OPTIONS FOR ABB DRIVES

FSE-31 pulse encoder interface module

User's manual

List of related manuals

Drive hardware manuals and guides	Code (English)
ACS880-01 hardware manual	3AUA0000078093
ACS880-11 hardware manual	3AXD50000045932
ACS880-31 hardware manual	3AXD50000045933
ACS880-04 hardware manual	3AUA0000128301
ACS880-04 single drive module packages hardware manual	3AUA0000138495
ACS880-14 and -34 single drive module packages hardware manual	3AXD50000022021
ACS880-04XT drive modules (500 to 1200 kW) hardware manual	3AXD50000025169
ACS880-07 (45 to 710 kW) hardware manual	3AUA0000105718
ACS880-07 (560 to 2800 kW) hardware manual	3AUA0000143261
ACS880-17 (160 to 3200 kW) hardware manual	3AXD50000020436
ACS880-37 (160 to 3200 kW) hardware manual	3AXD50000020437
ACS880-17 (45…400 kW) hardware manual	3AXD50000035158
ACS880-37 (45…400 kW) hardware manual	3AXD50000035159
ACS880-104 hardware manual	3AUA0000104271
ACS880-107 hardware manual	3AUA0000102519
DCS880 hardware manual	3ADW000462R
DCS880 supplement for functional safety	3ADW000452R
Drive firmware manuals and guides	
ACS880 primary control program firmware manual	3AUA0000102519
DCS880 firmware manual	3ADW000474R
Option manuals and guides	
ACX-AP-x assistant control panels user's manual	3AUA0000085685
FSO-21 safety functions module user's manual	3AXD50000015614
Drive PC tool manuals	
Drive composer start-up and maintenance PC tool user's manual	3AUA0000094606
Functional safety design tool user's manual	3AXD10000102417
General safety guides	
Functional safety; Technical guide No. 10	3AUA0000048753
ABB Safety information and solutions	www.abb.com/safety

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

FSE-31 pulse encoder interface module

User's manual

3AXD50000016597 Rev D
EN
EFFECTIVE: 2021-11-23

Table of contents

6. Commissioning

7. Fault tracing

8. Technical data

Further information

1

Safety instructions

Contents of this chapter

The chapter contains the warning symbols used in this manual and the safety instructions which you must obey when you install or connect an option module to a drive. If you ignore the safety instructions, injury, death or damage can occur. Read this chapter before you start the installation.

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:

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

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

Electrical safety precautions

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

This manual does not give detailed information for disconnecting and isolating all drive types. Refer also to the drive or inverter unit hardware manual.

WARNING! Obey these instructions and 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. Do these steps before you start 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.
   - 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. Use a quality voltage tester.

- Before and after measuring the installation, verify the operation of the voltage tester on a known voltage source.
- ACS880 drives:
  - 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 and the grounding (PE) busbar is zero.
- DCS880 drives:
  - Make sure that the voltage between drive input phases U1, V1 and W1 and the frame is zero.
  - Make sure that the voltage between terminals C+ and D- and the frame is zero.

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 introduces this manual.

Applicability

This manual is applicable to the FSE-31 pulse encoder interface module, revision F.

Compatibility

The FSE-31 pulse encoder interface module is compatible with:

- ACS880 primary control program version 2.21 or later
- DCS880 series with firmware version 2.07 or later
  ABB recommends to always use the latest drive firmware.
- FSO-21 safety functions module, revision B or later
- Drive composer pro PC tool, version 1.8 or later.

The supported safety encoder type is:

- differential push-pull HTL encoder

Target audience

This manual is intended for people who plan the installation, install, start up, use and service the module. Before you do work on the module, read this manual and the applicable drive manual that contains the information for the product in question.

You are expected to know the fundamentals of functional safety, electricity, wiring, electrical components and electrical schematic symbols.

General safety system considerations

The FSE-31 module is part of a functional safety system. Any functional safety system must be validated and verified according to the functional safety process. For general safety considerations and information to be taken into account when building a safety system, see *FSO-21 safety functions module user's manual* (3AXD50000015614 [English]).

WARNING! User safety must be ensured by other means in all of the stages of the product's lifecycle when the safety option may not provide protection, especially during commissioning, system maintenance, fault tracing, and decommissioning.

WARNING! Do not bypass the FSE-31 pulse encoder interface module or FSO-21 safety functions module under any circumstances.

Risk assessment of the application must determine at least the following safety critical requirements:

- The need for a safety encoder. ABB recommends to use a safety encoder if it is necessary to measure the safe speed close to the zero speed region and in active load applications.
- the required SIL or PL level
- identifying the safety relevant application-specific parameters, for example, process safety time
- the required encoder resolution.

The operation environment of the FSE-31 module must comply with the specified conditions. See *FSO-21 safety functions module user's manual* (3AXD50000015614 [English]).

For instructions on decommissioning the module, see *FSO-21 safety functions module user's manual* (3AXD50000015614 [English]).

Contents

The manual consists of these chapters:

- *Safety instructions* contains the electrical safety instructions which you must obey when you install the module.
- *Hardware description* gives a short description of the module.
- *Mechanical installation* contains a delivery checklist and instructions on installing the module.
- *Electrical installation* contains instructions on wiring the module.
- *Commissioning* contains instructions on taking the module into use as a part of a functional safety system.
- *Fault tracing* shows how to trace faults with the status LED on the module.
- *Technical data* contains the technical data of the module.

Terms and abbreviations

Term/abbreviation	Description
Drive	Frequency converter for controlling motors
Fail-safe mode	The FSO module has activated the drive STO function as a result of an error. To exit this mode and continue normal operation, repair the possible fault and reboot the FSO module.
FEA-03	F-series extension adapter module
FSO-21	Safety functions adapter module which supports a safety encoder
hi-Z state	A digital signal is neither driven to a logical high nor low level. It is “floating”.
HFT	Hardware fault tolerance. (IEC/EN 62061)
HTL	High-threshold logic
Inverter unit	Inverter module(s) under control of one control unit, and related components. One inverter unit typically controls one motor.
PL	Performance level. Levels a...e correspond to SIL (EN ISO 13849-1)
Safety system	Whole functional safety system including, for example, human-machine interface (HMI), safety encoder, FSE-31 module, FSO module, drive and sensors.
SIL	Safety integrity level (1...3) (IEC 61508, IEC 62061, IEC 61800-5-2)
STO	Safe torque off (IEC/EN 61800-5-2)
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.

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.

3

Hardware description

Contents of this chapter

This chapter gives a short description of the module.

Product overview

The FSE-31 pulse encoder interface module is an option module that lets you use a safety encoder in the safety system. It is used together with the FSO-21 safety functions module.

The FSE-31 module delivers speed, direction and position data from the safety encoder to:

- the functional safety system through the FSO-21 safety functions module, and
- the ACS880/DCS880 drive for motor control.

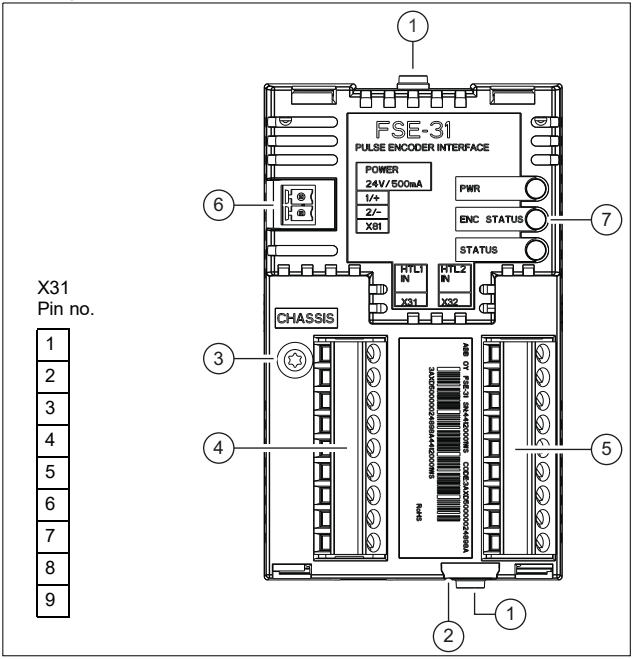
The FSE-31 module also monitors the operation of the encoder and indicates faults to the FSO-21 module.

The FSE-31 module supports one HTL safety encoder. The module has two built-in encoder interface connectors, X31 and X32. Only X31 can be used. Interface X32 is reserved for future use and must be left unconnected.

The FSE-31 module needs an external 24 V DC power supply which must be connected to connector X81. For the safety encoder, the module provides a 15 V DC power supply through connector X31. The safety encoder must be powered from this interface only.

Only one FSE-31 module can be installed to a drive/inverter unit.

Layout



Item	Description
1	Retaining clips
2	Lock
3	Mounting/grounding screw

4	Encoder interface connector X31
5	Encoder interface connector X32 (reserved for future use)
6	External power supply X81
7	Diagnostic LEDs

Type designation label

The type designation label is attached on the top of the FSE module. An example label and description of the label contents are shown below.

Item	Description
1	Type
2	Serial number of format RYWWSSSSWS, where R component revision; A, B, … Y: Last digit of the manufacturing year: 4, 5, … for 2014, 2015 WW: Manufacturing week: 01, 02, … for week 1, week 2, … SSSS: Integer starting every week from 0001 WS: Manufacturing location
3	ABB MRP code of the FSE module
4	Combined ABB MRP code, component revision, serial number and manufacturing location
5	RoHS mark

4

Mechanical installation

Contents of this chapter

This chapter contains a delivery checklist and instructions on installing the module.

Necessary tools and instructions

- Torx screwdriver (T10)

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

Examining the delivery

Make sure that these items are included in the delivery:

- FSE-31 pulse encoder interface module
- this manual.

Make sure that there are no signs of damage to the items.

Installing the module

WARNING! Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur. If you are not a qualified electrical professional, do not do installation or maintenance work.

Install the FSE-31 module to the drive control unit as follows:

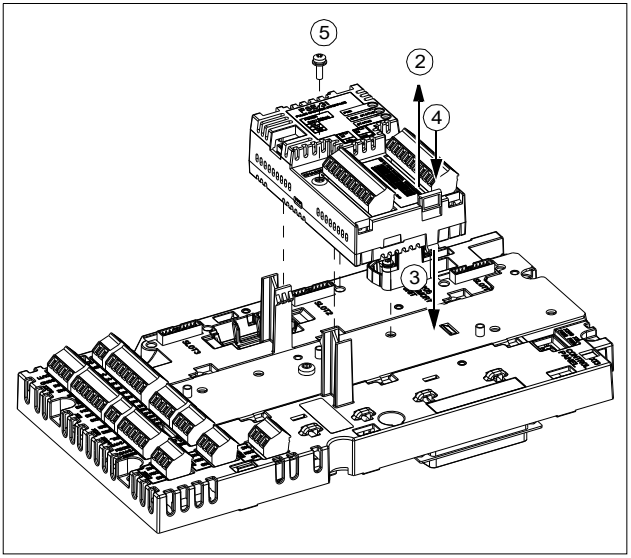
1. Stop the drive and do the steps in section *Electrical safety precautions* on page *8* before you start the work.
2. Pull out the lock.
3. Put the module carefully into its position on the control unit until the retaining clips lock it into position.
4. Push in the lock.
5. Torque the screw to 0.8 N·m (7.1 lbf·in).

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

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

Do not install the FSE-31 module onto an FEA-03 F-series extension adapter.

For more information, refer to the drive hardware manual.


5
2
4
3

5

Electrical installation

Contents of this chapter

This chapter contains instructions on wiring the module.

Warnings

WARNING! Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur. If you are not a qualified electrical professional, do not do installation or maintenance work.

Necessary tools and instructions

- Slot-head screwdriver, 0.5 × 3.0 mm for encoder connectors
- Slot-head screwdriver, 0.4 × 2.0 mm for power connector
- Cabling tools

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

Terminal designations

Pin allocation of the encoder interface connector 1 (X31)

X31	HTL		
No.	**Name**	**Specification**	**Description**
1	VCC_ENC_1	15 V DC	Encoder channel 1 power supply output
2	COM_ENC_1	0 V	Encoder channel 1 supply/signal common (ground)
3	A+_1	0…15 V DC	Encoder channel 1 signal A+ input
4	A-_1	0…15 V DC	Encoder channel 1 signal A- input
5	B+_1	0…15 V DC	Encoder channel 1 signal B+ input
6	B-_1	0…15 V DC	Encoder channel 1 signal B- input
7	Z+_1	0…15 V DC	Encoder channel 1 signal Z+ input
8	Z-_1	0…15 V DC	Encoder channel 1 signal Z- input
9	SHIELD_1	N/A	Encoder channel 1 cable shield

Pin allocation of the power supply connector (X81)

X81	Description
1/+	Supply voltage
2/-	Supply ground

Wiring

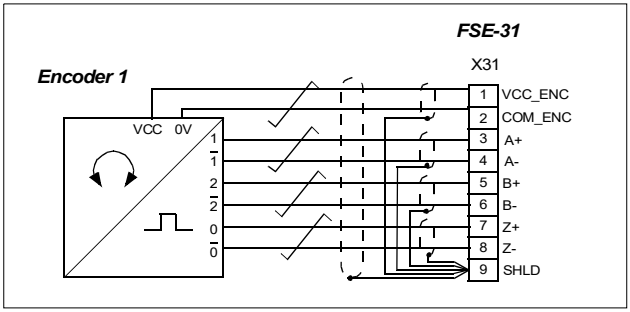
General guidelines

- For planning the FSE-31 wiring, see chapter *Planning for installation* in the *FSO-21 safety functions module user's manual* (3AXD50000015614 [English]).
- Route the encoder cables separately from power cables (drive, motor, etc).
- Do not install more than one FSE-31 module to a drive/inverter unit.
- Use the same power supply for the FSE-31 module and the FSO-21 module. If there is no power, or if the power is not sufficient, FSE-31 remains in Safe state. If this occurs when FSO is in running mode, FSO will go into fail-safe mode.
- The safety encoder must be attached to the motor shaft according to the instructions of the encoder manufacturer. FSE-31 does not detect mechanical failures outside of the encoder (for example, motor shaft slipping).

WARNING! Use only connector X31 of the FSE-31 module to supply power to the encoder. If you supply power to the encoder from a different source, you can cause damage to the module.

Installation procedure

1. Stop the drive and do the steps in section *Electrical safety precautions* on page *8* before you start the work.
2. Connect the power supply cables to terminal X81.
3. Connect the safety encoder to terminal X31 as shown in the diagram:



Note: This diagram is applicable to all revisions of FSE-31. But the voltage for VCC is:

- 24 V DC in revisions A…E
- 15 V DC in revisions F and later.

For the revision of the module, see the type designation label. Refer to *Type designation label* on page *19*.

4. Make sure that the electrical installation is completed. See chapter *Installation checklists* in the *FSO-21 safety functions module user's manual* (3AXD50000015614 [English]).

6

Commissioning

Contents of this chapter

This chapter gives instructions for taking the safety subsystem into use.

Before you start

Make sure that you have completed the installation of the drive, the FSO-21 module and the FSE-31 module.

Required tools

Drive composer pro PC tool, version 1.8 or later.

Setting the parameters

To take the FSE-31 module into use, set the related safety parameters of the FSO-21 module with the Drive composer pro PC tool. Make sure that the parameter settings agree with the safety encoder used.

Validation of the safety system

See the validation instructions in *FSO-21 safety functions module user's manual* (3AXD50000015614 [English]).

Commissioning test for FSE-31

1. Make sure that only one safety encoder is connected to the FSE-31 module and that it is connected to connector X31.
2. Make sure that only one FSE-31 module is connected to the drive/inverter unit.
3. Make sure that the installed encoder type, pulse count, and safety rating match the system design specification.
4. Make sure that the installed encoder is correct for the application and that the encoder is compatible with the FSE module. See section *Supported safety encoders* on page *36*.
5. Make sure that the encoder is installed according to the instructions of the safety encoder manufacturer and according to the wiring instructions of this manual.
6. For the encoder interface configuration and validation instructions, see *FSO-21 safety functions module user's manual* (3AXD50000015614 [English]).

7

Fault tracing

Contents of this chapter

This chapter shows how to trace faults with the status LEDs on the module.

Reporting problems and failures related to safety functions

Contact ABB.

Faults and warning messages

The FSE-31 module power input (X81) is protected against overvoltage, undervoltage and overcurrent, and it has reverse polarity protection. The FSE-31 module enters fail-safe mode if any of these protections trip. The module enters fail-safe mode also if output voltages of the internal power supply are outside the specified limits due to power input overvoltage.

The FSE-31 module detects short-circuits between the signal channels in the encoder cable.

For the fault and warning messages concerning the FSE-31 module and the safety encoder, see the drive firmware manual and *FSO-21 safety functions module user's manual* (3AXD50000015614 [English]).

LEDs

The FSE-31 module has three diagnostic LEDs.

Name	Color	Description
PWR	Green	The module is powered up.
ENC STATUS	Green	The encoder is in normal operation.
	Off	An encoder fault is active.
STATUS	Green	The module is in normal operation.
	Green flashing	The module is initializing.
	Off	A module fault is active.

Safety encoder fault reaction

The FSE-31 module indicates the internal faults of the safety encoder as cabling faults.

If an internal safety encoder failure occurs, the safety encoder goes into Safe state. To recover from these situations, you must reboot the FSE-31 module by switching the power off and on.

The fault reaction depends on the FSO-21 module parameter settings. For more information, see *FSO-21 safety functions module user's manual* (3AXD50000015614 [English]).

FSE-31 module replacement

If there is a failure in the FSE-31 module, you must replace it with a new one. Do not try to repair the module.

For instructions about replacing the FSE-31 module, see *FSO-21 safety functions module user's manual* (3AXD50000015614 [English]).

8

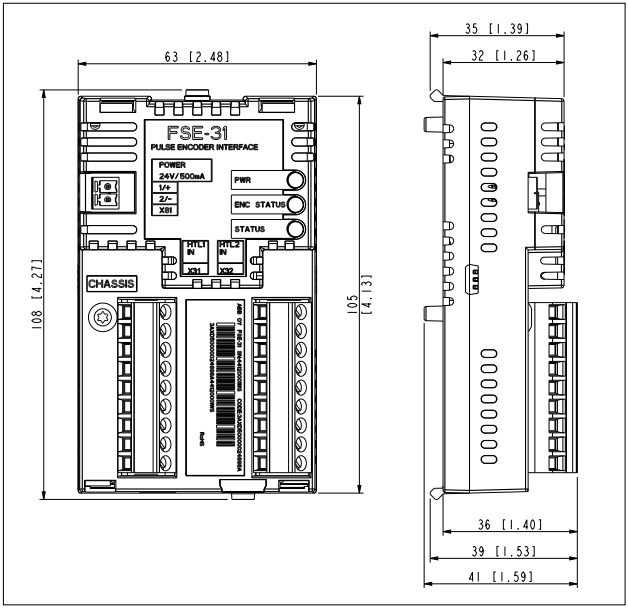
Technical data

Contents of this chapter

This chapter contains the technical data of the module.

Dimension drawing

The dimensions are in millimeters and [inches].



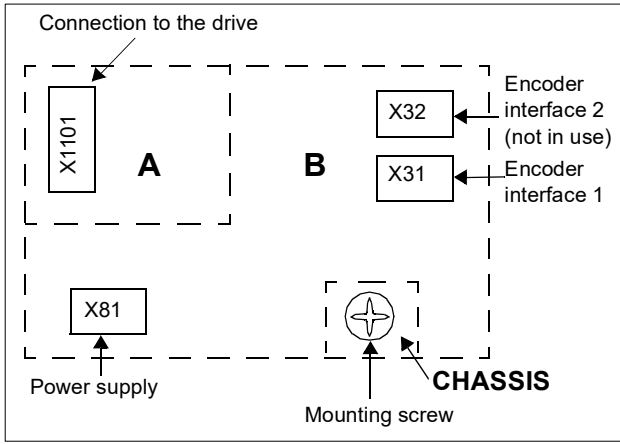
General data

- Degree of protection: IP20
- Ambient conditions: Same as FSO-21. See *FSO-21 safety functions module user's manual* (3AXD50000015614 [English]).

Isolation areas

The following figure describes the different isolation areas of the module.

The shield pins of connectors X31 and X32 are connected to chassis. The mounting screw connects the chassis to ground.



Encoder interface connector 1 (X31)

Connector pitch: 5.0 mm, wire size: max. 2.5 mm^2 (14 AWG)

Power supply (X81)

- Connector pitch: 3.5 mm, wire size: max. 1.5 mm^2 (16 AWG)
- 24 V DC (tolerance ±20%)
- Maximum current consumption: 500 mA
- SELV- or PELV-type power supply

Supported safety encoders

- Differential push-pull HTL encoders
- Supply voltage: 15 V DC
- Only safety-certified encoders are supported.

The safety encoder must indicate its internal faults either by

- setting its outputs to the hi-Z state (“floating” the outputs) or
- setting its complement outputs to identical states.

Note: The FSE-31 module does not support the use of a separate error indication signal from the safety encoder.

The HTL encoder input can detect signal frequencies up to 300 kHz.

The installation and use must comply with the safety encoder manufacturer’s instructions related to, for example, installation, maximum cable lengths, etc.

Supported encoder cables

- Double-shielded twisted-pair cable (Draka JAMAK 4×(2+1)×0.5 mm^2 or equivalent)

The maximum cable length depends on the encoder type, cable type, and cable termination. For more information, see the encoder manufacturer’s data.

Safety performance

When the FSE-31 module and a safety encoder are used in a safety function with a SIL/PL requirement, the safety encoder must be SIL/PL classified. The user must make sure that the SIL/PL capability of the safety encoder and the complete safety function meets the required SIL/PL. This includes the possible application of, for example, a signal splitter.

Examples of the SIL/PL capability of the safe speed measurement:

Safety performance with an HTL encoder classified to SIL 3, PL e and the FSE-31 and FSO-21 modules:

- SIL 3, PL e

Safety performance with an HTL encoder classified to SIL 2, PL d and the FSE-31 and FSO-21 modules:

- SIL 2, PL d

Safety data

The safety data of the FSE-31 module is given in *FSO-21 safety functions module user's manual* (3AXD50000015614 [English]).

Related standards

The FSE-31 and FSO-21 module combination complies with:

- IEC 61508 ed. 2.0: 2010
- IEC 62061:2021
- EN 62061:2005 + AC:2010 + A1:2013 + A2:2015
- IEC 61800-5-2:2016
- EN 61800-5-2:2007
- EN ISO 13849-1:2015 Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design.
- EN ISO 13849-2:2012 Safety of machinery – Safety-related parts of control systems – Part 2: Validation

All components are RoHS compliant.

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 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 abb.com/drives/documents.

abb.com/drives

3AXD50000016597 Rev D (EN) 2021-11-23