Application guide
ATEX-certified Safe disconnection function, Ex II (2) GD
### List of related manuals

<table>
<thead>
<tr>
<th>General drive manuals</th>
<th>Code (English)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety instructions for ACS880 multidrive cabinets and modules</td>
<td>3AUA0000102301</td>
</tr>
<tr>
<td>Safety instructions for ACS880 liquid-cooled multidrive cabinets and modules</td>
<td>3AXD50000048633</td>
</tr>
<tr>
<td>Electrical planning instructions for ACS880 multidrive cabinets and modules</td>
<td>3AUA0000102324</td>
</tr>
<tr>
<td>Electrical planning instructions for ACS880 liquid-cooled multidrive cabinets and modules</td>
<td>3AXD50000048634</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drive hardware manuals and guides</th>
<th>Code (English)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACS880-01 drives (0.55 to 250 kW) hardware manual</td>
<td>3AUA0000078093</td>
</tr>
<tr>
<td>ACS880-04 drive modules (200 to 710 kW, 300 to 700 hp) hardware manual</td>
<td>3AUA0000128301</td>
</tr>
<tr>
<td>ACS880-04 single drive module packages hardware manual</td>
<td>3AUA0000138495</td>
</tr>
<tr>
<td>ACS880-04XT drive modules (500 to 1200 kW) hardware manual</td>
<td>3AXD5000025169</td>
</tr>
<tr>
<td>ACS880-14 and -34 single drive module packages hardware manual</td>
<td>3AXD50000022021</td>
</tr>
<tr>
<td>ACS880-104 inverter modules hardware manual</td>
<td>3AUA0000104271</td>
</tr>
<tr>
<td>ACS880-104LC inverter modules hardware manual</td>
<td>3AXD50000045610</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drive firmware manuals</th>
<th>Code (English)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACS880 primary control program firmware manual</td>
<td>3AUA0000085967</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PC tool manuals</th>
<th>Code (English)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start-up and maintenance PC tool Drive composer user’s manual</td>
<td>3AUA0000094606</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Option manuals and guides</th>
<th>Code (English)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACS-AP-x Assistant control panels user’s manual</td>
<td>3AUA0000085685</td>
</tr>
<tr>
<td>FSO-12 safety functions module user’s manual</td>
<td>3AXD50000015612</td>
</tr>
<tr>
<td>FSO-21 safety functions module user’s manual</td>
<td>3AXD50000015614</td>
</tr>
<tr>
<td>FSE-31 pulse encoder interface module user’s manual</td>
<td>3AXD50000016597</td>
</tr>
<tr>
<td>FPTC-02 ATEX-certified thermistor protection module, Ex II (2) GD (option +L537 +Q971) for ACS880 drives user’s manual</td>
<td>3AXD5000027782</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>General safety guides</th>
<th>Code (English)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional safety; Technical guide No. 10</td>
<td>3AUA0000048753</td>
</tr>
<tr>
<td>Safety and functional safety; A general guide</td>
<td>1SFC001008B0201</td>
</tr>
<tr>
<td>ABB Safety information and solutions</td>
<td><a href="http://www.abb.com/safety">www.abb.com/safety</a></td>
</tr>
<tr>
<td>Potentially explosive atmospheres. The basics you need to know about motors and drives</td>
<td>3AUA0000037223</td>
</tr>
</tbody>
</table>

You can find manuals and other product documents in PDF format on the Internet. See section [Document library on the Internet](#) on the inside of the back cover. For manuals not available in the Document library, contact your local ABB representative.
Application guide

ATEX-certified Safe disconnection function, Ex II (2) GD for ACS880 drives (option +Q971)
## Table of contents

### 1. Introduction

Contents of this chapter .................................................. 7  
Applicability ................................................................. 7  
Target audience ............................................................. 7  
Safety instructions .......................................................... 7  
The ATEX-certified Safe disconnection function ....................... 8  
Commissioning the drive for a motor in a hazardous area .......... 9  
Compliance with the European ATEX Product Directive 2014/34/EU 9  
Contents ........................................................................ 9  
Related documents ........................................................... 9  
Terms and abbreviations .................................................... 10  
Exclusion of liability ......................................................... 11

### 2. Implementing a motor thermal protection circuit

Contents of this chapter .................................................. 13  
Overview ........................................................................ 13  
Two-channel connection to drive STO terminals ..................... 15  
  General ........................................................................ 15  
  Resetting the safety function .......................................... 15  
  Indications of the safety function .................................... 15  
  Connection diagram ....................................................... 16  
One-channel connection to drive STO terminals .................... 17  
  General ........................................................................ 17  
  Resetting the safety function .......................................... 17  
  Indications of the safety function .................................... 17  
  Connection diagram ....................................................... 18  
One-channel or two-channel connection to an FSO module .... 19  
  General ........................................................................ 19  
  Resetting the safety function .......................................... 19  
  Indications of the safety function .................................... 19  
  Connection diagram (two-channel connection) ................. 20  
  Connection diagram (one-channel connection) ................. 21  
Sensors ........................................................................... 21  
Protection relays ............................................................... 22  
Wiring ............................................................................ 22  
  General wiring instructions ............................................ 22  
  Wiring diagrams ............................................................. 22

### 3. Parameter settings

Contents of this chapter .................................................. 23  
Drive/inverter module ....................................................... 23  
  Switching frequency limitation ........................................ 23  
Reset method and status indications ................................... 24  
  31.22 STO indication run/stop ......................................... 24  
  Motor overtemperature indication .................................... 24  
  31.11 Fault reset selection .............................................. 24
Other recommended settings .................................................. 25
FSO module ............................................................................. 26
General parameters ................................................................. 26
Parameters for the STO function .............................................. 28
Parameters for the SSE function .............................................. 29
Parameters for the SS1 function .............................................. 29
  SS1 ramp parameters in the drive/inverter module .............. 31
Safety pulse encoder interface .............................................. 31
Mechanical brake control ....................................................... 31

4. Technical data

Contents of this chapter .......................................................... 33
Related standards and directives ............................................. 33
Safety data .............................................................................. 34
  Drive/inverter module STO function ..................................... 34
  Drive/inverter module STO function and an FSO module ...... 34
Safety block diagrams .......................................................... 35
  Response times .................................................................... 35
Markings of the drive/inverter module .................................. 36
ATEX certificate ..................................................................... 37
Declarations of Conformity ........................................................ 40

Further information

Product and service inquiries .................................................. 43
Product training ..................................................................... 43
Providing feedback on ABB manuals ..................................... 43
Document library on the Internet ............................................. 43
Introduction

Contents of this chapter
This chapter contains information on the guide and gives safety instructions and some other general information for the reader.

Applicability
This guide is applicable to the ACS880 drives and inverter modules with the ATEX-certified Safe disconnection function (option +Q971).

Target audience
This guide is intended for personnel who install, start-up, use and service the ATEX-certified Safe disconnection function (option +Q971) of the drive. Read the guide before working on the drive. You must know the fundamentals of electricity, wiring, electrical components, electrical schematic symbols and ATEX/Ex regulations.

Safety instructions
Only qualified specialists are allowed to install, control and maintain the ATEX-certified motor thermal protection functions (see EN IEC 60079-14). Obey all safety regulations required with application of Ex motors in Zone 1/21 (equipment category 2) or Zone 2/22 (equipment category 2 or 3).

WARNING! Read and obey all safety instructions given for the drive. If you ignore them, injury or death, or damage to the equipment can occur.
This guide does not repeat the complete safety instructions of the drive but it only includes the instructions related to the scope of this guide. The general instructions are given in this section and the option-specific instructions in the appropriate chapter.

In addition to this guide,
- for ACS880 single drives, see the hardware manual
- for ACS880 air-cooled multidrive modules and single drive modules, see Safety instructions for ACS880 multidrive cabinets and modules (3AUA000102301 [English])
- for ACS880 liquid-cooled multidrive modules and single drive modules, see Safety instructions for ACS880 liquid cooled multidrive cabinets and modules (3AXD50000048633 [English]).

The safety function described in this guide activates the Safe torque off (STO) function of the drive/inverter module. The STO function of the ACS880 drives is certified (SIL 3 according to EN/ IEC 61800-5-2 and IEC 61508). For a detailed description of the STO function, see the hardware manual of your drive/inverter module.

**WARNING!** The functions described in this guide do not disconnect the voltage of the main and auxiliary circuits from the drive. Never work on the electrical parts of the drive or the motor before you have also disconnected the drive system from the electric supply, from rotating permanent magnet motors and from rotating motors equipped with sine filters, and made sure by measuring that there is no dangerous voltage present.

**WARNING!** The STO function of ACS880 drives cannot prevent the intermediate DC current from flowing through, and heating up, the motor in case a short circuit occurs in the output stage of the drive. The supplier must take this into account when planning the protection of the installation.

*Note:* When you connect the temperature sensor(s) of the Ex motor to the drive STO terminals through a relay, ensure the availability of required reinforced (double) insulation between the main circuit (motor) and the control unit. For example, the insulation of the temperature sensor in the Ex motor and the insulation of the protection relay affect the insulation of the whole circuit. All Ex motors manufactured by ABB have basic insulation between the main circuit and the temperature sensor. Similarly, ABB protection relays have basic insulation between the sensor circuit and relay output. This ensures double insulation for the ATEX-certified motor thermal protection function between the main circuit and the drive control unit.

**The ATEX-certified Safe disconnection function**

When the drive/inverter module is equipped with the option +Q971, its Safe torque off (STO) function is certified as a Safe disconnection function. It can be used as a protective system to protect equipment in potentially explosive atmospheres. The certificate is an EU Type examination certificate in accordance with the ATEX Product Directive 2014/34/EU.
Commissioning the drive for a motor in a hazardous area

Commission the drive according to the requirements and limitations set by the application, the instructions of the motor manufacturer, drive firmware manual and local laws and regulations.

The certificate of the Ex motor typically requires that you set a minimum limit for the output switching frequency of the drive. Make sure that the Ex motor is operated above the minimum output switching frequency specified by the motor manufacturer. See section Switching frequency limitation on page 23 for instructions on how to make the setting.

Compliance with the European ATEX Product Directive 2014/34/EU

The system integrator is responsible for the compliance of the complete motor thermal protection circuit with the European ATEX Product Directive 2014/34/EU. If the compliance of the system with the ATEX Product Directive requires the motor thermal protection, make sure that the:

• drive/inverter module is equipped with the ATEX-certified Safe disconnection function (option +Q971)
• motor thermal protection relay is ATEX-compliant
• motor thermal protection circuit is wired according to the instructions given in this guide and in the motor manual and according to the installation requirements of the relevant standard(s) of EN/IEC 60079 series.

Contents

This guide consists of the following chapters:

• Introduction (this chapter) introduces to this guide and gives safety instructions and some other general information for the reader.
• Implementing a motor thermal protection circuit gives instructions for implementing an ATEX-compliant motor thermal protection circuit using the ATEX-certified Safe disconnection function (option +Q971) of the drive/inverter module.
• Parameter settings for the ATEX-certified motor thermal protection functions.
• Technical data contains a list of related standards and directives, safety data and the drive ATEX certificates and Declaration of Conformity documents.

Related documents

• Product manuals (see the inside of the front cover)
### Terms and abbreviations

<table>
<thead>
<tr>
<th>Term/abbreviation</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATEX</td>
<td>Directives 2014/34/EU and 1999/92/EC refers to the ATEX directives (from “ATmosphères EXplosibles”).</td>
<td></td>
</tr>
<tr>
<td>CM-MSS.41</td>
<td>ABB thermistor motor protection relay</td>
<td></td>
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<tr>
<td>Ex</td>
<td>An IEC term used in the context of explosive atmospheres.</td>
<td>IEC 60079 series</td>
</tr>
<tr>
<td>Ex d</td>
<td>Type of protection, flameproof enclosures</td>
<td>EN/IEC 60079-1</td>
</tr>
<tr>
<td>Ex e</td>
<td>Type of protection, increased safety, replaced with Ex eb</td>
<td>EN 60079-7:2007 and IEC 60079-7:2006</td>
</tr>
<tr>
<td>Ex eb, Ex ec</td>
<td>Types of protection, increased safety</td>
<td>EN/IEC 60079-7:2015</td>
</tr>
<tr>
<td>Ex motors</td>
<td>Motors used in explosive atmospheres</td>
<td>-</td>
</tr>
<tr>
<td>Ex nA</td>
<td>Type of protection, non-sparking enclosures, replaced with Ex ec</td>
<td>EN/IEC 60079-15:2010</td>
</tr>
<tr>
<td>FSE-31</td>
<td>Pulse encoder interface module which can be used in safety applications</td>
<td>-</td>
</tr>
<tr>
<td>FSO</td>
<td>Safety functions module (FSO-12 or FSO-21)</td>
<td>-</td>
</tr>
<tr>
<td>FSO-12</td>
<td>Safety functions module which does not support the use of safety encoders</td>
<td>-</td>
</tr>
<tr>
<td>FSO-21</td>
<td>Safety functions module which supports the FSE-31 module and the use of safety encoders</td>
<td>-</td>
</tr>
<tr>
<td>HFT</td>
<td>Hardware fault tolerance</td>
<td>IEC 61508</td>
</tr>
<tr>
<td>PFH</td>
<td>Probability of dangerous failures per hour</td>
<td>IEC 61508</td>
</tr>
<tr>
<td>PFD</td>
<td>Probability of failure on demand</td>
<td>IEC 61508</td>
</tr>
<tr>
<td>Pt100</td>
<td>Platinum resistance temperature detector, platinum resistance thermometer.</td>
<td>-</td>
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<tr>
<td>PTC</td>
<td>Positive temperature coefficient; PTC thermistor, PTC resistor temperature sensor.</td>
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</tr>
<tr>
<td>SAR</td>
<td>Safe acceleration range. In the FSO module, there are two sets of SAR parameters (SAR0 and SAR1) that are used to define and/or monitor the deceleration ramp in safety functions. SAR0 parameters are used in the SSE function. SAR1 parameters are used in the SS1 function.</td>
<td>-</td>
</tr>
<tr>
<td>SBC</td>
<td>Safe brake control. A safety function in the FSO module.</td>
<td>-</td>
</tr>
<tr>
<td>SFF</td>
<td>Safe failure fraction (%)</td>
<td>IEC 61508</td>
</tr>
<tr>
<td>SIL</td>
<td>Safety integrity level</td>
<td>IEC 61508</td>
</tr>
<tr>
<td>SS1</td>
<td>Safe stop 1. A safety function in the FSO module.</td>
<td>EN/IEC 61800-5-2</td>
</tr>
<tr>
<td>SSE</td>
<td>Safe stop emergency. A safety function in the FSO module.</td>
<td>-</td>
</tr>
</tbody>
</table>
Exclusion of liability

ABB is not responsible for the implementation, verification and validation of the overall safety system. It is the responsibility of the end user (or other party) who is responsible for the overall system, system safety and compliance with ATEX/Ex regulations.

The end user (or other responsible party) must make sure that the entire implementation complies with all relevant standards, directives and local electrical code, and that the system is tested, verified and validated correctly.
Introduction
Implementing a motor thermal protection circuit

Contents of this chapter

This chapter contains instructions on implementing an ATEX-compliant motor thermal protection circuit using the ATEX-certified Safe disconnection function (option +Q971) of the ACS880 drive/inverter module.

Overview

You can implement the motor thermal protection circuit with or without an FSO safety functions module.

The FSO safety functions module (FSO-12 or FSO-21) is an optional device used with the ACS880 drives to implement safety functions. When installed, it reserves the standard STO connection of the drive. In this case, the FSO module activates the STO function of the drive (that is, opens the drive STO circuit) either immediately or after a deceleration ramp.

Note: You cannot connect the temperature sensor directly to the FSO module. You must use an ATEX-compliant protection relay in between.

Without an FSO module: The opening contacts of the protection relay(s) open the STO circuit of the drive (see sections Two-channel connection to drive STO terminals on page 15 and One-channel connection to drive STO terminals on page 17).

With an FSO module: The opening contacts of the protection relay(s) activate the STO or Safe stop 1 (SS1) function of the FSO module and the FSO module opens the STO circuit of the drive (see section One-channel or two-channel connection to an FSO module on page 19).
Implementing a motor thermal protection circuit

For more information on the safety functions of the FSO module, see _FSO-12 safety functions module user’s manual_ (3AXD50000015612 [English]) or _FSO-21 safety functions module user’s manual_ (3AXD50000015614 [English]).

You can also use the FPTC-02 ATEX-certified thermistor protection module, Ex II (2) GD (option +L537+Q971) to implement the ATEX-compliant motor thermal protection function. For more information, see _FPTC-02 ATEX-certified thermistor protection module, Ex II (2) GD (option +L537 +Q971) for ACS880 drives user’s manual_ (3AXD50000027782 [English]).
Two-channel connection to drive STO terminals

■ General

This section describes an implementation of the ATEX-compliant motor thermal protection circuit. The circuit uses the ATEX-certified Safe disconnection function (option +Q971) of the drive and a two-channel (redundant) connection to the drive STO terminals.

■ Resetting the safety function

A manual reset is mandatory in the temperature protection function, if it is required for ensuring the compliance of the system with Ex/ATEX regulations. When the protection relay detects motor overtemperature, the drive must not restart before a manual reset command. You can implement a manual reset in the ATEX-compliant protection relay (recommended).

In this example, it is also possible to use the STO indication in the drive to implement the manual reset (see section Reset method and status indications on page 24).

■ Indications of the safety function

In this example, you can use the drive STO indication to indicate the motor overtemperature. See section Reset method and status indications on page 24.

Note: Make sure that this indication generates a fault if the protection relay does not contain a manual reset.
Implementing a motor thermal protection circuit

Connection diagram

The diagram below shows the connections. The system integrator must acquire the components and do the installations drawn outside the drive border line.

1) An ATEX-compliant protection relay. The relay monitors a sensor circuit, and activates the STO function of the drive by opening the control circuits when necessary.

2) You can use the drive STO function for several external safety functions at the same time (for example, ATEX-compliant motor thermal protection and emergency stop). If you do, you must connect the STO activation switches or relays used in other safety functions in series with the protection relay.

When you install the equipment, make sure that you maintain separation of the switching (safety) signal with any other signals.
One-channel connection to drive STO terminals

General

This section describes an implementation of the ATEX-compliant motor thermal protection circuit:

- The circuit uses the ATEX-certified Safe disconnection function (option +Q971) of the drive.
- There is a one-channel (non-redundant) connection of the motor protection relay to the drive STO terminals. Both STO inputs of the drive are connected to same output contact of the protection relay.
- One output contact of the protection relay is connected to a digital input of the drive.
- The drive shows an overtemperature indication when the digital input switches off (the protection relay trips).

If you plan to use the one-channel (non-redundant) connection, make sure that you can reach the necessary safety integrity level (SIL). According to EN 50495, SIL1 is sufficient for the protection of category 2 and 3 equipment.

Note: The STO function of the drive must always have a redundant connection. See Connection diagram on page 18.

Resetting the safety function

A manual reset is mandatory in the temperature protection function, if it is required for ensuring the compliance of the system with Ex/ATEX regulations. When the protection relay detects motor overtemperature, the drive must not restart before a manual reset command. You can implement a manual reset in the ATEX-compliant protection relay (recommended).

In this example, you can also configure a manual reset in the drive with the motor overtemperature or STO indication parameters (see section Reset method and status indications on page 24).

Indications of the safety function

In this example, you can use the drive STO or the motor overtemperature indication. See section Reset method and status indications on page 24.

If you want to avoid parallel indications in motor overtemperature situations, you can set one or several of the indication parameters value to No indication (or None) or Event:
- the motor overtemperature indication with drive parameters 31.01...31.02 or 35.11...35.12 (see page 24),
- the STO indication in the drive with drive parameter 31.22 STO indication run/stop (see page 24).

Note: Make sure that at least one of these indications generates a fault if the protection relay does not contain a manual reset.
Implementing a motor thermal protection circuit

Connection diagram

The diagram below shows the connections. The system integrator must acquire the components and do the installations drawn outside the drive border line.

1) An ATEX-compliant protection relay. The relay monitors a sensor circuit, and activates the Safe torque off function of the drive by opening the control circuits when necessary.

2) You can use the drive STO function for several external safety functions at the same time (for example, ATEX-compliant motor thermal protection, and emergency stop). If you do, you must connect the STO activation switches or relays used in other safety functions in series with the protection relay.

3) The STO function of the drive must always have a redundant connection. Connect the XSTO terminals 3 and 4 as shown in this figure.

4) Connect to a digital input on the control board for the protection relay status indication. In this example, digital input DI6 is in use.

When you install the equipment, make sure that you maintain separation of the switching (safety) signal with any other signals.
One-channel or two-channel connection to an FSO module

**General**
This section describes two implementations of the ATEX-compliant motor thermal protection circuit with an FSO module:
- The circuit uses the ATEX-certified Safe disconnection function (option +Q971) of the drive.
- The FSO module (FSO-12 or FSO-21) is connected to the drive STO terminals.
- The protection relay is connected to the FSO module either with:
  - a two-channel (redundant) connection, or
  - a one-channel connection (non-redundant). In this case, one output contact of the protection relay is used for monitoring the status of the relay by the drive.

**Note:** The STO function of the drive must always have a redundant connection. See *Connection diagram (two-channel connection)* on page 20 or *Connection diagram (one-channel connection)* on page 21.

If you plan to use the one-channel connection in the protection relay, make sure that you can reach the necessary safety integrity level (SIL). According to standard EN 50495, SIL1 is sufficient for the protection of category 2 and 3 equipment.

**Resetting the safety function**
A manual reset is mandatory in the temperature protection function, if it is required for ensuring the compliance of the system with Ex/ATEX regulations. When the protection relay detects motor overtemperature, the drive must not restart before a manual reset command. You can implement a manual reset in the ATEX-compliant protection relay (recommended).

In this example, you can also configure a manual reset either in:
- the drive with the motor overtemperature (one-channel connection only) or STO indication parameters (see page 24)
- the FSO module by connecting a reset circuit to the FSO module (see page 26).

**Indications of the safety function**
In this example, an indication of the safety function can come from several sources:
- the motor overtemperature indication in the drive (one-channel connection only)
- the STO indication in the drive
- the STO indication in the FSO module.

If you want to avoid parallel indications after overtemperature activation, you can set one or several of the indication parameters value to *No indication* (or *None*) or *Event*:
- the motor overtemperature indication with drive parameters 31.01...31.02 or 35.11...35.12 (see page 24),
- the STO indication in the drive with drive parameter 31.22 STO indication run/stop (see page 24),
- the STO indication in the FSO module with FSO parameter FSOGEN.61 STO indication ext request (see page 27).

**Note:** Make sure that at least one of these indications generates a fault if the protection relay does not contain a manual reset.
20 Implementing a motor thermal protection circuit

- Connection diagram (two-channel connection)

The diagram below shows the wiring of the two-channel connection. The system integrator must acquire the components and do the installations drawn outside the drive border line.

1) An ATEX-compliant protection relay. The relay monitors a sensor circuit, and de-energizes the FSO module input by opening the control circuits when necessary.

When you install the equipment, make sure that you maintain separation of the switching (safety) signal with any other signals.
Connection diagram (one-channel connection)

The diagram below shows the wiring of the one-channel connection. The system integrator must acquire the components and do the installations drawn outside the drive border line.

1) An ATEX-compliant protection relay. The relay monitors a sensor circuit, and de-energizes the FSO module input by opening the control circuits when necessary.

2) Connect to a digital input on the control board for the protection relay status indication. In this example, digital input DI6 is in use.

In this one-channel connection, there is no redundant connection between the protection relay and FSO module. Still, the STO connection signal between the FSO module and STO circuit is redundant.

When you install the equipment, make sure that you maintain separation of the switching (safety) signal with any other signals.

Sensors

Make sure that the sensor type and the on-off resistances of the used sensors match with the protection relay specifications. Check the requirements for sensors and installation from the documentation of the protection relay to be used.
Protection relays

The protection relay monitors the motor equipped with temperature sensors. The sensor indicates the motor temperature for the protection relay. For example, with a PTC thermistor, when the motor temperature reaches the wake-up level of the sensor, the resistance of the temperature sensor increases sharply. The relay detects the change and indicates motor overtemperature through its output contacts. The opening contacts open the STO circuit of the drive. This disconnects the power supply from the motor.

Use an ATEX-compliant protection relay only. The example employs an ABB CM-MSS.41 thermistor motor protection relay. You can find more information on the relay on the Internet, for example, in the data sheet of the relay (2CDC112216D0201). In this thermistor relay, it is possible to implement a manual reset.

Include the protection relay test to the start-up and acceptance test of the motor thermal protection circuit. See the relay manual for the relay tests.

Wiring

- General wiring instructions

Wire only the sensor circuit into the potentially explosive atmosphere.

Install the drive/inverter module, the Safe torque off circuit, and the protection relay outside the hazardous zone.

For the STO circuit wiring, use the type of cable specified in the appropriate hardware manual.

Route the sensor cables away from the motor cable.

We recommend to use shielded sensor cable to minimize electromagnetic interference from power cables.

Connect the control cable shields to the chassis only.

The installation must comply with the requirements of the relevant standard(s) of EN/IEC 60079 series.

The installation of the sensor circuit in the Ex Zone must comply with the requirements for the applicable type of protection, such as:
  - Ex d (EN/IEC 60079-1),
  - Ex eb (EN/IEC 60079-7:2015; Ex e in EN 60079-7:2007 and IEC 60079-7:2006),

- Wiring diagrams

See the appropriate section.
Parameter settings

Contents of this chapter

This chapter lists the parameters that you have to set for the ATEX-certified motor thermal protection functions in this guide.

Drive/inverter module

- **Switching frequency limitation**

  The certificate of the Ex motor typically requires that you set a minimum limit for the switching frequency of the drive.

  For ABB Ex motors, use parameter 95.15 to set the required minimum switching frequency. For more information, see the firmware manual.

  For Ex motors supplied by other motor manufacturers, contact the motor manufacturer for the correct value and your local ABB representative for instructions on how to make the parameter setting in the drive.
Reset method and status indications

To configure a manual reset for the temperature protection function in the drive, you can set either the STO indication (parameter 31.22 STO indication run/stop) or the motor overtemperature indication so that it generates a fault.

### 31.22 STO indication run/stop

Set this parameter to value Fault/Fault or Fault/Warning.
- **Fault/Fault**: This generates a fault in the drive/inverter module every time the drive/inverter module STO function is activated.
- **Fault/Warning**: This generates a fault in the drive/inverter module when the drive is running and a warning when the drive is stopped.

When this STO fault is generated, the drive trips due to overtemperature and you must reset the drive with a manual reset command before you can restart the drive.

**Note**: You can also configure the FSO module so that it sends a fault to the drive each time it activates the drive STO function. See parameter FSOGEN.61 on page 27.

#### Motor overtemperature indication

There are two ways to configure the motor overtemperature indication.

**Example 1**

The ACS880 primary control program has two separate temperature monitoring functions. In this example, one of these functions (External event function 1) is configured to monitor digital input DI6 (you can also use another digital input). When off (0), the function triggers the user-selected indication and shows the user-defined message.

To configure the motor overtemperature indication in the drive:

1. Select the digital input which indicates the status of the external event:
   - set parameter 31.01 External event 1 source to DI6.

2. Select the type of the external event 1:
   - set parameter 31.02 External event 1 type to Fault, Warning or Warning/Fault.
     If you set this parameter to Fault, the drive trips due to overtemperature and you must reset the drive with a manual reset command before you can restart the drive.

3. If necessary, edit the indication message with the control panel (see ACS-AP-x Assistant control panels user’s manual (3AUA0000085685 [English]).

**Example 2**

In this example, the motor temperature is read from digital input DI6 (in this case you cannot use any other digital input).

1. Select PTC DI6 as the source of the temperature with parameter 35.11 Temperature 1 source (use the same setting also with Pt100 sensors)
   This creates a warning indication.

2. If you want a fault indication, set also parameter 35.12 Temperature 1 fault limit to 4000 ohm.

3. If necessary, edit the indication message with the control panel (see ACS-AP-x Assistant control panels user’s manual (3AUA0000085685 [English]).

### 31.11 Fault reset selection

Select the correct source of an external fault reset signal with parameter 31.11 Fault reset selection.
Other recommended settings

We recommend that you also set these parameters to improve the safety of the application:

- minimum and maximum speeds (parameter group 30)
- maximum current, power and torque (group 30)
- acceleration and deceleration times
- stall protection (parameters 31.24 … 31.28)
- motor load curve (parameters 35.50 … 35.55)
- motor cable protection (parameters 35.60 …. 35.62)

For more information, see the drive firmware manual.
## FSO module

If you use an FSO module in the safety system configuration, set and check the FSO parameters listed in this section.

You need the Drive composer pro PC tool to set the FSO module parameters, and a password to be able to download the configuration to the FSO module from Drive composer pro. For the default password of the FSO module, see the FSO module user’s manual. For more information on the Drive composer pro PC tool, see *Start-up and maintenance PC tool Drive composer user’s manual* (3AUA0000094606 [English]).

Follow the configuration steps described in the FSO module user’s manual, chapter *Configuration*.

There are parameters that you must set always when you use the FSO module and parameters that are related only to certain safety functions. This section lists the parameters that are relevant to the option +Q971. The example values apply to the two-channel wiring example on page 20. The protection relay is connected to digital inputs X113:1 and X114:1 of the FSO module.

You can configure the FSO module so that it opens the drive STO circuit either immediately after the safety function request (stop category 0) or after a deceleration ramp (stop category 1). In the first case, the FSO module activates the STO function in the FSO module. In the second case, it activates the SS1 function. Example values are given for both cases.

Always consider which stop category is more appropriate for the motor in overtemperature situations.

**Note:** If other safety functions are configured in the same FSO module, the same parameter values apply to all safety functions. You must take all safety functions into consideration when you configure the FSO module. See the FSO module user's manual.

### General parameters

These parameters are common to all safety functions in the STO module.

<table>
<thead>
<tr>
<th>Index</th>
<th>Name</th>
<th>Example value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FSOGEN.11</td>
<td>Stop completed output</td>
<td>None</td>
<td>Sets the digital output that indicates the completion of any stop function. Active when the FSO module has completed the STO, SSE or SS1 function.</td>
</tr>
<tr>
<td>FSOGEN.21</td>
<td>Motor nominal speed</td>
<td>1500 rpm</td>
<td>Sets the nominal motor speed. Adjust the default value to meet the ratings of the motor in use.</td>
</tr>
<tr>
<td>FSOGEN.22</td>
<td>Motor nominal frequency</td>
<td>50 Hz</td>
<td>Sets the nominal motor frequency. Adjust the default value to meet the ratings of the motor in use.</td>
</tr>
</tbody>
</table>
| FSOGEN.41  | Power-up acknowledgement    | Automatic     | Sets the power-up acknowledgement method of the FSO module.  
  *Automatic:* You do not need to push a reset button after switching on the FSO module. The FSO module generates the acknowledgement signal automatically after the power-up.  
  *Manual:* The FSO module reads the external acknowledgement signal through the digital input defined by parameter FSOGEN.42.  
  Make sure that the value is *Automatic*. |
<table>
<thead>
<tr>
<th>Index</th>
<th>Name</th>
<th>Example value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FSOGEN.42</td>
<td>Acknowledgement button input</td>
<td>None or eg. DI X113:2</td>
<td>Sets the digital input for the acknowledgement signal when parameter <strong>STO.02 STO acknowledgement</strong> has value <strong>Manual</strong>. Set to <strong>None</strong> if no acknowledgement signal is connected/required (parameter <strong>STO.02 STO acknowledgement</strong> has value <strong>Automatic</strong>). DI X113:2: The acknowledgement signal (reset circuit) is connected to this digital input. In the safety function described in this guide, you can use this parameter to implement a manual reset in the FSO module (see section <strong>Resetting the safety function</strong> on page 19).</td>
</tr>
<tr>
<td>FSOGEN.51</td>
<td>Zero speed without encoder</td>
<td>90 rpm</td>
<td>Sets the general zero speed limit for safety functions when no safety encoder is in use. STO function: The value has no effect. SS1 function: The FSO module activates drive STO function when the drive has decelerated the motor speed below this value. Adjust the default value when necessary.</td>
</tr>
<tr>
<td>FSOGEN.52</td>
<td>Zero speed with encoder</td>
<td>0 rpm</td>
<td>Sets the general zero speed limit for safety functions when a safety encoder is in use. STO function: The value has no effect. SS1 function: The FSO module activates drive STO function when the drive has decelerated the motor speed below this value. Adjust the default value when necessary. <strong>Note:</strong> This parameter is used only with FSO-21 and when a safety encoder is used in the application.</td>
</tr>
<tr>
<td>FSOGEN.61</td>
<td>STO indication ext request</td>
<td>Warning</td>
<td>Sets the type of the event that the FSO module generates and sends to the drive after external requests that end to a successful activation of the drive STO function (STO, SSE or SS1). None, Warning, Event: You do not have to reset the drive/inverter module after motor overtemperature situations. Fault: You have to reset the drive/inverter module. In the safety functions described in this guide, you can use this indication as the motor overtemperature indication message and to implement a manual reset. Adjust the default value when necessary.</td>
</tr>
<tr>
<td>FSOGEN.62</td>
<td>STO indication safety limit</td>
<td>Fault</td>
<td>Sets the type of the event that the FSO module generates and sends to the drive for limit hits during ramp and time monitoring of safety ramps SAR0 and SAR1. STO function: The value has no effect. SS1 function: When the motor speed does not follow the stop ramp or the time limit is exceeded, the FSO module activates the STO function and generates this user-defined indication. Check the default setting and adjust if necessary. If you select <strong>Fault</strong>, you must reset the drive before you can restart it.</td>
</tr>
</tbody>
</table>
Parameters for the STO function

These parameters are related to the STO function of the FSO module. With stop category 0, the FSO module activates the STO function in overtemperature situations. In addition, the FSO module can activate the STO function in fault situations.

<table>
<thead>
<tr>
<th>Index</th>
<th>Name</th>
<th>Example value</th>
<th>Description</th>
</tr>
</thead>
</table>
| STO.02| STO acknowledgement       | Automatic or Manual | Sets the acknowledgement method used in the STO, SSE and SS1 functions.  
**Automatic:** The FSO module resets the STO function automatically after the STO request have been removed.  
**Manual:** The FSO module reads the external acknowledgement signal through the digital input defined by parameter FSOGEN.42. In the safety functions described in this guide, you can use this setting to implement a manual reset for the motor temperature protection function in the FSO module (see section *Resetting the safety function* on page 19). |
| STO.11| STO input A               | STO: DI X113:1 & X114:1, SS1: None | Sets the digital input that is connected to the primary input of the STO function.  
**Note:** The default value after factory reset is DI X113:1 & X114:1. Always check this parameter after factory reset. |
| STO.12| STO input B               | None           | Sets the digital input that is connected to the secondary input of the STO function.                                                                                                                                 |
| STO.13| Restart delay after STO   | 2000 ms        | Sets the time after which the restart of the drive is allowed after the FSO module has activated the STO function and opened the drive STO circuit. With this parameter, you can allow a restart of the drive before the motor has stopped (fly-start). This parameter is valid only if the STO function is requested from STO input A (STO.11) or STO input B (STO.12).  
**STO function:** Adjust the default value when necessary. If you do not want to use the fly-start feature, set this parameter to the same value as parameter STO.14.  
**SS1 function:** This value has no effect. |
| STO.14| Time to zero speed with STO or modoff | 2000 ms | Sets the time after which the acknowledgement is allowed after coast stop in the STO and SSE functions. Set this parameter value to the estimated time in which the motor coasts to a stop from the maximum speed.  
**STO function:** This parameter sets the time after which the STO function is completed. Parameter STO.13 defines the time after which the restart of the drive is allowed. Adjust the value when necessary.  
**SS1 function:** This parameter is used only when the motor speed does not follow the ramp settings or the time monitoring limit is exceeded and the FSO module activates the STO function. Adjust the value when necessary.  
When a safety encoder is used: This parameter is relevant only if an encoder or FSE module failure occurs. The FSO module goes into the Fail-safe mode and activates the STO function. For more information, see the FSO-21 module user’s manual.  
**Note:** The default value after factory reset is 3,600,000 ms. Always check this parameter after factory reset. |

SBC usage

<table>
<thead>
<tr>
<th>Index</th>
<th>Name</th>
<th>Example value</th>
<th>Description</th>
</tr>
</thead>
</table>
| SBC.11| STO SBC usage             | None          | Sets how the mechanical brake is used together with the STO function.  
In the safety functions described in this guide, this feature is not used. Make sure that the value is None. |
Parameters for the SSE function

These parameters are related to the Safe stop emergency (SSE) function of the FSO module. The safety functions described in this guide do not use this function, but the FSO module can activate the SSE function in internal fault situations.

<table>
<thead>
<tr>
<th>Index</th>
<th>Name</th>
<th>Example value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSE.13</td>
<td>SSE function</td>
<td>Immediate STO or Emergency ramp</td>
<td>Sets the type of the SSE function. Immediate STO: The FSO module activates the drive STO function immediately after the SSE request. Emergency ramp: The FSO module first ramps down the motor speed and when the speed is below the zero speed limit (parameter FSOGEN.51 or FSOGEN.52) it activates the STO function. SAR0 parameters define the deceleration ramp (for more information, see the FSO module user’s manual). Note: The default value after factory reset is Emergency ramp. Always check this parameter after factory reset.</td>
</tr>
</tbody>
</table>

SBC usage

<table>
<thead>
<tr>
<th>Index</th>
<th>Name</th>
<th>Example value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBC.15</td>
<td>SSE/SS1 SBC speed</td>
<td>0 rpm</td>
<td>Sets the absolute speed below which the FSO module activates the brake (SBC) while ramping. 0 rpm: The feature is not in use. In the safety functions described in this guide, this feature is not used. Make sure that the value is 0 rpm.</td>
</tr>
</tbody>
</table>

Parameters for the SS1 function

Set these parameters only if you want that the FSO module activates the SS1 function in overtemperature situations.

<table>
<thead>
<tr>
<th>Index</th>
<th>Name</th>
<th>Example value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS1.01</td>
<td>SS1 activity and version</td>
<td>Version 1</td>
<td>Activates or deactivates the SS1 function and shows the version of the SS1 function. Version 1: Activates version 1 of the SS1 function. For more information, see the FSO module user’s manual.</td>
</tr>
<tr>
<td>SS1.11</td>
<td>SS1 input A</td>
<td>STO: None SS1: DI X113:1 &amp; X114:1</td>
<td>Sets the digital input that is connected to the primary input of the SS1 function. Note: The default value after factory reset is None. Always check this parameter after factory reset.</td>
</tr>
<tr>
<td>SS1.12</td>
<td>SS1 input B</td>
<td>None</td>
<td>Sets the digital input that is connected to the secondary input of the SS1 function.</td>
</tr>
</tbody>
</table>
## Parameter settings

<table>
<thead>
<tr>
<th>Index</th>
<th>Name</th>
<th>Example value</th>
<th>Description</th>
</tr>
</thead>
</table>
| SS1.13| SS1 monitoring method             | Time or Ramp  | Sets the method used for the SS1 monitoring. Adjust the default value when necessary.  
  **Time monitoring:** The FSO module monitors that a user-defined deceleration time limit is not exceeded. (See parameter SS1.14.)  
  **Ramp monitoring:** The FSO module monitors that the motor decelerates along a user-defined stop ramp. (See SAR1 ramp parameters 200.112, SARx.21, SARx.22 and SARx.02.) |
| SS1.14| SS1 delay for STO                 | 20000 ms      | Sets the security delay after which the FSO module activates the drive STO and SBC at the latest, if the motor speed has not gone below the zero speed limit (parameter FSOGEN.51 or FSOGEN.52) yet.  
  **Time monitoring:** This value sets the security delay that the FSO module monitors. Adjust the default value when necessary.  
  **Ramp monitoring:** This value has no effect in the operation. |

### SAR1 ramp settings

<table>
<thead>
<tr>
<th>Name</th>
<th>Example value</th>
<th>Description</th>
</tr>
</thead>
</table>
| SAR1 ramp time to zero            | 2000 ms       | Sets the target time for the stop ramp SAR1 that is used in the SS1 and function. Adjust the default value when necessary.  
  **Target time:** The time in which the drive decelerates the motor from speed 200.202 SAR speed scaling to zero.  
  **Note:** With value 0 ms, the drive uses the emergency stop ramp set by drive parameter 23.23 (see section SS1 ramp parameters in the drive/inverter module below). |
| SAR speed scaling                 | 1500 rpm      | Sets a speed value that the FSO module uses as a reference point in ramp parameter calculations (see SAR1 ramp parameters 200.112, SARx.21, SARx.22 and SARx.02).  
  Adjust the default value when necessary. |
| SAR initial allowed range         | 100 ms        | Sets the initial allowed range for the SAR0/SAR1 ramp. This parameter moves the location of the maximum monitoring ramp forward on the time axis, when monitoring is started. The slope of the ramp stays the same as defined with parameters 200.202 and SARx.22. For more information, see the FSO module user’s manual.  
  **Time monitoring:** This value has no effect in the operation.  
  **Ramp monitoring:** Adjust the default value when necessary. |
| SAR min ramp time to zero         | 1000 ms       | Sets the minimum ramp time for the SAR1 ramp monitoring.  
  **Time monitoring:** This value has no effect in the operation.  
  **Ramp monitoring:** Sets the minimum stop ramp time for the emergency stop. Adjust the default value when necessary.  
  **Note:** With value 0 ms, the minimum ramp is not monitored. |
| SAR max ramp time to zero         | 3000 ms       | Sets the maximum ramp time for the SAR1 ramp monitoring.  
  **Time monitoring:** This value has no effect in the operation.  
  **Ramp monitoring:** Sets the maximum stop ramp time for the emergency stop. Adjust the default value when necessary. |
SS1 ramp parameters in the drive/inverter module

You must set these parameters only for the SS1 function.

If FSO parameter 200.112 SAR1 ramp time to zero is set to 0, drive parameters define the stop ramp that is used in the SS1 function:

- 21.04 Emergency stop mode is set to value Eme ramp stop (Off3)
- 23.23 Emergency stop time is set to a suitable value.

Also in this case, the FSO module monitors the actual stop ramp (ramp monitoring or time monitoring). For more information, see the firmware manual.

Safety pulse encoder interface

If you use a safety pulse encoder and the FSE-31 module with the FSO-21 module, configure the encoder interface according to the instructions in FSO-21 safety functions module user's manual (3AXD50000015614 [English]).

Mechanical brake control

If you use a mechanical brake with the motor thermal protection circuit, pay special attention to the control of the mechanical brake.

If the motor deceleration by the mechanical brake causes extra heat generation in the ATEX area, make sure that the use of the brake does not rise the temperature excessively. In this case, make sure that the mechanical brake is activated only at the zero speed (see parameters SBC.11 STO SBC usage, SBC.15 SSE/SS1 SBC speed and FSOGEN.51 or FSOGEN.52).

In some cases you cannot use the brake for the motor deceleration when the motor thermal protection circuit has tripped, and the motor temperature is excessive already.

For more information, see the drive firmware manual (or the FSO user’s manual if you use the Safe brake control (SBC) function of the FSO module).
32 Parameter settings
## Technical data

### Contents of this chapter

This chapter contains a list of related standards and directives, safety data and the drive ATEX certificates and Declaration of Conformity documents.

### Related standards and directives

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN 50495: 2010</td>
<td>Safety devices required for the safe functioning of equipment with respect to explosion risks</td>
</tr>
<tr>
<td>IEC 61508: 2010</td>
<td>Part 1: General Requirements</td>
</tr>
<tr>
<td></td>
<td>Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems</td>
</tr>
<tr>
<td>IEC 61511-1:2016</td>
<td>Functional safety - Safety instrumented systems for the process industry sector</td>
</tr>
<tr>
<td></td>
<td>Part 5-2: Safety requirements - Functional</td>
</tr>
<tr>
<td>2014/34/EU</td>
<td>European ATEX Product Directive</td>
</tr>
</tbody>
</table>
Safety data

- Drive/inverter module STO function

The drive/inverter module hardware manual contains the safety data for the internal Safe torque off function (STO).

- Drive/inverter module STO function and an FSO module

The table below lists the safety data for the Safe disconnection function, including the safety data of the FSO module, the FSE-31 module (optional) and the safety data of worst case ACS880 Safe torque off (STO). See the section One-channel or two-channel connection to an FSO module on page 19.

Note:

- The PFD values of the drive STO and the FSO and FSE-31 modules are based on T1 (proof test interval) of two or five years. The safety data and SIL capability are valid only when proof testing is done with an interval of maximum two or five years.
- The safety data in the table is valid only when parameter settings for the FSO digital inputs are done according to section FSO module on page 26 in chapter Parameter settings.
- The FSE-31 module is included in the calculations only if a safety encoder is used in the application, the FSO-21 module is configured to activate the SS1 function (stop category 1) in overtemperature situations and the ramp monitoring method is used in the SS1 function.
- The safety integrity of the protection function must be verified as required in EN 50495. The SIL capability of the drive/inverter module internal STO and the FSO and FSE-31 modules is up to SIL3 when parameter settings for the FSO digital inputs are done according to section FSO module on page 26 in chapter Parameter settings.
- The PFD value defines the safety integrity for a low-demand application (demand rate < 1/year) in respect to random failure rate.
- The safety data below contains the failure rates (PFD) of the FSO and FSE-31 modules and the drive internal STO.

<table>
<thead>
<tr>
<th>Safety data</th>
<th>1-channel digital input</th>
<th>2-channel digital input</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIL capability</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PFH (1/h, T1=20a)</td>
<td>1.11E-08</td>
<td>1.06E-08</td>
</tr>
<tr>
<td>PFD (T1=2a)</td>
<td>2.58E-04</td>
<td>2.54E-04</td>
</tr>
<tr>
<td>PFD (T1=5a)</td>
<td>1.33E-04</td>
<td>1.21E-04</td>
</tr>
<tr>
<td>SFF (%)</td>
<td>&gt; 99</td>
<td>&gt; 99</td>
</tr>
<tr>
<td>HFT</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
Safety block diagrams

The safety block diagrams show the components that are included in the safety data calculations. The temperature sensor(s) and protection relay(s) are not included in the calculations.

One-channel digital input

```
Customer motor sensor(s) | Protection relay(s) | FSO module | FSE module (optional) | Drive STO
```

Two-channel digital input

```
Customer motor sensor(s) | Protection relay(s) | FSO module | FSE module (optional) | Drive STO
```

Response times

The response time of the Safe disconnection (STO) function is < 50 ms for all ACS880 drives. For the exact response times for each drive/inverter module type, see the drive/inverter module hardware manual.

When the function contains the FSO module, the response time of the Safe disconnection function is < 100 ms.
Markings of the drive/inverter module

The ATEX label is attached to the drive/inverter module to signify compliance with the European ATEX Product Directive 2014/34/EU.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Specific marking of explosion protection.</td>
</tr>
<tr>
<td>3</td>
<td>“II” = Product for other than mining applications.</td>
</tr>
<tr>
<td>4</td>
<td>“2” = Category 2 equipment. Parentheses indicate that the drive/inverter module must be installed outside the potentially explosive atmosphere.</td>
</tr>
<tr>
<td>5</td>
<td>Certified for use in explosive atmospheres caused by: “G” = gases, vapors or mists “D” = dust.</td>
</tr>
<tr>
<td>6</td>
<td>Certificate reference.</td>
</tr>
</tbody>
</table>
ATEX certificate

1. EU-TYPE EXAMINATION CERTIFICATE

2. Equipment or Protective System Intended for use in potentially explosive atmospheres
   Directive 2014/34/EU

3. Reference: VTT 12 ATEX 053X Issue 3

4. Equipment: Safe Disconnection Function for converter drive
   Certified types: ACS880/ACS880LC +Q971
   ACS880/ACS880LC +Q971 +Q973 (FSO-12)
   ACS880/ACS880LC +Q971 +Q972 (FSO-21)
   ACS880/ACS880LC +Q971 +Q972 +LS21 (FSO-21 & FSE-31)

5. Applicant: ABB Oy Drives
   Hiomatie 13
   FIN-00381 Helsinki
   Finland

6. Manufacturers: ABB Oy Drives
   Hiomatie 13
   FIN-00381 Helsinki
   Finland
   ABB AS/LV Drives
   Aruküla tee 59
   Rae vald
   75301 Harjumaa
   Estonia
   ABB Oy Drives
   Drives Service
   Kiitoradantie 14
   FI-01530 Vantaa
   Finland

VTT Expert Services Ltd
Giviniettie 4, Espoo
9454 Box 1091, FIN-02044 VTT, Finland
7. This equipment or protective system and any acceptable variations thereto are specified in the schedule and possible supplement(s) to this Certificate and the documents therein referred to.

8. VTT Expert Services Ltd, notified body number 0537, in accordance with Article 21 of the Directive 2014/34/EU of February 2014, certifies that this equipment or protective system has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective system intended for use in potentially explosive atmospheres given in Annex II to the Directive.

9. Compliance with the Essential Health and Safety Requirements has been assured by compliance with:

   EN 50495 (2010)

10. If the sign "X" is placed after the certificate number, it indicates that the equipment or protective system is subject to special conditions for safe use specified in the schedule to this certificate.

11. This EU-Type examination certificate relates only to the design, examination and tests of the specified equipment or protective system in accordance to the Directive 2014/34/EU. Further requirements of the Directive apply to the manufacturing process and supply of this equipment or protective system. These are not covered by this certificate.

12. The marking of the equipment or protective system shall include the following:

   II (2) GD

Espoo, 30.6.2017

VTT Expert Services Ltd

Kari Koskela
Expert

Risto Sulonen
Product Manager

---
Certificate without signatures shall not be valid.
This certificate, including the schedule, may only be reproduced in its entirety and without any change.
13. Schedule

14. EC-TYPE EXAMINATION CERTIFICATE VTT 12 ATEX 053X Issue 3

15. Description

Thermal protection is based on ATEX-compliant protection relay. The relay monitors a sensor circuit, and activates the SIL 3 certified "Safe Torque Off" (STO)-function which is integrated in the standard drive as an internal hardware-solution. Power that can cause rotation is not applied to the motor. The safety related part of the adjustable speed electrical power drive system PDS (SR) will not provide energy to the motor which can generate torque.

16. Documents

FSO-xx+ACS880 Safety data in ATEX-Certified Safe Disconnection Function, doc 3AXD10000113948, rev E
Certificate No. SEBS-A.093457/16 V1.0 by TUV Nord
Certificate No. SEBS-A.161334/16 V1.0 by TUV Nord
Certificate No. SEBS-A.102621/15 V1.0 by TUV Nord

17. Special conditions for safe use

The drive themselves are to be installed outside potentially explosive atmospheres (article 1, section 2 of the Directive). All manufacturer’s instructions shall be followed.

18. Essential Health and Safety Requirements

Assessment using standard referred in point 9 have confirmed compliance with the Directive 2014/34/EU, Annex II and particular point 1.5.

Certificate history

<table>
<thead>
<tr>
<th>Issue</th>
<th>Date</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>3.5.2013</td>
<td>Prime certificate</td>
</tr>
<tr>
<td>1</td>
<td>15.10.2014</td>
<td>Adding safety functions module FSO-12 and deleting two type designations covered by another certificate.</td>
</tr>
<tr>
<td>2</td>
<td>1.3.2016</td>
<td>The introduction of new manufacturing places and a new safety functions module FSO-21</td>
</tr>
<tr>
<td>3</td>
<td>30.6.2017</td>
<td>The introduction of a new converter type and deleting one manufacturing place. Updating the certificate according to the new directive.</td>
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</table>

Espoo, 30.6.2017
VTT Expert Services Ltd

Kari Koskela
Expert

Risto Sulonen
Product Manager

Certificate without signatures shall not be valid.
This certificate, including the schedule, may only be reproduced in its entirety and without any change.
Declarations of Conformity

EU Declaration of Conformity

ATEX Directive 2014/34/EU

We
Manufacturer: ABB Oy
Address: Hiomotie 13, 00380 Helsinki, Finland.
Phone: +358 10 22 11
declare under our sole responsibility that the following products:

**Frequency converters and frequency converter components**

ACS880-01, -11, -31
ACS880-04, -04XT, -04F, -M04, -14, -34
ACS880-104, -104LC

Identified with serial numbers beginning with 1 or 8

with regard to the safety function

**ATEX certified safe disconnection function** (option code +Q971)

are in conformity with all the relevant requirements for protective system of EU Directive for Equipment for Explosive atmospheres 2014/34/EU.

Specific marking of explosion protection

EX II (2) GD

The following harmonized standard has been applied:

<table>
<thead>
<tr>
<th>EN 50495:2010</th>
<th>Safety devices required for the safe functioning of equipment with respect to explosion risks</th>
</tr>
</thead>
</table>

The following other standards have been applied:

<table>
<thead>
<tr>
<th>EN 61800-5-2:2007</th>
<th>Adjustable speed electrical power drive systems – Part 5-2: Safety requirements - Functional</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 61508:2010, parts 1-2</td>
<td></td>
</tr>
</tbody>
</table>

Notified Body: VTT Expert Services Ltd, Notified Body number: 0537, Address: Klvimiehen tie 4, 02150 Espoo, Finland

has assessed the conformity of the "ATEX certified thermal motor protection" function and has issued the certificate VTT 14 ATEX 053X.

Note: If the Declaration of Conformity is needed in any other official language of European Union than in English, contact ABB.
The products referred in this Declaration of conformity fulfil the relevant provisions of other European Union Directives which are notified in Single EU Declarations of conformity 3AXD10000497305 and 3AXD10000497831.

Helsinki, 05 May 2018

Manufacturer representatives:

[Signature]
Peter Lindgren
Vice President, ABB Oy

[Signature]
Yrjö Kästölä
Vice President, ABB Oy

Note: If the Declaration of Conformity is needed in any other official language of European Union than in English, contact ABB.
Further information

Product and service inquiries
Address any inquiries about the product to your local ABB representative, quoting the type designation and serial number of the unit in question. A listing of ABB sales, support and service contacts can be found by navigating to www.abb.com/searchchannels.

Product training
For information on ABB product training, navigate to new.abb.com/service/training.

Providing feedback on ABB manuals
Your comments on our manuals are welcome. Navigate to new.abb.com/drives/manuals-feedback-form.

Document library on the Internet
You can find manuals and other product documents in PDF format on the Internet at www.abb.com/drives/documents.
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