Options for ABB drives

User's manual
Emergency stop, stop category 1 (option +Q964) for ACS880-07/17/37 drives

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List of related manuals

Drive hardware manuals and guides	Code (English)
ACS880-07 drives (560 to 2800 kW) hardware manual	*3AUA0000143261*
ACS880-07 drives (45 to 630 kW, 50 to 700 hp) hardware manual	*3AUA0000105718*
ACS880-17 hardware manual	*3AXD50000020436*
ACS880-37 hardware manual	*3AXD50000020437*

Drive firmware manuals and guides	
ACS880 primary control program firmware manual	*3AUA0000085967*
ACS880 primary control program quick start-up guide	*3AUA0000098062*
ACS880 diode supply control program firmware manual	*3AUA0000103295*
ACS880 IGBT supply control program firmware manual	*3AUA0000131562*

PC tool manuals	
Start-up and maintenance PC tool Drive composer user's manual	*3AUA0000094606*
Functional safety design tool user's manual	*3AXD10000102417*

Option manuals and guides	
ACS-AP-x Assistant control panels user's manual	*3AUA0000085685*
Functional safety; Technical guide No. 10	*3AUA0000048753*
Safety and functional safety; A general guide	*1SFC001008B0201*
ABB Safety information and solutions	*www.abb.com/safety*
Manuals and quick guides for I/O extension modules, fieldbus adapters, etc.	

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

ACS880-07 (45 to 630 kW) manuals

ACS880-07 (560 to 2800 kW) manuals

ACS880-17 manuals

ACS880-37 manuals

User’s manual

Emergency stop, stop category 1 (option +Q964)
for ACS880-07/17/37 drives

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Further information

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Introduction to the manual

Contents of this chapter

This chapter describes the manual in short and gives some general information for the reader. The chapter also contains a quick reference for implementing a safety system.

Applicability

This manual applies to ACS880-07/17/37 drives which have the option: Emergency stop, stop category 1 with STO, with safety relays (option +Q964). In this emergency stop option, the main contactor/breaker of the drive is not opened. For the option +Q964, ABB installs the FIO-01 digital I/O extension module (option +L501) to the drive.

Safety instructions

Only a qualified electrician who has appropriate knowledge on functional/machine/process safety is allowed to install, start up and maintain the safety circuit.

WARNING! This safety function does not disconnect the voltage of the main and auxiliary circuits from the drive. You must not work on the electrical parts of the drive or the motor before you have also disconnected the drive system from the electric supply and ensured by measuring that there is no dangerous voltage present.

WARNING! After making additions to the drive safety circuit or modifying it, or changing circuit boards inside the drive, always test the functioning of the safety circuit according to the acceptance test procedure. Any changes in the electrical installations of the drive may affect the safety performance or operation of the drive unexpectedly. All customer-made changes are on the customer’s responsibility.

WARNING! Frames nxDXT + nxR8i: The Safe torque off functionality is only achieved through the XSTO connector of the inverter control unit. True Safe torque off functionality is not achieved through the XSTO connectors of the supply control unit. In the supply unit, the XSTO input must not be used for any safety function purposes to ensure personnel safety. The Safe torque off function is supported by any ACS880 inverter or drive firmware. It is not supported by supply firmware.

WARNING! Read and obey all safety instructions given for the drive in its hardware manual. If you ignore them, injury or death, or damage to the equipment can occur.

This manual does not repeat the complete safety instructions of the drive but it only includes the instructions related to the scope of this manual.

Target audience

The manual is intended for people who install, start up, use and service the safety option of the drive. Read the manual before working on the drive. You are expected to know the fundamentals of electricity, wiring, electrical components, electrical schematic symbols, and functional safety.

Contents

The chapters of this manual are briefly described below.

Introduction to the manual (this chapter) introduces this manual.

Option description and instructions describes the safety option and instructs how to wire, start up, test, validate, use and maintain it. The chapter also contains the safety data.

Related documents

- Product manuals (see the inside of the front cover)
- Circuit diagrams delivered with the drive
- Part lists delivered with the drive
- Safety data report (if the safety circuit is application engineered)

Abbreviations

Abbreviations used in this manual are listed below.

Abbreviation	Description	Reference
Cat.	Category 1. Stop category according to EN/IEC 60204-1 The stop categories are: 0 (uncontrolled stop) and 1 (controlled stop) 2. Classification of the safety-related parts of a control system in respect of their resistance to faults and their subsequent behavior in the fault condition, and which is achieved by the structural arrangement of the parts, fault detection and/or by their reliability. The categories are: B, 1, 2, 3 and 4.	 EN/IEC 60204-1 EN ISO 13849-1
CCF	Common cause failure (%)	EN ISO 13849-1
D8T	Frame size designation of the diode supply module	
DC	Diagnostic coverage	EN ISO 13849-1
DI	Digital input	
DIIL	Digital input interlock	
E-stop	Emergency stop	
FIO-01	Digital I/O extension module	
Frame (size)	Relates to the construction type of the drive in question. For example, several drive types with different power ratings can have the same basic construction, and a frame size is used in reference to all those drive types. With the ACS880-07 (smaller), the frame size marking of the drive indicates the physical size of the drive, eg, R6. With the ACS880-07 (larger), the frame size marking of the drive indicates the quantity and frame size of the diode supply modules plus the quantity and frame size of the inverter modules, eg, “2×D8T +3×R8i”. With the ACS880-17 and ACS880-37, the frame size marking of the drive indicates the quantity and frame size of the IGBT supply modules plus the quantity and frame size of the inverter modules, eg, “2×R8i +3×R8i”.	
HFT	Hardware fault tolerance	IEC 61508, EN/IEC 62061
IGBT	Insulated gate bipolar transistor	
PFD	Probability of dangerous failure on demand	IEC 61508
PFH	Probability of a dangerous failure per hour	IEC 61508, EN ISO 13849-1, EN/IEC 62061, EN/IEC 61800-5-2
PL	Performance level (levels are: a, b, c, d and e). Corresponds to SIL.	EN ISO 13849-1
R6...R11, R8i	Frame size designation of the drive, inverter or IGBT supply module	
RO	Relay output	
SC	Systematic capability	IEC 61508
SIL	Safety integrity level	IEC 61508, IEC 61511, EN/IEC 62061, EN/IEC 61800-5-2
SILCL	Maximum SIL that can be claimed for a safety function or subsystem	EN/IEC 62061
SS1	Safe stop 1	EN/IEC 61800-5-2
STO	Safe torque off	EN/IEC 61800-5-2

Abbreviation	Description	Reference
T1	Proof test interval or lifetime (the smaller one)	IEC 61508, EN/IEC 62061

Exclusion of liability

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

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

Quick reference guide for implementing a safety system

Task	☑
Select the appropriate functional safety standard for the implementation: EN ISO 13849-1, EN/IEC 62061, IEC 61511 or other.	☐
If you select EN/IEC 62061 or IEC 61511, make a safety plan. See EN/IEC 62061 or IEC 61511.	☐
Assess safety: analyze and evaluate risks (estimate SIL/PL) and define risk reduction strategies. Define the safety requirements.	☐
Design the safety system. The part of the design made by ABB is described in chapter *Option description and instructions* on page *11*.	☐
If you made any changes to the delivered safety system, verify the achieved SIL/PL with, for example, FSDT-01 Functional safety design tool or similar. See *Functional safety design tool user's manual* (3AXD10000102417 [English]).	☐
Connect the wiring. See section *Wiring* on page *17*.	☐
Set the parameters. See section *Parameter settings* on page *15*.	☐
Validate that the implemented system meets the safety requirements: • Do the acceptance test. See section *Start-up and acceptance test* on page *18*.	☐
Write the necessary documentation.	☐

2

Option description and instructions

Contents this chapter

This chapter describes the +Q964 emergency stop option and instructs how to wire, start up, test, validate, use and maintain it. The safety data is also given.

Overview

The option +Q964 corresponds to a controlled stop in accordance with stop category 1 (EN/IEC 60204-1). The option corresponds to the Safe Stop 1 (SS1) function. After the user has given the emergency stop command, the drive first decelerates the motor(s) to zero speed according to a preset ramp time. Then, the option activates the Safe torque off (STO) function which 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(s). The main contactor/breaker of the drive is not opened.

For the option +Q964, ABB installs the FIO-01 digital I/O extension module (option +L501) to the drive control board (Slot 1).

For a detailed description of the Safe torque off function, see the appropriate hardware manual.

Note: Drives with the Prevention of unexpected start-up (POUS) option (+Q957):
If the user activates the POUS function during the emergency stop deceleration ramp, it overrides the emergency stop function. This activates the Safe torque off (STO) function of the drive immediately and the motor coasts to a stop. For more information on the POUS safety function, see *Prevention of unexpected start-up (option +Q957) for ACS880-07/17/37 drives* (3AUA0000119910 [English]).

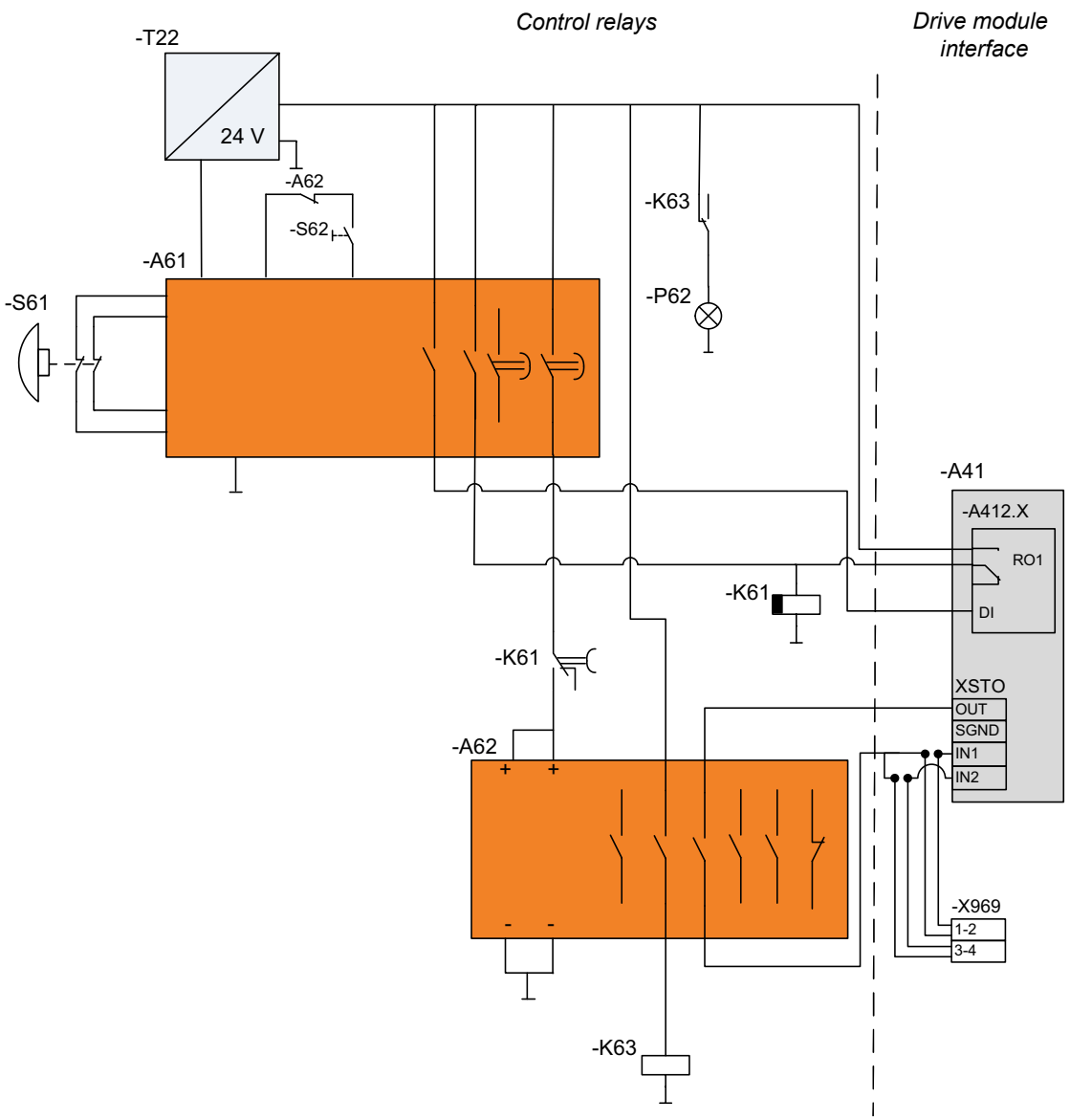
Note: ACS880-07 drives, frames nxDXT + nxR8i with a main contactor/breaker (option +F250/+F255) and ACS880-17/37 drives, frames nxR8i + nxR8i: When the STO function is activated in the inverter unit, the main contactor/breaker is opened after a user-defined delay (defined with parameter *94.11*, the default value is *600 s*). See the hardware and firmware manuals for more information.

The SS1 and STO functions comply with EN/IEC 61800-5-2:2007.

The design principles of the option +Q964 comply with EN ISO13850.

For a complete list of related standards and European directives, see section *Related standards and directives* on page *26*.

Operation principle



A41	Control board (inverter unit)	K63	Auxiliary relay
A412.X	Digital I/O extension module	P62	Emergency stop indication lamp
A61	Emergency stop safety relay	S61	Emergency stop button
A62	Extension safety relay	S62	Emergency stop reset button
K61	Timer relay	T22	24 V power supply
X969	STO terminal block		

Initial status: The drive is in operation and the motors is running.

Step	Operation
1.	The user activates the emergency stop with the emergency stop button [S61].
2.	The emergency stop safety relay [A61] switches off the digital input on the drive control board (A41] giving the emergency stop command. The emergency stop safety relay [A61] switches off the power supply for the timer relay [K61]. The break delay counter of the emergency stop safety relay [A61] starts (user-adjustable delay). The break delay counter of the timer relay [K61] starts (non-user-adjustable delay).
3.	The drive acknowledges the emergency stop command by energizing the relay output RO1 of the digital I/O extension module [A412.X]. The relay output of the digital I/O extension module [A412.X] re-energizes the timer relay [K61] resetting its break delay counter. The relay keeps its delayed break contact closed. **Note:** If the drive fails to acknowledge the reception of the emergency stop command in 2 seconds, the STO cuts off the drive control pulses preventing motor control and rotation.
4.	The drive decelerates the motor to zero speed in emergency stop deceleration time (parameter setting).
5.	The break delay counter of the emergency stop safety relay [A61] trips and the relay switches off the power supply for the extension safety relay [A62]. The extension safety relay [A62] switches off the Safe torque off (STO) control signals on the drive control board [A41]. The STO cuts off the drive control pulses preventing motor control and rotation.
6.	The contact of the auxiliary relay [K63] energizes the indication lamp [P62] of the emergency stop reset button [S62].
7.	Normal operation resumes after the user: • releases the emergency stop button [S61] to normal (up) position • resets the emergency stop circuit with the emergency stop reset button [S62] (the user must push the button for 0.1 to 3 seconds) • resets the drive (if the STO indication parameter *31.22* has been set so that a fault is generated) • makes sure that the drive has received the start signal (depends on the configuration, see the firmware manual).

Fault reaction function

Definition: A safety function requires a ‘fault reaction function’ that attempts to initiate a safe state if the safety function's diagnostics detect a fault within the hardware/software that performs the safety function.

The fault reaction function of the emergency stop safety relay [A61] trips if it detects a failure (short circuit between signals, open circuits, redundancy fault when the emergency stop button is pushed) in the safety circuit. The fault reaction function shifts the drive immediately into the safe state by activating the Safe torque off (STO) function, switching on the drive emergency stop command, and keeping it on until the detected fault has been repaired. The indication lamp of the reset button is on until the fault has been repaired.

The emergency stop reset circuit must be open when the user releases the emergency stop button. The emergency stop safety relay [A61] detects if the reset circuit is closed and the relay does not close.The user must reset the safety relay, see section *Fault tracing* on page *20*. For a detailed description of the emergency stop safety relay [A61], see section *Hardware settings* on page *16*.

The STO function has its own internal fault diagnostics and fault reaction function.

Parameter settings

ACS880-07/17/13 drives, all frame sizes

This table lists the drive parameters settings in ACS880 primary control program. For more information, see the firmware manual.

No.	Name	Value	Description
14.01	Module 1 type	FIO-01	Activates (and specifies the type of) I/O extension module 1.
14.02	Module 1 location	Slot 1	Specifies the slot (1…3) on the control unit of the drive into which the I/O extension module is installed.
14.09	DIO 1 function	Input	Selects whether DIO1 of the extension module is used as a digital input or output.
14.14	DIO 2 function	Input	Selects whether DIO2 of the extension module is used as a digital input or output.
14.34	RO1 source	P.14.5.1-	Selects a drive signal to be connected to relay output RO1. In this case, the RO1 is energized by the status of DIO2 of the FIO module (inverted value).
21.04	Emergency stop mode	Eme ramp stop (Off3)	Selects the way the motor is stopped when an emergency stop command is received.
21.05	Emergency stop source	P.14.5.1	Selects the source of the emergency stop signal. In this case, the source is DI02 of the FIO module.
23.23	Emergency stop time	User-defined	Select a suitable value. See the firmware manual and section *Hardware settings* on page *16*.
31.03	External event 2 source	P.14.5.0	Selects the source of external event 1. In this case, the source is DI01 of the FIO module.
31.04	External event 2 type	Warning/ Fault	Selects the type of external event 2.
31.22	STO indication run/ stop	Warning/ Warning	Selects which indications are given when one or both Safe torque off (STO) signals are switched off or lost. Warning/Warning is the recommended setting.
46.01	Speed scaling to zero	User-defined	Selects the maximum speed value used to define the initial speed value used to define the deceleration ramp rate. Select a suitable value. See the firmware manual and section *Hardware settings* on page *16*.

ACS880-07 drives, frames nxDXT + nxR8i and ACS880-17/37 drives

Note: ACS880 primary control program controls the inverter unit by default. There are dedicated control boards for the supply and inverter units.

The inverter unit parameter setting in ACS880 primary control program:

- see the table above.

The supply unit parameter setting in the ACS880 supply control programs:

- parameter *121.05 Emergency stop source* to value *Inactive*.

For more information, see the firmware manuals.

Hardware settings

Set the time delay of the emergency stop safety relay [A61] according to the application needs with the rotary switches on the safety relay.

Switch	Value	Description
t_{Fkt}	1	Selects the delay mode. Must be 1.
t_{max}	User-defined	Selects the time range (in seconds) for the delayed contacts. Value range: 1-300 s.
t	User-defined	Adjusts the time within the selected range in 10% steps. Value range: 0.1-1.

Example: Required time (t_v) = 30 s, set:

- t_{max} = 30 s and t = 1 ($t_v = t_{max}$ x t = 30 s x 1 = 30 s),

  or
- t_{max} = 300 s and t = 0.1 ($t_v = t_{max}$ x t = 300 s x 0.1 = 30 s).

Tune the delay for the emergency stop safety relay [A61] a little longer than the emergency stop deceleration time defined by drive parameters *23.23* and *46.01* (see section *Parameter settings* on page *15*).

Wiring

One emergency stop button and one reset button are installed on the cabinet door and wired to the drive at the factory. There are double contacts in the emergency stop button and double wiring (two-channel connection) between the button and the emergency stop safety relay [A61]. The safety relay detects cross faults and faults across one contact from the emergency stop button. This function must be used in a redundant manner, that is, the emergency stop button must be connected to both terminals with a separate contact.

If needed, install additional emergency stop buttons on site and wire them to the appropriate terminal block inside the drive cabinet. See the circuit diagrams delivered with the drive. Follow the rules below:

1. Use only double-contact buttons approved for the emergency stop circuits.
2. Connect the emergency stop buttons with two conductors (two-channel connection). **Note:** Keep the channels separate. If you use only one channel, or if the first and second channels are connected together (for example, in a chain), the cross fault detection of the emergency stop safety relay trips and activates the emergency stop command of the drive as it detects a redundancy fault.
3. Use shielded, twisted pair cable. We recommend a double-shielded cable and gold-plated contacts in the emergency stop button.
4. Ensure that the sum resistance for one channel (loop resistance) does not exceed 1 kohm.
5. Follow the general control cable installation instructions given in the drive hardware manual.

You can also install additional reset buttons and indication lamps for the emergency stop circuit on site. We recommend gold-plated contacts in the reset button. Wire the buttons to the appropriate terminal block inside the drive cabinet. See the circuit diagrams delivered with the drive. Follow the rules below:

1. Sum resistance of the external reset circuit may not exceed 1 kohm.
2. Follow the general control cable installation instructions given in the drive hardware manual.

Start-up and acceptance test

You need the Drive composer PC tool or a control panel to perform the start-up and acceptance test.

Initial status: Make sure that the drive is ready for use, that is, you have done the tasks of the drive start-up procedure. See the hardware manual.

Action	☑
⚠ **WARNING!** Obey the *Safety instructions*, page *7*. If you ignore them, injury or death, or damage to the equipment can occur.	
Checks and settings with no voltage connected	
If any connections of emergency stop circuit have been done on site (such as wiring of additional emergency stop buttons, connection of shipping splits of large drives, etc.), check the connections against the appropriate circuit diagrams.	☐
Drives with R8i inverter modules: Check that the STO OUT output on the inverter control unit [A41] is chained to the STO inputs of all inverter modules. The STO circuit is disabled in spare part modules.	☐
Check that the hardware settings relevant to the safety function are set as defined in section *Hardware settings* on page *16*.	☐
Settings with voltage connected	
Check that the parameters relevant to the safety function are set as defined in section *Parameter settings* on page *15*.	☐
Acceptance test	
Ensure that the motor can be run and stopped freely during the test.	☐
Start the drive and ensure that the motor is running. If possible, use a motor speed close to the maximum speed of the application.	☐
Push the emergency stop button [S61].	☐
Ensure that the drive stops the motor by decelerating and displays a warning. For a description of the messages, see the firmware manual of the drive.	☐
Ensure that the indication lamp [P62] switches on.	☐
Drives with R8i inverter modules: Ensure that “STO hardware failure” (5090) is not generated.	☐
Ensure that you cannot started the drive and motor from any control location: Ensure that the motor does not start even if you switch the start signal off and on or push the start key of the panel.	☐
Turn the emergency stop button [S61] until it releases and returns to the up position.	☐
Push the emergency stop reset button [S62]. Ensure that the emergency stop indication lamp [P62] switches off.	☐
Switch off the drive start signal. If a fault message is generated, reset the drive. See section *Parameter settings* on page *15*.	☐
Restart the drive and motor and check that they operate normally.	☐
Repeat the test from each operating location (every emergency stop button and reset button).	☐
Fill in and sign the acceptance test report which verifies that the safety function is safe and accepted to operation.	☐

Use of the safety function

Activating

1. Push the emergency stop button [S61]. The emergency stop activates and the button locks in “ON” (open) position.

Resetting

1. Turn the emergency stop button [S61] until it releases.
2. Push the emergency stop reset button [S62] on the cabinet door. The indication lamp [P62] of the reset button [S62] goes out, the emergency stop deactivates.
   Note: You must push the reset button [S62] for 0.1 to 3 seconds.
3. Reset the drive if necessary.
4. Make sure that the drive has received the start signal (depends on the configuration, see the firmware manual).
5. You can now restart the drive.

Note: You have to reset the emergency stop circuit with the reset button [S62] also after you have powered up the drive.

Emergency stop indications

When the emergency stop is on:

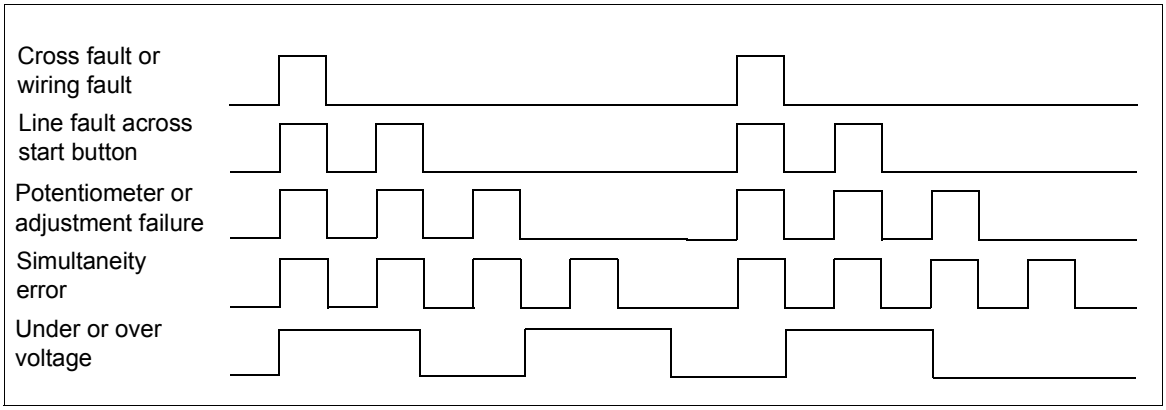
- the drive control program has the warning *Safe torque off* and warning *Emergency stop (off1 or off3)* active.
- the emergency stop reset button [S62] on cabinet door is illuminated (indication lamp [P62]) after the emergency stop deceleration ramp time has passed.
- the ON LED of the emergency stop safety relay [A61] is green and steady.

Fault tracing

This table describes the status LEDs of the emergency stop safety relay [A61].

LED	Color	LED is lit and steady	LED is lit and flashing	LED is not lit
ON	Green	Power supply is connected		Power supply is not connected.
ERR	Red	System error. Replace the unit if the error is not removed after restart.	During external errors. See the figure below for details.	
K1/K2	Green	Relays K1 and K2 energized (instantaneous contact)	During external errors.	
K3/K4	Green	Relays K3 and K4 energized (delayed contacts)	During the time delay.	

This figure describes the ERR LED indications in fault situations.



To reset the emergency stop safety relay [A61] after fault situations, switch off the external power supply of the safety relay.

This table describes the status LEDs of the extension safety relay [A62].

LED	LED is lit and steady
K1	Power supply is connected and relay K1 energized.
K2	Power supply is connected and relay K2 energized.

For more fault tracing possibilities, see the hardware and firmware manuals of the drive.

Maintenance

After the operation of the circuit is tested at start-up, it does not need any scheduled maintenance during its specified lifetime.

In addition to proof testing, it is a good practice to check the operation of the function when other maintenance routines of the machinery are carried out.

If you change any wiring or component after the start up, or restore parameters to their default values:

- Use only ABB approved spare parts.
- Register the change to the change log for the safety circuit.
- Test the safety function again after the change. Follow the rules given in section *Start-up and acceptance test* on page *18*.
- Document the tests and store the report into the logbook of the machine.

Proof test interval

After the operation of the safety function is validated at start-up, the safety function must be maintained by periodic proof testing. In high demand mode of operation, the maximum proof test interval is 20 years. In low demand mode of operation, the maximum proof test interval is 2 years (high or low demand as defined in IEC 61508, EN/IEC 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. Do the test as described in section *Start-up and acceptance test* on page *18*.

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 for Machinery 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 performed 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 performed at least every 12 months.

This is a recommendation and depends on the required (not achieved) SIL/PL. For example, safety relays, contactor relays, emergency stop buttons, switches etc. are typically safety devices which contain electromechanical outputs. The STO circuit of the drive does not contain any electromechanical components.

Competence

The maintenance and proof test activities of the safety function must be carried out by a competent person with adequate expertise and knowledge of the safety function as well as functional safety, as required by IEC 61508-1 clause 6.

Residual risk

The safety functions are used to reduce the recognized hazardous conditions. In spite of this, it is not always possible to eliminate all potential hazards. Therefore the warnings for the residual risks must be given to the operators.

Intentional misuse

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

Decommissioning

When you decommission an emergency stop circuit or a drive, make sure that the safety of the machine is maintained until the decommissioning is complete.

Safety data

The safety data given below is valid for the default design of the safety circuit. In case the final design differs from the default, ABB calculates new safety data and delivers it separately to the customer.

Safety data values

The safety data calculations are based on the assumption that the emergency stop is used once a week.

Drive module frame size	SIL / SILCL	SC	PL	PFH [1/h]	PFD	DC[1)] [%]	Cat.	HFT	CCF	Lifetime [a]	T1[2)] [a]
R6, R7	3	3	e	4.6E-08	3.5E-04	>90	3	1	80	20	20/2
R8, R9	3	3	e	4.8E-08	3.5E-04	>90	3	1	80	20	20/2
R10, R11	3	3	e	4.8E-08	3.6E-04	>90	3	1	80	20	20/2
1×R8i	3	3	e	4.4E-08	3.3E-04	>90	3	1	80	20	20/2
2×R8i	3	3	e	4.4E-08	3.3E-04	>90	3	1	80	20	20/2
3×R8i	3	3	e	4.4E-08	3.3E-04	>90	3	1	80	20	20/2
4×R8i	3	3	e	4.4E-08	3.3E-04	>90	3	1	80	20	20/2
5×R8i	3	3	e	4.4E-08	3.3E-04	>90	3	1	80	20	20/2
6×R8i	3	3	e	4.4E-08	3.3E-04	>90	3	1	80	20	20/2

1) DC for low demand mode is 25% (determined by the DC of the worst component in the subsystem). 3AXD10000097591 Rev C

2) T1 = 20a is used with high demand mode of operation. T1 = 2a is used with low demand mode of operation.
See also section *Proof test interval* on page *21*.

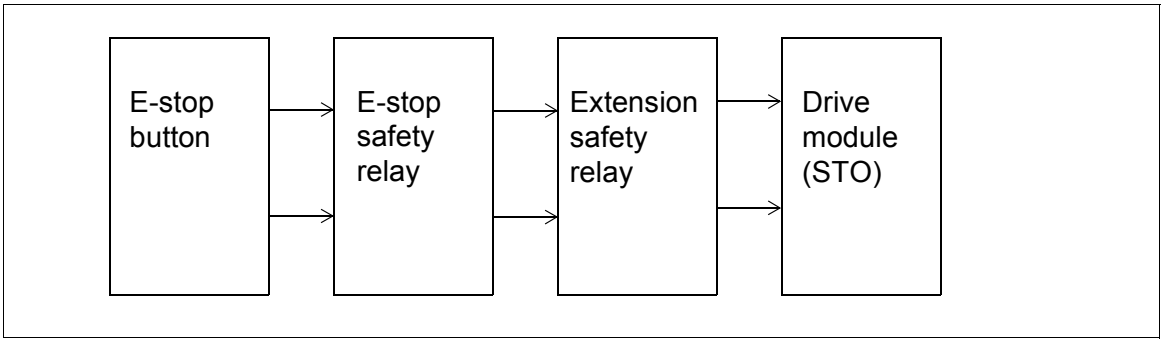
Safety component types

Safety component types as defined in IEC 61508-2:

- emergency stop button: type A
- safety relays: type A
- drive STO circuit:
  - frame sizes R1...R9 and drives with R1i...R7i inverter modules: type A
  - frame sizes R10 and R11 and drives with R8i inverter modules: type B.

Safety block diagram

The components that are included in the safety circuit are shown in the safety block diagram below.



Relevant failure modes

Internal failures of safety relays, the emergency stop button and STO. These failures are included in the PFH value of the function.

Fault exclusions

Fault exclusions (not considered in the calculations):

- any short and open circuits in the cables of the safety circuit
- any short and open circuits in the cabinet terminal blocks of the safety circuits.

Operation delays

Emergency stop total delay: Emergency stop deceleration ramp time + 250 ms

General rules, notes and definitions

Validation of the safety functions

You must do an acceptance test (validation) to validate the correct operation of safety functions.

Validation procedure

You must do the acceptance test using the checklist given in section *Start-up and acceptance test* on page *18*:

- at initial start-up of the safety function
- after any changes related to the safety function (wiring, components, safety function related parameter settings etc.)
- after any maintenance action related to the safety function.

The acceptance test must include at least the following steps:

- you must have an acceptance test plan
- you must test all commissioned functions for proper operation, from each operation location
- you must document all acceptance tests.

Acceptance test reports

You must store the signed acceptance test reports in the logbook of the machine. 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 acceptance test reports performed due to changes or maintenance in the logbook of the machine.

Competence

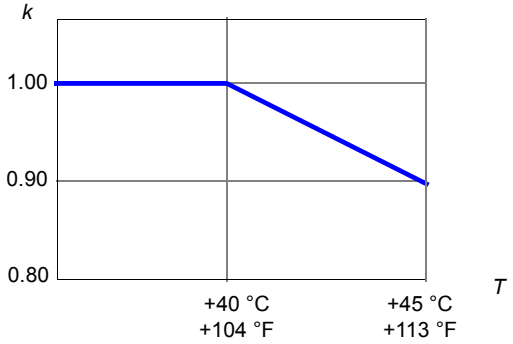
The acceptance test of the safety function must be carried out by a competent person with adequate expertise and knowledge of the safety function as well as functional safety, as required by IEC 61508-1 clause 6. The test procedures and report must be documented and signed by this person.

Ambient conditions

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

ACS880-07 drives, frames R6 to R11

The maximum ambient temperature for the drive with safety relays is 45 °C (113 °F). In the temperature range +40…45 °C (+104…113 °F), the rated output current must be derated by 2% for every added 1 °C (1.8 °F). The output current can be calculated by multiplying the current given in the rating table by the derating factor (*k*):



Reporting problems and failures related to safety functions

Contact your local ABB representative.

Related standards and directives

Standard	Name
EN 60204-1:2006 + AC:2010 IEC 60204-1:2005 + A1:2008	*Safety of machinery – Electrical equipment of machines – Part 1: General requirements*
IEC 61508:2010	*Functional safety of electrical/electronic/programmable electronic safety-related systems.* Contains all parts 1…7 of IEC 61508.
EN/IEC 61800-5-2:2007	*Adjustable speed electrical power drive systems – Part 5-2: Safety requirements – Functional*
EN/IEC 62061:2005 + A1:2013	*Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems*
EN ISO 12100:2010	*Safety of machinery – General principles for design – Risk assessment and risk reduction*
EN ISO 13849-1:2008 + AC:2009 ISO 13849-1:2006	*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 control systems – Part 2: Validation*
EN ISO 13850:2008 ISO 13850:2006	*Safety of machinery. Emergency stop. Principles for design*
IEC 61511:2003	*Functional safety – Safety instrumented systems for the process industry sector*
IEC 61326-3-1: 2008	*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*
2006/42/EC	*European Machinery Directive*
Other	Machine-specific C-type standards

Compliance with the European Machinery Directive

The drive is an electronic product which is covered by the European Low Voltage Directive. However, the drive internal safety function of this manual (option +Q964) is in the scope of the Machinery Directive as a safety component. This function complies with European harmonized standards such as EN/IEC 61800-5-2. The declaration of conformity is delivered with the drive.

Further information

Product and service inquiries

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

Product training

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

Providing feedback on ABB manuals

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

Document library on the Internet

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

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