
OPTIONS FOR ABB DRIVES

FPTC-02 ATEX-certified thermistor protection module, Ex II (2) GD (option +L537+Q971) ACS880 drives

User's manual

FPTC-02 ATEX-certified thermal protection module, Ex II (2) GD (option +L537+Q971) for ACS880 drives

User's manual

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Further information

Safety instructions

Contents of this chapter

This chapter contains the safety instructions which you must obey when you ins
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 i
or death, or damage to the equipment.

WARNING!

General warning tells about conditions other than those caused by elect
which can cause injury or death, or damage to the equipment.

WARNING!

Electrostatic sensitive devices warning tells you about the risk of electro
discharge which can cause damage to the equipment.

10 Safety instructions

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 to the manual

Contents of this chapter

This chapter gives basic information on the manual.

Applicability

This manual is applicable to the FPTC-02 module and to the Safe motor temperature (SMT) function which uses the FPTC-02 module (option +L537+Q971).

Compatibility

The FPTC-02 module is compatible with:

- ACS880-01/11/31 drives
- ACS880-04/04XT/04F/04FXT/M04/14/34 drive modules
- ACS880-104/104LC inverter modules
- ACS880-07/07LC/17/17LC/37/37LC cabinet-built drives
- ACS880-107/107LC inverter units
- FSO-12 and FSO-21 safety functions modules

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electrical components, electrical schematic symbols, functional safety, and Ex regulations.

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.

Related manuals

| Name | Code |
|---|-----------------|
| Drive hardware | |
| ACS880-01 hardware manual | 3AUA0000078093 |
| ACS880-11 hardware manual | 3AXD50000045932 |
| ACS880-31 hardware manual | 3AXD50000045933 |
| ACS880-04 drive modules (200 to 710 kW, 300 to 700 hp) hardware manual | 3AUA0000128301 |
| ACS880-04 single drive module packages (560 to 2200 kW) hardware manual | 3AUA0000138495 |
| ACS880-04F drive modules hardware manual | 3AXD50000034664 |
| ACS880-04XT drive module packages (500 to 1200 kW) hardware manual | 3AXD50000025169 |
| ACS880-04FXT drive module packages hardware manual | 3AXD50000274444 |
| ACS880-M04 drive hardware manual | 3AXD50000028613 |
| ACS880-14 drive modules (132 to 400 kW) hardware manual | 3AXD50000035160 |
| ACS880-34 drive modules (132 to 400 kW) hardware manual | 3AXD50000035191 |
| ACS880-14 and -34 single drive module packages hardware manual | 3AXD50000022021 |
| ACS880-07 drives (45 to 710 kW) hardware manual | 3AUA0000105718 |
| ACS880-07 drives (560 to 2800 kW) hardware manual | 3AUA0000143261 |
| ACS880-07LC drives hardware manual | 3AXD50000569786 |
| ACS880-17 drives (160 to 3200 kW) hardware manual | 3AXD50000020436 |
| ACS880-17 drives (45 to 400 kW, 60 to 450 hp) hardware manual | 3AXD50000035158 |
| ACS880-17LC drives hardware manual | 3AXD50000250295 |

| | |
|--|--|
| | Introduction |
| Name | Code |
| Drive firmware | |
| ACS880 primary control program firmware manual | 3AUA0000 |
| PC tools | |
| Drive composer start-up and maintenance PC tool user's manual | 3AUA0000 |
| Safety | |
| ABB Safety information and solutions | www.abb.com |
| FPTC-02 pairing instruction | 3AXD5000 |
| Motors and drives in potentially explosive atmospheres - What you need to know | 3AUA0000 |
| Using motors with drives in potentially explosive atmospheres | https://new.abb.com/motors/motors-in-potentially-explosive-atmospheres |
| Option manuals | |
| ACS-AP-I, -S, -W and ACH-AP-H, -W Assistant control panels user's manual | 3AUA0000 |
| FSO-12 safety functions module user's manual | 3AXD5000 |
| FSO-21 safety functions module user's manual | 3AXD5000 |
| FSE-31 pulse encoder interface module user's manual | 3AXD5000 |
| FPTC-02 ATEX-certified thermistor protection module, Ex II (2) GD (option +L537 +Q971) user's manual | 3AXD5000 |
| Manuals and quick guides for I/O extension modules, fieldbus adapters, etc. | |

See www.abb.com/drives/documents for all manuals on the Internet.

Terms and abbreviations

| Term | Description |
|------|--|
| ATEX | Directives 2014/34/EU and 1999/92/EC are commonly referred to as ATEX directives (from "Atmosphères Explosibles") |
| Cat. | Classification of the safety-related parts of a control system in terms of their resistance to faults and their subsequent behavior in the event of a fault and which is achieved by the structural arrangement of the parts and/or by their reliability. The categories are: B, 1, 2, 3 and 4. (EN ISO 13849-1) |
| CCF | Common cause failure (%) (EN ISO 13849-1) |
| DC | Diagnostic coverage (EN ISO 13849-1) |
| DI | Digital input |

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| Term | Description |
|-----------------|--|
| FPTC-02 | Optional ATEX-certified thermistor protection module for potentially 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. |
| $MTTF_D$ | Mean time to dangerous failure: (Total number of life units) / (Number of dangerous, undetected failures) during a particular measurement interval under stated conditions (EN ISO 13849-1) |
| PFD_{avg} | Average probability of dangerous failure on demand (IEC 61508) |
| PFH | Average frequency of dangerous failures per hour (IEC 61508) |
| PL | Performance level. Levels a...e correspond to SIL (EN ISO 13849-1) |
| 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 |
| SC | Systematic capability (IEC 61508) |
| SFF | Safe failure fraction (%) (IEC 61508) |
| SIL | Safety integrity level (1...3) (IEC 61508, IEC 62061, IEC 61800-5-2) |
| SMT | Safe motor temperature (IEC/EN 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) of 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, IEC 61800-5-2) |

Hardware description

Contents of this chapter

This chapter gives a short description of the module.

Product overview

The FPTC-02 module together with the drive/inverter STO implements the Safe temperature (SMT) safety function as defined in IEC/EN 61800-5-2.

The FPTC-02 module is Type Examined as a protective device within the scope of the European ATEX (and UKEX) Product Directive. This allows the use of the module for the temperature protection of motors in explosive atmospheres (Ex motors).

Inside the module, there is reinforced insulation between the motor thermistor connection and the other terminals of the module. The insulation forms a reliable protective separation between the motor main circuit and the drive control unit. Thus, the drive control unit is Protective Extra Low Voltage (PELV) compatible when the FPTC-02 module and a thermistor protection circuit are installed.

■ Operation basics

The module includes two PTC sensor inputs:

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The FPTC-02 module then activates the SMT function by opening the drive Safe torque off (STO) circuit. This activates the drive STO function.

The STO function disables the control voltage of the power semiconductors of the drive output stage. This prevents the drive from generating the torque required to rotate the motor. If the motor is running when the STO function is activated, it coasts to a stop.

XWRN input (Warning)

When the motor temperature increases above the PTC sensor temperature limit, the sensor resistance increases sharply. The FPTC-02 module sends a warning indication to the drive. The XWRN input is not safety-related and does not activate the drive STO function.

For the resistance limits and other technical details of the FPTC-02 module, see the technical data.

■ **Layout**

1

3

4

XWRN

XFLT

2

1

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Markings

- **Module**

Type designation label

ABB OY FPTC-02 SN:A5450043WS CODE:3AXD50000017196

3AXD50000017196A5450043WS

ROH

4

5

- 1 Type
- 2 Serial number in format RYWWSSSSWS, where:
R: Component revision
Y: Last digit of the manufacturing year (for example, 5 = 2015)
WW: Manufacturing week (for example, 01 = week 1)
SSSS: Number that starts every week from 0001
WS: Manufacturing location
- 3 ABB MRP code of the module
- 4 Combined ABB MRP code, serial number and manufacturing location
- 5 RoHS mark

ATEX/UKEX markings

The markings on the module show the ATEX/UKEX classification of the FPTC-02 module.

■ Drive

SMT function

When the FPTC-02 module is delivered as an add-on kit, the package contains a sticker to show the ATEX/UKEX classification of the Safe motor temperature (SMT) function. The user must attach this sticker near the type designation label of the drive/inverter to ensure the ATEX/UKEX compliance of the safety circuit.

In the factory-installed options, this sticker is already attached to the drive/inverter module at the factory.

In the cabinet-built drives, this sticker is attached to the cabinet door at the factory.

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|--|---|---|---|---|
| 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 in a non-potentially explosive atmosphere. | | | | |
| 6 | Certified for use in explosive atmospheres caused by: G = gases, vapors or mists, D = dust. | | | | |
| 7 | Certificate references | | | | |

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| 1 | 2 | 3 | 4 | 5 | 6 |
|---|--|---|---|---|---|
| 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 | | | | |

The option code +Q971 is included in the type designation label of the drive. In cabinet-built drives, this is on the cabinet door. In cabinet-built drives, there is no separate ATEX/UKEX classification label for the Safe disconnection function.

Option description and instruction

Contents of this chapter

This chapter describes the Safe motor temperature function implemented in the FPTC-02 module and the drive Safe torque off function and gives instructions for the user.

Overview

To implement the Safe motor temperature (SMT) function, you can connect the FPTC-02 module directly to the drive Safe torque off (STO) circuit, or you can use it together with an FSO module.

The FSO safety functions module (FSO-12 or FSO-21) is an optional device for ACS880 drives to implement safety functions. When installed, it reserves the STO connection of the drive. Safety functions in the FSO module can open the STO circuit, which activates the STO function of the drive.

Note: The Safe motor temperature function is motor-specific. This is the case for ACS880 multidrives where multiple motors are connected to the drive.

- **Wall-mounted drives, drive modules and inverter modules**

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ACS880-04XT/-04FXT/-04/-14/-34 single drive module packages and ACS880-1 and -104LC multidrive modules

- attaches the included ATEX/UKEX label for the SMT function near the type designation label (CE/UKCA marking) of the drive/inverter
- installs the option module to an option slot of the drive control unit and sets the applicable drive parameters
- connects the PTC temperature sensors of the motor to the PTC inputs of the option module
- connects the drive STO terminals to the STO output of the option module (or to the FSO module and then configures the FSO module to do the STO function).

■ Cabinet-built drives

For cabinet-built ACS880 single drives and ACS880 multidrives, the module is available as factory-installed options:

- +L537+Q971
- +L537+Q971+Q973 (with the FSO-12 module)
- +L537+Q971+Q972 (with the FSO-21 module)
- +L537+Q971+Q972+L521 (with the FSO-21 and FSE-31 modules).

The user connects the PTC temperature sensors of the motor to the PTC inputs of the module.

Safe disconnection function

The ATEX/UKEX-certified Safe motor temperature function described in this manual requires that the drive/inverter Safe torque off function (STO) is certified for use as a Safe disconnection function to protect equipment in potentially explosive atmospheres according to European ATEX (and UKEX) Product Directive. For more information on the drive STO function, see the applicable hardware manual.

You can use the FPTC-02 module only when serial number of the drive/inverter starts with 1, 4, 7, 8, M or Y.

Note: You do not need a separate ATEX/UKEX certification (and label) for the Safe disconnection function (option +Q971), because the ATEX/UKEX certificate of the SMT function includes also the ATEX/UKEX-certified Safe torque off function (STO).

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

Resetting the safety function

The Ex regulations require that the safety function must be reset manually. When the XFLT input detects a motor overtemperature situation, the FPTC-02 module generates a fault to the drive. You must reset the drive before it is possible to restart the motor.

When the XWRN input detects a motor overtemperature situation, the FPTC-02 module generates a warning to the drive. This is not a safety-related function, and does not need a reset.

If an FSO module is used together with the FPTC-02 module, it is possible that you must reset the safety function also with a reset button connected to the FSO module. This depends on parameter settings and other safety functions in the FSO module. For more information, see section [FSO module \(page 37\)](#).

Note: The reset function of the safety function is not SIL classified.

Indications of the safety function

The possible indications of the safety function are:

1. LED indications on the FPTC-02 module:
 - The FAULT LED is on when the motor temperature is outside the permitted (safe) temperature range (XFLT input).
 - The WARNING LED is on when the motor temperature is outside the temperature warning range (XWRN input).
2. Motor temperature indication in the drive:
 - Safe motor temperature fault (XFLT input)
 - Motor temperature warning (XWRN input)
3. STO indication in the drive: The drive STO indication is active when the SMT function has activated the drive STO function. The type of the indication is set with parameter 31.22 STO indication run/stop .
4. STO indication in the FSO module: The STO LED (green) is on when the safety function has activated the drive STO function.
5. STO indication from the FSO module to the drive: The FSO module sends an indication to the drive when the FSO module activates the drive STO function. The type of the indication is set with parameter FSOGEN.61 STO indication external .

If you use an FSO module, the activation of the SMT function can generate two indications in the drive. To prevent this, you can set one of the two STO indication parameters (31.22 STO indication run/stop or FSOGEN.61 STO indication external) to value None/No indication or Event . See chapter [Parameter setting](#).

Note: The indications of the safety function are not SIL classified.

■ **STO function in the drive/inverter**

The STO function in the drive/inverter has internal fault diagnostics and a fault reaction function. The fault reaction function causes a fault trip if it detects a redundancy fault of STO control signals or an internal failure. For more information, see the hardware and firmware manuals of the drive/inverter.

■ **FSO module**

The fault reaction function of the FSO module trips the drive if it detects a failure. The FSO module activates the STO or Safe stop emergency (SSE) function. This activates the drive STO function. The drive STO function is active until the fault is repaired.

Note: With the FPTC module, the recommended type of the SSE function is Immediate STO , but other safety functions in the FSO module can require that the type is Emergency ramp . With both settings, the FSO module always activates the drive STO function immediately in motor overtemperature situations (the drive trips on a SMT fault).

The FSO module goes into the Fail-safe mode. The FSO module LED STATUS/FAULT is red until the fault is repaired. To exit the Fail-safe mode, remove the cause of the fault and reset the FSO module. To reset the FSO module:

- switch the power off and on, or
- click the Reboot FSO button on the Safety view of the Drive composer pro PC tool, or
- use drive parameter 96.09 FSO reboot .

For more information, see the drive firmware manual and the FSO module user's manual.

Mechanical installation

Contents of this chapter

This chapter contains a delivery checklist and instructions on installing the mod

Necessary tools and instructions

- Torx screwdriver (T10)

For a complete list of tools, see the applicable drive hardware manual.

Unpacking and examining the delivery

1. Open the option package.
2. Make sure that the package contains:
 - FPTC-02 module
 - STO cable
 - ATEX/UKEX label (with the ATEX/UKEX classification markings)
 - this manual.
3. Make sure that there are no signs of damage to the items.

Installing the module

WARNING!

Obey the safety instructions of the drive. If you ignore them, injury

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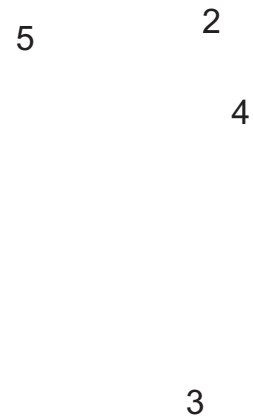
1. Stop the drive and do the electrical safety precautions in the drive safety instructions.
2. Pull out the lock.
3. Put the module carefully into its position on the control unit until the retaining clips lock it into position.
4. Push in the lock.
5. Torque the screw to 0.8 N·m (7.1 lbf·in).

Note: The screw tightens the connections and grounds the module, which is necessary for fulfilling the EMC requirements and for correct operation of the module.

WARNING!

Do not tighten the screw too much. If you tighten it too much, you can cause damage to the threads.

For more information, refer to the drive hardware manual.



WARNING!

Electrical installation

Contents of this chapter

This chapter contains instructions on wiring the module.

Warnings

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.

WARNING!

Cabinet-built drives: Do not connect, test or measure a drive based on the diagrams in this manual. Each delivery is unique. Before starting the work on the electric circuits of a drive, always refer to the delivery-specific circuit diagrams.

WARNING!

Make sure that the drive is disconnected from the input power during installation. Before you start the work, stop the drive and do the electrical safety precautions in the drive safety instructions.

General wiring instructions

1. For the STO circuit wiring, use the type of cable specified in the applicable drive or inverter unit hardware manual. With an FSO module, use the STO cable that is included in the FSO module delivery.
2. 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).
3. Install the drive or inverter unit, including the components of the ATEX-certified motor thermal protection function, outside the potentially explosive atmosphere.
4. For the sensor connection, ABB recommends to use shielded twisted-pair cable. This type of cable decreases electromagnetic interference in the sensor circuit.
5. Route the sensor cables away from the motor cable. Power cables can cause electromagnetic interference in the sensor circuit.
6. 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.

Terminal designations

The table that follows shows the terminal designations of the module.

| Terminal | Description |
|----------|----------------------------------|
| XSTO1 | STO channel 1 |
| 11 | In, +24 V DC in for STO |
| 12 | Out, +24 V DC out for STO |
| XSTO2 | STO channel 2 |
| 21 | In, +24 V DC in for STO |
| 22 | Out, +24 V DC out for STO |
| XFLT | PTC FAULT (SMT function) |
| T1 | In, 0 ... +5 V DC |
| T2 | Out |
| XWRN | PTC WARNING (non-safety related) |
| T3 | In, 0 ... +5 V DC |
| T4 | Out |

PTC sensor inputs

To disable the SMT function, connect a resistor (100 ohm ... 1 kohm ¼ W wire-wound) to the XFLT input.

Note: If you do not connect a PTC sensor or resistor to the XFLT input, the STO function stays active. You cannot start the motor while the STO function is active.

■ XWRN input

To enable motor temperature warnings, connect the PTC sensor to the XWRN input.

If you do not use the XWRN input, you can:

- connect a resistor (100 ohm ... 1 kohm ¼ W wire-wound) to the XWRN input, or
- suppress the motor temperature warnings with parameter 35.30 .

Note: If you do not connect a PTC sensor or resistor to the XWRN input, the WARNING LED of the module stays on.

Wiring examples

This section shows five methods to connect the FPTC-02 module to the drive.

If you use a one-channel connection, make sure that you can reach the required safety integrity level (SIL).

[Wiring example 1 \(page 30\)](#): The STO outputs of the FPTC-02 module are connected directly to the STO terminals of the drive.

- ACS880 wall-mounted drives and drive modules: In the factory-installed option (+L537+Q971), the wiring is done at the factory according to this example.
- ACS880 cabinet-built drives: In option +L537+Q971, terminal block [X969] is located between the module and the drive control unit (not shown in the figure). See the circuit diagrams delivered with the drive for the actual wiring.

[Wiring example 2 \(page 31\)](#): The STO outputs of the FPTC-02 module are connected to an FSO module, and the STO outputs of the FSO module to the STO terminals of the drive with a two-channel connection. In this case, the FSO module controls the drive STO function.

- ACS880 cabinet-built drives: In option +L537+Q971+Q973/Q972 (+L521), terminal block [X68] is located between the module and the FSO module (not shown in the figure). See the circuit diagrams delivered with the drive for the actual wiring.

[Wiring example 3 \(page 32\)](#): An external safety relay is connected between the FPTC-02 module and the drive STO inputs with a two-channel connection.

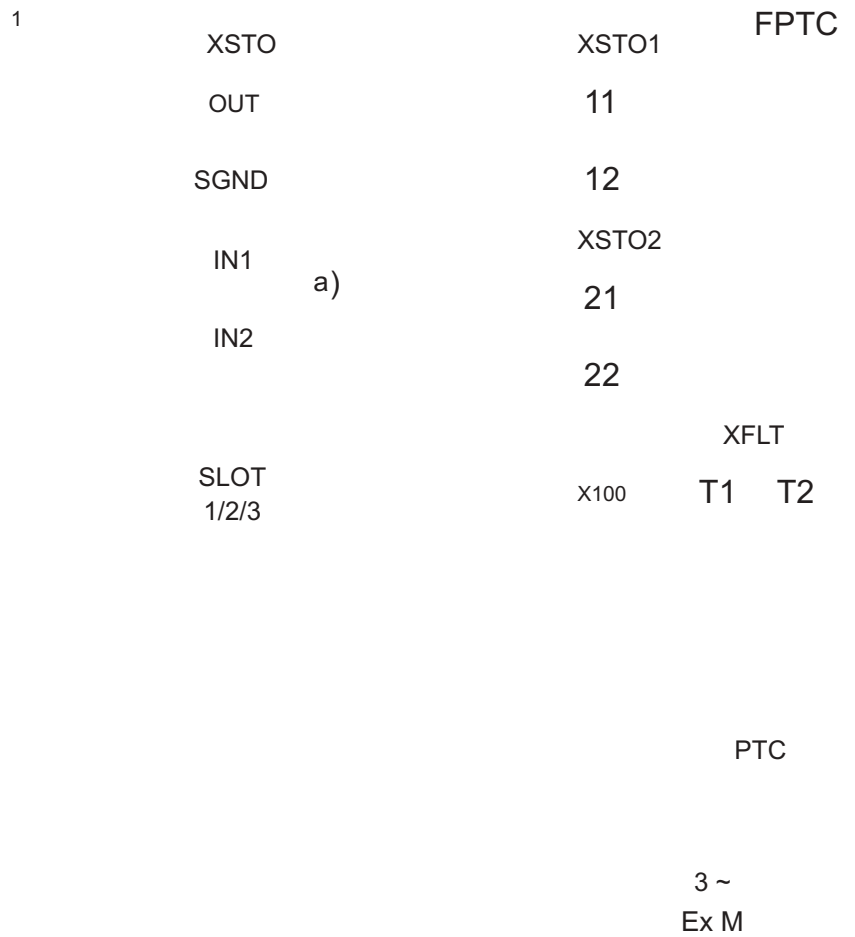
[Wiring example 4 \(page 33\)](#): The STO outputs of the FPTC-02 module are connected directly to the STO terminals of the drive with a one-channel connection.

[Wiring example 5 \(page 34\)](#): The STO outputs of the FPTC-02 module are connected to an FSO module, and the STO outputs of the FSO module to the STO terminals of the drive with a one-channel connection.

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■ Wiring example 1

This connection is SIL 2 capable (redundancy between STO channels).



2

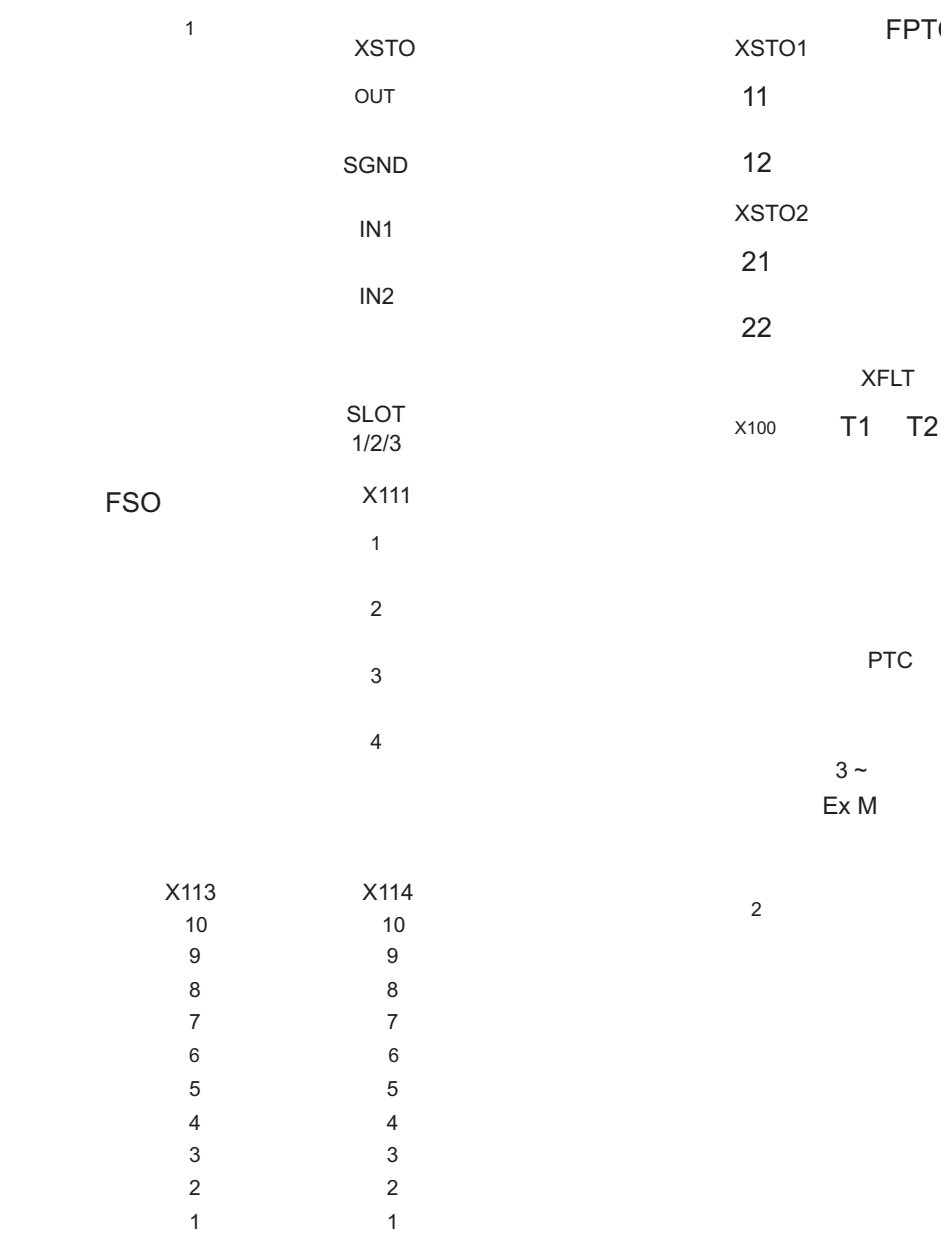
1 Control unit

2 Potentially explosive atmosphere

a) If necessary, you can also connect an external device (for example, an emergency stop button) between the XSTO input of the control unit and the XSTO1 and XSTO2 outputs of the FPTC module. See [Wiring example 3 \(page 32\)](#).

■ **Wiring example 2**

With an FSO module, two-channel connection. This connection is SIL 2 capable (redundancy between STO channels).

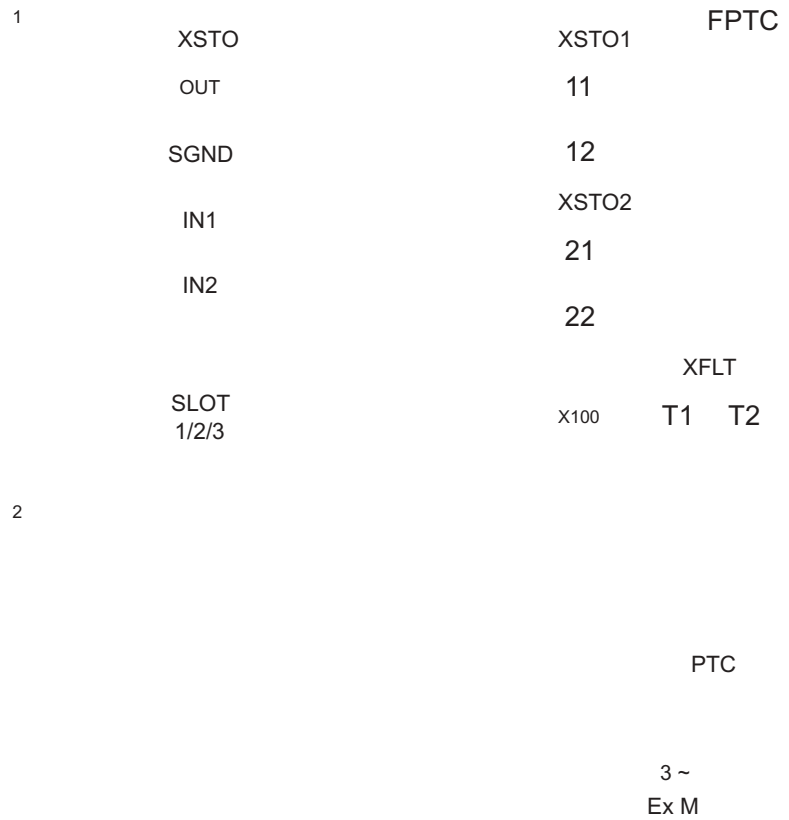


- 1 Control unit
- 2 Potentially explosive atmosphere

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■ Wiring example 3

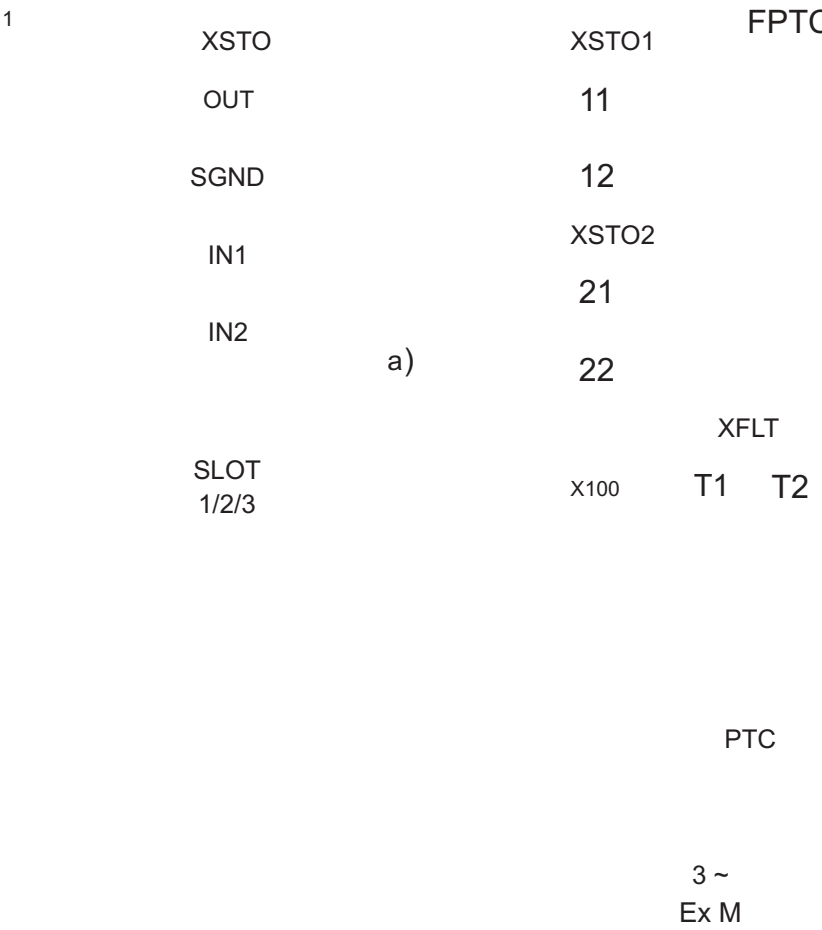
With an external safety relay, two-channel connection. This connection is SIL 2 capable (redundancy between STO channels).



- 1 Control unit
- 2 External safety relay
- 3 Potentially explosive atmosphere

■ **Wiring example 4**

One-channel connection. This connection is SIL 1 capable (no redundancy between STO channels).

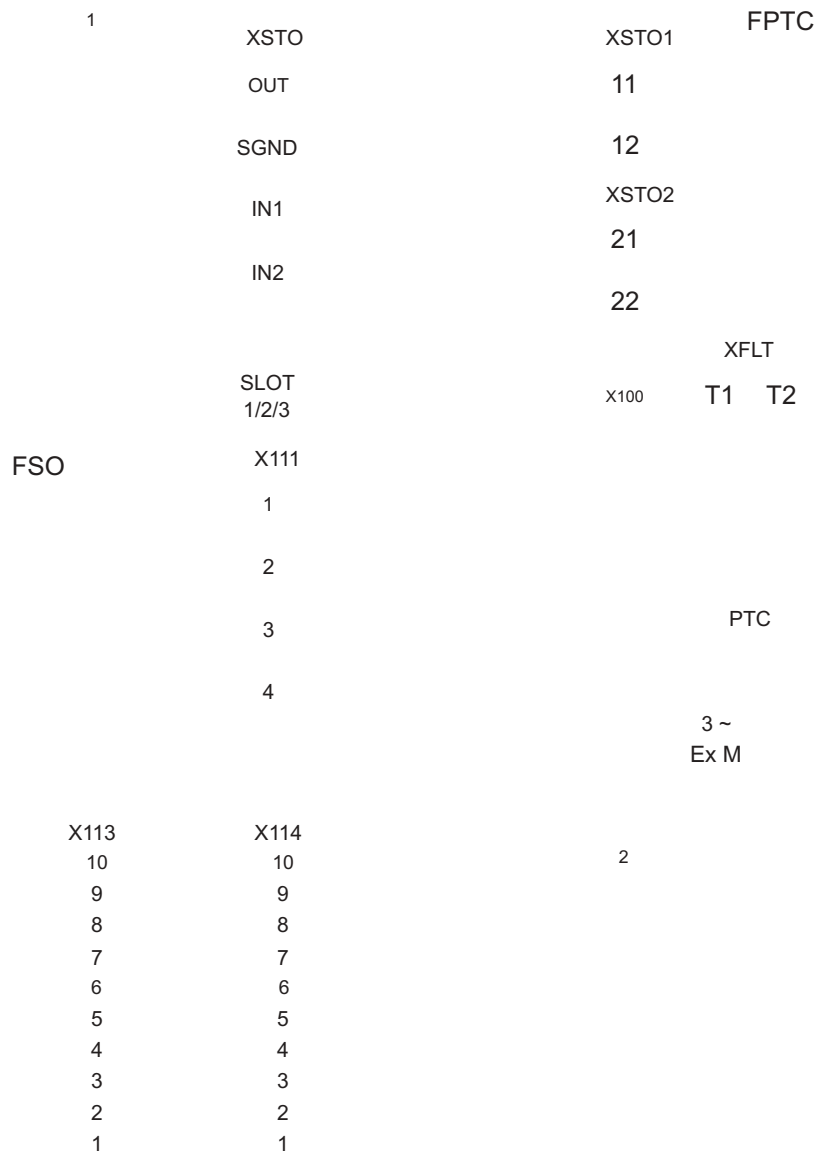


- 1 Control unit
- 2 Potentially explosive atmosphere
- a) If necessary, you can also connect an external device (for example, an emergency stop button) between the XSTO input of the control unit and the XSTO2 output of the FPTC module.

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■ Wiring example 5

With an FSO module, one-channel connection. This connection is SIL 1 capable (no redundancy between STO channels).



- 1 Control unit
- 2 Potentially explosive atmosphere

Parameter settings

Contents of this chapter

This chapter contains the drive and FSO module parameter settings.

Drive / inverter

Use the Drive Composer PC tool or the control panel to set the parameter va

This table lists the parameters related to the safety function in ACS880 prima
program. For more information, see the drive firmware manual.

| Index | Name | Description |
|-------|--------------------------|--|
| 31.22 | STO indication run/stop | Selects the indications that the drive gives function is activated. |
| | Value Warning/Warning | Description The drive generates a warning both when running and when it is stopped. This parameter value does not have an ef function, but this is the recommended s inet-built drives, ABB sets this value at |

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| Index | Name | Description |
|-------|-------------------------|---|
| 35.30 | FPTC configuration word | <p>Activates FPTC modules installed on the control unit of the drive.</p> <p>With this word, it is also possible to suppress the motor temperature warnings from the XWRN input. It is not possible to suppress the SMT faults from the XFLT input.</p> |
| | Bit | Name |
| | 0 | Module in slot 1 |
| | 1 | Disable slot 1 warning |
| | 2 | Module in slot 2 |
| | 3 | Disable slot 2 warning |
| | 4 | Module in slot 3 |
| | 5 | Disable slot 3 warning |
| | 6...15 | Reserved |
| 35.04 | FPTC status word | <p>Displays the status of FPTC modules. The word can be used as the source of eg. external events. This parameter is read-only.</p> |
| | Bit | Name |
| | 0 | Module found in slot 1 |
| | 1 | Fault active in slot 1 |
| | 2 | Warning active in slot 1 |
| | 3 | Module found in slot 2 |
| | 4 | Fault active in slot 2 |
| | 5 | Warning active in slot 2 |
| | 6 | Module found in slot 3 |
| | 7 | Fault active in slot 3 |
| | 8 | Warning active in slot 3 |
| | 9...15 | Reserved |

■ Switching frequency limitation

The certificate of the Ex motor typically requires that you set a minimum limit 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.

■ Other recommended settings

ABB recommends that you also set these parameters to improve the safety of your 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 (option +Q972 or +Q973) in the safety system controller, set the parameters according to the system requirements. Example values are given 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, parameter values, or upload or download the FSO configuration file.

38 Parameter settings

If you use the FSO-21 module (+Q972) with a FSE-31 pulse encoder interface module (+L521) and safety encoder, set the parameters listed in section [FSE module and safety encoder parameters \(page 41\)](#).

The example values are factory default values in ACS880 cabinet-built drives delivered with an FPTC module. You must set the parameter values as required by the application. Change the parameter default values when necessary. One FPTC module is connected to the FSO module with a two-channel connection (digital inputs X113:4 and X114:4).

Configure the FSO module so that it opens the drive STO circuit immediately after the safety function request from the FPTC module (stop category 0). With the FPTC module, you cannot use a stop function with a deceleration ramp (stop category 1). The FPTC module always generates a fault and activates the drive STO function immediately in overtemperature situations.

Note: Setting parameters related to STO and SSE 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 ¹⁾ | Sets the digital output that indicates the completion of any stop function. Active when the FSO module has completed the STO or SSE 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 | 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 |

| Index | Name | Example value | Description |
|-----------|---------------------------------|-----------------------|---|
| FSOGEN.42 | Acknowledgement button input | None ¹⁾ | <p>Sets the digital input for the acknowledgement signal when parameter STO.02 has value Automatic.</p> <p>In the safety function described in Figure 10-1, parameter STO.02 has value Automatic. If parameter FSOGEN.42 has value None (no acknowledgement signal connected to the input).</p> |
| FSOGEN.61 | STO indication external request | Warning ¹⁾ | <p>Sets the type of the event that the FSO module generates and sends to the drive when the STO function requests that end to a successful acknowledgement of the drive STO function (STO or SSE).</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> |

¹⁾ The value does not have an effect on the SMT function, but other safety functions in the FSO module can request a certain value.

■ Parameters for the STO function

These parameters are related to the STO function of the FSO module. With safety category 0, the FSO module activates the STO function in overtemperature situation. Also, the FSO module can activate the STO function in fault situations.

| Index | Name | Example value | Description |
|--------|----------------------------|-------------------------|---|
| STO.02 | STO acknowledgement method | Automatic ¹⁾ | <p>Sets the acknowledgement method for the STO and SSE and SS1 functions.</p> <p>Automatic: The FSO module resets the STO function automatically after the STO request is acknowledged.</p> <p>Manual: The FSO module reads the acknowledgement signal through the digital input by parameter FSOGEN.42.</p> |
| STO.11 | STO input A | None | <p>Sets the digital input that is connected to the primary input of the STO function.</p> <p>In this example, this parameter has value None.</p> |
| STO.12 | STO input B | DI X113:4 & X114:4 | <p>Sets the digital input that is connected to the secondary input of the STO function.</p> <p>Note: In a non-redundant system, you must connect a one-channel input (for example, DI X113:4).</p> |
| STO.13 | Restart delay after STO | 2000 ms | <p>Sets the time after which the drive can restart after the FSO module has activated the STO function and opened the drive STO circuit. With parameter STO.13, you can let the drive restart before the drive is stopped (fly-start). This parameter is only valid if the STO function is requested from the primary input (STO.11) or STO input B (STO.12).</p> <p>STO function: A digital input that is connected to the primary input of the STO function.</p> |

40 Parameter settings

| Index | Name | Example value | Description |
|---------------------|---|------------------|--|
| 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 STO and SSE 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>STO function: This parameter sets the time after which the STO function is completed and the STO completed indication goes on. Parameter SBC.11 defines the time after which the acknowledgement is allowed. Adjust the value according to application requirements.</p> <p>When an encoder is used: 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.36 | DI X113:4 diag pulse on/off | On ²⁾ | <p>Sets the diagnostic pulse of digital input X113:4 or off.</p> <p>On: The input monitors that it receives test pulses. Off: The input does not monitor for test pulses.</p> |
| SAFEIO.40 | DI X114:4 diag pulse on/off | On ²⁾ | <p>Sets the diagnostic pulse of digital input X114:4 or off.</p> <p>On: The input monitors that it receives test pulses. Off: The input does not monitor for test pulses.</p> <p>Note: In a non-redundant system, you can use a one-channel input (for example, DI X113:4). In this case, this parameter has no effect.</p> |

1) The value does not have an effect on the SMT function, but other safety functions in the FSO module can require a certain value.

2) The safety data is based on the assumption that this diagnostic measure for the wiring is active (On). If pulsing is

■ 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. The FSO module can activate the SSE function in internal fault situations.

| Index | Name | Example value | Description |
|------------------|-------------------|-----------------------------|---|
| SSE.13 | SSE function | Immediate STO ¹⁾ | <p>Sets the type of the SSE function.</p> <p>Immediate STO: The FSO module activates the STO function immediately after the stop (stop category 0).</p> <p>Emergency ramp: The FSO module ramps down the motor speed and when the speed reaches the zero speed limit it activates the STO (stop category 1). SAR0 parameters determine the deceleration ramp (for more information see the FSO module user's manual).</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).</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 the speed is not 0.0 rpm.</p> |

1) With the FPTC module, the recommended value is Immediate STO , but other safety functions in the FSO module can require that the value is Emergency ramp . With both settings, the FSO module always activates the STO function immediately in motor overtemperature situations (SMT function activated).

■ FSE module and safety encoder parameters

Set these parameters only when you use a safety pulse encoder and the FSE-31 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 module (the version of the encoder parameters is 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 sets the parameter group S_ENCGEN. |
| S_ENCGEN.11 | FSE diagnostic failure reaction | STO | <p>Sets the action taken when there is a diagnostic failure in the FSE module or the safety encoder.</p> <p>STO: The FSO module goes into the stop state 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.</p> <p>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 | Sets the type of the safety encoder interface module 1. |
| 91.12 | Module 1 location | 2 | Sets the slot in which the safety encoder interface module 1 is located. |
| 92.01 | Encoder 1 type | HTL1 | Activates or deactivates the communication with the safety encoder interface module 1 and sets the type for the safety encoder. |
| 92.02 | Encoder 1 source | Module 1 | Sets the safety encoder interface module that the safety encoder 1 is connected to. |
| 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 some cases you cannot use the brake for the motor deceleration when the 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).

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 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

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- 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).

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

WARNING!

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

Initial status

With an FSO-21 and FSE-31 module: If you use a safety encoder in the safety application, validate the safety encoder interface as described in FSO-21 safety functions module user's manual.

Action

With an FSO module: 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.

Note: If you use a safety encoder, and parameter S_ENCGEN.11 is set to Est switch not active load, both STO function with speed estimate and STO function with encoder feedback must be tested - most importantly, the value of parameter STO.14 must be set according to the application requirements.

Checks and settings with no voltage connected

Stop the drive and do the electrical safety precautions in the drive safety instructions.

Make sure that the necessary ATEX/UKEX markings are attached.

Make sure that the classification of the motor thermal protection function corresponds to the Ex classification of the environment and the Ex motor.

The motor manufacturer selects the PTC sensors for the motor temperature measurement according to the specified temperature class. Make sure that the temperature on-off resistances match those of the module.

If you have done any changes to the wiring, do a check of the connections against the applicable circuit diagrams.

Make sure that the installation of the motor temperature sensor complies with the requirements for the applicable type of protection.

Make sure that the SIL/PL of the safety function meets the target SIL/PL. If SIL2 is required, make sure that the STO connection between the FPTC-02 module and drive STO is kept redundant.

Make sure that the wires are connected to the correct terminals and that the terminal connections are tightened to the correct torque.

Settings with voltage connected

Make sure that you have activated the FPTC-02 module in the correct slot (parameter 35.30).

Make sure that you have set all the necessary parameters for the safety function. See chapter [Parameter settings \(page 35\)](#).

Validation test procedure

Make sure that you can run and stop the motor freely during the test.

Start the drive and make sure that the motor is running.

Do an overtemperature monitoring test: increase the resistance in the XFLT input to more than 4 kohm (for example, open the circuit by disconnecting the wires).

Make sure that the correct indications are activated: the SMT fault and other indications depending on the parameter settings and if an FSO module is installed.

Make sure that the STO is activated and that the motor coasts to a stop.

Make sure that you cannot start the drive before you reset the drive.

Reset the drive. Make sure that you cannot reset and restart the drive before the resistance in the XFLT input is reset to the correct value (first instruction in the test procedure).

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Action

Make sure that the correct indications are activated: the SMT fault and other indications depending on the parameter settings and if an FSO module is installed.

Make sure that the STO is activated and that the motor coasts to a stop.

Make sure that you cannot start the drive before you reset the drive.

Reset the drive. Make sure that you cannot reset and restart the drive before the resistance in the XFLT input increases to more than 50 ohm (that is, the jumper wire connected earlier is removed).

Restart the drive and the motor. Make sure that they operate normally.

If used, do the overtemperature monitoring and short-circuit detection tests for the XWRN input. Make sure that the motor temperature warning indication is activated in both cases.

Create a backup file of the drive parameters with the Drive composer PC tool or control panel.

If you use an FSO module, save the FSO safety file (button Save safety file in the Drive composer pro PC tool).

Fill in and sign the validation test report. Store the report in the logbook of the machine.

Fault tracing

Contents of this chapter

This chapter shows how to trace faults with fault and warning messages of the ACS880 and LEDs on the module.

Reporting problems and failures related to safety functions

Contact ABB.

FPTC-02 module replacement

If there is a failure in the FPTC-02 module, you must replace it with a new one. Do not try to repair the module.

Fault and warning messages

Fault and warning messages in the ACS880 primary control program:

| Code | Name | Cause | Action |
|------|------|-------|--------|
|------|------|-------|--------|

50 Fault tracing

| Code (hex) | Name | Cause | Action |
|-----------------|--|---|---|
| 4991 | Safe motor temperature 1 ¹⁾ | The FPTC-02 module in option slot 1 indicates overtemperature in the XFLT input (safety related). 1. Motor temperature is too high, or 2. the thermistor is short-circuited or disconnected. | 1. Make sure that the motor has sufficient cooling. 2. Make sure that the drive and the motor are compatible with each other. 3. Make sure that the motor is not overloaded. 4. Make sure that the drive parameter settings are correct. |
| 4992 | Safe motor temperature 2 ¹⁾ | The FPTC module in option slot 2 indicates overtemperature in the XFLT input (safety related). See 4991. | 5. Examine the wiring of the temperature sensor. If necessary, repair the wiring. |
| 4993 | Safe motor temperature 3 ¹⁾ | The FPTC module in option slot 3 indicates overtemperature in the XFLT input (safety related). See 4991. | 6. Measure the resistance of the sensor. If necessary, replace the sensor. |
| Warnings | | | |
| A497 | Motor temperature 1 ¹⁾ | The FPTC module in option slot 1 has activated a motor temperature warning in the XWRN input (non-safety related). 1. Motor temperature is too high, or 2. the thermistor is short-circuited or disconnected. | 1. Make sure that the motor has sufficient cooling. 2. Make sure that the drive and the motor are compatible with each other. 3. Make sure that the motor is not overloaded. 4. Make sure that the drive parameter settings are correct. |
| A498 | Motor temperature 2 ¹⁾ | The FPTC module in option slot 2 has activated a motor temperature warning in the XWRN input (non-safety related). See A497. | 5. Examine the wiring of the temperature sensor. If necessary, repair the wiring. |
| A499 | Motor temperature 3 ¹⁾ | The FPTC module in option slot 3 has activated a motor temperature warning in the XWRN input (non-safety related). See A497. | 6. Measure the resistance of the sensor. If necessary, replace the sensor. |

1) Editable message text

For the fault and warning messages of the FSO module, see the FSO module user's manual.

LEDs

The FPTC-02 module has three diagnostic LEDs.

| Name | Color | Description |
|-------|-------|--|
| FAULT | Red | The motor temperature is outside the permitted temperature range and |

Maintenance

Contents of this chapter

This chapter contains information for the maintenance and decommissioning of the safety function.

Safety circuit maintenance

After the safety function is validated, it must be maintained by periodic proof tests.

If you change the wiring or a component after the start-up, replace a power unit, replace its circuit boards, replace the FPTC-02 module, modify parameters, or reset parameters to their factory default values:

- Use only ABB-approved spare parts.
- Register the change to the change log for the safety circuit.
- If parameters were restored to the factory default values: Set the parameters related to the safety function.
- Do the validation test of the safety function.
- Document the tests and store the report into the logbook of the machine.

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maximum proof test interval is 5 or 2 years (high or low demand as defined in IEC 61508, IEC/EN 62061 and EN ISO 13849-1). Regardless of the mode of operation, it is a good practice to check the operation of the safety function at least once a year.

The person responsible for the design of the complete safety function should also note the Recommendation of Use CNB/M/11.050 published by the European co-ordination of Notified Bodies concerning dual-channel safety-related systems with electromechanical outputs:

- When the safety integrity requirement for the safety function is SIL 3 or PL e (cat. 3 or 4), the proof test for the function must be done at least every month.
- When the safety integrity requirement for the safety function is SIL 2 (HFT = 1) or PL d (cat. 3), the proof test for the function must be done at least every 12 months.

This is a recommendation and depends on the required (not achieved) SIL/PL. For example, contactors, breakers, safety relays, contactor relays, emergency stop buttons, switches, etc. are typically safety devices which have electromechanical outputs. The FPTC-02 module, the FSO module and the STO circuit of the drive do not have electromechanical outputs.

Functional safety components

The mission time of functional safety components is 20 years which equals the time during which failure rates of electronic components remain constant. This applies to the components of the standard Safe torque off circuit as well as any modules, relays and, typically, any other components that are part of functional safety circuits.

The expiry of mission time terminates the certification and SIL/PL classification of the safety function. The following options exist:

- Renewal of the whole drive and all optional functional safety module(s) and components.
- Renewal of the components in the safety function circuit. In practice, this is economical only with larger drives that have replaceable circuit boards and other components such as relays.

Note that some of the components may already have been renewed earlier, restarting their mission time. The remaining mission time of the whole circuit is however determined by its oldest component.

Contact your local ABB service representative for more information.

Competence

The person who does the maintenance and proof test activities of the safety function must be a competent person with expertise and knowledge of the safety function and

Intentional misuse

The safety circuit is not designed to protect a machine against intentional

Decommissioning

When you decommission the module, make sure that the safety of the machine is maintained until the decommissioning is complete. Mark clearly on the machine that it is decommissioned.

Technical data

Contents of this chapter

This chapter contains the technical data of the module, gives general rules, n definitions related to safety functions and lists the related standards and c The safety data, relevant certificates and Declarations of Conformity are also

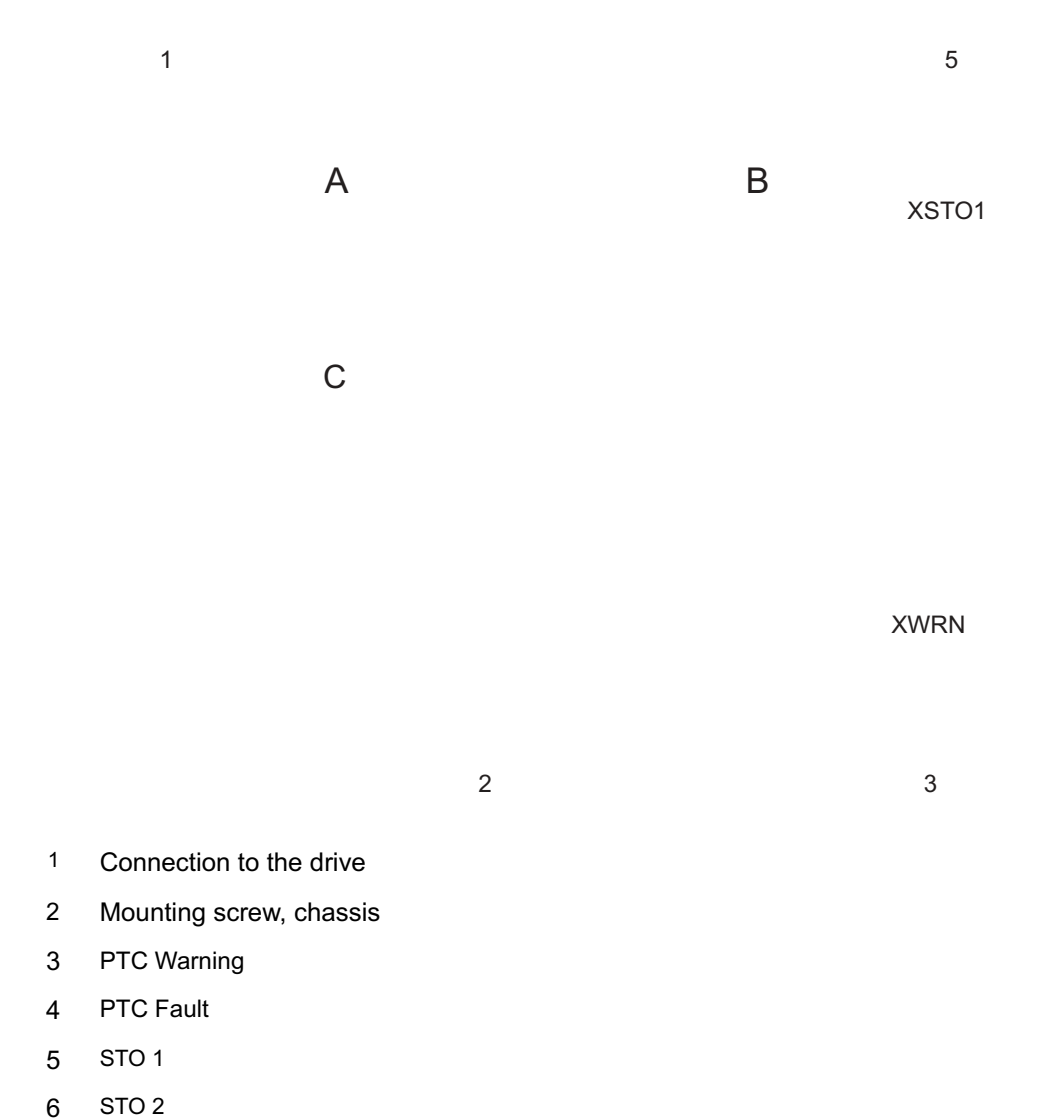
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Dimension drawing

The dimensions are shown in millimeters and inches.

Isolation areas

The following figure shows the different isolation areas of the module. Isolation areas A and B and the mounting screw are connected to ground. Isolation area C is at the same potential as the PTC sensor element in the motor.



There is reinforced insulation between:

- isolation areas A and C
- isolation areas B and C.

Connections

■ Motor thermistor connection

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- Number of PTC thermistors: 1, 3 or 6 in series (in both inputs)
- Triggering threshold: 3.6 kohm \pm 10%
- Recovery threshold: 1.6 kohm \pm 10%
- PTC terminal voltage: < 5.0 V
- PTC terminal current: < 1 mA
- Short-circuit detection (start-up and in normal operation): 0 ... 50 ohm, min. 0 ... 10 ohm). For the effect of the cable length, see above.

■ STO output connection

- Maximum wire size:
 - 2.5 mm² (14 AWG) without FSO module
 - 1.5 mm² (16 AWG) with FSO module
- Maximum wire length: 30 m (98 ft) for the whole loop
- Tightening torque: 0.5 N·m (4.4 lbf·in)
- Contact rating: 24 V DC (17 ... 30 V), 1 A / channel
- Maximum breaking capacity: 1000 VA

Ambient conditions

For the environmental limits for the safety functions and the drive, refer to the drive hardware manual.

Safety data

The FPTC-02 module is a type A safety component as defined in IEC 61508-2. For the types of the drive/inverter STO and the FSO module, see the applicable hardware manual or FSO user's manual.

The table gives the safety data for the SMT function with different configurations. The calculations are based on the worst case data of the drive Safe torque off (STO) function. The PFH/PFD_{avg} values can be different based on the internal configuration of the FSO module. The FSE-31 module is included in the calculations for the FSO module.

Note: The failure rate of the PTC sensor is not included in the calculations.

These are the configurations in the table:

1. FPTC module + drive STO, two-channel configuration. See [Wiring example 1 \(page 30\)](#).

| | Two-channel configurations | | | One-channel configuration |
|---|----------------------------|----------|----------|---------------------------|
| Configuration | 1 | 2 | 3 | 4 |
| SIL | 2 | 2 | 2 | 1 |
| PL | c | c | c | c |
| SFF (%) | >90 | >90 | >90 | >60 |
| PFH (1/h) $T_1 = 20$ a | 5.48E-09 | 5.51E-09 | 5.48E-09 | 7.68E-09 |
| PFD_{avg} $T_1 = 2$ a | 5.40E-05 | 5.44E-05 | 5.40E-05 | 8.44E-05 |
| PFD_{avg} $T_1 = 5$ a | 1.35E-04 | 1.36E-04 | 1.35E-04 | 2.12E-04 |
| DC (%) | 60 | 60 | 60 | 0 |
| SC | 2 | 2 | 2 | 2 |
| Cat. | 1 | 1 | 1 | 1 |
| HFT | 0 | 0 | 0 | 0 |
| CCF | 65 | 65 | 65 | 65 |
| T_M (a) | 20 | 20 | 20 | 20 |
| Type [A/B] | B | B | B | B |

The MTTF_D value (EN ISO 13849-1) of the FPTC-02 module:

- 1697 years (two-channel connection)
- 1703 years (one-channel connection)

Safety block diagrams

The components that are included in the safety data calculations are shown in the safety block diagrams below. The dashed line identifies a component that is not included in the safety data calculations shown in this manual.

Note: The failure rate of the PTC sensor is not included in the calculations.

■ Two-channel configurations

This diagram is applicable to configuration 1. See [Wiring example 1 \(p. 10\)](#)

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This diagram is applicable to configuration 2. See [Wiring example 2 \(page 31\)](#).

4

- 1 PTC sensor
- 2 FPTC module
- 3 FSO module (and FSE-31 module, if used)
- 4 Drive STO

Note: The failure rate of the safety encoder is not included in the calculation.

This diagram is applicable to configuration 3. See [Wiring example 3 \(page 32\)](#).

4

- 1 PTC sensor
- 2 FPTC module
- 3 External safety relay
- 4 Drive STO

Note: The failure rate of the external safety relay is not included in the calculation.

- **One-channel configurations**

This diagram is applicable to configuration 4. See [Wiring example 4 \(page 33\)](#).

This diagram is applicable to configuration 5. See

[Wiring example 5 \(p](#)

1

2

3

- 1 PTC sensor
- 2 FPTC module
- 3 FSO module (and FSE-31 module, if used)
- 4 Drive STO

Note: The failure rate of the safety encoder is not included in the calculation

Response times

- FPTC-02 module: less than 10 ms
- SMT function: the response time of the PTC sensor + FPTC-02 module (<10 ms) + FSO module (<50 ms) + drive STO (<50 ms)

Relevant failure modes

- The SMT function activates when not necessary (safe failure)
- The SMT function does not activate when requested

A fault exclusion on the failure mode "short-circuit on printed circuit board" has been made (EN 13849-2, table D.5). The analysis is based on the assumption that one failure occurs at one time. No accumulated failures have been analyzed.

The failures of the PTC sensor (thermistor) are not included in the failure analysis. The customer is responsible for the applicability of the PTC element.

Related standards and directives

EN 50495:2010

Safety devices required for the safe functioning of equipment with regard to explosion risks

IEC 61508:2010

Functional safety of electrical/electronic/programmable electronic related systems

| | |
|---|---|
| EN ISO 13849-2:2012 | Safety of machinery – Safety-related parts of control systems – Part 2: Validation |
| EN 60204-1:2018 IEC 60204-1:2021 | Safety of machinery – Electrical equipment of machines – Part 1: General requirements |
| IEC 61326-3-1:2017 | Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 3-1: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) – General industrial applications |
| 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 |
| 2006/42/EC | Machinery Directive (EU) |
| 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) |

Compliance with the Machinery Directive (EU)

The drive is an electronic product which is covered by the Low Voltage Directive. However, the drive internal safety function of this manual (option +L537+Q971) is in the scope of the Machinery Directive as a safety component. This function complies with harmonized standards such as EN 61800-5-2. The declaration of conformity is shown below.

Compliance with the Supply of Machinery (Safety) Regulations (UK)

The drive is an electronic product which is covered by the Electrical Equipment (Safety) Regulations. However, the drive internal safety function of this manual (option +L537+Q971) is in the scope of the Supply of Machinery (Safety) Regulations as a safety component. This function complies with designated standards such as EN 61800-5-2. The declaration of conformity is shown below.

Compliance with the ATEX Directive (EU)

The safety function of this manual (option +L537+Q971) is within the scope of the ATEX product directive 2014/34/EU as a protective system. The function complies with European harmonized standard EN 50495. The declaration of conformity is shown below.

Declaration of Conformity (EU)

EU Declaration of Conformity

ATEX Directive 2014/34/EU and Machinery Directive 2006/42/EC

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, -104, -104LC

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

identified with serial numbers beginning with 1 or 8

with FPTC-02 module

with regard to the safety function

ATEX certified thermistor protection (Safe Motor Temperature) (option code +L537 +Q971)

are in conformity with all the relevant requirements for

protective system of EU Directive for Equipment for Explosive atmospheres 2014/34/EU, and

safety component of the EU Machinery Directive 2006/42/EC, when the listed safety function is used for safety component functionality

Directive 2014/34/EU

Specific marking of explosion protection

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

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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 thermistor protection" function and has issued
the certificate EESF 20 ATEX 050.

Directive 2006/42/EC

The following harmonized standards have been applied:

| | |
|---------------------|--|
| EN 61800-5-2:2007 | Adjustable speed electrical power drive systems – Part 5-2: Safety requirements - Functional |
| EN 62061:2021 | Safety of machinery – Functional safety of safety-related control systems |
| EN ISO 13849-1:2015 | Safety of machinery – Safety-related parts of control systems. Part 1: General principles for design |
| EN ISO 13849-2:2012 | Safety of machinery – Safety-related parts of the control systems. Part 2: Validation |
| EN 60204-1:2018 | Safety of machinery – Electrical equipment of machines – Part 1: General requirements |

The following other standards have been applied:

| | |
|---------------------------|---|
| IEC 61800-5-2:2016 | 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 |

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.

Authorized to compile the technical file: ABB Oy, Hiomotie 13, 00380 Helsinki, Finland

Helsinki, 19 Jun 2023

Signed for and on behalf of:

Peter Lindgren
Vice President, ABB Oy

Tomi Väisälä
Product Unit Manager, ABB Oy

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) and Supply of Machinery (Safety) Regulations 2008

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, -104, -104LC

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

identified with serial numbers beginning with 1 or 8

with FPTC-02 module

with regard to the safety function

ATEX certified thermistor protection (Safe Motor Temperature) (option code +L5:
+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),

and

safety component of the the Supply of Machinery (Safety) Regulations 2008, when the
listed safety function is used for safety component functionality

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

Specific marking of explosion protection

66 Technical data

The following designated standard has been applied:

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

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 thermistor protection" function and has issued the certificate CML 21 UKEX 9300.

The Supply of Machinery (Safety) Regulations 2008

The following designated standards have been applied:

| | |
|---------------------|--|
| EN 61800-5-2:2007 | Adjustable speed electrical power drive systems – Part 5-2: Safety requirements - Functional |
| EN 62061:2021 | Safety of machinery – Functional safety of safety-related control systems |
| EN ISO 13849-1:2015 | Safety of machinery – Safety-related parts of control systems. Part 1: General principles for design |
| EN ISO 13849-2:2012 | Safety of machinery – Safety-related parts of the control systems. Part 2: Validation |
| EN 60204-1:2018 | Safety of machinery – Electrical equipment of machines – Part 1: General requirements |

The following other standards have been applied:

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

Authorized to compile the technical file:

ABB Limited, Daresbury Park, Cheshire, United Kingdom, WA4 4BT

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, 19 Jun 2023

Signed for and on behalf of:

Peter Lindgren
Vice President, ABB Oy

Tomi Väisälä
Product Unit Manager, ABB Oy

ATEX certificate

ATEX certificate for the Safe motor temperature function with the FPTC-0 and ACS880 drive series (EESF 20 ATEX 050).

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UKEX certificate

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TÜV Nord certificate

The TÜV Nord certificate for the FPTC-02 module and ACS880 drive series is below.

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 contacts can be found by navigating to www.abb.com/contact-centers.

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

Providing feedback on ABB manuals

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