



Operating instructions for

# AX5801

TwinSAFE drive option card for the AX5000 servo drive

Version: 1.2.1  
Date: 2020-07-20

**BECKHOFF**



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# 1 Foreword

## 1.1 Notes on the manual

### 1.1.1 Intendent audience

It is essential that the following notes and explanations are followed when installing and commissioning these components.

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

### 1.1.2 Origin of the document

These operating instructions were originally written in German. All other languages are derived from the German original.

### 1.1.3 Actuality

Please check whether you have the latest and valid version of this document. On the Beckhoff homepage under the link <http://www.beckhoff.de/english/download/twinsafe.htm> you may find the latest version for download. If in doubt, please contact the technical support (see chapter 4.1 Beckhoff Support and Service).

### 1.1.4 Product properties

Valid are only the product properties that are specified in the respectively current user documentation. Other information, which is given on the product pages of the Beckhoff homepage, in emails or other publications is not relevant.

### 1.1.5 Disclaimer

The documentation has been prepared with care. The products described are, however, constantly under development. For that reason the documentation is not in every case checked for consistency with performance data, standards or other characteristics.

If it should contain technical or editorial errors, we reserve the right to make changes at any time and without notice.

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.

### 1.1.6 Trademarks

Beckhoff®, TwinCAT®, EtherCAT®, Safety over EtherCAT®, TwinSAFE® and XFC® 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.

### 1.1.7 Patent Pending

The EtherCAT technology is patent protected, in particular by the following applications and patents: EP1590927, EP1789857, DE102004044764, DE102007017835 with the corresponding applications and registrations in various other countries.

The TwinCAT technology is patent protected, in particular by the following applications and patents: EP0851348, US6167425 with corresponding applications or registrations in various other countries.

### 1.1.8 Copyright

© Beckhoff Automation GmbH & Co. KG.

The reproduction, distribution and utilization of this document as well as the communication of its contents to others without express authorization are prohibited. Offenders will be held liable for the payment of damages. All rights reserved in the event of the grant of a patent, utility model or design.

### 1.1.9 Delivery conditions

In addition, the general delivery conditions of the company Beckhoff Automation GmbH & Co. KG apply.

## 1.2 Safety instructions

### 1.2.1 Delivery state

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.

### 1.2.2 Operator's obligation to exercise diligence

The operator must ensure that

- the TwinSAFE products are only used as intended (see chapter Product description);
- the TwinSAFE products are only operated in sound condition and in working order (see chapter *Cleaning*).
- the TwinSAFE products are operated only by suitably qualified and authorized personnel.
- the personnel is instructed regularly about relevant occupational safety and environmental protection aspects, and is familiar with the operating instructions and in particular the safety instructions contained herein.
- the operating instructions are in good condition and complete, and always available for reference at the location where the TwinSAFE products are used.
- none of the safety and warning notes attached to the TwinSAFE products are removed, and all notes remain legible.

### 1.2.3 Description of safety symbols

The following safety symbols are used in these operating instructions. They are intended to alert the reader to the associated safety instructions.

 <b>DANGER</b>	<p><b>Serious risk of injury!</b></p> <p><b>Failure</b> to follow the safety instructions associated with this symbol directly endangers the life and health of persons.</p>
 <b>WARNING</b>	<p><b>Caution - Risk of injury!</b></p> <p><b>Failure</b> to follow the safety instructions associated with this symbol endangers the life and health of persons.</p>
 <b>CAUTION</b>	<p><b>Personal injuries!</b></p> <p><b>Failure</b> to follow the safety instructions associated with this symbol can lead to injuries to persons.</p>
 <b>Attention</b>	<p><b>Damage to the environment or devices</b></p> <p><b>Failure</b> to follow the instructions associated with this symbol can lead to damage to the environment or equipment.</p>
 <b>Note</b>	<p><b>Tip or pointer</b></p> <p>This symbol indicates information that contributes to better understanding.</p>

### 1.2.4 Documentation issue status

Version	Comment
1.2.1	<ul style="list-style-type: none"> <li>• Certificate updated</li> </ul>
1.2.0	<ul style="list-style-type: none"> <li>• Reliability document updated</li> <li>• Safety parameters updated</li> <li>• Foreword overworked</li> </ul>
1.1.2	<ul style="list-style-type: none"> <li>• Reliability document updated</li> </ul>
1.1.1	<ul style="list-style-type: none"> <li>• Certificate updated</li> </ul>
1.1.0	<ul style="list-style-type: none"> <li>• Company address amended</li> <li>• Documentation versions added</li> <li>• Safety parameters extended</li> </ul>
1.0.0	<ul style="list-style-type: none"> <li>• First released version</li> </ul>

## 2 Product description

### 2.1 General description

#### AX5801 – TwinSAFE drive option card for the AX5000 servo drive series

The AX5801 TwinSAFE drive option card is an optional extension of the Beckhoff AX5000 servo drive series. The following safety functions can be implemented by the installation of the AX5801 in the AX5000:

- Stop functions (STO, SS1)

The time delay for the SS1 function must take place in the higher-level safety controller.

The AX5801 drive option card has two relays (Rel1 and Rel2). The relays are equipped with positively driven contacts including feedback contacts (K1 and K2). These feedback contacts are connected in series and also have a potential-free connection to pins (5) and (6) of the six-pin plug. The NO contacts of the two relays are connected in series and switch the AX5000 on two-channels according to STO.

The two coils (S1 and S2) must be supplied with 24 V DC via pins 1 and 2 or 3 and 4 of the six-pin or four-pin plug. Terminals 1-1, 2-2, 3-3 and 4-4 of the two connectors are bridged internally.

If a relay releases, the de-energizing circuit of the AX5000 servo drive range ensures that the connected motors (both channels) are switched torque-free.

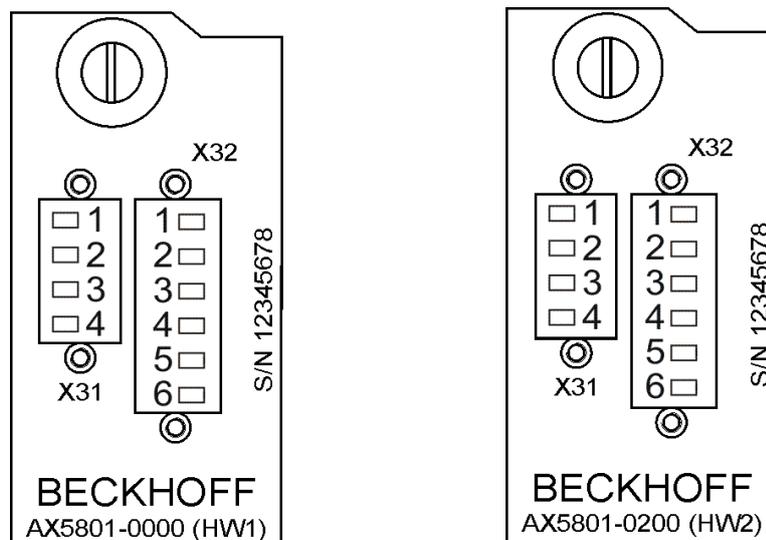


Fig. 2-1: AX5801-0000 and AX5801-0200 TwinSAFE drive option card

## 2.2 Intended use

 <b>WARNING</b>	<p><b>Caution - Risk of injury!</b></p> <p>Use of the TwinSAFE drive option card other than for the intended purpose as described below is not permitted!</p>
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The AX5801 TwinSAFE drive option card is intended exclusively for use in the safety option card slot of a servo drive from the AX5000 series. The cards are installed together with the servo drive as components in electrical systems and machinery and may only be used in this way.

 <b>Attention</b>	<p><b>Compatibility of AX5000 and AX5801</b></p> <p>The AX5801-0000 TwinSAFE drive option card must be used for the AX5xxx-xxxx-0000 servo drive.          The AX5801-0200 TwinSAFE drive option card must be used for the AX5xxx-xxxx-x2xx servo drive.</p> <p>An attempt to install the AX5801-0200 into AX5000 servo drives of an older generation can lead to irreparable damage to the AX5000.</p>
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 <b>DANGER</b>	<p><b>Caution - Danger of death!</b></p> <p>Due to the DC link capacitors, there may still be a potentially lethal voltage on the DC link contacts X02 even after disconnecting the servo drive from the mains supply. Wait 5 minutes after disconnection and measure the voltage on the DC link contacts DC+ and DC-. The device is safe once the voltage has fallen below 50 V.</p>
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 <b>WARNING</b>	<p><b>Caution - Risk of injury!</b></p> <p>Electronic equipment is not fail-safe. The machine manufacturer is responsible for ensuring that the connected motors and the machine are brought into a safe state in the event of a fault in the drive system.</p>
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 <b>Attention</b>	<p><b>Caution - Destruction of the option card by electrostatic charges!</b></p> <p>The AX5801 option card is an ESD-sensitive component. Follow the usual ESD safety procedures when handling the card (anti-static wrist straps, earthing of the relevant components etc.).</p>
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 <b>CAUTION</b>	<p><b>Follow the machinery directive</b></p> <p>The TwinSAFE Drive option cards may be used in machines only as defined in the machine directive.</p>
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 <b>CAUTION</b>	<p><b>Ensure traceability</b></p> <p>The buyer has to ensure the traceability of the device via the serial number.</p>
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## 2.3 Technical data

Product designation	AX5801-0000	AX5801-0200
Operating voltage of the relay (connections 1 to 4)	24 V <sub>DC</sub> (-15% +20%)	
Operating voltage of the feedback contacts (5 and 6)	24 V <sub>DC</sub> (-15% +20%)	
For the AX5000 servo drive	AX5000-xxxx-x0xx	AX5000-xxxx-x2xx
Max. switching current of the feedback contacts (5 and 6)	0.35 A	
Conductor cross-section, connections 1 to 6	0.2 -1.5 mm <sup>2</sup> (the use of wire end sleeves is recommended)	
Strip length of the wires, connections 1 to 6	10 mm	
Current consumption (total for both relays)	50 mA (typical)	
Dimensions (W x H x D)	105 mm x 53 mm x 23 mm	
Weight	approx. 85 g	
Permissible ambient temperature (operation)	0°C to +55°C	
Permissible ambient temperature (transport/storage)	-25 C to +70 C	
Permissible air humidity	5% to 95%, non-condensing	
Permissible air pressure (operation/storage/transport)	750 hPa to 1100 hPa	
Permissible level of contamination	Contamination level 2 according to EN 60204 / EN 50178	
Impermissible operating conditions	TwinSAFE components must not be used under the following operating conditions: <ul style="list-style-type: none"> <li>• under the influence of ionizing radiation</li> <li>• in corrosive environments</li> <li>• in an environment that leads to unacceptable soiling</li> </ul>	
EMC immunity/emission	conforms to EN 61000-6-2 / EN 61000-6-4	
Protection class	IP20	
Approvals	CE, TÜV SÜD	

## 2.4 Safety parameters

Key figures	AX5801
PFH <sub>D</sub>	2.47E-08
%SIL3	24.70%
MTTF <sub>d</sub>	High
B10 <sub>d</sub> (cycles)	780 000
DC	High
Performance level	PL e
Category	4
HFT	1
Element classification*	Type B

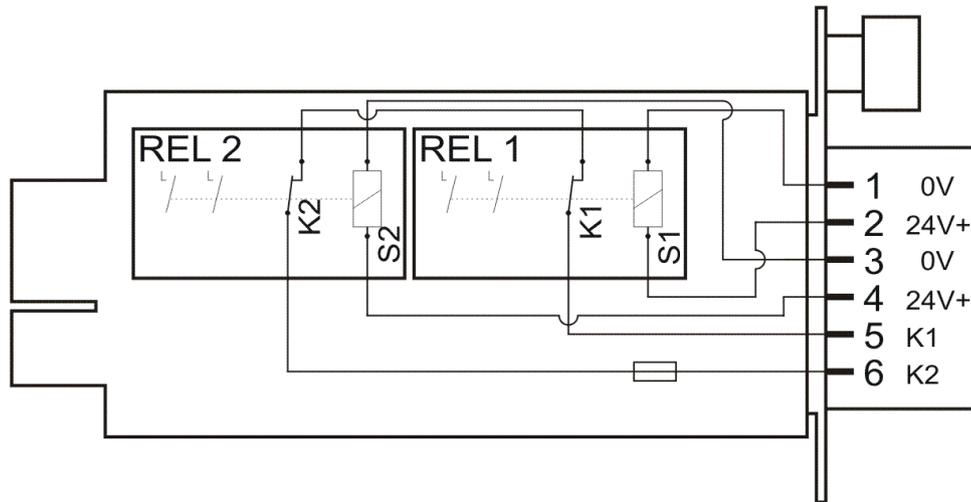
\* ) Classification according to IEC 61508-2:2010 (see chapter 7.4.4.1.2 and 7.4.4.1.3)

To calculate the MTTF<sub>d</sub> value, a value of 8760 (1 operation per hour) was assumed for n<sub>op</sub>.

To calculate the  $MTTF_d$  value out of the  $B10_d$  value please refer to the Application Guide TwinSAFE.

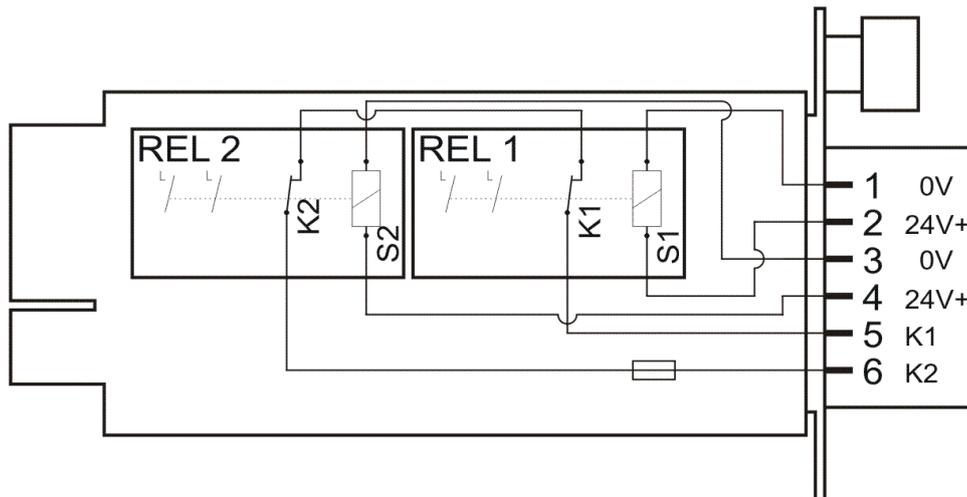
The TwinSAFE drive option card AX5801 can be used for safety-related applications within the meaning of IEC 61508:2010 up to SIL3 and EN ISO 13849-1 up to PL e (Cat4).

## 2.5 Dimensions



Width: 105 mm  
 Height: 53 mm  
 Depth 23 mm

Fig. 2-2: Dimensions of the AX5801-0000



Width: 105 mm  
 Height: 53 mm  
 Depth 23 mm

Fig. 2-3: Dimensions of the AX5801-0200

## 3 Operation

Please ensure that the TwinSAFE option cards are only transported, stored and operated under the specified conditions (see technical data)!

 <b>WARNING</b>	<p><b>Caution - Risk of injury!</b></p> <p>The TwinSAFE drive option cards may not be used under the following operating conditions:</p> <ul style="list-style-type: none"><li>• under the influence of ionizing radiation</li><li>• in corrosive environments</li><li>• in an environment that leads to unacceptable soiling of the Bus Terminal</li></ul>
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### 3.1 Installation

#### 3.1.1 Safety instructions

Before installing and commissioning the TwinSAFE drive option cards, please also read the safety instructions in the foreword of this documentation.

#### 3.1.2 Transport / storage

For storage and transport of the digital TwinSAFE drive option cards, use the original packaging in which the terminals were delivered.

 <b>CAUTION</b>	<p><b>Observe the specified environmental conditions!</b></p> <p>Please ensure that the digital TwinSAFE option cards are only transported and stored under the specified environmental conditions (see technical data).</p>
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### 3.1.3 Mechanical installation

 <b>DANGER</b>	<p><b>Caution - Risk of injury through electric shock!</b></p> <p>Disconnect the servo drive from the mains and system voltage before installing the TwinSAFE drive option card!</p> <p>Due to the DC link capacitors, there may still be a potentially lethal voltage on the DC link contacts X02 even after disconnecting the servo drive from the mains supply. Wait 5 minutes after disconnection and measure the voltage on the DC link contacts DC+ and DC-. The device is safe once the voltage has fallen below 50 V.</p>
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#### Attaching the two plugs to the AX5801 TwinSAFE drive option card

- Insert the enclosed 4-pin connector (1) into the socket.
- Tighten the two screws (2).
- Insert the 6-pin connector (3) into the socket (4).
- Tighten the two screws (5).

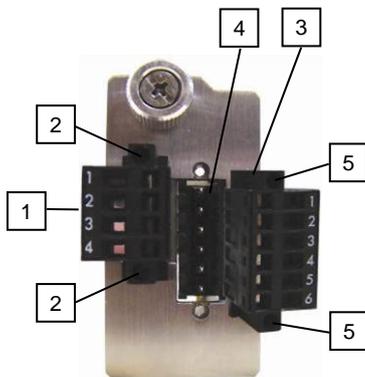


Fig. 3-1: Assembling the plug

#### AX5801 - TwinSAFE Drive Option card

- Fully release the screw (6).
- Remove the insert (7) in the direction of the arrow (8).
- Insert the TwinSAFE drive option card (9) carefully into the opening in the direction of the arrow (10). The slot has guides for the card on the short sides. Ensure that the card is inserted into these guides.

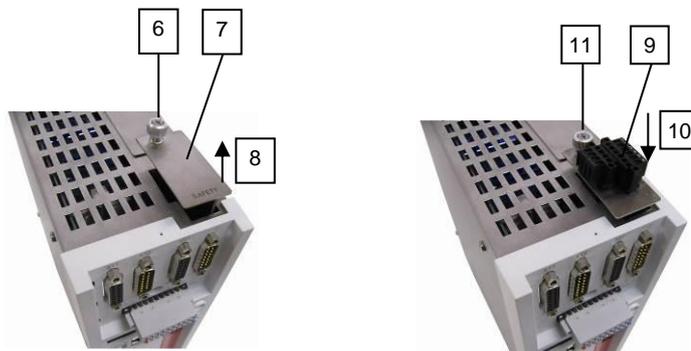


Fig. 3-2: AX5801 - TwinSAFE Drive Option card

### 3.1.4 Connections

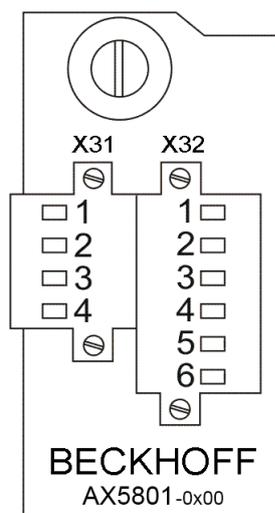


Fig. 3-3: Connection configuration X31 and X32

Connection	Signal
X31 - 1	Relay 1 (coil S1) - 0V (internally bridged with X32 - 1)
X31 - 2	Relay 1 (coil S1) - 24V (internally bridged with X32 - 2)
X31 - 3	Relay 2 (coil S2) - 0 V (internally bridged with X32 - 3)
X31 - 4	Relay 2 (coil S2) - 24 V (internally bridged with X32 - 4)
X32 - 1	Relay 1 (coil S1) - 0V (internally bridged with X31 - 1)
X32 - 2	Relay 1 (coil S1) - 24V (internally bridged with X31 - 2)
X32 - 3	Relay 2 (coil S2) - 0 V (internally bridged with X31 - 3)
X32 - 4	Relay 2 (coil S2) - 24 V (internally bridged with X31 - 4)
X32 - 5	Feedback contacts in series via relays 1 + 2 (potential-free)
X32 - 6	Feedback contacts in series via relays 1 + 2 (potential-free)

### 3.1.5 Electrical installation

 <b>DANGER</b>	<p><b>Caution - Risk of injury through electric shock!</b></p> <p>Disconnect the servo drive from the mains and system voltage before installing the TwinSAFE drive option card!</p> <p>Due to the DC link capacitors, there may still be a potentially lethal voltage on the DC link contacts X02 even after disconnecting the servo drive from the mains supply. Wait 5 minutes after disconnection and measure the voltage on the DC link contacts DC+ and DC-. The device is safe once the voltage has fallen below 50 V.</p>
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Configure the safety operation of the servo drive via the drive parameter IDN P-0-2000. The next time the system is started, the servo drive automatically recognizes whether a TwinSAFE drive option card has been inserted and whether the parameterization of the IDN P-0-2000 is correct. Error message 0xFDD4 indicates incorrect configuration.

The two relay coils (S1 and S2) must be supplied with 24 V<sub>DC</sub> via pins 1 and 2 or 3 and 4 of the six-pin or four-pin plug. Terminals 1-1, 2-2, 3-3 and 4-4 of the two connectors are bridged internally.

If the servo drive with the TwinSAFE drive option card does not attain the safe status, the error message 0xFDD5 appears on the display of the servo drive and you must consult Beckhoff without fail.

 <b>CAUTION</b>	<p><b>Danger for persons or equipment!</b></p> <p>If an error message appears on the display of the AX5000 the servo drive must not be put into service if the servo drive in the system or machine represents a safety-relevant part of the control system.</p>
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### 3.1.6 Application example

Application examples can be found in the TwinSAFE Application Guide. The document can be downloaded from the Beckhoff homepage.

## 3.2 Maintenance

The TwinSAFE drive option cards are maintenance-free.

 <b>WARNING</b>	<p><b>Observe the specified environmental conditions!</b></p> <p>Please ensure that the TwinSAFE option cards are only stored and operated under the specified conditions (see technical data).</p>
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### 3.2.1 Cleaning

Protect the TwinSAFE Drive option cards against unacceptable soiling during operation and storage!

The TwinSAFE Drive option card may not be used any further if it has been exposed to impermissible contamination!

 <b>WARNING</b>	<p><b>Have soiled components checked!</b></p> <p>Cleaning of the TwinSAFE Drive option card by the user is not permitted! Please send soiled terminals to the manufacturer for inspection and cleaning!</p>
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## 3.3 Decommissioning

 <b>DANGER</b>	<p><b>Serious risk of injury!</b></p> <p>Disconnect the servo drive from the mains and system voltage before removing the TwinSAFE drive option card! Due to the DC link capacitors, there may still be a potentially lethal voltage on the DC link contacts X02 even after disconnecting the servo drive from the mains supply. Wait 5 minutes after disconnection and measure the voltage on the DC link contacts DC+ and DC-. The device is safe once the voltage has fallen below 50 V.</p>
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### 3.3.1 Disposal

In order to dispose of the device, it must be removed and fully dismantled.

- Metal parts can be sent for metal recycling.
- Electronic parts such as disk drives and circuit boards must be disposed of in accordance with national electronics scrap regulations.

## 4 Appendix

### 4.1 Beckhoff Support and Service

Beckhoff and their partners around the world offer comprehensive support and service, making available fast and competent assistance with all questions related to Beckhoff products and system solutions.

#### 4.1.1 Beckhoff branches and partner companies Beckhoff Support

Please contact your Beckhoff branch office or partner company for [local support and service](#) on Beckhoff products!

The contact addresses for your country can be found in the list of Beckhoff branches and partner companies: [www.beckhoff.com](http://www.beckhoff.com). You will also find further [documentation](#) for Beckhoff components there.

#### 4.1.2 Beckhoff company headquarters

Beckhoff Automation GmbH & Co.KG  
Huelshorstweg 20  
33415 Verl  
Germany

Phone: + 49 (0) 5246/963-0  
Fax: + 49 (0) 5246/963-198  
E-mail: [info@beckhoff.com](mailto:info@beckhoff.com)  
Web: [www.beckhoff.com](http://www.beckhoff.com)

##### Beckhoff Support

Support offers you comprehensive technical assistance, helping you not only with the application of individual Beckhoff products, but also with other, wide-ranging services:

- world-wide support
- design, programming and commissioning of complex automation systems
- and extensive training program for Beckhoff system components

Hotline: + 49 (0) 5246/963-157  
Fax: + 49 (0) 5246/963-9157  
E-mail: [support@beckhoff.com](mailto:support@beckhoff.com)

##### Beckhoff Service

The Beckhoff Service Center supports you in all matters of after-sales service:

- on-site service
- repair service
- spare parts service
- hotline service

Hotline: + 49 (0) 5246/963-460  
Fax: + 49 (0) 5246/963-479  
E-mail: [service@beckhoff.com](mailto:service@beckhoff.com)

## 4.2 Certificates

### Reliability of AX5801

#### Test and Certification body

TÜV SÜD Rail GmbH  
Rail Automation - IQSE  
Barthstraße 16  
D-80339 Munich



#### Manufacturer

Beckhoff Automation GmbH & Co. KG  
Huelshorstweg 20  
D-33415 Verl

#### Safety parameters AX5801

Key figures	AX5801
Lifetime [a]	-
Prooftest Intervall [a]	-
PFH <sub>D</sub>	2,47E-08
%SIL3	24,70%
MTTF <sub>d</sub>	High
B10 <sub>a</sub> (cycles)	780 000
DC	High
Performance level	PL e
Category	4
HFT	1
Element classification*	Type B

\*) Classification according to IEC 61508-2:2010 (see chapters 7.4.4.1.2 and 7.4.4.1.3)

To calculate the MTTF<sub>D</sub> value, a value of 8760 (1 operation per hour) was assumed for n<sub>op</sub>.

The AX5801 drive option card can be used for safety-related applications within the meaning of IEC 61508:2010 up to SIL3 and EN ISO 13849-1 up to PL e (Cat4).

Munich, 2016-03-07

Günter Greil

Digital unterschrieben von  
Günter Greil  
DN: c=DE, o=TÜEV SÜED Rail  
GmbH, ou=Rail & Automation,  
cn=Günter Greil,  
email=günter.greil@tuev-  
sued.de  
Datum: 2016.03.07 17:52:35  
+0100

TÜV SÜD  
 ZERTIFIKAT ◆ CERTIFICATE ◆ CERTIFICADO ◆ CERTIFIKAT ◆ 認證證書 ◆ CERTIFICATE ◆ ZERTIFIKAT

A4 / 07.17



Product Service

# CERTIFICATE

No. Z10 062386 0074 Rev. 00

**Holder of Certificate:** Beckhoff Automation GmbH & Co. KG

Hülshorstweg 20  
33415 Verl  
GERMANY

**Factory(ies):** 062386

**Certification Mark:**



**Product:** Safety components  
**Model(s):** Safety Card AX5801  
 for use in AX5000-Series

**Parameters:** Supply voltage: 24VDC (-15%/+20%)  
 Operating temperature: 0°C...+55°C

**Tested according to:** 2006/42/EC  
 EN ISO 13849-1:2015 (Cat 4, PL e)  
 IEC 61508-1:2010 (SIL 3)  
 IEC 61508-2:2010 (SIL 3)  
 IEC 61508-3:2010 (SIL 3)  
 IEC 62061:2005 (SIL CL3)  
 IEC 62061:2005/AMD1:2012  
 IEC 62061:2005/AMD2:2015  
 IEC 61800-5-2:2016 (SIL 3)

The product was tested on a voluntary basis and complies with the essential requirements. The certification mark shown above can be affixed on the product. It is not permitted to alter the certification mark in any way. In addition the certification holder must not transfer the certificate to third parties. See also notes overleaf.

**Test report no.:** BV86472T  
**Valid until:** 2025-03-23

**Date,** 2020-03-24 ( Christian Dirmeier )