronous data exchange with larger data quantities.



Example topology EL6692

EtherCAT bridge terminal

Technical data	EL6692
Technology	primary side: E-bus (terminal strand), secondary side: 2 x 100 Mbit/s Ethernet, RJ 45, In/Out
Function	EtherCAT distributed clock synchronisation, data exchange



The EL6692 is designed for the synchronisation of two EtherCAT systems. In addition, it can exchange data packets of up to 480 bytes in both directions with a transfer time of > 1 ms. The power supply on the primary side (E-bus) comes from the E-bus, on the secondary side (RJ 45) via an external connection. If several bridge terminals are used, the data traffic continues if the power supply to a device fails. The bridge terminal can also be used for integrating a subordinate PC system as an EtherCAT slave. Plug X3 is included in the scope of supply.

Nominal voltage	24 V DC (secondary side)
Current consumption power contacts	—
Current consumption E-bus	E-bus: 120 mA, external: 60 mA/24 V typ.
Distributed clocks	yes
Power supply	primary: via the E-bus, secondary: via connector
Special features	usable in TwinCAT as a reference clock, up to 480 byte asynchronous data transfer in each direction, supports ADS over EtherCAT (AoE)
Operating temperature	0...+55 °C
Approvals	CE, Ex
Weight	approx. 85 g
Further information	<a href="http://www.beckhoff.com/EL6692">www.beckhoff.com/EL6692</a>

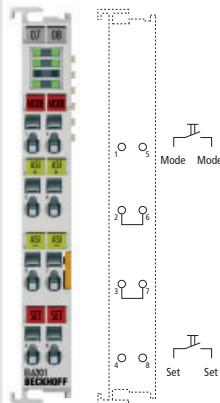
# Communication | AS-Interface master terminal

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 master terminal

<b>Technical data</b>	<b>i</b> EL6201   ES6201
<b>Technology</b>	AS-Interface master terminal
<b>AS-Interface versions</b>	V 2.0, V 2.1, V 3.0
<b>AS-Interface slaves</b>	31 for V 2.0, 62 for V 2.1
<b>Number of channels</b>	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 2.0, 2.1 and 3.0. The connected devices are supplied via the EL9520 AS-Interface potential feed terminal with filter.

<b>Cycle time</b>	max. 5 ms (31 devices)
<b>Current consumption power contacts</b>	–
<b>Current consumption E-bus</b>	typ. 180 mA (E-bus), approx. 60 mA (AS-Interface)
<b>Distributed clocks</b>	–
<b>AS-Interface diagnostics</b>	power failure, slave failure, parameterisation error
<b>Special features</b>	AS-Interface address allocation: automatic or via configuration
<b>Operating temperature</b>	0...+55 °C
<b>Approvals</b>	CE
<b>Weight</b>	approx. 55 g
<b>Further information</b>	<a href="http://www.beckhoff.com/EL6201">www.beckhoff.com/EL6201</a>

**i** For availability status see Beckhoff website at: [www.beckhoff.com/EL6201](http://www.beckhoff.com/EL6201)

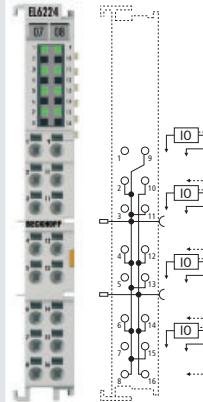
# Communication | IO-Link terminal

An IO-Link system consists of IO-Link devices such as sensors, actuators or combinations of both. They are connected using the classic 3-wire technique. The EL6224 performs the IO-Link master function and is equipped with four ports. Only one IO-Link device can ever be connected to each port. IO-Link thus represents a point-to-point communication method and not a fieldbus.



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

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



The IO-Link terminal enables connection of up to four IO-Link devices. A point-to-point connection is used between the terminal and the device. The terminal is parameterised via the EtherCAT master in TwinCAT. Both the 2-wire connection (physics 1) and the 3-wire connection (physics 2) are supported. During commissioning, the four channels of the EL6224 must be configured as inputs or outputs and parameterised for the corresponding sensor/actuator data. However, they can also be used as standard 24 V inputs.

Supply current for devices	< 200 mA per device (method 1)
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	<a href="http://www.beckhoff.com/EL6224">www.beckhoff.com/EL6224</a>

# Communication | PROFINET controller/device

The EL6631 PROFINET IO 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 IO devices can be projected on the EL6631.

The EL6631-0010 PROFINET I/O device (slave) terminal enables the simple exchange of data between EtherCAT and the PROFINET I/O 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 RJ 45 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 IO controller/  
device terminal

PROFINET IRT controller

Technical data	EL6631	EL6632
Technology	PROFINET IO	
Ethernet interface	100BASE-TX Ethernet with 2 x RJ 45	
Protocol	RT	RT or IRT
Number of channels	1	1
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	<a href="http://www.beckhoff.com/EL6631">www.beckhoff.com/EL6631</a>	<a href="http://www.beckhoff.com/EL6632">www.beckhoff.com/EL6632</a>
Special terminals	<b>EL6631-0010</b>	
Distinguishing features	PROFINET IO device	

For availability status see Beckhoff website at: [www.beckhoff.com/EL6632](http://www.beckhoff.com/EL6632)

# Communication | Lightbus master terminal

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 **648**

**LIGHTBUS**

Lightbus master terminal

Technical data	EL6720
Technology	Lightbus master terminal
Data transfer rates	2.5 Mbaud
Interfaces	2 x fibre optic standard connector Z1000 (plastic fibre), Z1010 (HCS fibre)
Number of channels	1



Fieldbus	Lightbus
Current consumption power contacts	–
Current consumption E-bus	typ. 240 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
Operating temperature	0...+55 °C
Approvals	CE, UL, Ex
Weight	approx. 70 g
Further information	<a href="http://www.beckhoff.com/EL6720">www.beckhoff.com/EL6720</a>

# 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, slave and PROFIBUS 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	0...+55 °C
Approvals	CE, UL, Ex
Weight	approx. 70 g
Further information	<a href="http://www.beckhoff.com/EL6731">www.beckhoff.com/EL6731</a>

# Communication | Interbus slave terminal

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.



Interbus slave terminal

Technical data	EL6740-0010
Technology	Interbus slave terminal
Data transfer rates	500 kbits, 2 Mbits (default)
Interfaces	2 x D-sub plug, 9-pin, plug and socket with screening and vibration lock
Number of channels	1



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.

Fieldbus	Interbus, max. 400 m between 2 stations at 500 kbit/s
Type of connection	only remote bus
Current consumption power contacts	–
Current consumption E-bus	typ. 450 mA
Distributed clocks	–
Special features	status LEDs
Operating temperature	0...+55 °C
Approvals	CE, UL, Ex
Weight	approx. 80 g
Further information	<a href="http://www.beckhoff.com/EL6740">www.beckhoff.com/EL6740</a>

# 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
- bus monitor function



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, 1,000 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	0...+55 °C	
Approvals	CE, UL, Ex	
Weight	approx. 70 g	
Further information	<a href="http://www.beckhoff.com/EL6751">www.beckhoff.com/EL6751</a>	

# 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 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	0...+55 °C	
Approvals	CE, UL, Ex	
Weight	approx. 70 g	
Further information	<a href="http://www.beckhoff.com/EL6752">www.beckhoff.com/EL6752</a>	

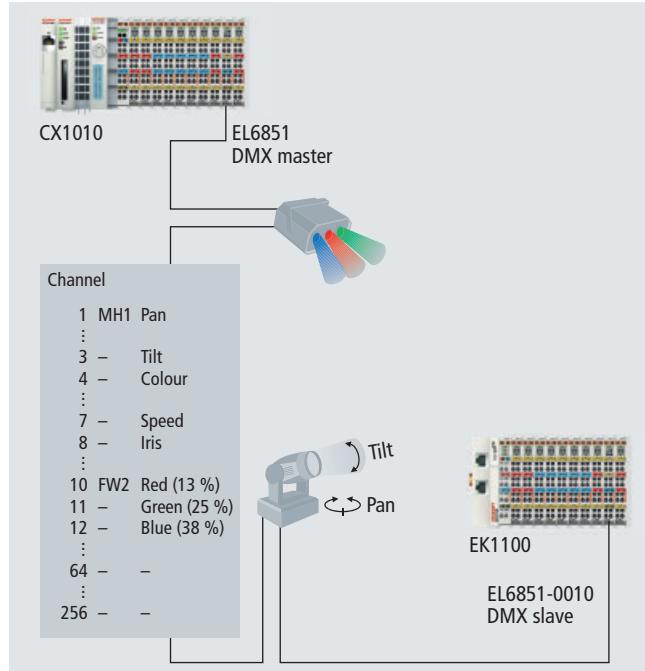
# Communication | DMX master/slave terminal

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).

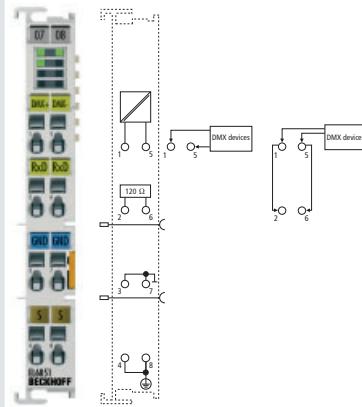
The EL6851-0010 DMX slave terminal acts as a link to the DMX world and enables professional stage and effect lighting to be implemented in conjunction with standard hardware. It takes on the information from the DMX master for the assigned automation equipment. This way, theatre and show stages can be 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.

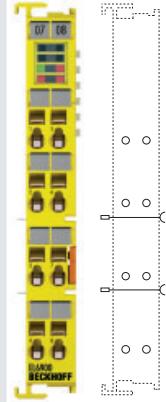
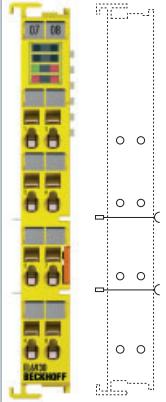
Data length	max. 512 bytes	
Protocol	DMX512	
Current consumption power contacts	-	
Current consumption E-bus	typ. 130 mA	
Distributed clocks	-	
Bus device	max. 32 without repeater	-
Line impedance	120 Ω	
Special features	supports RDM protocol, library available; electrically isolated	start address and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

# Communication | TwinSAFE, PROFIsafe

TwinSAFE enables networks with up to 1,024 TwinSAFE devices. Multiple TwinSAFE PLCs are cascadable within a network. The EL6900 and EL6930 EtherCAT Terminals feature certified safety function blocks, which are configured according to the application to be realised. Functions such as emergency stop, safety door monitoring etc. can thus easily be selected and linked. All blocks can be freely connected among each other and are complemented by operators such as AND, OR, etc. The necessary functions are configured using the TwinCAT System Manager and loaded into the terminal via the bus.

The EL6930 logic terminal can be operated as a slave in a PROFIsafe control (V.2). This gateway functionality enables safe data transfer between a PROFIsafe and a Safety over EtherCAT network.

For further information on TwinSAFE and the TwinSAFE products see page **914**

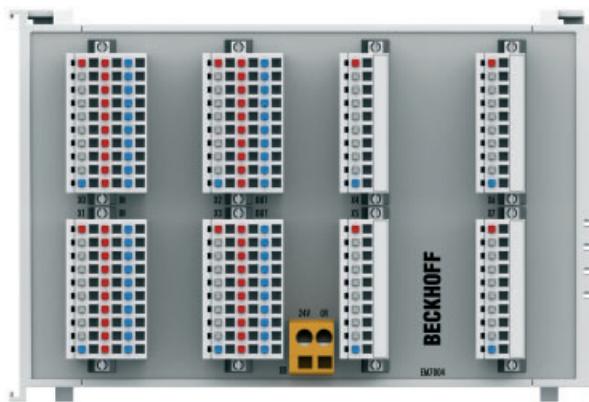
	TwinSAFE PLC	TwinSAFE/PROFIsafe logic and gateway terminal
<b>Technical data</b>	<b>EL6900</b>	<b>EL6930</b>
<b>Technology</b>	TwinSAFE PLC	TwinSAFE/PROFIsafe logic and gateway terminal
<b>Safety standard</b>	IEC 61508 SIL 3 and DIN EN ISO 13849-1:2008 PLe	
<b>Protocol</b>	TwinSAFE/Safety over EtherCAT	(TwinSAFE/Safety over EtherCAT), PROFIsafe
		
	The TwinSAFE PLC can establish 128 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.
<b>Nominal voltage</b>	24 V DC (-15 %/+20 %)	24 V DC (-15 %/+20 %)
<b>Current consumption power contacts</b>	–	–
<b>Current consumption E-bus</b>	approx. 188 mA	approx. 188 mA
<b>Cycle time</b>	500 µs...~25 ms	500 µs...~25 ms
<b>Fault response time</b>	≤ watchdog time (parameterisable)	≤ watchdog time (parameterisable)
<b>Permiss. degree of contamination</b>	2	2
<b>Climate class EN 60721-3-3</b>	3K3	3K3
<b>Installation position</b>	horizontal	horizontal
<b>Special features</b>	backup restore	1 PROFIsafe slave connection
<b>Operating temperature</b>	0...+55 °C	0...+55 °C
<b>Electrical interference</b>	EN 61000-6-2/EN 61000-6-4	EN 61000-6-2/EN 61000-6-4
<b>Vibration/shock resistance</b>	EN 60068-2-6/EN 60068-2-27	EN 60068-2-6/EN 60068-2-27
<b>Approvals</b>	CE, UL, Ex, TÜV Süd	CE, UL, Ex, TÜV Süd
<b>Weight</b>	approx. 50 g	approx. 50 g
<b>Further information</b>	<a href="http://www.beckhoff.com/EL6900">www.beckhoff.com/EL6900</a>	<a href="http://www.beckhoff.com/EL6930">www.beckhoff.com/EL6930</a>

# Motion | 4-axis interface

The EM7004 interface module is designed for direct connection of servo drives with  $\pm 10$  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 $\pm 10$ V (2 mA)
Encoder inputs	4 x (A, /A, B, /B, gate, latch, ground); A B – isolated RS485 inputs (RS422); 4 x 16 bits 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	<a href="http://www.beckhoff.com/EM7004">www.beckhoff.com/EM7004</a>

# Motion | Stepper motor terminal

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. However, safe positioning is only guaranteed within the performance limits.

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  $\alpha$ . 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 EL7031 and EL7041 EtherCAT stepper motor terminals, which are suitable for highly dynamic movement, solve this problem also in areas of higher speeds of rotation.

The EL7031 and EL7041 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. Together with a stepper motor, the stepper motor terminals represent an inexpensive small servo axis. The EL7041 also includes an incremental encoder interface to read position data.

The EL7031 and EL7041 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, 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.

The EL7031 stepper motor terminal is designed exclusively for 24 V supply voltage. The motor current can reach up to 1.5 A. The EL7041 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 EL7041-1000 special version is compatible to the KL2541.

The EL7051 can power motors up to a voltage of 80 V DC and up to a current of 8 A. Thanks to the integrated field-orientated controller, the stepper motor behaves almost like a servomotor. The usual stepper motor noises disappear and the motor can be driven up to its maximum torque without step loss.

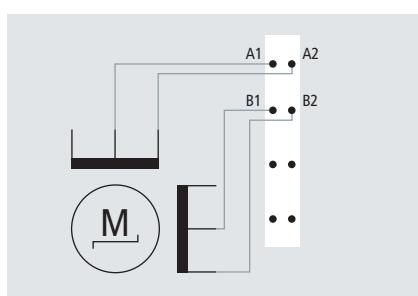
The peak current may briefly significantly exceed the rated current and in this way makes the whole drive system very dynamic. In such dynamic applications, negative acceleration causes the feedback of energy, which leads to voltage peaks at the power supply unit. A EL9570 buffer capacitor terminal protects 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.

**AS1xxx | Stepper motors**

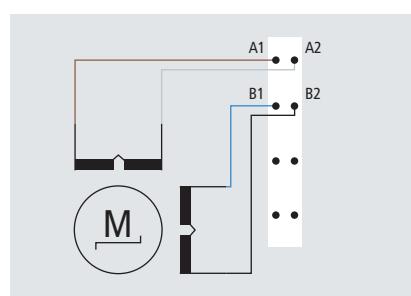
see page **814**

**EL9570 | Buffer capacitor terminal**

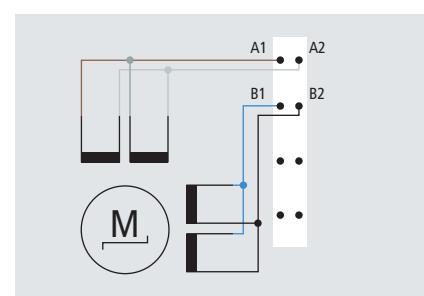
see page **429**



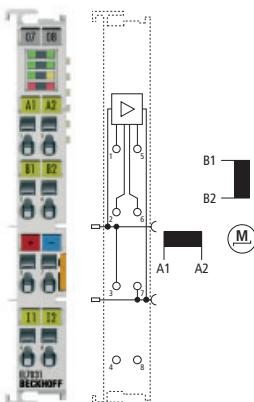
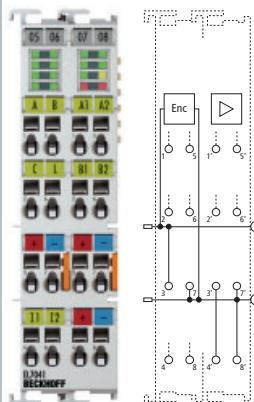
Connection of a unipolar stepper motor



Connection of a bipolar AS10x0 stepper motor, serial



Connection of a bipolar AS10x0 stepper motor, parallel

	Stepper motor terminal 24 V DC, 1.5 A	Stepper motor terminal 50 V DC, 5 A, with incremental encoder	Stepper motor terminal 80 V DC, 8 A, with incremental encoder
<b>Technical data</b>	<b>EL7031   ES7031</b>	<b>EL7041   ES7041</b>	<b>EL7051</b>
<b>Technology</b>	direct motor connection		
<b>Load type</b>	uni- or bipolar stepper motors		
<b>Max. output current</b>	1.5 A (overload- and short-circuit-proof)	5 A (overload- and short-circuit-proof)	8 A (overload- and short-circuit-proof)
<b>Number of channels</b>	1 stepper motor, 2 digital inputs	1 stepper motor, encoder input, 2 digital inputs	1 stepper motor, encoder input, 2 digital inputs
			
<b>Nominal voltage</b>	24 V DC (-15 %/+20 %)	8...50 V DC	15...80 V DC
<b>Current consum. pow. cont.</b>	typ. 30 mA + motor current	typ. 50 mA	—
<b>Current consumption E-bus</b>	typ. 120 mA	typ. 140 mA	typ. 140 mA
<b>Distributed clocks</b>	yes	yes	yes
<b>Maximum step frequency</b>	1,000, 2,000, 4,000 or 8,000 full steps/s (configurable)	1,000, 2,000, 4,000 or 8,000 full steps/s (configurable)	1,000, 2,000, 4,000 or 8,000 full steps/s (configurable)
<b>Step pattern</b>	64-fold micro stepping	64-fold micro stepping	64-fold micro stepping
<b>Current controller frequency</b>	approx. 25 kHz	approx. 30 kHz	approx. 64 kHz
<b>Control resolution</b>	approx. 5,000 positions in typ. applications (per revolution)	approx. 5,000 positions in typ. applications (per revolution)	approx. 5,000 positions in typ. applications (per revolution)
<b>Encoder signal</b>	—	5...24 V DC, 5 mA, single-ended	5...24 V DC, 5 mA, single-ended
<b>Pulse frequency</b>	—	max. 400,000 increments/s (with 4-fold evaluation)	max. 400,000 increments/s (with 4-fold evaluation)
<b>Special features</b>	travel distance control	travel distance control, encoder input	travel distance control, encoder input, field-oriented control
<b>Weight</b>	approx. 50 g	approx. 90 g	approx. 160 g
<b>Operating temperature</b>	0...+55 °C	0...+55 °C	0...+55 °C
<b>Approvals</b>	CE	CE	CE
<b>Further information</b>	<a href="http://www.beckhoff.com/EL7031">www.beckhoff.com/EL7031</a>	<a href="http://www.beckhoff.com/EL7041">www.beckhoff.com/EL7041</a>	<a href="http://www.beckhoff.com/EL7051">www.beckhoff.com/EL7051</a>
<b>Special terminals</b>	<b>EL7041-1000</b>		
<b>Distinguishing features</b>	for resonance-critical applications		

# Motion | Servomotor terminal

Servomotors demonstrate their advantages in highly dynamic and precise positioning applications:

- very high positioning accuracy in applications where maximum precision is required through integrated position feedback
- high efficiency and high acceleration capacity
- Servomotors are overload-proof and therefore have far greater dynamics than stepper motors, for example.
- The high torque is load-independent up to the upper speed ranges.
- The use of servomotors reduces maintenance to a minimum.

These advantages increase the performance and efficiency of an application: the high dynamics with fast start-stop changes and the precise positioning capability thanks to the integrated positional feedback enable the coordination of several servomotors with one another for the synchronisation of several axes.

The EL7201 and EL7201-0010 servomotor terminals are a fully functional servo drive in a standard HD (High Density) terminal housing with a width of 12 mm for the

direct driving of servomotors up to 200 W. They offer terminal points for a servomotor as well as for a motor brake and a resolver. 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 such as overvoltage and undervoltage, overcurrent, terminal temperature and motor load, which are derived from the calculation of an  $I^2T$  model, guarantees the user maximum operational reliability.

Since the EL7201 and the EL7201-0010 servomotor terminals are completely integrated into the EtherCAT Terminal network, it is not necessary to wire up the controller; the space requirement is significantly reduced. The E-bus connection provides the user with all well-known EtherCAT features: in particular short cycle times, low jitter and simple diagnostics. EtherCAT offers precisely the performance that imposes no limits on the dynamics of a servomotor. Modern power semiconductors guarantee minimum power losses and also enable energy recovery in the intermediate circuit in braking mode. For highly dynamic applications and for supplying several servomotors from one power

supply unit, the additional use of the EL9570 buffer capacitor terminal is recommended. It 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.

Together with Synchronous Servomotors from the AM31xx and AM81xx series, the EL7201 and EL7201-0010 enable very dynamic, precise and compact applications.

The EL7201 and EL7201-0010 are tested and pre-configured for the synchronous servo motors from the AM31xx and AM81xx series. In conjunction with the AM31xx and AM81xx they make very dynamic, precise and compact applications possible.

## AM31xx | Servomotors

see page **800**

## AM8131 | Servomotors

see page **800**

## EL9570 | Buffer capacitor terminal

see page **429**

## ZB85xx | Shielding connection system

see page **431**



For further information on servomotors

see page **800**



EL7201 | Servomotor terminal

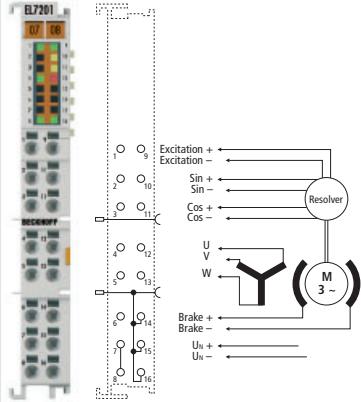
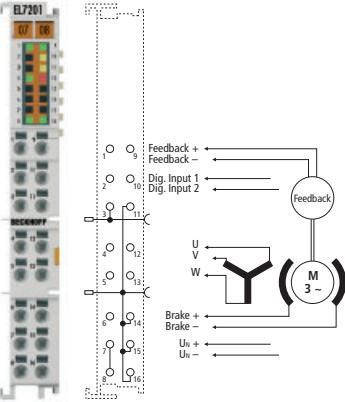
Motor cables and further cables

see page **820**



EL7201-0010 | Servomotor terminal with OCT

Reduced commissioning costs due to omission of the encoder cable thanks to One Cable Technology (OCT)

	Servomotor terminal 50 V DC, 4 A	Servomotor terminal with OCT, 50 V DC, 4 A
<b>Technical data</b>	EL7201	EL7201-0010
<b>Connection method</b>	direct motor connection	
<b>Load type</b>	permanent-magnet synchronous motors	
<b>Number of channels</b>	1 servomotor, resolver, motor brake	1 servomotor, absolute feedback, motor brake, 2 digital inputs
		
<b>Nominal voltage</b>	8...50 V DC	8...50 V DC
<b>Current consumption power contacts</b>	typ. 50 mA + holding current motor brake	typ. 50 mA + holding current motor brake
<b>Current consumption E-bus</b>	120 mA	120 mA
<b>Current controller frequency</b>	double PWM clock frequency	double PWM clock frequency
<b>Output current <math>I_N</math></b>	4 A	4 A
<b>Peak current <math>I_N</math></b>	8 A, 1 s	8 A, 1 s
<b>Frequency range</b>	0...1 kHz	0...1 kHz
<b>PWM clock frequency</b>	16 kHz	16 kHz
<b>Rated speed controller frequency</b>	16 kHz	16 kHz
<b>Output voltage motor brake</b>	24 V DC (+6 %/-10 %)	24 V DC (+6 %/-10 %)
<b>Output current motor brake</b>	max. 0.5 A	max. 0.5 A
<b>Special features</b>	compact design (only 12 mm wide)	compact design (only 12 mm wide), absolute feedback, One Cable Technology (OCT), plug-and-play
<b>Weight</b>	approx. 60 g	approx. 60 g
<b>Operating temperature</b>	0...+55 °C	0...+55 °C
<b>Approvals</b>	CE	CE
<b>Further information</b>	<a href="http://www.beckhoff.com/EL7201">www.beckhoff.com/EL7201</a>	<a href="http://www.beckhoff.com/EL7201-0010">www.beckhoff.com/EL7201-0010</a>

# Motion | 2-channel DC motor output stage

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:

1. Simple controller | low demands on the cycle time | 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.
2. 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.

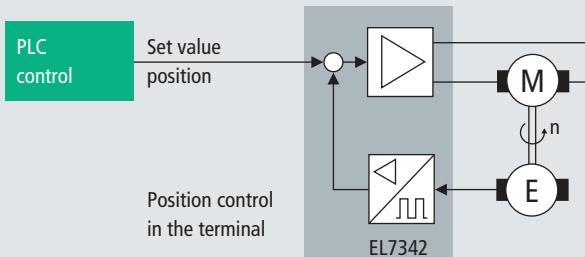
For demanding positioning tasks a closed speed control loop with a feedback system is needed. Apart from the operation of two DC motors, the EL7342 EtherCAT Terminal enables the connection of an incremental encoder. The control loop can be closed either by the EtherCAT Terminal itself or by higher-level 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 EL9570 buffer capacitor terminal

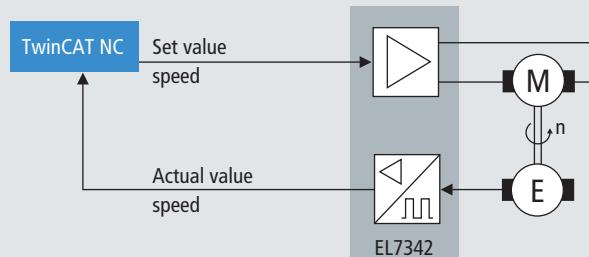
protects from the effects of overvoltage, in that it absorbs some of the energy. If the voltage exceeds the capacity of the terminal, it gets rid of the excess energy via an external resistance.

**EL9570 | Buffer capacitor terminal**  
see page **429**

Control of a DC motor with travel distance control



Control of a DC motor with encoder feedback



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

# 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	0...+55 °C	0...+55 °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	<a href="http://www.beckhoff.com/EL9100">www.beckhoff.com/EL9100</a>	<a href="http://www.beckhoff.com/EL9110">www.beckhoff.com/EL9110</a>	<a href="http://www.beckhoff.com/EL9150">www.beckhoff.com/EL9150</a>	<a href="http://www.beckhoff.com/EL9160">www.beckhoff.com/EL9160</a>



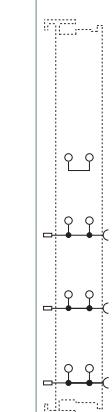
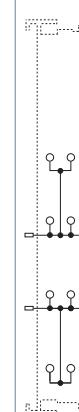
For availability status see Beckhoff website at: [www.beckhoff.com/EL9160](http://www.beckhoff.com/EL9160)

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	EL9250	EL9260	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 K-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	0...+55 °C	
CE, UL	CE, UL, Ex	CE, UL, Ex	CE	CE	CE	CE	CE, UL	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	

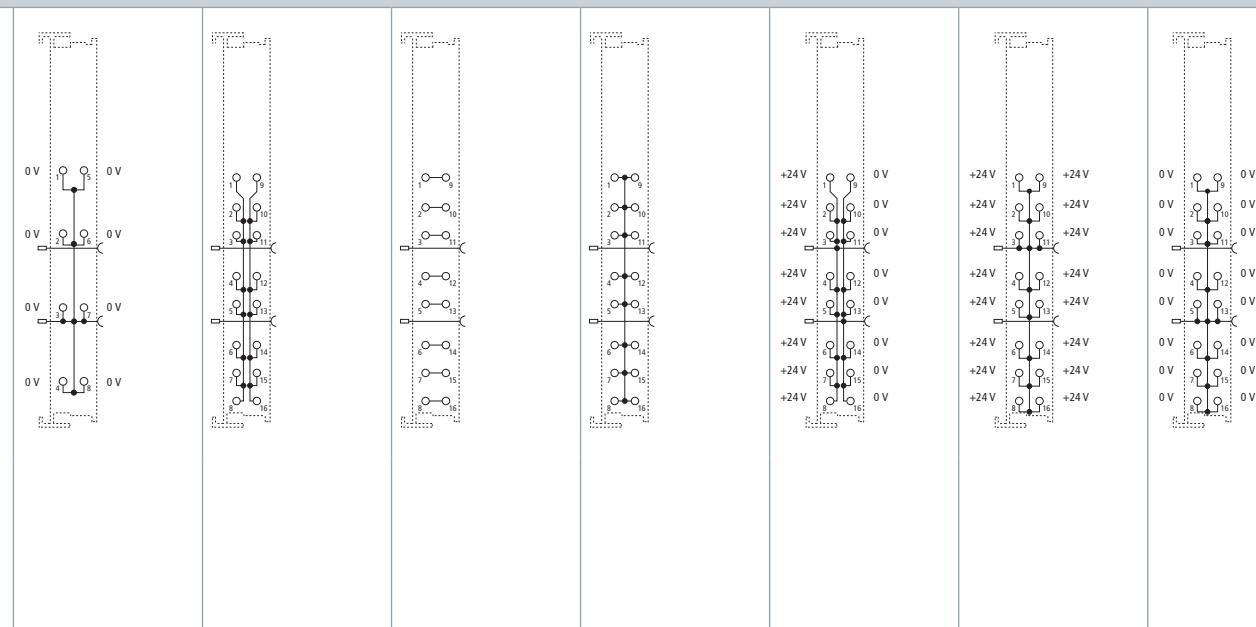
# System terminals | Function terminals

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
<b>Technical data</b>	<b>EL9011</b>	<b>EL9180   ES9180</b>	<b>EL9185   ES9185</b>	<b>EL9186   ES9186</b>
<b>Technology</b>	end cap	potential distribution terminal		
<b>Diagnostics in the process image</b>	–			
				
<b>Nominal voltage</b>	end cap	arbitrary up to 230 V AC/DC	arbitrary up to 230 V AC/DC	≤ 60 V
<b>Integrated fine-wire fuse</b>	–	–	–	–
<b>Current load</b>	≤ 10 A	≤ 10 A	≤ 10 A	≤ 10 A
<b>Power LED</b>	–	–	–	–
<b>Defect LED</b>	–	–	–	–
<b>PE contact</b>	–	yes	–	–
<b>Shield connection</b>	–	–	–	–
<b>Current consumption E-bus</b>	–	–	–	–
<b>Electrical connection to DIN rail</b>	–	–	–	–
<b>Electrical isolation</b>	yes	–	–	–
<b>Special features</b>	cover for the E-bus contacts	–	–	–
<b>Operating temperature</b>	0...+55 °C	0...+55 °C	0...+55 °C	0...+55 °C
<b>Approvals</b>	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex	CE, UL, Ex
<b>Weight</b>	approx. 10 g	approx. 50 g	approx. 50 g	approx. 50 g
<b>Further information</b>	<a href="http://www.beckhoff.com/EL9011">www.beckhoff.com/EL9011</a>	<a href="http://www.beckhoff.com/EL9180">www.beckhoff.com/EL9180</a>	<a href="http://www.beckhoff.com/EL9185">www.beckhoff.com/EL9185</a>	<a href="http://www.beckhoff.com/EL9186">www.beckhoff.com/EL9186</a>

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



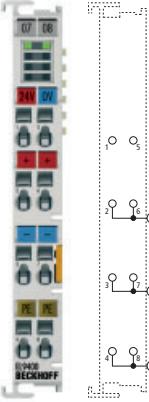
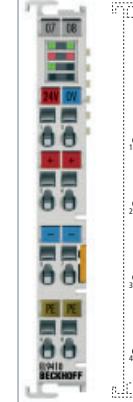
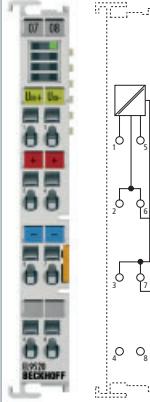
≤ 60 V	≤ 60 V AC/DC	≤ 60 V AC/DC	≤ 60 V AC/DC	≤ 60 V	≤ 60 V	≤ 60 V
–	–	–	–	–	–	–
≤ 10 A	max. 10 A (per terminal point)	max. 10 A (per terminal point)	max. 10 A (per terminal point)	≤ 10 A	≤ 10 A	≤ 10 A
–	–	–	–	–	–	–
–	–	–	–	–	–	–
–	–	–	–	–	–	–
–	–	–	–	–	–	–
–	–	–	–	–	–	–
–	500 V (E-bus/field potential)	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
0...+55 °C	0...+55 °C	0...+55 °C	0...+55 °C	0...+55 °C	0...+55 °C	0...+55 °C
CE, UL, Ex	CE	CE	CE	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 and 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 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
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Technical data	EL9400   ES9400	EL9410   ES9410	EL9520   ES9520
Technology	power supply terminal		AS-Interface potential feed terminal
Diagnostics in the process image	–		–
			
<b>Input voltage</b>	24 V DC	24 V DC	up to 35 V
<b>Output voltage</b>	5 V for E-bus supply	5 V for E-bus supply	up to 35 V
<b>Input current</b>	approx. 70 mA + (E-bus/4)	approx. 70 mA + (E-bus/4)	load-dependent
<b>Max. output current</b>	2 A	2 A	2 A
<b>Short-circuit-proof</b>	–	yes	–
<b>Current consumption E-bus</b>	–	–	–
<b>Electrical isolation</b>	–	–	–
<b>Insulation voltage input/output</b>	–	–	–
<b>Special features</b>	not for new projects, please use EL9410 instead	standard EL supply	no electrical isolation
<b>Operating temperature</b>	0...+55 °C	0...+55 °C	0...+55 °C
<b>Approvals</b>	CE, UL, Ex	CE, UL, Ex	CE
<b>Weight</b>	approx. 65 g	approx. 65 g	approx. 90 g
<b>Further information</b>	<a href="http://www.beckhoff.com/EL9400">www.beckhoff.com/ EL9400</a>	<a href="http://www.beckhoff.com/EL9410">www.beckhoff.com/ EL9410</a>	<a href="http://www.beckhoff.com/EL9520">www.beckhoff.com/ EL9520</a>

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					
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
90 mA	90 mA	90 mA	90 mA	90 mA	90 mA
–	–	–	–	–	1,500 V AC constant load field side/E-bus
–	–	–	–	–	500 V AC permanent load (field side)
diagnostics overcurrent, output voltage	diagnostics overcurrent, output voltage	diagnostics overcurrent, output voltage	diagnostics overcurrent, output voltage	diagnostics overcurrent, output voltage	automatic restart after short-circuit, diagnostics U <sub>IN</sub> /U <sub>OUT</sub>
0...+55 °C	0...+55 °C	0...+55 °C	0...+55 °C	0...+55 °C	0...+55 °C
CE, Ex	CE, Ex	CE, Ex	CE, Ex	CE, Ex	CE
approx. 65 g	approx. 65 g	approx. 65 g	approx. 65 g	approx. 65 g	approx. 65 g
<a href="http://www.beckhoff.com/EL9505">www.beckhoff.com/ EL9505</a>	<a href="http://www.beckhoff.com/EL9508">www.beckhoff.com/ EL9508</a>	<a href="http://www.beckhoff.com/EL9510">www.beckhoff.com/ EL9510</a>	<a href="http://www.beckhoff.com/EL9512">www.beckhoff.com/ EL9512</a>	<a href="http://www.beckhoff.com/EL9515">www.beckhoff.com/ EL9515</a>	<a href="http://www.beckhoff.com/EL9560">www.beckhoff.com/ EL9560</a>

# 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
PE connection	yes	–
Operating temperature	0...+55 °C	0...+55 °C
Approvals	CE, UL	CE, UL
Weight	approx. 50 g	approx. 50 g
Further information	<a href="http://www.beckhoff.com/EL9540">www.beckhoff.com/EL9540</a>	<a href="http://www.beckhoff.com/EL9550">www.beckhoff.com/EL9550</a>

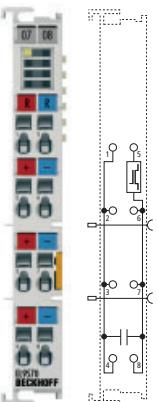
# System terminals | Buffer capacitor terminal

The EL9570 EtherCAT Terminal contains high-performance capacitors for stabilising supply voltages. It can be used in connection with the drive terminals of the EL7xxx series. 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 EL9570 switches the load voltage through to the terminal points 1 and 5. The energy is dissipated by the connection of an external ballast resistor.

EL7xxx | Motion terminals

see page **415**

Buffer capacitor terminal

Technical data	EL9570   ES9570
Technology	buffer capacitor
Diagnostics	–
	
	<p>The EL9570 buffers the connected voltage via its integrated capacitors and connects the external brake resistor if the internal voltage of approx. 56 V is exceeded.</p>
Nominal voltage	50 V
Capacity	500 µF
Ripple current	10 A in continuous operation
Internal resistance	< 10 mΩ
Surge voltage protection	> 56 V
Recommended ballast resistor	10 Ω, typ. 10 W
Oversupply control range	±2 V
Ballast resistor	load-dependent, 2-point control
Electrical isolation	1,500 V (terminal/E-bus)
Operating temperature	0...+55 °C
Approvals	CE, Ex
Weight	approx. 90 g
Further information	<a href="http://www.beckhoff.com/EL9570">www.beckhoff.com/EL9570</a>

# Accessories EtherCAT

## Cables

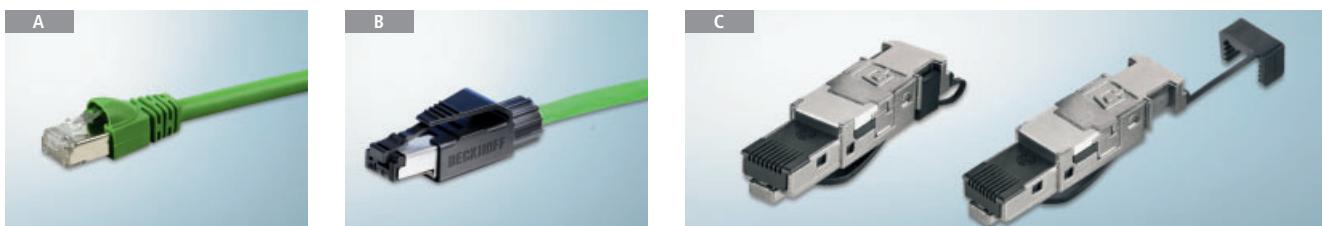
The pre-assembled Industrial Ethernet/EtherCAT cables with RJ 45 plug enable fast, easy wiring inside the control cabinet and are suitable for short distances on the machine. The robust, industrial quality PUR cables distinguish themselves from office cables by both their mechanical and their EMC characteristics. Further lengths and variants on request.

Technical data	ZK1090-9191-xxxx	A
Cross-section	4 x 2 x AWG26/7...4 x 2 x 0.128 mm <sup>2</sup>	
Cable sheath material	PUR	
Colour	green (RAL 6018)	
Line configuration	SF/UTP (shielded)	
Diameter	sheath: typ. 5.9 mm ±0.2 mm	
Bending radius	> 5 x diameter	
Category/class	CAT 5, class D	
Operating/installation temperature	-40...+75 °C/-10...+60 °C	
Insertion cycles	min. 750	
Ordering information	Patch cable	
ZK1090-9191-0001	Industrial Ethernet/EtherCAT patch cable, 0.17 m	
ZK1090-9191-0002	Industrial Ethernet/EtherCAT patch cable, 0.26 m	
ZK1090-9191-0005	Industrial Ethernet/EtherCAT patch cable, 0.5 m	
ZK1090-9191-0010	Industrial Ethernet/EtherCAT patch cable, 1.0 m	
ZK1090-9191-0020	Industrial Ethernet/EtherCAT patch cable, 2.0 m	
ZK1090-9191-0030	Industrial Ethernet/EtherCAT patch cable, 3.0 m	
ZK1090-9191-0050	Industrial Ethernet/EtherCAT patch cable, 5.0 m	
ZK1090-9191-0100	Industrial Ethernet/EtherCAT patch cable, 10.0 m	
ZK1090-9191-0150	Industrial Ethernet/EtherCAT patch cable, 15.0 m	
ZK1090-9191-0200	Industrial Ethernet/EtherCAT patch cable, 20.0 m	
ZK1090-9191-0250	Industrial Ethernet/EtherCAT patch cable, 25.0 m	
ZK1090-9191-0300	Industrial Ethernet/EtherCAT patch cable, 30.0 m	
ZK1090-9191-0350	Industrial Ethernet/EtherCAT patch cable, 35.0 m	
ZK1090-9191-0400	Industrial Ethernet/EtherCAT patch cable, 40.0 m	
ZK1090-9191-0450	Industrial Ethernet/EtherCAT patch cable, 45.0 m	
ZK1090-9191-0500	Industrial Ethernet/EtherCAT patch cable, 50.0 m	

Ordering information	Industrial Ethernet/EtherCAT cable	
ZB9010	Industrial Ethernet/EtherCAT cable, fixed installation, CAT 5e, 4 wires, SF/UTP	
ZB9020	Industrial Ethernet/EtherCAT cable, drag chain suitable, CAT 5e, 4 wires, SF/UTP	
ZB903x	Industrial Ethernet/EtherCAT cable, for M8 wiring, SF/UTP, AWG 26, see page	488

Ordering information	Fibre-optic cables for EK1501, EK1521 (multimode 50/125 µm)
ZK1091-1001-0001	fibre-optic duplex cable, SC connector, 1 m
ZK1091-1001-0005	fibre-optic duplex cable, SC connector, 5 m
ZK1091-1001-0010	fibre-optic duplex cable, SC connector, 10 m

Further lengths and variants on request



## Connectors

Ordering information	Description	Pict.
ZS1090-0003	EtherCAT/Ethernet RJ 45 connector, IP 20, 4-pin, for field assembly, AWG 22-24, packing unit = 10	B
ZS1090-0005	EtherCAT/Ethernet RJ 45 plug, IP 20, 8-pin, for field assembly, AWG 22-26, packing unit = 10	C

## Connectors for KS Bus Terminals, ES EtherCAT Terminals

Ordering information	Description
ZS2010	10 connectors for KS and ES series, spare part (KS/ES terminals are supplied with connector.)

## Connectors for KM and EM modules

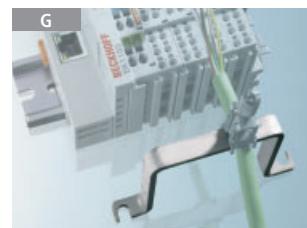
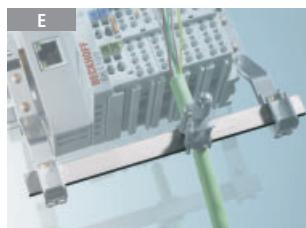
Ordering information	Description
ZS2001-0001	connector for KM/EM module, 1-pin, without LED; spare part (KM/EM terminals are supplied with connector.)
ZS2001-0002	connector for KM/EM module, 1-pin, with LED; spare part (KM/EM terminals are supplied with connector.)
ZS2001-0004	connector for KM/EM module, 3-pin, with LED; spare part (KM/EM terminals are supplied with connector.)
ZS2001-0005	connector for KM/EM module, 1-pin, without LED, labelling (1...10); spare part (KM/EM terminals are supplied with connector.)

## Shielding connection system

The shielding connection system enables the shielding to be located very close to the terminals of the shielded line, so that interference is reduced to a minimum. Two variants are available for the realisation of this function: a shield busbar for attachment to a mounting rail or a bracket for separate mounting in the control cabinet.

Ordering information	Shield busbar with mounting rail holder	Pict.
ZB8500	clamp strap for shield connection with knurled screw, width 11 mm, shield diameter max. 8 mm, packing unit = 10	D
ZB8510	shield busbar 10 x 3 mm, 1000 mm galvanised Cu, packing unit = 1	E
ZB8520	mounting rail holder for shield busbar (10 x 3 mm), packing unit = 2	F
ZB8530	U-clamp terminal up to 4 mm <sup>2</sup> for PE connection to the rail (10 x 3 mm), packing unit = 20	

Ordering information	Shield busbar clamps	Pict.
ZB8500	clamp strap for shield connection with knurled screw, width 11 mm, shield diameter max. 8 mm, packing unit = 10	D
ZB8511	shield busbar clamp 10 x 3 mm for 5 Bus Terminals/EtherCAT Terminals 12 mm, packing unit = 10	G
ZB8530	U-clamp terminal up to 4 mm <sup>2</sup> for PE connection to the rail (10 x 3 mm), packing unit = 20	



## Assembly aids

Ordering information	Description
ZB8700	slot screwdriver assembly tool for pressing the spring force clamps on the coupler and the terminals

## Bus system housing

The BG1558 and BG1559 housings are especially suitable for the construction of compact I/O stations with a higher protection class (IP 65). The housings are supplied with mounting rails. If desired, the housings can be supplied fully fitted with EtherCAT Terminals, flanges and PG threaded fittings. Further sizes are available on request.

Ordering information	Description	Pict.
BG1558	bus system housing 400 mm x 200 mm x 120 mm (W x H x D) with mounting rails and holes	A
BG1559	bus system housing 600 mm x 200 mm x 120 mm (W x H x D) with mounting rails and holes	

## Marking material

The EtherCAT Terminals can be individually labelled with standard contact signs. The marking material is not included in the EtherCAT Terminal delivery. Other versions in other colours and with other texts are available on request or on the internet ([www.beckhoff.com](http://www.beckhoff.com)).

Ordering information	Unprinted	B
BZ1000	100 unprinted contact labels, white	
BZ1002	100 unprinted contact labels, yellow	
BZ1005	100 unprinted contact labels, red	
BZ1006	100 unprinted contact labels, blue	
BZ1007	100 unprinted contact labels, orange	
BZ1008	100 unprinted contact labels, light green	
BZ3000	180 equipment identification labels 12 x 7 mm for Bus Terminals with removable identification section, blank	

Ordering information	Printed
BZ1100	100 contact labels, printed with: 0 V, blue
BZ1102	100 contact labels, printed with: -, blue
BZ1104	100 contact labels, printed with: 24 V, red
BZ1106	100 contact labels, printed with: +, red
BZ1107	100 contact labels, printed with: +, white
BZ1108	100 contact labels, printed with: PE, light green
BZ1300	100 contact labels, ten of each printed with: 0...7, 20 unprinted, white
BZ1400	100 contact labels, two of each printed with: 00 01...48 49, white
BZ3010	180 equipment identification labels 12 x 7 mm for Bus Terminals with removable identification section, printed (printed according to customer specification [in Excel file])



## Slide-in label cover, transparent

The slide-in label covers BZ3200 enable clear labelling of the individual channels or text-based functional description of the EtherCAT Terminals. The labels are inserted in the designated slots. For connecting the individual channels the label cover can be tilted upwards.

Ordering information	Description	C
BZ3200	insertable label cover, transparent, pluggable, 11.5 mm x 104.5 mm, packing unit = 50	
BZ5100	push-in strips for labels, A4 sheet, 160 pieces, pre-punched, packing unit = 10	

## Coding pins and sockets for KS and ES terminals

The coding pins and sockets for KS/ES terminals with pluggable wiring level enable coding between terminal and plug in order to prevent incorrect plug insertion.

Ordering information	Description	D
ZS2010-0010	The set contains 100 sockets and 100 pins.	

## Demokit

The TC9910-B11x EtherCAT demokit offers a quick introduction into EtherCAT communication. It includes EtherCAT Terminals and a Coupler for testing simple I/O functions. The enclosed CD contains a step-by-step guide and a full version of TwinCAT as programming environment for the

Beckhoff EtherCAT master. EtherCAT slaves of any type can be tested with this field-proven EtherCAT master. It also includes a comprehensive help collection that facilitates familiarisation with Beckhoff ADS communication and programming according to IEC 61131-3.

The demokit consists of:

- EK1100 EtherCAT Coupler
- 2 digital input terminals 24 V DC
- 2 digital output terminals 24 V DC
- Beckhoff product folder
- Beckhoff TwinCAT CD
- "TwinCAT Quickstart" documentation

- documentation describing the EK1100
- a 25 cm section of 35 mm mounting rail for fitting the terminal system
- TwinCAT PLC licence (only TC9910-B110)
- EL9011 end cap
- Ethernet cable

Ordering information	Description	E
TC9910-B110	EtherCAT demokit, with TwinCAT PLC licence	
TC9910-B111	EtherCAT demokit, without TwinCAT PLC licence	
TC9910-B112	EtherCAT demokit, without TwinCAT PLC licence (1 instead of 2 digital input terminals)	

