OPTIONS FOR ABB INDUSTRIAL DRIVES

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

Application guide
ATEX-certified Safe disconnection function, Ex II (2) GD for ACS880 drives (option +Q971)

Application guide

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1. Safety instructions

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Further information
Safety instructions

Contents of this chapter
This chapter contains the safety instructions which you must obey when you install, operate and do maintenance on the safety functions of a drive.

Use of warnings and notes
Warnings tell you about conditions which can cause injury or death, or damage to the equipment. They also tell you how to prevent the danger. Notes draw attention to a particular condition or fact, or give information on a subject.

The manual uses these warning symbols:

- **WARNING!**
  - Electricity warning tells about hazards from electricity which can cause injury or death, or damage to the equipment.

- **WARNING!**
  - General warning tells about conditions, other than those caused by electricity, which can cause injury or death, or damage to the equipment.

- **WARNING!**
  - Electrostatic sensitive devices warning tells you about the risk of electrostatic discharge which can cause damage to the equipment.

ATEX-certified motor thermal protection functions
Only qualified specialists are permitted 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!**
Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur.

This manual does not contain the complete safety instructions of the drive. It only includes the instructions related to the scope of this manual. The general instructions are given in this section and the option-specific instructions in the applicable chapter.

In addition to this manual:
- For ACS880 single drives, see the drive hardware manual
- For ACS880 air-cooled multidrives, multidrive modules and single drive modules, see *ACS880 multidrive cabinets and modules safety instructions* (3AUA0000102301 [English])
- For ACS880 liquid-cooled multidrives, multidrive modules and single drive modules, see *ACS880 liquid-cooled multidrive cabinets and modules safety instructions* (3AXD50000048633 [English]).

**WARNING!**
The functions described in this manual do not disconnect the voltage of the main and auxiliary circuits from the drive. Do not do work on the drive, motor cable or motor when they are energized. Before you start the work, do the steps in section *Electrical safety precautions (page 9).*

**WARNING!**
If a short-circuit occurs in the output stage of the drive, the STO function does not prevent the intermediate DC current from flowing through and heating up the motor. The system integrator must take this into account when planning the protection of the installation.
Electrical safety precautions

These electrical safety precautions are for all personnel who do work on the drive, motor cable or motor.

---

**WARNING!**

Obey these instructions. If you ignore them, injury or death, or damage to the equipment can occur.

- If you are not a qualified electrical professional, do not do installation or maintenance work.
- Go through these steps before you begin any installation or maintenance work.

---

1. Clearly identify the work location and equipment.
2. Disconnect all possible voltage sources. Make sure that re-connection is not possible. Lock out and tag out.
   - Open the main disconnecting device of the drive.
   - Open the charging switch if present.
   - Open the disconnector of the supply transformer. (The main disconnecting device in the drive cabinet does not disconnect the voltage from the AC input power busbars of the drive cabinet.)
   - If the drive is equipped with a DC/DC converter unit (optional): Open the DC switch-disconnector [Q11] of the DC/DC converter. Open the disconnecting device of the energy storage connected to the DC/DC converter unit (outside the drive cabinet).
   - Open the auxiliary voltage switch-disconnector (if present), and all other possible disconnecting devices that isolate the drive from dangerous voltage sources.
   - In the liquid cooling unit (if present), open the motor protective circuit breaker(s) of the cooling pumps.
   - If you have a permanent magnet motor connected to the drive, disconnect the motor from the drive with a safety switch or by other means.
   - Disconnect any dangerous external voltages from the control circuits.
   - After you disconnect power from the drive, always wait 5 minutes to let the intermediate circuit capacitors discharge before you continue.

3. Protect any other energized parts in the work location against contact.
4. Take special precautions when close to bare conductors.
5. Measure that the installation is de-energized. If the measurement requires removal or disassembly of shrouding or other cabinet structures, obey the local laws and regulations applicable to live working (including – but not limited to – electric shock and arc protection).
   - Use a multimeter with an impedance greater than 1 Mohm.
   - Make sure that the voltage between the drive input power terminals (L1, L2, L3) and the grounding (PE) busbar is close to 0 V.
   - Make sure that the voltage between the drive output terminals (T1/U, T2/V, T3/W) and the grounding (PE) busbar is close to 0 V.
   - Make sure that the voltage between the drive DC busbars (+ and -) and the grounding (PE) busbar is close to 0 V.
   - Make sure that the voltage between the drive DC terminals (R+/UDC+ and UDC-) and the grounding terminal (PE) is close to 0 V.
10 Safety instructions

6. Install temporary grounding as required by the local regulations.
7. Ask the person in control of the electrical installation work for a permit to work.
Introduction

Contents of this chapter
This chapter contains information on the manual and gives other general information for the reader.

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

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

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 motor manufacturer’s instructions, drive firmware manual, local laws and regulations and this manual.
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.

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)
- the motor thermal protection relay is ATEX-compliant
- the motor thermal protection circuit is wired according to the instructions given in this manual and in the motor manual and according to the installation requirements of the relevant standard(s) of EN/IEC 60079 series.

Exclusion of liability

ABB is not responsible for the implementation, verification and validation of the overall safety system. It is the responsibility of the system integrator (or other party) who is responsible for the overall system and system safety.

The system integrator (or other responsible party) must make sure that the entire implementation complies with the instructions in this manual, all relevant standards, directives and local electrical code, and that the system is tested, verified and validated correctly.

Terms and abbreviations

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
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<tr>
<td>ATEX</td>
<td>Directives 2014/34/EU and 1999/92/EC are commonly referred to as the ATEX directives (from &quot;Atmosphères Explosibles&quot;)</td>
</tr>
<tr>
<td>Drive</td>
<td>Frequency converter for controlling AC motors</td>
</tr>
<tr>
<td>Drive module</td>
<td>Frequency converter enclosed in a metal frame or enclosure. Intended for cabinet installation.</td>
</tr>
<tr>
<td>Ex</td>
<td>An IEC term used in the context of explosive atmospheres (IEC 60079)</td>
</tr>
<tr>
<td>Ex d</td>
<td>Type of protection, flameproof enclosures (EN/IEC 60079-1)</td>
</tr>
<tr>
<td>Ex eb, Ex ec</td>
<td>Types of protection, increased safety (EN/IEC 60079-7)</td>
</tr>
<tr>
<td>Ex motors</td>
<td>Motors used in explosive atmospheres</td>
</tr>
<tr>
<td>FSE-31</td>
<td>Optional pulse encoder interface module for safety encoder</td>
</tr>
<tr>
<td>FSO-21</td>
<td>Safety functions module which supports the FSE-31 module and the use of safety encoders</td>
</tr>
<tr>
<td>FSO-12</td>
<td>Safety functions module which does not support the use of encoders</td>
</tr>
<tr>
<td>HFT</td>
<td>Hardware fault tolerance (IEC 61508)</td>
</tr>
<tr>
<td>Inverter module</td>
<td>Inverter bridge, related components and drive DC link capacitors enclosed in a metal frame or enclosure. Intended for cabinet installation.</td>
</tr>
<tr>
<td>PFD&lt;sub&gt;avg&lt;/sub&gt;</td>
<td>Average probability of dangerous failure on demand (IEC 61508)</td>
</tr>
<tr>
<td>PFH</td>
<td>Average frequency of dangerous failures per hour (IEC 61508)</td>
</tr>
<tr>
<td>SAR</td>
<td>Safe acceleration range</td>
</tr>
<tr>
<td>SBC</td>
<td>Safe brake control</td>
</tr>
<tr>
<td>SFF</td>
<td>Safe failure fraction (%) (IEC 61508)</td>
</tr>
<tr>
<td>Term</td>
<td>Description</td>
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<td>------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>SIL</td>
<td>Safety integrity level (1...3) (IEC 61508)</td>
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<tr>
<td>SS1</td>
<td>Safe stop 1 (IEC/EN 61800-5-2)</td>
</tr>
<tr>
<td>SSE</td>
<td>Safe stop emergency</td>
</tr>
<tr>
<td>STO</td>
<td>Safe torque off (IEC/EN 61800-5-2)</td>
</tr>
</tbody>
</table>

Stop category

- stop category 0: an uncontrolled stop where power to the machine actuators is removed immediately (STO)
- stop category 1: a controlled stop where the machine actuators have power for stopping, after which the power is removed (SS1)
- stop category 2: a controlled stop where the machine actuators continue to have power (SS2).

\( T_1 \)

Proof test interval. Defines the probabilistic failure rate (PFH or \( PFD_{avg} \)) for the safety function or subsystem. Performing a proof test at a maximum interval of \( T_1 \) is required to keep the SIL capability valid. The same interval must be followed to keep the PL capability (EN ISO 13849) valid. Note that any \( T_1 \) values given cannot be regarded as a guarantee or warranty.

\( T_M \)

Mission time: the period of time covering the intended use of the safety function/device. After the mission time elapses, the safety device must be replaced. Note that any \( T_M \) values given cannot be regarded as a guarantee or warranty. (EN ISO 13849-1)

Zone

Potentially explosive atmosphere. Hazardous areas are divided into zones, based on the frequency and duration of the occurrence of an explosive atmosphere. (EN/IEC 60079)

Later in this manual, the term “drive” is used to refer to drives, drive modules and inverter modules.

**Related manuals**

<table>
<thead>
<tr>
<th>Manual</th>
<th>Code</th>
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<tr>
<td><strong>Drive hardware</strong></td>
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<tr>
<td>ACS880-01 drives (0.55 to 250 kW) hardware manual</td>
<td>3AUA00000078093</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>3AXD50000025169</td>
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<tr>
<td>ACS880-04F drive modules hardware manual</td>
<td>3AXD50000034664</td>
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<tr>
<td>ACS880-04FXT drive module packages hardware manual</td>
<td>3AXD50000274444</td>
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<tr>
<td>ACS880-M04 Machinery drive hardware manual</td>
<td>3AXD5000028613</td>
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<tr>
<td>ACS880-11 hardware manual</td>
<td>3AXD50000045932</td>
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<tr>
<td>ACS880-31 hardware manual</td>
<td>3AXD50000045933</td>
</tr>
<tr>
<td>ACS880-14 and -34 single drive module packages hardware manual</td>
<td>3AXD5000022021</td>
</tr>
<tr>
<td>ACS880 multidrive cabinets and modules electrical planning instructions</td>
<td>3AUA0000102324</td>
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<tr>
<td>ACS880 liquid-cooled multidrive cabinets and modules electrical planning</td>
<td>3AXD50000048634</td>
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<tr>
<td><strong>Inverter units</strong></td>
<td></td>
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<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>
<tr>
<td><strong>Drive firmware</strong></td>
<td></td>
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<tr>
<td>ACS880 primary control program firmware manual</td>
<td>3AUA0000085967</td>
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<tr>
<td>ACS880 primary control program quick start-up guide</td>
<td>3AUA0000098062</td>
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<tr>
<td>Drive composer start-up and maintenance PC tool user’s manual</td>
<td>3AUA0000094606</td>
</tr>
<tr>
<td>Functional safety design tool user’s manual</td>
<td>3AXD1000030417</td>
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<tr>
<td><strong>Safety</strong></td>
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<tr>
<td>ACS880 multidrive cabinets and modules safety instructions</td>
<td>3AUA0000102301</td>
</tr>
<tr>
<td>ACS880 liquid-cooled multidrive cabinets and modules safety instructions</td>
<td>3AXD50000048633</td>
</tr>
<tr>
<td>Functional safety; Technical guide No. 10</td>
<td>3AUA0000048753</td>
</tr>
<tr>
<td>Safety and functional safety; A general guide</td>
<td>1SFC0010080201</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>Motors and drives in potentially explosive atmospheres - What you need to know</td>
<td>3AUA0000037223</td>
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<td><strong>Options</strong></td>
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<tr>
<td>ACX-AP-x assistant control panels user’s manual</td>
<td>3AUA0000085685</td>
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<tr>
<td>ATEX-certified Safe disconnection function, Ex II (2) GD for ACS880 drives (option +Q971)</td>
<td>3AUA0000132231</td>
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<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>3AXD50000027782</td>
</tr>
<tr>
<td>Manuals and quick guides for I/O extension modules, fieldbus adapters, etc.</td>
<td></td>
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<tr>
<td><strong>Other documents</strong></td>
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<tr>
<td>Circuit diagrams</td>
<td>Delivered with the drive</td>
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<tr>
<td>Part lists</td>
<td>Delivered with the drive</td>
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You can find manuals and other product documents in PDF format on the Internet. See Document Library. For manuals not available in the Document library, contact your local ABB representative.

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 drive.

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 ACS880 drives to implement safety functions. When an FSO module is installed, it reserves the standard STO connection of the drive. With the safety function shown in this manual, the FSO module activates the drive STO function (opens the STO circuit) immediately (STO) or after a deceleration ramp (SS1). You can configure several different safety functions in the FSO module at the same time. The wiring and parameter settings in this manual show how to configure the ATEX-certified Safe disconnection function as a safety function in the FSO module. For more information on the FSO module, see the FSO module user's manuals.

Note: You cannot connect the temperature sensor directly to the drive or 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 (page 16) and One-channel connection to drive STO terminals (page 18)). The STO stops the motor (if running) and prevents the motor start.

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. The FSO module opens the STO circuit of the drive (see section One-channel or two-channel connection to an FSO module (page 20)).
The STO stops the motor (if running) and prevents the motor start. You must select the stop category according to the system risk assessment.

As an alternative, you can 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. If you use the FPTC-02 module, it is not necessary to use an ATEX-compliant protection relay. For more information, see the FPTC-02 user's manual.

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.

- **Implementing the reset of the safety function**

A manual reset is mandatory in the motor thermal protection function, if it is required for ensuring the compliance of the system with Ex/ATEX regulations. After the motor thermal protection function activates, the motor must not restart before a manual reset command is given. You can implement a manual reset in the ATEX-compliant protection relay (recommended). Use the reset button of the relay, or connect an external reset button to the relay.

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 (page 25)*.

- **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 (page 25)*.

Make sure that this indication generates a fault if the protection relay does not contain a manual reset.
Connection diagram

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

1 Drive
2 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.
3 Motor temperature sensor
4 Potentially explosive atmosphere

a) 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.
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 (page 19).

Implementing the reset of the safety function
A manual reset is mandatory in the motor thermal protection function, if it is required for ensuring the compliance of the system with Ex/ATEX regulations. After the motor thermal protection function activates, the motor must not restart before a manual reset command is given. You can implement a manual reset in the ATEX-compliant protection relay (recommended). Use the reset button of the relay, or connect an external reset button to the relay.

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 (page 25).

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 (page 25).

If you want to avoid parallel indications in 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
- the STO indication in the drive with drive parameter 31.22 STO indication run/stop

Make sure that at least one of these indications generates a fault if:
- the protection relay does not contain a manual reset, and
- the FSO module is not configured for an STO manual reset.
Connection diagram

The diagram below shows the connections. The system integrator must get the components and do the installations drawn outside the drive borderline.

1. Drive
2. 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.
3. Motor temperature sensor
4. Potentially explosive atmosphere

a) 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.

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

c) Connect to a digital input on the control board for the protection relay status indication. In this example, digital input DI6 is in use.
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 (non-redundant) connection. In this case, one output contact of the protection relay is used for monitoring the status of the relay.

Note: The STO function of the drive must always have a redundant connection. See Connection diagram (two-channel connection) (page 21) or Connection diagram (one-channel connection) (page 22).

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.

Implementing the reset of the safety function

A manual reset is mandatory in the motor thermal protection function, if it is required for ensuring the compliance of the system with Ex/ATEX regulations. After the motor thermal protection function activates, the motor must not restart before a manual reset command is given. You can implement a manual reset in the ATEX-compliant protection relay (recommended). Use the reset button of the relay, or connect an external reset button to the relay.

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 section Reset method and status indications (page 25).
- the FSO module by connecting a reset circuit to the FSO module. See section FSO module (page 27).

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 or SS1 indication in the FSO module.

If you want to avoid parallel indications in 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
- the STO indication in the drive with drive parameter 31.22 STO indication run/stop
- the STO or SS1 indication in the FSO module with FSO parameter FSOGEN.61 STO indication ext request.

See section Reset method and status indications (page 25) or FSO module (page 27).
Make sure that at least one of these indications generates a fault if:

- the protection relay does not contain a manual reset, and
- the FSO module is not configured for an STO manual reset.

### Connection diagram (two-channel connection)

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

1. Drive
2. FSO module
3. ATEX-compliant protection relay. The relay monitors a sensor circuit, and de-energizes the FSO module input by opening the control circuits when necessary.
4. Motor temperature sensor
5. Potentially explosive atmosphere
Connection diagram (one-channel connection)

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

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Drive</td>
</tr>
<tr>
<td>2</td>
<td>FSO module</td>
</tr>
<tr>
<td>3</td>
<td>ATEX-compliant protection relay. The relay monitors a sensor circuit, and de-energizes the FSO module input by opening the control circuits when necessary.</td>
</tr>
<tr>
<td>4</td>
<td>Motor temperature sensor</td>
</tr>
<tr>
<td>5</td>
<td>Potentially explosive atmosphere</td>
</tr>
<tr>
<td>a)</td>
<td>Connect to a digital input on the control board for the protection relay status indication. In this example, digital input DI6 is in use.</td>
</tr>
</tbody>
</table>

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

**Sensors**

Make sure that the sensor type and the on-off resistances of the used sensors agree with the protection relay specifications. See the requirements for sensors and installation from the documentation of the protection relay.
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 uses an ABB CM-MSS.41 thermistor motor protection relay. You can find more information in the CM-MSS.41 data sheet (2CDC112216D0201 [English]). 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 documentation for the relay tests.

Wiring

When you install the motor thermal protection circuit, keep the switching (safety) signal isolated from all other signals.

- Insulation of the sensor circuit

When you connect the temperature sensor(s) of the Ex motor to the drive STO terminals through a relay, make sure that there is reinforced (double) insulation between the main circuit (motor) and the drive control unit as required by IEC 61800-5-1. The insulation of the temperature sensor in the Ex motor and the insulation of the protection relay form the insulation of the whole circuit. All Ex motors manufactured by ABB have basic insulation between the main circuit and the temperature sensor.

- General wiring instructions

1. Install only the sensor circuit into the potentially explosive atmosphere. 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, Ex e in EN 60079-7:2007 and IEC 60079-7:2006)
2. Install the drive or inverter unit, including the components of the ATEX-certified motor thermal protection function, outside the potentially explosive atmosphere.
3. For the sensor connection, ABB recommends to use shielded twisted-pair cable. This type of cable decreases electromagnetic interference in the sensor circuit.
4. Route the sensor cables away from the motor cable. Power cables can cause electromagnetic interference in the sensor circuit.
5. Ground all sensor cable shields to a single grounding point outside the potentially explosive atmosphere. 360-degree grounding of the cable shields is recommended. Do not connect the cable shields to ground at the sensor end of the cable.
6. Connect the control cable shields to the chassis only.
Note: ABB recommends to use shielded twisted-pair cable for the connection between the protection relay and drive control unit when:
• the drive is not installed into a cabinet, or
• the drive is not installed into the same cabinet as the protection relay.
Contents of this chapter

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

Drive / inverter

- **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 drive 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 temperature 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 unit when STO is activated.
  - *Fault/Warning*: This generates a fault in the drive/inverter unit when the drive is running and warning when the drive is stopped.
When the drive/inverter unit generates a fault indication because of STO activation, you must reset the drive/inverter unit 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**.

### 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 1*) is configured to monitor digital input DI6. 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 shows the status of the external event: set parameter **31.01 External event 1 source** to DI6. You can also use another digital input.
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. You can use the control panel or Drive composer PC tool to edit messages.

#### Example 2

In this example, the motor temperature is read from digital input DI6.

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.
2. By default, an excessive temperature will generate a warning. If you want a fault instead, set parameter **35.12 Temperature 1 fault limit** to 4000 ohm.
3. If necessary, edit the indication message. You can use the control panel or Drive composer PC tool to edit messages.

For more information, see [ACS880 primary control program firmware manual](https://www.abb.com/global/en/services/servicemanuals) (3AUA0000085967 [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**

  ABB recommends 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 the parameters according to the system requirements. Example values are shown in this section.

You need the Drive composer pro PC tool to set the FSO module parameters. You also need 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 applicable FSO module user’s manual. For more information on the Drive composer pro PC tool, see Drive composer start-up and maintenance PC tool user’s manual (3AU0000094606 [English]).

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

There are parameters that you must always set when you use the FSO module, and parameters that are related only to some safety functions. This section lists the parameters that are relevant to the option +Q971. The example values apply to the two-channel wiring example in section Connection diagram (two-channel connection) (page 21). The protection relay is connected to digital inputs X113:1 and X114:1 of the FSO module.

You can use an FSO-21 module with a safety pulse encoder and the FSE-31 pulse encoder interface module. If you do, set the parameters listed in section FSE module and safety pulse encoder parameters (page 33).

You can configure the FSO module so that it opens the drive or inverter STO circuit immediately (STO function in the FSO module, stop category 0) or after a deceleration ramp (SS1 function in the FSO module, 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. Select the stop category according to the system risk assessment. Do not configure the STO function and the SS1 function to the same input at the same time.

**Note:** Setting parameters related to STO and SS1 can also have an effect on other safety functions. You must take all safety functions into consideration when you configure the FSO module. See the applicable FSO module user’s manual and safety option user’s manual.

**Note:** The factory reset of the FSO module clears the configuration and sets the parameters to the factory default values. These values are not the same as the pre-set values in an FSO module that was ordered as an option (with a plus code). You cannot restart the drive with the factory default values. If you do a factory reset of the FSO module, you must reconfigure the FSO module and set the applicable parameters. See the applicable FSO module user’s manual.

### General parameters

These parameters are common to all safety functions in the FSO 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>1500.0 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>50.00 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>
## 28 Parameter settings

<table>
<thead>
<tr>
<th>Index</th>
<th>Name</th>
<th>Example value</th>
<th>Description</th>
</tr>
</thead>
</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*. |
| FSOGEN.42| Acknowledgement button input  | None or eg. DI X113:2 | Sets the digital input for the acknowledgement signal when parameter STO.02 has value *Manual*.  
*None*: No acknowledgement signal connected/required (parameter STO.02 has value *Automatic*).  
*DI X113:2*: The acknowledgement signal (reset circuit) is connected to this digital input.  
In the safety function described in this manual, you can use this parameter to implement a manual reset in the FSO module. |
| FSOGEN.51| Zero speed without encoder    | 90.0 rpm      | 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 the drive STO function when the drive has decelerated the motor speed below this value. Adjust the default value according to application requirements. |
| FSOGEN.52| Zero speed with encoder       | 0.0 rpm       | Sets the general zero speed limit for safety functions when a safety encoder is in use.  
*STO function*: The drive STO function is active (cannot be reset) until the motor speed is less than or equal to this value.  
*SS1 function*: The FSO module activates the drive STO function when the drive has decelerated the motor speed to less than this value. Adjust the default value according to application requirements.  
**Note**: This parameter is used only with FSO-21 and when a safety encoder is used in the application. |
| FSOGEN.61| STO indication ext request    | Warning       | 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 unit.  
*Fault*: You have to reset the drive/inverter unit.  
In the safety functions described in this manual, you can use this indication as the motor overtemperature indication message and to implement a manual reset. Adjust the default value when necessary. |
**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. Also, 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>
<tbody>
<tr>
<td>STO.02</td>
<td>STO acknowledge-</td>
<td>Automatic or</td>
<td>Sets the acknowledgement method used in the STO,</td>
</tr>
<tr>
<td></td>
<td>ment</td>
<td>Manual</td>
<td>SSE and SS1 functions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Automatic</em>: The FSO module resets the STO function automatically after the STO request is removed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Manual</em>: The FSO module reads the external acknowledgement signal through the digital input defined by parameter FSOGEN.42. In the safety functions described in this manual, you can use this setting to implement a manual reset for the motor temperature protection function in the FSO module.</td>
</tr>
<tr>
<td>STO.11</td>
<td>STO input A</td>
<td>STO; DI X113:1 &amp; X114:1</td>
<td>Sets the digital input that is connected to the primary input of the STO function.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SS1: None</td>
<td>If you set this parameter to DI X113:1 &amp; X114:1, set parameter SS1.11 to None.</td>
</tr>
<tr>
<td>STO.12</td>
<td>STO input B</td>
<td>None</td>
<td>Sets the digital input that is connected to the secondary input of the STO function.</td>
</tr>
<tr>
<td>STO.13</td>
<td>Restart delay after STO</td>
<td>2000 ms</td>
<td>Sets the time after which the drive can restart when the FSO module has activated the STO function and opened the drive STO circuit. With this parameter, you can let the drive restart before the motor has stopped (fly-start). This parameter is applicable only if the STO function is requested from STO input A (STO.11) or STO input B (STO.12).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>STO function</em>: Adjust the 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.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>SS1 function</em>: This value has no effect.</td>
</tr>
</tbody>
</table>
Setsthetimethatisneededtocoastthemotortoa standstillfrommaximumprocessspeed. If this time is not known, it can be measured with Drive composer pro PC tool when an encoder is used for motor control (otherwise you have to make sure that the motor shaft has stopped rotating by other means, eg, visually).

Acknowledgement is allowed after coast stop in the STO, SSE and SS1 functions (when SBC is not used). If the drive STO is activated or modulation stopped while a monitoring safety function is indicating “unsafe”, after this time acknowledgement is allowed. For example, if the drive modulation is lost during SLS deceleration ramp, SLS OK will be indicated after this time has elapsed.

STO function: This parameter sets the time after which the STO function is completed and the STO completed indication goes on. Parameter STO.13 defines the time after which the acknowledgement is allowed. Adjust the value according to application requirements.

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 according to application requirements.

When an encoder is used: This parameter is relevant only if there is an encoder failure and the FSO module activates the STO function.

<table>
<thead>
<tr>
<th>Index</th>
<th>Name</th>
<th>Example value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>STO.14</td>
<td>Time to zero speed with STO and modoff</td>
<td>2000 ms</td>
<td>Sets the time that is needed to coast the motor to a standstill from maximum process speed. If this time is not known, it can be measured with Drive composer pro PC tool when an encoder is used for motor control (otherwise you have to make sure that the motor shaft has stopped rotating by other means, eg, visually). Acknowledgement is allowed after coast stop in the STO, SSE and SS1 functions (when SBC is not used). If the drive STO is activated or modulation stopped while a monitoring safety function is indicating “unsafe”, after this time acknowledgement is allowed. For example, if the drive modulation is lost during SLS deceleration ramp, SLS OK will be indicated after this time has elapsed. STO function: This parameter sets the time after which the STO function is completed and the STO completed indication goes on. Parameter STO.13 defines the time after which the acknowledgement is allowed. Adjust the value according to application requirements. 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 according to application requirements. When an encoder is used: This parameter is relevant only if there is an encoder failure and the FSO module activates the STO function.</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.11</td>
<td>STO SBC usage</td>
<td>None</td>
<td>Sets how the mechanical brake is used together with the STO function. In the safety functions described in this manual, this feature is not used and this parameter has value None.</td>
</tr>
</tbody>
</table>

I/O settings

<table>
<thead>
<tr>
<th>Index</th>
<th>Name</th>
<th>Example value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAFEIO.33</td>
<td>DI X113:1 diag pulse on/off</td>
<td>On ¹)</td>
<td>Sets the diagnostic pulse of digital input X113:1 on or off. On: The input monitors that it receives test pulses. In this example (see section Connection diagram (two-channel connection) (page 21)), the STO/SS1 request is connected to this digital input.</td>
</tr>
<tr>
<td>SAFEIO.37</td>
<td>DI X114:1 diag pulse on/off</td>
<td>On ¹)</td>
<td>Sets the diagnostic pulse of digital input X114:1 on or off. On: The input monitors that it receives test pulses. In this example (see section Connection diagram (two-channel connection) (page 21)), the STO/SS1 request is connected to this digital input.</td>
</tr>
</tbody>
</table>

¹) The safety data in this manual is based on the assumption that this diagnostic measure for the wiring is active (On). If pulsing is disabled, you must consider other measures to ensure sufficient diagnostic coverage of the failures in wiring.
### 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 manual 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>
</table>
| SSE.13| SSE function | Immediate STO or Emergency ramp | Sets the type of the SSE function.  
Immediate STO: The FSO module activates the drive STO function immediately after the SSE request (stop category 0).  
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 (stop category 1). SAR0 parameters define the deceleration ramp (for more information, see the FSO module user’s manual). |

#### SBC usage

<table>
<thead>
<tr>
<th>Index</th>
<th>Name</th>
<th>Example value</th>
<th>Description</th>
</tr>
</thead>
</table>
| SBC.15| SSE/SS1 SBC speed      | 0.0 rpm       | Sets the absolute speed below which the FSO module activates the brake (SBC) while ramping.  
0.0 rpm: The feature is not in use.  
In the safety functions described in this manual, this feature is not used. Make sure that the value is 0.0 rpm. |

### Parameters for the SS1 function

Set these parameters only if you want that the FSO module activates the SS1 function in overtemperature situations (stop category 1).

<table>
<thead>
<tr>
<th>Index</th>
<th>Name</th>
<th>Example value</th>
<th>Description</th>
</tr>
</thead>
</table>
| SS1.01| SS1 activity and version     | Version 1     | 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. |
| SS1.11| SS1 input A                  | STO: None     | Sets the digital input that is connected to the primary input of the SS1 function.  
If you set this parameter to `DI X113:1 & X114:1`, set parameter `STO.11` to `None`. |
| SS1.12| SS1 input B                  | None          | Sets the digital input that is connected to the secondary input of the SS1 function. |
| SS1.13| SS1 type                     | SS1-t or SS1-r| Sets the method used for the SS1 monitoring. Adjust the default value when necessary.  
Time monitoring (SS1-t): The FSO module monitors that a user-defined deceleration time limit is not exceeded. (See parameter `SS1.14`.)  
Ramp monitoring (SS1-r): 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`.) |
### 32 Parameter settings

<table>
<thead>
<tr>
<th>Index</th>
<th>Name</th>
<th>Example value</th>
<th>Description</th>
</tr>
</thead>
</table>
| SS1.14| SS1-t delay for STO           | 20000 ms      | Sets the monitoring 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>200.112</th>
<th>SAR1 ramp time to zero</th>
<th>2000 ms</th>
<th>Sets the target time for the stop ramp SAR1 that is used in the SS1 and function. Adjust the default value when necessary.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>The target time is the time in which the drive decelerates the motor from the speed defined by parameter <code>200.202</code> to zero.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Note:</strong> With value 0 ms, the drive uses the emergency stop ramp set by drive parameter <code>23.23</code> (see section <code>SS1 ramp parameters in the drive/inverter unit (page 33)</code>). Also in this case, the FSO module only monitors the actual ramp (ramp monitoring or time monitoring).</td>
</tr>
<tr>
<td>200.202</td>
<td>SAR speed scaling</td>
<td>1500 rpm</td>
<td>Sets a speed value that the FSO module uses as a reference point in ramp parameter calculations (see SAR1 ramp parameters <code>200.112</code>, <code>SARx.21</code>, <code>SARx.22</code> and <code>SARx.02</code>). Adjust the default value when necessary.</td>
</tr>
</tbody>
</table>
| SARx.02| 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. |
| SARx.21| SAR1 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.                                                                                                                                              |
| SARx.22| SAR1 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 unit

Set these parameters only for the SS1 function.

If FSO parameter 200.112 is set to 0 ms, 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 drive firmware manual and FSO module user's manual.

### FSE module and safety pulse encoder parameters

Set these parameters only when you use a safety pulse encoder and the FSE-31 pulse encoder interface module with the FSO-21 module.

<table>
<thead>
<tr>
<th>Index</th>
<th>Name</th>
<th>Example value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>200.231</td>
<td>FSE 3X act and par version</td>
<td>Version 1</td>
<td>Activates the FSE-31 encoder interface and shows the version of the encoder parameter groups (91 and 92).</td>
</tr>
<tr>
<td>200.232</td>
<td>Number of encoders</td>
<td>Single encoder CH1</td>
<td>Shows the number of safety pulse encoders connected to the FSE module.</td>
</tr>
<tr>
<td>S_ENCGEN.01</td>
<td>Safe pulse encoder version</td>
<td>Version 1</td>
<td>Activates the safety pulse encoder and shows the version parameter group S_ENCGEN.</td>
</tr>
<tr>
<td>S_ENCGEN.11</td>
<td>FSE diagnostic failure reaction</td>
<td>STO</td>
<td>Sets the action taken when there is a problem with the FSE module. STO: The FSO module goes into the Fail-safe mode and activates the drive STO function.</td>
</tr>
<tr>
<td>S_ENCGEN.14</td>
<td>Enc speed cross comp tolerance</td>
<td>1.0 rpm</td>
<td>Sets the encoder speed cross comparison tolerance. This defines how much the axle speed of the motor can change within 1 ms. Adjust the default value to meet the motor in use. This parameter is used for the encoder diagnostic. It defines the maximum difference between the speed information from channel A and B of the encoder. If the difference of these two values is more than defined by this parameter, FSO will safely stop the system (STO). The suitable value depends on the configuration (motor and load). Typically this value is between 2...10 rpm. A value that is too small will cause an encoder fault (A7D8). A value that is too big will prevent the encoder diagnostic related to this parameter.</td>
</tr>
<tr>
<td>S_ENCGEN.41</td>
<td>Gear numerator encoder 1</td>
<td>1</td>
<td>Sets the rotation direction for the safety pulse encoder. With this parameter, you can change the rotation direction of the motor. Adjust the default value if necessary.</td>
</tr>
</tbody>
</table>
### Parameter settings

<table>
<thead>
<tr>
<th>Index</th>
<th>Name</th>
<th>Example value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>91.11</td>
<td>Module 1 type</td>
<td>FSE-31</td>
<td>Sets the type of the safety pulse encoder interface module 1.</td>
</tr>
<tr>
<td>91.12</td>
<td>Module 1 location</td>
<td>2</td>
<td>Sets the slot in which the safety pulse encoder interface module 1 is located.</td>
</tr>
<tr>
<td>92.01</td>
<td>Encoder 1 type</td>
<td>HTL1</td>
<td>Activates or deactivates the communication with the safety pulse encoder interface module 1 and sets the type for the safety pulse encoder.</td>
</tr>
<tr>
<td>92.02</td>
<td>Encoder 1 source</td>
<td>Module 1</td>
<td>Sets the safety pulse encoder interface module that the safety pulse encoder 1 is connected to.</td>
</tr>
<tr>
<td>92.10</td>
<td>Pulses/revolution</td>
<td>2048</td>
<td>Sets the number of HTL pulses per revolution for safety pulse encoder 1. Adjust the default value to meet the safety pulse encoder in use. Make sure that the value is according to the encoder nameplate.</td>
</tr>
<tr>
<td>92.17</td>
<td>Accepted pulse freq of encoder 1</td>
<td>300 kHz</td>
<td>Sets the maximum pulse frequency range of encoder 1. Adjust the default value to meet the motor and safety pulse encoder in use. You can use this formula to define the value: $r_{\text{max}} \cdot \text{ppr}_{\text{enc}} + 10%$, where</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• $r_{\text{max}}$: the maximum motor speed (rpm) used in the application (or the motor nominal speed)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• $\text{ppr}_{\text{enc}}$: pulses/revolution of the safety pulse encoder (parameter 92.10).</td>
</tr>
</tbody>
</table>

### 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 Ex zone, make sure that the use of the brake does not increase the temperature too much. In this case, make sure that the mechanical brake is activated only at zero speed (see parameters SBC.11, SBC.15 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 too high.

For more information, see the drive firmware manual (or the FSO module user's manual if you use the Safe brake control (SBC) function of the FSO module).
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>Standards</th>
<th>Description</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></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>EN 61800-5-2:2007</td>
<td>Adjustable speed electrical power drive systems – Part 5-2: Safety requirements</td>
</tr>
<tr>
<td>IEC 61800-5-2:2016</td>
<td>– Functional</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 1:Framework, definitions, system, hardware and application programming requirements</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 section *One-channel or two-channel connection to an FSO module (page 20).*

**Note:**
- The PFD values of the drive STO and the FSO and FSE-31 modules are based on T1 (proof test interval) of 2 or 5 years. The safety data and SIL capability are valid only when proof testing is done with an interval of maximum 2 or 5 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 (page 27)* 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 over temperature 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 (page 27)* 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>SIL capability</th>
<th>One-channel pulsed digital input</th>
<th>Two-channel pulsed digital input</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFH (1/h, T1 = 20 a)</td>
<td>1.10E-08</td>
<td>1.05E-08</td>
</tr>
<tr>
<td>PFDavg (T1 = 2 a)</td>
<td>9.05E-05</td>
<td>8.57E-05</td>
</tr>
<tr>
<td>PFDavg (T1 = 5 a)</td>
<td>2.17E-04</td>
<td>2.06E-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>
<tr>
<td>TM (a)</td>
<td>20</td>
<td>20</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**

1. Customer motor sensor(s)
2. Customer protection relay(s)
3. FSO module
4. FSE module (optional)
5. Drive STO

**Two-channel digital input**

1. Customer motor sensor(s)
2. Customer protection relay(s)
3. FSO module
4. FSE module (optional)
5. 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

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Specific marking of explosion protection</td>
</tr>
<tr>
<td>3</td>
<td>Equipment group II: Product for surface industry (other than mining applications)</td>
</tr>
<tr>
<td>4</td>
<td>Equipment category 2. Parentheses show that the drive (or inverter unit) 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 +L521 (FSO-21 & FSE-31)

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

6. Manufacturers:
   ABB Oy Drives
   Hiomotie 13
   FIN-00381 Helsinki
   Finland

   ABB AS/LV Drives
   Aruküla tee 59
   Rae vald
   75301 Harjumaa
   Estonia

   ABB Oy Drives
   Drives Service
   Kiiutoradantie 14
   FI-01530 Vantaa
   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

[Signatures]

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 TüV Nord
Certificate No. SEBS-A.161334/16 V1.0 by TüV Nord
Certificate No. SEBS-A.102621/15 V1.0 by TüV 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>
</tr>
</tbody>
</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.
Declaration of Conformity

EU Declaration of Conformity

ATEX Directive 2014/34/EU

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

Frequency converters and frequency converter components
ACSB880-01, -11, -31
ACSB880-04, -04XT, -04F, -04FXT, -M04, -14, -34
ACSB880-104, -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:

| EN 50495:2010 | Safety devices required for the safe functioning of equipment with respect to explosion risks |

The following other standards have been applied:

| EN 61800-5-2:2007 | Adjustable speed electrical power drive systems – Part 5-2: Safety requirements - Functional |

Notified Body: Eurofins Expert Services Oy, Notified Body number: 0537, Address: Kivimiehetie 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.

1/2

3X221000118868 rev. G
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, 16 Dec 2019

Signed for and on behalf of:

Peter Lindgren
Vice President, ABB Oy

Tuomo Tarula
Vice President, ABB Oy

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.

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