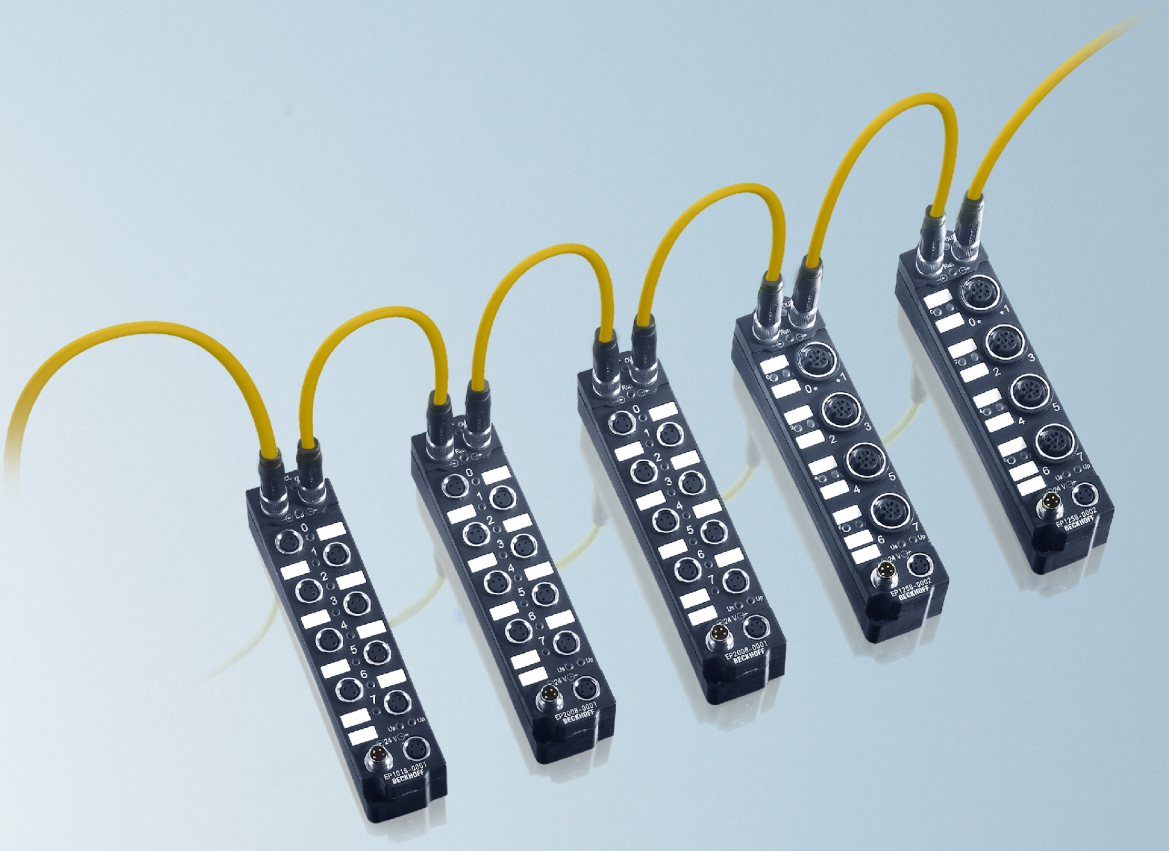
BECKHOFF New Automation Technology

Documentation | EN

Ex-Protection for EtherCAT Box Modules

Notes on the use of the EtherCAT Box Modules in hazardous areas according to ATEX, UKEX and IECEx



2025-02-20 | Version: 3.0.0

Table of contents

1 Foreword

1.1 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.

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

Copyright

Third-party brands

Trademarks of third parties may be used in this documentation. You can find the trademark notices here:
https://www.beckhoff.com/trademarks

1.2 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.

1.3 Validation

This document applies to all Beckhoff fieldbus components that bear ATEX, UKEX and/or IECEx markings and witch product code is build as follows:

EPxxxx-xxxx

At this each small character x stands for a cipher from 0 to 9.

NOTICE	
	**Certificates and approvals** The current certificates and approvals are available for download from the Beckhoff homepage www.beckhoff.com on the respective product page (see Documentation and downloads / Certificates, approvals / Downloads).

2 Notes on operation in areas subject to an explosion hazard

2.1 ATEX/UKEX - Special conditions

⚠ WARNING

Observe the special conditions for the intended use of EtherCAT Box modules in potentially explosive areas!

- The certified components are to be installed in a BG2000-0000 [▶ 12] protection enclosure that guarantees a protection against mechanical hazards!
- Provisions shall be made to prevent the rated voltage from being exceeded by transient disturbances of more than 119 V!
- If the temperatures during rated operation are higher than 70°C at the feed-in points of cables, lines or pipes, or higher than 80°C at the wire branching points, then cables must be selected whose temperature data correspond to the actual measured temperature values!
- Observe the permissible ambient temperature range of 0 … +55°C for the use of EtherCAT Box modules in potentially explosive areas!
- Measures must be taken to protect against the rated operating voltage being exceeded by more than 40% due to short-term interference voltages!
- The individual components may only be unplugged or removed from the bus system if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
- The connections of the certified components may only be connected or disconnected if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
- Address selectors and ID switches may only be adjusted if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
- Only for connection to connection sets providing a degree of protection not less than IP54 in accordance with IEC 60079-0!
- To avoid an electrostatic charge, wipe the enclosure surface with a damp cloth only.
- The equipment shall only be used in an environment where it is protected against exposure to UV light.
- For use in Zone 2/22 the equipment shall be installed in a suitable protective housing that meets the requirements of the impact resistance test according to EN IEC 60079-0.
- When used in an area requiring the use of equipment with EPL Gc, the following additional conditions apply:

  ⇨ The equipment shall only be used in an area of not more than pollution degree 2, as defined in EN 60664-1.

  ⇨ Provisions shall be made to prevent the rated voltages from being exceeded by transient disturbances of more than 40%.

  ⇨ Fieldbus connectors may only be disconnected or connected when the system supply is switched off, or when the location is known to be non-hazardous.

  ⇨ Address selectors and ID switches may only be adjusted when the system supply is switched off, or when the location is known to be non-hazardous.

Standards

The fundamental health and safety requirements are fulfilled by compliance with the following standards:

- **EN 60079-7:2015+A1:2018**
- **EN IEC 60079-0:2018**
- **EN IEC 60079-31:2024**

Marking

The Beckhoff EtherCAT Box modules certified according to regulations for potentially explosive areas bear the following marking:

II 3G Ex ec IIC T4 Gc
II 3D Ex tc IIIC T135°C Dc
DEKRA 11ATEX0080 X
DEKRA 22UKEX6019 X
Ta: 0 ... +55°C

2.2 IECEx - Special conditions

⚠ WARNING

Observe the special conditions for the intended use of EtherCAT Box modules in potentially explosive areas!

- The certified components are to be installed in a BG2000-0000 [▶ 12] protection enclosure that guarantees a protection against mechanical hazards!
- Provisions shall be made to prevent the rated voltage from being exceeded by transient disturbances of more than 119 V!
- If the temperatures during rated operation are higher than 70°C at the feed-in points of cables, lines or pipes, or higher than 80°C at the wire branching points, then cables must be selected whose temperature data correspond to the actual measured temperature values!
- Observe the permissible ambient temperature range of 0 … +55°C for the use of EtherCAT Box modules in potentially explosive areas!
- Measures must be taken to protect against the rated operating voltage being exceeded by more than 40% due to short term interference voltages!
- The individual components may only be unplugged or removed from the bus system if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
- The connections of the certified components may only be connected or disconnected if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
- Address selectors and ID switches may only be adjusted if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
- Only for connection to connection sets providing a degree of protection not less than IP54 in accordance with IEC 60079-0!
- To avoid an electrostatic charge, wipe the enclosure surface with a damp cloth only.
- The equipment shall only be used in an environment where it is protected against exposure to UV light.
- For use in Zone 2/22 the equipment shall be installed in a suitable protective housing that meets the requirements of the impact resistance test according to EN IEC 60079-0.
- When used in an area requiring the use of equipment with EPL Gc, the following additional conditions apply:

  ⇨ The equipment shall only be used in an area of not more than pollution degree 2, as defined in IEC 60664-1.

  ⇨ Provisions shall be made to prevent the rated voltages from being exceeded by transient disturbances of more than 40%.

  ⇨ Fieldbus connectors may only be disconnected or connected when the system supply is switched off, or when the location is known to be non-hazardous.

  ⇨ Address selectors and ID switches may only be adjusted when the system supply is switched off, or when the location is known to be non-hazardous.

Standards

The fundamental health and safety requirements are fulfilled by compliance with the following standards:

- **IEC 60079-0:2017 (Edition 7.0)**
- **IEC 60079-7:2017 (Edition 5.1)**
- **IEC 60079-31:2022 (Edition 3.0)**

Marking

EtherCAT Box modules that are certified in accordance with IECEx for use in areas subject to an explosion hazard bear the following markings:

IECEx DEK 23.0017 X
Ex ec IIC T4 Gc
Ex tc IIIC T135°C Dc

2.3 Batch number

The EtherCAT Box modules bear a batch number that is structured as follows:

WW YY FF HH

Key:	Example with batch number 29 20 02 01:
WW - week of production	week of production - 29
YY - year of production	year of production - 2020
FF - firmware version	firmware version - 02
HH - hardware version	hardware version - 01

2.4 Further documentations

NOTICE	
	**Refer product specific documentations** In addition, please refer to the product-specific documents for installation, parameterization, programming etc., which are available to you on the internet at www.beckhoff.com in the download section of the respective product pages.

3 BG2000-0000 - Protection enclosure for EtherCAT Box

⚠ WARNING

Risk of injury through electric shock and damage to the device!

Bring the EtherCAT system into a safe, de-energized state before starting mounting, disassembly or wiring of the modules.

Usage

The BG2000-0000 protection enclosure is mounted over a single EtherCAT Box in order to comply with the special ATEX requirements.

Installation

Push the connecting cables for EtherCAT, power supply and the sensors/actuators through the opening of the BG2000-0000 protection enclosure.

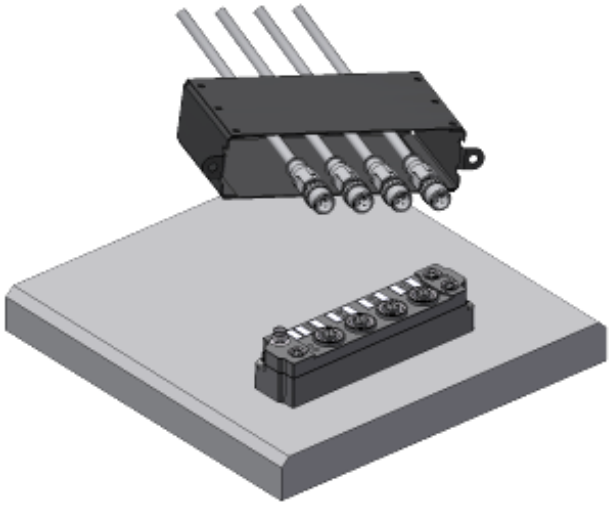


Fig. 1: BG2000-0000 - push the connecting cables through

Screw the connecting cables for EtherCAT, the power supply and the sensors/actuators to the EtherCAT Box. Also seal unused connectors with protective caps!

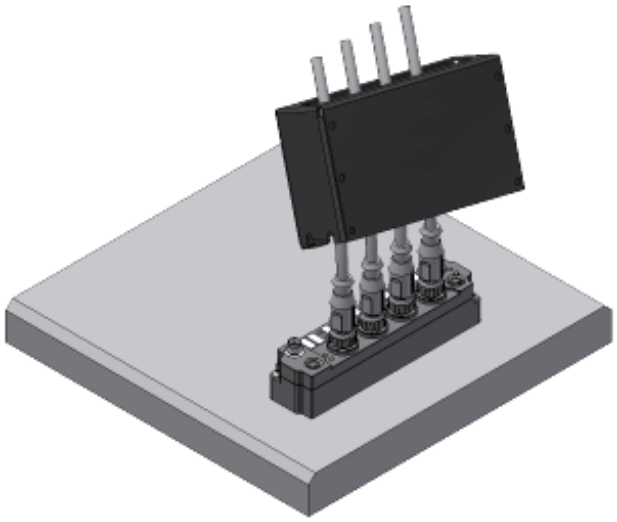


Fig. 2: BG2000-0000 - tighten the connecting cables

Mount the BG2000-0000 protection enclosure over the EtherCAT Box.

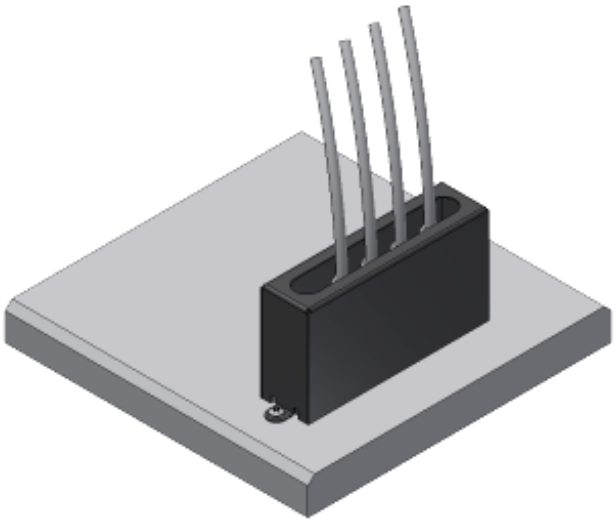


Fig. 3: BG2000-0000 - mount the protection enclosure

4 Basic principles of explosion protection

4.1 Why explosion protection?

In many industries, such as chemicals and process engineering, combustible substances are processed whose ignition can cause an explosion. These may be flammable liquids and gases or finely distributed dusts and fibers. In addition to a combustible substance, the prerequisites for the occurrence of an explosion are the presence of oxygen and a source of ignition. No explosion can occur if one of these factors is lacking.

Different protective measures are taken to avoid explosions and the resulting damage, and these measures are divided into three categories. Primary and secondary explosion protection is taken to mean measures to prevent the occurrence of an explosion. While primary explosion protection counteracts the formation of an explosive atmosphere, secondary explosion protection eliminates potential sources of ignition. Tertiary (or structural) explosion protection concerns measures to prevent or reduce personal injuries and damage to materials and the environment due to explosions if the risk of explosion cannot be ruled out by primary and secondary explosion protection.

Differentiation of the protective measures

Primary explosion protection	Secondary explosion protection	Tertiary explosion protection
Measures that prevent or limit the formation of explosive atmospheres.	Measures that prevent the ignition of the explosive atmosphere.	Measures that limit the effects of an explosion or reduce them to a safe level.
• Avoidance of flammable materials in an explosive form • Inertization (displacement of the oxygen)	• Avoidance of the source of ignition • Enclosure of the ignition source	• Explosion-proof design • Explosion pressure relief

For the approval of electrical equipment for use in areas subject to an explosion hazard, there are various standards that define the requirements for the equipment. Conformity to the respective standard is verified by an independent certificate authority as part of a certification process. Conformity to the standard is certified by the issuing of a certificate. The applicable standard usually depends on the place of use of the electrical equipment. The most important standards are briefly described below.

The International Electrotechnical Commission is responsible for global standardization in the field of electrical engineering. The IEC 60079 (IECEx scheme) series of standards deals with explosion protection for areas subject to a gas and dust explosion hazard. National regulations must be observed depending on the place of use of the electrical equipment.

In the ATEX directive 2014/34/EU, the European Union has created the basis for binding uniform property requirements with regard to the protection of systems, equipment and components against explosion, which apply to use in Europe. The application of the directive 2014/34/EC for explosion-protected applications has been compulsory throughout the EU since April 2016.

The basic principles of explosion protection are the same all over the world. Nevertheless, the explosion protection regulations of the US National Electrical Code (NEC) and the Canadian Electrical Code (CEC) in North America differ in part from those of the IEC, e.g. in the definition of areas subject to an explosion hazard. This document applies exclusively to the provisions of the ATEX Directive and the IECEx scheme.

Furthermore, this chapter serves as reference for the decoding of device markings.

4.2 Marking of equipment

The areas where the equipment may be used, the constructive safety level to which the equipment is certified and the material group in which the equipment may be used must be recognizable on the basis of adequate marking of the equipment. The following illustration shows the marking of equipment for zone 2. The individual elements of the marking are explained in the remainder of this document.

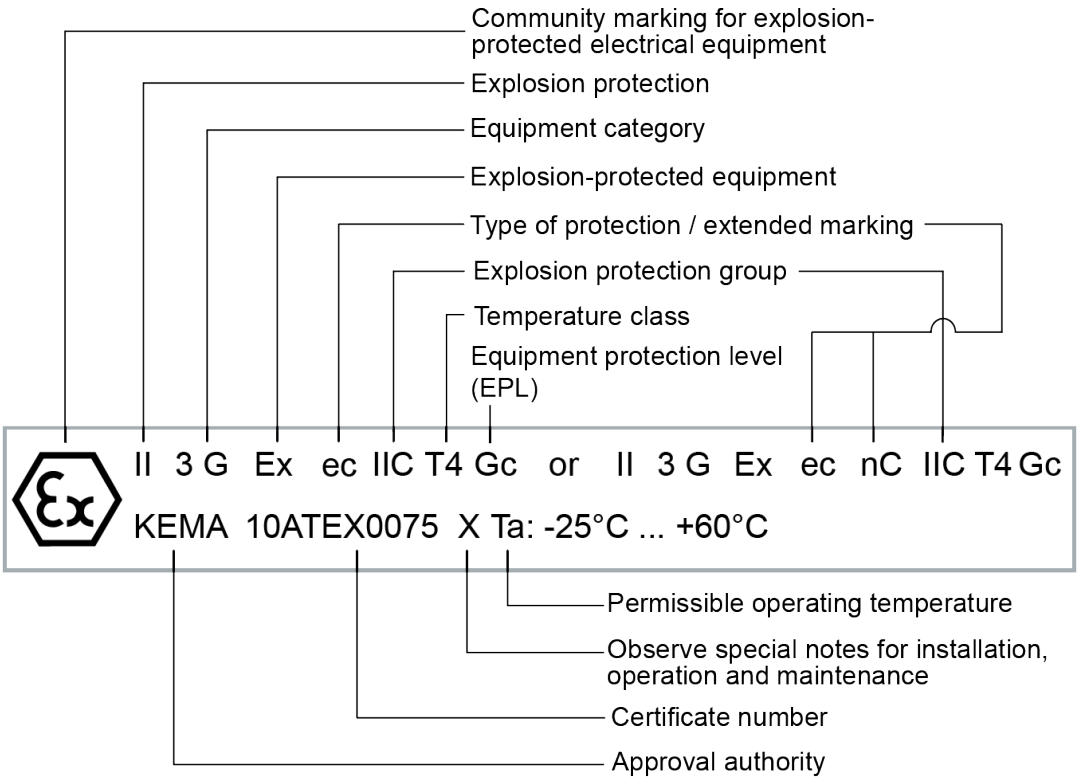


Fig. 4: Marking of equipment

4.3 Classification of electrical equipment into protection groups

The usability of electrical equipment in potentially explosive atmospheres is classified into three groups:

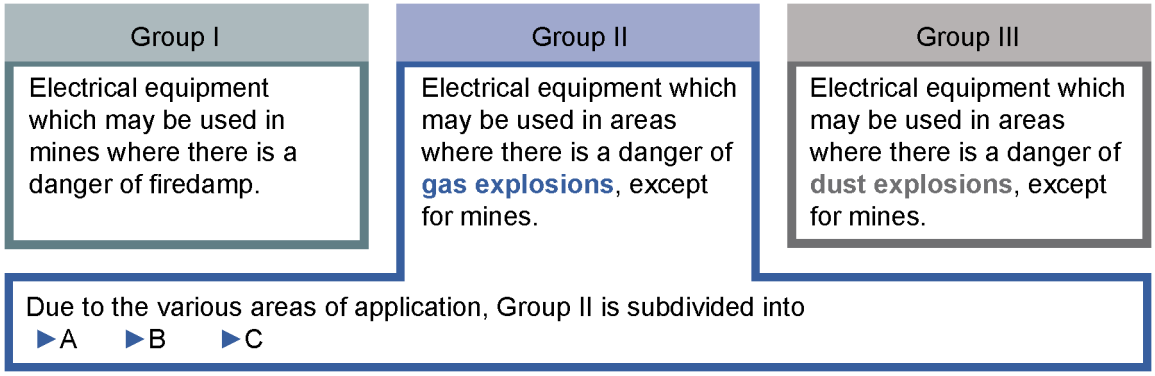


Fig. 5: Explosion protection groups

The gases are divided into the subgroups A, B and C according to their flammability. The classification is based on the minimum ignition current ratio (MIC), a characteristic value for determining the flammability of the gas in comparison with methane. Substances from the IIC group have the highest flammability and can therefore be ignited by a lower energy input than substances from the other subgroups.

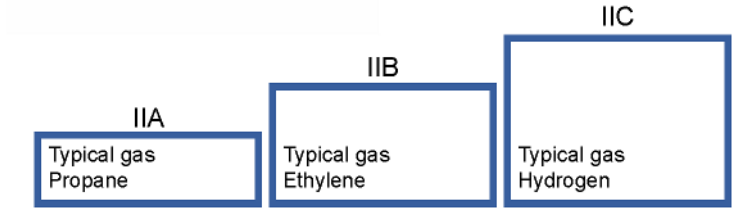


Fig. 6: Subdivision of Group II

Equipment from higher groups is suitable for use in lower groups.

Group IIC contains the most highly flammable gases.

4.4 Classification of surrounding atmosphere into zones

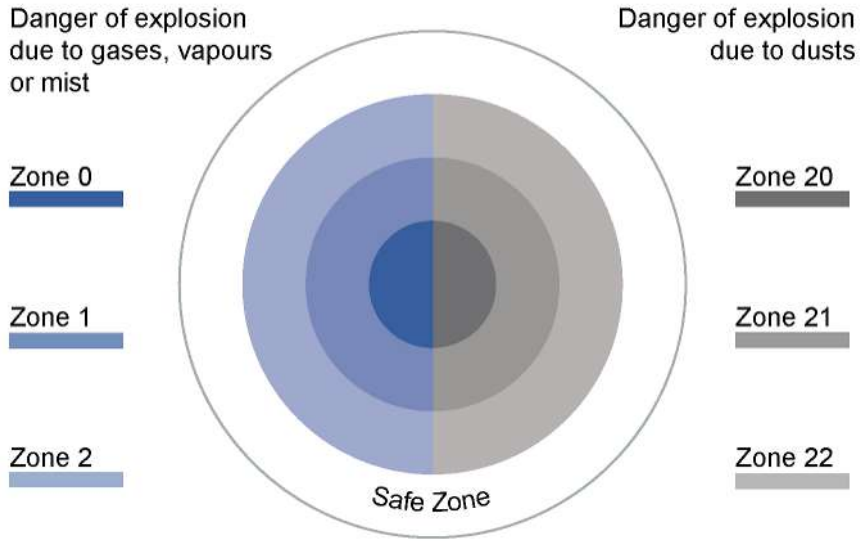


Fig. 7: Classification of surrounding atmosphere into zones

Areas where explosive mixtures can form are called areas subject to an explosion hazard. In principle, a distinction is made between areas subject to a gas explosion hazard and those subject to a dust explosion hazard. The classification into the individual zones is based on the frequency and duration of the occurrence of an explosive atmosphere; this is greatest, for example, for gas explosions in zone 0. Accordingly, higher requirements apply to equipment used within zone 0 than to equipment for zone 1 or 2.

This classification takes into account the various dangers due to explosive atmospheres according to the probabilities and enables the implementation of explosion protection with regard to the boundary conditions for safety and economy.

Potentially explosive areas

Zone 0	An atmosphere where a mixture of air and flammable substances in the form of gas, vapor or mist is present frequently, continuously or for long periods.
Zone 1	An atmosphere where a mixture of air and flammable substances in the form of gas, vapor or mist is likely to occur in normal operation occasionally.
Zone 2	An atmosphere where a mixture of air and flammable substances in the form of gas, vapor or mist is not likely to occur in normal operation but, if it does occur, will persist for only a short period.
Zone 20	An atmosphere where a cloud of combustible dust in the air is present frequently, continuously or for long periods.
Zone 21	An atmosphere where a cloud of combustible dust in the air is likely to occur in normal operation occasionally.
Zone 22	An atmosphere where a cloud of combustible dust in the air is not likely to occur in normal operation but, if it does occur, will persist for only a short period.

4.5 Usability of electrical equipment

Based on the level of probability of ignition and the type of potentially explosive atmosphere, there are different safety requirements for equipment.

To this end, devices are classified into device categories according to the EC Directive 94/9/EC and the ATEX Directive 2014/34/EU. At international level, IEC 60079-0 assigns Equipment Protection Levels (EPL).

On the basis of the device category or Equipment Protection Level (EPL), the usability of a device in a specific atmosphere can be derived unambiguously and in a simple way.

4.5.1 Equipment category

Electrical equipment intended for use in potentially explosive atmospheres is classified into different categories depending on the type of ignition protection used and the degree of protection derived from it.

Equipment for use in mines at risk of firedamp is classified into two different categories (M1 and M2). Conversely, equipment for use in areas subject to a gas explosion hazard, or where combustible dusts occur, can be classified into three different categories.

Protection group	Area	Equipment category	
I	–	**I M1**	Operation in case of explosion risk
	–	**I M2** or **I M1**	Shutdown in case of explosion risk
II	Zone 0	**II 1G**	
	Zone 1	**II 2G** or **II 1G**	
	Zone 2	**II 3G** or **II 2G** or **II 1G**	
III	Zone 20	**III 1D**	
	Zone 21	**III 2D** or **III 1D**	
	Zone 22	**III 3D** or **III 2D** or **III 1D**	

Fig. 8: Equipment category

4.5.1.1 Mines at risk of firedamp

Category M1

The devices must be designed and manufactured in such a way that sources of ignition do not take effect even in the event of rare device malfunctions. They must be equipped with explosion protection measures so that

- at least one second independent technical protection measure ensures the necessary safety in the event of the failure of a technical protection measure, or
- the required level of safety is guaranteed when two independent errors occur.

Category M2

The devices must be equipped with protective measures to ensure that ignition sources do not take effect during normal operation, even under difficult conditions and in particular in the case of harsh treatment and changing environmental influences. It must be possible to switch the devices off if an explosive atmosphere occurs.

4.5.1.2 Areas subject to a gas explosion or dust explosion hazard

Category 1

The devices must be designed and manufactured in such a way that sources of ignition are avoided even in the event of rare device malfunctions. They must be equipped with explosion protection measures so that

- at least one second independent technical protection measure ensures the necessary safety in the event of the failure of a technical protection measure, or
- the required level of safety is guaranteed when two independent errors occur.

Category 2

The devices must be designed and manufactured in such a way that the necessary level of safety can be guaranteed, even in the event of frequently occurring device malfunctions or faulty operating conditions that are usually to be expected.

Category 3

Devices of this category ensure the required level of safety during normal operation.

4.5.2 Equipment Protection Level (EPL)

Based on the level of probability of ignition and the type of potentially explosive atmosphere, there are different safety requirements for equipment. The Equipment Protection Level (EPL) describes the device-specific level of protection and allows easy determination of the usability in an explosive atmosphere.

EPL Ma

Device with a "very high" level of protection for installation in mines at risk of firedamp, which ensures the necessary level of safety so that there is no risk of ignition during normal operation or in the case of foreseeable or rare errors/ malfunctions, even if the device is still in operation during an escape of gas.

EPL Mb

Device with a "high" level of protection for installation in mines at risk of firedamp, which ensures the necessary level of safety so that, during normal operation or in the case of foreseeable errors/ malfunctions, there is no risk of ignition in the time between the escape of gas and the device being switched off.

EPL Ga

Device with a "very high" level of protection for use in areas subject to an explosion hazard where there is no risk of ignition during normal operation or in the case of foreseeable or rare errors/malfunctions.

EPL Gb

Device with a "high" level of protection for use in areas subject to an explosion hazard where there is no risk of ignition during normal operation or in the case of foreseeable errors/malfunctions.

EPL Gc

Device with an "extended" level of protection for use in areas subject to an explosion hazard where there is no risk of ignition during normal operation and which features some additional protective measures to ensure that there is no risk of ignition in the event of normally foreseeable device faults (e.g. a defective lamp).

EPL Da

Device with a "very high" level of protection for use in combustible dust atmospheres where there is no risk of ignition during normal operation or in the case of foreseeable or rare errors/malfunctions.

EPL Db

Device with a "high" level of protection for use in combustible dust atmospheres where there is no risk of ignition during normal operation or in the case of foreseeable errors/malfunctions.

EPL Dc

Device with an "extended" level of protection for use in combustible dust atmospheres where there is no risk of ignition during normal operation and which features some additional protective measures to ensure that there is no risk of ignition in the event of normally foreseeable device faults.

Assignment of the EPL to device categories and zones (source: EN 60079-0:2012)

EN 60079-0		Directive 2014/34/EU (ATEX)		EN 60079-10-X
EPL	Group	Device group	Equipment category	Zone
Ma	I	I	M1	NA
Mb			M2	
Ga	II	II	1G	0
Gb			2G	1
Gc			3G	2
Da	III		1D	20
Db			2D	21
Dc			3D	22

4.5.3 Types of protection for electrical equipment

As part of the secondary explosion protection, there are various types of ignition protection that prevent the development of a source of ignition or prevent a potential source of ignition from coming into contact with the explosive atmosphere. Sources of ignition can occur in various ways, e.g. in the form of electrical/mechanical sparks or the input of heat by hot surfaces. A suitable type of ignition protection is selected depending on the type of equipment and the potential source of ignition.

The types of ignition protection relevant for Beckhoff fieldbus components are briefly explained below.

Ex nC – sparking equipment with protected contacts

Sparking equipment in which the contacts are protected in a suitable manner belong to the Ex nC ignition protection type. This type of protection is permissible only for zone 2.

Ex e – increased safety

In the case of the Ex e ignition protection type, measures are taken to prevent - with an increased degree of safety - the occurrence of impermissibly high temperatures or sparks on internal and external parts of electrical equipment in which they do not occur during normal operation. The Ex ec type of protection is permissible only for zone 2.

Ex t – protection by housing

The Ex t ignition protection type, which is approved only for areas subject to dust explosion hazards, prevents the source of ignition inside the equipment from coming into contact with the surrounding atmosphere by means of a housing construction.

Ex i - intrinsic safety

By limiting the electrical current and voltage, the Ex i ignition protection type prevents a spark or thermal effect that can cause the ignition of the surrounding atmosphere. The intrinsic safety must be maintained even when defined errors occur.

At Beckhoff, the intrinsic safety ignition protection type is used only for the ELX terminals. All functional and safety information on the ELX terminals can be found in the product-specific documents.

Some ignition protection types allow certification for the use of equipment in different zones. To be more precise, the designation of the ignition protection type is specified in this case by the letters a, b or c for zones 0/20, 1/21 and 2/22 respectively. Example: Ex ia - intrinsically safe ignition protection type for zone 0/20.

4.5.4 Temperature class

The temperature class is also relevant to the determination of usability. The temperature of a heated surface is decisive for classification into the appropriate temperature class. The rule is that the next higher temperature class includes all lower classes.

Surface temperatures | gas explosion protection

Temperature class	Ignition temperature [°C]	Max. surface temperature [°C]
T1	> 450	450
T2	> 300 to ≤ 450	300
T3	> 200 to ≤ 300	200
T4	> 135 to ≤ 200	135
T5	> 100 to ≤ 135	100
T6	> 85 to ≤ 100	85

Fig. 9: Temperature classes

4.6 Safety barriers - cross-zone circuits

The connection of signal transducers (sensors) from zone 0 and 1 to evaluation units (fieldbus devices) from zone 2 is subject to special conditions, which are coarsely outlined here. Only intrinsically safe circuits may be used in zones 0 and 1.

A circuit is considered to be intrinsically safe if neither a spark nor a thermal effect can cause the ignition of a certain explosive atmosphere. One of the most important measures when constructing intrinsically safe circuits is the safe isolation of all intrinsically safe circuits from non-intrinsically safe circuits.

If an intrinsically safe circuit from zone 0 or 1 is to be connected to a non-intrinsically safe device in zone 2, the circuit must be routed through a safety barrier. This ensures the adequate isolation of intrinsically safe and non-intrinsically safe circuits. The following illustration shows an exemplary arrangement.

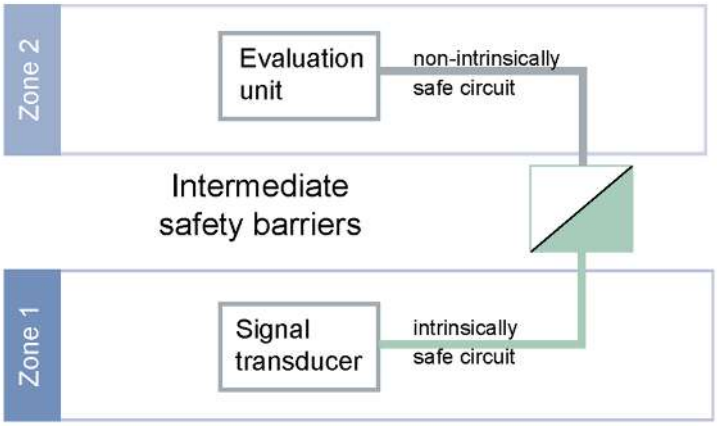


Fig. 10: Safety barriers

5 Appendix

5.1 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.

Beckhoff's branch offices and representatives

Please contact your Beckhoff branch office or representative for local support and service on Beckhoff products!

The addresses of Beckhoff's branch offices and representatives round the world can be found on her internet pages: www.beckhoff.com

You will also find further documentation for Beckhoff components there.

Support

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

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

Hotline:	+49 5246 963 157
e-mail:	support@beckhoff.com
web:	www.beckhoff.com/support

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 5246 963 460
e-mail:	service@beckhoff.com
web:	www.beckhoff.com/service

Headquarters Germany

Beckhoff Automation GmbH & Co. KG

Hülshorstweg 20
33415 Verl
Germany

Phone:	+49 5246 963 0
e-mail:	info@beckhoff.com
web:	www.beckhoff.com

Table of figures

Trademark statements

More Information:
www.beckhoff.com/EPxxxx

Beckhoff Automation GmbH & Co. KG
Hülshorstweg 20
33415 Verl
Germany
Phone: +49 5246 9630
info@beckhoff.com
www.beckhoff.com