MC Standard Terminals Selection Levels

Motion Control & Automation Group

DOCUMENT REVISION HISTORY

Revision	Reason for revision	Date
v0-1	New Document, Draft	11. 08. 2017
v0-2	Add EK1110 and EL9183	01. 12. 2017
v1-0	Exchange EL9183 with EL9189. Add EL 2014	23. 01. 2018
v1-1	Add description of power supply for encoders + use of i/o in motor terminals, add 4ax modularity in terminal layouts, add power concept	15. 03. 2018

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SUMMARY

As part of the ESS MCAG standardization effort across all instrument projects, this document describes the EtherCAT terminals that are supported. In an attempt to cover all use cases and applications experts and in-kind partners were consulted. The selected supported EtherCAT terminals and their envisioned application are explained in this document.

The selection of the terminals according to the previously selected motion components is done also in a level based approach. This also serves as a design guideline for motion solutions. Level 1 is the most recommended and desirable terminal to select. If your application cannot be controlled with the level 1 terminals, then level 2 terminals may be used and so on. The description of the levels is also shown in this document. If the application cannot be solved with the first two levels we ask to contact the MCAG to discuss further options and solutions.

Project Specification
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LIST OF ABBREVIATIONS

Abbreviation	Definition
ESS	European Spallation Source
MCA, MCAG	Motion Control & Automation (Group)
ICS	Integrated Controls Systems Division
DMSC	Data Management & Software Centre
NSS	Neutron Scattering Systems
EPICS	Experimental Physics and Industrial Control System
MCU	Motion Control Unit
E2H2C	ESS Electronics Hardware Harmonisation Committee

1.   STANDARD TERMINALS

A project the size of ESS, with so many partners of different countries involved, represents a challenge in coordinating all the parties involved. To facilitate the communication and work, ESS MCAG is trying to standardizing as much as possible. Taking into account the best practice and experience of our in-kind partners, the MCAG selected and defined standard terminals for the MC electronics.

This document describes the Beckhoff terminals (Beckhoff Automation GmbH & Co. KG, 2017) that MCAG will support and a description of the purpose of each terminal. For the sake of simplicity for design and maintenance, MCAG proposes a modular approach with a standard setup of terminals in a modularity of 4 axes.

However, the MCAG knows that every project is different and sometimes a specific terminal that is not described in this document might be required.

This document and the levels are a guideline for design of applications. MCAG encourages to use mainly the components of level 1. If the specific application cannot be solved with level 1 or 2, please inform and contact the MCAG to discuss further options.

ESxxxx VERSION LIST

Beckhoff terminal (ELxxxx)	Has an ESxxxx version?
5V PS in power contacts EL9505	YES
Power supply and E-Bus refresher EL9410	YES
2-channel DI 5V DC + timestamp EL1252-0050	5V DC-No, 24V DC-YES
HD 8-channel DI 24V DC EL1808	NO
4-channel analogue input EL3174-0002	NO
HD 4-channel PT100 temperature sensor EL3214	NO, but there is a 2 wire-connection type (ES3204)
HD 16-channel DO 24V DC/0.5A EL2819	NO
2-channel DO 24V DC/0.5A + timestamp EL2252	YES
2-channel SSI Absolute Encoder EL5002	YES
HD Resolver EL7201	NO
Incremental Encoder EL5101	YES
HD BiSS-C Absolut Encoder EL5042	NO
SinCos Encoder EL5021	YES
HD 5-channel potentiometer measurement EL3255	NO
Stepper motor 8…50V/3.5A$_{rms}$ EL7047	NO
HD Servo + resolver 8…50V DC/4.5A$_{rms}$ EL7211	NO
HD 2-channel incremental encoder simulation terminal EL2522	YES
4-channel analogue output -10…10V EL4134	YES

2.   CPU AND ETHERCAT COUPLER

The configuration of terminals inside the electrical cabinet makes it necessary to have EtherCAT coupler beside the CPU. Depending on the requirements and number of axes, a number of CPU's will be calculated. However, for every new row (DIN rail) an EtherCAT coupler will be needed at the beginning and a bus end cap at the end.

2.1   CPU CXxxxx

Two Beckhoff CPU models will be selected as MCU. A "low" performance CPU for 1 to 8 axes and a "high" performance CPU for 9 up to 32 axes. The specific model of the Beckhoff CPU's is still under evaluation.

2.2   EtherCAT Coupler EK1100

The EK1100 coupler connects EtherCAT with the EtherCAT terminals. One station consists of an EK1100 coupler, any number of EtherCAT terminals and a bus end terminal. The coupler converts the passing telegrams from Ethernet 100BASE-TX to E-bus signal representation. The coupler is connected to the network via the upper Ethernet interface. The lower RJ45 socket may be used to connect further EtherCAT devices in the same strand. In the EtherCAT network, the EK1100 coupler can be installed anywhere in the Ethernet signal transfer section

2.3   EtherCAT extension EK1110

Like the E-bus end terminal, the EK1110 EtherCAT extension is connected to the end of the EtherCAT terminal block. The terminal offers the option of connecting an Ethernet cable with RJ45 connector, thereby extending the EtherCAT strand electrically isolated by up to 100 m. In the EK1110 terminal, the E-bus signals are converted on the fly to 100BASE-TX Ethernet signal representation. Power supply to the EK1110 electronics is via the E-bus. No parameterization or configuration tasks are required.
This terminal is needed at the end of the EtherCAT terminal block where the CPU is. It is used to continue the same EtherCAT network to other EtherCAT terminal blocks.

2.4   License key terminal EL6070

TwinCAT 3.1 enables management of TwinCAT licenses via the EL6070 EtherCAT terminal. The EL6070 is used as a hardware license key in the modular EtherCAT I/O system. Data transfer takes place via EtherCAT.
For even more convenient handling of the TwinCAT 3.1 licensing, from hardware version 02 the EL6070 license key terminal is equipped with a local data memory. The data memory is used for storing the TwinCAT 3.1 license files. It is not freely accessible and is managed by TwinCAT 3.1.

3.   SYSTEM TERMINALS

This section contains the terminals corresponding the change of power in the power contacts and the refreshing of the E-Bus. As a mean to separate motors with different power characteristics or power zones between the terminals an isolation terminal is also included.

3.1   5V PS in power contacts EL9505

The EL9505 power supply unit terminal generates an output voltage of 5 V DC from the 24 V DC input voltage. The output voltage can be accessed at the terminal. The following EtherCAT terminals are also supplied with this voltage via the power contacts. The Power Bus is therefore changing from 24V to 5V.
Immediately after the CPU and the non-axis related system I/Os a reduction of the power contacts from 24V to 5V is added. This reduction is necessary for the terminal that will read the 5V inputs from the timing system (EL1252-0050). This terminal has a 5V nominal voltage requirement.

3.2   Power supply and E-Bus refresher EL9410

The EL9410 refreshes the E-Bus and provides a monitoring of the 24V power supply voltage. Each terminal draws a certain amount of current from the E-bus. This current is fed into the E-bus by the relevant coupler's power supply unit. In configurations with a large number of terminals it is possible to use the EL9410 in order to supply an extra 2 A to the E-bus.
It also isolates the power bus left of the terminal and allows changes back to 24V Power Bus for the terminals ahead. This will provide the power for all the I/O's that are located in that rail.

3.3   HD 16-channel potential distribution terminal EL9189

The potential distribution terminal EL9189 provides 16 terminal points with a potential and enables the voltage to be picked up without further bus terminal blocks or wiring. In combination with the 16 DO terminal we have now 16x 24V and 16x 0V for I/O's.

3.4   Bus end cap EL9011

This is a cap to cover the E-bus contacts. Each assembly must be terminated at the right-hand end with an EL9011 bus end cap.

4.   INPUT TERMINALS

Different types of inputs are offered to cover all the possible requirements the instruments might have. All the supported digital and analogue input terminals are described in this section.

4.1   Usage level of input terminals

Levels	Terminals
Level 1	• Digital inputs • If synchronization is needed *EL1252-0050*
Level 2	• Analog inputs • For motors with PT100 *EL3214*

4.2   Digital Inputs

This section contains the description of the digital input terminals that MCAG supports. Each subsection includes a description of the envisioned usage of the terminals.

4.2.1   2-channel DI 5V DC + timestamp EL1252-0050

The EL1252-0050 digital input terminal acquires the fast binary control signals from the process level. The signals are furnished with a timestamp that identifies the time of the last edge change with a resolution of 1 ns. The integration of the MCU to the ESS timing system creates the need of having a 5V digital input with time stamping.
This 2-channel digital input with timestamp enables signals to be traced exactly over time and synchronized with the distributed clocks across the system. This will be essential for applications that need to be synchronized with ESS pulse frequency or with other external signals.

4.2.2   HD 8-channel DI 24V DC EL1808

The EtherCAT terminal contains eight channels, consisting of a signal input and 24 V DC. For the EL1808 EtherCAT terminal, the reference ground for all inputs is the 0 V power contact. The wires can be connected without tools in the case of solid wires using a direct plug-in technique.
An 8-channel terminal digital input is included for every two axes. The first 4 inputs are for one axis and the last four for another axis. The inputs are used for the limit switches and the home sensor, leaving one in put free in case it is needed.
Input 1 is uses for the PLIM, input 2 for the MLIM and input 3 for the home sensor. Input 4 is left empty and following the same approach the next inputs will be used for the next axis. Input 5 PLIM, input 6 MLIM, input 7 home sensor and input 8 free. This means that for every two axes one 8-channel digital input terminal will be used. Solid wire: 0.08…1.5 mm²; stranded wire: 0.25…1.5 mm²; ferrule: 0.14…0.75 mm².

4.3   Analogue Inputs

Some sensors or external signals might come as an analogue input, to cover these possibilities we selected some terminals to allow these signals to be incorporated to the MCU.

4.3.1   4-channel analogue input EL3174-0002

The EL3174-0002 analog input terminal has four individually programmable inputs. Signals in the range from -10/0 to +10 V or -20/0/+4 to +20 mA can be processed via each channel. Each channel should be set by the controller to U or I mode via CoE. The input voltage or current is digitized with a resolution of 16 bits, and is transmitted, electrically isolated, to the higher-level automation device. The four differential inputs are electrically isolated against each other and against the fieldbus (2,500 V DC).

In case that a sensor or other application output is an analog type. This terminal can be programmed to accept from -10…10V or 4…20mA.

4.3.2   HD 4-channel PT100 temperature sensor EL3214

The EL3214 analog input terminal allows four resistance sensors to be connected directly. The EtherCAT terminal circuit can operate sensors using the 3-wire technique in a compact 12 mm housing. A microprocessor handles linearization across the whole temperature range, which is freely selectable. The EtherCAT terminal's standard settings are: resolution 0.1 °C. Sensor malfunctions such as broken wires are indicated by error LEDs.

A 4-channel temperature sensor input PT100 is included. Some motors have a temperature sensor included or in some applications the temperature plays an important role, for these reasons the terminal is included.

5.   OUTPUT TERMINALS

The supported output terminals are explained in this section. With these digital output terminals is foreseen to cover all the needs of motion application of the instruments.

5.1   Usage level of output terminals

Levels	Terminals
Level 1	• Digital outputs • If synchronization is needed *EL2252*

5.2   Digital Outputs

This section contains the description of the digital outputs terminals that MCAG supports. Each subsection includes a description of the envisioned usage of the terminals

5.2.1   HD 16-channel DO 24V DC/0.5A EL2819

The EL2819 EtherCAT terminal has 16 digital output channels for the switching of 24 V loads up to 0.5 A. The integrated diagnostics can be evaluated by the controller and indicated by the LEDs. Over temperature and the lack of a voltage supply to the terminal are supplied as diagnostic information. Moreover, each of the channels can signal e.g. a short circuit. The switching state and any error of the output are indicated by the LED. Maintenance of the application is simplified by the diagnostic function. The power contacts are connected through; reference ground of the outputs is the 0 V power contact.
The 16-channel digital output will be used for powering the limit switches and home sensors. Similar to the 8-channel digital input, one 16-channel digital output terminal will be used for every 4 axes. The first 4 for one axis, the next 4 for the other one and so on. Output 1 will power the limit switches and home sensor. The next three outputs might be used for a brake or other sensor related to the respective axis. Solid wire: 0.08…1.5 mm²; stranded wire: 0.25…1.5 mm²; ferrule: 0.14…0.75 mm².

5.2.2   HD 4-channel DO 24V DC/0.5A EL2014

The EL2014 digital EtherCAT terminal connects the binary control signals from the automation device on to the actuators at the process level. It is suitable for the connection of four actuators in 1-wire technology. The EL2014 is protected against polarity reversal and processes load currents with outputs protected against overload and short-circuit. The integrated diagnostics can be evaluated in the controller and is indicated by the LEDs. Over temperature and the lack of a voltage supply to the terminal are supplied as diagnostic information. Beyond that each channel can among other things signal a short circuit individually. The output behavior of the channels in the case of a bus error can be parameterized. Maintenance of the application is simplified by the diagnostics. The power contacts are continuous; reference potential of the outputs is the 0 V power contact. The outputs are fed via the 24 V power contact.
This terminal is intended to be use with the SSI encoder terminal (EL5002). The terminal can provide the power to 4 SSI encoders.

5.2.3   2-channel DO 24V DC/0.5A + timestamp EL2252

The outputs are switched precisely synchronized with the transferred timestamp, which has a resolution of 10 ns. This technology enables output switching times to be specified precisely across the system. The distributed clocks are used for reference. In conjunction with the EL1252 (digital input terminal with timestamp), the EL2252 enables responses with equidistant time intervals, largely independent of the bus cycle time.
For some applications, it will be necessary to time stamp events. For this reason, as a time stamped trigger signal a 2-channel digital output terminal is provided.

6. POSITION MEASUREMENT TERMINALS

For assuring an accurate movement it is highly recommendable to have a position feedback. For this reason, we make available many types of feedback terminals to try to fulfil every possible application.

6.1 Usage level of position measurement terminals

Levels	Terminals
Level 1	• 2-channel SSI *EL5002* • Resolver *EL7201* (radiation)
Level 2	• Incremental Enc. RS422 *EL5101* • 2-channel BiSS-C *EL5042*
Level 3	• SinCos *EL5021* • 5-channel potentiometer *EL3255*

6.1.1 2-channel SSI Absolute Encoder EL5002

2-channel SSI interface absolute encoder terminal. Various operating modes, transmission frequencies and bit widths can be permanently stored in a control register.
The 24V/0.5A power supply for the encoder is provided by a digital output of the 4 DO terminal EL2014.

6.1.2 Resolver EL7201

In case of a resolver there is not a specific resolver terminal. However, the EL7201 servomotor EtherCAT terminal, with integrated resolver interface, offers high servo performance in a very compact design. This terminal will be used as the resolver terminal, regardless if the motor is a stepper or servo.
No DC power supply is needed for the resolver.

6.1.3 Incremental Encoder EL5101

Terminal for incremental encoders with differential inputs (RS422). A 32/16-bit counter with a quadrature decoder and a 32/16-bit latch for the zero pulse can be read, set or enabled. The gate input allows the counter to be halted. The counter state is taken over with a rising edge at the latch input.
The 5V/0.5A output of the terminal card is used to power the encoder.

6.1.4 HD 2-channel BiSS-C Absolut Encoder EL5042

The 2-channel BiSS-C interface can be used for direct connection of BiSS-C encoders. As a master, the EL5042 sends the clock signal to the BiSS-C slave (encoder), which transmits the position data. Here a position value can be represented in the process image with up to 64 bits, depending on the resolution of the connected sensor.
The 2 x 5V or 9V output of the terminal card is used to power the encoder. In case of 24V power needs the supply for the encoder is provided by a digital output of the 4 DO terminal EL2014.

6.1.5   SinCos Encoder EL5021

SinCos EtherCAT terminal serves as interface for the direct connection of a measuring sensor, e.g. a measuring probe with sinusoidal voltage output 1 V_{PP} to the higher-level fieldbus. The measuring signal is processed, interpolated and made available as a 32-bit value.
The 5V/0.5A output of the terminal card is used to power the encoder.

6.1.6   HD 5-channel potentiometer measurement EL3255

The EL3255 EtherCAT terminal enables potentiometers to be connected directly. A stabilized power supply in the terminal and the ratiometric measurement of the input voltage offer the preconditions for precise measurement. On account of its high sampling rate and together with potentiometer position encoders, the compact 5-channel EtherCAT terminal represents an economical position detector.

7.   MOTOR DRIVE TERMINALS

To cover all the possible applications and needs of the instruments regarding motion control, a variety of drivers for different motors are included. Following the standard for motion control components, here are some of the drivers that are included.

7.1   Usage level of motor drive terminals

Levels	Terminals
Level 1	• Stepper motor 8…50V <3.5A$_{rms}$ *EL7047*
Level 2	• Technosoft EtherCAT drive >5A • *AX5106*
Level 3	• Servo motors *EL7211* • External drive with pulse direction *EL2522* • Analog output -10…10V *EL4134*

7.1.1   Stepper motor 8…50V/3.5A$_{rms}$ EL7047

The EL7047 EtherCAT terminal is intended for stepper motors with medium performance range. The PWM output stages cover a wide range of voltages and currents. The voltage range of this terminal goes from 8 to 50V with a max. output current of 5A$_{peak}$.
The encoder inputs of the terminal are not used, as they are only TTL inputs (no differential). The digital inputs are only used in very special cases for local machine protection purposes.

7.1.2   EtherCAT stepper drives for high current motors

Kuhnke, Technosoft (8 or 10 A$_{rms}$), Elmo (3.5 or 7 A$_{rms}$)

7.1.3   Servo drive 100…480V AC/6A AX5106

Digital Compact Servo Drive, 1-axis module ranging from 100 up to 480 V AC, with rated output current 6A and EtherCAT interface. The integrated control technology supports fast and highly dynamic positioning tasks. EtherCAT as a high-performance communication system enables ideal interfacing with PC-based control technology.

7.1.4   HD Servo + resolver 8…50V DC/4.5A$_{rms}$ EL7211

Similar to the EL7201 this servomotor EtherCAT terminal with integrated resolver interface offers high servo performance in a very compact design for motors ranging up to 4.5A$_{RMS}$. The fast control technology, based on field-orientated current and PI speed control, supports fast and highly dynamic positioning tasks.

7.1.5   HD Incremental encoder simulation terminal EL2522

The EL2522 incremental encoder simulation terminal (pulse train) outputs a signal that is modulated via the frequency signal on two channels with four outputs. The signal can be used to control motor drivers or other signal receivers, which are controlled by single cycles. As

with the EL2521, the pulse sequence and pulse number can be directly specified via the process data in the frequency. For each channel the operating mode (frequency modulation, pulse/direction specification and incremental encoder simulation) can be selected.
(2 axes) The special purpose motion control applications, are applications that the standard MCU will not be able to drive directly. These cases will normally use their own controller however, it is planned to still be able to control these actuators through a pulse/direction signal. To generate this pulse train, the terminal EL2522 will be used.

7.1.6   4-channel analogue output -10…10V EL4134

The EL4134 analog output terminal generates signals in the range between -10 and +10 V. The voltage is supplied to the process level with a resolution of 16 bits and is electrically isolated. The output channels of the EtherCAT terminal have a common ground potential. The EL4134 has four channels. The signal state of the EtherCAT terminal is indicated by light emitting diodes.
Some external drivers (E.g. piezo drives) can be controlled with an analog output. For these cases an analog output form -10…10V is provided.

8.   TERMINAL LAYOUT FOR N-AXES MOTION CONTROL UNIT

Motion control units need to be well adapted to the requirements of the single application. They are typically composed of the different terminals providing the exact functionality for the single use case. In order to facilitate design and maintenance, we propose a modular approach with a standard setup of terminals for a dedicated number of axes. This leads to a modularity of 4 axes described below.

8.1   Closed loop control with stepper motor + INC encoder

8.1.1   Functionality per axis

The functionalities per axis on the example of a closed-loop stepper motor control with incremental encoder:

I/O	Function	Terminal
Motor (A1, A2, B1, B2)	Stepper motor	EL7047
Encoder (A, B, C, Latch)	**Not used**	EL7047
Input E1, E2	**Not used**	EL7047
Encoder (A, A/, B, B/, C, C/)	Differential encoder inputs	EL5101
Input G1, G2, I1	**Not used**	EL5101
Output U_E, U_0	5V, 0.5A power supply for encoder	EL5101
Digital Input 1	Limit Switch + (PLIM)	EL1808
Digital Input 2	Limit Switch – (MLIM)	EL1808
Digital Input 3	Home Switch	EL1808
Digital Input 4	GPI	EL1808
Digital Output 1	24V, 0.5A power supply for switches	EL2819
Digital Output 2	Brake, air pad, pneumatics valve	EL2819
Digital Output 3	GPO	EL2819
Digital Output 4	GPO	EL2819
0V	0V distribution bar (for outputs)	EL9189

8.1.2   Layout for 4 axes

8.2 Closed loop control with stepper motor + SSI encoder

8.2.1 Functionality per axis

The functionalities per axis on the example of a closed-loop stepper motor control with absolute SSI encoder:

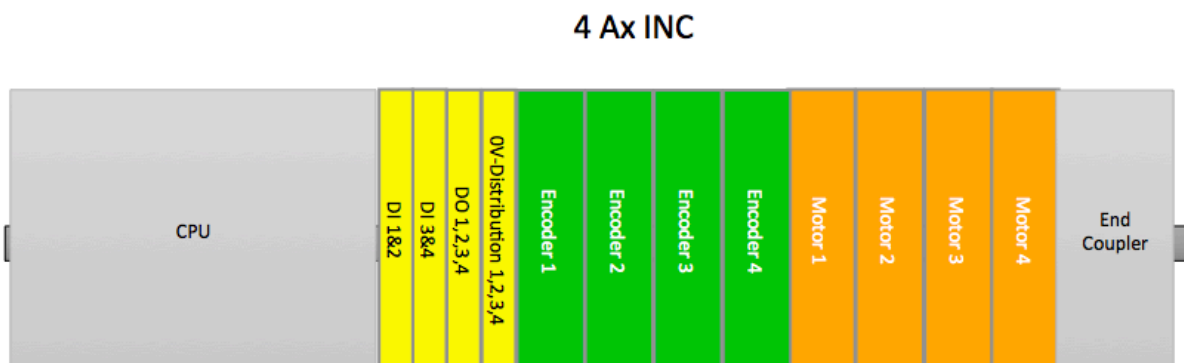| I/O	Function	Terminal
Motor (A1, A2, B1, B2)	Stepper motor	EL7047
Encoder (A, B, C, Latch)	**Not used**	EL7047
Input E1, E2	**Not used**	EL7047
Encoder (D1+, D1-, CL1+, CL1-	Differential encoder inputs	EL5002
Digital Output 1	24V, 0.5A power supply for encoder	EL2014
Digital Input 1	Limit Switch + (PLIM)	EL1808
Digital Input 2	Limit Switch – (MLIM)	EL1808
Digital Input 3	GPI	EL1808
Digital Input 4	GPI	EL1808
Digital Output 1	24V, 0.5A power supply for switches	EL2819
Digital Output 2	Brake, air pad, pneumatics valve	EL2819
Digital Output 3	GPO	EL2819
Digital Output 4	GPO	EL2819
0V	0V distribution bar (for outputs)	EL9189

8.2.2 Layout for 4 axes

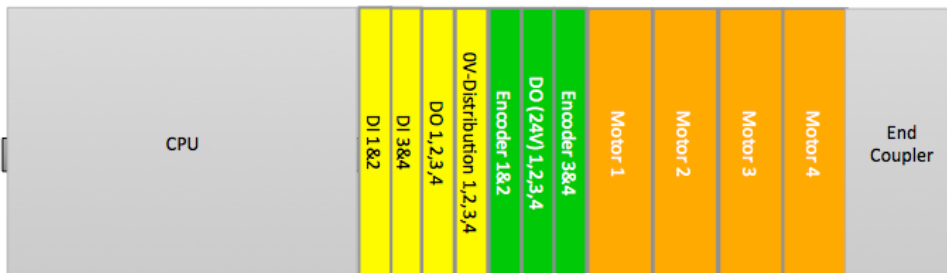## 8.3 Closed loop control with stepper motor + BiSS C encoder

8.3.1 Functionality per axis

The functionalities per axis on the example of a closed-loop stepper motor control with absolute BiSS C encoder:

I/O	Function	Terminal
Motor (A1, A2, B1, B2)	Stepper motor	EL7047
Encoder (A, B, C, Latch)	**Not used**	EL7047
Input E1, E2	**Not used**	EL7047
Encoder (Data1+, Data1-, Clock1+, Clock1-)	Differential encoder inputs	EL5042
ENC supply, GND	5V or 9V, 0.25A power supply for encoder	EL5042
Digital Input 1	Limit Switch + (PLIM)	EL1808
Digital Input 2	Limit Switch – (MLIM)	EL1808
Digital Input 3	GPI	EL1808
Digital Input 4	GPI	EL1808
Digital Output 1	24V, 0.5A power supply for switches	EL2819
Digital Output 2	Brake, air pad, pneumatics valve	EL2819
Digital Output 3	GPO	EL2819
Digital Output 4	GPO	EL2819
0V	0V distribution bar (for outputs)	EL9189

8.3.2   Layout for 4 axes
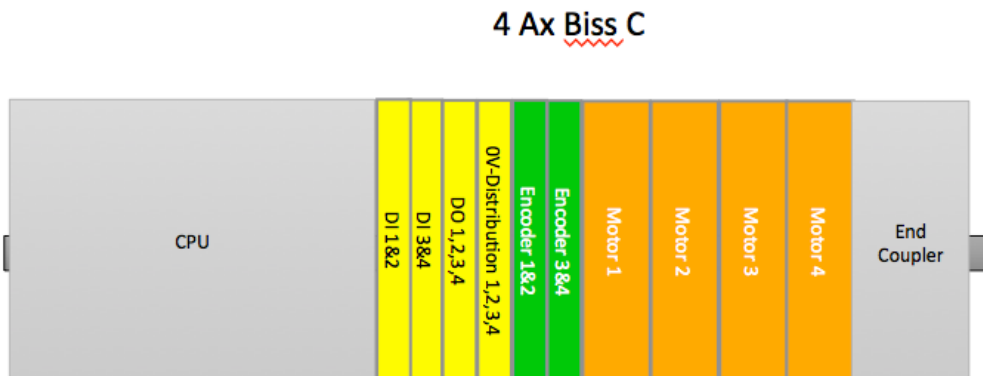
8.4   Power Concept and 16 Axes layout

8.4.1   Power supplies

An n-axes motion control unit will be supplied by a minimum of 3 power supplies: A 24V Control PS (C1) for the CPU, the system I/Os and any other 24V needs in the cabinet, another 24V control PS (C2) for the E-Bus and the Power Bus of the Axes I/Os, the encoder terminals and the motor terminals and a 48V Motor PS (M1) for the motor supply in the motor terminals.
Applications with a small number of axes can live with 2 power supplies only (C1 24V and M1 48V).

8.4.2   5V power supply for fast digital inputs

Fast input terminals need a 5V supply on the power bus. More details in 3.1.

8.4.3   Power refresh for E-Bus and Power Bus

In the configuration below the power for E-Bus and the power contacts of the Power Bus needs to be refreshed roughly every16 axes with a new terminal EL9410.

Generic Setup for 16 axes
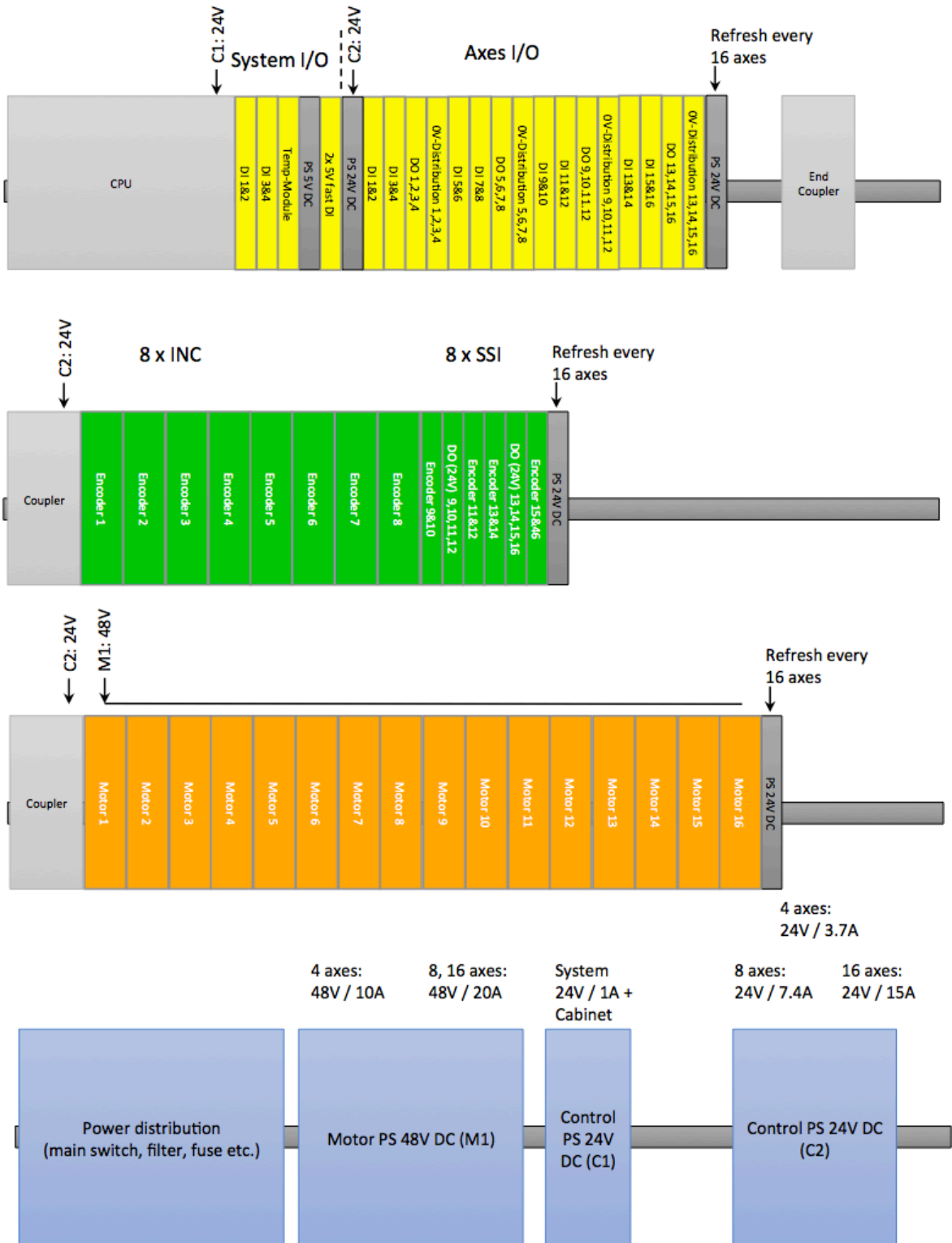
9.   REFERENCES

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http://www.beckhoff.se/english.asp?ethercat/ethercat_terminals.htm?id=235616333

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APPENDIX A

A.1   CPU's CX5130

A.2   EtherCAT Coupler EK1100
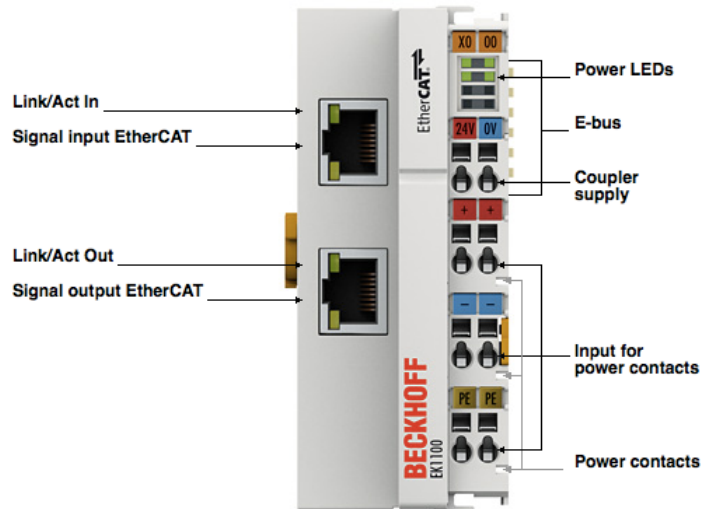
Technical data	EK1100
Task within EtherCAT system	coupling of EtherCAT Terminals (ELxxxx) to 100BASE-TX EtherCAT networks
Data transfer medium	Ethernet/EtherCAT cable (min. CAT 5), shielded
Distance between stations	max. 100 m (100BASE-TX)
Number of EtherCAT Terminals	up to 65,534
Protocol	EtherCAT
Delay	approx. 1 μs
Data transfer rates	100 Mbaud
Configuration	not required
Bus interface	2 x RJ45
Power supply	24 V DC (-15 %/+20 %)
Current consumption from U$_S$	70 mA + (Σ E-bus current/4)
Current consumption from U$_P$	load
Current supply E-bus	2000 mA
Power contacts	24 V DC max./10 A max.
Electrical isolation	500 V (power contact/supply voltage/Ethernet)
Operating/storage temperature	-25…+60 °C/-40…+85 °C
Relative humidity	95 %, no condensation
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4
Protect. class/installation pos.	IP 20/variable
Approvals	CE, UL, Ex

A.3   License key terminal EL6070

Top view   Contact assembly
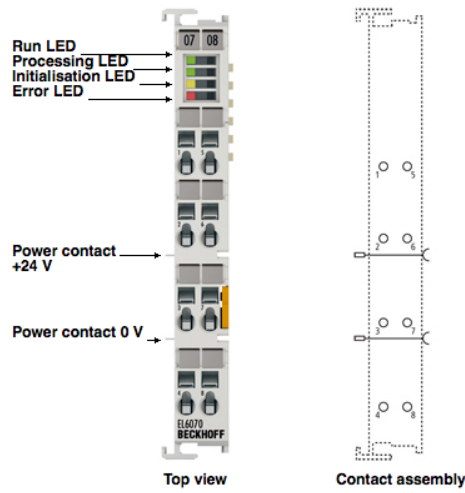
Technical data	EL6070
Technology	EtherCAT license key terminal
Distributed clocks	–
Current consumption power contacts	–
Current consumption E-bus	typ. 130 mA
Special features	transmission of licence information via EtherCAT
Weight	approx. 50 g
Operating/storage temperature	-25…+60 °C/-40…+85 °C
Relative humidity	95 %, no condensation
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4
Protect. class/installation pos.	IP 20/variable
Approvals	CE, UL

A.4   5V PS in power contacts EL9505
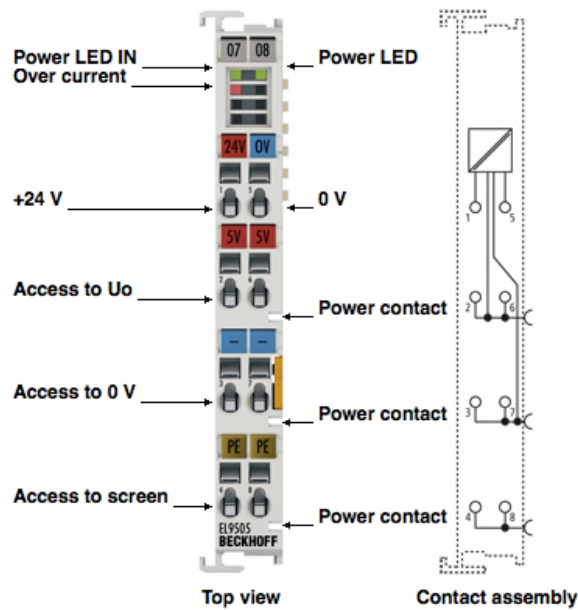
Technical data	EL9505 I ES9505
Technology	power supply terminal with diagnostics and overcurrent LED
Short-circuit-proof	yes
Input voltage	24 V DC (-15 %/+20 %)
Output voltage	5 V DC ±1 %
Output current	0.5 A
Current consumption E-bus	90 mA
Electrical isolation	500 V (E-bus/field potential)
Residual ripple	< 5 mV
Insulation voltage input/output	–
Diagnostics in the process image	yes
Special features	stabilised output voltage
Weight	approx. 65 g
Operating/storage temperature	0…+55 °C/-25…+85 °C
Relative humidity	95 %, no condensation
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4
Protect. class/installation pos.	IP 20/variable
Pluggable wiring	for all ESxxxx terminals
Approvals	CE, UL, Ex

Project Specification
Document Number   ESS-0000961
Date   Sep 24, 2012March 15, 2018

A.5   Power supply and E-Bus refresher EL9410

Technical data	EL9410
Technology	power supply terminal
Short-circuit-proof	yes
Input voltage	24 V DC
Input current	approx. 70 mA + (E-bus/4)
Output voltage	5 V for E-bus supply
Output current	2 A
Current consumption E-bus	–
Electrical isolation	500 V (E-bus/field potential)
Insulation voltage input/output	–
Power contacts	24 V DC max./10 A max.
Diagnostics in the process image	yes
Special features	standard EL supply
Weight	approx. 65 g
Operating/storage temperature	0…+55 °C/-25…+85 °C
Relative humidity	95 %, no condensation
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4
Protect. class/installation pos.	IP 20/variable
Pluggable wiring	for all ESxxxx terminals
Approvals	CE, UL, Ex

Project Specification
Document Number   ESS-0000961
Date   Sep 24, 2012March 15, 2018

A.6   HD 16-channel potential distribution terminal EL9189

Top view   **Contact assembly**

Technical data	EL9189
Technology	potential distribution terminal
Number of outputs	e.g.: 16 x 0 V contact
Current load	≤ 10 A
Power LED	–
Defect LED	–
Renewed infeed	yes
Current consumption E-bus	–
Nominal voltage	≤ 60 V
Integrated fine-wire fuse	–
Electrical isolation	500 V (E-bus/field potential)
Diagnostics in the process image	–
Reported to E-bus	–
PE contact	–
Shield connection	–
Bit width in the process image	0
Electrical connection to DIN rail	–
Housing width in mm	12
Side by side mounting on EtherCAT Terminals with power contact	yes, left without PE
Side by side mounting on EtherCAT Terminals without power contact	yes
Special features	direct plug-in technique
Conductor types	solid wire, stranded wire and ferrule
Conductor connection	solid wire conductors: direct plug-in technique; stranded wire conductors and ferrules: spring actuation by screwdriver
Rated cross-section	solid wire: 0.08…1.5 mm²; stranded wire: 0.25…1.5 mm²; ferrule: 0.14…0.75 mm²
Weight	approx. 60 g
Operating/storage temperature	-25…+60 °C/-40…+85 °C
Approvals	CE, UL, Ex

A.7   Bus end cap EL9011

Technical data	EL9011
Technology	end cover
Current load	–
Power LED	–
Defect LED	–
Renewed infeed	–
Current consumption E-bus	–
Integrated fine-wire fuse	–
Diagnostics in the process image	–
Reported to E-bus	–
PE contact	–
Shield connection	–
Connection facility to additional power contact	–
Bit width in the process image	0
Electrical connection to DIN rail	–
Housing width in mm	5
Side by side mounting on EtherCAT Terminals with power contact	yes
Side by side mounting on EtherCAT Terminals without power contact	yes
Special features	cover for the E-bus contacts
Weight	approx. 10 g
Operating/storage temperature	-25…+60 °C/-40…+85 °C
Approvals	CE, UL, Ex

A.8   2-channel DI 5V DC + timestamp EL1252-0050
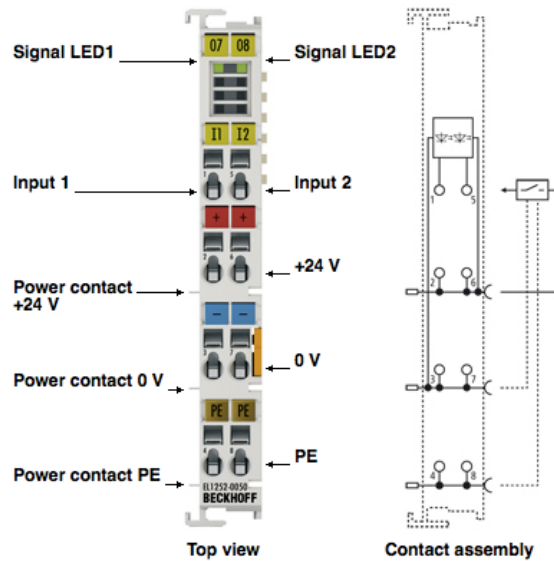
Technical data	EL1252-0050
Connection technology	4-wire
Number of inputs	2
Nominal voltage	5 V DC
"0" signal voltage	< 0.8 V
"1" signal voltage	> 2.4 V
Input current	typ. 50 μA
Input filter	typ. < 1 μs
Oversampling/multi-timestamping factor	–
Resolution timestamp	1 ns (channel 0/1)
Precision of timestamp in the terminal	10 ns (+ input delay)
Internal sampling/execution	10 ns (+ input delay)
Distributed clock precision	<< 1 μs
Input delay T_{ON}/T_{OFF}	< 1 μs
Distributed clocks	yes
Time resolution signal	1 ns
Current consumption power contacts	typ. 6 mA + load
Current consumption E-bus	typ. 90 mA
Electrical isolation	500 V (E-bus/field potential)
Bit width in the process image	2 inputs + 36 byte timestamp
Configuration	no address or configuration setting
Special features	time stamp, latch last edge
Weight	approx. 55 g
Operating/storage temperature	-25…+60 °C/-40…+85 °C
Relative humidity	95 %, no condensation
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4
Protect. class/installation pos.	IP 20/variable
Approvals	CE, UL, Ex

A.9   HD 8-channel DI 24V DC EL1808

Top view   **Contact assembly**
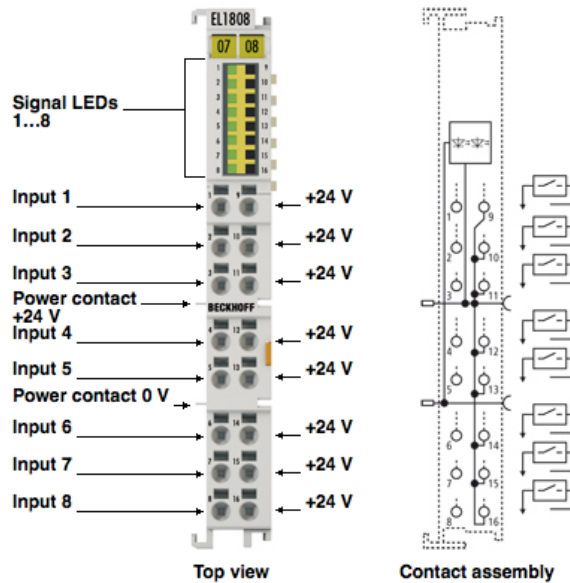
Technical data	EL1808
Connection technology	2-wire
Specification	EN 61131-2, type 1/3
Number of inputs	8
Nominal voltage	24 V DC (-15 %/+20 %)
"0" signal voltage	-3…+5 V (EN 61131-2, type 1/3)
"1" signal voltage	11…30 V (EN 61131-2, type 3)
Input current	typ. 3 mA (EN 61131-2, type 3)
Input filter	typ. 3.0 ms
Distributed clocks	–
Current consumption power contacts	typ. 2 mA + load
Current consumption E-bus	typ. 100 mA
Electrical isolation	500 V (E-bus/field potential)
Bit width in the process image	8 inputs
Configuration	no address or configuration setting
Conductor types	solid wire, stranded wire and ferrule
Conductor connection	solid wire conductors: direct plug-in technique; stranded wire conductors and ferrules: spring actuation by screwdriver
Rated cross-section	solid wire: 0.08…1.5 mm²; stranded wire: 0.25…1.5 mm²; ferrule: 0.14…0.75 mm²
Special features	direct plug-in technique, 2-wire connection
Weight	approx. 60 g
Operating/storage temperature	-25…+60 °C/-40…+85 °C
Relative humidity	95 %, no condensation
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4
Protect. class/installation pos.	IP 20/variable (see documentation)
Approvals	CE, UL, Ex

A.10   4-channel analogue input EL3174-0002

Top view   **Contact assembly**
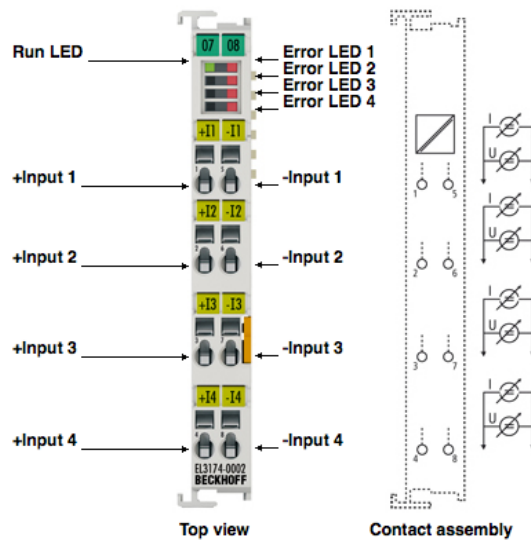
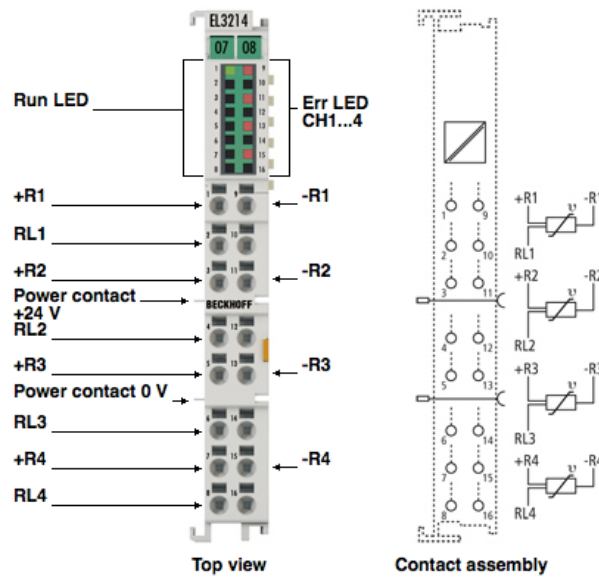| Technical data	EL3174-0002
Number of inputs	4
Power supply	via the E-bus
Technology	differential input, channels electrically isolated
Oversampling factor	–
Distributed clocks	yes
Distributed clock precision	<< 1 µs
Internal resistance	> 200 kΩ I 85 Ω typ
Input filter limit frequency	5 kHz
Conversion time	minimum 150 µs
Measuring range, nominal	-10/0…+10 V I -20/0/+4…+20 mA
Measuring range, technical	-10.73…+10.73 V I -21.47…+21.47 mA
Resolution	16 bit (incl. sign)
Measuring error	< ±0.2 % (at 25 °C ±5 °C, or else < ±0.3 %, relative to full scale value)
Electrical isolation	2500 V functional isolation (test voltage channel/channel and channel/fieldbus, production test)
Current consumption power contacts	–
Current consumption E-bus	typ. 150 mA
Bit width in the process image	inputs: 16 byte
Configuration	no address or configuration setting
Special features	U/I parameterisable, Extended Range,standard and compact process image, activatable FIR/IIR filters
Weight	approx. 65 g
Operating/storage temperature	0…+55 °C/-25…+85 °C
Relative humidity	95 %, no condensation
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4
Protect. class/installation pos.	IP 20/variable
Approvals	CE

A.11   HD 4-channel PT100 temperature sensor EL3214

Top view   Contact assembly

Technical data	EL3214
Number of inputs	4
Power supply	via the E-bus
Technology	2-/3-wire
Distributed clocks	–
Input filter limit frequency	typ. 1 kHz
Sensor types	PT100, PT200, PT500, PT1000, Ni100, Ni120, Ni1000 resistance measurement (e.g. potentiometer, 10 Ω…1.2/4 kΩ), KTY sensors (types see documentation)
Connection method	3-wire
Conversion time	approx. 170 ms default setting
Measuring current	< 0.5 mA (load-dependent)
Measuring range	-200…+850 °C (PT sensors); -60…+250 °C (Ni sensors)
Temperature range	-200…+850 °C (PT sensors); -60…+250 °C (Ni sensors)
Resolution	0.1 °C per digit
Measuring error	< ±0.5 °C for PT sensors, 4 x 3-wire connection
Electrical isolation	500 V (E-bus/signal voltage)
Current consumption power contacts	–
Current consumption E-bus	typ. 140 mA
Special features	integrated digital filter, limit value monitoring, variable connection technology
Weight	approx. 60 g
Operating/storage temperature	-25…+60 °C/-40…+85 °C
Relative humidity	95 %, no condensation
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4
Protect. class/installation pos.	IP 20/variable
Approvals	CE, UL

A.12 HD 16-channel DO 24V DC/0.5A EL2819
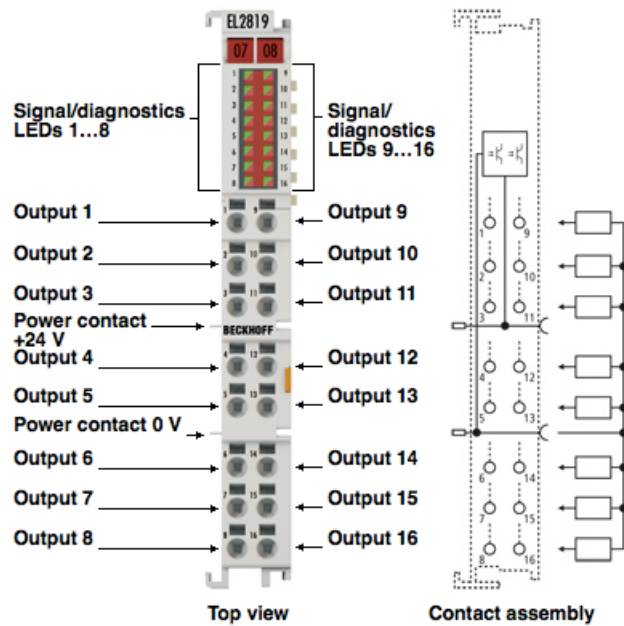
Technical data	EL2819
Connection technology	1-wire
Number of outputs	16
Rated load voltage	24 V DC (-15 %/+20 %)
Load type	ohmic, inductive, lamp load
Distributed clocks	–
Max. output current	0.5 A (short-circuit-proof) per channel
Short circuit current	< typ. 1 A
Reverse voltage protection	yes
Breaking energy	< 150 mJ/channel
Output stage	push (high-side switch)
Current consumption E-bus	typ. 90 mA
Electrical isolation	500 V (E-bus/field potential)
Current consumption power contacts	typ. 50 mA + load
Bit width in the process image	16 bit output and diagnostics
Conductor types	solid wire, stranded wire and ferrule
Conductor connection	solid wire conductors: direct plug-in technique; stranded wire conductors and ferrules: spring actuation by screwdriver
Rated cross-section	solid wire: 0.08…1.5 mm²; stranded wire: 0.25…1.5 mm²; ferrule: 0.14…0.75 mm²
Special features	diagnostics via process data and LED: overtemperature, PowerFail, short circuit (per channel)
Weight	approx. 70 g
Operating/storage temperature	0…+55 °C/-25…+85 °C
Relative humidity	95 %, no condensation
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4
Protect. class/installation pos.	IP 20/see documentation
Approvals	CE, UL

A.13   4-channel DO 24V DC/0.5A EL2014

Top view   **Contact assembly**
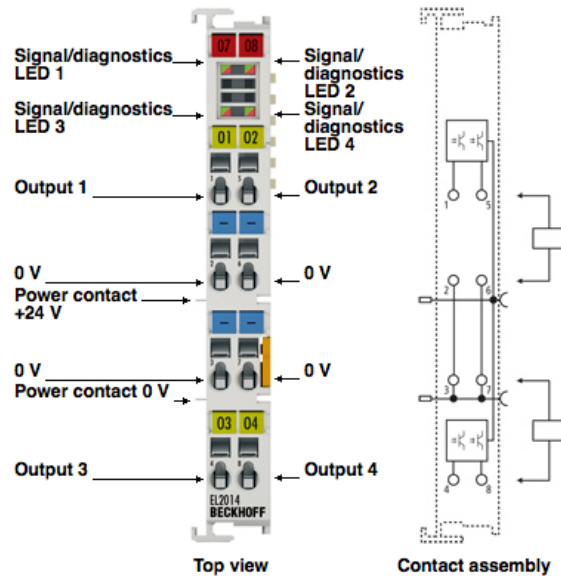
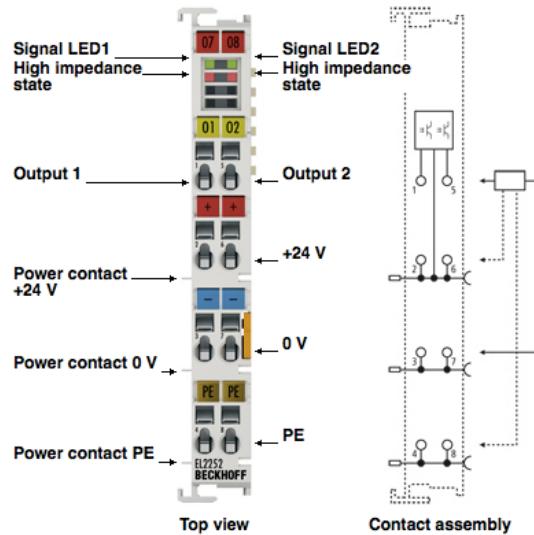| Technical data	EL2014
Connection technology	1-wire
Number of outputs	4
Rated load voltage	24 V DC (-15 %/+20 %)
Load type	ohmic, inductive, lamp load
Distributed clocks	–
Max. output current	0.5 A (short-circuit-proof) per channel
Short circuit current	< typ. 1 A
Reverse voltage protection	yes
Breaking energy	< 150 mJ/channel
Switching times	typ. T_{ON}: 50 μs, typ. T_{OFF}: 100 μs
Current consumption E-bus	typ. 60 mA
Electrical isolation	500 V (E-bus/field potential)
Current consumption power contacts	typ. 15 mA + load
Bit width in the process image	4 bit output, 20 bit diagnositcs
Configuration	via TwinCAT System Manager
Special features	diagnostics via process data and LED: overtemperature, PowerFail, short circuit (per channel)
Weight	approx. 70 g
Operating/storage temperature	0…+55 °C/-25…+85 °C
Relative humidity	95 %, no condensation
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4
Protect. class/installation pos.	IP 20/variable
Approvals	CE

A.14   2-channel DO 24V DC/0.5A + timestamp EL2252

Top view   **Contact assembly**

Technical data	EL2252 I ES2252
Connection technology	4-wire
Number of outputs	2
Rated load voltage	24 V DC (-15 %/+20 %)
Load type	ohmic, inductive, lamp load
Resolution timestamp	1 ns
Precision of timestamp in the terminal	10 ns
Distributed clocks	yes
Distributed clock precision	<< 1 μs
Output delay through 24 V power section	typ. < 1 μs
Max. output current	0.5 A (short-circuit-proof) per channel
Short circuit current	typ. < 1.5 A
Reverse voltage protection	yes
Current limitation	typ. 1.5 A
Breaking energy	< 150 mJ/channel
Switching times	typ. T_{ON}: < 1 μs, typ. T_{OFF}: < 1 μs
Output stage	push-pull
Current consumption E-bus	typ. 130 mA
Electrical isolation	500 V (E-bus/field potential)
Current consumption power contacts	typ. 30 mA + load
Bit width in the process image	8 bit output (ch. 1 + ch. 2), 9 byte timestamp
Special features	Timestamping, outputs can be connected in high-resistance mode, short-circuit-proof.
Weight	approx. 60 g
Operating/storage temperature	0…+55 °C/-25…+85 °C
Relative humidity	95 %, no condensation
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4
Protect. class/installation pos.	IP 20/variable
Pluggable wiring	for all ESxxxx terminals
Approvals	CE, Ex

A.15   2-channel SSI Absolute Encoder EL5002

Top view   Contact assembly
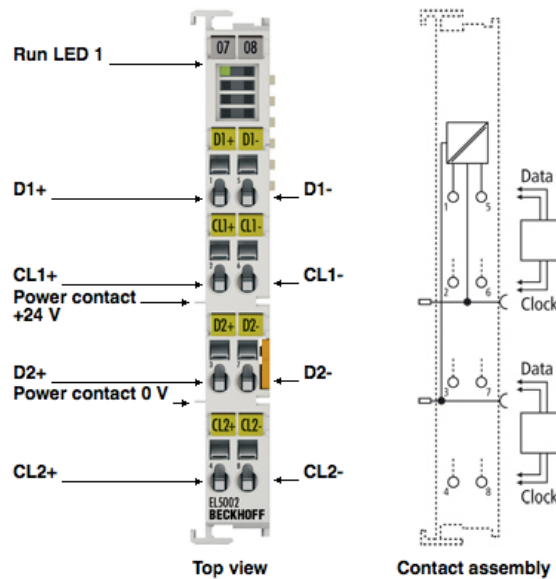
Technical data	EL5002 I ES5002
Technology	SSI encoder interface
Number of channels	2
Encoder connection	binary input: D+, D-, binary output: Cl+, Cl-
Distributed clocks	yes
Signal output (pulse)	difference signal (RS422)
Signal input (data)	difference signal (RS422)
Power supply	24 V via power contacts
Current consumption	typ. 20 mA without encoder
Current consumption power contacts	typ. 20 mA
Encoder supply	external e.g. EL91xx
Data transfer rates	variable up to 1 MHz, 250 kHz default
Serial input	24 bit width (variable)
Data direction	read
Electrical isolation	500 V (E-bus/field potential)
Current consumption E-bus	typ. 130 mA
Bit width in the process image	2 x 32 bit input, 16 bit status
Special features	adjustable baud rate, coding and data length
Weight	approx. 55 g
Operating/storage temperature	-25…+60 °C/-40…+85 °C
Relative humidity	95 %, no condensation
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4
Protect. class/installation pos.	IP 20/variable
Pluggable wiring	for all ESxxxx terminals
Approvals	CE, UL, Ex

A.16   Resolver EL7201
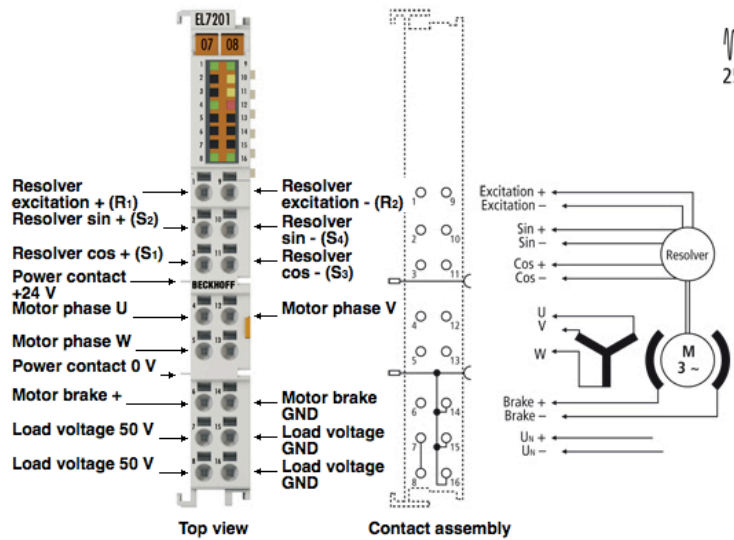
Technical data	EL7201
Number of channels	1 servomotor, resolver, motor brake
Connection method	direct motor connection
Load type	permanent-magnet synchronous motors
Nominal voltage	8…50 V DC
Output current I_N	2.8 A (rms)
Performance increase	Yes, through ZB8610 fan cartridge
output current with ZB8610	max. 4.5 A_{RMS} (overload- and short-circuit-proof)
Peak current I_N	5.7 A (rms) for 1 s
Frequency range	0…599 Hz
PWM clock frequency	16 kHz
Current controller frequency	32 kHz
Rated speed controller frequency	16 kHz
Output voltage motor brake	24 V DC (+6 %/-10 %)
Output current motor brake	max. 0.5 A
Current consumption power contacts	typ. 50 mA + holding current motor brake
Current consumption E-bus	typ. 120 mA
Special features	compact (only 12 mm wide), system-integrated
Weight	approx. 60 g
Operating/storage temperature	0…+55 °C/-25…+85 °C
Relative humidity	95 %, no condensation
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4
Protect. class/installation pos.	IP 20/see documentation
Approvals	CE, UL

A.17   Incremental Encoder EL5101

Top view   **Contact assembly**
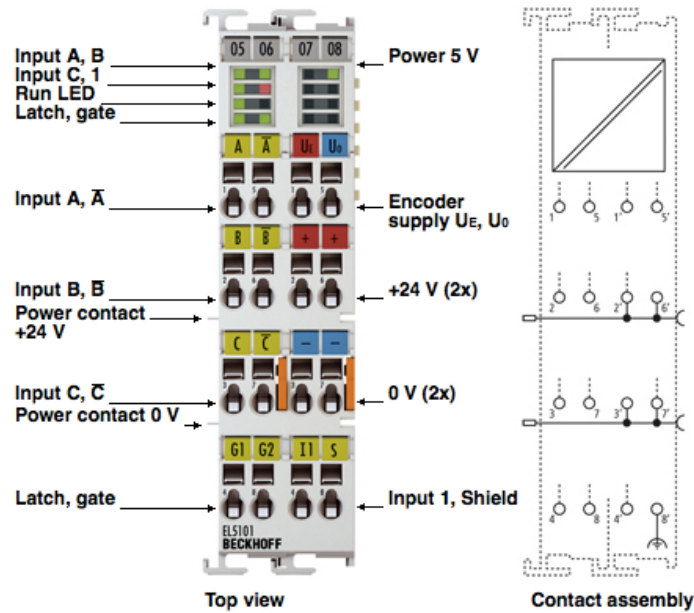
| Technical data	EL5101 I ES5101
Technology	incremental encoder interface RS422
Number of channels	1
Encoder connection	A, A (inv), B, B (inv), C,C (inv), differential inputs (RS422); status input 5 V DC; gate/latch input 24 V DC
Encoder operating voltage	5 V DC/max. 0.5 A
Encoder output current	0.5 A
Counter	1 x 16/32 bit switchable
Input frequency	max. 4 million increments/s (with 4-fold evaluation)
Quadrature decoder	4-fold evaluation
Zero-pulse latch	32 or 16 bits
Commands	read, set, enable
Distributed clocks	yes
Input signal	difference signal (RS422), single-ended possible
Supply voltage	24 V DC (-15 %/+20 %)
Nominal voltage	24 V DC at power contact
Current consumption power contacts	typ. 100 mA + load
Resolution	1/256 bit microincrements
Current consumption E-bus	typ. 130 mA
Bit width in the process image	1 x 32 bit input, 1 x 16 bit output, 8 bit control, 8 bit status
Special features	wire breakage detection, latch and gate function, period duration and frequency measurement, microincrements, timestamping of edges, filters
Weight	approx. 100 g
Operating/storage temperature	-25…+60 °C/-40…+85 °C
Relative humidity	95 %, no condensation
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4
Protect. class/installation pos.	IP 20/variable
Pluggable wiring	for all ESxxxx terminals
Approvals	CE, UL, Ex

A.18   HD 2-channel BiSS-C Absolut Encoder EL5042

Top view   **Contact assembly**
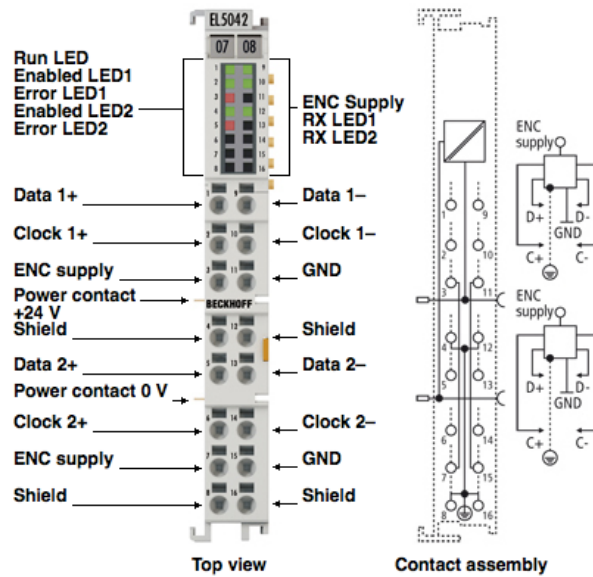
Technical data	EL5042
Technology	position measurement
Encoder type	BiSS-C, unidirectional
Number of channels	2
Encoder connection	D+, D-, C+, C-
Encoder operating voltage	optionally 5 V DC or 9 V DC
Encoder output current	max. 0.5 A for both channels
Supply voltage electronics	24 V DC (via power contacts)
Resolution	max. 64 bit position, 2 bit status, 16 bit CRC
Data transfer rates	up to 10 MHz, variable
Current consumption power contacts	typ. 150 mA
Current consumption E-bus	typ. 120 mA
Distributed clocks	yes
Special features	adjustable baud rate, data length, two status bits (error and warning) can be evaluated separately
Electrical isolation	500 V (E-bus/field potential)
Weight	approx. 50 g
Operating/storage temperature	0…+50 °C/-25…+85 °C
Relative humidity	95 %, no condensation
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4
Protect. class/installation pos.	IP 20/variable
Approvals	CE

A.19   SinCos Encoder EL5021

Top view   **Contact assembly**
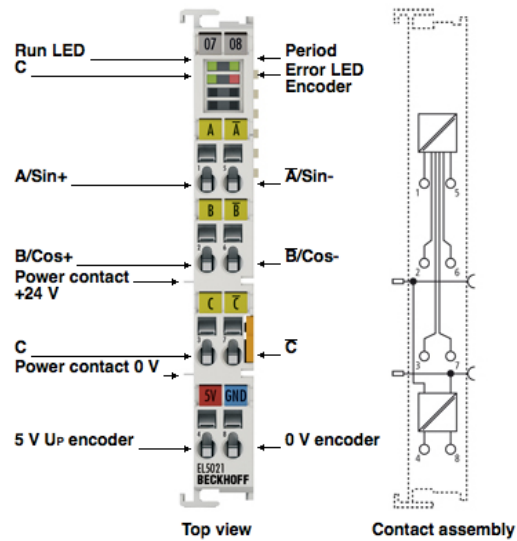
| Technical data	EL5021 I ES5021
Technology	SinCos encoder interface for differential 1 V$_{PP}$ signal
Number of channels	1
Encoder connection	A, A (inv), B, B (inv), C,C (inv)
Encoder operating voltage	5 V DC/max. 0.5 A
Counter	max. 24 bit
Input frequency	250 kHz @ 10 bit (scanning of the input signals with 70 MHz)
Commands	set count, evaluate reference mark latch (C/C [inv]), change of direction, frequency control
Distributed clocks	yes
Input signal	1 V$_{PP}$
Power supply	24 V via power contacts
Current consumption	130 mA
Nominal voltage	24 V DC at power contact
Current consumption power contacts	typ. 50 mA + load
Sensor supply	5 V DC from power voltage, 0.5 A max.
Resolution	max. 13 bit, 8192 steps per period
Electrical isolation	500 V (E-bus/field potential)
Current consumption E-bus	typ. 120 mA
Special features	latch, reset, amplitude and frequency error recognition, frequency-dependent period resolution, frequency counter max. 24 bit
Weight	approx. 55 g
Operating/storage temperature	0…+55 °C/-25…+85 °C
Relative humidity	95 %, no condensation
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4
Protect. class/installation pos.	IP 20/variable
Pluggable wiring	for all ESxxxx terminals
Approvals	CE, UL, Ex

A.20   HD 5-channel potentiometer measurement EL3255
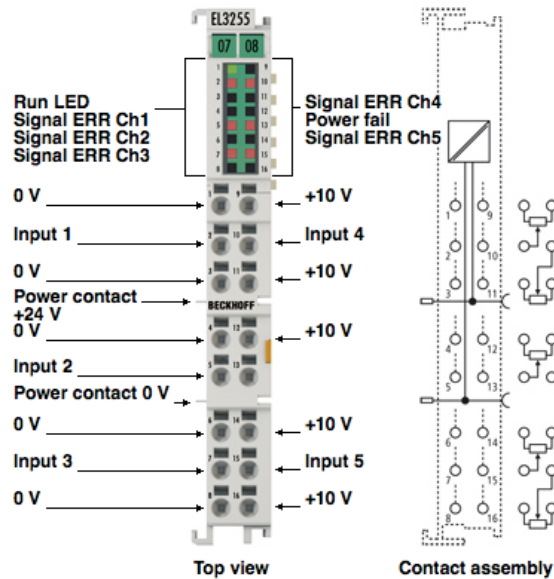
Technical data	EL3255
Number of inputs	5
Power supply	via power contacts
Technology	ratiometric potentiometer evaluation with own supply, 3-wire connection
Distributed clocks	yes
Feed voltage potentiometer	typ. 10 V ±10 %
Internal resistance	>> 100 kΩ to wiper connection
Input filter limit frequency	typ. -3 dB at 3 kHz and potentiometer 50 kΩ
Sensor types	potentiometer 300 Ω…50 kΩ
Output current	max. 0.3 A total supply current for the potentiometers
Wiring fail indication	yes
Conversion time	typ. 300…700 µs, dependent on settings, default setting: approx. 500 µs (5 channels, filter deactivated)
Resolution	16 bit (incl. sign)
Measuring error	< ±0.5 % (relative to full scale value)
Electrical isolation	500 V (E-bus/field potential)
Current consumption power contacts	dependent on the potentiometers, max. 70 mA
Current consumption E-bus	typ. 80 mA
Bit width in the process image	5 x 16 bit input
Configuration	no address setting, configuration via the controller
Conductor types	solid wire, stranded wire and ferrule
Conductor connection	solid wire conductors: direct plug-in technique; stranded wire conductors and ferrules: spring actuation by screwdriver
Rated cross-section	solid wire: 0.08…1.5 mm²; stranded wire: 0.25…1.5 mm²; ferrule: 0.14…0.75 mm²
Special features	open-circuit recognition, supply monitoring, activatable filters, simultaneous measurement of the channels
Weight	approx. 70 g
Operating/storage temperature	-25…+60 °C/-40…+85 °C
Relative humidity	95 %, no condensation
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4
Protect. class/installation pos.	IP 20/variable

A.21   Stepper motor 8…50V/3.5A$_{rms}$ EL7047
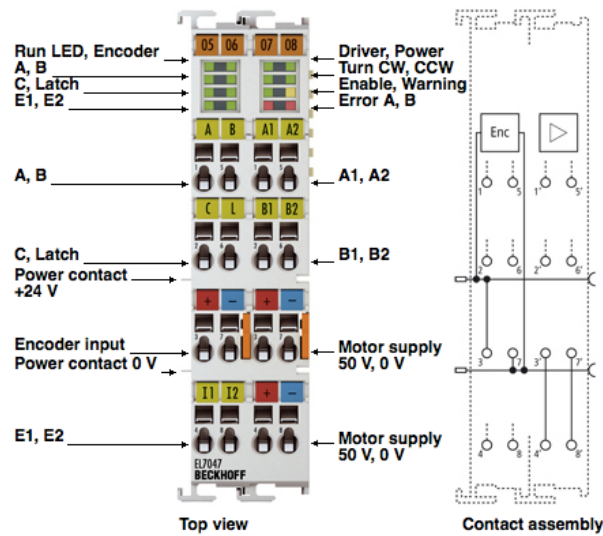
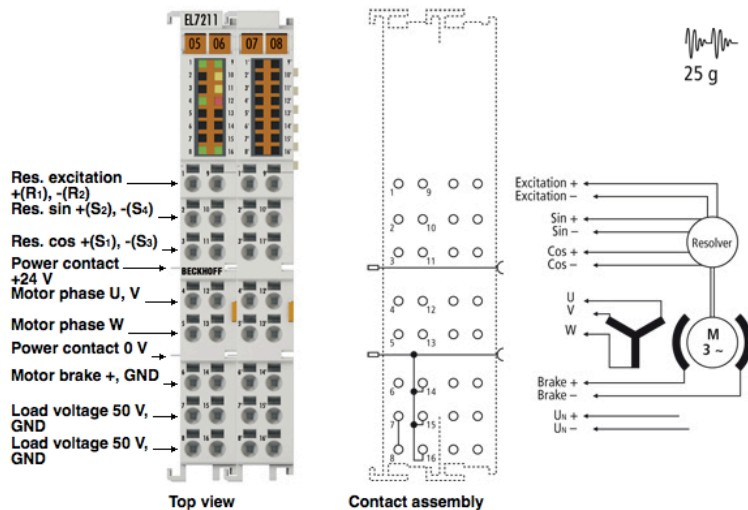| Technical data	EL7047
Technology	direct motor connection
Number of outputs	1 stepper motor, 2 phases, 1 brake configurable (0.5 A)
Number of inputs	2 limit position, 4 for an encoder system
Load type	uni- or bipolar stepper motors
Nominal voltage	8…50 V DC
Power supply	via the E-bus
Max. output current	5 A (overload- and short-circuit-proof)
Performance increase	Yes, through ZB8610 fan cartridge
output current with ZB8610	max. 6.5 A (overload- and short-circuit-proof)
Max. step frequency	1000, 2000, 4000, 8000 or 16,000 full steps/s (configurable)
Step pattern	64-fold micro stepping
Current controller frequency	approx. 30 kHz
Diagnostics LED	error phase A and B, loss of step/stagnation, power, enable
Resolution	approx. 5000 positions in typ. applications (per revolution)
Electrical isolation	500 V (E-bus/signal voltage)
Current consumption power contacts	typ. 50 mA
Current consumption E-bus	typ. 100 mA
Distributed clocks	yes
Encoder input 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, encoder input, vector control
Weight	approx. 90 g
Operating/storage temperature	0…+55 °C/-25…+85 °C
Relative humidity	95 %, no condensation
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4
Protect. class/installation pos.	IP 20/see documentation
Approvals	CE, UL

A.22   High current steppers

A.23   Servo drive 100...480V AC/6A AX5106

AX5101, AX5103, AX5106, AX5112

Project Specification
Document Number   ESS-0000961
Date   Sep 24, 2012March 15, 2018

Technical data	AX5101	AX5103	AX5106	AX5112
Function	servo drive for one drive axis			
Rated output current at 50 °C (1-phase connection)	1 x 1.5 A	1 x 3 A	1 x 4.5 A	–
Rated output current at 50 °C (3-phase connection)	1 x 1.5 A	1 x 3 A	1 x 6 A	1 x 12 A
Minimum rated motor current at full current resolution	0.35 A	1 A	1 A	6 A
Minimum rated channel current at full current resolution	0.35 A	1 A	1 A	6 A
Rated supply voltage	3 x 100…480 V AC ±10 % 1 x 100…240 V AC ±10 %	3 x 100…480 V AC ±10 % 1 x 100…240 V AC ±10 %	3 x 100…480 V AC ±10 % 1 x 100…240 V AC ±10 %	3 x 100…480 V AC ±10 %
DC-Link voltage	max. 875 V DC			
Peak output current (1)	4.5 A	7.5 A	13 A	26 A
Rated apparent power for S1 operation (selection) 120 V (1-/3-phase connection) 230 V (1-/3-phase connection) 400 V (only 3-phase connection) 480 V (only 3-phase connection)	0.3 kVA 0.6 kVA 1.0 kVA 1.2 kVA	0.6 kVA 1.2 kVA 2.1 kVA 2.5 kVA	1.2 kVA 2.4 kVA 4.2 kVA 5.0 kVA	2.5 kVA 4.8 kVA 8.3 kVA 10.0 kVA
Continuous braking power (2)	50 W	50 W	150 W	90 W
Max. braking power (3)	14 kW			
Power loss (4)	35 W	50 W	85 W	160 W
System bus	EtherCAT			
Weight	4.0 kg	4.0 kg	5.0 kg	5.0 kg

A.24   HD Servo + resolver 8…50V DC/4.5A$_{rms}$ EL7211

Top view   Contact assembly

Technical data	EL7211
Number of channels	1 servomotor, resolver, motor brake
Connection method	direct motor connection
Load type	permanent-magnet synchronous motors
Nominal voltage	8…50 V DC
Output current I_N	4.5 A (rms)
Performance increase	–
Peak current I_N	9.0 A (rms) for 1 s
Frequency range	0…599 Hz
PWM clock frequency	16 kHz
Current controller frequency	32 kHz
Rated speed controller frequency	16 kHz
Output voltage motor brake	24 V DC (+6 %/-10 %)
Output current motor brake	max. 0.5 A
Current consumption power contacts	typ. 50 mA + holding current motor brake
Current consumption E-bus	typ. 120 mA
Special features	compact and system-integrated
Weight	approx. 95 g
Operating/storage temperature	0…+55 °C/-25…+85 °C
Relative humidity	95 %, no condensation
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4
Protect. class/installation pos.	IP 20/see documentation
Approvals	CE, UL

A.25   HD Incremental encoder simulation terminal EL2522

Top view   **Contact assembly**
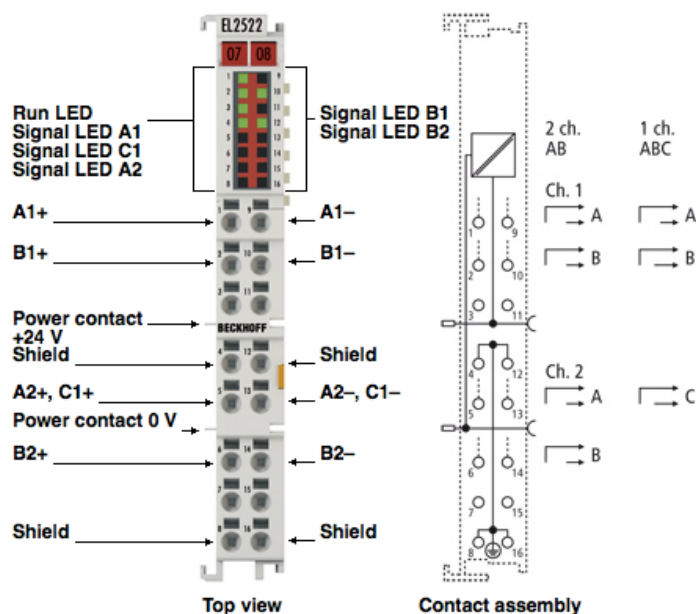
Technical data	EL2522
Connection technology	pulse train (frequency output)
Number of outputs	2 channel A/B, 1 channel A/B/C (4 differential outputs)
Distributed clocks	yes
Output specification	RS422, differential, 50 mA, min. 220 Ω load
Short circuit current	short-circuit-proof
Base frequency	0…4 MHz, 50 kHz default
Resolution	16 bit (incl. sign, scaled via the set frequency range)
Step size	min. 10 ns (internal)
Current consumption E-bus	typ. 120 mA
Electrical isolation	500 V (E-bus/field potential)
Current consumption power contacts	typ. 50 mA (load-dependent)
Special features	operating modes as with EL2521, ABC incremental encoder simulation including interfacing with TwinCAT NC
Weight	approx. 50 g
Operating/storage temperature	0…+55 °C/-25…+85 °C
Relative humidity	95 %, no condensation
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4
Protect. class/installation pos.	IP 20/variable
Approvals	CE, UL

A.26   4-channel analogue output -10...10V EL4134

Top view   **Contact assembly**
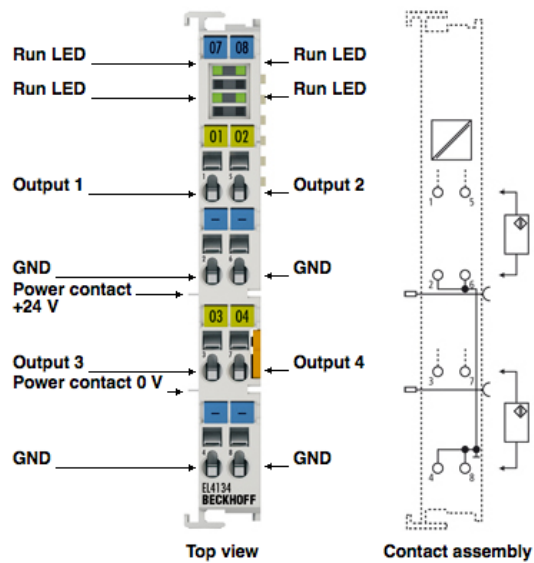
Technical data	EL4134 I ES4134
Connection technology	2-wire, single-ended
Number of outputs	4
Power supply	via the E-bus
Signal voltage	-10...+10 V
Distributed clocks	yes
Distributed clock precision	<< 1 μs
Load	> 5 kΩ (short-circuit-proof)
Output error	< 0.1 % (relative to end value)
Resolution	16 bit (incl. sign)
Electrical isolation	500 V (E-bus/signal voltage)
Conversion time	~ 290 μs
Current consumption power contacts	–
Current consumption E-bus	typ. 265 mA
Bit width in the process image	4 x 16 bit AO output
Special features	Watchdog parameterisable; user synchronisation can be activated.
Weight	approx. 65 g
Operating/storage temperature	-25...+60 °C/-40...+85 °C
Relative humidity	95 %, no condensation
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4
Protect. class/installation pos.	IP 20/variable
Pluggable wiring	for all ESxxxx terminals
Approvals	CE, UL, Ex