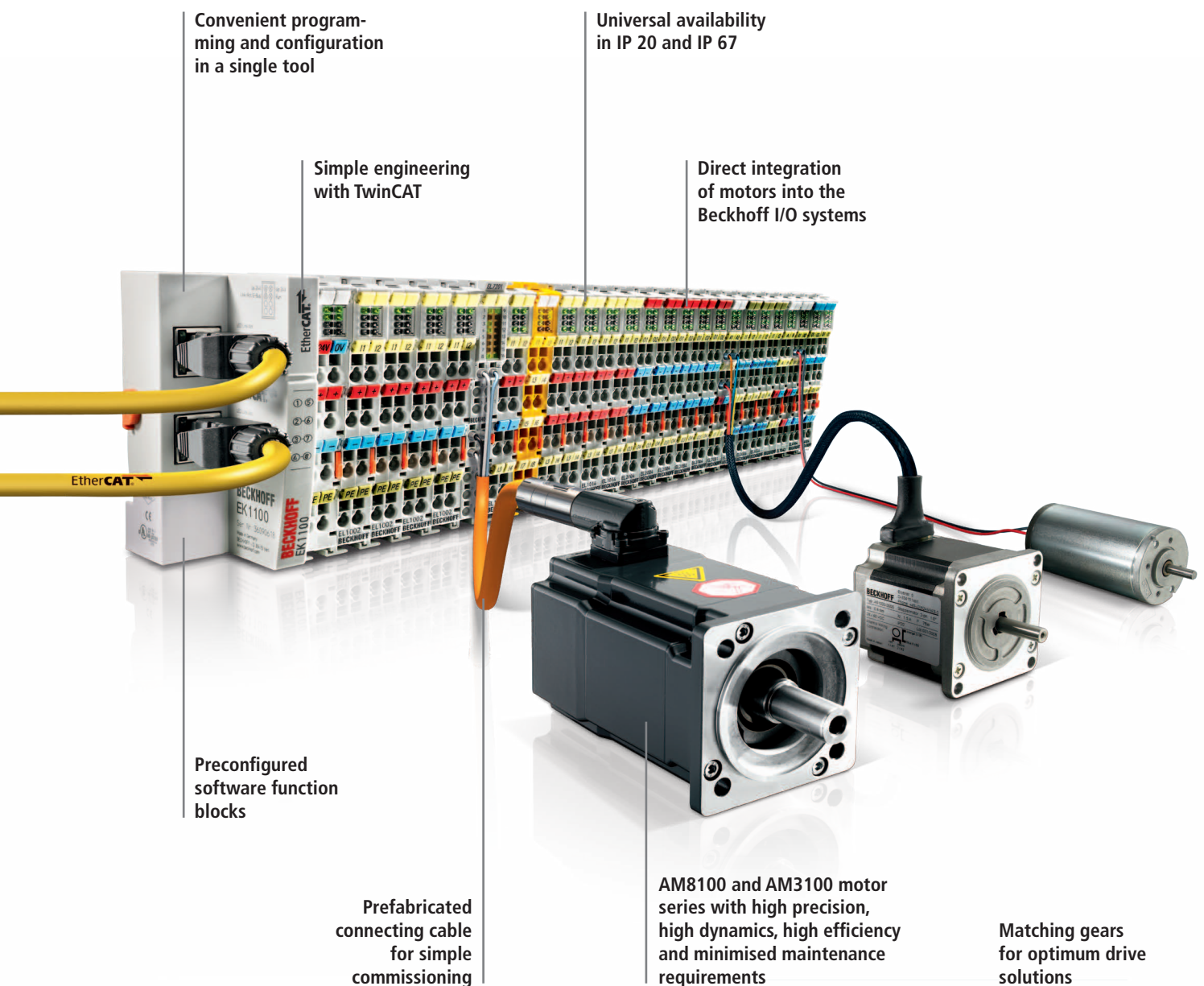# BECKHOFF New Automation Technology

Product Overview | **Compact Drive Technology**

Compact Drive Technology

**Convenient program-
ming and configuration
in a single tool**

**Universal availability
in IP 20 and IP 67**

**Simple engineering
with TwinCAT**

**Direct integration
of motors into the
Beckhoff I/O systems**

**Preconfigured
software function
blocks**

**Prefabricated
connecting cable
for simple
commissioning**

**AM8100 and AM3100 motor
series with high precision,
high dynamics, high efficiency
and minimised maintenance
requirements**

**Matching gears
for optimum drive
solutions**

▶ **www.beckhoff.com/compact-drive-technology**

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In combination with the wide range of available motors and gears the Beckhoff I/O systems enable the implementation of compact and affordable drive solutions: the modularly expandable motion terminals support servo, stepper and DC motors of different performance classes. For stepper and DC motors EtherCAT Box Modules with IP 67 protection are available for use outside of control cabinets. All compact drive solutions are integrated into the Beckhoff TwinCAT automation software, making parameterisation convenient.

Solutions for less complex motion requirements

High quality servo axes are not required for auxiliary drives such as simple adjustable axes, mobile stops, small conveying movements or simple positioning drives; in fact, stepper or DC motors are entirely adequate.

Motion | AS1000 stepper motors

The AS1000 stepper motors with flange sizes from 42 to 86 mm (NEMA17, NEMA23, NEMA34) and torques from 0.4 to 5 Nm are ideally suited to the simpler tasks mentioned above. They are characterised by robustness and high holding torques. Due to the integrated micro-stepping the motors can position very well even without a feedback system and require only a motion terminal for power electronics. Stepper or DC motors can also be operated with TwinCAT NC PTP for synchronisation functions such as cam plates or flying saws.

I/O | Stepper motor terminals

For stepper motor terminals, I/O components with different performance features are available: Bus Terminal (KL2531, KL2541),

EtherCAT Terminal (EL7031, EL7041) and EtherCAT Box (EP7041). The KL2531 and EL7031 stepper motor terminals are exclusively designed for 24 V DC power supplies. The motor current can reach up to 1.5 A. The KL2541 and EL7041 stepper motor terminals cover a supply voltage range from 8 to 50 V DC and additionally require a 24 V supply via the power contacts. The motor current can be set from 1 to 5 A. The EP7041 stepper motor module allows the connection of stepper motors up to 50 V DC and 5 A.

Solutions for high precision and dynamics

As a downside to stepper motors there is always a risk of "steps being lost" in an overloaded condition. When combined with an incremental encoder, however, they can also be used where higher precision is required. The encoder evaluation required for this is already integrated in the EL7041 and KL2541 50 V DC output stages. With the integrated incremental encoder connection, the EP7041 enables the implementation of a simple servo axis in a compact IP 67 module.

However, the typical stepper motor disadvantages remain: their less dynamic behaviour, low efficiency and limited speed. Beckhoff also has a solution to this, however, in form of an EtherCAT Terminal: together with the AM8100 servomotors, the EL7201 servomotor EtherCAT Terminal is probably the world's smallest servo multi-axis system.

Motion | AM8100 servomotors

Full-value servo axes can be implemented using the EL7201 and EL7211 EtherCAT Terminals in combination with AM8100 servomotors. The servo system delivers best-possible performance with respect to dynam-

ics, accuracy, energy efficiency and robustness. The small motors from the AM811x series with an edge size of only 40 mm fit in the tiniest installation spaces. Nominal torques of up to 0.52 Nm can be achieved in the power range from 80 to 170 Watts with these small power packs. An integrated 18-bit absolute encoder with electronic identification plate simplifies commissioning and meets the highest requirements for precision. The absolute encoder is also available as a multiturn absolute encoder, which detects the absolute position of the drive during switch-on. Thus, reference trips (homing function) and additional limit switches are not required, saving costs and time. Thanks to the innovative One Cable Technology (OCT) wiring costs are drastically reduced, since no separate feedback cable is required and only six cores have to be connected at the most.

I/O | Servomotor terminals

The EL7201, EL7211, EL7201-0010 and EL7211-0010 servomotor terminals are fully functional Servo Drives for the direct control of servomotors. They offer terminal points for connection of a servomotor as well as motor brake and resolver. On 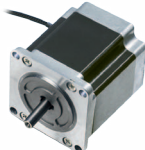the software side, solutions based on TwinCAT NC PTP are recommended even for moderate requirements to enable the synchronisation between axes. While the EL7201 and EL7211 support a resolver as feedback system, the EL7201-0010 and EL7211-0010 offer the option to use an absolute feedback system (OCT).

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Product overview

DC motor			Stepper motor		
IP 20 Bus Terminals	**IP 67** EtherCAT Terminals	EtherCAT Box	**IP 20** Bus Terminals	EtherCAT Terminals	**IP 67** EtherCAT Box

I/O

DC motor			Stepper motor		
KL2532 `24` 1 A	**EL7332** `22` 1 A	**EP/ER7342** `26` 3.5 A	**KL2531** `16` 1.5 A	**EL7031** `12` 1.5 A	**EP/ER7041-3002** `15` 5 A
KL2552 `24` 5 A	**EL7342** `22` 3.5 A		**KL2541** `16` 5 A	**EL7041** `12` 5 A	

Cables

			Stepper motor		
			ZK4000-6700-2xxx `20` Motor cable		**ZK4000-6261-xxxx** `21` Motor cable
			ZK4000-5100-2xxx `20` Encoder cable		**ZK4000-5151-xxxx** `21` Encoder cable

Motors

			Stepper motor		
			AS10xx `18` 0.38…5.0 Nm, 1…5 A		`18`

Gear units

			Stepper motor		
			`21` **AG1000-+PM52.i** at AS1030/AS1050		**AG1000-+PM81.i** `21` at AS1060

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Servo motor

IP 20
EtherCAT Terminals

EL7201-0010	6	**EL7201**	6
OCT, 2.8 A_{RMS}		Resolver, 2.8 A_{RMS}	
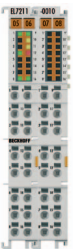
EL7211-0010	6	**EL7211**	6
OCT, 4.5 A_{RMS}		Resolver, 4.5 A_{RMS}	
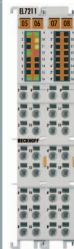
ZK4704-0421-2xxx	10	**ZK4704-0411-2xxx**	10
OCT motor cable		Motor cable	
		ZK4724-0410-2xxx	10
		Resolver cable	

AM811x	8	**AM8122**	8	**AM3111**	8	**AM3121**	8
0.20…0.52 Nm, 2.8…4.8 A		0.8 Nm, 4.0 A		0.21 Nm, 3.22 A		0.69 Nm, 4.6 A	
AM8121	8	**AM8131**	8	**AM3112**	8		
0.5 Nm, 4.0 A		1.25 Nm, 4.7 A		0.34 Nm, 3.4 A			

AG2250-+PLE40 **AG2250-+WPLE40**	11	**AG2250-+PLE60** **AG2250-+WPLE60**	11	**AG2250-+PLE40** **AG2250-+WPLE40**	11	**AG2250-+PLE60** **AG2250-+WPLE60**	11

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EtherCAT Terminal | **Servomotor terminals**

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 EL72x1 and EL72x1-0010 servomotor terminals are a fully functional servo drive in a standard HD (High Density) terminal housing with a width of 12 mm or 24 mm for the direct driving of servomotors. They offer terminal points for a servomotor as well as for a motor brake and a feedback system. 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.

While the EL72x1 supports a resolver as feedback system, the EL72x1-0010 offers the user the option to use an absolute feedback system. With the One Cable Technology (OCT) the encoder cable is omitted by transmitting the encoder signal digitally via the existing motor cable. The EL7211 and EL2711-00010 are characterised by their increased performance of 4.5 A_{RMS}.

Since the EL72x1 and the EL72x1-0010 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 EL9576 brake chopper 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.

The EL72x1 and EL72x1-0010 are tested and pre-configured for the synchronous servo motors from the AM31xx and AM81xx series. In conjunction with the AM31xx and AM81xx they enable very dynamic, precise and compact applications.

AM81xx | Servomotors with OCT
see page   8

AM31xx | Servomotors
see page   8

EL9576 | Brake chopper terminal
see page   27

EL7201 | Servomotor terminal:
Motor cables and further cables
see page   10

EL7201-0010 | Servomotor terminal with OCT:
Reduced commissioning costs due to ommis-
sion of the encoder cable
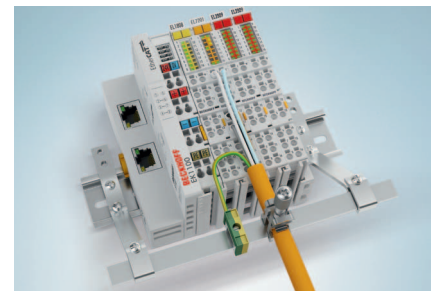
The shielding connection system enables
the shielding to be located very close to the
terminals of the shielded line.

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	Servomotor terminal 50 V DC, 2.8 A$_{RMS}$		Servomotor terminal 50 V DC, 4.5 A$_{RMS}$	Servomotor terminal with OCT, 50 V DC, 2.8 A$_{RMS}$	Servomotor terminal with OCT, 50 V DC, 4.5 A$_{RMS}$
Technical data	**EL7201**		**EL7211**	**EL7201-0010**	**EL7211-0010**
Connection method	direct motor connection				
Load type	permanent-magnet synchronous motors				
Number of channels	1 servomotor, resolver, motor brake			1 servomotor, absolute feedback, motor brake, 2 digital inputs	
Nominal voltage	8…50 V DC			8…50 V DC	
Current consum. pow. cont.	typ. 50 mA + holding current motor brake			typ. 50 mA + holding current motor brake	
Current consumption E-bus	typ. 120 mA			120 mA	
Current controller frequency	double PWM clock frequency			double PWM clock frequency	
Output current I$_N$	2.8 A (rms)/4 A (peak value)		4.5 A (rms)/6.3 A (peak value)	2.8 A (rms)/4 A (peak value)	4.5 A (rms)/6.3 A (peak value)
Peak current I$_N$	5.7 A (rms)/ 8 A (peak value) for 1 s		9.0 A (rms)/ 12.6 A (peak value) for 1 s	5.7 A (rms)/ 8 A (peak value) for 1 s	9.0 A (rms)/ 12.6 A (peak value) for 1 s
Frequency range	0…599 Hz			0…599 Hz	
PWM clock frequency	16 kHz			16 kHz	
Rated speed controller frequency	16 kHz			16 kHz	
Output voltage motor brake	24 V DC (+6 %/-10 %)			24 V DC (+6 %/-10 %)	
Output current motor brake	max. 0.5 A			max. 0.5 A	
Special features	compact (only 12 mm wide), system-integrated		compact and system-integrated	compact (only 12 mm wide), system-integrated, absolute feedback, One Cable Technology (OCT), plug-and-play	compact and system-integrated, absolute feedback, One Cable Technology (OCT), plug-and-play
Weight	approx. 60 g		approx. 95 g	approx. 60 g	approx. 95 g
Operating temperature	0…+55 °C			0…+55 °C	
Approvals	CE			CE	
Further information	www.beckhoff.com/EL7201		www.beckhoff.com/EL7211	www.beckhoff.com/ EL7201-0010	www.beckhoff.com/ EL7211-0010

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AM8100

AM3100

AM8100, AM3100 | Synchronous Servomotors

AM8100

The AM8100 servomotors from the AM8000 series are especially designed for operation with the EL7201 and EL7211 servo terminals. The high dynamics of the servomotors open up a multitude of possible applications: for example in industrial robots for pick-and-place applications, or in general in mechanical engineering, where a compact design and high positioning accuracy are necessary. Like all motors of the AM8xxx family they are available in One Cable Technology (OCT) versions where power and feedback are combined in a single cable.

Homing is no longer necessary thanks to the absolute value encoder integrated in the motor: the position of the drive is saved in the EEPROM, which is ideal for adjustable axes. The encoder data are transmitted entirely digitally to the EL7201-0010 or EL7211-0010 servo terminal via the motor cable. The encoder cable can be dispensed with. The full integration of the servo terminal in the Beckhoff control system facilitates the commissioning of the drive axis. All motors of the AM8xxx family use the electronic type plate, with which the engineering expenditure is additionally reduced

by the simple reading of the motor parameters. The Beckhoff TwinCAT automation software enables the convenient parameterisation of the servomotors.

The AM81xx motors can optionally be equipped with a backlash-free permanent magnet holding brake, a sealing ring or a feather key groove. They are equipped with a sturdy rotary resolver encoder and for the purpose of long life have been developed with generously dimensioned bearings for general mechanical engineering. Matching gears and prefabricated connecting cables complete the ultra-compact drive axis.

AM3100

The AM3100 series of pole-wound servomotors with maximum torque yield covers three types with rated outputs of 50 W (rated voltage 24 V DC) as well as 100 W and 140 W (rated voltage 48 V DC).

In the standard version, the AM3100 servomotors are equipped with a resolver and a smooth shaft. They can be optionally equipped with a holding brake, even in the smallest size.

Technical data	AM81xx	AM31xx
Motor type	permanent magnet-excited three-phase synchronous motor	
Magnet material	neodymium-iron-boron	
Insulation class	thermal class F (155 °C)	
Design form	flange-mounted according to IM B5, IM V1, IM V3	
Protection class	IP 54, IP 65 (shaft seal only for AM812x, AM813x)	IP 54
Cooling	convection, permissible ambient temperature 40 °C	
Coating/surface	dark grey powder coating, similar to RAL7016	matt black coating RAL 9005
Connection method	round plug connector, swivelling, angled	straight connectors at 30 cm cable ends
Life span	$L_{10h} = 30,000$ hrs for ball bearings	$L_{10h} = 20,000$ hrs for ball bearings
Approvals	CE, UL	CE
Feedback system	resolver, OCT	resolver

We reserve the right to make technical changes.

AM8100 | Servomotors 0.20 – 0.52 Nm (standstill torque), OCT

Data for 50 V DC	AM8111-wFyz	AM8112-wFyz	AM8113-wFyz
Standstill torque	0.20 Nm	0.38 Nm	0.52 Nm
Rated torque	0.19 Nm	0.36 Nm	0.50 Nm
Rated speed	4000 min^{-1}	4500 min^{-1}	3000 min^{-1}
Rated power	0.08 kW	0.17 kW	0.16 kW
Standstill current	2.85 A	4.7 A	4.8 A
Rotor moment of inertia	0.029 kgcm²	0.048 kgcm²	0.067 kgcm²
Rotor moment of inertia (with brake)	0.052 kgcm²	0.071 kgcm²	0.090 kgcm²
EtherCAT Terminal	EL7201-0010	EL7211-0010	EL7211-0010

AM8100 | Servomotors 0.5 – 1.25 Nm (standstill torque), OCT

Data for 50 V DC	AM8121-wFyz	AM8122-wFyz	AM8131-wFyz
Standstill torque	0.5 Nm	0.8 Nm	1.35 Nm
Rated torque	0.5 Nm	0.8 Nm	1.35 Nm
Rated speed	3000 min^{-1}	2000 min^{-1}	1000 min^{-1}
Rated power	0.16 KW	0.17 KW	0.14 KW
Standstill current	4.0 A	4.0 A	5.0 A
Rotor moment of inertia	0.134 kgcm²	0.253 kgcm²	0.462 kgcm²
Rotor moment of inertia (with brake)	0.156 kgcm²	0.276 kgcm²	0.541 kgcm²
EtherCAT Terminal	EL7211-0010	EL7211-0010	EL7211-0010

▶ www.beckhoff.com/AM81xx
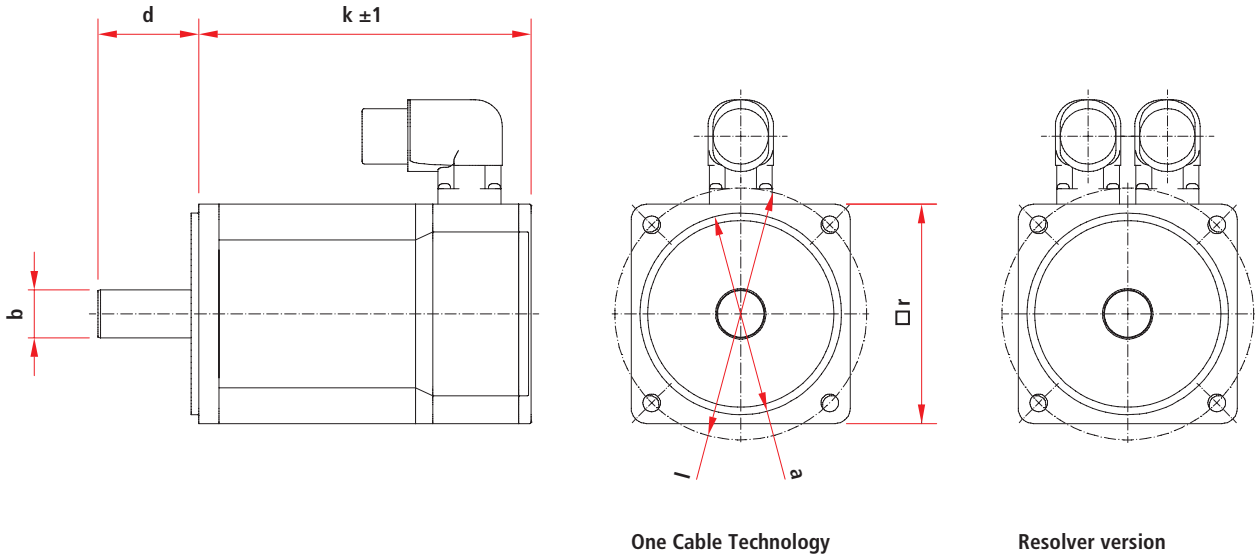
AM3100 | Servomotors 0.21 – 0.69 Nm (standstill torque)

Data for 50 V DC	AM3111-w30z	AM3112-w40z	AM3121-w20z
Standstill torque	0.21 Nm	0.34 Nm	0.69 Nm
Rated torque	0.16 Nm	0.28 Nm	0.65 Nm
Rated speed	3000 min^{-1}	3500 min^{-1}	2000 min^{-1}
Rated power	0.05 kW	0.10 kW	0.14 kW
Standstill current	3.22 A	3.40 A	4.60 A
Rotor moment of inertia	0.026 kgcm²	0.046 kgcm²	0.150 kgcm²
Rotor moment of inertia (with brake)	0.034 kgcm²	0.054 kgcm²	0.200 kgcm²
EtherCAT Terminal	EL7201-0000	EL7211-0000	EL7211-0000

▶ www.beckhoff.com/AM31xx

Order reference	AM81uv-wxyz	AM31uv-wxyz-000a
u	flange code	
v	motor length	
w = 0	smooth shaft	
w = 1	shaft with groove and feather key according to DIN 6885	
w = 2	shaft with IP 65 sealing ring and smooth shaft (only for AM812x, AM813x)	–
w = 3	shaft with IP 65 sealing ring and shaft with groove and feather key (only for AM812x, AM813x)	–
x	winding code F	key number for rated speed in RPM x 1000, not available for selection
y = 0	resolver (only for AM812x, AM813x)	resolver
y = 1	One Cable Technology for power and feedback: feedback transmission via motor cable, no feedback cable necessary, electronic identification plate, single-turn, absolute position within one revolution, 18 bit resolution	–

The order reference is continued on the next page.

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Order reference	AM81uv-wxyz	AM31uv-wxyz-000a
y = 2	One Cable Technology for power and feedback: feedback transmission via motor cable, no feedback cable necessary, electronic identification plate, multi-turn, absolute position within 4096 revolution, 18 bit resolution	–
z = 0	without holding brake	
z = 1	with holding brake	
a = 1	–	cable 0.3 m, with iTec plug for power, M12 plug for feedback

One Cable Technology   Resolver version

Dimensions	a	b	d	l	r	k (without brake)	k (with brake)
AM8111	30 h7	8 h7	25 mm	46 mm	40 mm	97 mm	129 mm
AM8112	30 h7	8 h7	25 mm	46 mm	40 mm	117 mm	149 mm
AM8113	30 h7	8 h7	25 mm	46 mm	40 mm	137 mm	169 mm
AM8121	40 j6	9 k6	20 mm	63 mm	58 mm	111.5 mm	146 mm
AM8122	40 j6	9 k6	20 mm	63 mm	58 mm	133.5 mm	168 mm
AM8131	60 j6	14 k6	30 mm	75 mm	72 mm	128.7 mm	168.2 mm
AM3111	30 j6	8 k6	25 mm	46 mm	40 mm	91 mm	122 mm
AM3112	30 j6	8 k6	25 mm	46 mm	40 mm	109 mm	140 mm
AM3121	50 j6	11 k6	23 mm	70 mm	60 mm	111 mm	148 mm

Accessories for AM8100 and AM3100 servomotors

Cables for servomotor terminal

Ordering information	Cables for servomotor terminal EL7201-0010/EL7211-0010 (OCT) and EL7201-0000/EL7211-0000 (resolver feedback)
ZK4704-0421-2xxx	motor cable for OCT, drag-chain usable cable, (4 x 0.75 mm² + (2 x 0.34 mm²) + (2 x AWG22)), shielded [1]
ZK4704-0411-2xxx	motor cable for resolver feedback, drag-chain usable cable, (4 x 0.75 mm² + (2 x 0.5 mm²)), shielded [2]
ZK4724-0410-2xxx	resolver cable, drag-chain usable cable, (3 x 2 x 0.25 mm²), shielded [2]

[1] Max. cable length 20 m

[2] Available in lengths of 1 m, 3 m, 5 m, 10 m and 20 m (xxx = length in decimetres, e.g. -2010 = 1 m)

Technical data for drag-chain use see ▶ www.beckhoff.com/compact-drive-technology

BECKHOFF New Automation Technology

AG2250 | Planetary gear series for AM8100 servomotors

The AG2250 planetary gears are especially matched to the compact drive technology motor series. They have been expanded by a two-stage version. For better design, planetary and angled planetary gears are available with the following transmission ratios: 12, 16, 20, 25, 32, 40 and 64.

The AG2250 series completes the range of small, affordable drive technology products. The gears are especially suited to applications where no particularly low torsional backlash is required.

Features
– low torsional backlash
– high output torques
– high efficiency
– single-stage planetary gear/ angled planetary gear, transmission ratios 3, 4, 5, 7, 8, 10
– two-stage planetary gear/ angled planetary gear,

transmission ratios 12, 16, 20, 25, 32, 40, 64
– flexible installation position
– lifetime lubrication
– suitable for motors of the AM801x (230 V AC) and AM8100/AM3100 (48 V DC) series

Planetary gears

AG2250-+PLEaa-M0s-i-wx1-Motorsize	Gear ratio	Rated torque	Torsional backlash	Typ. combination with AM80xx	AM81xx	AM31xx
AG2250-+PLE40-M01-i-wx1	3, 4, 5, 7, 8, 10	5…15 Nm	> 15 arcmin	AM801x	AM811x	AM311x
AG2250-+PLE40-M02-i-wx1	12, 16, 20, 25, 32, 40, 64	7.5…20 Nm	> 19 arcmin	AM801x	AM811x	AM311x
AG2250-+PLE60-M01-i-wx1	3, 4, 5, 7, 8, 10	15…40 Nm	> 10 arcmin	–	AM812x/AM813x	AM312x
AG2250-+PLE60-M02-i-wx1	12, 16, 20, 25, 32, 40, 64	18…44 Nm	> 12 arcmin	–	AM812x/AM813x	AM312x

Angled planetary gears

AG2250-+WPLEaa-M0s-i-wx1-Motorsize	Gear ratio	Rated torque	Torsional backlash	Typ. combination with AM80xx	AM81xx	AM31xx
AG2250-+WPLE40-M01-i-wx1	3, 4, 5, 7, 8, 10	4.5…8,5 Nm	> 21 arcmin	AM801x	AM811x	AM311x
AG2250-+WPLE40-M02-i-wx1	12, 16, 20, 25, 32, 40, 64	7.5…20 Nm	> 25 arcmin	AM801x	AM811x	AM311x
AG2250-+WPLE60-M01-i-wx1	3, 4, 5, 7, 8, 10	14…25 Nm	> 16 arcmin	–	AM812x/AM813x	AM312x
AG2250-+WPLE60-M02-i-wx1	12, 16, 20, 25, 32, 40, 64	18…44 Nm	> 18 arcmin	–	AM812x/AM813x	AM312x

AG2250-+ = compact drive technology gear series
PLEaa / WPLEaa = series/size (PLE40; PLE60; WPLE40; WPLE60)
M0s-i = gear ratio, M01-i = single-stage with i = 3, 4, 5, 7, 8, 10, MF2-i = two-stage with i = 12, 16, 20, 25, 32, 40, 64
w = shaft form (w = 0: smooth shaft; w = 1: shaft with groove and feather key)
x = identifying letter for clamping hub diameter (not available for selection, is selected automatically based on the respective motor)
Motorsize = AM801x/AM811x/AM812x/AM813x/AM311x/AM312x

▶ www.beckhoff.com/AG2250

BECKHOFF New Automation Technology

EtherCAT Terminal | Stepper motor terminals

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

In contrast with a DC motor the control of a stepper motor is carried out by the different energisation of the individual motor windings following a defined pattern of pulses. The electromagnetic field of the stator is switched intermittently so that the shaft turns through the step angle α. The motor follows the impulse pattern of the control unit, until the coupled momentum exceeds its holding momentum or the impulse demand is too dynamic, which leads to standstill of the motor. The 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 even with standard technology. 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 stepper motor terminals can be controlled like a servo drive by a speed interface from a Motion Control software such as TwinCAT for example. In applications with a less complex and less powerful CPU the control is also possible via a position interface (travel distance control). The stepper motor terminals move the motor themselves to a desired position. Ramp steepness and maximum speed can be entered as parameters.

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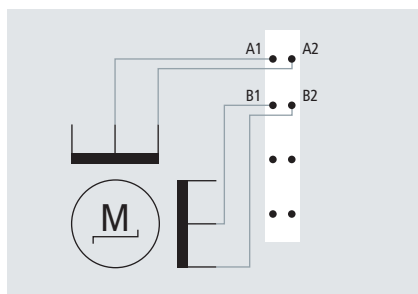
The EL7041-1000 special version with field-oriented control is particularly well suited for such low-mass and therefore resonance-critical applications.

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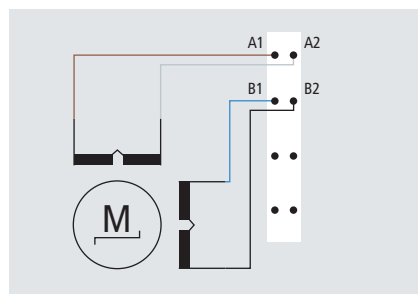
The peak current may briefly significantly exceed the rated current and in this way makes the whole drive system very dynamic. In such dynamic applications, negative acceleration causes the feedback of energy, which leads to voltage peaks at the power supply unit. An EL9576 brake chopper terminal protects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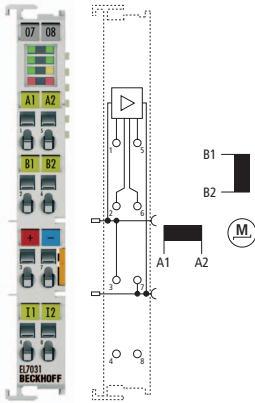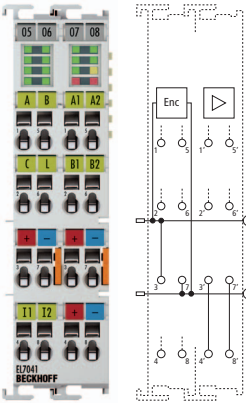
Connection of a unipolar stepper motor

Connection of a bipolar AS10xx stepper motor, serial

Connection of a bipolar AS10xx stepper motor, parallel

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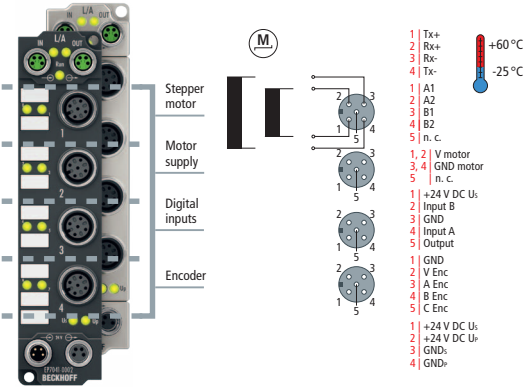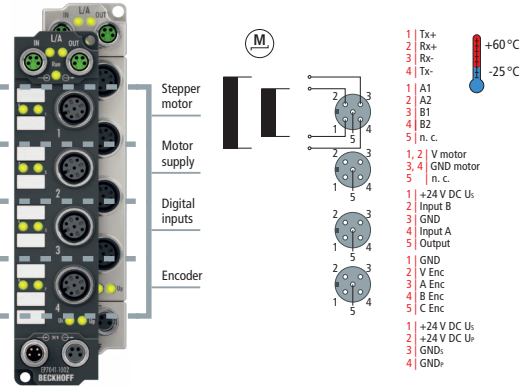
	Stepper motor terminal 24 V DC, 1.5 A	Stepper motor terminal 50 V DC, 5 A, with incremental encoder
Technical data	**EL7031** | ES7031	**EL7041** | ES7041
Technology	direct motor connection	
Load type	uni- or bipolar stepper motors	
Max. output current	1.5 A (overload- and short-circuit-proof)	5 A (overload-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

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BECKHOFF New Automation Technology

EtherCAT Box | **Stepper motor modules**

	Stepper motor module, 50 V DC, 5 A, with incremental encoder, 2 digital inputs, 1 digital output	Stepper motor module, 50 V DC, 1.5 A, with incremental encoder, 2 digital inputs, 1 digital output
Industrial housing	**EP7041-0002**	**EP7041-1002**
Zinc die-cast housing	ⓘ **ER7041-0002**	ⓘ **ER7041-1002**
Connection method	screw type M12	screw type M12
Load type	uni- or bipolar stepper motors	uni- or bipolar stepper motors
Number of outputs	1 stepper motor, 1 digital 24 V DC output	1 stepper motor, 1 digital 24 V DC output
Number of inputs	2 digital inputs, encoder system (24 V DC encoder)	2 digital inputs, encoder system (24 V DC encoder)

The EP7041-0002/ER7041-0002 and EP7041-1002/ER7041-1002 EtherCAT Box modules are intended for the direct connection of different stepper motors. The PWM output stages for two motor coils with compact design are located in the module together with two inputs for limit switches and cover a wide voltage and current range. The EP7041/ER7041 can be adjusted to the motor and the application by changing just a few parameters. 64-fold micro-stepping ensures particularly quiet and precise motor operation. Connection of an incremental encoder enables a simple servo axis to be realised. Two digital inputs and a digital 0.5 A output enable connection of end switches and a motor brake.

Nominal voltage	8…50 V DC	8…50 V DC
Distributed clocks	yes	yes
Protocol	EtherCAT	EtherCAT
Output current	2 x 3.5 A, 2 x 5 A peak current (overload- and short-circuit-proof)	2 x 1 A, 2 x 1.5 A peak current (overload- and short-circuit-proof)
Maximum step frequency	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)
Step pattern	64-fold micro stepping	64-fold micro stepping
Current controller frequ.	approx. 30 kHz	approx. 30 kHz
Resolution	approx. 5,000 positions (per revolution, depending on motor and encoder type)	approx. 5,000 positions (per revolution)
Encoder signal	5…24 V, 5 mA, single-ended	5…24 V, 5 mA, single-ended
Pulse frequency	max. 400,000 increments/s (with 4-fold evaluation)	max. 400,000 increments/s (with 4-fold evaluation)
Current consumption from U_S	120 mA	120 mA
Special features	travel distance control, encoder input	travel distance control, encoder input
Operating temperature	-25…+60 °C	-25…+60 °C
Approvals	CE, Ex	CE, Ex
Further information	www.beckhoff.com/EP7041-0002 www.beckhoff.com/ER7041-0002	www.beckhoff.com/EP7041-1002 www.beckhoff.com/ER7041-1002

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	Stepper motor module, 50 V DC, 5 A, with incremental encoder, 2 digital inputs, 1 digital output, motor connection via plug	Stepper motor module, 50 V DC, 5 A, with incremental encoder, 2 digital inputs, 1 digital output, motor connection via plug, for high-speed applications
	EP7041-2002 ⓘ **ER7041-2002**	**EP7041-3002** ⓘ **ER7041-3002**
	screw type M12	screw type M12
	uni- or bipolar stepper motors	uni- or bipolar stepper motors
	1 stepper motor, 1 digital 24 V DC output	1 stepper motor, 1 digital 24 V DC output
	2 digital inputs, encoder system (24 V DC encoder)	2 digital inputs, encoder system (24 V DC encoder)
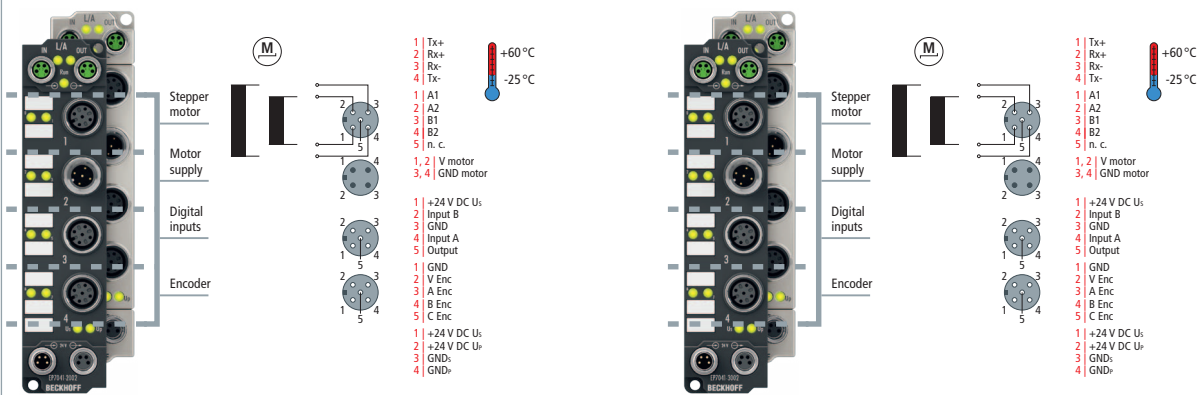
The EP7041-2002/ER7041-2002 and EP7041-3002/ER7041-3002 EtherCAT Box modules are intended for the direct connection of different stepper motors. The PWM output stages for two motor coils with compact design are located in the module together with two inputs for limit switches and cover a wide voltage and current range. The EP7041/ER7041 can be adjusted to the motor and the application by changing just a few parameters. 64-fold micro-stepping ensures particularly quiet and precise motor operation. Connection of an incremental encoder enables a simple servo axis to be realised. Two digital inputs and a digital 0.5 A output enable connection of end switches and a motor brake. The external motor is fed via an integrated plug.

	8…50 V DC	8…50 V DC
	yes	yes
	EtherCAT	EtherCAT
	2 x 3.5 A, 2 x 5 A peak current (overload- and short-circuit-proof)	2 x 3.5 A, 2 x 5 A peak current (overload- and short-circuit-proof)
	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)
	64-fold micro stepping	256-fold micro stepping
	approx. 30 kHz	dynamic
	approx. 5,000 positions (per revolution, depending on motor and encoder type)	approx. 5,000 positions (per revolution, depending on motor and encoder type)
	5…24 V, 5 mA, single-ended	5…24 V, 5 mA, single-ended
	max. 400,000 increments/s (with 4-fold evaluation)	max. 400,000 increments/s (with 4-fold evaluation)
	120 mA	120 mA
	travel distance control, encoder input, motor supply via plug	for high-speed applications, travel distance control, encoder input, load indication, motor supply via plug
	-25…+60 °C	-25…+60 °C
	CE, Ex	CE, Ex
	www.beckhoff.com/EP7041-2002 www.beckhoff.com/ER7041-2002	www.beckhoff.com/EP7041-3002 www.beckhoff.com/ER7041-3002

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

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BECKHOFF New Automation Technology

Bus Terminal | **Stepper motor terminals**

Stepper motors are often used in positioning drives. They allow, by the combination of single steps, a positioning process without feedback of the rotor positions. This "open control chain" mode of operation and the longevity of a stepper motor are particularly interesting for price-sensitive fields of application. 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 α. The motor follows the impulse pattern of the control unit, until the coupled momentum exceeds its holding momentum or the impulse demand is too dynamic, which leads to standstill of the motor. With the KL2531 and KL2541 stepper motor terminals, which are suitable for highly dynamic movement, this problem in areas of higher speeds of rotation can be solved.

The KL2531 and KL2541 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 KL2541 also includes an incremental encoder interface to read position data.

Both KL2531 and KL2541 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.
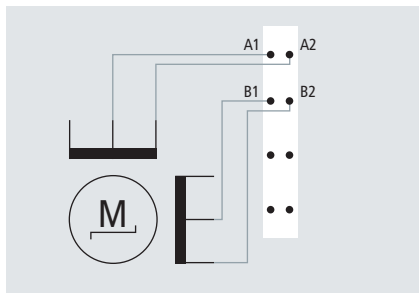
Irregular operation at certain speed ranges, particularly without coupled load, indicates that the stepper motor is being runat its resonance frequency. Under certain circumstances the motor may even stop. Resonances in the lower frequency range essentially result from the mechanical motor parameters. 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. Due to their sine/cosine current profile, KL2531 and KL2541 stepper motor terminals are able to prevent

this effect in almost all standard motors. The rotor is not moved from step to step, so it no longer jumps to the next position, but moves through 64 intermediate steps. So the rotor is carefully moved from one step to the next. The usual loss of torque at certain speeds is avoided and operation can be optimised for the particular application. This means that the lower speed range, where particularly high torque is available, can be fully utilised.
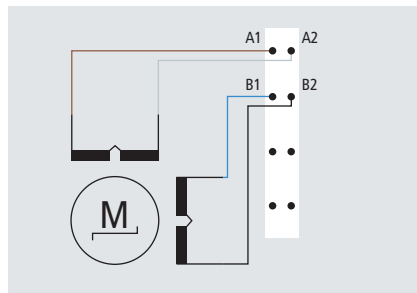
The KL2531 stepper motor terminal is designed exclusively for 24 V supply voltage. The motor current can reach up to 1.5 A. The KL2541 covers a supply voltage range from 8 V DC to 50 V DC and also needs a 24 V supply from the power contacts. The motor current can be set from 1 to 5 A.

The peak current may briefly significantly exceed the rated current and in this way makes the whole drive system very dynamic. In such dynamic applications, negative acceleration causes the feedback of energy, which leads to voltage peaks at the power supply unit. A KL9570 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.
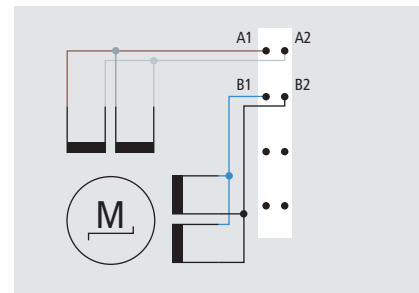
Connection of a unipolar stepper motor

Connection of a bipolar AS10xx stepper motor, serial

Connection of a bipolar AS10xx stepper motor, parallel

	Stepper motor terminal 24 V DC, 1.5 A	Stepper motor terminal 50 V DC, 5 A, with incremental encoder
Technical data	**KL2531** | KS2531	**KL2541** | KS2541
Connection technology	direct motor connection	
Load type	uni- or bipolar stepper motors	
Max. output current	1.5 A (overload- and short-circuit-proof)	5 A (overload- and short-circuit-proof)
Number of outputs	1 stepper motor	1 stepper motor, encoder input
Nominal voltage	24 V (-15 %/+20 %)	8…50 V DC
Current consumption power contacts	only load	typ. 35 mA
Current consumpt. K-bus	typ. 60 mA	typ. 100 mA
Number of inputs	2	2 for limit position, 4 for an encoder system
Maximum step frequency	125,000 steps/s	125,000 steps/s
Step pattern	full step, half step, up to 64-fold micro stepping	full step, half step, up to 64-fold micro stepping
Current controller frequency	approx. 25 kHz	approx. 25 kHz
Resolution	approx. 5,000 positions in typ. applications (per revolution)	approx. 5,000 positions in typ. applications (per revolution)
Encoder signal	–	5…24 V, 5 mA, single-ended
Pulse frequency	–	max. 400,000 increments/s (with 4-fold evaluation)
Special features	travel distance control	travel distance control, encoder input
Operating temperature	0…+55 °C	0…+55 °C
Approvals	CE	CE
Weight	approx. 50 g	approx. 100 g
Further information	www.beckhoff.com/KL2531	www.beckhoff.com/KL2541
Special terminals		**KL2541-0006**
Distinguishing features		stepper motor terminal 50 V DC, 5 A, 5 V encoder supply

BECKHOFF New Automation Technology

AS1000 | Stepper motors

Motion | AS1000 stepper motors

The AS1000 stepper motors with flange sizes from 42 to 86 mm (NEMA17, NEMA23, NEMA34) and torques from 0.4 to 5 Nm are ideally suited for use as auxiliary axes and positioning drives. They are characterised by robustness and high holding torques. Due to the integrated micro-stepping the motors can position very well even without a feedback system and require only a motion terminal for power electronics. Stepper motors can also be operated with TwinCAT NC PTP for synchronisation functions such as cam plates or flying saws.

I/O | Stepper motor terminals

For stepper motor terminals, I/O components with different performance features are available: Bus Terminal (KL2531, KL2541), EtherCAT Terminal (EL7031, EL7041) and EtherCAT Box (EP7041). The KL2531 and EL7031 stepper motor terminals are exclusively designed for 24 V DC power supplies. The motor current can reach up to 1.5 A. The KL2541 and EL7041 stepper motor terminals cover a supply voltage range from 8 to 50 V DC and additionally require a 24 V DC supply via the power contacts. The motor current can be set from 1 to 5 A. The EP7041 stepper motor module allows the connection of stepper motors up to 50 V DC and 5 A.

| Technical data	AS10xx
Motor type	stepper motor
Rated supply voltage	24…50 V DC
Resolution	1.8°/200 full steps
Insulation system	class B (130 °C)
Design form	AS1010/AS1020: flange-mounted according IM B14, IM V1, IM V3 AS1030/AS1050/AS1060: flange-mounted according IM B5, IM V1, IM V3
Protection class	IP 43, AS1060: IP 20
Cooling	Free ventilation of the motors must be ensured.
Connection method	direct cable outlet via cable gland with connected M12 coupling
Life span	L_{10h} = 30,000 hrs for ball bearings
Approvals	CE

AS10xx | **Rated current 1.0…1.5 A**

Data for 24…50 V DC	AS1010-0000	AS1020-0xyz	AS1030-0000
Flange size	42 mm (NEMA17)	42 mm (NEMA17)	56 mm (NEMA23)
Rated current (per phase)	1.0 A	1.0 A	1.5 A
Standstill torque	0.38 Nm	0.5 Nm	0.6 Nm
Rotor moment of inertia	0.056 kgcm²	0.074 kgcm²	0.21 kgcm²
Bus Terminal	KL2531	KL2531/KL2541	KL2531
EtherCAT Terminal	EL7031	EL7031/EL7041	EL7031
EtherCAT Box	EP7041-1002	EP7041-1002	EP7041-1002
Gear unit	–	–	AG1000-+PM52.i

AS10xx | **Rated current 5 A**

Data for 24…50 V DC	AS1050-0xyz	AS1060-wxyz
Flange size	56 mm (NEMA23)	86 mm (NEMA34)
Rated current (per phase)	5.0 A	5.0 A
Standstill torque	1.2 Nm	5.0 Nm
Rotor moment of inertia	0.36 kgcm²	3.0 kgcm²
Bus Terminal	KL2541	KL2541
EtherCAT Terminal	EL7041	EL7041
EtherCAT Box	EP7041-3002	EP7041-3002
Gear unit	AG1000-+PM52.i	AG1000-+PM81.i

Order reference	AS10u0-wxyz
u	type
w = 0	AS1010, AS1020: smooth shaft with 1 flat
	AS1030, AS1050: smooth shaft
	AS1060: smooth shaft with 2 flats
w = 1	shaft with groove and feather key according to DIN 6885 (only available with AS1060)
x = 0	standard motor without second shaft
x = 1	second shaft (AS1020/AS1050/AS1060 only), necessary for y = 1 and y = 2
y = 0	no incremental encoder
y = 1	incremental encoder, 24 V DC, 200 lines (only available for AS1020, AS1050, AS1060), requires x = 1
y = 2	incremental encoder, 24 V DC, 1024 lines (only available for AS1020, AS1050, AS1060), requires x = 1

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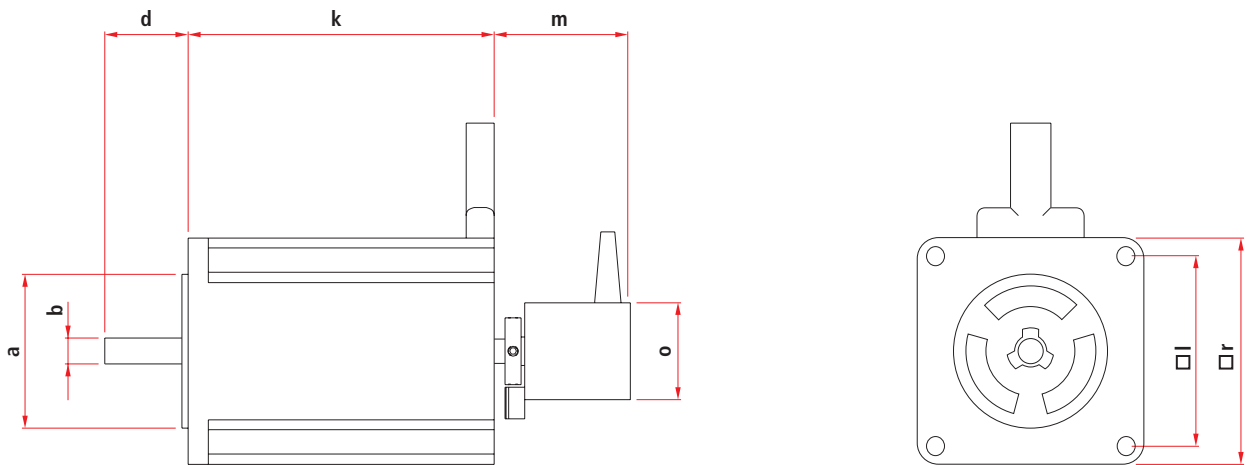
Dimensions	a	b	d	k	l	m	o	r
AS1010	22 mm	5 mm	24 mm	39 mm	31 mm	–	–	42 mm (NEMA17)
AS1020	22 mm	5 mm	24 mm	48 mm	31 mm	33 mm	24 mm	42 mm (NEMA17)
AS1030	38.1 mm	6.35 mm	20.6 mm	54 mm	47.14 mm	–	–	56 mm (NEMA23)
AS1050	38.1 mm	6.35 mm	20.6 mm	75.8 mm	47.14 mm	33 mm	24 mm	56 mm (NEMA23)
AS1060	73 mm	14 mm	30 mm	96.5 mm	69.6 mm	33 mm	24 mm	85.5 mm (NEMA34)

▶ **www.beckhoff.com/AS10xx**

Accessories for AS1000 stepper motors

Cables for AS1000 at Bus Terminal/EtherCAT Terminal up to 5 A

Ordering information	Cables for stepper terminals EL7031, EL7041 and KL2531, KL2541	Pict.
ZK4000-5100-2xxx	encoder cable, drag-chain suitable, (5 x 0.25 mm²), shielded, for EL7041 or KL2541	A
ZK4000-6200-2xxx	motor cable, drag-chain suitable, 4 x 0.5 mm², for EL7031/EL7041 or KL2531/KL2541	B
ZK4000-6700-2xxx	motor cable, drag-chain suitable, (4 x 0.5 mm²), shielded, for EL7031/EL7041 or KL2531/KL2541	

Available in lengths of 1 m, 3 m, 5 m and 10 m (2xxx = length in decimetres, e.g. -2010 = 1 m)

Technical data for drag-chain use see ▶ **www.beckhoff.com/compact-drive-technology**

A

B

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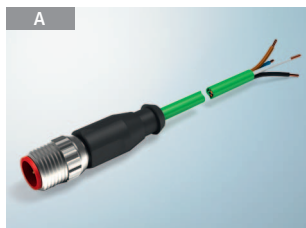
Cables for AS1000 at EtherCAT Box up to 5 A

Ordering information	Cables for stepper EtherCAT Box EP7041	Pict.
ZK4000-5151-xxxx	encoder cable, drag-chain suitable, (4 x 0.35 mm²), shielded, for EP7041	C
ZK4000-6261-xxxx	motor cable, drag-chain suitable, 4 x 0.5 mm², for EP7041	D

Available in lengths of 0.5 m, 1 m, and 2 m (xxxx = length in decimetres, e.g. -0005 = 0.5 m)

Technical data for drag-chain use see ▶ www.beckhoff.com/compact-drive-technology
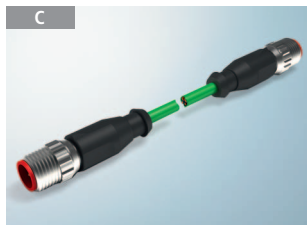
AG1000 | Planetary gear units for stepper motors

Technical data	AG1000-+PM52.4	AG1000-+PM52.7	AG1000-+PM81.4	AG1000-+PM81.7
Nominal output torque	4 Nm	4 Nm	20 Nm	20 Nm
Max. acceleration torque	6 Nm	6 Nm	30 Nm	30 Nm
Gear ratio	3.7 resp. 63/17	6.75 resp. 27/4	3.7 resp. 63/17	6.75 resp. 27/4
Max. torsional backlash	≤ 0.7 °	≤ 0.7 °	≤ 0.5 °	≤ 0.5 °
Max. radial load	200 N	200 N	400 N	400 N
Efficiency	approx. 80 %			
Type of gear	planetary gear			
Weight	0.7 kg	0.7 kg	1.8 kg	1.8 kg
Combination with AS10xx	AS1030, AS1050	AS1030, AS1050	AS1060	AS1060

The planetary gears are delivered as a unit with the assembled stepper motor.
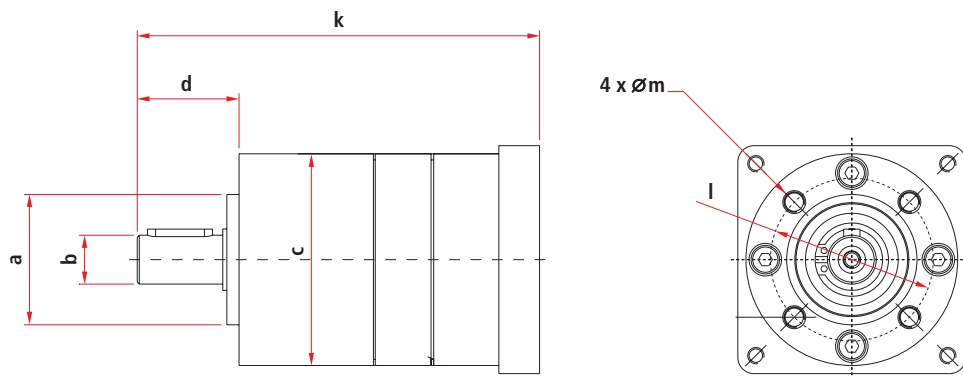
Dimensions	a	b	c	d	k	l	m
AG1000-+PM52.i	32 mm	12 mm	52 mm	25 mm	99.8 mm	40 mm	M5 x 10
AG1000-+PM81.i	50 mm	19 mm	81 mm	49 mm	151.2 mm	65 mm	M6 x 12

BECKHOFF New Automation Technology

EtherCAT Terminal | DC motor output stages

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

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

The control of a DC motor is simple to implement in comparison with other motors, since the speed of rotation is proportional to the voltage. It can be adjusted directly via the process data with the EL7332 and EL7342 EtherCAT Terminals. The integrated compensation of the internal resistance keeps the motor at the desired speed for load changes. Thus a simple drive task can be solved using a simple controller.
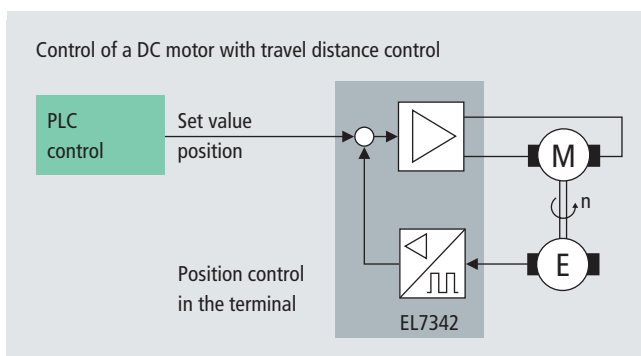
The EL7332 EtherCAT Terminal enables direct operation of two DC motors. It is electrically isolated from the E-bus. The speed is preset by a 16 bit value from the automation unit. The EtherCAT Terminal contains two channels whose signal state is indicated by LEDs. The LEDs enable quick local diagnosis.

For demanding positioning tasks a closed speed control loop with a feedback system is needed. Apart from the operation of two DC motors, the EL7342 EtherCAT Terminal enables the connection of an incremental encoder. The control loop can be closed either by the EtherCAT Terminal itself or by higher-level controller (see illustration).
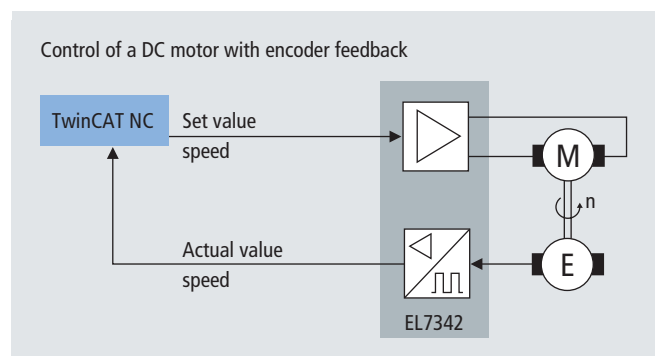
The peak current may briefly significantly exceed the rated current and in this way makes the whole drive system very dynamic. In such dynamic applications, negative acceleration causes the feedback of energy, which leads to voltage peaks at the power supply unit. The EL9576 brake chopper terminal protects from the effects of overvoltage, in that it absorbs some of the energy. If the voltage exceeds the capacity of the terminal, it gets rid of the excess energy via an external resistance.

EL9576 | Brake chopper terminal
see page 27

Control of a DC motor with travel distance control

PLC control | Set value position

Position control in the terminal

EL7342

Control of a DC motor with encoder feedback

TwinCAT NC | Set value speed

Actual value speed

EL7342

Realisation possibilities for position control loops

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

BECKHOFF New Automation Technology

Bus Terminal | DC motor output stages

DC motors can replace the servomotors in many applications if they are operated with an intelligent controller. A DC motor can be integrated very simply into the control system using the KS2532 and KL2552 Bus Terminals. All parameters are adjustable via the field-bus. The small, compact design and DIN rail mounting make the DC motor output stages suitable for a wide range of applications. The output stages are protected against over-load and short circuit and offer an integrated feedback system for incremental encoders on a case-by-case basis.

Through integration into TwinCAT NC, the DC motor can be used in combination with the DC motor output stage – like a servo-axis – for the application without any modifications.

Compared to other motors a DC motor is easier to adjust. The speed of rotation is proportional to the voltage. With the KS2532 Bus Terminal the rotation speed can easily be set through the process data. The integrated

compensation of the internal resistance keeps the motor at the desired speed for load changes. A simple drive task can be performed by a simple controller.
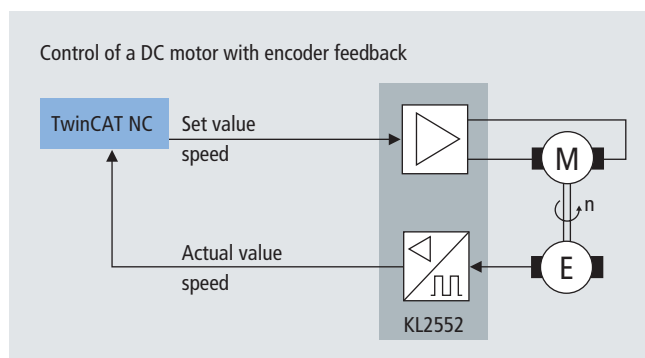
For demanding positioning tasks a closed speed control loop with a feedback system is needed. The KL2552 allows connection of an incremental encoder. The control loop can be closed by the higher-level controller.

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 accel-eration causes the feedback of energy, which leads to voltage peaks at the power supply unit. A KL9570 buffer capacitor terminal pro-tects from the effects of overvoltage, in that it absorbs some of the energy. If the voltage exceeds a threshold, the terminal dissipates the excess energy via an external resistance.
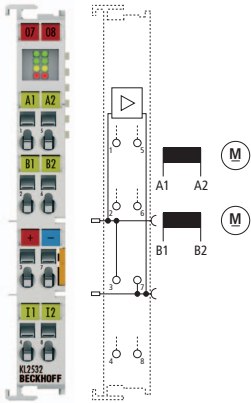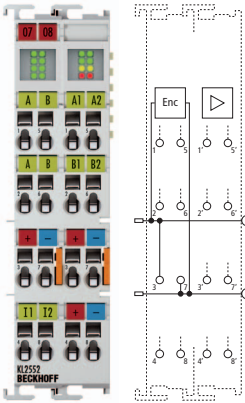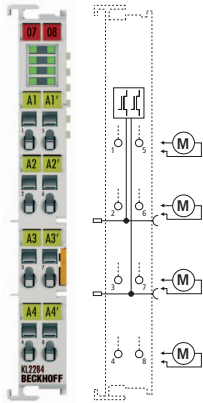
The KL2284 output terminal is sufficient for applications with start/stop or right/left running functions without controllers.

It switches loads in selectable polarity. This means that DC motors can be used in both directions of rotation. A polarity is switched with two output bits per channel. An interlock prevents simultaneous switching of both directions. Advanced power semicon-ductors enable safe and wear-free switching with minimum dimensions. The high starting and short-circuit currents of the KL2284 are comparable with a robust relay. The number of switching cycles is almost unlimited.

KL9570 | Buffer capacitor terminal
see page 28

Control of a DC motor with encoder feedback

TwinCAT NC   Set value
speed

Actual value
speed

KL2552

M

E

n

Realising demanding positioning tasks by closed speed control loop

We reserve the right to make technical changes.

	2-channel DC motor output stage, 24 V DC, 1 A	2-channel DC motor output stage, 50 V DC, 5 A	4-channel digital output terminal, 24 V DC, 2-wire
Technical data	**KL2532** | KS2532	**KL2552** | KS2552	**KL2284** | KS2284
Connection technology	direct motor connection		2-wire
Load type	DC brush motors, inductive		AC/DC loads
Max. output current	2 x 1 A (short-circuit-proof, thermal over-load-proof for both channels together)	2 x 5 A (short-circuit-proof, thermal over-load-proof for both channels together)	2 A
Number of outputs	2 DC motors	2 DC motors, encoder input	4 x H-bridge circuit
Nominal voltage	24 V DC (-15 %/+20 %)	8…50 V DC	0…24 V AC/DC
Current consumption power contacts	typ. 30 mA + load	typ. 50 mA	only load
Current consumpt. K-bus	typ. 50 mA	typ. 100 mA	100 mA
Current limitation/ short circuit current	controlled, adjustable	controlled, adjustable	90 A
Peak current	–	–	5 A (100 ms), < 50 A (10 ms)
On-resistance	–	–	typ. 0.03 Ω
PWM clock frequency	30 kHz with 180° phase shift each	30 kHz with 180° phase shift each	–
Duty factor	0…100 % (voltage-controlled)	0…100 % (voltage-controlled)	–
Resolution	max. 10 bits current, 16 bits speed	max. 10 bits current, 16 bits speed	–
Encoder signal	–	5…24 V, 5 mA, single-ended	–
Pulse frequency	–	max. 400,000 increments/s (with 4-fold evaluation)	–
Switching on speed	–	–	typ. 235 ms, max. 300 ms
Switching off speed	–	–	typ. 30 ms, max. 50 ms
Operating temperature	0…+55 °C	0…+55 °C	0…+55 °C
Approvals	CE	CE	CE
Weight	approx. 55 g	approx. 100 g	approx. 70 g
Further information	www.beckhoff.com/KL2532	www.beckhoff.com/KL2552	www.beckhoff.com/KL2284

BECKHOFF New Automation Technology

EtherCAT Box | DC motor output stage

DC motors can replace the considerably more expensive 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 EP7342/ER7342 EtherCAT Box. All parameters are adjustable via the fieldbus. The small, compact design and the possibility to fit the modules directly to machines makes the EtherCAT DC motor output stage suitable for a wide range of applications. The output stage is protected against overload and short circuit and offers an integrated feedback system for incremental encoders. Two DC motors can be controlled by one module.

2-channel DC motor output stage,
50 V DC, 3.5 A

Industrial housing Zinc die-cast housing	EP7342-0002 ℹ ER7342-0002
Connection method	screw type M12
Load type	DC brush motors, inductive
Number of outputs	2
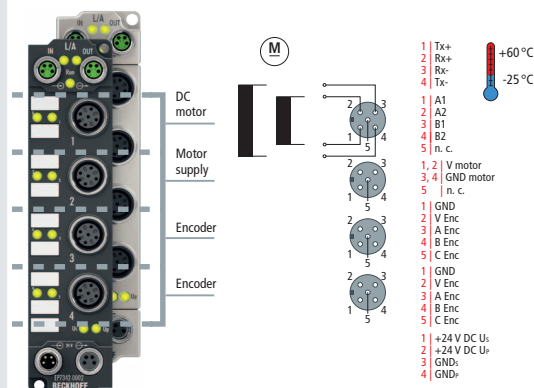
The EP7342/ER7342 EtherCAT Box enables direct operation of two DC motors. The speed or position is specified by the automation device via a 16 bit value. By connection of an incremental encoder, a simple servo axis can be realised. The output stage is protected against overload and short-circuit.

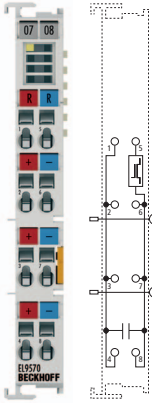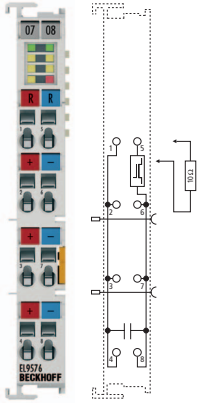| Nominal voltage	8…50 V DC
Distributed clocks	yes
Protocol	EtherCAT
Output current	max. 2 x 3.5 A (short-circuit-proof, common thermal overload warning for both output stages) per channel
PWM clock frequency	32 kHz with 180° phase shift each
Duty factor	0…100 % (voltage-controlled)
Resolution	max. 10 bits current, 16 bits speed
Current consumption from U_S (without sensor current)	120 mA
Special features	travel distance control, encoder input
Operating temperature	-25…+60 °C
Approvals	CE, Ex
Further information	www.beckhoff.com/EP7342 www.beckhoff.com/ER7342

ℹ For availability status see Beckhoff website at: www.beckhoff.com/ER7342

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EtherCAT Terminal | **Brake chopper terminals**

The EtherCAT Terminals of the EL957x series contain high-performance capacitors for stabilising supply voltages. They can be used in connection with the drive terminals of the EL7xxx series, e.g. the EL70x1 stepper motor terminals, the EL73x2 DC motor terminals or the EL72x1 servomotor terminals.

Low internal resistance and high pulsed current capability enable good buffering in parallel with a power supply unit. Return currents are stored, particularly in the context of drive applications, thereby preventing overvoltages. If the fed back energy exceeds the capacity of the capacitors, the EL957x switches the load voltage through to the terminal points 1 and 5. The energy is dissipated by the connection of an external ballast resistor.

The EL9576 is characterised in particular by adjustable threshold values and various diagnostic possibilities and is thus recommended for new projects.

|	Buffer capacitor terminal, 50 V, 500 µF	Brake chopper terminal, 72 V, 155 µF
Technical data	**EL9570** | ES9570	**EL9576** | ES9576
Technology	buffer capacitor	brake chopper
Diagnostics	–	temperature on board, over-/undervoltage
	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.	The EL9576 buffers the connected voltage via its integrated capacitors and connects the external brake resistor if the preset threshold of the internal voltage is exceeded.
Nominal voltage	50 V	arbitrary up to 72 V
Capacity	500 µF	155 µF
Ripple current (max.)	10 A @ 100 kHz	10 A
Internal resistance	< 20 mΩ @ 100 kHz	< 5 mΩ
Chopper voltage	> 56 V	adjustable
Recommended ballast resistor	see documentation	10 Ω, typ. 100 W (dependent on application)
Overvoltage control range	±2 V	typ. 1 V, parametrisable by CoE data
Ballast resistor clock rate	load-dependent, 2-point control	load-dependent, max. 1 ms, 2-point control
Electrical isolation	1,500 V (terminal/E-bus)	1,500 V (terminal/E-bus)
Special features	for new projects: please use EL9576	adjustabel threshold
Operating temperature	0…+55 °C	0…+55 °C
Approvals	CE	CE
Weight	approx. 90 g	approx. 90 g
Further information	www.beckhoff.com/EL9570	www.beckhoff.com/EL9576

BECKHOFF New Automation Technology

Bus Terminal | **Buffer capacitor terminal**

The KL9570 Bus Terminal contains high-performance capacitors for stabilising supply voltages. It can be used in connection with small drive terminals. Low internal resistance and high pulsed current capability enable good buffering in parallel with a power supply unit. Return currents are stored, particularly in the context of drive applications, thereby preventing overvoltages. If the fed back energy exceeds the capacity of the capacitors, the KL9570 switches the load voltage through to the terminal points 1 and 5. The energy is dissipated by the connection of an external ballast resistor.

Buffer capacitor terminal

Technical data	**KL9570**	KS9570
Technology	buffer capacitor terminal
Diagnostics	–
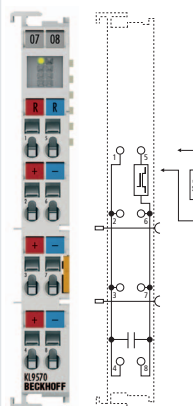
The KL9570 buffers the connected voltage via its integrated capacitors and connects the external brake resistor if the internal voltage of approx. 56 V is exceeded.

|	
Nominal voltage	50 V
Capacity	500 µF
Ripple current (max.)	10 A @ 100 kHz
Internal resistance	< 20 mΩ @ 100 kHz
Surge voltage protection	> 56 V
Recommended ballast resistor	see documentation
Overvoltage control range	±2 V
Ballast resistor clock rate	load-dependent, 2-point control
Electrical isolation	1,500 V (terminal/K-bus)
Operating temperature	0…+55 °C
Approvals	CE, Ex
Weight	approx. 65 g
Further information	www.beckhoff.com/KL9570

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Drive Technology for the medium and high-performance range up to 118 kW

▶ **www.beckhoff.com/Linear-motors**
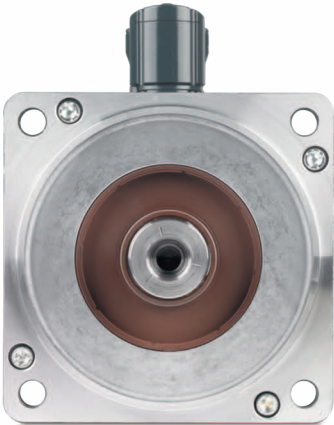
▶ **www.beckhoff.com/ Servomotors**
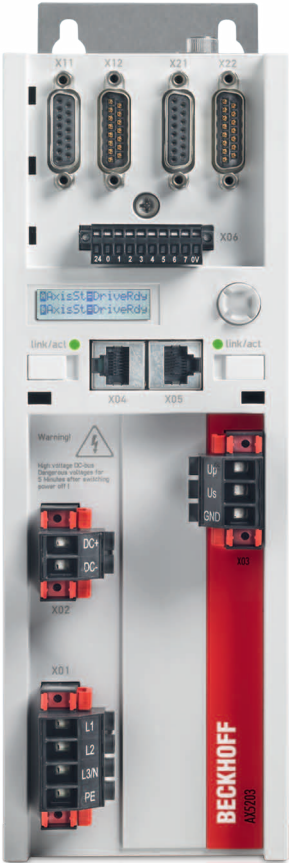
▶ **www.beckhoff.com/ Servo-Drives**

▶ **www.beckhoff.com/XTS**

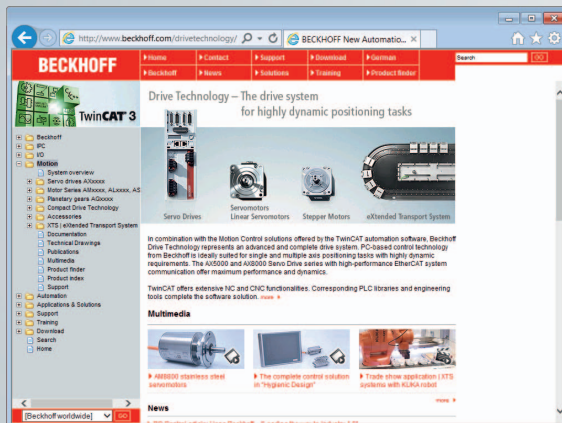**BECKHOFF** New Automation Technology

Headquarters

Beckhoff Automation GmbH & Co. KG
Huelshorstweg 20
33415 Verl
Germany
Phone: + 49 5246 963-0
info@beckhoff.com
www.beckhoff.com

Beckhoff Drive Technology
This flyer provides an overview over the compact
Drive Technology. The complete product range up
to 118 KW can be found on the Internet:

▶ **www.beckhoff.com/DriveTechnology**