ABB industrial drives

Application guide
ATEX-certified Safe disconnection function for ACS850 drives (+Q971)

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List of related manuals

Hardware and firmware manuals	Code (English)
ACS850-04 (1.1 to 45 kW) hardware manual	*3AUA0000045496*
ACS850-04 (55 to 160 kW) hardware manual	*3AUA0000045487*
ACS850-04 (200 to 500 kW) hardware manual	*3AUA0000026234*
ACS850 Standard Control Program firmware manual	*3AUA0000045497*

Other	Code (English)
Application guide - Safe torque off function for ACSM1, ACS850 and ACQ810 drives	*3AFE68929814*
Technical catalogue - Electronic products and relays	*2CDC110004C0206*

All manuals are available in PDF format on the Internet. See section *Further information* on the inside of the back cover.

Application guide

ATEX-certified Safe disconnection function for ACS850 drives (+Q971)

3AUA0000074343 Rev B
EN
EFFECTIVE: 2011-04-05

Table of contents

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General

The ATEX-certified Safe disconnection function

The Safe torque off (STO) feature of ACS850 drives is certified for use as a Safe disconnection function to protect equipment in potentially explosive atmospheres according to European Council Directive 94/9/EC.

About this guide

This document is delivered with ACS850 drives that have been ordered with the ATEX-certified Safe disconnection function option (code +Q971). The guide is intended for people who plan the installation, install, commission, use, or service the equipment related to the Safe disconnection function. The reader is expected to know the fundamentals of electricity, wiring, electrical components and electrical schematic symbols.

The guide contains information on implementing an ATEX-compliant protective circuit using the Safe torque off feature, along with a motor thermal protection method example, and the ATEX certification documents.

Note: The conformance of the whole installation with all relevant standards, directives, and local electrical code is the responsibility of the supplier of the system.

For further information of the Safe torque off function, refer to *Application guide – Safe torque off function for ACSM1, ACS850 and ACQ810 drives* (3AFE68929814 [English]), and the *Hardware Manual* and *Firmware Manual* of the drive.

Safety instructions

WARNING! Only qualified electricians are allowed to carry out the installation work described in this manual.

- Follow all safety regulations required with application of motors in Zone 1 areas (EN 60079-14).
- Follow the safety instructions given in the *Hardware manual* of the drive, and the *Safe torque off function for ACSM1, ACS850 and ACQ810 drives Application guide*. Ignoring the safety instructions can cause injury or death, or damage to the equipment.
- Never work on the drive, the braking chopper circuit, the motor cable or the motor when input power is applied to the drive. Always ensure by measuring that no voltage is actually present.

WARNING! The Safe torque off feature of ACS850 drives cannot prevent the intermediate DC current from flowing through, and heating up, the motor in case a short-circuit occurs in the output stage of the drive. The supplier must take this into account when planning the protection of the installation.

- Ensure that the safety requirements of EN 50495 are fulfilled. The protective system shall be at least SIL1 compliant. When using CM MSS (3) relay in the protective system, a proof test interval (T1) of maximum 7 years is required to fulfill SIL1 requirements. The safety values of STO function are available in *Safe torque off function for ACSM1, ACS850 and ACQ810 drives Application guide* (3AFE68929814 [English]).

2

Implementing a Safe disconnection function

What this chapter contains

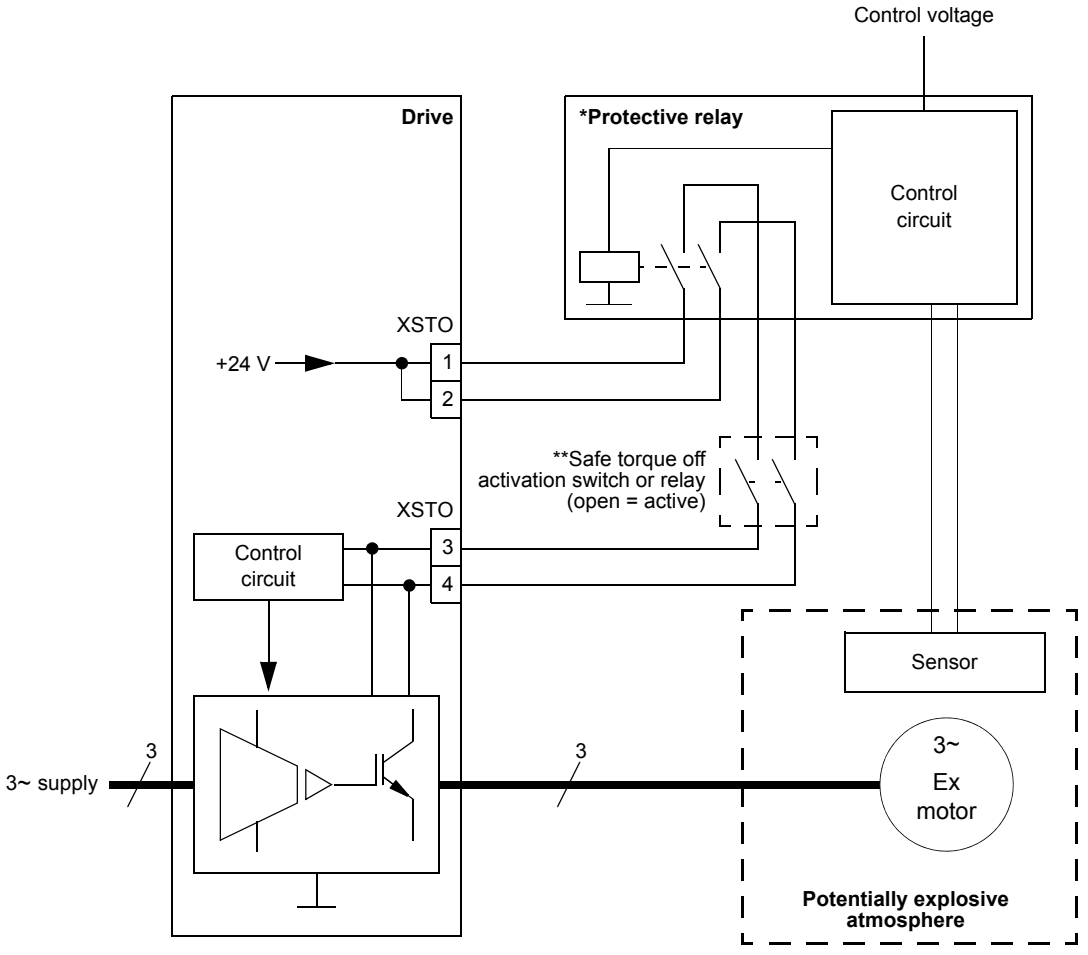
This chapter describes how the Safe torque off (STO) feature of the drive is used for ATEX-compliant protective functions.

Safe disconnection principle

Protective functions that require safe disconnection of the motor can be implemented using the Safe torque off circuit of the drive as shown below.

Two-channel connection

The output contacts of the protective relay are connected in series with the Safe torque off activation switch/relay (if present).



*An ATEX-certified protective relay. The relay monitors a sensor circuit, and activates the Safe torque off function of the drive by opening the control circuits when necessary.
**Optional Safe torque off activation switch or relay with a minimum Safety Integrity Level of SIL 1. The Safe torque off function disables the control voltage of the power semiconductors of the drive output stage, thus preventing the inverter from generating the voltage required to rotate the motor.

One-channel connection

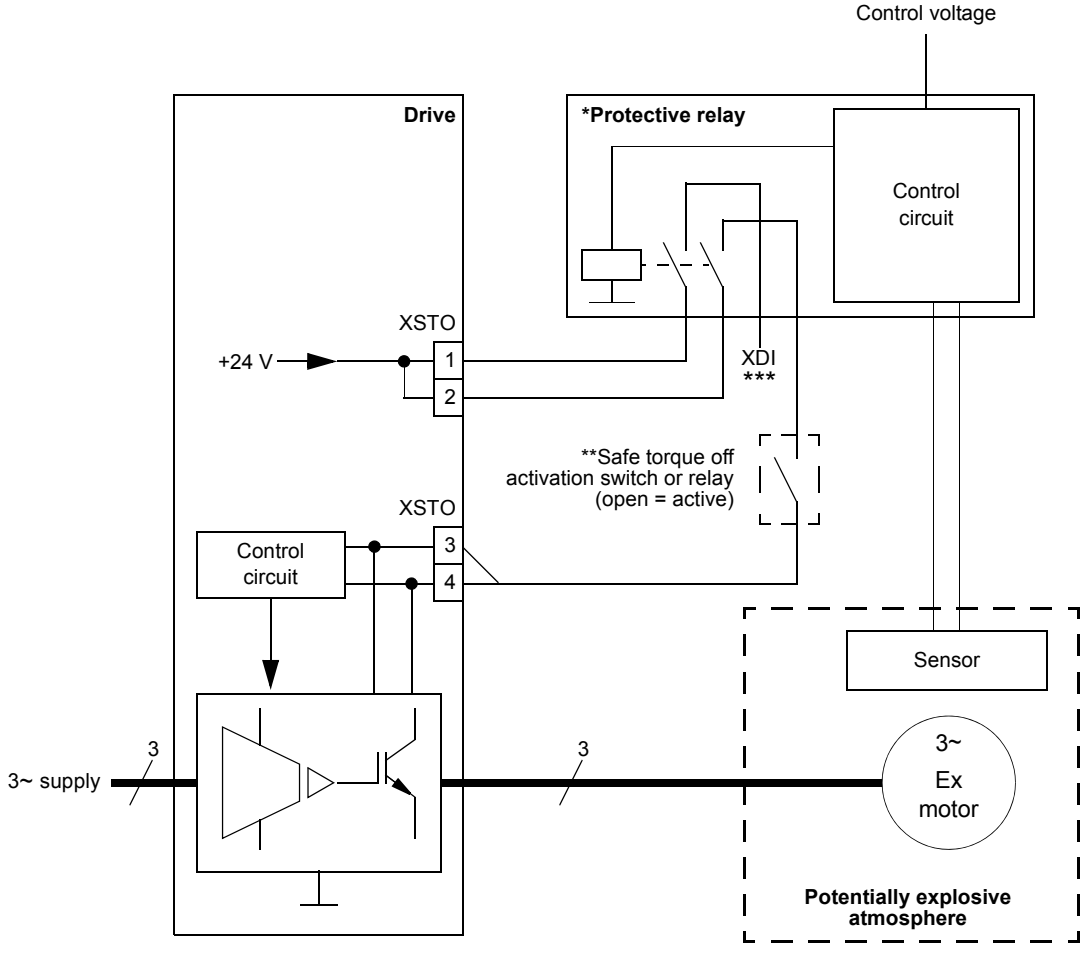
One of the output contacts of the protective relay can be connected to a digital input on the drive control board to use it for diagnostics.

For example, it can be connected to a digital input configured as a PTC thermistor input (XDI:6 in ACS850). In this case, the diagnostic information is received as a MOTOR TEMPERATURE alarm. To use this configuration, set the following parameters:

- 31.01 Mot temp1 prot: (2) fault
- 31.02 Mot temp1 src: (4) PTC JCU

See the relevant *Firmware manual* for more information.

The protective functions are implemented as shown below:



*An ATEX-certified protective relay. The relay monitors a sensor circuit, and activates the Safe torque off function of the drive by opening the control circuits when necessary.
**Optional Safe torque off activation switch or relay with a minimum Safety Integrity Level of SIL 1. The Safe torque off function disables the control voltage of the power semiconductors of the drive output stage, thus preventing the inverter from generating the voltage required to rotate the motor.
*** Connected to a digital input on the control board of the drive for diagnostics.

General wiring instructions

Only the sensor circuit is wired into the potentially explosive atmosphere. The drive, the Safe torque off circuit, and the protective relay must be installed outside the hazardous zone.

For the STO circuit wiring, use the type of cable specified under *STO circuit cable specification* on page *21*.

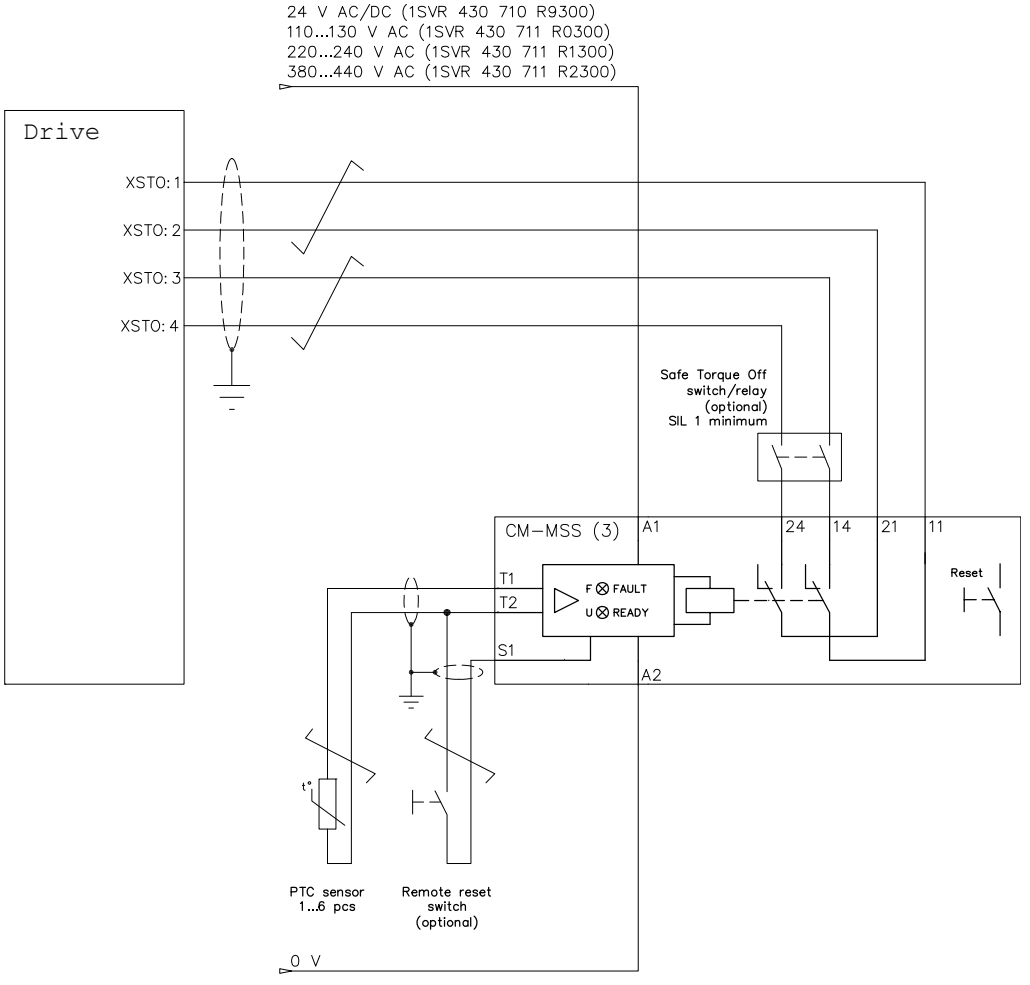
Route the sensor cables away from the motor cable. Shielded sensor cable is recommended to minimize electromagnetic interference from power cables.

Example – Thermal motor protection

The following example shows an ATEX-compliant thermal motor protection function with the two-channel connection. For examples with the one-channel connection, see *Application guide – Safe torque off function for ACSM1, ACS850 and ACQ810 drives* (3AFE68929814 [English]).

The example employs an ABB CM-MSS (3) thermistor motor protection relay. The relay monitors a motor fitted with PTC resistor sensors (PTC thermistors). When motor temperature rises to the thermistor wake-up level, the resistance of the thermistor increases sharply. The relay detects the change and indicates motor overtemperature through its output contacts. The opening contacts break the Safe torque off circuit of the drive, thus disconnecting the power supply from the motor.

Wiring diagram



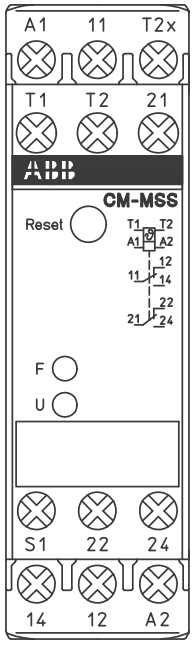
Thermistor motor protection relay specification

The order codes of CM-MSS (3) relays for different control voltages are listed below.

Rated control supply voltage	Order code
24 V AC/DC	1SVR 430 710 R9300
110…130 V AC	1SVR 430 711 R0300
220…240 V AC	1SVR 430 711 R1300
380…440 V AC	1SVR 430 711 R2300

For technical data of the relays, see page 21. More information on the CM-MSS series of relays is available from *Electronic products and relays - Technical catalogue* (2CDC110004C0206).

Layout



A1-A2 Control voltage input

T1-T2 Measurement circuit with 1…6 sensors. Maximum total resistance: 1500 ohm

T1-T2x Temperature switch circuit (not used in the particular application described by this guide).

S1-T2 Remote reset push button switch

WARNING! Even though autoreset of the relay can be implemented by connecting these terminals together, this is not allowed in a potentially explosive atmosphere.

11-12/14 Output contacts (1)

11: Common
12: Normally-closed
14: Normally-open

21-22/24 Output contacts (2)

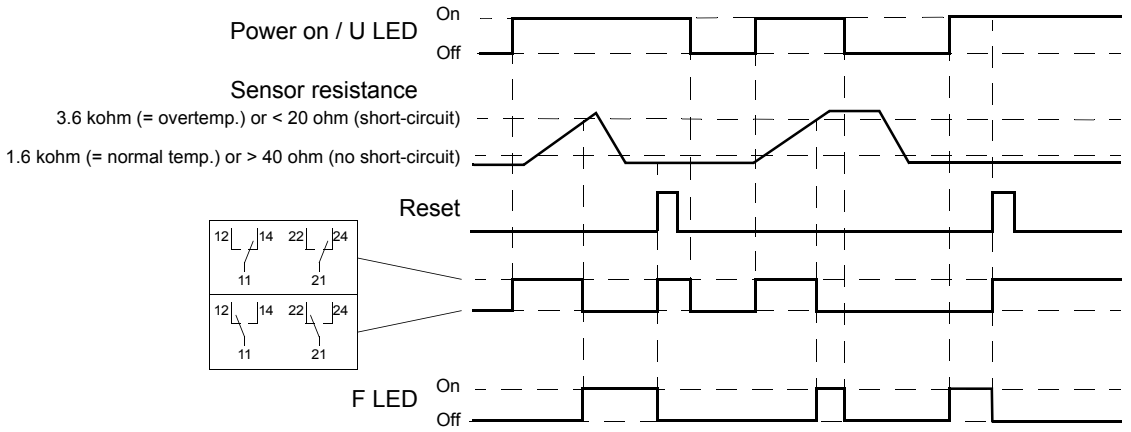
21: Common
22: Normally-closed
24: Normally-open

Reset Fault reset button

“F” LED Fault indicator LED (excessive motor temperature, or wire breakage or short-circuit in the measurement circuit)

“U” LED Supply voltage present

Operation diagram



User checks

The motor manufacturer selects the PTC sensors for the motor temperature measurement. The temperature on-off resistances must match those of the protection relay.

Before commissioning the installation, perform the following tests:

Test	How	Expected result
Short-circuit detection	Short-circuit the sensor input with a 20 ohm resistance. The sensor circuit need not be disconnected.	Fault trip (F LED lights)
Wire breakage detection	Disconnect the sensor circuit.	
Excessive temperature detection	Increase the resistance of the sensor circuit from 50…1500 ohm to 4 kohm.	

3

Technical data

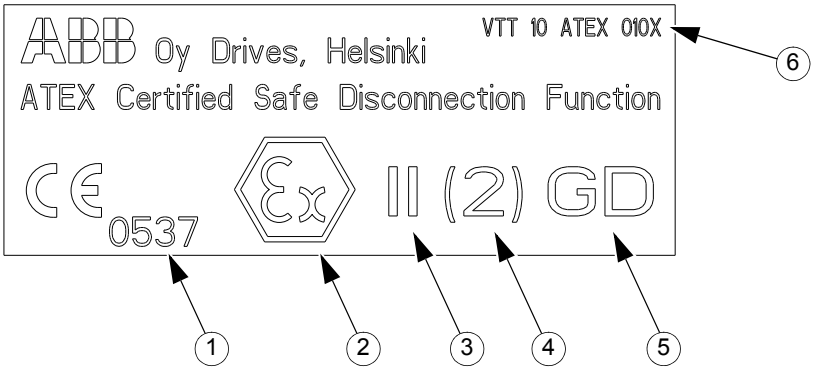
Applicable standards

The ATEX-certified Safe disconnection function of the drive complies with the standards listed below.

EN 50495: 2010	Safety devices required for the safe functioning of equipment with respect to explosion risks
IEC 61508	Part 1: 1998 - General Requirements
	Part 2: 2000 - Requirements for electrical/electronic/programmable electronic safety-related systems
EN 61800-5-2: 2007	Adjustable speed electrical power drive systems Part 5-2: Safety requirements - Functional

Markings of the drive

A sticker is attached to the drive to signify ATEX Certification.



1	CE marking with Notified Body identification: The manufacturer declares that the product conforms with ATEX Directive 94/9/EC. Notified Body: VTT Expert Services Ltd.
2	Specific marking of explosion protection.
3	“II” = Product for other than mining applications.
4	“2” = Category 2 equipment. Parentheses indicate that the drive is to be installed outside the potentially explosive atmosphere.
5	Certified for use in explosive atmospheres caused by: “G” = gases, vapours or mists “D” = dust.
6	Certificate reference.

Compliance with the ATEX Directive

The requirements of the ATEX Directive can be met as follows:

1. The protective relay is ATEX-certified
2. The sensors and the Safe torque off (STO) circuit are wired according to the instructions given in this manual and in the motor manual.

ATEX certificates

VTT EXPERT SERVICES LTD

EC-TYPE EXAMINATION
CERTIFICATE
VTT 10 ATEX 010X Issue 1

1 (2)

1. **EC-TYPE EXAMINATION CERTIFICATE**

2. **Equipment or Protective System Intended for use in Potentially explosive atmospheres Directive 94/9/EC**

3. Reference: **VTT 10 ATEX 010X Issue 1**

4. Equipment: **Safe Disconnection Function of converter drives**

   Certified type: **ACS850 and ACQ810 with option code + Q971**

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

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

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

7. This equipment or protective system and any acceptable variations thereto is specified in the schedule and possible supplement(s) to this Certificate and the documents therein referred to.

8. VTT Expert Services Ltd, notified body number 0537, in accordance with Article 9 of the Council Directive 94/9/EC of March 1994, certifies that this equipment or protective system has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective system intended for use in potentially explosive atmospheres given in Annex II to the Directive

VTT Expert Services Ltd
Electrical Ex-apparatus
Otakaari 7B, Espoo
P.O.Box 1001, FIN-02044 VTT, Finland

Tel + 358 20 722 111
Fax + 358 20 722 7042

FINAS
Finnish Accreditation Service
I018 (EN ISO/IEC 17020)
(Tyyppi A / Type A)

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

EN 50495 (2010)

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

11. This EC-Type examination certificate relates only to the design, examination and tests of the specified equipment or protective system in accordance to the directive 94/9/EC. Further requirements of the Directive apply to the manufacturing process and supply of this equipment or protective system. These are not covered by this certificate.

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

II (2) GD

Espoo, 14.2.2011

VTT Expert Services Ltd

Pertti Kokkonen
Research engineer

Risto Sulonen
Senior research scientist

VTT EXPERT SERVICES LTD

SCHEDULE TO EC-TYPE
EXAMINATION CERTIFICATE
VTT 10 ATEX 010X Issue 1

13. **Schedule**

14. **EC-TYPE EXAMINATION CERTIFICATE VTT 10 ATEX 010X Issue 1**

15. Description

Safe disconnection is achieved by using "Safe Torque Off "(STO)-function which is integrated in the standard drive as an internal hardware-solution. Power that can cause rotation is not applied to the motor. The safety related part of the adjustable speed electrical power drive system PDS (SR) will not provide energy to the motor which can generate torque.

16. Documents

ATEX Safe Disconnection Function, 3AXD10000016980, rev A (dated 10.12.2010)
Report No. SAS-0203/2008TB2 by TÜV Nord. (dated 2010-12-10)
Report No. SLA-0016/2010TB1 by TÜV Nord. (dated 2010-09-27)

17. Special conditions for safe use

Circuit activating Safe Torque Off- function shall be constructed using fail-safe principle and ATEX-certified safety components (eg. thermal relays). All manufacturer's instructions shall be followed.

The drive themselves are to be installed outside potentially explosive atmospheres (article 1, section 2 of the Directive).

18. Essential Health and Safety Requirements

Assessment using standard referred in point 9 have confirmed compliance with the Directive 94/9/EC, Annex II and particular point 1.5.

Certificate history

Issue	Date	Comment
0	23.3.2010	Prime certificate
1	14.2.2011	The introduction of new type ACQ810 and the one channel option .The introduction of the new manufacturing site.

Espoo, 14.2.2011
VTT Expert Services Ltd

Pertti Kokkonen
Research engineer

Risto Sulonen
Senior research scientist

Declaration of Conformity

Declaration of Conformity

(According to ATEX Directive 94/9/EC)

Manufacturer: ABB Oy, Drives

Address: Hiomotie 13, P.O Box 184, FIN-00381 Helsinki, Finland.

hereby declares under our sole responsibility that the product:

ATEX certified safe disconnection function of ACS850 and ACQ810 drives, identified with option code

+Q971

with marking

Ex II (2) GD

to which this declaration relates, is in conformity with the requirements of the Council directive for explosive atmospheres, 94/9/EC of March 1994

and the following harmonized standard has been applied :

EN 50495: 2010

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

Notified Body: VTT Expert Services Ltd, NB number 0537

Address: Otakaari 7B, FIN-02044 Espoo, Finland

has assessed the conformity of the Safe Disconnection Function of ACS850 and ACQ810 drives and has issued the certificate VTT 10 ATEX 010X.

Helsinki, 04 Oct 2010

Jukka Poutanen

Vice President
ABB Oy

STO circuit cable specification

Type	2 × 2 × 0.75 mm^2 low voltage, single shielded, twisted pair cable
Maximum length	25 m between STO inputs and the operating contact
Example	Li YCY TP 2×2×0.75 mm^2 shielded twisted pair cable by HELUKABEL or CEAM

ABB CM-MSS (3) Thermistor motor protection relay

Control voltage input A1-A2	
Rated voltage and voltage tolerance	1SVR 430 710 R9300: 24 V AC/DC 1SVR 430 711 R0300: 110…130 V AC 1SVR 430 711 R1300: 220…240 V AC 1SVR 430 711 R2300: 380…440 V AC
Voltage tolerance	-15%…+10%
Frequency	15...400 Hz
Power consumption	24...240 VDC range: approx. 1.4...1.7 W; 24...240 V / 50 Hz range: approx. 3.5...5.7 VA
Measuring circuit T1-T2	
Monitoring function	Temperature monitoring by means of PTC sensors
Number of sensor circuits	1
Short-circuit monitoring	Yes
Switch-off resistance (relay de-energizes)	3.6 kohm ± 5%
Switch-on resistance (relay energizes)	1.6 kohm ± 5%
Short-circuit switch-off resistance (relay de-energizes)	< 20 ohm
Short-circuit switch-on resistance (relay energizes)	> 40 ohm
Number of sensors in series	1…6
Max. total resistance with sensors in cold state in the circuit	$\leq$ 1.5 kohm
Max. sensor cable length for short-circuit detection	2 × 100 m with 0.75 mm^2, 2 × 400 m with 2.5 mm^2
Response time	< 100 ms
Measuring circuit T1-T2x	
Monitoring function	Temperature monitoring by means of a temperature switch (not used in the particular application described by this document)
Short-circuit monitoring of sensor circuit	No
Reset circuit S1-T2	
Remote reset switch type	Normally-open, momentary
Max. no-load voltage	1SVR 430 710 R9300: 5.5 V approx. 1SVR 430 711 R0300, 1SVR 430 711 R1300, 1SVR 430 711 R2300: 25 V approx.
Max. cable length	With unshielded cable: 50 m With shielded cable: 100...200 m
Indication of operating states	
Control voltage present	“U” LED (green)
Fault	“F” LED (red)
Output contacts	
Number of contacts	Two switchover contacts (common/NO/NC)
Contact material	AgNi
Max. switching voltage	250 V

Rated switching current EN 60947-5-1	AC-12 (resistive) 230 V: 4 A AC-15 (inductive) 230 V: 3 A DC-12 (resistive) 24 V: 4 A DC-13 (inductive) 24 V: 2 A
Mechanical life	30 million switching cycles
Electrical life	100000 switching cycles with a resistive load of 4 A at 230 V.
Max. fuse rating	Normally-open contact: 10 A fast, operating class gL Normally-closed contact: 2 A fast, operating class gL
Ambient temperature	
Operation	-20...+60 °C
Storage	-40...+85 °C
Terminals	
Wire size	Minimum: 2 × 0.5 mm^2 massive or 2 × 0.75 mm^2 stranded with wire end ferrule. Maximum: 2 × 2.5 mm^2 (2 × 14 AWG), stranded with wire end ferrule. Tightening torque 0.8 N•m.
Dimensions	
Height × width × depth	78 × 22.5 × 100 mm (3.07 × 0.89 × 3.94 in.)
Approvals	
ATEX Ex II (2) G D C-UL US listed	
Isolation data	
Rated insulation between supply, measuring and output circuits	250 V
Rated impulse withstand voltage between all isolated circuits	4 kV / 1.2...50 microseconds
Test voltage between all isolated circuits	2.5 kV, 50 Hz, 1 minute
Pollution degree	III
Overvoltage category	III

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/drives and selecting *Sales, Support and Service network*.

Product training

For information on ABB product training, navigate to www.abb.com/drives and select *Training courses*.

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Contact us

ABB Oy
Drives
P.O. Box 184
FI-00381 HELSINKI
FINLAND
Telephone +358 10 22 11
Fax +358 10 22 22681
www.abb.com/drives

ABB Inc.
Automation Technologies
Drives & Motors
16250 West Glendale Drive
New Berlin, WI 53151
USA
Telephone 262 785-3200
1-800-HELP-365
Fax 262 780-5135
www.abb.com/drives

ABB Beijing Drive Systems Co. Ltd.
No. 1, Block D, A-10 Jiuxianqiao Beilu
Chaoyang District
Beijing, P.R. China, 100015
Telephone +86 10 5821 7788
Fax +86 10 5821 7618
www.abb.com/drives

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