

OPTIONS FOR ABB INDUSTRIAL DRIVES

Emergency stop functions with button monitoring (options +Q951+Q984 and +Q952+Q984) for ACS880 liquid-cooled drives

User's manual



Emergency stop functions with button monitoring (options +Q951+Q984 and +Q952+Q984) for ACS880 liquid-cooled drives

User's manual

Table of contents



1. Safety instructions



5. Electrical installation



7. Start-up and validation test



Table of contents

1 Safety instructions

Contents of this chapter	7
Use of warnings and notes	7
Instructions for functional safety circuits	8
Electrical safety precautions	9

2 Introduction to the manual

Contents of this chapter	11
Applicability	11
Target audience	11
Exclusion of liability	12
Quick reference guide for implementing a safety system	12
Related documents	12
Terms and abbreviations	13

3 Description of option +Q951+Q984

Contents of this chapter	15
Overview	15
Operation principle	16
ACS880-07CLC drives	16
ACS880-07LC drives	18
ACS880-17LC/37LC drives	20
ACS880 multidrives	22
Fault reaction function	23
Parameter settings	24
ACS880-07CLC/07LC/17LC/37LC drives	24
ACS880 multidrives	24
Hardware settings	25
ACS880-07CLC drives	25
ACS880-07LC/17LC/37LC drives and ACS880 multidrives	25
Push button monitoring relays	25

4 Description of option +Q952+Q984

Contents of this chapter	27
Overview	27
Operation principle	28
ACS880-07LC drives	28
ACS880-17LC/37LC drives	30
ACS880 multidrives	32
Fault reaction function	34
Parameter settings	34
ACS880-07LC/17LC/37LC drives	34
ACS880 multidrives	36
Hardware settings	37
Emergency stop safety relay	37



Push button monitoring relays 37

5 Electrical installation

Contents of this chapter 39
 Wiring 39
 Connecting the user-defined push buttons 39
 Connecting the push button fault indication 40

6 Use of the safety function

Contents of this chapter 41
 Activating the safety function 41
 Resetting the safety function 42

7 Start-up and validation test

Contents of this chapter 43
 Validation of the safety functions 43
 Competence 43
 Validation procedure 43
 Validation test reports 44
 Validation test 44

8 Fault tracing

Contents of this chapter 47
 General 47
 Emergency stop safety relay 47
 ACS880-07CLC drives with option +Q951+Q984 47
 ACS880-07LC/17LC/37LC drives and ACS880 multidrives with option +Q951+Q984 . 48
 ACS880-07LC/17LC/37LC drives and ACS880 multidrives with option +Q952+Q984 . 48
 Monitoring relays 49

9 Maintenance

Contents of this chapter 51
 Safety circuit maintenance 51
 Proof test 51
 Proof test interval 51
 Safety components 52
 Competence 52
 Residual risk 52
 Intentional misuse 52
 Decommissioning 52

10 Technical data

Contents of this chapter 53
 Operation delays 53
 Mission time 53
 Ambient conditions 53

Further information



1

Safety instructions



Contents of this chapter

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

Use of warnings and notes

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

The manual uses these warning symbols:

**WARNING!**

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

**WARNING!**

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

**WARNING!**

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

Instructions for functional safety circuits

This manual does not contain the complete safety instructions of the drive. It only includes the instructions related to the scope of this manual.

Only a qualified electrical professional who has sufficient knowledge about functional, machine, and process safety is permitted to install, start up and maintain the safety circuit. All user-made changes are on the user's responsibility.



WARNING!

The safety functions described in this manual do 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 steps in section *Electrical safety precautions (page 9)*.



WARNING!

Do the validation test of the safety function at the start-up and also after you make changes to the safety circuit.



WARNING!

Make sure that the functional safety of the machine is maintained in situations where the safety option does not provide protection, for example, during commissioning, system maintenance, fault tracing, or decommissioning.



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 or maintenance work.

Electrical safety precautions

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



WARNING!

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

If you are not a qualified electrical professional, do not do installation or maintenance work.

Go through these steps before you begin any installation or maintenance work.

1. Clearly identify the work location and equipment.
2. Disconnect all possible voltage sources. Make sure that re-connection is not possible. Lock out and tag out.
 - Open the main disconnecting device of the drive.
 - Open the charging switch if present.
 - Open the disconnecter of the supply transformer. (The main disconnecting device in the drive cabinet does not disconnect the voltage from the AC input power busbars of the drive cabinet.)
 - If the drive is equipped with a DC/DC converter unit (optional): Open the DC switch-disconnector ([Q11], option +F286) of the DC/DC converter. Open the disconnecting device of the energy storage connected to the DC/DC converter unit (outside the drive cabinet).
 - Open the auxiliary voltage switch-disconnector (if present), and all other possible disconnecting devices that isolate the drive from dangerous voltage sources.
 - In the liquid cooling unit (if present), open the switch-disconnector of the cooling pumps.
 - If you have a permanent magnet motor connected to the drive, disconnect the motor from the drive with a safety switch or by other means.
 - Disconnect all dangerous external voltages from the control circuits.
 - After you disconnect power from the drive, always wait 5 minutes to let the intermediate circuit capacitors discharge before you continue.
3. Protect any other energized parts in the work location against contact.
4. Take special precautions when close to bare conductors.



5. Measure that the installation is de-energized. If the measurement requires removal or disassembly of shrouding or other cabinet structures, obey the local laws and regulations applicable to live working (including – but not limited to – electric shock and arc protection).

- Before and after measuring the installation, verify the operation of the voltage tester on a known voltage source.
- Make sure that the voltage between the drive input power terminals (L1, L2, L3) and the grounding (PE) busbar is zero.
- Make sure that the voltage between the drive output terminals (T1/U, T2/V, T3/W) and the grounding (PE) busbar is zero.
- Make sure that the voltage between the drive DC terminals (UDC+ and UDC-) and the grounding (PE) terminal is zero. In cabinet-built drives, measure between the drive DC busbars (+ and -) and the grounding (PE) busbar.



WARNING!

The busbars inside the cabinet of liquid-cooled drives are partially coated. Measurements made through the coating are potentially unreliable, so only measure at uncoated portions. Note that the coating does not constitute a safe or touch-proof insulation.



6. Install temporary grounding as required by the local regulations.

7. Ask the person in control of the electrical installation work for a permit to work.

2

Introduction to the manual

Contents of this chapter

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

Applicability

This manual is applicable to ACS880 liquid-cooled drives which have one of these options:

- Emergency stop, stop category 0 with main contactor/breaker, with safety relays and push button monitoring (option +Q951+Q984), or
- Emergency stop, stop category 1 with main contactor/breaker, with safety relays and push button monitoring (option +Q952+Q984).

Note: The contents of this manual are applicable only to drives with push button monitoring (option +Q984). There are separate manuals for options +Q951 and +Q952, which are not applicable when combined with option +Q984.

This manual shows the default design of the safety circuit. The actual design can be different from the default design because of customer-defined modifications. Always refer to the documentation delivered with the drive.

Target audience

This manual is intended for people who install, commission, use and service the safety function. Read the manual before working on the unit. You are expected to know the fundamentals of electricity, wiring, electrical components, electrical schematic symbols, and functional safety.

Exclusion of liability

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

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

Quick reference guide for implementing a safety system

Task	<input checked="" type="checkbox"/>
Do a risk assessment according to the relevant standards or regulations, such as ISO 12100.	<input type="checkbox"/>
Select the applicable functional safety standard for the implementation.	<input type="checkbox"/>
Assess safety: analyze and evaluate risks and define risk reduction strategies. Define the safety requirements.	<input type="checkbox"/>
Design the safety system. The part of the design made by ABB is shown in this manual.	<input type="checkbox"/>
Connect the wiring. See the wiring instructions in this manual and the circuit diagrams delivered with the drive.	<input type="checkbox"/>
Set the parameters related to the safety function (as listed in this manual).	<input type="checkbox"/>
Do the validation test. You can find instructions for the validation test in this manual.	<input type="checkbox"/>
Document the validation test procedure. You can find the guidelines for the validation test report in this manual.	<input type="checkbox"/>

Related documents

Name	Code
Drive hardware	
ACS880-07CLC drives hardware manual	3AXD50000131457
ACS880-07LC drives hardware manual	3AXD50000569786
ACS880-17LC drives hardware manual	3AXD50000250295
ACS880-37LC drives hardware manual	3AXD50000251407
ACS880-107LC inverter units hardware manual	3AXD50000196111
ACS880-207LC IGBT supply units hardware manual	3AXD50000174782
ACS880-307LC...+A018 diode supply units hardware manual	3AXD50000579662
ACS880 liquid-cooled multidrive cabinets and modules electrical planning	3AXD50000048634
ACS880 liquid-cooled multidrive cabinets and modules safety instructions	3AXD50000048633
ACS880 liquid-cooled multidrive cabinets mechanical installation instructions	3AXD50000048635
Drive firmware	
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 tools	
Drive composer start-up and maintenance PC tool user's manual	3AUA0000094606

Name	Code
Safety	
Functional safety; Technical guide No. 10	3AUA0000048753
ABB Safety information and solutions	www.abb.com/safety
Options	
Emergency stop functions with button monitoring (options +Q951+Q984 and +Q952+Q984) for ACS880 liquid-cooled drives user's manual	3AXD50000328659
ACX-AP-x assistant control panels user's manual	3AUA0000085685
Other documents	
Circuit diagrams	Delivered with the drive
Part lists	Delivered with the drive

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



[ACS880-07CLC manuals](#)



[ACS880-07LC manuals](#)



[ACS880-17LC manuals](#)



[ACS880-37LC manuals](#)

Terms and abbreviations

Term	Description
Control unit	Control board built in a housing (often rail-mountable)
Drive	Frequency converter for controlling AC motors
Inverter	Converts direct current and voltage to alternating current and voltage.
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.
Multidrive	Drive for controlling several motors which are typically coupled to the same machinery. Includes one supply unit, and one or several inverter units.
PE	Protective earth (ground)

14 Introduction to the manual

Term	Description
PL	Performance level. Levels a...e correspond to SIL (EN ISO 13849-1)
Proof test	Periodic test performed to detect failures in the safety function. The target of the proof test is to ensure that the safety function still operates correctly and is able to achieve the safe state. (IEC 61508, IEC 62061)
SIL	Safety integrity level (1...3) (IEC 61508)
STO	Safe torque off (IEC/EN 61800-5-2)
Supply unit	Supply module(s) under control of one control unit, and related components.
Validation	Confirmation by, for example, analysis that the safety system meets the functional safety requirements of the specific application.
Verification	Confirmation by, for example, testing that the safety system meets the requirements set by the specification.

3

Description of option +Q951+Q984

Contents of this chapter

This chapter contains a description of the safety function. This chapter also shows the settings related to the safety function.

Overview

The emergency stop function with push button monitoring (option +Q951+Q984) corresponds to an uncontrolled stop in accordance with stop category 0. This emergency stop function does not have a SIL/PL classification.

In this emergency stop function, the drive has two different safety circuits:

- the primary safety circuit that consists of the emergency stop button (optional in ACS880 multidrives), the relays, and the contacts wired to them. The emergency stop button activates the emergency stop function when pushed. Line faults in the primary safety circuit will cause the emergency stop function to activate.
- the user-implemented push button circuits, which are connected to the push button monitoring relays. The push buttons activate the emergency stop function when pushed, but line faults in the push button circuits will not cause the emergency stop function to activate.

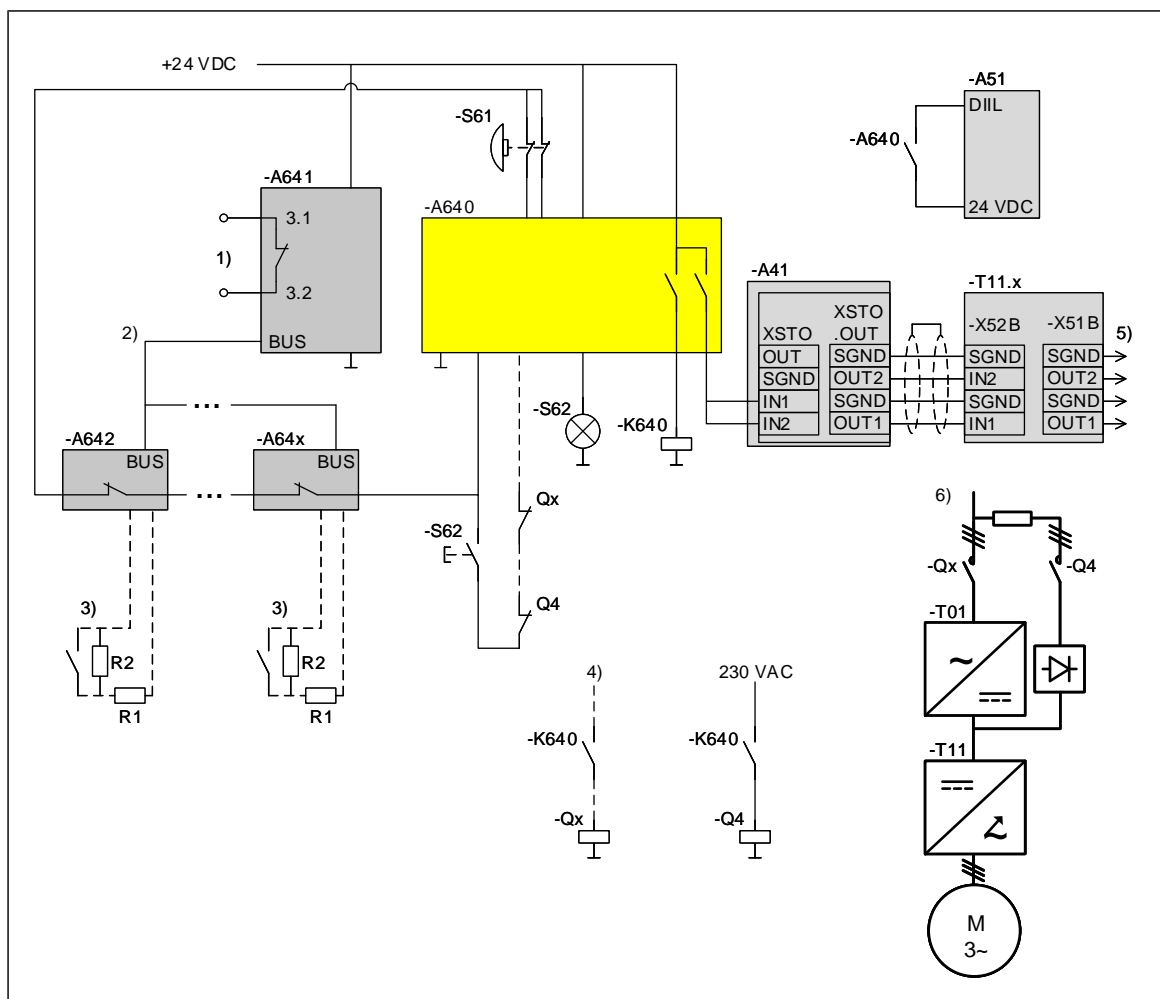
You can connect push buttons to the push button monitoring relays. The push button monitoring system monitors the status of each button. If there is a fault (for example, a short circuit or damaged wire) in a push button circuit, the emergency stop function is not activated, but the main monitoring relay opens a normally-closed relay contact. You can use the relay contact to implement a fault indication system.

When the drive receives the emergency stop command:

1. ACS880-07CLC/07LC/17LC/37LC drives: The drive activates the Safe torque off (STO) function.
2. The drive opens the main contactor/breaker, which disconnects the input power from the drive.
3. The motor(s) coast(s) to a stop.

Operation principle

■ ACS880-07CLC drives

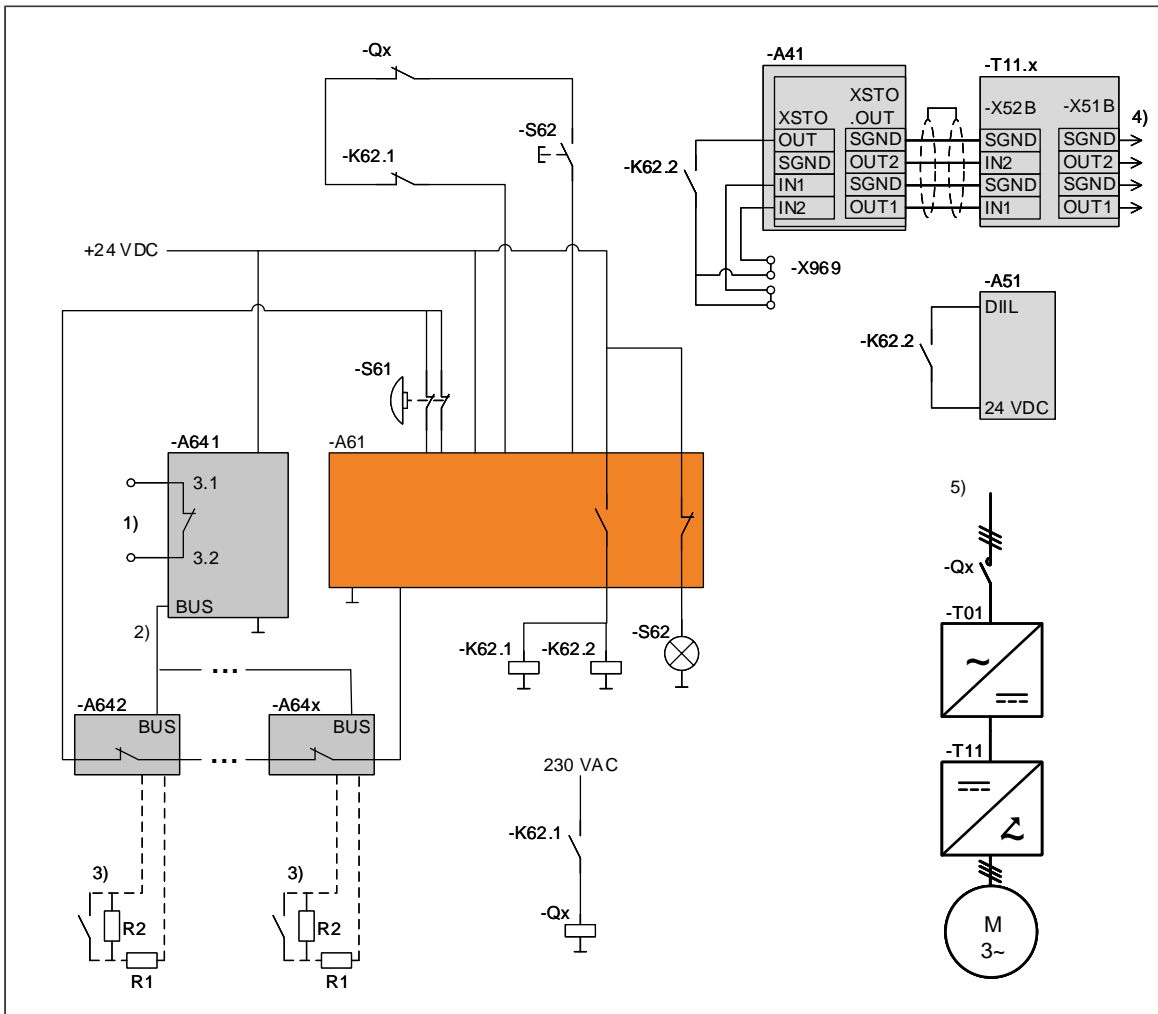


---	User-defined connection
A41	Inverter control unit
A51	Supply control unit
A640	Emergency stop safety relay
A641	Main monitoring relay for the push buttons
A642 ... A64x	Push button monitoring relays
K640	Safety relay
Qx	Main contactor/breaker (user-defined)
Q4	Charging contactor (option +F272)
R1, R2	Push button resistors

S61	Emergency stop button
S62	Emergency stop reset button with indicator light
T01	Supply unit
T11	Inverter unit which contains inverter module(s)
T11.x	Inverter module
1)	Relay contact for the push button fault indication signal (for user-defined use). If there is a fault in a push button circuit, the main monitoring relay opens the relay contact.
2)	Fault signal connection between main monitoring relay and push button monitoring relays
3)	User-defined push buttons
4)	Supply voltage for main contactor/breaker control (user-defined)
5)	Connection to parallel inverter modules (if any)
6)	Main circuit

Step	Operation
	Initial status: The drive is in operation and the motor is running.
1	The user pushes the emergency stop button [S61] or a user-defined push button. This activates the emergency stop function.
2	<p>The emergency stop safety relay [A640] de-energizes XSTO inputs IN1 and IN2 of the inverter control unit [A41]. This activates the inverter unit Safe torque off function.</p> <p>The emergency stop safety relay [A640] de-energizes the DIIL input on the supply control unit [A51]. This gives the emergency stop command to the supply unit.</p> <p>The emergency stop safety relay [A640] de-energizes the safety relay [K640].</p> <p>The safety relay [K640] opens the main contactor/breaker [Qx], which disconnects the input power from the supply unit [T01].</p> <p>The charging contactor [Q4] is opened, if the emergency stop is activated during charging.</p>
3	The emergency stop reset button indicator light [S62] comes on.
4	The motor coasts to a stop.
5	<p>Normal operation resumes after the user:</p> <ul style="list-style-type: none"> • releases the emergency stop button [S61] or the user-defined button to the normal (up) position • pushes the emergency reset button [S62] to reset the emergency stop circuit • resets the drive (if the drive tripped on a fault) • makes sure that the drive receives the start signal (depends on the configuration, see the firmware manual).

■ ACS880-07LC drives

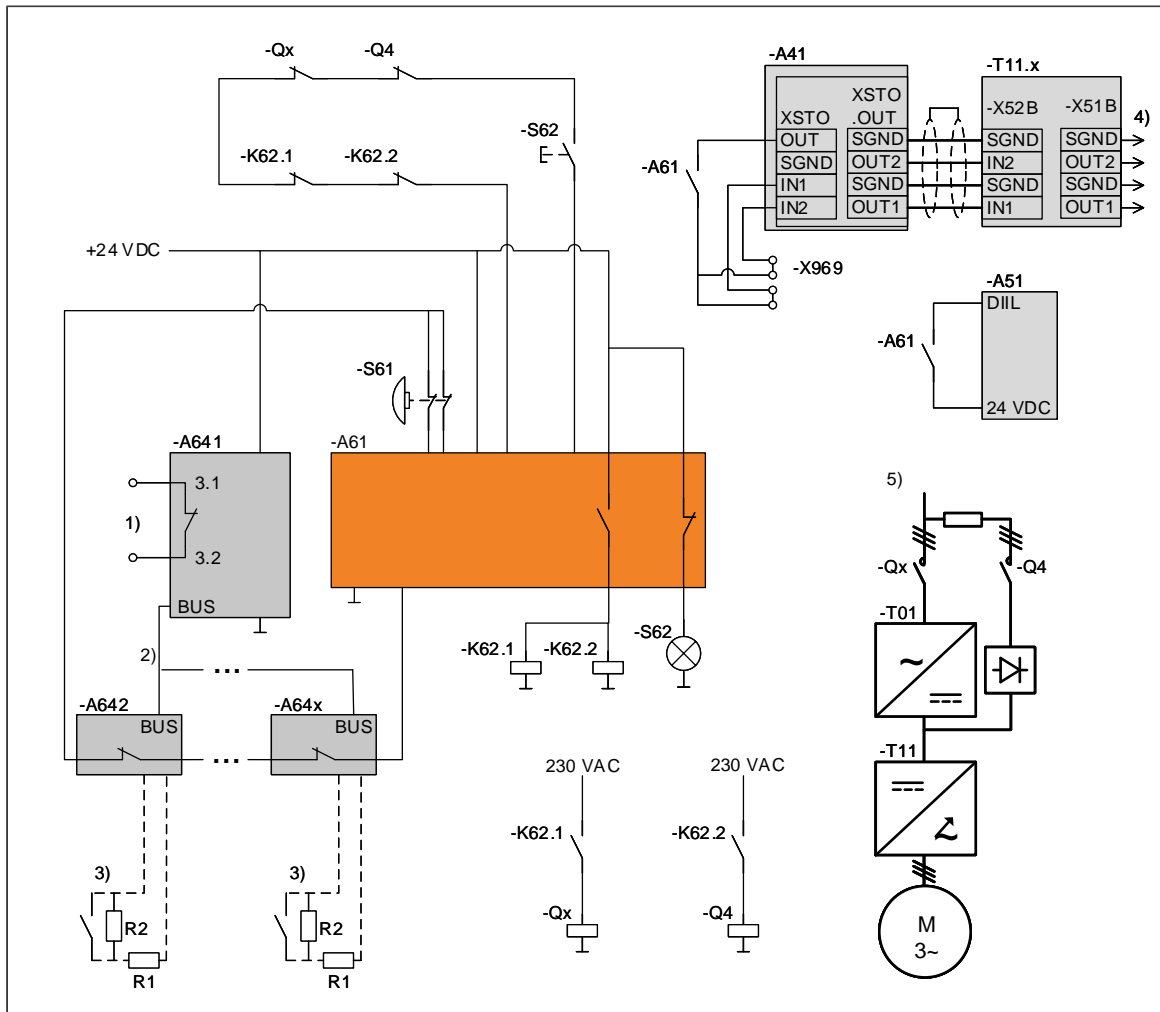


---	User-defined connection
A41	Inverter control unit
A51	Supply control unit
A61	Emergency stop safety relay
A641	Main monitoring relay for the push buttons
A642 ... A64X	Push button monitoring relays
K62.1, K62.2	Safety relays
R1, R2	Push button resistors
Qx	Main contactor/breaker
S61	Emergency stop button
S62	Emergency stop reset button with indicator light
T01	Supply unit
T11	Inverter unit which contains inverter module(s)
T11.x	Inverter module
X969	STO terminal block
1)	Relay contact for the push button fault indication signal (for user-defined use). If there is a fault in a push button circuit, the main monitoring relay opens the relay contact.
2)	Fault signal connection between main monitoring relay and push button monitoring relays

3)	User-defined push buttons
4)	Connection to parallel inverter modules (if any)
5)	Main circuit

Step	Operation
	Initial status: The drive is in operation and the motor is running.
1	The user pushes the emergency stop button [S61] or a user-defined push button. This activates the emergency stop function.
2	The emergency stop safety relay [A61] de-energizes safety relays [K62.1] and [K62.2]. Safety relay [K62.2] de-energizes XSTO inputs IN1 and IN2 of the inverter control unit [A41]. This activates the inverter unit Safe torque off function. Safety relay [K62.2] de-energizes the DIIL input on the supply control unit [A51]. This gives the emergency stop command to the supply unit. Safety relay [K62.1] opens the main contactor/breaker [Qx], which disconnects the input power from the supply unit [T01].
3	The emergency stop reset button indicator light [S62] comes on.
4	The motor coasts to a stop.
5	Normal operation resumes after the user: <ul style="list-style-type: none"> •releases the emergency stop button [S61] or the user-defined button to normal (up) position •pushes the emergency stop reset button [S62] to reset the emergency stop circuit •resets the drive (if the drive tripped on a fault) •makes sure that the drive receives the start signal (depends on the configuration, see the firmware manual).

■ ACS880-17LC/37LC drives



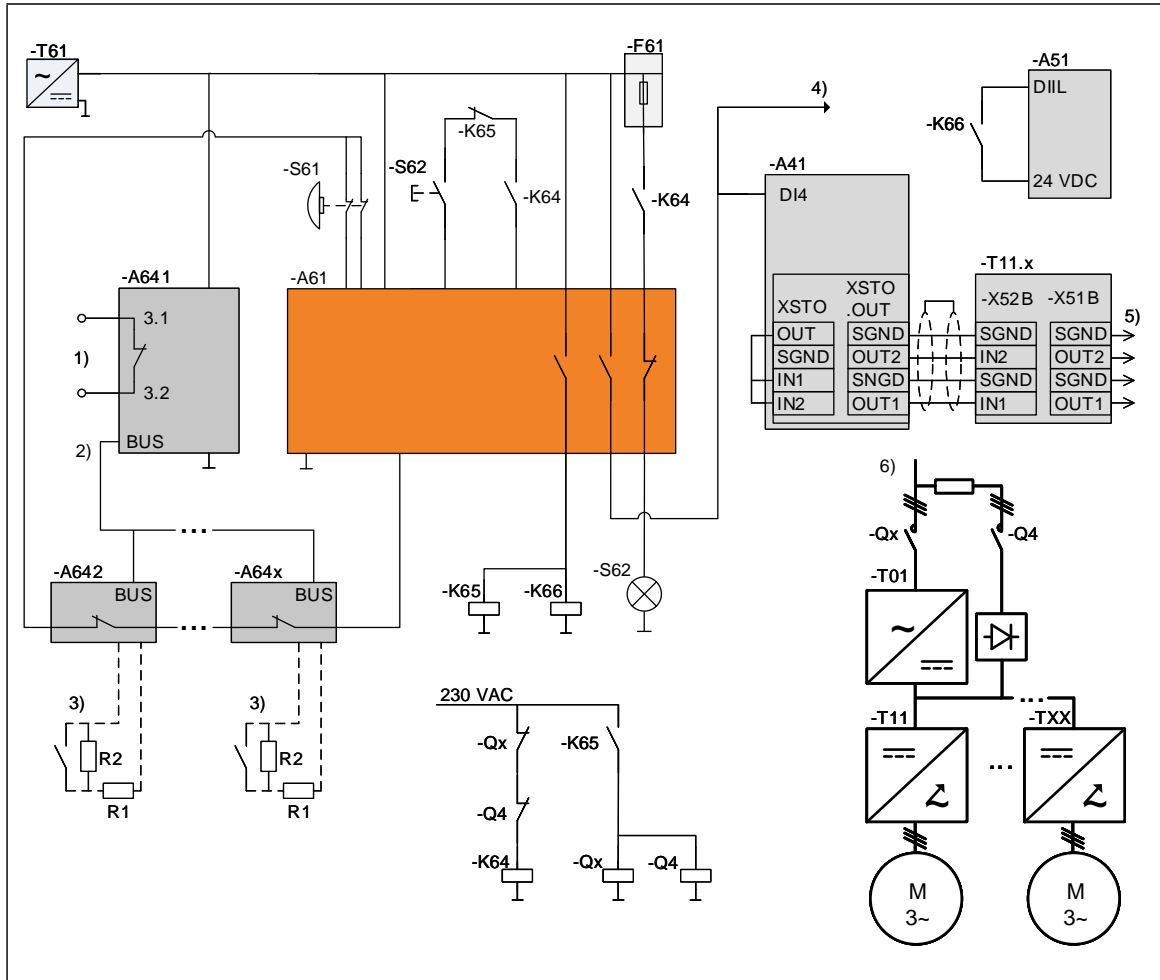
---	User-defined connection
A41	Inverter control unit
A51	Supply control unit
A61	Emergency stop safety relay
A641	Main monitoring relay for the push buttons
A642 ... A64X	Push button monitoring relays
K62.1, K62.2	Safety relays
R1, R2	Push button resistors
Qx	Main contactor/breaker
Q4	Charging contactor
S61	Emergency stop button
S62	Emergency stop reset button with indicator light
T01	Supply unit
T11	Inverter unit which contains inverter module(s)
T11.x	Inverter module
X969	STO terminal block
1)	Relay contact for the push button fault indication signal (for user-defined use). If there is a fault in a push button circuit, the main monitoring relay opens the relay contact.

2)	Fault signal connection between main monitoring relay and push button monitoring relays
3)	User-defined push buttons
4)	Connection to parallel inverter modules (if any)
5)	Main circuit

Step	Operation
	Initial status: The drive is in operation and the motor is running.
1	The user pushes the emergency stop button [S61] or a user-defined push button. This activates the emergency stop function.
2	<p>The emergency stop safety relay [A61] de-energizes the XSTO inputs IN1 and IN2 of the inverter control unit [A41]. This activates the inverter unit Safe torque off function.</p> <p>The emergency stop safety relay [A61] de-energizes the DIIL input on the supply control unit [A51]. This gives the emergency stop command to the supply unit.</p> <p>The emergency stop safety relay [A61] de-energizes safety relay [K62.1].</p> <p>Safety relay [K62.1] opens the main contactor/breaker [Qx], which disconnects the input power from the supply unit [T01].</p> <p>The charging contactor [Q4] is opened, if the emergency stop is activated during charging.</p>
3	The emergency stop reset button indicator light [S62] comes on.
4	The motor coasts to a stop.
5	<p>Normal operation resumes after the user:</p> <ul style="list-style-type: none"> • releases the emergency stop button [S61] or the user-defined button to normal (up) position • pushes the emergency stop reset button [S62] to reset the emergency stop circuit • resets the drive (if the drive tripped on a fault) • makes sure that the drive receives the start signal (depends on the configuration, see the firmware manual).

■ ACS880 multidrives

The figure shows a simplified operation principle. The implementation of the main contactor/breaker [Qx] and charging circuit can be different than shown in the figure. For a detailed description, refer to the circuit diagrams delivered with the drive.



---	User-defined connection
A41	Inverter control unit
A51	Supply control unit
A61	Emergency stop safety relay with delay contacts
A641	Main monitoring relay for the push buttons
A642 ... A64x	Push button monitoring relay
F61	Circuit protection switch
K64, K65, K66	Safety relays
R1, R2	Push button resistors
Qx	Main contactor/breaker
Q4	Charging contactor
S61	Emergency stop button (option +G331)
S62	Emergency stop reset button with indicator light
T01	Supply unit
T11 ... Txx	Inverter units which contain inverter module(s)
T11.x	Inverter module

T61	24 V power supply
1)	Relay contact for the push button fault indication signal (for user-defined use). If there is a fault in a push button circuit, the main monitoring relay opens the relay contact.
2)	Fault signal connection between main monitoring relay and push button monitoring relays
3)	User-defined push buttons
4)	Connection to other inverter control units
5)	Connection to parallel inverter modules (if any)
6)	Main circuit

Step	Operation
	Initial status: The drive is in operation and the motors are running.
1	The user pushes the emergency stop button [S61] or a user-defined push button. This activates the emergency stop function.
2	The emergency stop safety relay [A61] de-energizes the digital input on the inverter control unit [A41]. This gives the emergency stop command to the inverter unit. The emergency stop safety relay [A61] de-energizes safety relays [K65] and [K66]. Safety relay [K66] de-energizes the DIIL input of the supply control unit [A51]. This gives the emergency stop command to the supply unit. Safety relay [K65] opens the main contactor/breaker [Qx], which disconnects the power supply from the supply unit [T01]. The charging contactor [Q4] is opened, if the emergency stop is activated during charging.
3	The emergency stop reset button indicator light [S62] comes on.
4	The motors coast to a stop.
5	Normal operation resumes after the user: <ul style="list-style-type: none"> • releases the emergency stop button [S61] or the user-defined push button to normal (up) position • pushes the emergency stop reset button [S62] to reset the emergency stop circuit • closes the main contactor/breaker [Qx] • makes sure that the inverter units receive the start signals (depends on the configuration, see the firmware manual).

Fault reaction function

Definition: A safety function requires a “fault reaction function” that tries to initiate a safe state if it detects a failure in the safety system.

The fault reaction function of the emergency stop safety relay trips the system, if it detects a failure in the primary safety circuit (emergency stop button [S61] and its connections). A failure can be, for example, an open circuit. A line fault in a push button monitoring circuit does not cause the fault reaction function to activate.

If a fault is detected, the fault reaction function:

- activates the emergency stop command
- activates the inverter unit STO function (not applicable to ACS880 multidrives)
- opens the main contactor/breaker
- keeps the safe state activated and the emergency stop reset button indicator light on until the fault is repaired and the safety function is reset.

Note: Resetting the safety function is not possible, if the reset circuit in the emergency stop safety relay is open.

Parameter settings

This section gives the parameters related to the safety function. Make sure that the values agree with the circuit diagrams delivered with the drive.

■ ACS880-07CLC/07LC/17LC/37LC drives

The parameter settings in the ACS880 primary control program:

No.	Name	Default value ¹⁾	Description
31.22	STO indication run/stop	Warning/Warning	Selects which indications are given when the Safe torque off (STO) function is activated. <i>Warning/Warning</i> is the recommended setting.

¹⁾ Value set by ABB at the factory for the default design.

The parameter settings in the ACS880 supply control programs:

No.	Name	Default value ¹⁾	Description
121.04	Emergency stop mode	Stop and warning	Selects the way the supply unit is stopped when an emergency stop command is received.
121.05	Emergency stop source	DIIL	Selects the source of the emergency stop signal. This parameter cannot be changed while the supply unit is running.

¹⁾ Value set by ABB at the factory for the default design.

■ ACS880 multidrives

The parameter settings in the ACS880 primary control program:

No.	Name	Default value ¹⁾	Description
10.24	RO1 source	P.10.1.3 - ²⁾	Selects a drive signal to be connected to relay output RO1. In this case, the source is the inverted value of parameter 10.01 DI status bit 3 (DI4).
21.04	Emergency stop mode	Coast stop (Off2)	Selects the way the motor is stopped when an emergency stop command is received.
21.05	Emergency stop source	DI4 ²⁾	Selects the source of the emergency stop signal.

¹⁾ Value set by ABB at the factory for the default design.

²⁾ Delivery-specific. Refer to the circuit diagrams.

The parameter settings in the ACS880 supply control programs:

No.	Name	Default value ¹⁾	Description
121.04	Emergency stop mode	Stop and warning	Selects the way the supply unit is stopped when an emergency stop command is received.
121.05	Emergency stop source	DIIL	Selects the source of the emergency stop signal. This parameter cannot be changed while the supply unit is running.

¹⁾ Value set by ABB at the factory for the default design.

Hardware settings

ABB sets the hardware settings for the safety function at the factory. Do not change these settings.

■ ACS880-07CLC drives

The emergency stop safety relay [A640] is set to the manual reset mode at the factory.

■ ACS880-07LC/17LC/37LC drives and ACS880 multidrives

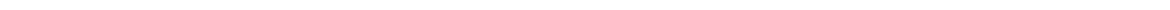
The settings in the emergency stop safety relay [A61] are:

- Cross fault detection is set to *Without*
- Start mode is set to *Manual*.

■ Push button monitoring relays

The DIP switches of the push button monitoring relays are set at the factory as follows:

Relay	DIP switch			
	S1	S2	S3	S4
K641	II	I	-	-
K642...K64x	I	II	I	I



4

Description of option +Q952+Q984

Contents of this chapter

This chapter contains a description of the safety function. This chapter also shows the settings related to the safety function.

Overview

The emergency stop function with push button monitoring (option +Q952+Q984) corresponds to a controlled stop in accordance with stop category 1. This emergency stop function does not have a SIL/PL classification.

In this emergency stop function, the drive has two different safety circuits:

- the primary safety circuit that consists of the emergency stop button (optional in ACS880 multidrives), the relays, and the contacts wired to them. The emergency stop button activates the emergency stop function when pushed. Line faults in the primary safety circuit will cause the emergency stop function to activate.
- the user-implemented push button circuits, which are connected to the push button monitoring relays. The push buttons activate the emergency stop function when pushed, but line faults in the push button circuits will not cause the emergency stop function to activate.

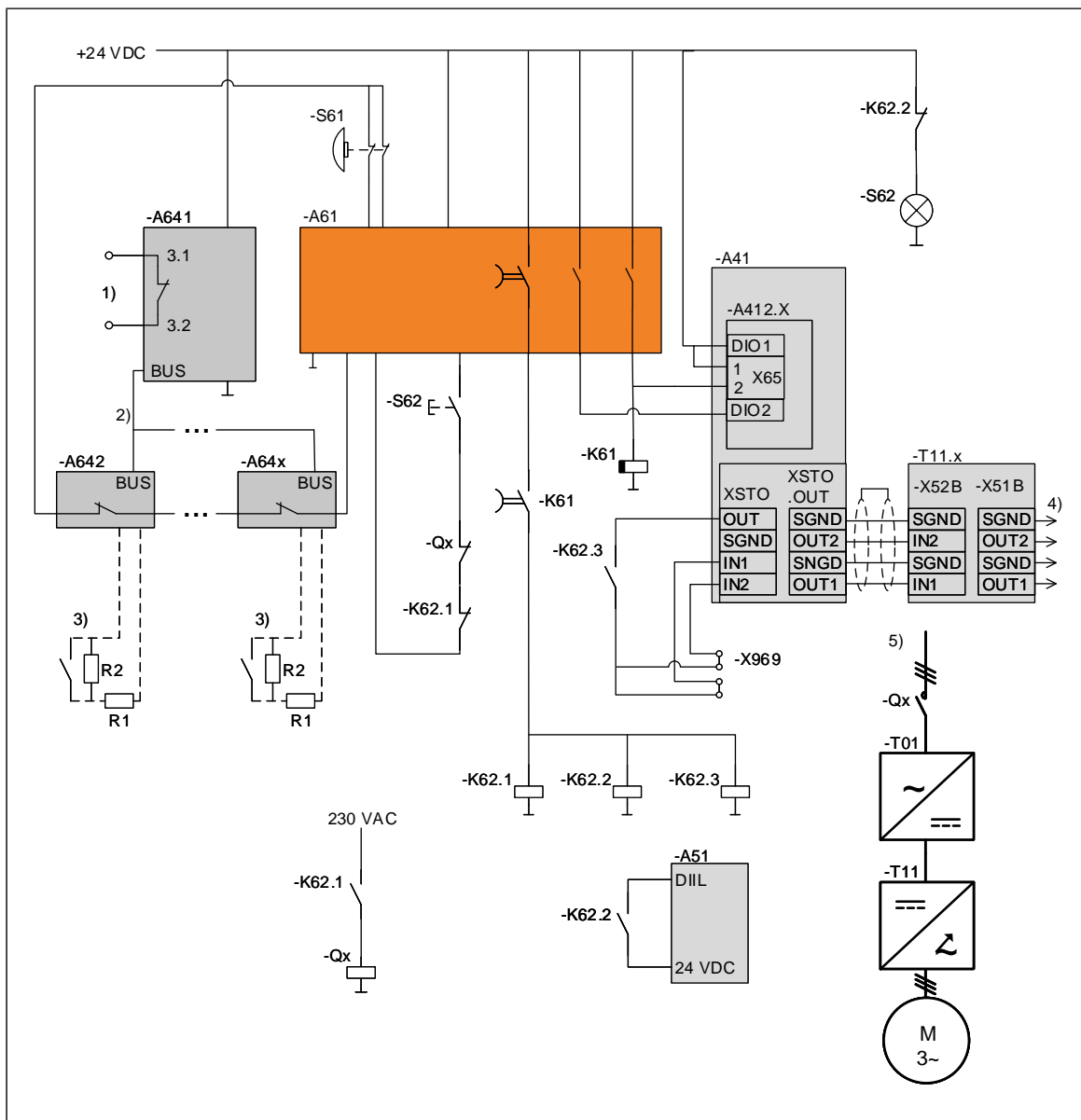
You can connect push buttons to the push button monitoring relays. The push button monitoring system monitors the status of each button. If there is a fault (for example, a short circuit or damaged wire) in a push button circuit, the emergency stop function is not activated, but the main monitoring relay opens a normally-closed relay contact. You can use the relay contact to implement a fault indication system.

When the drive receives the emergency stop command:

1. The drive decelerates the motor to zero speed according to a user-defined ramp time. Zero speed is a user-defined parameter setting.
2. ACS880-07LC/17LC/37LC drives: The drive activates the Safe torque off (STO) function.
3. The drive opens the main contactor/breaker, which disconnects the input power from the drive.
4. The motor(s) coast(s) to a stop.

Operation principle

■ ACS880-07LC drives



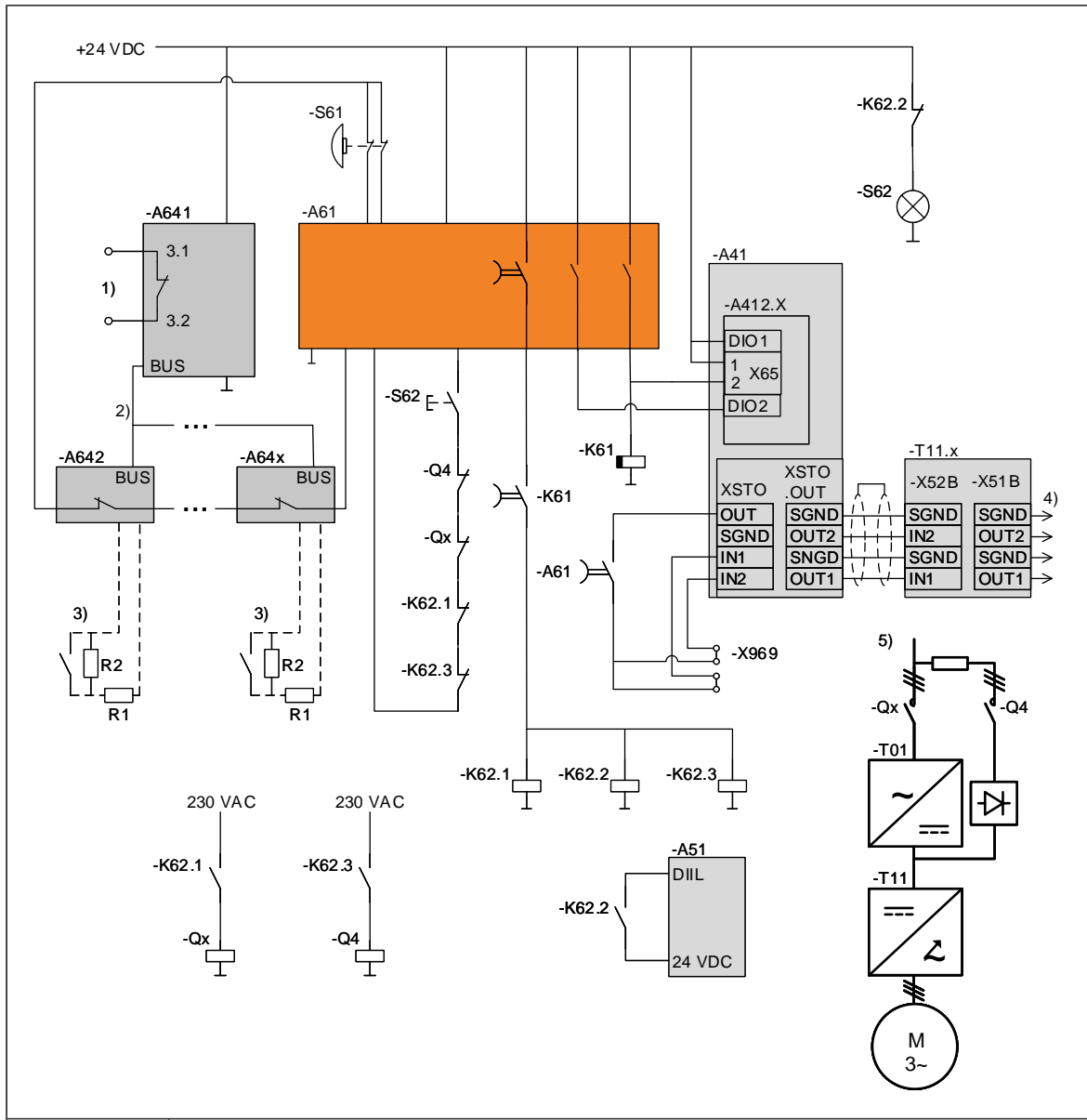
---	User-defined connection
A41	Inverter control unit
A51	Supply control unit
A61	Emergency stop safety relay

A412.X	Digital I/O extension module
A641	Main monitoring relay for the push buttons
A642 ... A64x	Push button monitoring relay
K61	Timer relay
K62.1 ... K62.3	Safety relays
Qx	Main contactor/breaker
R1, R2	Push button resistors
S61	Emergency stop button
S62	Emergency stop reset button with indicator light
T01	Supply unit
T11	Inverter unit which contains inverter module(s)
T11.x	Inverter module
X969	STO terminal block
1)	Relay contact for the push button fault indication signal (for user-defined use). If there is a fault in a push button circuit, the main monitoring relay opens the relay contact.
2)	Fault signal connection between main monitoring relay and push button monitoring relays
3)	User-defined push buttons
4)	Connection to parallel inverter modules (if any)
5)	Main circuit

Step	Operation
	Initial status: The drive is in operation and the motor is running.
1	The user pushes the emergency stop button [S61] or a user-defined push button. This activates the emergency stop function.
2	The emergency stop safety relay [A61] de-energizes the digital input on the digital I/O extension module [A412.X] of the inverter unit. This gives the emergency stop command to the inverter unit. The emergency stop safety relay [A61] de-energizes 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 inverter unit acknowledges the reception of the emergency stop command by energizing the relay output (X65) of the digital I/O extension module [A412.X]. The relay output (X65) of the extension module [A412.X] energizes the timer relay [K61], resetting its break delay counter. The relay keeps its delayed break contact closed. Note: If the drive does not acknowledge the reception of the emergency stop command in 2 seconds, the main contactor/breaker [Qx] opens and the system is tripped.
4	The drive decelerates the motor to zero speed in emergency stop deceleration time (user-defined parameter).
5	The break delay counter of the emergency stop safety relay [A61] trips and the delay contact de-energizes safety relays [K62.1 ... K62.3]. Safety relay [K62.3] de-energizes the XSTO inputs IN1 and IN2 of the inverter control unit [A41]. This activates the inverter unit Safe torque off function. Safety relay [K62.2] de-energizes the DIIL input of the supply control unit [A51]. This gives the emergency stop command to the supply unit. Safety relay [K62.1] opens the main contactor/breaker [Qx], which disconnects the power supply from the supply unit [T01].
6	The contact of the safety relay [K62.2] energizes the emergency stop reset button indicator light [S62].

Step	Operation
7	<p>Normal operation resumes after the user:</p> <ul style="list-style-type: none"> •releases the emergency stop button [S61] to normal (up) position •pushes the emergency stop reset button [S62] for 0.1 ... 3 seconds to reset the emergency stop circuit •resets the drive (if the drive tripped on a fault) •makes sure that the drive receives the start signal (depends on the configuration, see the firmware manual).

■ ACS880-17LC/37LC drives



---	User-defined connection
A41	Inverter control unit
A51	Supply control unit
A61	Emergency stop safety relay
A412.X	Digital I/O extension module
A641	Main monitoring relay for the push buttons

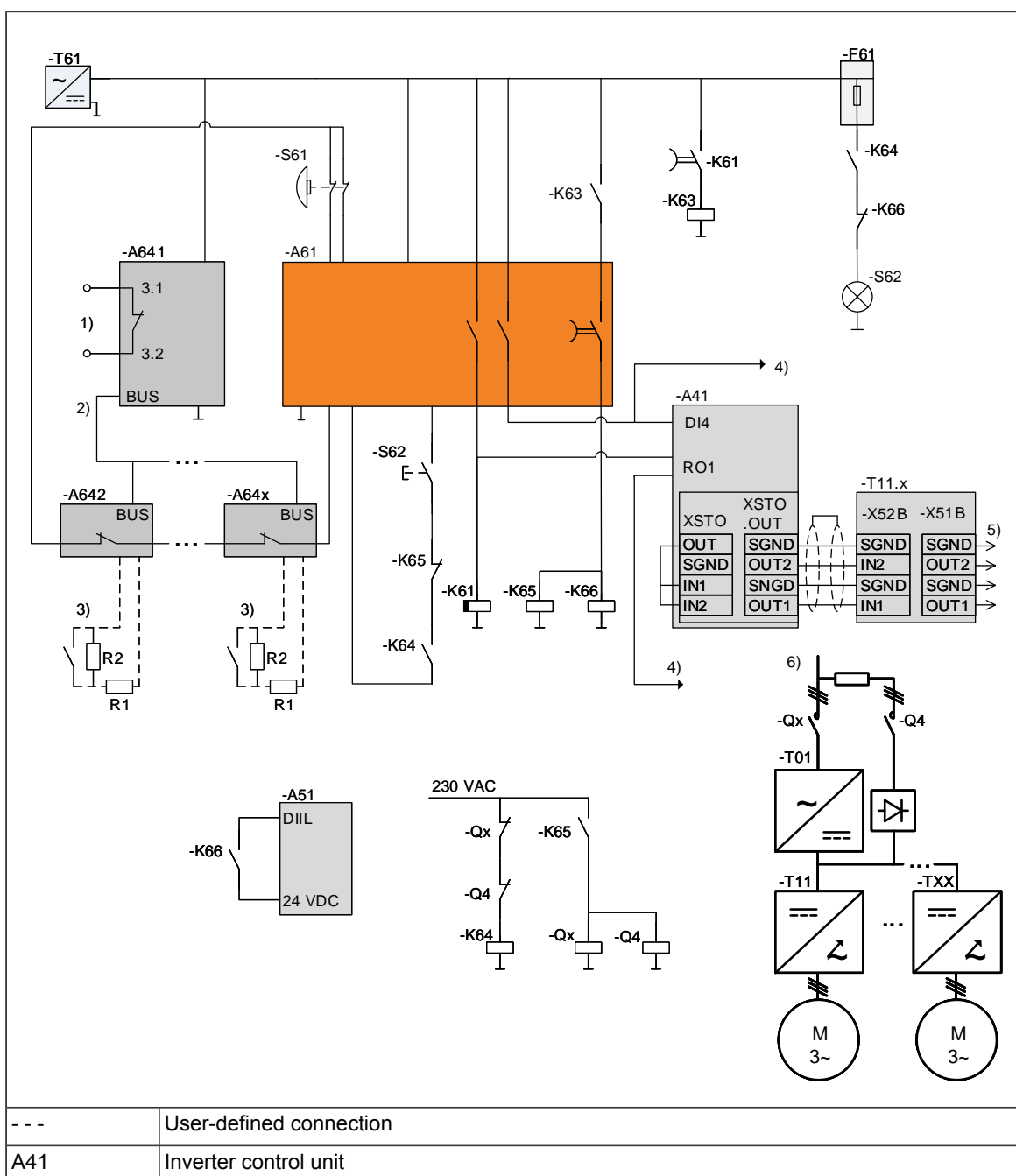
A642 ... A64x	Push button monitoring relay
K61	Timer relay
K62.1 ... K62.3	Safety relays
Qx	Main contactor/breaker
Q4	Charging contactor
R1, R2	Push button resistors
S61	Emergency stop button
S62	Emergency stop reset button with indicator light
T01	Supply unit
T11	Inverter unit which contains inverter module(s)
T11.x	Inverter module
X969	STO terminal block
1)	Relay contact for the push button fault indication signal (for user-defined use). If there is a fault in a push button circuit, the main monitoring relay opens the relay contact.
2)	Fault signal connection between main monitoring relay and push button monitoring relays
3)	User-defined push buttons
4)	Connection to parallel inverter modules (if any)
5)	Main circuit

Step	Operation
	Initial status: The drive is in operation and the motor is running.
1	The user pushes the emergency stop button [S61] or a user-defined push button. This activates the emergency stop function.
2	The emergency stop safety relay [A61] de-energizes the digital input on the digital I/O extension module [A412.X] of the inverter unit. This gives the emergency stop command to the inverter unit. The emergency stop safety relay [A61] de-energizes 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 inverter unit acknowledges the reception of the emergency stop command by energizing the relay output (X65) of the digital I/O extension module [A412.X]. The relay output (X65) of the extension module [A412.X] energizes the timer relay [K61], resetting its break delay counter. The relay keeps its delayed break contact closed. Note: If the drive does not acknowledge the reception of the emergency stop command in 2 seconds, the main contactor/breaker [Qx] opens and the system is tripped.
4	The drive decelerates the motor to zero speed in emergency stop deceleration time (user-defined parameter).
5	The break delay counter of the emergency stop safety relay [A61] trips and the delay contact de-energizes the XSTO inputs IN1 and IN2 of the inverter control unit [A41]. This activates the inverter unit Safe torque off function. The emergency stop safety relay [A61] de-energizes safety relays [K62.1 ... K62.3]. Safety relay [K62.2] de-energizes the DIIL input of the supply control unit [A51]. This gives the emergency stop command to the supply unit. Safety relay [K62.1] opens the main contactor/breaker [Qx], which disconnects the power supply from the supply unit [T01]. The charging contactor [Q4] is opened, if the emergency stop is activated during charging.
6	The contact of the safety relay [K62.2] energizes the emergency stop reset button indicator light [S62].

Step	Operation
7	Normal operation resumes after the user: <ul style="list-style-type: none"> • releases the emergency stop button [S61] to normal (up) position • pushes the emergency stop reset button [S62] for 0.1 ... 3 seconds to reset the emergency stop circuit • resets the drive (if the drive tripped on a fault) • makes sure that the drive receives the start signal (depends on the configuration, see the firmware manual).

■ ACS880 multidrives

The figure shows a simplified operation principle. The implementation of the main contactor/breaker [Qx] and charging circuit can be different than shown in the figure. For a detailed description, refer to the circuit diagrams delivered with the drive.



A51	Supply control unit
A61	Emergency stop safety relay with delay contacts
A641	Main monitoring relay for the push buttons
A642 ... A64x	Push button monitoring relays
F61	Circuit protection switch
K61	Timer relay
K63 ... K6x	Safety relays
Qx	Main contactor/breaker
Q4	Charging contactor
R1, R2	Push button resistors
S61	Emergency stop button (option +G331)
S62	Emergency stop reset button with indicator light
T01	Supply unit
T11 ... Txx	Inverter units which contain inverter module(s)
T11.x	Inverter module
T61	24 V power supply
1)	Relay contact for the push button fault indication signal (for user-defined use). If there is a fault in a push button circuit, the main monitoring relay opens the relay contact.
2)	Fault signal connection between main monitoring relay and push button monitoring relays
3)	User-defined push buttons
4)	Connection to other inverter control units
5)	Connection to parallel inverter modules (if any)
6)	Main circuit

Step	Operation
	Initial status: The drive is in operation and the motors are running.
1	The user pushes the emergency stop button [S61] or a user-defined push button. This activates the emergency stop function.
2	The emergency stop safety relay [A61] de-energizes the digital input on the inverter unit control units [A41]. This gives the emergency stop command to the inverter units. The break delay counter of the emergency stop safety relay [A61] starts (user-adjustable delay).
3	Each inverter unit acknowledges the reception of the emergency stop command by energizing the relay outputs (RO1) on the inverter control units [A41]. The relay output (RO1) of the inverter control unit [A41] energizes the timer relay [K61], resetting its break delay counter. The relay keeps its delayed break contact closed. Note: If an inverter unit does not acknowledge the reception of the emergency stop command in 2 seconds, the main contactor/breaker [Qx] opens and the system is tripped.
4	The inverter units decelerate the motors to zero speed in the emergency stop deceleration time (user-defined parameter).
5	The break delay counter of the emergency stop safety relay [A61] trips and the delay contact de-energizes safety relays [K65] and [K66]. Safety relay [K66] de-energizes the DIIL input on supply control unit [A51]. This gives the emergency stop command to the supply unit. Safety relay [K65] opens the main contactor/breaker [Qx], which disconnects the power supply from the supply unit [T01]. The charging contactor [Q4] is opened, if the emergency stop is activated during charging.

Step	Operation
6	The emergency stop reset button indicator light [S62] comes on.
7	Normal operation resumes after the user: <ul style="list-style-type: none"> • releases the emergency stop button [S61] or the user-defined button to the normal (up) position • pushes the emergency stop reset button [S62] for 0.1 ... 3 seconds to reset the emergency stop circuit • closes the main contactor/breaker [Qx] • makes sure that the inverter units receive the start signals (depends on the configuration, see the firmware manual).

Fault reaction function

Definition: A safety function requires a “fault reaction function” that tries to initiate a safe state if it detects a failure in the safety system.

The fault reaction function of the emergency stop safety relay trips the system, if it detects a failure in the primary safety circuit (emergency stop button [S61] and its connections). A failure can be, for example, an open circuit. A line fault in a push button monitoring circuit does not cause the fault reaction function to activate.

If a fault is detected, the fault reaction function:

- activates the emergency stop command
- activates the inverter unit STO function (not applicable to ACS880 multidrives)
- opens the main contactor/breaker
- keeps the safe state activated and the emergency stop reset button indicator light on until the fault is repaired and the safety function is reset.

Note: Resetting the safety function is not possible, if the reset circuit in the emergency stop safety relay is open.

If you hold the reset button [S62] pushed for more than 10 seconds, the emergency stop safety relay [A61] goes into a fault state. You must then reset the relay. See the fault tracing instructions.

Parameter settings

This section gives the parameters related to the safety function. Make sure that the values agree with the circuit diagrams delivered with the drive.

■ ACS880-07LC/17LC/37LC drives

The parameter settings in the ACS880 primary control program:

No.	Name	Default value ¹⁾	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.

No.	Name	Default value ¹⁾	Description
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 DIO2 of the FIO module.
31.03	External event 2 source	P.14.5.0	Selects the source of external event 1. In this case, the source is DIO1 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 the Safe torque off (STO) function is activated. <i>Warning/Warning</i> is the recommended setting.

¹⁾ Value set by ABB at the factory for the default design.

The table that follows gives the parameters in the ACS880 primary control program that you must set according to application requirements. Make sure that the selected values agree with the time delay settings of the emergency stop safety relay [A61]. Refer to [Hardware settings \(page 37\)](#).

No.	Name	Value	Description
21.06	Zero speed limit	User-defined	Defines the zero speed limit. The motor is stopped along a speed ramp until this limit is reached. After the zero speed delay (parameter 21.07, default value 0 ms), the motor coasts to a stop.
23.23	Emergency stop time	User-defined	Defines the deceleration time for emergency stop Off3. The deceleration time is the time it takes to decelerate the motor from the maximum process speed defined by parameter 46.01 or 46.02 to the zero speed limit defined by parameter 21.06.
46.01	Speed scaling	User-defined	Defines the maximum motor speed used in the application. Set this parameter if you use the speed control mode or torque control mode.
46.02	Frequency scaling	User-defined	Defines the maximum motor frequency used in the application. Set this parameter if you use the frequency control mode.

The table that follows gives the parameters related to the safety function in the ACS880 supply control programs. The parameters are set at the factory.

No.	Name	Default value ¹⁾	Description
121.04	Emergency stop mode	Stop and warning	Selects the way the supply unit is stopped when an emergency stop command is received.
121.05	Emergency stop source	DIIL	Selects the source of the emergency stop signal. This parameter cannot be changed while the supply unit is running.

¹⁾ Value set by ABB at the factory for the default design.

For more information, see the firmware manuals.

■ ACS880 multidrives

The parameter settings in the ACS880 primary control program:

No.	Name	Default value ¹⁾	Description
10.24	RO1 source	P.10.1.3 -2)	Selects a drive signal to be connected to relay output RO1. In this case, the source is the inverted value of parameter 10.01 DI status bit 3 (DI4).
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	DI4 ²⁾	Selects the source of the emergency stop signal.

¹⁾ Value set by ABB at the factory for the default design.

²⁾ Delivery-specific. Refer to the circuit diagrams.

The table that follows gives the parameters in the ACS880 primary control program that you must set according to application requirements. Make sure that the selected values agree with the time delay settings of the emergency stop safety relay [A61]. Refer to [Hardware settings \(page 37\)](#).

No.	Name	Value	Description
21.06	Zero speed limit	User-defined	Defines the zero speed limit. The motor is stopped along a speed ramp until this limit is reached. After the zero speed delay (parameter 21.07, default value 0 ms), the motor coasts to a stop.
23.23	Emergency stop time	User-defined	Defines the deceleration time for emergency stop Off3. The deceleration time is the time it takes to decelerate the motor from the maximum process speed defined by parameter 46.01 or 46.02 to the zero speed limit defined by parameter 21.06.
46.01	Speed scaling	User-defined	Defines the maximum motor speed used in the application. Set this parameter if you use the speed control mode or torque control mode.
46.02	Frequency scaling	User-defined	Defines the maximum motor frequency used in the application. Set this parameter if you use the frequency control mode.

The table that follows gives the parameters related to the safety function in the ACS880 supply control programs. The parameters are set at the factory.

No.	Name	Default value ¹⁾	Description
121.04	Emergency stop mode	Stop and warning	Selects the way the supply unit is stopped when an emergency stop command is received.
121.05	Emergency stop source	DIIL	Selects the source of the emergency stop signal. This parameter cannot be changed while the supply unit is running.

¹⁾ Value set by ABB at the factory for the default design.

For more information, see the firmware manuals.

Hardware settings

■ Emergency stop safety relay

The time delay on the emergency stop safety relay [A61] is adjustable. Set the delay according to the application requirements. Make sure that the delay is slightly longer than the emergency stop deceleration time defined by drive parameter 23.23 *Emergency stop time*.

Use the rotary switches on the relay to set the time delay. Refer to the table that follows:

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.

Multiply the values of t_{max} and t to get the time delay ($t_v = t_{max} \cdot t$). For example, if the required time is 30 s, you can set the switches as follows:

- $t_{max} = 30$ s, $t = 1$ (30 s · 1 = 30 s), or
- $t_{max} = 300$ s, $t = 0.1$ (300 s · 0.1 = 30 s).

■ Push button monitoring relays

The DIP switches of the push button monitoring relays are set at the factory as follows:

Relay	DIP switch			
	S1	S2	S3	S4
K641	II	I	-	-
K642...K64x	I	II	I	I

5

Electrical installation

Contents of this chapter

This chapter describes the wiring of the safety option done at the factory and contains guidelines for making user connections.

Wiring

**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 or maintenance work.

In ACS880-07CLC/07LC/17LC/37LC drives, one emergency stop button is installed on the cabinet door. This is the case also in ACS880 multidrives ordered with option +G331. The button is connected with a one-channel connection to the emergency stop safety relay [A61] or [A640] at the factory. User-made connections to this circuit are not necessary. You must not install additional emergency stop buttons in series with the emergency stop button.

If the drive does not have a factory-installed main contactor/breaker, you must install one and connect its control circuit and status monitoring circuit to the drive. Refer to the drive hardware manual and the circuit diagrams delivered with the drive.

Note: The safety system and all user-made connections are on the user's responsibility.

■ Connecting the user-defined push buttons

Obey the rules below:

- Use buttons that are suitable for the application.
 - Use shielded, twisted-pair cable. ABB recommends gold-plated contacts in the buttons.
-

Installation procedure:

1. Stop the drive and do the steps in section [Electrical safety precautions \(page 9\)](#) before you start the work.
2. Connect the push buttons with the resistors to the terminal blocks. Refer to the circuit diagrams delivered with the drive. For the correct resistance values for the resistors, refer to the table that follows:

Resistor	Resistance
R1	1000 ohm
R2	10000 ohm

■ Connecting the push button fault indication

The main monitoring relay [A641] has a normally-closed relay contact that you can use to implement a fault indication system.

Installation procedure:

1. Stop the drive and do the steps in section [Electrical safety precautions \(page 9\)](#) before you start the work.
2. Connect the relay contact to the user-defined fault indication system. Refer to the circuit diagrams delivered with the drive.



6

Use of the safety function

Contents of this chapter

This chapter describes the use of the safety function with factory default settings.

Activating the safety function

Activation procedure:

1. Push the emergency stop button [S61] or a user-defined push button. The emergency stop is activated. If the emergency stop button [S61] is pushed, the button locks in the "ON" (open) position.
 - ACS880-07CLC/07LC/17LC/37LC drives: the inverter unit control program has the warning *Safe torque off* active
 - ACS880 multidrives: the inverter unit control program has the warning *Emergency stop* active
 - the supply unit control program has the warning *Emergency stop* active
 - the emergency stop reset button indicator light [S62] on the cabinet door is on.

If configured with parameter *31.22 STO indication run/stop*, an indication for Safe torque off is shown when the drive STO is activated.

Resetting the safety function



WARNING!

Make sure that the drive does not start accidentally. This can occur after the reset of the safety function, if a level-triggered start command and the start enable signal are on at the same time.

1. Return the emergency stop button [S61] or user-defined push button to the normal position. For example, turn the emergency stop button [S61] until it releases.
2. Push the emergency stop reset button [S62] on the cabinet door for 0.1 ... 3 seconds. The emergency stop reset button indicator light [S62] goes off, and the emergency stop is deactivated.
3. If necessary, reset faults from the drive.
4. If necessary, close the main contactor/breaker.
5. Make sure that the drive receives the start signal.
6. You can now restart the drive.

For more information, see the hardware and firmware manuals.

Note: You must also reset the emergency stop safety relay [A61] or [A640] with the emergency stop reset button [S62] each time after you energize the relay. If you do not reset the relay, you cannot close the main contactor/breaker.

7

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. This person must document and sign the test procedures and report.

■ Validation procedure

You must do the validation test using the checklist given in this manual:

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

Validation test

You must use the Drive composer PC tool or a control panel to do the validation test.


Action	<input checked="" type="checkbox"/>
 WARNING! Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur.	<input type="checkbox"/>
Initial status	
Make sure that the drive is ready for use, that is, you have done the tasks of the drive start-up procedure. See the hardware manual.	<input type="checkbox"/>
Make sure that the STO function is configured and validated. See the drive or inverter unit hardware manual.	<input type="checkbox"/>
Checks and settings with no voltage connected	
Stop the drive and do the steps in section <i>Electrical safety precautions (page 9)</i> before you start the work.	<input type="checkbox"/>
Check the connections against the applicable circuit diagrams and the wiring instructions in this manual. Check the the push buttons, reset circuit, STO circuits, and connections to the main contactor/breaker [Qx].	<input type="checkbox"/>
<u>Inverter units with parallel R8i inverter modules:</u>	
Make sure that the XSTO.OUT output on the inverter control unit [A41] is chained to the STO inputs of all inverter modules.	<input type="checkbox"/>
Make sure that the hardware settings related to the safety function are set as defined in the option-specific chapter.	<input type="checkbox"/>
Settings with voltage connected	
Close the cabinet doors and power up the drive. See the hardware manual.	<input type="checkbox"/>



Action	<input checked="" type="checkbox"/>
Make sure that the parameter settings related to the safety functions are set as defined in the option-specific chapter.	<input type="checkbox"/>
Validation test	
<p>ABB recommends that you monitor at least these signals with the Drive composer PC tool:</p> <ul style="list-style-type: none"> •01.01 Motor speed used (rpm) •01.02 Motor speed estimated (rpm) •01.07 Motor current (A) •01.10 Motor torque (%) •06.18 Start inhibit status word •23.01 Speed ref ramp input (rpm) •23.02 Speed ref ramp output (rpm) •90.01 Motor speed for control (rpm) •<u>When using an encoder, also:</u> 90.10 Encoder 1 speed (rpm) 	<input type="checkbox"/>
Make sure that it is safe to start, run and stop the motor(s) during the test.	<input type="checkbox"/>
Start the drive and make sure that the motor is running. If possible, use a motor speed close to the maximum speed of the application.	<input type="checkbox"/>
Push an emergency stop button.	<input type="checkbox"/>
<p>Make sure that the drive stops the motor(s) as follows:</p> <ul style="list-style-type: none"> •<u>ACS880-07CLC/07LC/17LC/37LC drives with option +Q951+Q984:</u> The drive activates the STO function. The motor coasts to a stop. •<u>ACS880-07LC/17LC/37LC drives with option +Q952+Q984:</u> The drive decelerates the motor to a stop according to a user-defined ramp. The drive then activates the STO function. •<u>ACS880 multidrives with option +Q951+Q984:</u> The motors coast to a stop. •<u>ACS880 multidrives with option +Q952+Q984:</u> The drive decelerates the motors to a stop according to a user-defined ramp. <p>Make sure that the drive shows the correct indications.</p>	<input type="checkbox"/>
Make sure that the emergency stop reset button indicator light [S62] comes on.	<input type="checkbox"/>
Make sure that the main contactor/breaker [Qx] opens.	<input type="checkbox"/>
<p>Make sure that the drive generates none of these faults:</p> <ul style="list-style-type: none"> •STO hardware failure (5090) •Safe torque off 1 loss (FA81) •Safe torque off 2 loss (FA82) <p>If the drive generates these faults, see the fault tracing instructions in this manual.</p>	<input type="checkbox"/>
Make sure that you cannot close the main contactor/breaker with the operating switch on the cabinet door, or by other means.	<input type="checkbox"/>
Make sure that you cannot start the drive from any control location. Make sure that the drive does not start when you switch the start signal off and on, or push the start key of the panel when the panel is in local control mode.	<input type="checkbox"/>
Switch off the drive start signal.	<input type="checkbox"/>
Turn the emergency stop button until it releases and returns to the up position.	<input type="checkbox"/>
Push the emergency stop reset button [S62] to reset the emergency stop circuit.	<input type="checkbox"/>
Make sure that the emergency stop reset button indicator light [S62] goes off.	<input type="checkbox"/>
Power up the drive (see the hardware and firmware manuals).	<input type="checkbox"/>
Restart the drive and make sure that the drive and the motor operate normally.	<input type="checkbox"/>



46 Start-up and validation test

Action	<input checked="" type="checkbox"/>
<p>Repeat the test from each operating location (for every emergency stop button and push button).</p> <p> WARNING! Do not power up the drive too frequently. The maximum number of drive power cycles is 5 times in 10 minutes. Power cycling the drive too frequently can cause damage to the charging circuit of the DC capacitors.</p>	<input type="checkbox"/>
<p>Test the user-implemented push button circuits:</p> <ol style="list-style-type: none"> 1. Cause a line fault in the push button circuit (for example, disconnect a wire from the push button). 2. Make sure that the fault indication from the main monitoring relay [A641] is activated. 3. Make sure that the emergency stop function is not activated. <p>Repeat this test for each push button circuit connected to the push button monitoring relays [A642...A64x].</p>	<input type="checkbox"/>
<p>Create a backup file of the drive parameters with the Drive composer PC tool or control panel.</p>	<input type="checkbox"/>
<p>Fill in and sign the validation test report. Store the report in the logbook of the machine.</p>	<input type="checkbox"/>





Fault tracing

Contents of this chapter

This chapter provides general diagnostics and troubleshooting tips.

General

If you cannot reset the emergency stop function with the emergency stop reset button [S62], check the reset circuit connections. Refer to the circuit diagrams delivered with the drive.

Use a multimeter to measure the STO circuit connections, if the inverter unit generates one or more of these faults:

- STO hardware failure (5090)
- Safe torque off 1 loss (FA81)
- Safe torque off 2 loss (FA82)

For more information, see the hardware and firmware manuals.

Emergency stop safety relay

■ ACS880-07CLC drives with option +Q951+Q984

The type of the emergency stop safety relay [A640] is Phoenix Contact PSR-MC34.

This table gives the indications of the Phoenix Contact PSR-MC34 relay:

PWR LED	IN1/2 LED	K1 LED	K2 LED	State
ON	OFF	OFF	OFF	All relays are not activated. The sensor circuit is off. Possible error, see the data sheet of the relay.
ON	ON	OFF	OFF	The sensor circuit is active. Relays K1 and K2 are ready to start and await reset/start command.

48 Fault tracing

PWR LED	IN1/2 LED	K1 LED	K2 LED	State
ON	ON	ON	ON	The sensor circuit is active. All relays are picked up.
Other LED combination				Possible error, see the data sheet of the relay.

For more information, see the data sheet of the relay (www.phoenixcontact.com).

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

■ ACS880-07LC/17LC/37LC drives and ACS880 multidrives with option +Q951+Q984

The type of the emergency stop safety relay [A61] is DOLD LG 5925.

This table gives the indications of the DOLD LG 5925 relay:

LED	LED is on	LED is off
Netz	Power supply is connected.	Power supply is not connected, or there is an external error.
K1	Relay K1 is energized.	There is an external error.
K2	Relay K2 is energized.	There is an external error.

For more information, see the data sheet of the relay (www.dold.com).

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

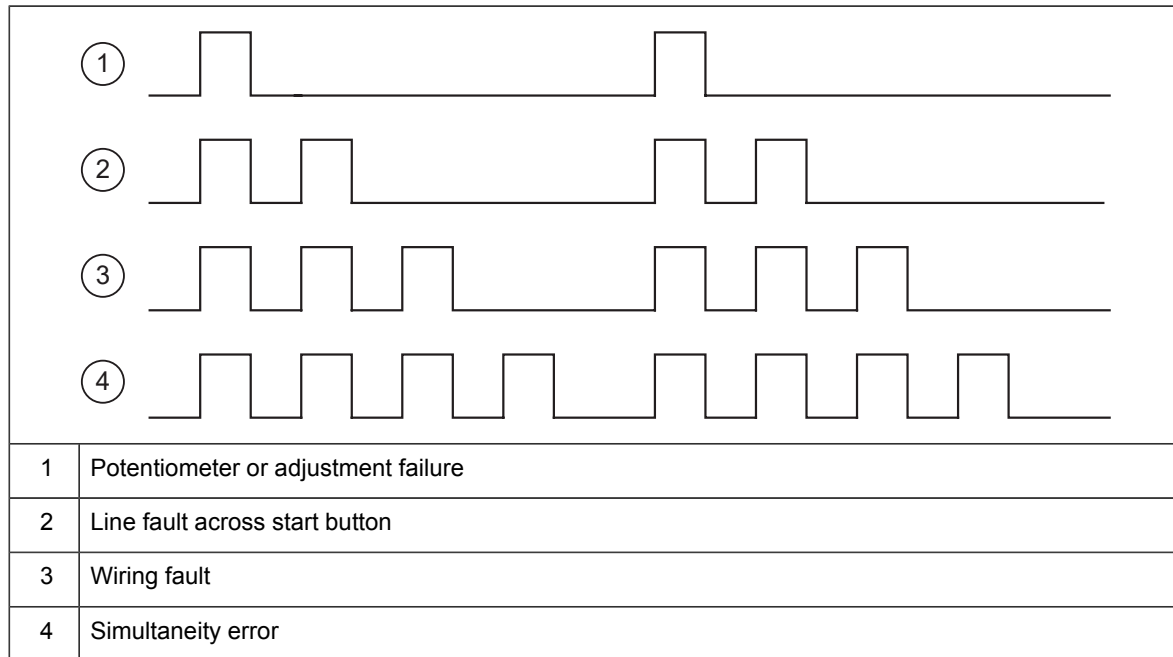
■ ACS880-07LC/17LC/37LC drives and ACS880 multidrives with option +Q952+Q984

The type of the emergency stop safety relay [A61] is DOLD UG 6960.

This table gives the indications of the DOLD UG 6960 relay:

LED	Color	LED is on	LED is flashing	LED is off
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.	<u>When flashing in 1:1 relation:</u> Power supply undervoltage or overvoltage. <u>When flashing in 4:1 relation:</u> There is an external error.	-
K1/K2	Green	Relays K1 and K2 are energized (instantaneous contact).	There is an external error. See the figure below for the indications of the LED.	-
K3/K4	Green	Relays K3 and K4 are energized (delayed contacts).	During the time delay.	-

If there are external errors, the K1/K2 LED shows an error code by flashing. This figure describes the K1/K2 LED indications.



For more information, see the data sheet of the relay (www.dold.com).

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

Monitoring relays

The monitoring relay types are:

- main monitoring relay [A641]: Phoenix Contact MCR-PTB-SP
- push button monitoring relays [A642...A64x]: Phoenix Contact MCR-SL-NAM-R-SP.

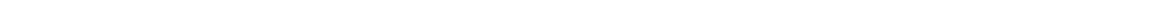
This table gives the indications of the Phoenix Contact MCR-PTB-SP relay:

LED	Color	Status indication
PWR 1	Green	Supply voltage
PWR 2	Green	Supply voltage
ERR	Red	Error

This table gives the indications of the MCR-SL-NAM-R-SP relay:

LED	Color	Status indication
PWR	Green	Power supply (on during normal operation)
OUT	Yellow	Switching state
LF	Red	Line fault

For more information, see the data sheets of the relays (www.phoenixcontact.com).



A large, bold, black number '9' is centered within a light grey square with rounded corners.

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 replacing the main contactor/breaker before the end of its specified lifetime.

If you change the wiring or a component after the start-up, or restore 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.

Proof test

To do a proof test, activate the safety function to make sure that it operates correctly. For guidelines, refer to the validation test procedure.

Proof test interval

It is a good practice to do a periodic proof test to ensure the correct operation of the safety function. In high demand mode of operation, the maximum proof test interval is 10 years. In low demand mode of operation, the maximum proof test interval is 1 year.

Safety components

The mission time of safety components is 10...20 years, depending on the component. During this time the failure rates of electronic components remain constant. This applies to the components of the standard Safe torque off circuit, modules, relays and other components that are part of safety circuits. After the mission time of a component expires, the component must be replaced with a new one.

The mission time of the safety function is 10 years. After this time, you can replace the push button monitoring relays [A642...A64x], which extends the mission time of the safety function by 10 years.

After a total of 20 years, the components of the safety circuit must be replaced. Note that some of the components may already have been replaced 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 functional safety.

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. Thus, 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 an inverter unit, make sure that the functional safety of the machine is maintained by other means until the decommissioning is completed.

10

Technical data

Contents of this chapter

This chapter contains technical data on the safety function.

Operation delays

Emergency stop total delay: less than 250 ms.

Mission time

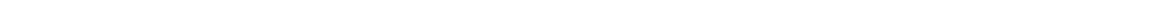
The mission times (T_M) of the safety circuit components are as follows:

- push button monitoring relays [A642...A64x]: 10 years
- other components: 20 years.

The mission time of the safety function is equal to the lowest mission time of the safety circuit components. Thus, for the safety functions shown in this manual, the mission time is 10 years.

Ambient conditions

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



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.



www.abb.com/drives



3AXD50000328659B