BECKHOFF New Automation Technology

Documentation | EN

EL32xx

Analog Input Terminals RTD (Pt100, Pt1000, ...)

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1 Overview Analog Input Terminals Pt100 (RTD)

EL3201 [▶ 18]	1 Channel Input Terminals Pt100 (RTD)
EL3201-0010/0020/0030 [▶ 22]	1 Channel Input Terminals Pt100 (RTD), high precision / with certificate
EL3202 [▶ 26]	2 Channel Input Terminals Pt100 (RTD)
EL3202-0010/0020/0030 [▶ 30]	2 Channel Input Terminals Pt100 (RTD), high precision / with certificate
EL3204 [▶ 34]	4 Channel Input Terminals Pt100 (RTD)
EL3204-0200 [▶ 38]	4 Channel Input Terminal for RTD up to 240 kΩ, NTC 20 k, 16 bit
EL3214 [▶ 50]	4 Channel HD Input Terminal Pt100 for 3-wire connection
EL3214-0090 [▶ 54]	4 Channel HD Input Terminal Pt100, 3-wire connection, TwinSAFE Single Channel
EL3208 [▶ 42]	8 Channel HD Input Terminal Pt100 (RTD)
EL3208-0010 [▶ 46]	8 Channel HD input terminal PT1000, Ni1000 (RTD); NTC sensors, potentiometer
EL3218 [▶ 58]	8 Channel analog HD input terminal for Pt100 (RTD) 2/3-wire connection

2 Foreword

2.1 Notes on the documentation

Intended audience

This description is only intended for the use of trained specialists in control and automation engineering who are familiar with the applicable national standards.
It is essential that the documentation and the following notes and explanations are followed when installing and commissioning these components.
The qualified personnel is obliged to always use the currently valid documentation.

The responsible staff must ensure that the application or use of the products described satisfy all the requirements for safety, including all the relevant laws, regulations, guidelines and standards.

Disclaimer

The documentation has been prepared with care. The products described are, however, constantly under development.

We reserve the right to revise and change the documentation at any time and without prior announcement.

No claims for the modification of products that have already been supplied may be made on the basis of the data, diagrams and descriptions in this documentation.

Trademarks

Beckhoff®, TwinCAT®, TwinCAT/BSD®, TC/BSD®, EtherCAT®, EtherCAT G®, EtherCAT G10®, EtherCAT P®, Safety over EtherCAT®, TwinSAFE®, XFC®, XTS® and XPlanar® are registered trademarks of and licensed by Beckhoff Automation GmbH. Other designations used in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owners.

Patent Pending

The EtherCAT Technology is covered, including but not limited to the following patent applications and patents: EP1590927, EP1789857, EP1456722, EP2137893, DE102015105702 with corresponding applications or registrations in various other countries.

EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

Copyright

2.2 Guide through documentation

NOTICE

Further components of documentation

This documentation describes device-specific content. It is part of the modular documentation concept for Beckhoff I/O components. For the use and safe operation of the device / devices described in this documentation, additional cross-product descriptions are required, which can be found in the following table.

Title	Description
EtherCAT System Documentation (PDF)	• System overview • EtherCAT basics • Cable redundancy • Hot Connect • EtherCAT devices configuration
I/O Analog Manual (PDF)	Notes on I/O components with analog in and outputs
Explosion Protection for Terminal Systems (PDF)	Notes on the use of the Beckhoff terminal systems in hazardous areas according to ATEX and IECEx
Control Drawing I/O, CX, CPX (PDF)	Connection diagrams and Ex markings (conform to cFMus)
Infrastructure for EtherCAT/Ethernet (PDF)	Technical recommendations and notes for design, implementation and testing
Software Declarations I/O (PDF)	Open source software declarations for Beckhoff I/O components

The documentations can be viewed at and downloaded from the Beckhoff website (www.beckhoff.com) via:

- the “Documentation and Download” area of the respective product page,
- the Download finder,
- the Beckhoff Information System.

2.3 Safety instructions

Safety regulations

Please note the following safety instructions and explanations!
Product-specific safety instructions can be found on following pages or in the areas mounting, wiring, commissioning etc.

Exclusion of liability

All the components are supplied in particular hardware and software configurations appropriate for the application. Modifications to hardware or software configurations other than those described in the documentation are not permitted, and nullify the liability of Beckhoff Automation GmbH & Co. KG.

Personnel qualification

This description is only intended for trained specialists in control, automation and drive engineering who are familiar with the applicable national standards.

Signal words

The signal words used in the documentation are classified below. In order to prevent injury and damage to persons and property, read and follow the safety and warning notices.

Personal injury warnings

⚠ DANGER
Hazard with high risk of death or serious injury.

⚠ WARNING
Hazard with medium risk of death or serious injury.

⚠ CAUTION
There is a low-risk hazard that could result in medium or minor injury.

Warning of damage to property or environment

NOTICE
The environment, equipment, or data may be damaged.

Information on handling the product

This information includes, for example:
recommendations for action, assistance or further information on the product.

2.4 Documentation issue status

Version	Comment
7.2.0	• Structural update
7.1	• Update chapter "Commissioning” • Structural update
7.0	• Update chapter "Commissioning” • Structural update
6.9	• Structural update
6.8	• Update chapter "Pin assignment, display and diagnosis” • Structural update
6.7	• Update chapter "Commissioning” • Update chapter "Technical data" • Structural update
6.6	• Update chapter "Introduction" • Update chapter "Technical data" • Structural update
6.5	• Update chapter "Technical data" • Update chapter "Basics of RTD technology" • Update chapter "RTD measurement in EL32xx" • Chapter "Similar products" inserted • Update chapter "EL32xx settings" • Chapter "Process data" inserted • Update chapter "Object description and parameterization" • Update revision status • Structural update
6.4	• Chapter "Note on power supply" amended • Update chapter "Object description and parameterization" • Update chapter "Technical data" • Update revision status • Structural update
6.3	• Update chapter "Introduction" • Update chapter "Technical data" • Update chapter "Connection, display and diagnostics" • Structural update
6.2	• Update chapter "Introduction" • Structural update
6.1	• Update chapter "Introduction" • Update chapter "LEDs and connection" • Update chapter "Ratiometric voltage measurement" • Structural update • Update revision status
6.0	• Update chapter "Introduction" • Chapter "Commissioning: self-heating of RTD sensors" amended
0.1 - 5.9	*archived*

2.5 Version identification of EtherCAT devices

2.5.1 General notes on marking

Designation

A Beckhoff EtherCAT device has a 14-digit designation, made up of

- family key
- type
- version
- revision

Example	Family	Type	Version	Revision
EL3314-0000-0016	EL terminal 12 mm, non-pluggable connection level	3314 4-channel thermocouple terminal	0000 basic type	0016
ES3602-0010-0017	ES terminal 12 mm, pluggable connection level	3602 2-channel voltage measurement	0010 high-precision version	0017
CU2008-0000-0000	CU device	2008 8-port fast ethernet switch	0000 basic type	0000

Notes

- The elements mentioned above result in the **technical designation**. EL3314-0000-0016 is used in the example below.
- EL3314-0000 is the order identifier, in the case of “-0000” usually abbreviated to EL3314. “-0016” is the EtherCAT revision.
- The **order identifier** is made up of
  - family key (EL, EP, CU, ES, KL, CX, etc.)
  - type (3314)
  - version (-0000)
- The **revision** -0016 shows the technical progress, such as the extension of features with regard to the EtherCAT communication, and is managed by Beckhoff.
  In principle, a device with a higher revision can replace a device with a lower revision, unless specified otherwise, e.g. in the documentation.
  Associated and synonymous with each revision there is usually a description (ESI, EtherCAT Slave Information) in the form of an XML file, which is available for download from the Beckhoff web site.
  From 2014/01 the revision is shown on the outside of the IP20 terminals, see Fig. *“EL2872 with revision 0022 and serial number 01200815”*.
- The type, version and revision are read as decimal numbers, even if they are technically saved in hexadecimal.

2.5.2 Version identification of EL terminals

The serial number/ data code for Beckhoff IO devices is usually the 8-digit number printed on the device or on a sticker. The serial number indicates the configuration in delivery state and therefore refers to a whole production batch, without distinguishing the individual modules of a batch.

Structure of the serial number: **KK YY FF HH**	Example with serial number 12 06 3A 02:
KK - week of production (CW, calendar week)	12 - production week 12
YY - year of production	06 - production year 2006
FF - firmware version	3A - firmware version 3A
HH - hardware version	02 - hardware version 02

Fig. 1: EL2872 with revision 0022 and serial number 01200815

2.5.3 Beckhoff Identification Code (BIC)

The Beckhoff Identification Code (BIC) is increasingly being applied to Beckhoff products to uniquely identify the product. The BIC is represented as a Data Matrix Code (DMC, code scheme ECC200), the content is based on the ANSI standard MH10.8.2-2016.

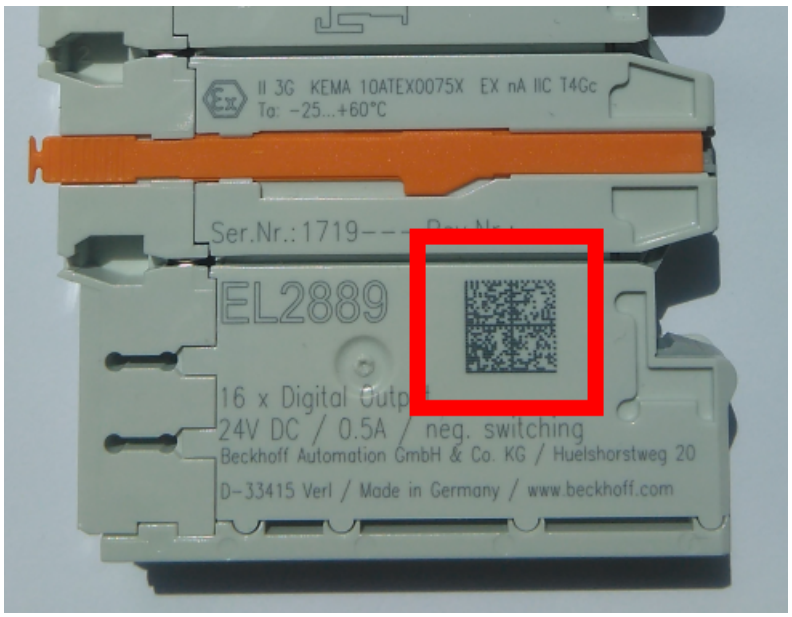


Fig. 2: BIC as data matrix code (DMC, code scheme ECC200)

The BIC will be introduced step by step across all product groups.

Depending on the product, it can be found in the following places:

- on the packaging unit
- directly on the product (if space suffices)
- on the packaging unit and the product

The BIC is machine-readable and contains information that can also be used by the customer for handling and product management.

Each piece of information can be uniquely identified using the so-called data identifier (ANSI MH10.8.2-2016). The data identifier is followed by a character string. Both together have a maximum length according to the table below. If the information is shorter, spaces are added to it.

Following information is possible, positions 1 to 4 are always present, the other according to need of production:

Position	Type of information	Explanation	Data identifier	Number of digits incl. data identifier	Example
1	Beckhoff order number	**Beckhoff order number**	1P	8	1P072222
2	Beckhoff Traceability Number (BTN)	**Unique serial number, see note below**	SBTN	12	SBTNk4p562d7
3	Article description	**Beckhoff article description, e.g. EL1008**	1K	32	1KEL1809
4	Quantity	**Quantity in packaging unit, e.g. 1, 10, etc.**	Q	6	Q1
5	Batch number	Optional: Year and week of production	2P	14	2P401503180016
6	ID/serial number	Optional: Present-day serial number system, e.g. with safety products	51S	12	51S678294
7	Variant number	Optional: Product variant number on the basis of standard products	30P	32	30PF971, 2*K183
...					

Further types of information and data identifiers are used by Beckhoff and serve internal processes.

Structure of the BIC

Example of composite information from positions 1 to 4 and with the above given example value on position 6. The data identifiers are highlighted in bold font:

1P072222**S**BTNk4p562d7**1K**EL1809 **Q**1 **51S**678294

Accordingly as DMC:

Fig. 3: Example DMC **1P**072222**S**BTNk4p562d7**1K**EL1809 **Q**1 **51S**678294

BTN

An important component of the BIC is the Beckhoff Traceability Number (BTN, position 2). The BTN is a unique serial number consisting of eight characters that will replace all other serial number systems at Beckhoff in the long term (e.g. batch designations on IO components, previous serial number range for safety products, etc.). The BTN will also be introduced step by step, so it may happen that the BTN is not yet coded in the BIC.

NOTICE

This information has been carefully prepared. However, the procedure described is constantly being further developed. We reserve the right to revise and change procedures and documentation at any time and without prior notice. No claims for changes can be made from the information, illustrations and descriptions in this documentation.

2.5.4 Electronic access to the BIC (eBIC)

Electronic BIC (eBIC)

The Beckhoff Identification Code (BIC) is applied to the outside of Beckhoff products in a visible place. If possible, it should also be electronically readable.

The interface that the product can be electronically addressed by is crucial for the electronic readout.

K-bus devices (IP20, IP67)

Currently, no electronic storage or readout is planned for these devices.

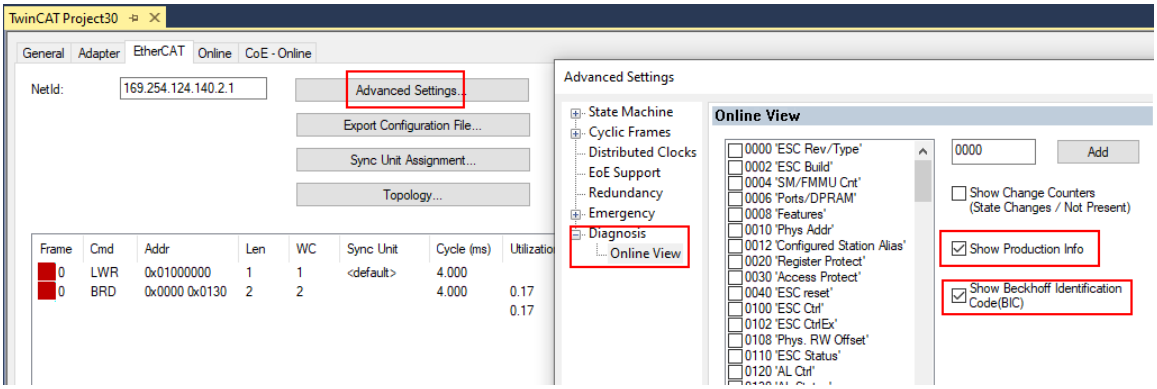
EtherCAT devices (IP20, IP67)

All Beckhoff EtherCAT devices have an ESI-EEPROM which contains the EtherCAT identity with the revision number. The EtherCAT slave information, also colloquially known as the ESI/XML configuration file for the EtherCAT master, is stored in it. See the corresponding chapter in the EtherCAT system manual (Link) for the relationships.

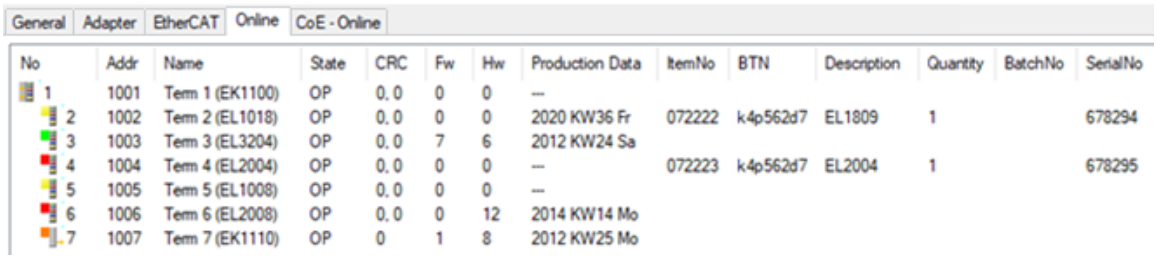
Beckhoff also stores the eBIC in the ESI-EEPROM. The eBIC was introduced into Beckhoff IO production (terminals, box modules) in 2020; as of 2023, implementation is largely complete.

The user can electronically access the eBIC (if present) as follows:

- With all EtherCAT devices, the EtherCAT master (TwinCAT) can read the eBIC from the ESI-EEPROM
  - From TwinCAT 3.1 build 4024.11, the eBIC can be displayed in the online view.
  - To do this, check the "Show Beckhoff Identification Code (BIC)" checkbox under EtherCAT → Advanced Settings → Diagnostics:

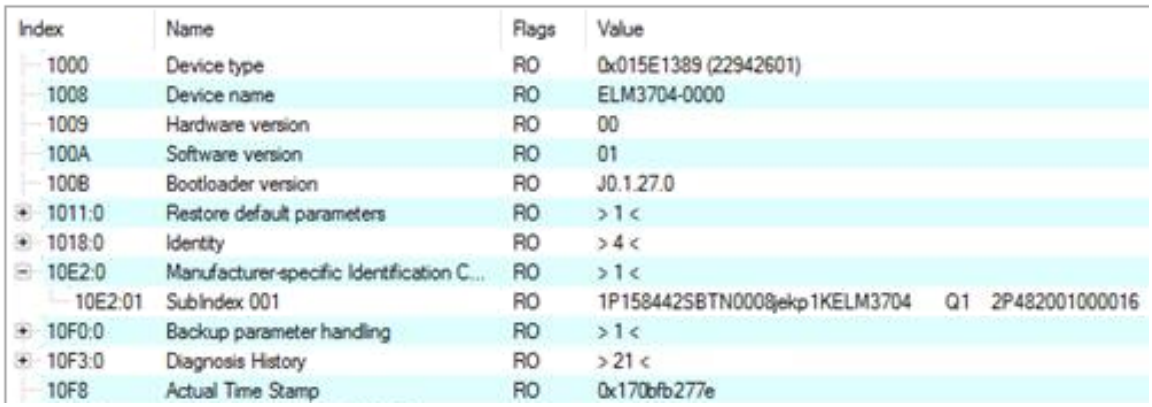


  - The BTN and its contents are then displayed:



  - Note: As shown in the figure, the production data HW version, FW version, and production date, which have been programmed since 2012, can also be displayed with "Show production info".
  - Access from the PLC: From TwinCAT 3.1. build 4024.24, the functions *FB_EcReadBIC* and *FB_EcReadBTN* for reading into the PLC are available in the Tc2_EtherCAT library from v3.3.19.0.
- EtherCAT devices with a CoE directory may also have the object 0x10E2:01 to display their own eBIC, which can also be easily accessed by the PLC:

- The device must be in PREOP/SAFEOP/OP for access:



Index	Name	Flags	Value
1000	Device type	RO	0x015E1389 (22942601)
1008	Device name	RO	ELM3704-0000
1009	Hardware version	RO	00
100A	Software version	RO	01
100B	Bootloader version	RO	J0.1.27.0
1011:0	Restore default parameters	RO	> 1 <
1018:0	Identity	RO	> 4 <
10E2:0	Manufacturer-specific Identification C...	RO	> 1 <
10E2:01	SubIndex 001	RO	1P158442SBTN0008jekp1KELM3704 Q1 2P482001000016
10F0:0	Backup parameter handling	RO	> 1 <
10F3:0	Diagnosis History	RO	> 21 <
10F8	Actual Time Stamp	RO	0x170bfb277e

  - The object 0x10E2 will be preferentially introduced into stock products in the course of necessary firmware revision.
  - From TwinCAT 3.1. build 4024.24, the functions *FB_EcCoEReadBIC* and *FB_EcCoEReadBTN* for reading into the PLC are available in the Tc2_EtherCAT library from v3.3.19.0
- The following auxiliary functions are available for processing the BIC/BTN data in the PLC in *Tc2_Utilities* as of TwinCAT 3.1 build 4024.24
  - F_SplitBIC: The function splits the Beckhoff Identification Code (BIC) sBICValue into its components using known identifiers and returns the recognized substrings in the ST_SplittedBIC structure as a return value
  - BIC_TO_BTN: The function extracts the BTN from the BIC and returns it as a return value
- Note: If there is further electronic processing, the BTN is to be handled as a string(8); the identifier "SBTN" is not part of the BTN.
- Technical background
  The new BIC information is written as an additional category in the ESI-EEPROM during device production. The structure of the ESI content is largely dictated by the ETG specifications, therefore the additional vendor-specific content is stored using a category in accordance with the ETG.2010. ID 03 tells all EtherCAT masters that they may not overwrite these data in the event of an update or restore the data after an ESI update.
  The structure follows the content of the BIC, see here. The EEPROM therefore requires approx. 50..200 bytes of memory.
- Special cases
  - If multiple hierarchically arranged ESCs are installed in a device, only the top-level ESC carries the eBIC information.
  - If multiple non-hierarchically arranged ESCs are installed in a device, all ESCs carry the eBIC information.
  - If the device consists of several sub-devices which each have their own identity, but only the top-level device is accessible via EtherCAT, the eBIC of the top-level device is located in the CoE object directory 0x10E2:01 and the eBICs of the sub-devices follow in 0x10E2:nn.

PROFIBUS; PROFINET, and DeviceNet devices

Currently, no electronic storage or readout is planned for these devices.

3 Product description

3.1 EL3201

3.1.1 Introduction

1-channel analog input, temperature, RTD (Pt100), 16 bit

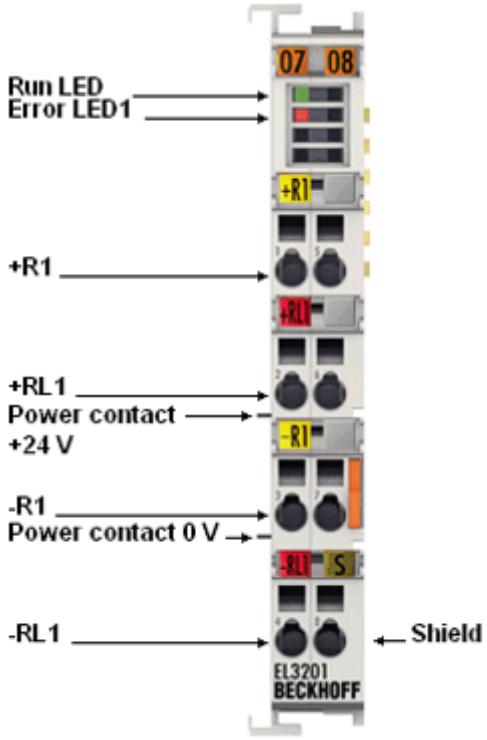


Fig. 4: EL3201

The analog input terminal EL3201 allows the direct connection of one resistance sensor.

The measured resistance value can either be output directly in ohm or transformed into a temperature. If the temperature at the measuring point is of interest, the conversion from resistance to temperature can be done in the terminal according to different sensor characteristics (Pt100, Pt1000, Ni120, Ni1000, KTY types and others).

The EL3201 can operate sensors in 3- and 4-wire technology, for 2-wire connection an external bridge is necessary.

The EtherCAT Terminals indicate their measuring capability via LEDs and status bits in the EtherCAT process image.

Also see about this

- Technical data [▶ 19]
- Pin assignment, display and diagnosis [▶ 20]
- Object description EL3201 [▶ 218]

3.1.2 Technical data

Technical data	EL3201
Number of inputs	1
Sensor types	Pt100, Pt200, Pt500, Pt1000, Ni100, Ni120, Ni1000 KT/KTY from firmware 06 [▶ 311] resistance measurement 10 Ω...1 kΩ or 10 Ω...4 kΩ (e.g. for potentiometer connection)
Connection technology	2-, 3-, 4-wire
Temperature range	Range-dependent: -200...+850°C (Pt sensors); -60...+250°C (Ni sensors)
Resolution (default)	0.1°C per digit
Sampling type	Simultaneous
Ground reference	Single-ended
Conversion time	Approx. 4... 500 ms (configurable), depending on configuration and filter setting approx. 24 ms, preset
ADC conversion method	ΔΣ (Delta-Sigma)
Measuring current (depending on the sensor element and temperature)	typ. < 0.5 mA
Sensor supply	Continuous current (not switched)
Support NoCoEStorage [▶ 76]	Yes
Measuring error	for Pt sensors: < ±0.5°C at ambient temperature 0°C... +55°C < ±1.5°C in extended temperature range
Width in the process image	Max. 4 bytes input
Power supply for the electronics	via the E-bus
Current consumption via E-bus	typ. 190 mA
Electrical isolation	500 V (E-bus/field voltage)
Configuration	via TwinCAT System Manager
Weight	Approx. 60 g
Permissible ambient temperature range during operation	-25°C... +60°C (extended temperature range)
Permissible ambient temperature range during storage	-40°C... +85°C
Permissible relative air humidity	95%, no condensation
Dimensions (W x H x D)	Approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)
Assembly [▶ 93]	On 35 mm mounting rail in compliance with EN 60715
Enhanced mechanical load capacity	Yes, see also Installation instructions for terminals with enhanced mechanical load capacity [▶ 96]
Vibration / shock resistance	In accordance with EN 60068-2-6 / EN 60068-2-27
EMC immunity / emission	In accordance with EN 61000-6-2 / EN 61000-6-4
Protection rating	IP20
Installation position	Any
Identification / approval*)	CE, EAC, UKCA ATEX [▶ 87], IECEx [▶ 88], cULus [▶ 92]

*) Real applicable approvals/markings see type plate on the side (product marking).

Ex markings

Standard	Marking
ATEX	II 3 G Ex nA IIC T4 Gc
IECEx	Ex nA IIC T4 Gc

3.1.3 Pin assignment, display and diagnosis

EL3201

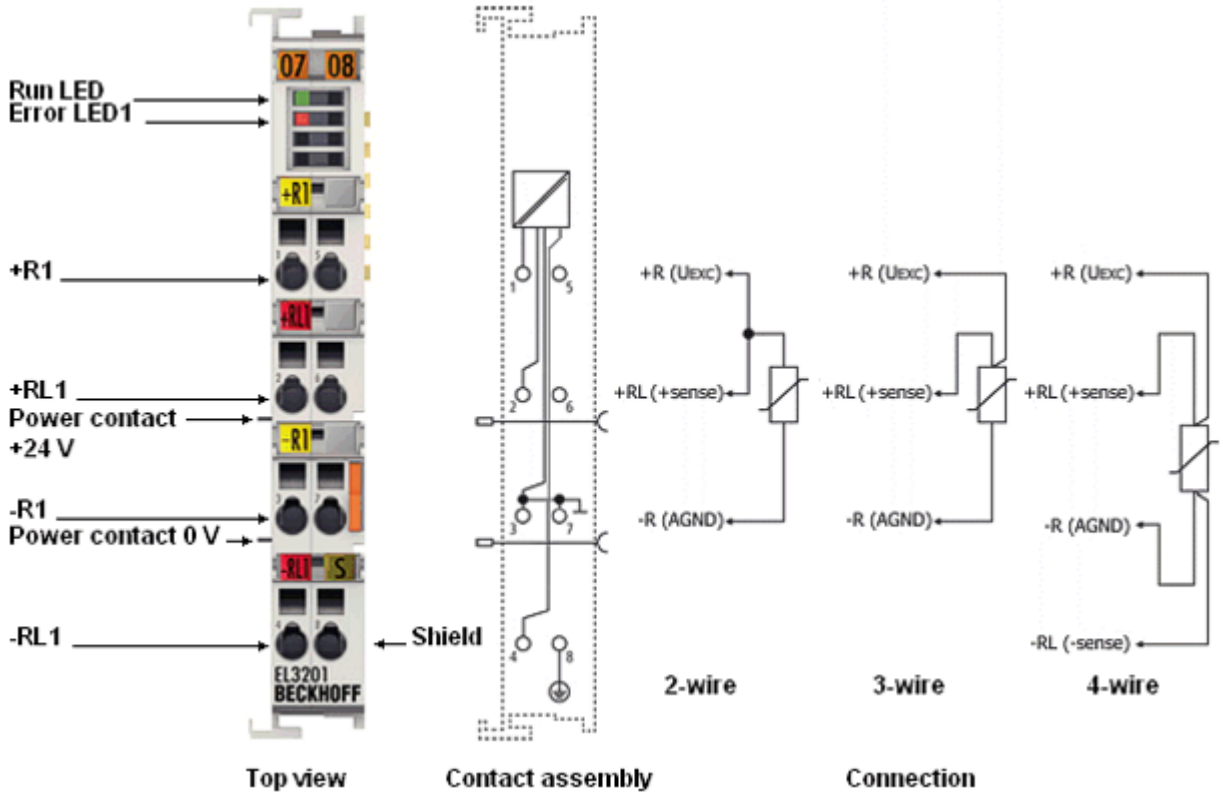


Fig. 5: EL3201 pin assignment

Two-wire connection EL3201

If the EL3201 is operated with a two-wire connection, the inputs +R and +RL must be bridged by the user.

EL3201 – pin assignment

Terminal point	No.	Comment
+R1	1	Input +R1, current-carrying
+RL1	2	Input +RL1, de-energized sense line
-R1	3	Input -R1, current-carrying
-RL1	4	Input -RL1, de-energized sense line
n. c.	5	not used
n. c.	6	not used
-R1	7	Input -R1, current-carrying
Shield	8	Shield

Connection of analog RTD signal lines

To ensure that the analog signals can be measured with as little interference as possible, also observe the notes in the chapter "Connection of analog RTD signal lines [▶ 64]".

EL3201 - LEDs

LED	Color	Meaning	
RUN	green	This LED indicates the terminal's operating state:	
		off	State of the EtherCAT state machine: **INIT** = initialization of the terminal or **BOOTSTRAP** = function for firmware updates of the terminal
		flashing	State of the EtherCAT state machine: **PREOP** = function for mailbox communication and different standard-settings set
		Single flash	State of the EtherCAT state machine: **SAFEOP** = verification of the sync manager channels and the distributed clocks. Outputs remain in safe state
		on	State of the EtherCAT state machine: **OP** = normal operating state; mailbox and process data communication is possible
ERROR1	red	Short circuit or wire breakage. The resistance is in the invalid range of the characteristic curve	

3.2 EL3201-0010, EL3201-0020, EL3201-0030

3.2.1 Introduction

1-channel analog input, temperature, RTD (Pt100), 16 bit, high-precision

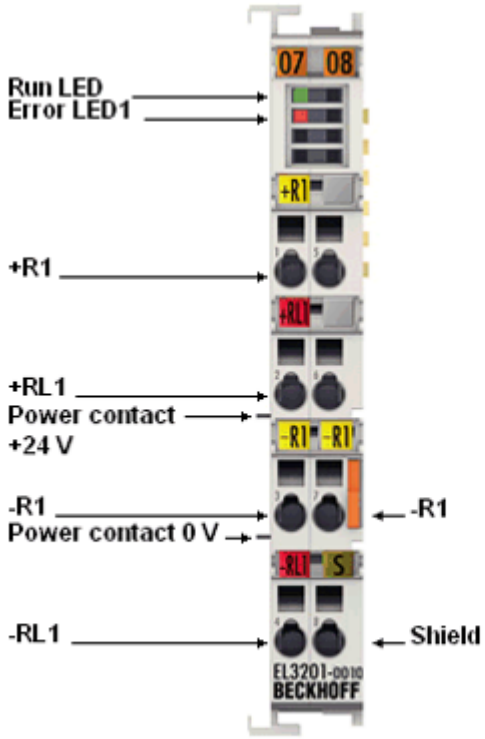


Fig. 6: EL3201-0010/0020/0030

The EL3201-0010 is the high precision version of the EL3201.

The analog input terminal EL3201-0010 allows the direct connection of a resistance sensor.

The measured resistance value can either be output directly in ohm or transformed into a temperature. If the temperature at the measuring point is of interest, the conversion from resistance to temperature can be done in the terminal according to different sensor characteristics (Pt100, Pt1000, Ni120, Ni1000, KTY types and others).

The EL3201-00x0 can currently operate sensors in 4-wire technology, external bridges must be set for 2- and 3-wire sensors. However, the intended operation for achieving the best accuracy is the 4-wire operation.

The EtherCAT Terminals indicate their measuring capability via LEDs and status bits in the EtherCAT process image.

The EL3201-0010 is also available as a calibrated version with a factory calibration certificate [▶ 67] (EL3201-0020) or optionally with a DAkkS or ISO 17025 certificate [▶ 67] (EL3201-0030) from an accredited service provider in cooperation with Beckhoff.

Also see about this

- Technical data [▶ 23]
- Pin assignment, display and diagnosis [▶ 24]
- Object description EL3201-0010, EL3201-0020, EL3201-0030 [▶ 226]

3.2.2 Technical data

Technical data	EL3201-0010	EL3201-0020/0030
Number of inputs	1	
Sensor types	Pt100, Pt200, Pt500, Pt1000, Ni100, Ni120, Ni1000 KT/KTY from firmware 06 [▶ 311] resistance measurement 10 Ω...1 kΩ or 10 Ω...4 kΩ (e. g. for potentiometer connection)	
Connection technology	4-wire	
Temperature range	Range-dependent: -200...+850°C (Pt sensors); -60...+250°C (Ni sensors) High-precision measurement only for Pt100 sensors, Measuring range -200...+320°C, see Note [▶ 201]!	
Resolution (default)	0.01°C per digit	
Sampling type	Simultaneous	
Ground reference	Single-ended	
Conversion time	Approx. 4.. 500 ms (configurable), depending on configuration and filter setting approx. 24 ms, preset	
ADC conversion method	ΔΣ (Delta-Sigma)	
Measuring current (depending on the sensor element and temperature)	typ. < 0.5 mA	
Sensor supply	Continuous current (not switched)	
Measuring error	for Pt100 sensors, 4-wire connection technology, measuring range -200 to 320°C, 50 Hz filter: < ±0.1°C at ambient temperature of 40°C < ±0.3°C in operating temperature range Note: other sensor cases according to CoE can be used with reduced accuracy (e.g. Pt1000, 3-wire connection etc.)	
Support NoCoEStorage [▶ 76]	Yes	
Width in the process image	Max. 4 bytes input	
Power supply for the electronics	via the E-bus	
Current consumption via E-bus	typ. 190 mA	
Electrical isolation	500 V (E-bus/field voltage)	
Configuration	via TwinCAT System Manager	
Weight	Approx. 60 g	
Permissible ambient temperature range during operation	-25°C... +60°C (extended temperature range)	0°C... +55°C
Permissible ambient temperature range during storage	-40°C... +85°C	-25°C... +85°C
Permissible relative air humidity	95%, no condensation	
Dimensions (W x H x D)	Approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)	
Assembly [▶ 93]	On 35 mm mounting rail in compliance with EN 60715	
Enhanced mechanical load capacity	Yes, see also Installation instructions for terminals with enhanced mechanical load capacity [▶ 96]	-
Vibration / shock resistance	In accordance with EN 60068-2-6 / EN 60068-2-27	
EMC immunity / emission	In accordance with EN 61000-6-2 / EN 61000-6-4	
Protection rating	IP20	
Installation position	Any	
Identification / approval*)	CE, EAC, UKCA ATEX [▶ 87], IECEx [▶ 88], cULus [▶ 92]	CE, EAC, UKCA ATEX [▶ 86], IECEx [▶ 88], cULus [▶ 92]

*) Real applicable approvals/markings see type plate on the side (product marking).

Ex markings

Standard	Marking
ATEX	II 3 G Ex nA IIC T4 Gc
IECEx	Ex nA IIC T4 Gc

3.2.3 Pin assignment, display and diagnosis

EL3201-00x0

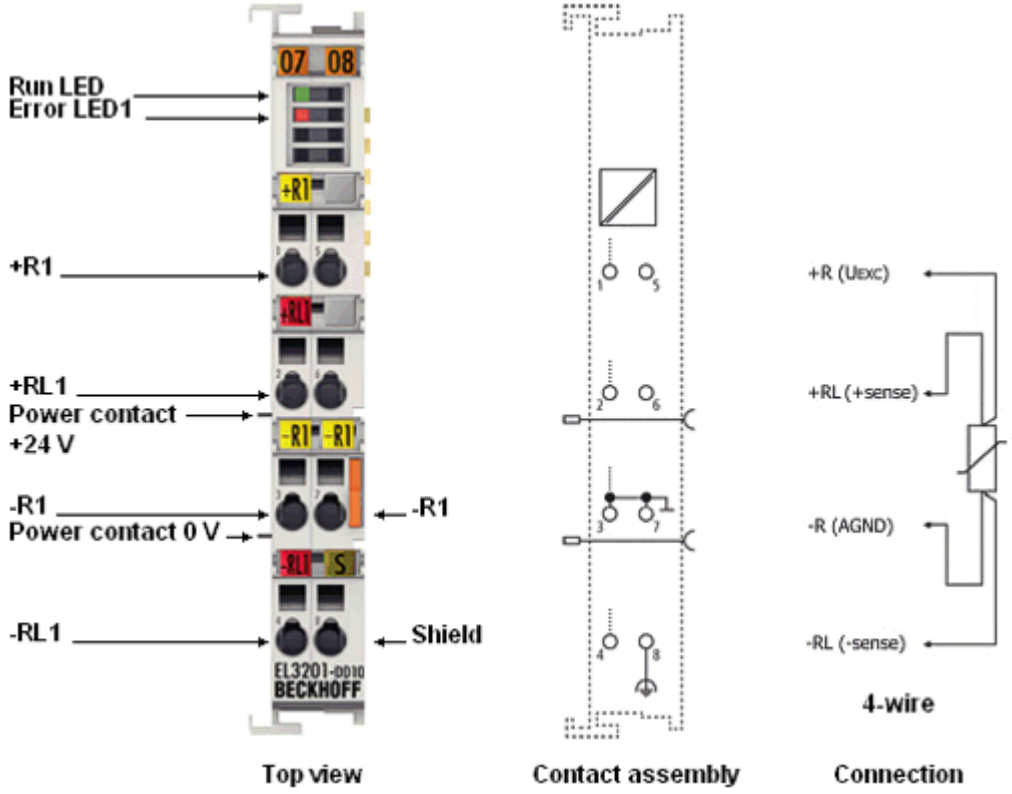


Fig. 7: EL3201-00x0 pin assignment

Four-wire connection

The EL3201-0010/0020/0030 high-precision terminals may be operated as intended only using the 4-wire connection technique!

EL3201-00x0 – pin assignment

Terminal point	No.	Comment
+R1	1	Input +R1, current-carrying
+RL1	2	Input +RL1, de-energized sense line
-R1	3	Input -R1, current-carrying
-RL1	4	Input -RL1, de-energized sense line
n. c.	5	not used
n. c.	6	not used
-R1	7	Input -R1, current-carrying
Shield	8	Shield

Connection of analog RTD signal lines

To ensure that the analog signals can be measured with as little interference as possible, also observe the notes in the chapter "Connection of analog RTD signal lines [▶ 64]".

EL3201-00x0 - LEDs

LED	Color	Meaning	
RUN	green	This LED indicates the terminal's operating state:	
		off	State of the EtherCAT state machine: **INIT** = initialization of the terminal or **BOOTSTRAP** = function for firmware updates of the terminal
		flashing	State of the EtherCAT state machine: **PREOP** = function for mailbox communication and different standard-settings set
		Single flash	State of the EtherCAT state machine: **SAFEOP** = verification of the sync manager channels and the distributed clocks. Outputs remain in safe state
		on	State of the EtherCAT state machine: **OP** = normal operating state; mailbox and process data communication is possible
ERROR1	red	Short circuit or wire breakage. The resistance is in the invalid range of the characteristic curve	

3.3 EL3202

3.3.1 Introduction

2-channel analog input, temperature, RTD (Pt100), 16 bit

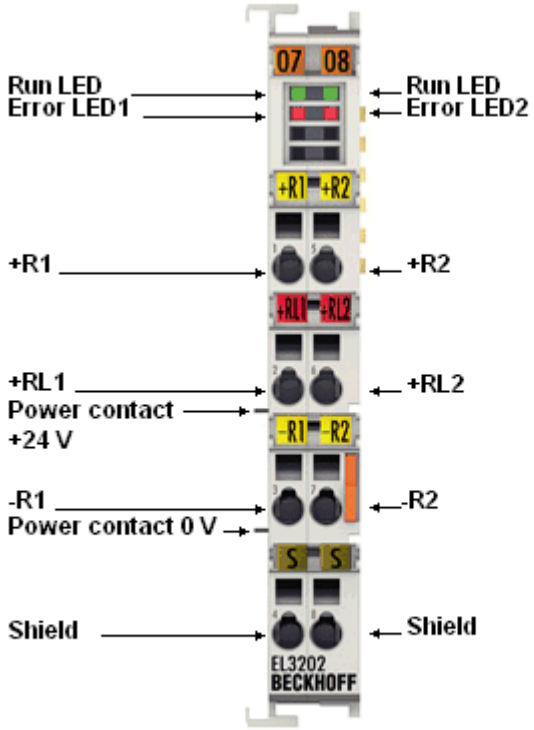


Fig. 8: EL3202

The EL3202 analog input terminal allows direct connection of two resistance sensors.

The measured resistance value can either be output directly in ohms or transformed into a temperature. If the temperature at the measuring point is of interest, the conversion from resistance to temperature can be done in the terminal according to different sensor characteristics (Pt100, Pt1000, Ni120, Ni1000, KTY types and others).

The EL3202 can operate sensors in 3-wire technology, for 2-wire connection an external bridge is necessary.

The EtherCAT Terminals indicate their measurement capability via LEDs and status bits in the EtherCAT process image.

Also see about this

- Technical data [▶ 27]
- Pin assignment, display and diagnosis [▶ 28]
- Object description EL3202 [▶ 234]

3.3.2 Technical data

Technical data	EL3202
Number of inputs	2
Sensor types	Pt100, Pt200, Pt500, Pt1000, Ni100, Ni120, Ni1000 KT/KTY from firmware 06 [▶ 311] resistance measurement 10 Ω...1 kΩ or 10 Ω...4 kΩ (e. g. for potentiometer connection)
Connection technology	2-, 3-wire
Temperature range	Range-dependent: -200…+850°C (Pt sensors); -60…+250°C (Ni sensors)
Resolution (default)	0.1°C per digit
Sampling type	Multiplex
Ground reference	Single-ended
Conversion time	Approx. 800 ms.. 2 ms (configurable), depending on configuration and filter setting approx. 85 ms, preset
ADC conversion method	ΔΣ (Delta-Sigma)
Measuring current (depending on the sensor element and temperature)	typ. < 0.5 mA
Sensor supply	Continuous current (not switched)
Measuring error	for Pt sensors: < ±0.5°C at ambient temperature 0°C... +55°C < ±1.5°C in extended temperature range
Support NoCoEStorage [▶ 76]	Yes
Width in the process image	Max. 8 bytes input
Power supply for the electronics	via the E-bus
Current consumption via E-bus	typ. 190 mA
Electrical isolation	500 V (E-bus/field voltage)
Configuration	via TwinCAT System Manager
Weight	Approx. 60 g
Permissible ambient temperature range during operation	-25°C... +60°C (extended temperature range)
Permissible ambient temperature range during storage	-40°C... +85°C
Permissible relative air humidity	95%, no condensation
Dimensions (W x H x D)	Approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)
Assembly [▶ 93]	On 35 mm mounting rail in compliance with EN 60715
Enhanced mechanical load capacity	Yes, see also Installation instructions for terminals with enhanced mechanical load capacity [▶ 96]
Vibration / shock resistance	In accordance with EN 60068-2-6 / EN 60068-2-27
EMC immunity / emission	In accordance with EN 61000-6-2 / EN 61000-6-4
Protection rating	IP20
Installation position	Any
Identification / approval*)	CE, EAC, UKCA ATEX [▶ 87], IECEx [▶ 88], cULus [▶ 92]

*) Real applicable approvals/markings see type plate on the side (product marking).

Ex markings

Standard	Marking
ATEX	II 3 G Ex nA IIC T4 Gc
IECEx	Ex nA IIC T4 Gc

3.3.3 Pin assignment, display and diagnosis

EL3202

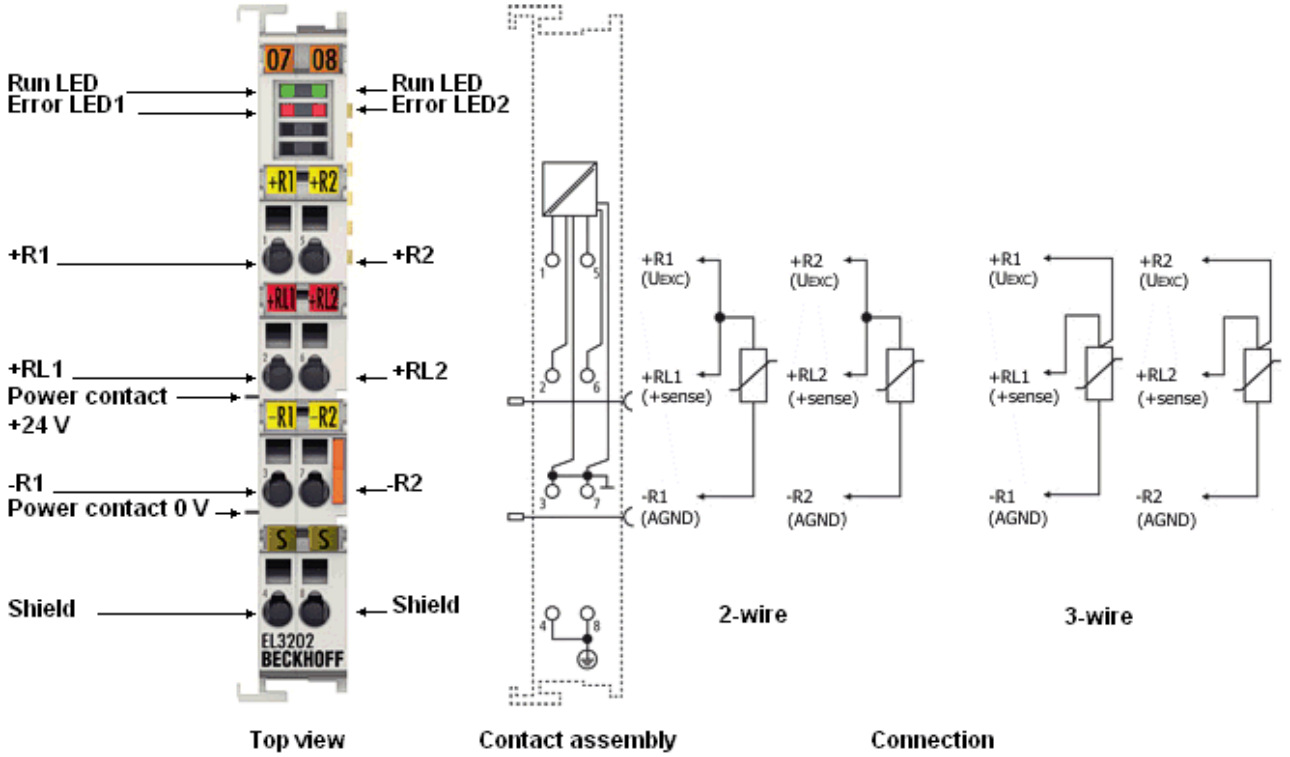


Fig. 9: EL3202 pin assignment

Two-wire connection EL3202

If the EJ3202 is operated in 2-wire connection, the +R and +RL inputs must be bridged by the user.

EL3202 – pin assignment

Terminal point	No.	Comment
+R1	1	Input +R1, current-carrying
+RL1	2	Input +RL1, de-energized sense line
-R1	3	Input -R1, current-carrying
Shield	4	Shield (internally connected to terminal point 8)
+R2	5	Input +R2, current-carrying
+RL2	6	Input +RL2, de-energized sense line
-R2	7	Input -R2, current-carrying
Shield	8	Shield (internally connected to terminal point 4)

NOTICE

Increased measurement uncertainty with signal bundling of the AGND line

In this terminal, the AGND contacts (signal return line -R) are connected in the terminal.
If the connection lines are to be reduced on the system side, one line instead of n lines can be used for all n RTD sensors at this terminal.
However, since each channel individually permanently drives its measuring current (some 100 µA, see explanations chapter "RTD measurement in EL32xx [▶ 62]"), all n RTD currents then flow via one line, there is an n-fold increase in voltage drop there, which is also recorded by the ratiometric voltage measurement in the terminal.
The result is the same as for long lines. If RTD sensors are to be connected in this way, a system-side check and, if necessary, compensation using WireCalibration CoE 0x80n0:1B (convert voltage drop to apparent line resistance for this purpose) or UserScale 0x80n0:11/12 is recommended.
Since the line resistances are temperature-dependent and the measuring current depends on the RTD resistance, however, such a static "compensation" cannot achieve the measurement uncertainty as in operation with two lines connected short.

Connection of analog RTD signal lines

To ensure that the analog signals can be measured with as little interference as possible, also observe the notes in the chapter "Connection of analog RTD signal lines [▶ 64]".

EL3202 – LEDs

LED	Color	Meaning	
RUN	green	This LED indicates the terminal's operating state:	
		off	State of the EtherCAT State Machine: **INIT** = initialization of the terminal or **BOOTSTRAP** = function for terminal firmware updates
		flashing	State of the EtherCAT State Machine: **PREOP** = function for mailbox communication and different default settings set
		single flash	State of the EtherCAT State Machine: **SAFEOP** = verification of the Sync Manager channels and the distributed clocks. Outputs remain in safe state
		on	State of the EtherCAT State Machine: **OP** = normal operating state; mailbox and process data communication is possible
ERROR1, ERROR2	red	Short circuit or wire break. The resistance value is in the invalid range of the characteristic curve	

3.4 EL3202-0010, EL3202-0020, EL3202-0030

3.4.1 Introduction

2-channel analog input, temperature, RTD (Pt100), 16 bit, high-precision

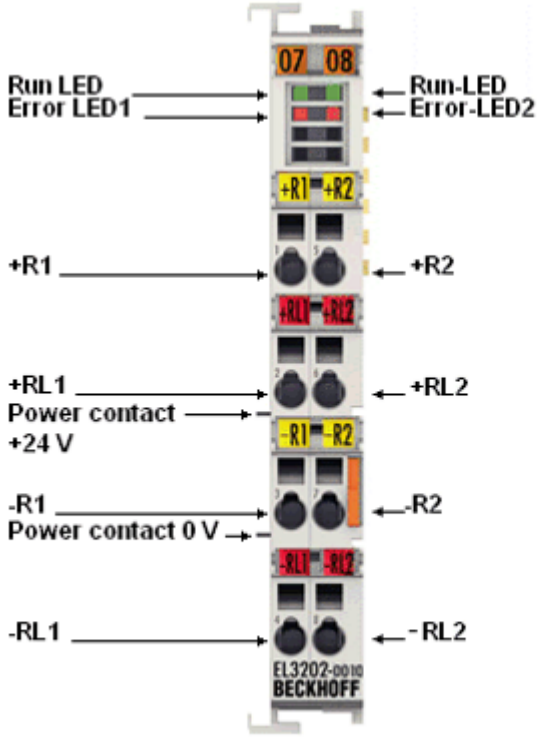


Fig. 10: EL3202-0010/0020/0030

The EL3202-0010 is the high-precision version of the EL3202.

The analog input terminal EL3202-0010 allows the direct connection of two resistance sensors.

The measured resistance value can either be output directly in ohms or transformed into a temperature. If the temperature at the measuring point is of interest, the conversion from resistance to temperature can be performed in the terminal according to various sensor characteristics (Pt100, Pt1000, Ni120, Ni1000, KTY types, etc.).

The EL3202-00x0 can currently operate sensors in 4-wire technology, external bridges must be set for 2- and 3-wire sensors. However, 4-wire operation is the intended mode for achieving the best accuracy.

The EtherCAT Terminals indicate their measuring capability via LEDs and status bits in the EtherCAT process image.

The EL3202-0010 is also available as a calibrated variant with a factory calibration certificate [▶ 67] (EL3202-0020) or optionally with a DAkkS or ISO 17025 certificate [▶ 67] (EL3202-0030) from an accredited service provider in cooperation with Beckhoff.

Also see about this

- Technical data [▶ 23]
- Pin assignment, display and diagnosis [▶ 24]
- Object description EL3202-0010, EL3202-0020, EL3202-0030 [▶ 242]

3.4.2 Technical data

Technical data	EL3202-0010	EL3202-0020/0030
Number of inputs	2	
Sensor types	Pt100, Pt200, Pt500, Pt1000, Ni100, Ni120, Ni1000 KT/KTY from firmware 06 [▶ 311] resistance measurement 10 Ω...1 kΩ or 10 Ω...4 kΩ (e.g. for potentiometer connection)	
Connection technology	4-wire	
Temperature range	Range-dependent: -200...+850°C (Pt sensors) -60...+250°C (Ni sensors) High-precision measurement only for Pt100 sensors, Measuring range -200...+320°C, see Note [▶ 201]!	
Resolution (default)	0.01°C per digit	
Sampling type	Multiplex	
Ground reference	Single-ended	
Conversion time	Approx. 800 ms.. 2 ms (configurable), depending on configuration and filter setting approx. 85 ms, preset	
ADC conversion method	ΔΣ (Delta-Sigma)	
Measuring current (depending on the sensor element and temperature)	typ. < 0.5 mA	
Sensor supply	Continuous current (not switched)	
Measuring error	for Pt100 sensors, 4-wire connection technology, measuring range -200 to 320°C, 50 Hz filter: < ±0.1°C at ambient temperature of 40°C < ±0.3°C in operating temperature range Note: other sensor cases according to CoE can be used with reduced accuracy (e.g. Pt1000, 3-wire connection etc.)	
Support NoCoEStorage [▶ 76]	Yes	
Width in the process image	Max. 8 bytes input	
Power supply for the electronics	via the E-bus	
Current consumption via E-bus	typ. 190 mA	
Electrical isolation	500 V (E-bus/field voltage)	
Configuration	via TwinCAT System Manager	
Weight	Approx. 60 g	
Permissible ambient temperature range during operation	-25°C... +60°C (extended temperature range)	0°C... +55°C
Permissible ambient temperature range during storage	-40°C... +85°C	-25°C... +85°C
Permissible relative air humidity	95%, no condensation	
Dimensions (W x H x D)	Approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)	
Assembly [▶ 93]	On 35 mm mounting rail in compliance with EN 60715	
Vibration / shock resistance	In accordance with EN 60068-2-6 / EN 60068-2-27	
EMC immunity / emission	In accordance with EN 61000-6-2 / EN 61000-6-4	
Protection rating	IP20	
Installation position	Any	
Identification / approval*)	CE, EAC, UKCA ATEX [▶ 87], IECEx [▶ 88], cULus [▶ 92]	CE, EAC, UKCA ATEX [▶ 86], IECEx [▶ 88], cULus [▶ 92]

*) Real applicable approvals/markings see type plate on the side (product marking).

Ex markings

Standard	Marking
ATEX	II 3 G Ex nA IIC T4 Gc
IECEx	Ex nA IIC T4 Gc

3.4.3 Pin assignment, display and diagnosis

EL3202-00x0

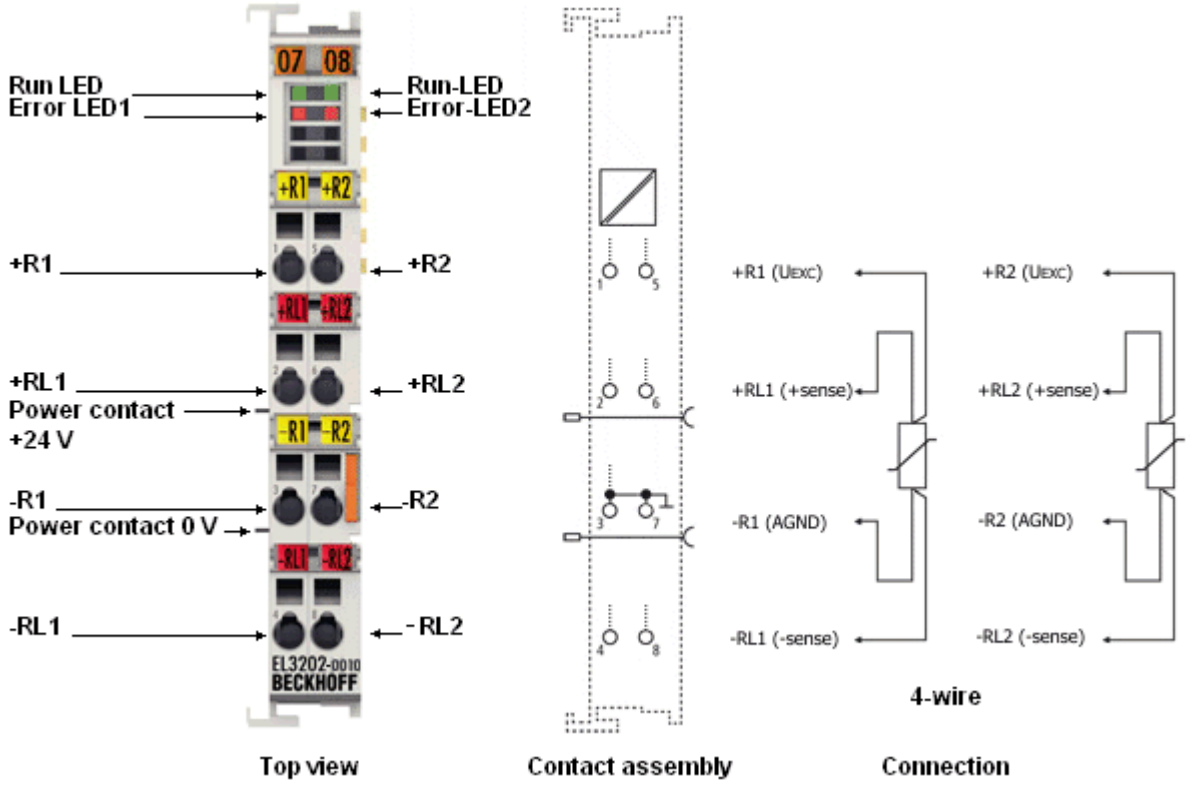


Fig. 11: EL3202-0010/0020/0030 pin assignment

Four-wire connection

The EL3202-0010/0020/0030 high-precision terminals may be operated as intended only using the 4-wire connection technique!

EL3202-00x0 – pin assignment

Terminal point	No.	Comment
+R1	1	Input +R1, current-carrying
+RL1	2	Input +RL1, de-energized sense line
-R1	3	Input -R1, current-carrying
-RL1	4	Input -RL1, de-energized sense line
+R2	5	Input +R2, current-carrying
+RL2	6	Input +RL2, de-energized sense line
-R2	7	Input -R2, current-carrying
-RL2	8	Input -RL2, de-energized sense line

NOTICE

Increased measurement uncertainty with signal bundling of the AGND line

In this terminal, the AGND contacts (signal return line -R) are connected in the terminal.
If the connection lines are to be reduced on the system side, one line instead of n lines can be used for all n RTD sensors at this terminal.
However, since each channel individually permanently drives its measuring current (some 100 µA, see explanations chapter "RTD measurement in EL32xx [▶ 62]"), all n RTD currents then flow via one line, there is an n-fold increase in voltage drop there, which is also recorded by the ratiometric voltage measurement in the terminal.
The result is the same as for long lines. If RTD sensors are to be connected in this way, a system-side check and, if necessary, compensation using WireCalibration CoE 0x80n0:1B (convert voltage drop to apparent line resistance for this purpose) or UserScale 0x80n0:11/12 is recommended.
Since the line resistances are temperature-dependent and the measuring current depends on the RTD resistance, however, such a static "compensation" cannot achieve the measurement uncertainty as in operation with two lines connected short.

Connection of analog RTD signal lines

To ensure that the analog signals can be measured with as little interference as possible, also observe the notes in the chapter "Connection of analog RTD signal lines [▶ 64]".

EL3202-00x0 - LEDs

LED	Color	Meaning	
RUN	green	This LED indicates the terminal's operating state:	
		off	State of the EtherCAT state machine: **INIT** = initialization of the terminal or **BOOTSTRAP** = function for firmware updates of the terminal
		flashing	State of the EtherCAT state machine: **PREOP** = function for mailbox communication and different standard-settings set
		Single flash	State of the EtherCAT state machine: **SAFEOP** = verification of the sync manager channels and the distributed clocks. Outputs remain in safe state
		on	State of the EtherCAT state machine: **OP** = normal operating state; mailbox and process data communication is possible
ERROR1, ERROR2	red	Short circuit or wire breakage. The resistance is in the invalid range of the characteristic curve	

3.5 EL3204

3.5.1 Introduction

4-channel analog input, temperature, RTD (Pt100), 16 bit

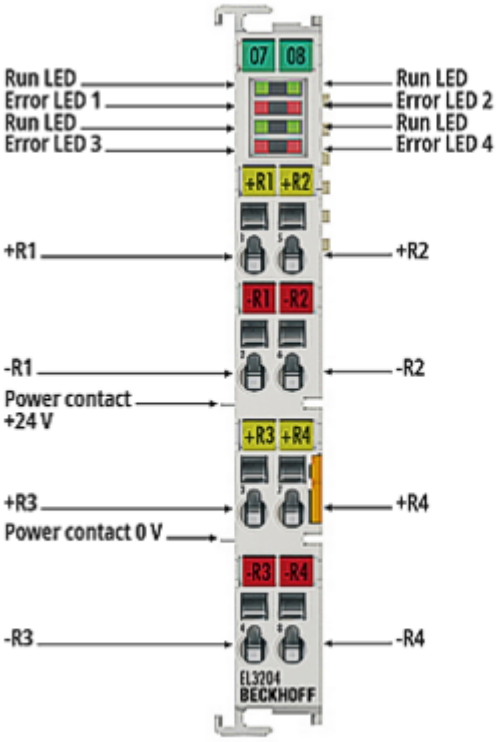


Fig. 12: EL3204

The EL3204 analog input terminal allows direct connection of four resistance sensors.

The measured resistance value can either be output directly in ohms or transformed into a temperature. If the temperature at the measuring point is of interest, the conversion from resistance to temperature can be performed in the terminal according to various sensor characteristics (Pt100, Pt1000, Ni120, Ni1000, KTY types, etc.).

The EL3204 can operate sensors in 2-wire technology.

The EtherCAT Terminals indicate their measurement capability via LEDs and status bits in the EtherCAT process image.

Also see about this

- Technical data [▶ 35]
- Pin assignment, display and diagnosis [▶ 36]
- Object description EL3204 [▶ 250]

3.5.2 Technical data

Technical data	EL3204
Number of inputs	4
Sensor types	Pt100, Pt200, Pt500, Pt1000, Ni100, Ni120, Ni1000 KT/KTY from firmware 06 [▶ 311] resistance measurement 10 Ω...1 kΩ or 10 Ω...4 kΩ (e.g. for potentiometer connection)
Connection technology	2-wire
Temperature range	Range-dependent: -200...+850°C (Pt sensors); -60...+250°C (Ni sensors)
Resolution (default)	0.1°C per digit
Sampling type	Multiplex
Ground reference	Single-ended
Conversion time	Approx. 800 ms.. 2 ms (configurable), depending on configuration and filter setting approx. 85 ms, preset
ADC conversion method	ΔΣ (Delta-Sigma)
Measuring current (depending on the sensor element and temperature)	typ. < 0.5 mA
Sensor supply	Continuous current (not switched)
Measuring error	< ±0.5°C for Pt sensors < ±1.5°C (extended temperature range)
Support NoCoEStorage [▶ 76]	Yes
Width in the process image	Max. 16 bytes input
Power supply for the electronics	via the E-bus
Current consumption via E-bus	typ. 190 mA
Electrical isolation	500 V (E-bus/field voltage)
Configuration	via TwinCAT System Manager
Weight	Approx. 60 g
Permissible ambient temperature range during operation	-25°C... +60°C (extended temperature range)
Permissible ambient temperature range during storage	-40°C... +85°C
Permissible relative air humidity	95%, no condensation
Dimensions (W x H x D)	Approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)
Assembly [▶ 93]	On 35 mm mounting rail in compliance with EN 60715
Enhanced mechanical load capacity	Yes, see also Installation instructions for terminals with enhanced mechanical load capacity [▶ 96]
Vibration / shock resistance	In accordance with EN 60068-2-6 / EN 60068-2-27
EMC immunity / emission	In accordance with EN 61000-6-2 / EN 61000-6-4
Protection rating	IP20
Installation position	Any
Identification / approval*)	CE, EAC, UKCA ATEX [▶ 87], IECEx [▶ 88], cFMus [▶ 90], cULus [▶ 92]

*) Real applicable approvals/markings see type plate on the side (product marking).

Ex markings

Standard	Marking
ATEX	II 3 G Ex nA IIC T4 Gc
IECEx	Ex nA IIC T4 Gc
cFMus	Class I, Division 2, Groups A, B, C, D Class I, Zone 2, AEx/Ex ec IIC T4 Gc