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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

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/UKEX-certified motor thermal protection functions

Only qualified specialists are permitted to install, control and maintain the ATEX/UKEX-certified motor thermal protection functions (see IEC/EN 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).

Instructions for functional safety circuits



WARNING!

Obey the safety instructions of the drive. 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, commissioning or maintenance work.

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 safety function described in this manual does not isolate the main circuit or auxiliary circuit from the power supply. Do not do work on the drive, motor cable or motor before you have isolated the drive system from all power supplies and measured that there are no dangerous voltages. Before you start the work, do the electrical safety precautions in the drive safety instructions.



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

This manual is intended for people who install, commission, 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, functional safety, and 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 a Type examination certificate in accordance with the ATEX (and UKEX) Product Directive.

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 hardware and firmware manuals, 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 ATEX (and UKEX) Product Directive

The system integrator is responsible for the compliance of the complete motor thermal protection circuit with the ATEX (and UKEX) Product Directive. If the compliance of the system with the ATEX (and UKEX) 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/UKEX-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 IEC/EN 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, Ex regulations 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.

Quick reference guide for implementing a safety system

Task	<input checked="" type="checkbox"/>
Obey the requirements of the relevant standard(s) of the IEC/EN 60079 series for implementing the temperature protection function of the Ex motor.	<input type="checkbox"/>
Select an ATEX/UKEX-compliant protection relay that is compatible with the motor temperature sensor(s).	<input type="checkbox"/>
Design the safety system.	<input type="checkbox"/>
Connect the wiring. See the wiring instructions in this manual.	<input type="checkbox"/>
Set the parameters related to the safety function (as listed in this manual).	<input type="checkbox"/>
Do the validation test. You can find instructions for the validation test in this manual.	<input type="checkbox"/>
Document the validation test procedure. You can find the guidelines for the validation test report in this manual.	<input type="checkbox"/>

Terms and abbreviations

Term	Description
ATEX	Directives 2014/34/EU and 1999/92/EC are commonly referred to as the ATEX directives (from "Atmosphères Explosibles")
Drive	Frequency converter for controlling AC motors
Drive module	Frequency converter enclosed in a metal frame or enclosure. Intended for cabinet installation.
Ex	An IEC term used in the context of explosive atmospheres (IEC 60079)
Ex d	Type of protection, flameproof enclosures (IEC/EN 60079-1)
Ex eb, Ex ec	Types of protection, increased safety (IEC/EN 60079-7)
Ex motors	Motors used in explosive atmospheres
FSE-31	Optional pulse encoder interface module for safety encoder
FSO-21	Safety functions module which supports the FSE-31 module and the use of safety encoders
FSO-12	Safety functions module which does not support the use of encoders
HFT	Hardware fault tolerance (IEC 61508)
Inverter module	Inverter bridge, related components and drive DC link capacitors enclosed in a metal frame or enclosure. Intended for cabinet installation.
Inverter unit	Inverter module(s) under control of one control unit, and related components. One inverter unit typically controls one motor.
PFD _{avg}	Average probability of dangerous failure on demand (IEC 61508)
PFH	Average frequency of dangerous failures per hour (IEC 61508)
Proof test	Periodic test performed to detect failures in a safety-related system so that, if necessary, a repair can restore the system to an "as new" condition or as close as practical to this condition. (IEC 61508, IEC 62061)
SAR	Safe acceleration range
SBC	Safe brake control
SFF	Safe failure fraction (%) (IEC 61508)
SIL	Safety integrity level (1...3) (IEC 61508, IEC 62061, IEC 61800-5-2)
SS1	Safe stop 1 (IEC/EN 61800-5-2)
SSE	Safe stop emergency
STO	Safe torque off (IEC/EN 61800-5-2)
Stop category	There are three categories of stop functions defined by IEC/EN 60204-1: <ul style="list-style-type: none"> • stop category 0: an uncontrolled stop where power to the machine actuators is removed immediately (for example, 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. 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. (IEC 61800-5-2)
UKEX	The Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 2016 (+ amendment SI 2019 No. 696)
Zone	Potentially explosive atmosphere. Hazardous areas are divided into zones, based on the frequency and duration of the occurrence of an explosive atmosphere. (IEC/EN 60079-10)

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

Related manuals

Manual	Code
Drive hardware	
ACS880-01 drives (0.55 to 250 kW) hardware manual	3AUA0000078093
ACS880-04 drive modules (200 to 710 kW, 300 to 700 hp) hardware manual	3AUA0000128301
ACS880-04 single drive module packages hardware manual	3AUA0000138495
ACS880-04XT drive modules (500 to 1200 kW) hardware manual	3AXD50000025169
ACS880-04F drive modules hardware manual	3AXD50000034664
ACS880-04FXT drive module packages hardware manual	3AXD50000274444
ACS880-M04 Machinery drive hardware manual	3AXD50000028613
ACS880-11 hardware manual	3AXD50000045932
ACS880-31 hardware manual	3AXD50000045933
ACS880-14 and -34 single drive module packages hardware manual	3AXD50000022021
ACS880 multidrive cabinets and modules electrical planning instructions	3AUA0000102324
ACS880 liquid-cooled multidrive cabinets and modules electrical planning	3AXD50000048634
Inverter hardware	
ACS880-104 inverter modules hardware manual	3AUA0000104271
ACS880-104LC inverter modules hardware manual	3AXD50000045610
Drive firmware	
ACS880 primary control program firmware manual	3AUA0000085967
ACS880 primary control program quick start-up guide	3AUA0000098062
PC tools	
Drive Composer start-up and maintenance PC tool user's manual	3AUA0000094606
Functional safety design tool user's manual	3AXD10000102417
Safety	
ACS880 multidrive cabinets and modules safety instructions	3AUA0000102301
ACS880 liquid-cooled multidrive cabinets and modules safety instructions	3AXD50000048633
ABB Safety information and solutions	www.abb.com/safety
Motors and drives in potentially explosive atmospheres - What you need to know	3AUA0000037223
Using motors with drives in potentially explosive atmospheres	https://newabb.com/drives/segments/motors-and-drives-in-potentially-explosive-atmospheres
Options	
ACS-AP-I, -S, -W and ACH-AP-H, -W Assistant control panels user's manual	3AUA0000085685
ATEX-certified Safe disconnection function, Ex II (2) GD for ACS880 drives (option +Q971)	3AUA0000132231
FSO-12 safety functions module user's manual	3AXD50000015612
FSO-21 safety functions module user's manual	3AXD50000015614
FSE-31 pulse encoder interface module user's manual	3AXD50000016597
FPTC-02 ATEX-certified thermistor protection module, Ex II (2) GD (option +L537+Q971) for ACS880 drives user's manual	3AXD50000027782

Manual	Code
Other documents	
Circuit diagrams	Delivered with the drive
Part lists	Delivered with the drive

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Implementing a motor thermal protection circuit

Contents of this chapter

This chapter contains instructions on how to implement an ATEX/UKEX-compliant motor thermal protection circuit with the ATEX-certified Safe disconnection function (option +Q971) of the drive.

Overview

You can use the ATEX-certified Safe disconnection function (option +Q971) to implement an ATEX/UKEX-compliant motor thermal protection circuit. The ATEX-certified Safe disconnection function uses the drive/inverter Safe torque off (STO) function. For a description of the STO function, see the drive/inverter hardware manual. To comply with ATEX and UKEX certification requirements, you must obey the instructions for the STO function in the drive/inverter hardware manual.

You can implement the motor thermal protection circuit with or without an FSO module. The FSO module (FSO-12 or FSO-21) is an optional device used with ACS880 drives to implement additional 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 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.

In applications with Ex motor(s), multi-motor operation with a single drive or inverter unit is not permitted. Each drive or inverter unit, including the motor thermal protection circuit, can only control one motor.

You cannot connect the motor temperature sensor directly to the drive or FSO module. You must use an ATEX/UKEX-compliant protection relay in between.

As an alternative to an ATEX/UKEX-compliant protection relay, you can use the FPTC-02 ATEX-certified thermistor protection module, Ex II (2) GD (option +L537+Q971) to implement the ATEX/UKEX-compliant motor thermal protection function. For more information, see the FPTC-02 user's manual.

Note: The FPTC-02 module is compatible only with PTC sensors.

Operation principle

■ Without an FSO module

When the protection relay detects overtemperature in the motor, it opens the STO circuit of the drive. The motor coasts to a stop. The motor cannot start while the STO function is active. For example diagrams, see sections [Two-channel connection to drive STO terminals \(page 16\)](#) and [One-channel connection to drive STO terminals \(page 18\)](#).

■ With an FSO module

When the protection relay detects overtemperature in the motor, it de-energizes the FSO inputs, which activates the STO function (stop category 0) or SS1 function (stop category 1) of the FSO module. You must select the stop category according to the system risk assessment.

STO function: The FSO module opens the STO circuit of the drive. The motor coasts to a stop. The motor cannot start while the STO function is active.

SS1 function: The drive decelerates the motor to zero speed according to a user-defined ramp. The FSO module then opens the STO circuit of the drive. The motor cannot start while the STO function is active.

For example diagrams, see section [One-channel or two-channel connection to an FSO module \(page 20\)](#).

Two-channel connection to drive STO terminals

■ General

This section describes an implementation of the ATEX/UKEX-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 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/UKEX-compliant protection relay (recommended). Use the reset button of the relay, or connect an external reset button to the relay. You can also configure a manual reset in the drive.

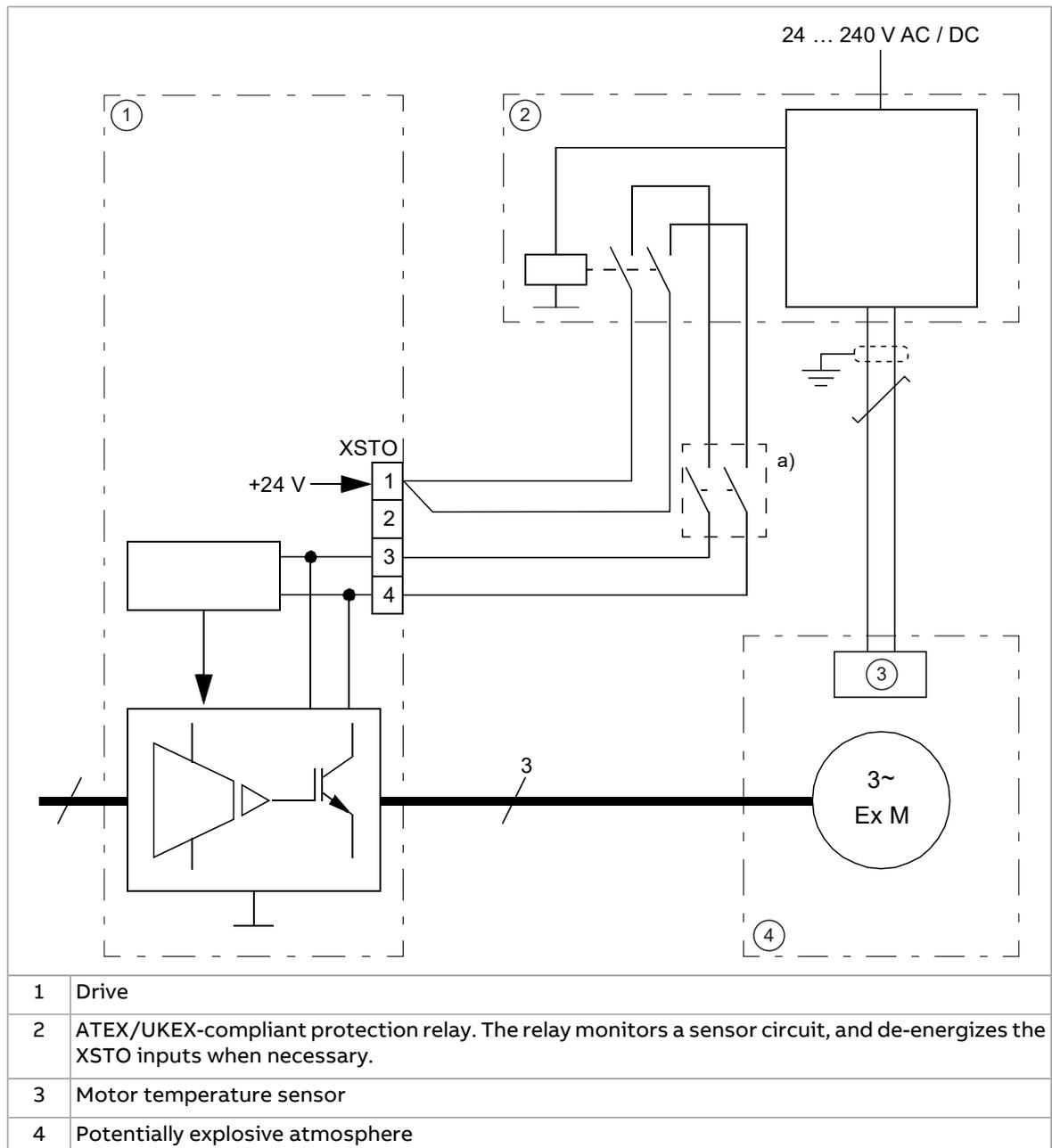
■ **Indications of the safety function**

In this example, you can use the drive STO indication to indicate the motor overtemperature.

Make sure that this indication generates a fault if the protection relay does not contain a manual reset. See section [Reset method and status indications \(page 25\)](#).

■ **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.



a)	<p>You can use the drive STO function for more than one external safety function at the same time (for example, ATEX/UKEX-compliant motor thermal protection and emergency stop). You must connect the STO activation switches or relays used in other safety functions in series with the protection relay.</p> <p>Note: If you use the drive STO function to implement several safety functions, all of them will generate the same STO indication when activated (defined by parameter <i>31.22</i>). If each safety function has a dedicated manual reset circuit in its safety relay, it is not necessary to configure an additional reset in the drive. If the ATEX/UKEX-compliant protection relay does not have a manual reset, parameter <i>31.22</i> must be set to <i>Fault/Fault</i>.</p>
----	--

One-channel connection to drive STO terminals

■ General

This section describes an implementation of the ATEX/UKEX-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 from the 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 is de-energized (the protection relay trips).

If you plan to use a one-channel (non-redundant) connection, make sure that you can reach the necessary safety integrity level (SIL). According to EN 50495, SIL 1 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 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/UKEX-compliant protection relay (recommended). Use the reset button of the relay, or connect an external reset button to the relay. You can also configure a manual reset in the drive.

■ Indications of the safety function

In this example, the indication of the safety function can come from these sources:

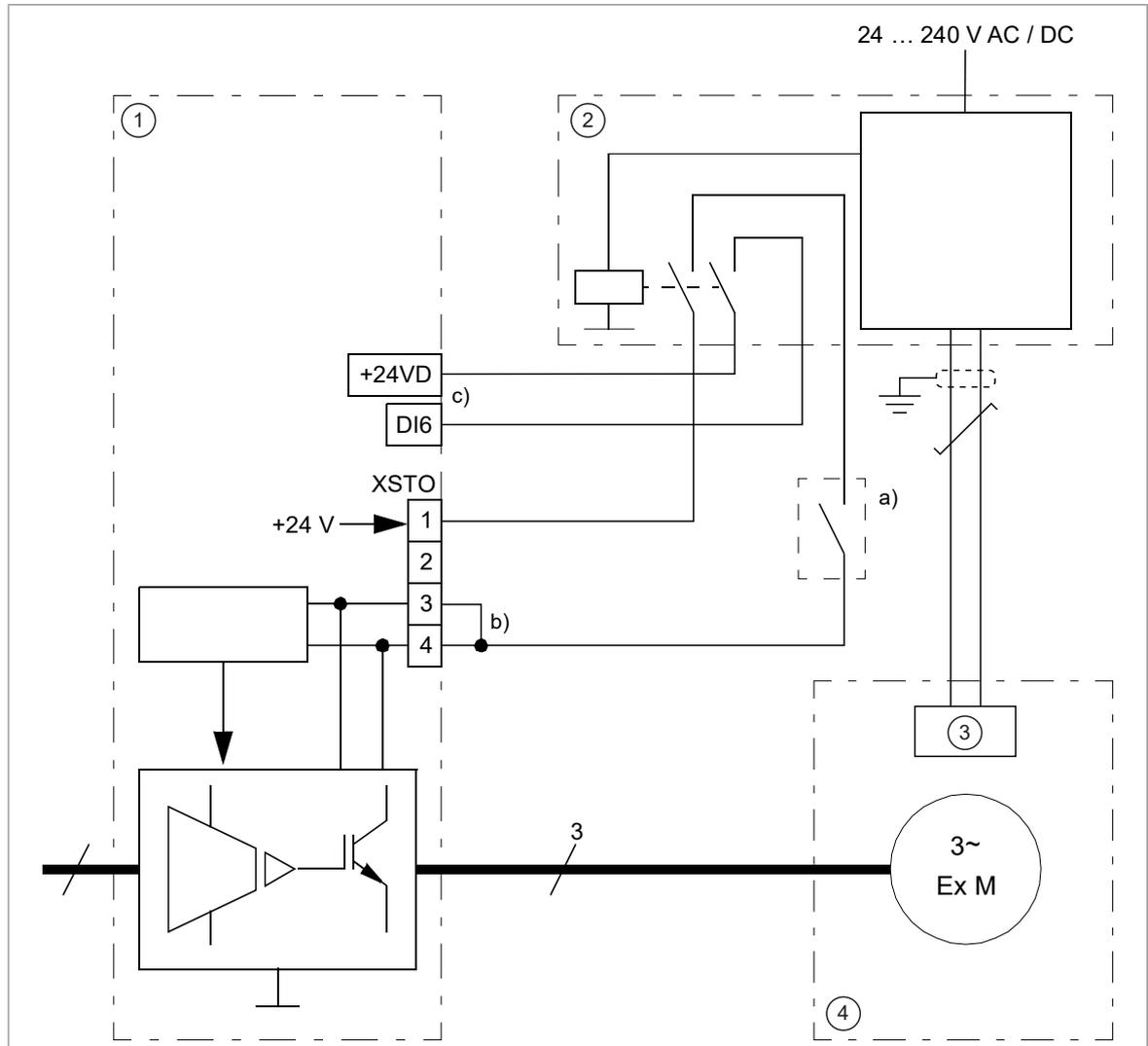
- the motor overtemperature indication (parameters **31.01...31.02**, **35.11...35.12**)
- the STO indication (parameter **31.22**)

To prevent parallel indications, you can set some indication parameters to value No indication, None or Event.

Make sure that at least one of these indications generates a fault if the protection relay does not contain a manual reset. See section [Reset method and status indications \(page 25\)](#).

■ **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/UKEX-compliant protection relay. The relay monitors a sensor circuit, and de-energizes the XSTO inputs when necessary.
3	Motor temperature sensor
4	Potentially explosive atmosphere
a)	You can use the drive STO function for more than one external safety function at the same time (for example, ATEX/UKEX-compliant motor thermal protection and emergency stop). You must connect the STO activation switches or relays used in other safety functions in series with the protection relay. Note: If you use the drive STO function to implement several safety functions, all of them will generate the same STO indication when activated (defined by parameter 31.22). If each safety function has a dedicated manual reset circuit in its safety relay, it is not necessary to configure an additional reset in the drive. If the ATEX/UKEX-compliant protection relay does not have a manual reset, parameter 31.22 must be set to <i>Fault/Fault</i> .
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 unit for the protection relay status indication. In this example, digital input DI6 is used.

One-channel or two-channel connection to an FSO module

■ General

This section describes two implementations of the ATEX/UKEX-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.

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, SIL 1 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 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/UKEX-compliant protection relay (recommended). Use the reset button of the relay, or connect an external reset button to the relay. You can also configure a manual reset in the drive.

■ Indications of the safety function

In this example, the indication of the safety function can come from these sources:

- the motor overtemperature indication (parameters 31.01...31.02, 35.11...35.12)
- the STO indication (parameter 31.22)
- the STO indication in the FSO module (FSO parameter FSOGEN.61).

To prevent parallel indications, you can set some indication parameters to value No indication, None or Event.

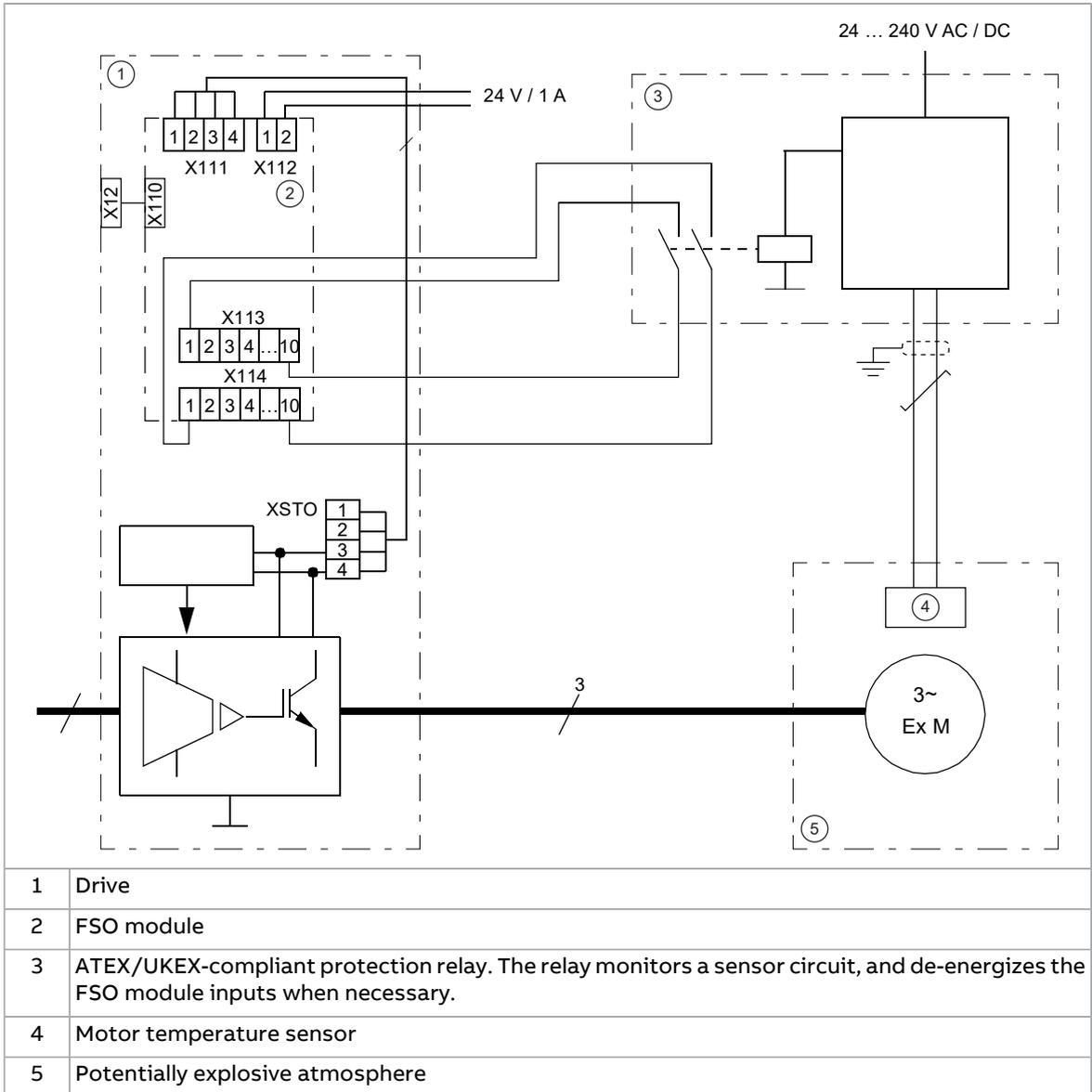
Make sure that at least one of these indications generates a fault if:

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

See sections [Reset method and status indications \(page 25\)](#) and [FSO module \(page 27\)](#).

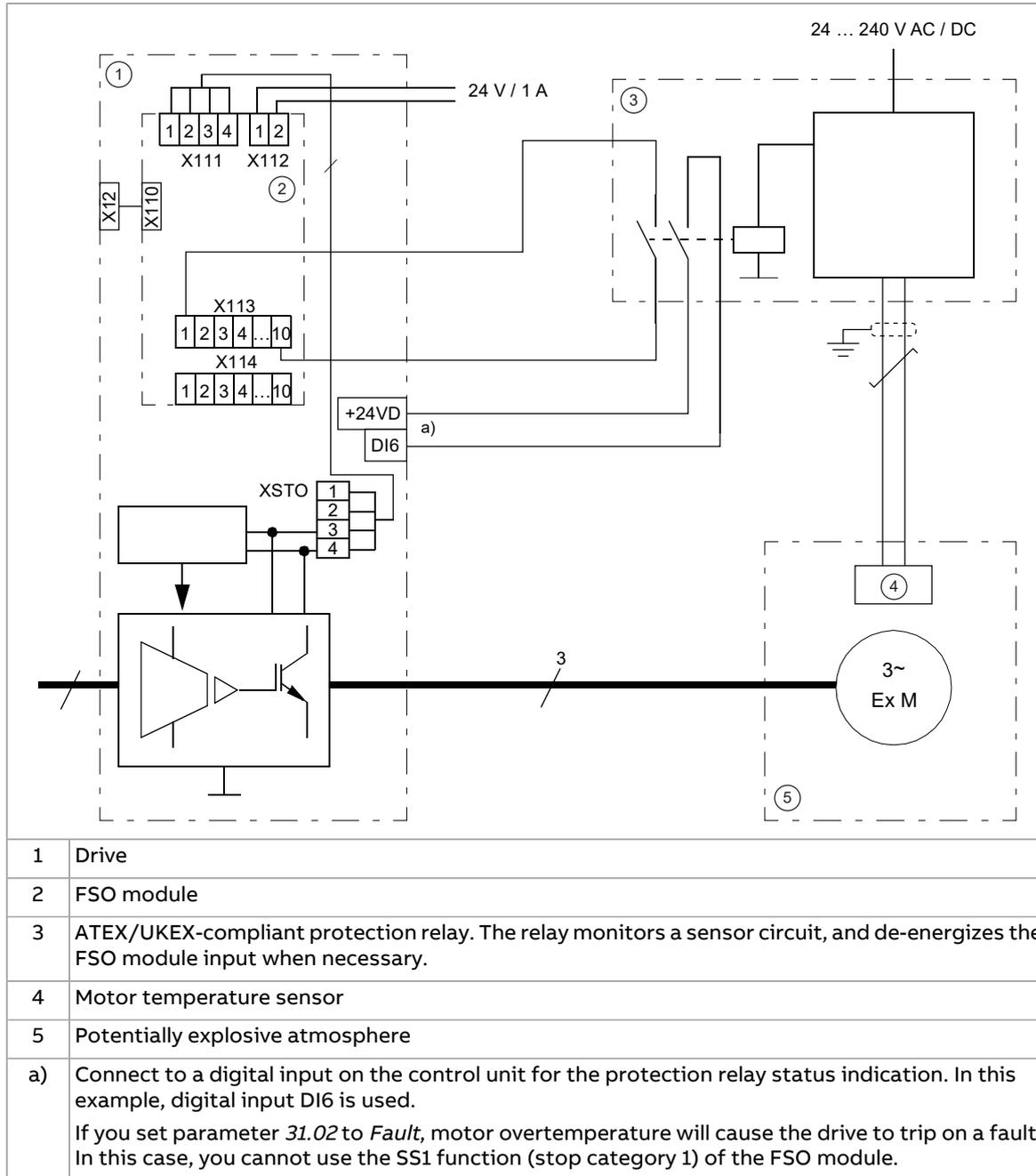
■ **Connection diagram (two-channel connection)**

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.



■ **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.



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/UKEX-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 (IEC/EN 60079-1)
 - Ex eb (IEC/EN 60079-7, Ex e in EN 60079-7:2007 and IEC 60079-7:2006)
 - Ex ec (IEC/EN 60079-7, Ex nA in IEC/EN 60079-15:2010).
 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 at the cable entry of the drive 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.
-

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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.
-

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Parameter settings

Contents of this chapter

This chapter lists the parameters that you have to set for the ATEX/UKEX-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, refer to 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) 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 the input is de-energized (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 value 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. If you use an FSO module and parameter 31.02 is set to Fault, you must configure the safety function in the FSO module so that it activates the STO function (stop category 0). The use of the SS1 stopping function is not possible with this motor overtemperature indication method.
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, the overtemperature indication is configured to give a warning. To generate 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 \(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.

The person who configures the safety functions in the FSO module must be a competent person as required by IEC 61508-1 clause 6. In this context, the person must have expertise and knowledge of functional safety, the safety functions and the configuration of the FSO module. ABB has training courses on the FSO module.

You must use 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 \(3AUA0000094606 \[English\]\)](#).

Note: When the drive is running/ modulating, you cannot change the password, adjust parameter values, or upload or download the FSO configuration file.

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 related to option +Q971. The example values are applicable 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.

If you use an FSO-21 module with a FSE-31 pulse encoder interface module and safety encoder, set the parameters listed in section [FSE module and safety 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, SSE 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 FSO module has a factory reset button. The factory reset button 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 all applicable parameters. Because of this, it is recommended to save the FSO safety file with the button **Save safety file** in the Drive Composer pro PC tool. For more information, see the FSO module user's manual and the Drive Composer PC tool user's manual.

■ General parameters

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

Index	Name	Example value	Description
FSOGEN.11	Stop completed output	None	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.
FSOGEN.21	Motor nominal speed	100.0 rpm	Sets the synchronous motor speed.
FSOGEN.22	Motor nominal frequency	50.00 Hz	Sets the nominal motor frequency. Adjust the default value to meet the ratings of the motor in use.
FSOGEN.41	Power-up acknowledgement	Automatic	<p>Sets the power-up acknowledgement method of the FSO module.</p> <p>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.</p> <p>Manual: The FSO module reads the external acknowledgement signal through the digital input defined by parameter FSOGEN.42.</p> <p>Make sure that the value is Automatic.</p>
FSOGEN.42	Acknowledgement button input	None or eg. DI X113:2	<p>Sets the digital input for the acknowledgement signal when parameter STO.02 has value Manual.</p> <p>None: No acknowledgement signal connected/required (parameter STO.02 has value Automatic).</p> <p>DI X113:2: The acknowledgement signal (reset circuit) is connected to this digital input.</p> <p>In the safety function described in this manual, you can use this parameter to implement a manual reset in the FSO module.</p>
FSOGEN.51	Zero speed without encoder	90.0 rpm	<p>Sets the general zero speed limit for safety functions when a safety encoder is not used.</p> <p><u>STO function</u>: The value has no effect.</p> <p><u>SS1 function</u>: The FSO module activates the drive STO function when the drive decelerates the motor speed below this value. Adjust the default value according to application requirements.</p>

Index	Name	Example value	Description
FSOGEN.52	Zero speed with encoder	0.0 rpm	<p>Sets the general zero speed limit for safety functions when a safety encoder is used.</p> <p>STO function: The drive STO function is active (cannot be reset) until the motor speed is less than or equal to this value.</p> <p>SS1 function: The FSO module activates the drive STO function when the drive decelerates the motor speed below this value. Adjust the default value according to application requirements.</p> <p>Note: This parameter is used only with FSO-21 and when a safety encoder is used in the application.</p>
FSOGEN.61	STO indication ext request	Warning	<p>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).</p> <p>None, Warning, Event: You do not have to reset the drive/inverter unit.</p> <p>Fault: You have to reset the drive/inverter unit.</p> <p>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.</p>
FSOGEN.62	STO indication safety limit	Fault	<p>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.</p> <p>STO function: The value has no effect.</p> <p>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. Adjust the default setting if necessary. If you select <i>Fault</i>, you must reset the drive before you can restart it.</p>

■ 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.

Index	Name	Example value	Description
STO.02	STO acknowledgement	Automatic or Manual	<p>Sets the acknowledgement method used in the STO, SSE and SS1 functions.</p> <p>Automatic: The FSO module resets the STO function automatically after the STO request is removed.</p> <p>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 manual, you can use this setting to implement a manual reset for the motor temperature protection function in the FSO module.</p>
STO.11	STO input A	<p>STO: DI X113:1 & X114:1</p> <p>SS1: None</p>	<p>Sets the digital input that is connected to the primary input of the STO function.</p> <p>If you set this parameter to DI X113:1 & X114:1, set parameter SS1.11 to None.</p>

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Index	Name	Example value	Description
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	<p>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 relevant only if the STO function is requested from STO input A (STO.11) or STO input B (STO.12).</p> <p><u>STO function:</u> Adjust the value when necessary. If you do not use the fly-start feature, set this parameter to the same value as parameter STO.14.</p> <p><u>SS1 function:</u> This value has no effect.</p>
STO.14	Time to zero speed with STO and mod-off	2000 ms	<p>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 the 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).</p> <p>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.</p> <p><u>STO function:</u> 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.</p> <p><u>SS1 function:</u> 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.</p> <p><u>When an encoder is used:</u> This parameter is relevant only if there is an encoder failure and the FSO module activates the STO function.</p>
SBC usage			
SBC.11	STO SBC usage	None	<p>Sets how the mechanical brake is used together with the STO function.</p> <p>In the safety functions described in this manual, this feature is not used and this parameter has value None.</p>
I/O settings			
SAFEIO.33	DI X113:1 diag pulse on/off	On ¹⁾	<p>Sets the diagnostic pulse of digital input X113:1 on or off. On: The input monitors that it receives test pulses.</p> <p>In this example, the STO/SS1 request is connected to this digital input.</p>

Index	Name	Example value	Description
SAFEIO.37	DI X114:1 diag pulse on/off	On ¹⁾	Sets the diagnostic pulse of digital input X114:1 on or off. On: The input monitors that it receives test pulses. In this example, the STO/SS1 request is connected to this digital input.

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 avoid 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.

Index	Name	Example value	Description
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			
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).

Index	Name	Example value	Description
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 SS1 : DI X113:1 & X114:1	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.

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Index	Name	Example value	Description
SS1.13	SS1 type	SS1-t or SS1-r	<p>Sets the method used for the SS1 monitoring. Adjust the default value when necessary.</p> <p><u>Time monitoring (SS1-t):</u> The FSO module monitors that a user-defined deceleration time limit is not exceeded. (See parameter SS1.14.)</p> <p><u>Ramp monitoring (SS1-r):</u> 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.)</p>
SS1.14	SS1-t delay for STO	20000 ms	<p>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.</p> <p><u>Time monitoring:</u> This value sets the security delay that the FSO module monitors. Adjust the default value when necessary.</p> <p><u>Ramp monitoring:</u> This value has no effect in the operation.</p>
SAR1 ramp settings			
200.112	SAR1 ramp time to zero	2000 ms	<p>Sets the target time for the stop ramp SAR1 that is used in the SS1 and function. Adjust the default value when necessary.</p> <p>The target time is the time in which the drive decelerates the motor from the speed defined by parameter 200.202 to zero.</p> <p>Note: With value 0 ms, the drive uses the emergency stop ramp set by drive parameter 23.23. See SS1 ramp parameters in the drive/inverter unit (page 33). Also in this case, the FSO module only monitors the actual ramp (ramp monitoring or time monitoring).</p>
200.202	SAR speed scaling	1500 rpm	<p>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.</p>
SARx.02	SAR initial allowed range	100 ms	<p>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.</p> <p><u>Time monitoring:</u> This value has no effect in the operation.</p> <p><u>Ramp monitoring:</u> Adjust the default value when necessary.</p>

Index	Name	Example value	Description
SARx.21	SAR1 min ramp time to zero	1000 ms	<p>Sets the minimum ramp time for the SAR1 ramp monitoring.</p> <p><u>Time monitoring:</u> This value has no effect in the operation.</p> <p><u>Ramp monitoring:</u> Sets the minimum stop ramp time for the emergency stop. Adjust the default value when necessary.</p> <p>Note: With value 0 ms, the minimum ramp is not monitored.</p>
SARx.22	SAR1 max ramp time to zero	3000 ms	<p>Sets the maximum ramp time for the SAR1 ramp monitoring.</p> <p><u>Time monitoring:</u> This value has no effect in the operation.</p> <p><u>Ramp monitoring:</u> Sets the maximum stop ramp time for the emergency stop. Adjust the default value when necessary.</p>
SBC usage			
SBC.15	SSE/SS1 SBC speed	0.0 rpm	<p>Sets the absolute speed below which the FSO module activates the brake (SBC) while ramping.</p> <p>0.0 rpm: The feature is not in use.</p> <p>In the safety functions described in this manual, this feature is not used. Make sure that the value is 0.0 rpm.</p>

SS1 ramp parameters in the drive/inverter unit

If you use the SS1 function (stop category 1) and set FSO parameter [200.112](#) to 0 ms, also set the drive parameters as follows:

- set 21.04 Emergency stop mode to Eme ramp stop (Off3)
- set 23.23 Emergency stop time according to application requirements.

If FSO parameter [200.112](#) is set to 0 ms, drive parameters define the stop ramp that is used in the SS1 function. Also, 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 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.

Index	Name	Example value	Description
200.231	FSE 3X act and par version	Version 1	Activates the FSE-31 encoder interface and shows the version of the encoder parameter groups (91 and 92).
200.232	Number of encoders	Single encoder CH1	Shows the number of safety encoders connected to the FSE module.
S_ENCGEN.01	Safe pulse encoder version	Version 1	Activates the safety encoder and shows the version parameter group S_ENCGEN.
S_ENCGEN.11	FSE diagnostic failure reaction	STO	<p>Sets the action taken when there is a problem with the FSE module or the safety encoder.</p> <p>STO: The FSO module goes into the Fail-safe mode and activates the drive STO function.</p>

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Index	Name	Example value	Description
S_ENCGEN.14	Enc speed cross comp tolerance	1.0 rpm	<p>Sets the encoder speed cross comparison tolerance. This defines how much the axle speed of the motor can change within 1 ms.</p> <p>Adjust the default value to meet the motor in use.</p> <p>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).</p> <p>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 large will prevent the encoder diagnostic related to this parameter.</p>
S_ENCGEN.41	Gear numerator encoder 1	1	<p>Sets the rotation direction for the safety encoder. With this parameter, you can change the rotation direction of the motor. Adjust the default value if necessary.</p>
91.11	Module 1 type	FSE-31	<p>Sets the type of the safety encoder interface module 1.</p>
91.12	Module 1 location	2	<p>Sets the slot in which the safety encoder interface module 1 is located.</p>
92.01	Encoder 1 type	HTL1	<p>Activates or deactivates the communication with the safety encoder interface module 1 and sets the type for the safety encoder.</p>
92.02	Encoder 1 source	Module 1	<p>Sets the safety encoder interface module that the safety encoder 1 is connected to.</p>
92.10	Pulses/revolution	2048	<p>Sets the number of HTL pulses per revolution for safety encoder 1.</p> <p>Adjust the default value to meet the safety encoder in use. Make sure that the value is according to the encoder nameplate.</p>
92.17	Accepted pulse freq of encoder 1	300 kHz	<p>Sets the maximum pulse frequency range of encoder 1. Adjust the default value to meet the motor and safety encoder in use. You can use this formula to define the value: $(r_max [rpm] / 60 \times ppr_snc [p/rev]) / 1000 + 10\%$, where</p> <ul style="list-style-type: none"> r_max: the maximum motor speed (rpm) used in the application (or the motor nominal speed) ppr_enc: pulses/revolution of the safety encoder (parameter 92.10).

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).

5

Start-up and validation test

Contents of this chapter

This chapter describes the start-up, validation test procedure, and validation of the safety function.

Validation of the safety functions

You must do a validation test to make sure that the safety function operates correctly and according to the safety requirements.

■ Competence

The person who does the validation test of the safety function must be a competent person with expertise and knowledge of the safety function and functional safety, as required by IEC 61508-1 clause 6 and Ex regulations. This person must document and sign the test procedures and report.

■ Validation procedure

If you use an FSO module in the safety system, you must validate the general settings of the FSO module and the safety encoder (if used) before you validate the safety function. Refer to the FSO module user's manual, chapter **Verification and validation**.

You must do the validation test using the checklist given in this manual and the validation test plan of the complete safety system:

- at the initial start-up of the safety function
 - after changes related to the safety function (wiring, components, safety function-related parameter settings, etc.)
 - after changes related to the power unit or its circuit boards
-



- after maintenance work related to the safety function
- at the proof test of the safety function.

The validation test must include at least the following steps:

- you must have a validation test plan
- you must test all commissioned functions for correct operation, from each operation location
- you must document all validation tests
- you must sign and store the validation test report for further reference.

■ Validation test reports

You must store the signed validation test reports in the logbook of the machine and in the explosion protection document under the scope of the ATEX User Directive 1999/92/EC or The Dangerous Substances and Explosive Atmospheres Regulations 2002 (UK). The report must include, as required by the referred standards:

- a description of the safety application (including a figure)
- a description and revisions of safety components that are used in the safety application
- a list of all safety functions that are used in the safety application
- a list of all safety-related parameters and their values
- documentation of start-up activities, references to failure reports and resolution of failures
- the test results for each safety function, checksums, date of the tests, and confirmation by the test personnel.

You must store any new validation test reports done due to changes or maintenance in the logbook of the machine and in the explosion protection document under the scope of the ATEX User Directive 1999/92/EC or The Dangerous Substances and Explosive Atmospheres Regulations 2002 (UK).

Start-up and validation test

Use the Drive composer PC tool or a control panel to do the validation test. If you use an FSO module, you must use the Drive composer pro PC tool.

Action	<input checked="" type="checkbox"/>
 WARNING! Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur.	<input type="checkbox"/>
Initial status	
Make sure that there is a safety requirement specification and a validation plan for the safety system.	<input type="checkbox"/>
Make sure that the required SIL level is achieved.	<input type="checkbox"/>
<u>With an FSO-21 and FSE-31 module:</u> If you use a safety encoder in the safety application, validate the safety encoder interface as described in <i>FSO-21 safety functions module user's manual</i> (3AXD50000015614 [English]), chapter <i>Verification and validation</i> .	<input type="checkbox"/>

Action	<input checked="" type="checkbox"/>
Make sure that the drive is ready for use, that is, you have done the tasks of the drive start-up procedure. See the hardware manual.	<input type="checkbox"/>
Make sure that the drive STO function is configured and validated. See the hardware manual.	<input type="checkbox"/>
<p><u>With an FSO module:</u> Make sure that the FSO STO function is configured and validated. Internal monitoring of the FSO module can trigger the STO function even if you have not defined an external request signal. The STO function must be validated before other safety functions.</p> <p>Note: If you use a safety encoder, and parameter <i>S_ENCGEN.11</i> is set to <i>Est switch not active load</i>, both STO function with speed estimate and STO function with encoder feedback must be tested - most importantly, the value of parameter <i>STO.14</i> must be set according to the application requirements.</p>	<input type="checkbox"/>
Checks and settings with no voltage connected	
Stop the drive and do the electrical safety precautions in the drive safety instructions.	<input type="checkbox"/>
Make sure that the classification of the motor thermal protection function (ATEX/UKEX-certified temperature protection relay and Safe disconnection function) corresponds to the Ex classification of the environment and the Ex motor.	<input type="checkbox"/>
The motor manufacturer selects the sensors for the motor temperature measurement. Make sure that the temperature on-off resistances match those of the protection relay. Also make sure that there is basic or reinforced insulation between the sensor and the motor main circuit.	<input type="checkbox"/>
Make sure that the installation of the motor temperature sensor complies with the requirements for the applicable type of protection. See section Wiring (page 23) .	<input type="checkbox"/>
Make sure that the wires are connected to the correct terminals and that the terminal connections are tightened to the correct torque.	<input type="checkbox"/>
Settings with voltage connected	
Set the parameters related to the safety function. See chapter Parameter settings (page 25) .	<input type="checkbox"/>
Configure the motor overtemperature and STO indications. See section Reset method and status indications (page 25) .	<input type="checkbox"/>
If a manual reset is not implemented in the protection relay(s), make sure that the drive (or FSO module) is configured for a manual reset of the safety function.	<input type="checkbox"/>
Validation test	
<p>Do a short-circuit detection test: cause a short-circuit in the sensor circuit. Make sure that the drive STO is activated and that the correct indications are shown.</p> <p><u>Inverter units with parallel R8i inverter modules:</u> Make sure that STO is activated in each inverter module.</p>	<input type="checkbox"/>
<p>Do a wire break detection test: disconnect the sensor circuit. Make sure that the drive STO is activated and that the correct indications are shown.</p> <p><u>Inverter units with parallel R8i inverter modules:</u> Make sure that STO is activated in each inverter module.</p>	<input type="checkbox"/>
<p>Do an overtemperature monitoring test: increase the resistance of the sensor circuit above the trip limit. Make sure that the drive STO is activated and that the correct indications are shown.</p> <p><u>Inverter units with parallel R8i inverter modules:</u> Make sure that STO is activated in each inverter module.</p>	<input type="checkbox"/>
With the drive in the tripped state, try to start the drive. Make sure that it does not start before you have reset the protection relay and/or the faults in the drive.	<input type="checkbox"/>



40 Start-up and validation test

Action	<input checked="" type="checkbox"/>
Make sure that the drive generates none of these faults: <ul style="list-style-type: none">• STO hardware failure (5090)• Safe torque off 1 loss (FA81)• Safe torque off 2 loss (FA82) If the drive generates these faults, refer to <i>ACS880 primary control program firmware manual</i> (3AUA0000085967 [English]).	<input type="checkbox"/>
Create a backup file of the drive parameters with the Drive composer PC tool or control panel.	<input type="checkbox"/>
If you use an FSO module, save the FSO safety file (button Save safety file in the Drive composer pro PC tool).	<input type="checkbox"/>
Fill in and sign the validation test report. Store the report in the logbook of the machine.	<input type="checkbox"/>





Technical data

Contents of this chapter

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

Related standards and directives

EN 50495:2010	Safety devices required for the safe functioning of equipment with respect to explosion risks
IEC 61508:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems. Part 1 – General Requirements Part 2 – Requirements for electrical/electronic/programmable electronic safety-related systems
EN 61800-5-2:2007 IEC 61800-5-2:2016	Adjustable speed electrical power drive systems – Part 5-2: Safety requirements – Functional
EN IEC 62061:2021	Safety of machinery – Functional safety of safety-related control systems
IEC 61511-1:2017 Ed.2.1	Functional safety – Safety instrumented systems for the process industry sector – Part 1: Framework, definitions, system, hardware and application programming requirements
2014/34/EU	ATEX Product Directive (EU)
	Supply of Machinery (Safety) Regulations 2008 (UK)
	The Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 2016 (+ amendment SI 2019 No. 696) (UK)

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 [One-channel or two-channel connection to an FSO module \(page 20\)](#).

Note:

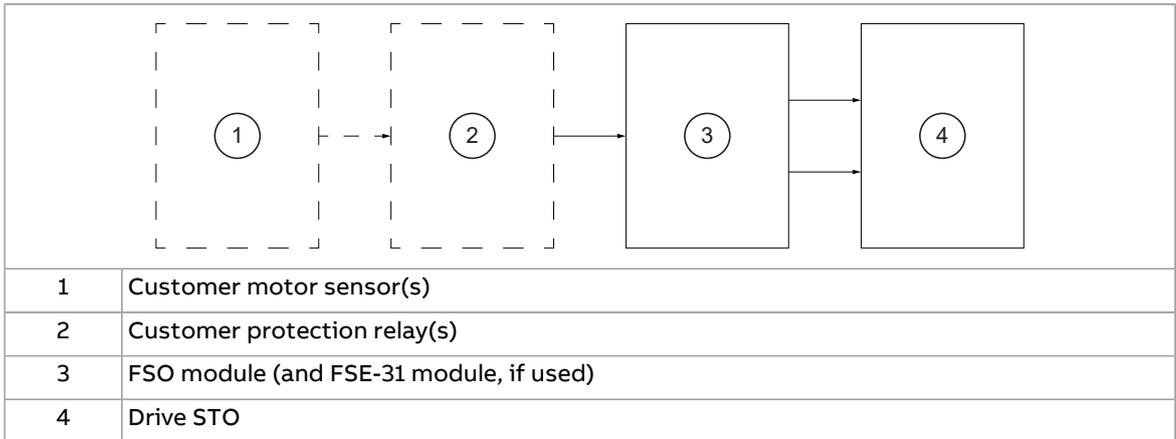
- The PFD values of the drive STO and the FSO and FSE-31 modules are based on T1 (proof test interval) of 2 or 5 years. The safety data and SIL capability are valid only when proof testing is done with an interval of maximum 2 or 5 years.
- The safety data in the table is valid only when parameter settings 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 for the FSO module.
- 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 SIL 3 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.

	One-channel connection	Two-channel connection
SIL capability	3	3
PFH (1/h)	2.27E-08	2.26E-08
PFD_{avg} (T₁ = 2 a)	1.55E-04	1.55E-04
PFD_{avg} (T₁ = 5 a)	3.41E-04	3.41E-04
SC	3	3
T_M (a)	20	20
		3AXD10000113948 M

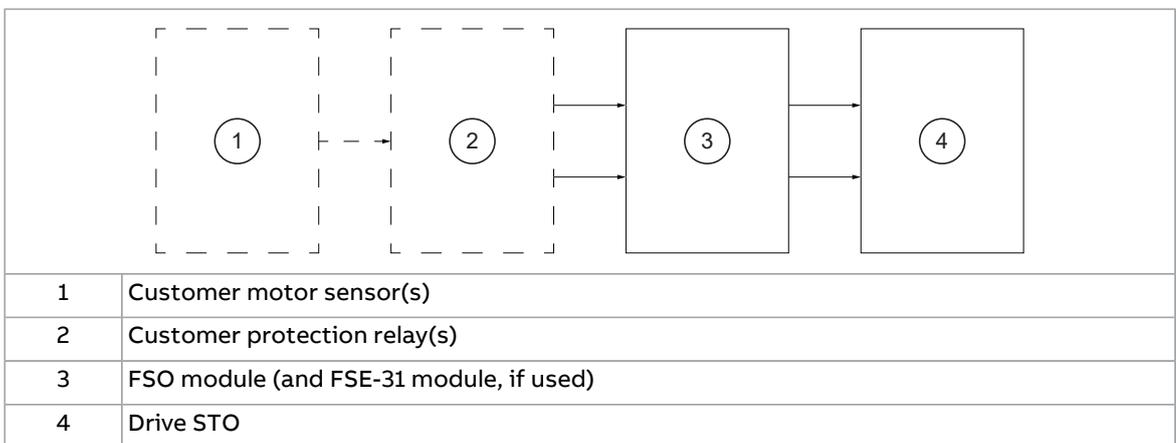
Safety block diagrams

The safety block diagrams show the components that are included in the safety data calculations. The dashed line identifies a component that is not included in the safety data calculations shown in this manual. See [One-channel or two-channel connection to an FSO module \(page 20\)](#).

One-channel digital input



Two-channel digital input



■ 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

1	CE marking with Notified Body identification: The manufacturer declares that the product conforms with ATEX Product Directive 2014/34/EU. Notified Body: Eurofins Expert Services
2	UKCA marking with Approved Body identification: The manufacturer declares that the product conforms with The Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 2016 (+ amendment SI 2019 No. 696). Approved Body: Eurofins E&E CML Limited
3	Specific marking of explosion protection
4	Equipment group II: Product for surface industry (other than mining applications)
5	Equipment category 2. Parentheses show that the drive (or inverter unit) must be installed outside the potentially explosive atmosphere.
6	Certified for use in explosive atmospheres caused by: G = gases, vapors or mists, D = dust.
7	Certificate references
3AXD50000003122 E	

ATEX certificate



EESF 20 ATEX 048X Issue 1
Page 1 of 2

1. **EU-TYPE EXAMINATION CERTIFICATE**
2. **Equipment or Protective System Intended for use in Potentially explosive atmospheres
Directive 2014/34/EU**
3. EU-Type Examination Certificate Number: **EESF 20 ATEX 048X Issue 1**
4. Product: **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. Manufacturer: **ABB Oy Drives**
6. Address: **Hiomotie 13, 00380 Helsinki, Finland**
 Additional manufacturing locations:
ABB AS, Drives, Aruküla tee 59, Rae vald, 75301 Harjumaa, Estonia
7. This product and any acceptable variation thereto is specified in the schedule to this certificate and the documents therein referred to.
8. Eurofins Electric & Electronics Finland Oy, Notified Body number 0537, in accordance with Article 17 of Directive 2014/34/EU of the European Parliament and of the Council, dated 26 February 2014, certifies that this product has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of products intended for use in potentially explosive atmospheres given in Annex II to the Directive.
 The examination and test results are recorded in confidential report No. EUFI29-23003044-T1.
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 product is subject to the Specific Conditions of Use specified in the schedule to this certificate.
11. This EU-Type Examination Certificate relates only to the design and construction of the specified product. Further requirements of the Directive apply to the manufacturing process and supply of this product. These are not covered by this certificate.
12. The marking of the product shall include the following:



Espoo, 20.12.2023
Eurofins Electric & Electronics Finland Oy


Kari Koskela
Senior Expert


Jenni Hirvelä
Senior Expert

This document is digitally signed.



This certificate, including the schedule, may only be reproduced in its entirety and without any change.

Eurofins Electric & Electronics Finland Oy, Kivimiehentie 4, FI-02150 Espoo, Finland
www.eurofins.fi/electrical-and-electronics



13. Schedule
14. EU-Type Examination Certificate EESF 20 ATEX 048X Issue 1
15. Description of Product

Thermal protection consists of the Safe Torque Off (STO) function which is subject to this certification, and an ATEX-compliant protection relay which shall be acquired by system builder. 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. Report Number

EUFI29-23003044-T1

17. Specific Conditions of Use

An ATEX-compliant protection relay shall be acquired, and it shall be installed according to manufacturer's instructions.

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.

19. Drawings and Documents

FSO-xx+ACS880 Safety data in ATEX-Certified Safe Disconnection Function, 3AXD10000113948, rev H
 Certificate No. SEBS-A.093457/16 V2.0 by TÜV Nord
 Certificate No. 1435.IM.153902/19 V1.0 by TÜV Nord

20. Certificate History

Issue	Date	Change
VTT 12 ATEX 053X	3.5.2013	Prime certificate
VTT 12 ATEX 053X Issue 1	15.10.2014	Adding safety functions module FSO-12 and deleting two type designations covered by another certificate.
VTT 12 ATEX 053X Issue 2	1.3.2016	The introduction of new manufacturing places and a new safety functions module FSO-21
VTT 12 ATEX 053X Issue 3	30.6.2017	The introduction of a new converter type and deleting one manufacturing place. Updating the certificate according to the new directive.
EESF 20 ATEX 048X	30.10.2020	Updates to safety data document, FSO-12 and FSO-21 TÜV Nord certificates have been combined into one certificate, one manufacturing location has been removed.
EESF 20 ATEX 048X Issue 1	20.12.2023	Update to the safety data calculation. STO certificate by TÜV Nord has been renewed.

UKEX certificate



UK Type Examination Certificate CML 21UKEX9298X Issue 1

United Kingdom Conformity Assessment

- 1 Product or Protective System Intended for use in Potentially Explosive Atmospheres UKSI 2016:1107 (as amended) – Schedule 3A, Part 1
- 2 Equipment Certified types **Safe Disconnection Function for converter drive**
ACS880/AC880LC +Q971
ACS880/AC880LC +Q971 +Q973 (FSO-12)
ACS880/AC880LC +Q971 +Q972 (FSO-21)
ACS880/AC880LC +Q971 +Q972 +L521 (FSO-21 & FSE-31)
 Applicant **ABB Oy Drives**
 Address **Hiomotie 13,**
00380 Helsinki,
Finland
- 3 Manufacturer **ABB Oy Drives** **ABB AS, Drives**
- 4 Address **Hiomotie 13,** **Aruküla tee 59,**
00380 Helsinki, **Rae vald, 75301 Harjumaa,**
Finland **Estonia**
- 5 The equipment is specified in the description of this certificate and the documents to which it refers.
- 6 Eurofins E&E CML Limited, Newport Business Park, New Port Road, Ellesmere Port, CH65 4LZ, United Kingdom, Approved Body Number 2503, in accordance with Regulation 42 of the Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 2016, UKSI 2016:1107 (as amended), certifies that this equipment has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment intended for use in potentially explosive atmospheres given in Schedule 1 of the Regulations.
 The examination and test results are recorded in the confidential reports listed in Section 12.
- 7 If an 'X' suffix appears after the certificate number, it indicates that the equipment is subject to specific conditions of use (affecting correct installation or safe use). These are specified in Section 14.
- 8 This UK Type Examination certificate relates only to the design and construction of the specified equipment. Further requirements of the Regulations apply to the manufacturing process and supply of the product. These are not covered by this certificate.
- 9 Compliance with the Essential Health and Safety Requirements, with the exception of those listed in the confidential report, has been demonstrated through compliance with the following documents:
 EN 50495:2010
- 10 The equipment shall be marked with the following:
 Refer to attached certificate EESF 20 ATEX 048X, Issue 1 for specific marking of explosion protection symbols.
 Refer to attached certificate EESF 20 ATEX 048X, Issue 1 for marked code and ambient temperature range.



This certificate shall only be copied in its entirety and without change
www.CMLEx.com


 S. Roumbedakis
 Technical Manager



11 Description

For product description refer to attached certificate EESF 20 ATEX 048X, Issue 1.

Variation 1

This variation introduced the following modification:

- i. Update to the safety data calculation. STO certificate by TÜV Nord has been renewed.

12 Certificate history and evaluation reports

Issue	Date	Associated report	Notes
0	21 Jun 2021	R14004A/00	Issue of the prime certificate. EESF 20 ATEX 048X, Issue 0 is attached and shall be referred to in conjunction with this certificate.
1	16 Jan 2024	R17302A/00	Issue of the variation certificate. EESF 20 ATEX 048X, Issue 1 is attached and shall be referred to in conjunction with this certificate.

Note: Drawings that describe the equipment are listed or referred to in the Annex.

13 Conditions of Manufacture

For conditions of manufacture, refer to attached certificate EESF 20 ATEX 048X, Issue 1.

Any routine tests/verifications required by the ATEX certification shall be conducted.

14 Specific Conditions of Use

For specific conditions of use, refer to attached certificate EESF 20 ATEX 048X, Issue 1.

Declaration of Conformity (EU)



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

ACS880-07, -17, -37, -107

ACS880-07CLC, -07LC, -17LC, -37LC, -107LC

identified with serial numbers beginning with 1 or 8

with regard to the safety function

ATEX certified thermal motor protection (option codes +L513 +Q971, +L514 +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



The following harmonized standard has been applied:

EN 50495:2010	Safety devices required for the safe functioning of equipment with respect to explosion risks
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The following other standards have been applied:

EN 61800-5-2:2007	Adjustable speed electrical power drive systems – Part 5-2: Safety requirements - Functional
IEC 61800-5-2:2016	
IEC 61508:2010, parts 1-2	Functional safety of electrical / electronic / programmable electronic safety-related systems

Notified Body: Eurofins Electric & Electronics Finland Oy, Notified Body number: 0537, Address: Kivimiehentie 4, 02150 Espoo, Finland

has assessed the conformity of the “ATEX certified thermal motor protection” function and has issued the certificate EESF 20 ATEX 049.



The products referred in this Declaration of conformity fulfil the relevant provisions of other European Union Directives which are notified in Single EU Declaration of conformity 3AXD10000497305.

Helsinki, 19 Jun 2023

Signed for and on behalf of:

Peter Lindgren
Peter Lindgren
Vice President, ABB Oy

Vesa Tiihonen
Vesa Tiihonen
Manager, Reliability and Quality, ABB Oy

If you need the Declaration of Conformity in an official language of the European Union other than English, contact ABB.

Declaration of Conformity (UK)



Declaration of Conformity

The Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 2016 (+ amendment SI 2019 No. 696)

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, -04FXT, -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 The Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 2016 (+ amendment SI 2019 No. 696).

Specific marking of explosion protection

 II (2) GD

The following designated standard has been applied:

EN 50495:2010	Safety devices required for the safe functioning of equipment with respect to explosion risks
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The following other standards have been applied:

EN 61800-5-2:2017	Adjustable speed electrical power drive systems – Part 5-2: Safety requirements - Functional
IEC 61508:2010, parts 1-2	Functional safety of electrical / electronic / programmable electronic safety-related systems



Approved Body: Eurofins E&E CML Limited, Approved Body number: 2503, Address: Newport Business Park, New Port Road, CH65 4LZ, Ellesmere Port, United Kingdom

has assessed the conformity of the "ATEX certified safe disconnection function" and has issued the certificate CML 21 UKEX 9298X.

The products referred in this Declaration of conformity fulfil the relevant provisions of other UK Legislation which are notified in Single UK Declarations of conformity 3AXD10001346556 and 3AXD10001326405.

Helsinki, 15 Apr 2021

Signed for and on behalf of:

Peter Lindgren
Peter Lindgren
Vice President, ABB Oy

Aaron D. Wade
Aaron D. Wade
Product Unit Manager, ABB Oy

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/contact-centers.

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.



www.abb.com/drives



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