Altivar Process

Variable Speed Drives ATV930, ATV95•, ATV960, ATV980, ATV993, ATV9A0, ATV9B0, ATV9L0

Embedded Safety Function Manual

NHA80947.10
03/2022

www.se.com

Legal Information

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Safety Information

Important Information

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

DANGER indicates a hazardous situation which, if not avoided, **will result in** death or serious injury.

⚠ WARNING

WARNING indicates a hazardous situation which, if not avoided, **could result in** death or serious injury.

⚠ CAUTION

CAUTION indicates a hazardous situation which, if not avoided, **could result** in minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury.

Please Note

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

Qualification of Personnel

Only appropriately trained persons who are familiar with and understand the contents of this manual and all other pertinent product documentation are authorized to work on and with this product. In addition, these persons must have received safety training to recognize and avoid hazards involved. These persons must have sufficient technical training, knowledge and experience and be able to foresee and detect potential hazards that may be caused by using the product, by changing the settings and by the mechanical, electrical and electronic equipment of the entire system in which the product is used. All persons working on and with the product must be fully familiar with all applicable standards, directives, and accident prevention regulations when performing such work.

Intended Use

This product is intended for industrial use according to this manual.

The product may only be used in compliance with all applicable safety standard and local regulations and directives, the specified requirements and the technical data. The product must be installed outside the hazardous ATEX zone. Prior to using the product, you must perform a risk assessment in view of the planned application. Based on the results, the appropriate safety measures must be implemented. Since the product is used as a component in an entire system, you must ensure the safety of persons by means of the design of this entire system (for example, machine design). Any use other than the use explicitly permitted is prohibited and can result in hazards.

Product Related Information

Read and understand these instructions before performing any procedure with this drive.

⚠⚠DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Only appropriately trained persons who are familiar with and fully understand the contents of the present manual and all other pertinent product documentation and who have received all necessary training to recognize and avoid hazards involved are authorized to work on and with this drive system.
- Installation, adjustment, repair and maintenance must be performed by qualified personnel.
- Verify compliance with all local and national electrical code requirements as well as all other applicable regulations with respect to grounding of all equipment.
- Only use properly rated, electrically insulated tools and measuring equipment.
- Do not touch unshielded components or terminals with voltage present.
- Prior to performing any type of work on the drive system, block the motor shaft to prevent rotation.
- Insulate both ends of unused conductors of the motor cable.
- Do not short across the DC bus terminals or the DC bus capacitors or the braking resistor terminals.

Failure to follow these instructions will result in death or serious injury.

⚠⚠DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Before performing work on the drive system:

- Disconnect all power, including external control power that may be present. Take into account that the circuit breaker or main switch does not de-energize all circuits.
- Place a “Do Not Turn On” label on all power switches related to the drive system.
- Lock all power switches in the open position.
- Wait 15 minutes to allow the DC bus capacitors to discharge.
- Verify the absence of voltage. (1)

Before applying voltage to the drive system:

- Verify that the work has been completed and that the entire installation cannot cause hazards.
- If the mains input terminals and the motor output terminals have been grounded and short-circuited, remove the ground and the short circuits on the mains input terminals and the motor output terminals.
- Verify proper grounding of all equipment.
- Verify that all protective equipment such as covers, doors, grids is installed and/or closed.

Failure to follow these instructions will result in death or serious injury.

(1) Refer to Verifying the Absence of Voltage in the Installation manual of the product.

Damaged products or accessories may cause electric shock or unanticipated equipment operation.

⚠⚠DANGER

ELECTRIC SHOCK OR UNANTICIPATED EQUIPMENT OPERATION

Do not use damaged products or accessories.

Failure to follow these instructions will result in death or serious injury.

Contact your local Schneider Electric sales office if you detect any damage whatsoever.

This equipment has been designed to operate outside of any hazardous location. Only install this equipment in zones known to be free of a hazardous atmosphere.

⚠DANGER

POTENTIAL FOR EXPLOSION

Install and use this equipment in non-hazardous locations only.

Failure to follow these instructions will result in death or serious injury.

Your application consists of a whole range of different interrelated mechanical, electrical, and electronic components, the drive being just one part of the application. The drive by itself is neither intended to nor capable of providing the entire functionality to meet all safety-related requirements that apply to your application. Depending on the application and the corresponding risk assessment to be conducted by you, a whole variety of additional equipment is required such as, but not limited to, external encoders, external brakes, external monitoring devices, guards, etc.

As a designer/manufacturer of machines, you must be familiar with and observe all standards that apply to your machine. You must conduct a risk assessment and determine the appropriate Performance Level (PL) and/or Safety Integrity Level (SIL) and design and build your machine in compliance with all applicable standards. In doing so, you must consider the interrelation of all components of the machine. In addition, you must provide instructions for use that enable the user of your machine to perform any type of work on and with the machine such as operation and maintenance in a safe manner.

The present document assumes that you are fully aware of all normative standards and requirements that apply to your application. Since the drive cannot provide all safety-related functionality for your entire application, you must ensure that the required Performance Level and/or Safety Integrity Level is reached by installing all necessary additional equipment.

⚠WARNING

INSUFFICIENT PERFORMANCE LEVEL/SAFETY INTEGRITY LEVEL AND/OR UNINTENDED EQUIPMENT OPERATION

- Conduct a risk assessment according to EN ISO 12100 and all other standards that apply to your application.
- Use redundant components and/or control paths for all critical control functions identified in your risk assessment.
- Implement all monitoring functions required to avoid any type of hazard identified in your risk assessment, for example, slipping or falling loads, in particular, if you do not operate the drive in closed loop mode which provides certain internal monitoring functions such as BRH3 **[BRH b3]**, BRH4 **[BRH b4]** and BRH5 **[BRH b5]**.
- Verify that the service life of all individual components used in your application is sufficient for the intended service life of your overall application.
- Perform extensive commissioning tests for all potential error situations to verify the effectiveness of the safety-related functions and monitoring functions implemented, for example, but not limited to, speed monitoring by means of encoders, short circuit monitoring for all connected equipment, correct operation of brakes and guards.
- Perform extensive commissioning tests for all potential error situations to verify that the load can be brought to a safe stop under all conditions.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

A specific application note NHA80973 is available on hoisting machines and can be downloaded on se.com.

The products may perform unexpected movements because of incorrect wiring, incorrect settings, incorrect data or other errors.

⚠WARNING

UNANTICIPATED EQUIPMENT OPERATION

- Carefully install the wiring in accordance with the EMC requirements.
- Do not operate the product with unknown or unsuitable settings or data.
- Perform a comprehensive commissioning test.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

⚠WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for critical control functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are emergency stop, overtravel stop, power outage and restart.
- Separate or redundant control paths must be provided for critical control functions.
- System control paths may include communication links. Consideration must be given to the implications of unanticipated transmission delays or failures of the link.
- Observe all accident prevention regulations and local safety guidelines (1).
- Each implementation of the product must be individually and thoroughly tested for proper operation before being placed into service.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

(1) For USA: Additional information, refer to NEMA ICS 1.1 (latest edition), Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control and to NEMA ICS 7.1 (latest edition), Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems.

The temperature of the products described in this manual may exceed 80 °C (176 °F) during operation.

⚠WARNING

HOT SURFACES

- Ensure that any contact with hot surfaces is avoided.
- Do not allow flammable or heat-sensitive parts in the immediate vicinity of hot surfaces.
- Verify that the product has sufficiently cooled down before handling it.
- Verify that the heat dissipation is sufficient by performing a test run under maximum load conditions.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Machines, controllers, and related equipment are usually integrated into networks. Unauthorized persons and malware may gain access to the machine as well as to other devices on the network/fieldbus of the machine and connected networks via insufficiently secure access to software and networks.

⚠WARNING

UNAUTHORIZED ACCESS TO THE MACHINE VIA SOFTWARE AND NETWORKS

- In your hazard and risk analysis, consider all hazards that result from access to and operation on the network/fieldbus and develop an appropriate cyber security concept.
- Verify that the hardware infrastructure and the software infrastructure into which the machine is integrated as well as all organizational measures and rules covering access to this infrastructure consider the results of the hazard and risk analysis and are implemented according to best practices and standards covering IT security and cyber security (such as: ISO/IEC 27000 series, Common Criteria for Information Technology Security Evaluation, ISO/ IEC 15408, IEC 62351, ISA/IEC 62443, NIST Cybersecurity Framework, Information Security Forum - Standard of Good Practice for Information Security, SE recommended Cybersecurity Best Practices*).
- Verify the effectiveness of your IT security and cyber security systems using appropriate, proven methods.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

(*) : SE Recommended Cybersecurity Best Practices can be downloaded on SE.com

⚠WARNING

LOSS OF CONTROL

Perform a comprehensive commissioning test to verify that communication monitoring properly detects communication interruptions

Failure to follow these instructions can result in death, serious injury, or equipment damage.

NOTICE

DESTRUCTION DUE TO INCORRECT MAINS VOLTAGE

Before switching on and configuring the product, verify that it is approved for the mains voltage.

Failure to follow these instructions can result in equipment damage.

About the Book

Document Scope

The purpose of this document is to provide information about the safety function incorporated in the drive.

The drive supports the STO safety function according to the IEC 61800-5-2 standard.

Validity Note

Original instructions and information given in this manual have been written in English (before optional translation).

This documentation is valid for the Altivar Process drives, drive systems and Modular drives described in the Installation manuals or Integration manual.

The technical characteristics of the devices described in the present document also appear online. To access the information online, go to the Schneider Electric home page www.se.com/ww/en/download/.

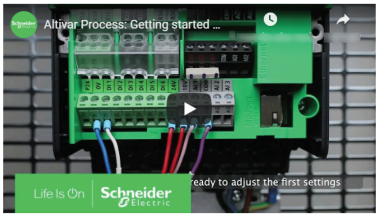
The characteristics that are described in the present document should be the same as those characteristics that appear online. In line with our policy of constant improvement, we may revise content over time to improve clarity and accuracy. If you see a difference between the document and online information, use the online information as your reference.

Related Documents

Use your tablet or your PC to quickly access detailed and comprehensive information on all our products on www.se.com.

The internet site provides the information you need for products and solutions:

- The whole catalog for detailed characteristics and selection guides,
- The CAD files to help design your installation, available in over 20 different file formats,
- All software and firmware to maintain your installation up to date,
- A large quantity of White Papers, Environment documents, Application solutions, Specifications... to gain a better understanding of our electrical systems and equipment or automation,
- And finally all the User Guides related to your drive, listed below:

Title of Documentation	Catalog Number
Catalog: Variable speed drives Altivar Process ATV900	DIA2ED2150601EN (English), DIA2ED2150601FR (French)
ATV600/ATV900 Getting Started - Video	FAQ FA364431 (English) 
ATV930, ATV950 Getting Started	NHA61578 (English), NHA61579 (French), NHA61580 (German), NHA61581 (Spanish), NHA61724 (Italian), NHA61582 (Chinese), NHA61578PT (Portuguese), NHA61578TR (Turkish)

Title of Documentation	Catalog Number
ATV900 Getting Started Annex (SCCR)	NHA61583 (English)
ATV930, ATV950 Installation manual	NHA80932 (English), NHA80933 (French), NHA80934 (German), NHA80935 (Spanish), NHA80936 (Italian), NHA80937 (Chinese), NHA80932PT (Portuguese), NHA80932TR (Turkish)
ATV600F, ATV900F Installation Instruction sheet	NVE57369 (English)
ATV900 Programming manual	NHA80757 (English), NHA80758 (French), NHA80759 (German), NHA80760 (Spanish), NHA80761 (Italian), NHA80762 (Chinese), NHA80757PT (Portuguese), NHA80757TR (Turkish)
ATV900 Embedded Modbus Serial Link manual	NHA80939 (English)
ATV900 Embedded Ethernet manual	NHA80940 (English)
ATV900 PROFIBUS DP manual (VW3A3607)	NHA80941 (English)
ATV900 DeviceNet manual (VW3A3609)	NHA80942 (English)
ATV900 PROFINET manual (VW3A3627)	NHA80943 (English)
ATV900 CANopen manual (VW3A3608, 618, 628)	NHA80945 (English)
ATV900 EtherCAT manual (VW3A3601)	NHA80946 (English)
ATV900 POWERLINK manual (VW3A3619)	PHA99693 (English)
ATV900 Communication Parameters addresses	NHA80944 (English)
ATV900 Embedded Safety Function manual	NHA80947 (English)
ATV900 Safety functions Manual (with Module VW3A3802) Upcoming commercialization	NVE64209 (English), NVE64210 (French), NVE64211 (German), NVE64212 (Spanish), NVE64213 (Italian), NVE64214 (Chinese), NVE64209PT (Portuguese), NVE64209TR (Turkish)
Drive Systems ATV960 handbook	NHA37115 (English), NHA37114 (German)
Drive Systems ATV980 handbook	NHA37117 (English), NHA37116 (German)
Drive Systems ATV990 handbook Multidrive Systems	NHA37145 (English), NHA37143 (German)
ATV991, ATV992 Supply units, Programming manual	QGH33275 (English)
Drive Systems Installation manual	NHA37118 (German), NHA37119 (English), NHA37121 (French), NHA37122 (Spanish), NHA37123 (Italian), NHA37124 (Dutch), NHA37126 (Polish), NHA37127 (Portuguese), NHA37129 (Turkish), NHA37130 (Chinese)
SoMove: FDT	SoMove_FDT (English, French, German, Spanish, Italian, Chinese)
ATV900: DTM	ATV9xx_DTM_Library_EN (English - to be installed first), ATV9xx_DTM_Lang_FR (French), ATV9xx_DTM_Lang_DE (German), ATV9xx_DTM_Lang_SP (Spanish), ATV9xx_DTM_Lang_IT (Italian), ATV9xx_DTM_Lang_CN (Chinese)
ATV61-71 to ATV600-900 Migration Manual	EAV64336 (English)
Altivar Application Note for Hoisting	NHA80973 (English)
Recommended Cybersecurity Best Practices	CS-Best-Practices-2019-340 (English)

You can download these technical publications and other technical information from our website at www.se.com/en/download

Terminology

The technical terms, terminology, and the corresponding descriptions in this manual normally use the terms or definitions in the relevant standards.

In the area of drive systems this includes, but is not limited to, terms such as **error, error message, failure, fault, fault reset, protection, safe state, safety function, warning, warning message**, and so on.

Among others, these standards include:

- IEC 61800 series: Adjustable speed electrical power drive systems
- IEC 61508 Ed.2 series: Functional safety of electrical/electronic/ programmable electronic safety-related
- EN 954-1 Safety of machinery - safety-related parts of control systems
- ISO 13849-1 & 2 Safety of machinery - safety related parts of control systems
- IEC 61158 series: Industrial communication networks - Fieldbus specifications
- IEC 61784 series: Industrial communication networks - Profiles
- IEC 60204-1: Safety of machinery - Electrical equipment of machines – Part 1: General requirements

In addition, the term **zone of operation** is used in conjunction with the description of specific hazards, and is defined as it is for a **hazard zone** or **danger zone** in the EC Machinery Directive (2006/42/EC) and in ISO 12100-1.

EC Declaration of Conformity

The EC Declaration of Conformity can be obtained on www.se.com.

Certification for Functional Safety

The integrated safety function is compatible and certified following IEC 61800-5-2 Ed.1 Adjustable speed electrical power drive systems – Part 5-2 : Safety requirements – Functional

IEC 61800-5-2 as a product standard, sets out safety-related considerations of Power Drive Systems Safety Related PDS (SR) s in terms of the framework of IEC 61508 series Ed.2 of standards.

Compliance with IEC 61800-5-2 standard, for the following described safety function, will facilitate the incorporation of a PDS(SR) (Power Drive System with safety-related functions) into a safety-related control system using the principles of IEC 61508, 60204 or the ISO 13849-1, as well as the IEC 62061 for process-systems and machinery.

The defined safety function is

- SIL 3 capability in compliance with IEC 61800-5-2 and IEC 61508 series Ed.2
- Performance Level **e** in compliance with ISO 13849-1
- Compliant with the Category 3 of European standard ISO 13849-1

Also refer to Safety function capability, page 23.

The safety demand mode of operation is considered in high demand or continuous mode of operation according to the IEC 61800-5-2 standard.

The certificate for functional safety is accessible on www.se.com

Contact Us

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Overview

Definitions

Safety Function In Altivar Process

The safety function incorporated in Altivar Process, helps to detect unsafe conditions of the installation and prevent hazardous conditions arising at the installation.

In some cases, further safety-related systems external to the drive (for example a mechanical brake) may be necessary to maintain the safe condition when electrical power is removed.

Safety integrated function provides the following benefits:

- Replacement of external safety-related equipment
- Reduced wiring efforts and space requirements
- Reduced costs

The Altivar Process drives are compliant with normative requirements to implement the safety function.

STO (Safe Torque Off)

No power that could cause torque or force is supplied to the motor.

Notation

The graphic display terminal menus and parameters are shown in square brackets, with capital letters for the menus and lowercase characters for the parameters.

Example: **[COMMUNICATION]**

Example: **[Fallback speed]**

Basics

Functional Safety

Automation and safety engineering are two areas that were completely separate in the past but have recently become more and more integrated.

The engineering and installation of complex automation solutions are greatly simplified by integrated safety functions.

Usually, the safety engineering requirements depend on the application.

The level of requirements results from the risk and the hazard potential arising from the specific application.

IEC 61508 Standard

The standard IEC 61508 Functional safety of electrical/electronic/programmable electronic safety-related systems covers the safety-related function.

Instead of a single component, an entire function chain (for example, from a sensor through the logical processing units to the actuator) is considered as a unit.

This function chain must meet the requirements of the specific safety integrity level as a whole.

Systems and components that can be used in various applications for safety tasks with comparable risk levels can be developed on this basis.

EN ISO 13849 Standard

This European Standard specifies the validation process, including both analysis and testing, for the safety functions and categories for the safety-related parts of control systems. Descriptions of the safety functions and the requirements for the categories are given in ISO 13849-1 which deals the general principles for design. Some requirements for validation are general and some are specific to the technology used. EN ISO 13849-2 also specifies the conditions under which the validation by testing of the safety-related parts of control systems should be carried out.

SIL - Safety Integrity Level

The standard IEC 61508 defines 4 safety integrity levels (SIL) for safety functions.

SIL1 is the lowest level and SIL4 is the highest level.

A hazard and risk analysis serves as a basis for determining the required safety integrity level.

This is used to decide whether the relevant function chain is to be considered as a safety function and which hazard potential it must cover.

PFH - Probability of a Dangerous Hardware Failure Per Hour

To maintain the safety function, the IEC 61508 standard requires various levels of measures for avoiding and controlling detected errors, depending on the required SIL.

All components of a safety function must be subjected to a probability assessment to evaluate the effectiveness of the measures implemented for controlling detected faults.

This assessment determined the PFH (Probability of a dangerous Failure per Hour) for a safety system.

This is the probability per hour that a safety system fails in a hazardous manner and the safety function cannot be correctly executed.

Depending on the SIL, the PFH must not exceed certain values for the entire safety system.

The individual PFH values of a function chain are added. The result must not exceed the maximum value specified in the standard.

Safety Integrity Level	Probability of a dangerous Failure per Hour (PFH) at high demand or continuous demand
4	$10^{-9} \leq ... < 10^{-8}$
3	$10^{-8} \leq ... < 10^{-7}$
2	$10^{-7} \leq ... < 10^{-6}$
1	$10^{-6} \leq ... < 10^{-5}$

PL - Performance Level

The standard IEC 13849-1 defines 5 Performance levels (PL) for safety functions.

Level **a** is the lowest level and **e** is the highest level.

Five levels (a, b, c, d, and e) correspond to different values of average probability of dangerous failure per hour.

Performance level	Probability of a dangerous Hardware Failure per Hour
e	$10^{-8} \leq ... < 10^{-7}$
d	$10^{-7} \leq ... < 10^{-6}$
c	$10^{-6} \leq ... < 3 \times 10^{-6}$
b	$3 \times 10^{-6} \leq ... < 10^{-5}$
a	$10^{-5} \leq ... < 10^{-4}$

HFT - Hardware Fault Tolerance and SFF - Safe Failure Fraction

Depending on the SIL for the safety system, the IEC 61508 standard requires a specific hardware fault tolerance HFT in connection with a specific proportion of safe failures SFF (Safe Failure Fraction).

The hardware fault tolerance is the ability of a system to execute the required safety function in spite of the presence of one or more hardware faults.

The SFF of a system is defined as the ratio of the rate of safe failures to the total failure rate of the system.

According to IEC 61508, the maximum achievable SIL of a system is partly determined by the hardware fault tolerance HFT and the safe failure fraction SFF of the system.

IEC 61508 distinguishes two types of subsystem (type A subsystem, type B subsystem).

These types are specified on the basis of criteria which the standard defines for the safety-relevant components.

SFF	HFT type A subsystem			HFT type B subsystem		
	0	1	2	0	1	2
< 60%	SIL1	SIL2	SIL3	—	SIL1	SIL2
60% <... < 90%	SIL2	SIL3	SIL4	SIL1	SIL2	SIL3
90% <... < 99 %	SIL3	SIL4	SIL4	SIL2	SIL3	SIL4
> 99%	SIL3	SIL4	SIL4	SIL3	SIL4	SIL4

PFD - Probability of Failure on Demand

The standard IEC 61508 defines SIL using requirements grouped into two broad categories: hardware safety integrity and systematic safety integrity. A device or system must meet the requirements for both categories to achieve a given SIL.

The SIL requirements for hardware safety integrity are based on a probabilistic analysis of the device. To achieve a given SIL, the device must meet targets for the maximum probability of dangerous failure and a minimum Safe Failure Fraction. The concept of 'dangerous failure' must be rigorously defined for the system in question, normally in the form of requirement constraints whose integrity is verified throughout system development. The actual targets required vary depending on the likelihood of a demand, the complexity of the device(s), and types of redundancy used.

The PFD (Probability of Failure on Demand) and RRF (Risk Reduction Factor) of low demand operation for different SILs are defined in IEC 61508 are as follows:

SIL	PFD	PFD (power	RRF
1	0.1 - 0.01	10^{-1} - 10^{-2}	10 - 100
2	0.01 - 0.001	10^{-2} - 10^{-3}	100 - 1000
3	0.001 - 0.0001	10^{-3} - 10^{-4}	1000 - 10,000
4	0.0001 - 0.00001	10^{-4} - 10^{-5}	10,000 - 100,000

In high demand or continuous operation, these changes to the following:

SIL	PFH	PFH (power	RRF
1	0.00001 - 0.000001	10^{-5} - 10^{-6}	100,000 - 1,000,000
2	0.000001 - 0.0000001	10^{-6} - 10^{-7}	1,000,000 - 10,000,000
3	0.0000001 - 0.00000001	10^{-7} - 10^{-8}	10,000,000 - 100,000,000
4	0.00000001 - 0.000000001	10^{-8} - 10^{-9}	100,000,000 - 1,000,0000,000

The hazards of a control system must be identified then analyzed in a risk analysis. These risks are gradually mitigated until their overall contribution to the hazard is deemed to be acceptable. The tolerable level of these risks is specified as a safety requirement in the form of a target probability of a dangerous failure over a given period, stated as a discrete SIL level.

Fault Avoidance Measures

Systematic errors in the specifications, in the hardware and the software, usage faults and maintenance faults in the safety system must be avoided to the maximum degree possible. To meet these requirements, IEC 61508 specifies a number of measures for fault avoidance that must be implemented depending on the required SIL. These measures for fault avoidance must cover the entire life cycle of the safety system, i.e. from design to decommissioning of the system.

Description

Safety Function STO (Safe Torque Off)

Overview

The safety function STO (Safe Torque Off) does not remove power from the DC bus. The safety function STO only removes power to the motor. The DC bus voltage and the mains voltage to the drive are still present.

⚠⚠DANGER

HAZARD OF ELECTRIC SHOCK

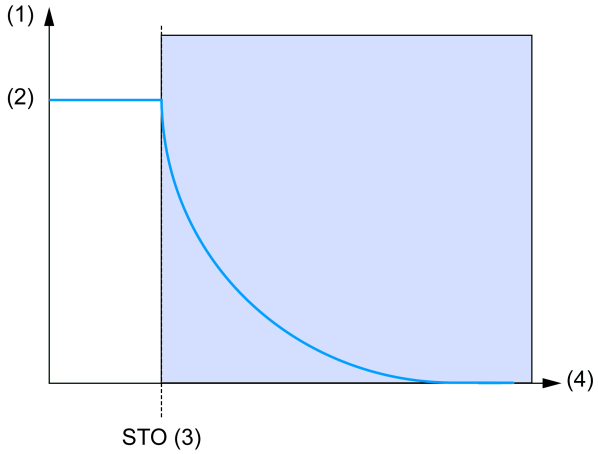
- Do not use the safety function STO for any other purposes than its intended function.
- Use an appropriate switch, that is not part of the circuit of the safety function STO, to disconnect the drive from the mains power.

Failure to follow these instructions will result in death or serious injury.

This function brings the machine safely into a no-torque state and / or prevents it from starting accidentally. The safe torque-off (safety function STO) function can be used to effectively implement the prevention of unexpected start-up functionality, thus making stops safe by preventing the power only to the motor, while still maintaining power to the main drive control circuits. The principles and requirements of the prevention of unexpected start-up are described in the standard EN 1037:1995+A1.

The logic inputs ($\overline{\text{STOA}}$ and $\overline{\text{STOB}}$) are always assigned to this function.

The safety function STO status can be displayed using the HMI of the drive or using the commissioning software.



(1) Motor speed - (2) Actual speed - (3) $\overline{\text{STOA}}$ and $\overline{\text{STOB}}$ - STO Activation - (4) Time

NOTE: If delay between $\overline{\text{STOA}}$ and $\overline{\text{STOB}}$ is greater than 1 s, the safety function STO is triggered and an error is triggered with the error code **[Safety Function Error]** $5AFF$.

Safety Function STO Standard Reference

The safety function STO is defined in section 4.2.2.2 of standard IEC 61800-5-2 (edition 1.0 2007.07):

Power that can cause rotation (or motion in the case of a linear motor), is not applied to the motor.The PDS(SR) (power drive system suitable for use in safety-related applications) will not provide energy to the motor which can generate torque (or force in the case of a linear motor).

- NOTE 1: This safety function corresponds to an uncontrolled stop in accordance with stop category 0 of IEC 60204-1.
- NOTE 2: This safety function may be used where power removal is required to prevent an unexpected start-up.
- NOTE 3: In circumstances where external influences (for example, falling of suspended loads) are present, additional measures (for example, mechanical brakes) may be necessary to prevent any hazard.
- NOTE 4: Electronic equipment and contactors do not provide adequate protection against electric shock, and additional insulation measures may be necessary.

Safety Function (SF) Level Capability for Safety Function STO

Configuration	SIL Safety Integrity Level according to IEC 61-508	PL Performance Level according to ISO-13849
STO with and without Safety module (such as Preventa module)	SIL3	PL**e**

Emergency Operations

Standard IEC 60204-1 introduces 2 emergency operations:

- **Emergency switching-off**:

  This function requires external switching components, and cannot be accomplished with drive based functions such as safe torque-off (STO).

- **Emergency stop**:

  An emergency stop must operate in such a way that, when it is activated, the hazardous movement of the machinery is stopped and the machine is unable to start under any circumstances, even after the emergency stop is released.

  An emergency stop shall function either as a stop category 0 or as a stop category 1.

  Stop category 0 means that the power to the motor is turned off immediately. Stop category 0 is equivalent to the safe torque-off (STO) function, as defined by standard EN 61800-5-2.

  In addition to the requirements for stop (see 9.2.5.3 of IEC 60204-1), the emergency stop function has the following requirements:

  - It shall override all other functions and operations in all modes.
  - This reset shall be possible only by a manual action at that location where the command has been initiated. The reset of the command shall not restart the machinery but only permit restarting.
  - For the machine environment (IEC 60204-1 and machinery directive), when safety function STO is used to manage an emergency stop category 0, the motor must not restart automatically when safety function STO has been triggered and deactivated (with or without a power cycle).

    If the drive configuration enable automatic machine restart after the safety function STO has been deactivated, an additional safety module (such as Preventa module) is required.

    If the use of an additional safety module is not possible, the drive control must be configured in 2 wires transition (`ECC = 2C` and `ECE = Etrn`) or 3 wires (`ECC = 3C`).

Limitations

Type Of Motor

The safety function STO can be used with all motors supported by the drive.

Prerequisites for Using Safety Functions

Following conditions have to be fulfilled for correct operation:

- The motor size is adequate for the application and is not at the limit of its capacity.
- The drive size has been correctly chosen for the supply mains, sequence, motor, and application and is not at the limit of its capacity as stated in the catalog.
- If required, the appropriate options are used.

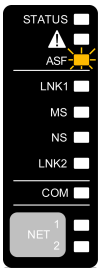
  Example: output filter.
- The drive is correctly set up with the correct speed loop and torque characteristics for the application; the reference frequency profile applied to the drive control loop is followed.

Disable Error Detection

When the safety function is used, the error code **[Safety Function Error]** SAFF cannot be disabled by the function **[Disable Error Detection]** inH.

Status of Safety Function

Description

If...	Then ...	
Safe Torque Off (STO) is not active	the orange LED is OFF	
STO is triggered	the power bridge is locked by redundant hardware the orange LED is steady ON STO is displayed	
[Safety Function Error] SAFF detected fault occurs (1)	the power bridge is locked the orange LED is steady ON the red LED is steady ON the Graphic Display terminal displays Sto then SAFF	

(1): Possible causes are exceeded delay between $\overline{\text{STOA}}$ and $\overline{\text{STOB}}$ signals > 1 s and internal hardware detected error.

Technical Data

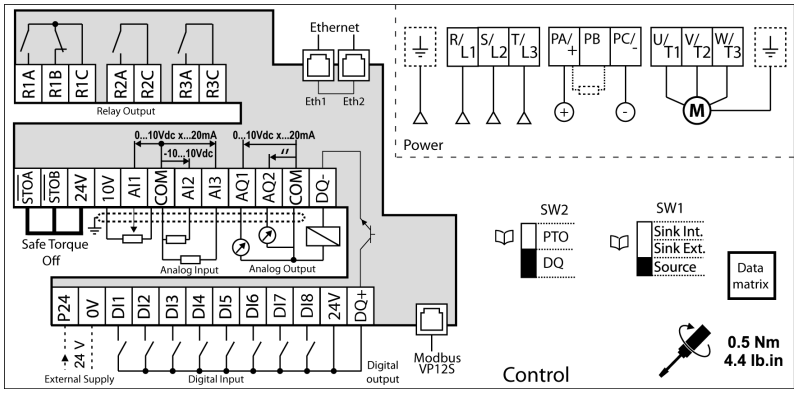
Electrical Data

Logic Type

Safety function must only be used in **Source mode**: current flows to input.

$\overline{\text{STOA}}$ and $\overline{\text{STOB}}$ inputs and signal inputs are protected against reverse polarity.

Cabling Label



Input Signal Safety Function

Input Signals Safety Function	Units	Value for STO
Logic 0 (Ulow)	Vdc	< 5 or open
Logic 1 (Uhigh)	Vdc	> 11
Current (at 19 Vdc)	mA	11
Debounce time (*)	ms	> 1
Delay between $\overline{\text{STOA}}$ and $\overline{\text{STOB}}$	s	< 1
Response time of safety function	ms	< 10
(*) A pulse shorter than “Debounce time” will be ignored.		

Safety Function Capability

PDS (SR) safety functions are part of an overall system

If the qualitative and quantitative safety objectives determined by the final application require some adjustments to help ensure safe use of the safety functions, the integrator of the BDM (Basic Drive Module) is responsible for these additional changes (for example, managing the mechanical brake on the motor).

Also, the output data generated by the use of safety functions (activation of the digital input set to **[Operating State Fault]**, error codes or information on the display, etc.) is not considered to be a safety-related data.

Machine Application Function Configuration

Standard	STO
IEC 61800-5-2 / IEC 61508	SIL3
IEC 62061 (1)	SIL3 CL
ISO 13849-1 (2)	Category 3 PL**e**
IEC 60204-1 (3)	Category stop 0

(1) Because the IEC 62061 standard concerns integration, this standard distinguishes the overall safety function (which is classified SIL3) from components which constitute the safety function (Altivar Process is one component which is classified SIL3 CL).

(2) According to table 3 of ISO 13849-1 (2015).

(3) If protection against supply interruption or voltage reduction and subsequent restoration is needed according to IEC 60204-1, a safety module type Preventa XPS AF or equivalent must be used.

Process Application Function Configuration

Standard	STO
IEC 61800-5-2 / IEC 61508	SIL3
IEC 62061	SIL3 CL

Summary Of The Reliability Study

Standard	Input	ATV930 ATV95• ATV960 ATV980 ATV993 ATV9A0 ATV9B0 ATV9L0
IEC 61508 Ed.2	SFF	91.5%
	PFH in /h	4×10^{-10}
	PFD	2×10^{-6}
	Type	A
	HFT	1
	T1 (proof test interval) in hours	8760
	SIL capability	3
IEC 62061	SIL CL capability	3
ISO 13849-1 (1)	PL	e
	Category	3
	MTTFd in years	5000
	DC avg	90%

(1) According to table 4 of EN 13849-1 (2008)

Preventive annual activation of the safety function is recommended.

However, the safety levels can be obtained (with lower margins) without annual activation.

For the machine environment, a safety module is required for the STO function.

NOTE: The table above is not sufficient to evaluate the PL of a PDS. The PL evaluation has to be done at the system level. The system integrator has to evaluate the random integrity as well as the systematic integrity at system level according to IEC61508, IEC 62061, ISO13849 or applicable product standard.

Summary Of The Reliability Study For Drive Systems and Modular Liquid Cooled Offer (ATV9L0) Options

Standard	Input	ATV960 / ATV980 / ATV9L0 / ATV993 With Option		
		VW3 AP 1502	VW3 AP 1503	STO Single
IEC 61508 Ed.2	PFH in /h	5×10^{-8}	5×10^{-8}	2×10^{-6}
	PFD	2×10^{-6}	4×10^{-4}	4×10^{-5}
	Type	A	A	A
	HFT	1	1	0
	T1 (proof test interval) in hours	8760	8760	8760
	SIL capability	3	3	1
IEC 62061	SIL CL capability	3	3	1
ISO 13849-1 (1)	PL	e	e	c
	Category	3	3	1
	MTTFd in years	> 100 (high)	> 100 (high)	> 100 (high)
	DC avg	> 90% (Medium)	> 90% (Medium)	0%

(1) According to table 4 of EN 13849-1 (2008)

Preventive annual activation of the safety function is recommended.

However, the safety levels can be obtained (with lower margins) without annual activation.

For the machine environment, a safety module is required for the STO function.

NOTE: The table above is not sufficient to evaluate the PL of a PDS. The PL evaluation has to be done at the system level. The system integrator has to evaluate the random integrity as well as the systematic integrity at system level according to IEC61508, IEC 62061, ISO13849 or applicable product standard.

Certified Architectures

Introduction

Certified Architectures

NOTE: For certification relating to functional aspects, only the PDS(SR) (Power Drive System suitable for use in safety-related applications) will be considered, not the complete system into which it is integrated to help to ensure the functional safety of a machine or a system/process.

These are the certified architectures:

- Process system SF - Case 1 - Suitable for Altivar Process drives and modular offer
- Process system SF - Case 2 - Suitable for Altivar Process drives and modular offer
- Process system SF - Case 3 - Suitable for Altivar Process drives and modular offer
- Process system SF - Case 4 - Only suitable for drive systems and modular liquid cooled offer (ATV9L0)
- Process system SF - Case 5 - Only suitable for drive systems and modular liquid cooled offer (ATV9L0)
- Process system SF - Case 6 - Only suitable for drive systems and modular liquid cooled offer (ATV9L0)
- Process system SF - Case 7 - Only suitable for drive systems and modular liquid cooled offer (ATV9L0)

The safety functions of a PDS(SR) (Power Drive System suitable for use in safety-related applications) are part of an overall system.

If the qualitative and quantitative safety-related objectives determined by the final application require some adjustments to ensure safe use of the safety functions, the integrator of the BDM (Basic Drive Module) is responsible for these additional changes (for example, managing the mechanical brake on the motor).

Also, the output data generated by the use of safety functions (activation of the digital input set to **[Operating State Fault]**, error codes or information on the display, etc.) is not considered to be a safety-related data.

Altivar Process Modular - Installation of DigiLink Communication Cables between Control Unit and Power Modules

For correct operation of Functional Safety "SAFE TORQUE OFF" circuit, adherence to the following conditions must be ensured:

- Only use Schneider-Electric parts or equivalent parts according Schneider-Electric specification for Digi-Link interconnection (GG45 type connection cable).
- The cables and connectors must not be damaged.
- Correct contact between connector and socket must be guaranteed.

Protected cable insulation

The STO safety function is triggered via 2 redundant inputs. These two circuits have to be wired according to protective cable insulation.

If short circuits and cross circuits can occur with safety-related signals and if they are not detected by upstream devices, protected cable installation as per ISO 13849-2 is required.

In the case of an unprotected cable installation, the two signals (both channels) of a safety function in short circuit state may be connected to external voltage if a cable is damaged. In this case, the safety function is no longer operative.

For EMC purpose, both STO inputs have to be shielded with twisted cables with a pitch of 25...50 mm (1 in. and 2 in.), connecting the shielding to Ground at each end of the shielded cables for the signal lines.

Ground loops may cause problems in machines. In this case the shield has to be connected to ground on drive side only.

Power Supply Unit

⚠⚠DANGER

ELECTRIC SHOCK CAUSED BY INCORRECT POWER SUPPLY UNIT

The +24VDC supply voltage is connected with many exposed signal connections in the drive system.

- Use a power supply unit that meets the PELV (Protective Extra Low Voltage) requirements.

Failure to follow these instructions will result in death or serious injury.

Acceptance Test

The system integrator/machine manufacturer must perform an acceptance test of the safety function STO to verify and document the correct functionality of the safety function. The system integrator/machine manufacturer hereby certifies to have tested the effectiveness of the safety functions used. The acceptance test must be performed on the basis of the risk analysis. All applicable standards and regulations must be adhered to.

Ambient Conditions

The ambient conditions to be met for the safety function STO correspond to the ambient conditions for the drives.

Please refer to the manual corresponding to the drive:

Drive Range	Documentation
ATV930, 95•	NHA80932
ATV960	NHA37115
ATV980	NHA37117
ATV990	NHA37145
ATV9•0	Refer to the information supplied by the system integrator.

Vertical Axis and External Forces

When the safety function STO is triggered, the power stage is immediately disabled. In the case of vertical applications or external forces acting on the motor shaft, you may have to take additional measures to bring the motor to a standstill and to keep it at a standstill when the safety function STO is used, for example, by using a service brake.

⚠WARNING

INSUFFICIENT DECELERATION OR UNINTENDED EQUIPMENT OPERATION

- Verify that using the safety function STO does not result in unsafe conditions.
- If standstill is required in your application, ensure that the motor comes to a secure standstill when the safety function STO is used.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Degree of Protection When the Safety Function Is Used

⚠WARNING

LOSS OF SAFETY FUNCTION CAUSED BY FOREIGN OBJECTS

Conductive foreign objects, dust or liquids may cause safety functions to become inoperative.

- Do not use a safety function unless you have protected the system against contamination by conductive substances.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Customer Care Center

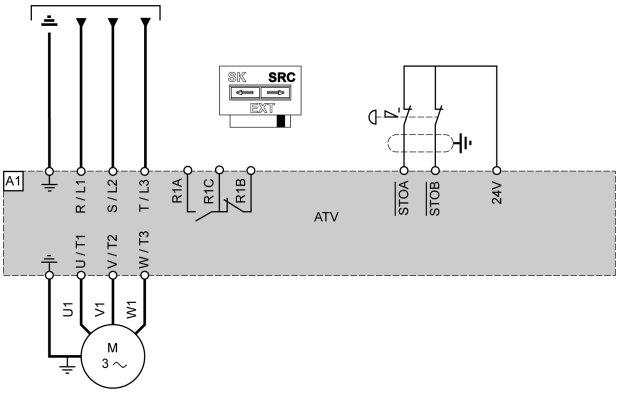
For additional support, you can contact our Customer Care Center on:

www.se.com/CCC.

Process System SF - Case 1 - Suitable for Altivar Process drives and modular offer

Single Drive Connection Diagram

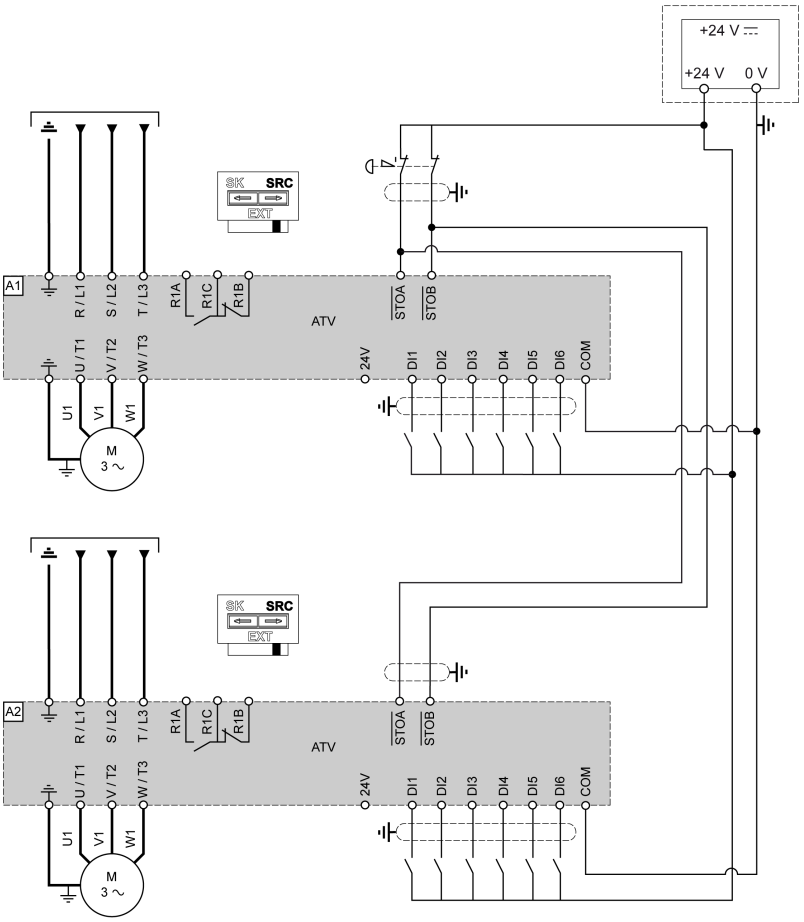
This connection diagram applies for a single drive configuration according to IEC 61508 capability SIL3, IEC 60204-1 stop category 0 without protection against subsequent rotation after supply interruption or voltage reduction.



Multidrive Connection Diagram

This connection diagram applies for multidrive configuration according to IEC 61508 capability SIL3, IEC 60204-1 stop category 0 without protection against supply interruption or voltage reduction and subsequent rotation.

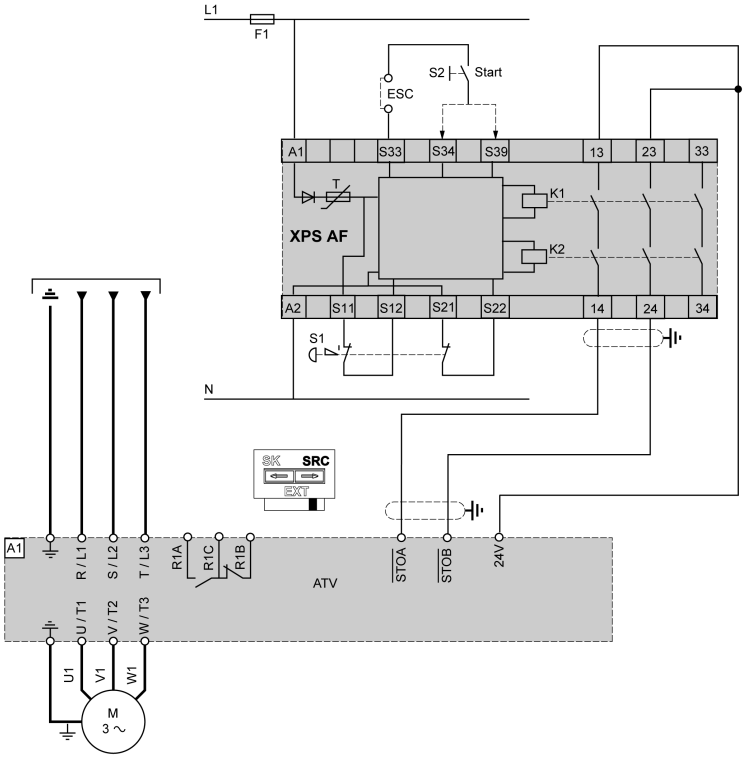
NOTE: The +24VDC power supply must meet the requirements of IEC 61131-2 (PELV standard power supply unit).



Process System SF - Case 2 - Suitable for Altivar Process drives and modular offer

Single Drive with Safety Module Type Preventa XPSAF or Equivalent — Connection Diagram

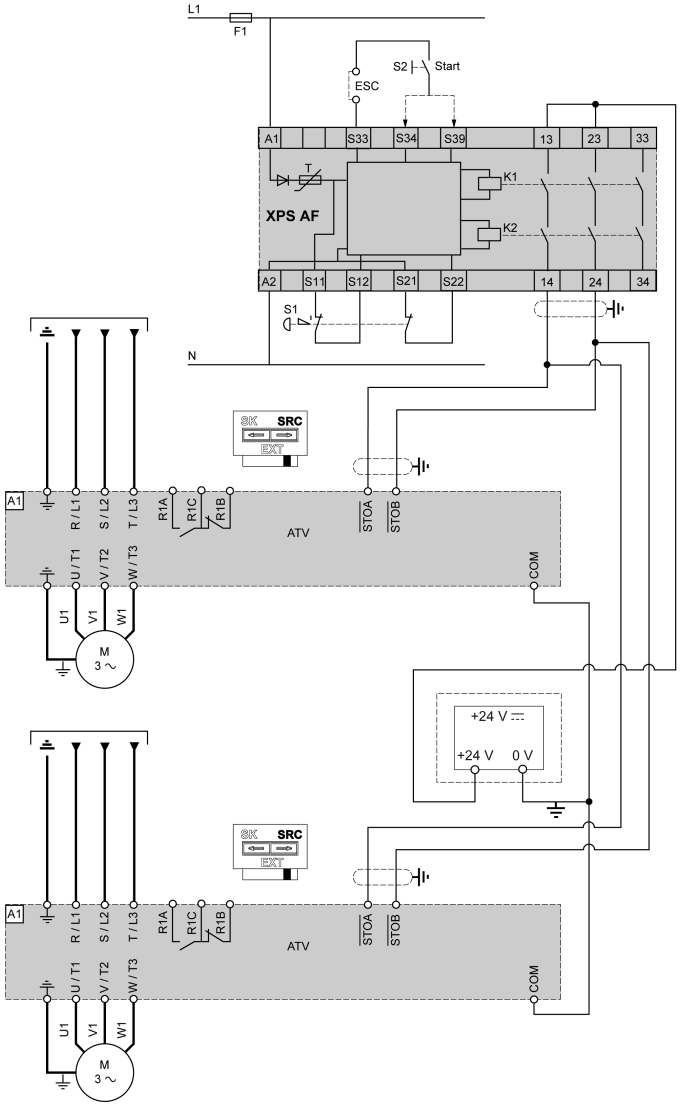
This connection diagram applies for a single drive configuration with the safety module type Preventa XPSAF or equivalent according to ISO 13849-1 category 3 PLe, IEC 62061 and 60204-1 stop category 0.



Multidrive with Safety Module Type Preventa XPSAF or Equivalent — Connection Diagram

This connection diagram applies for a multidrive configuration with the safety module type Preventa XPSAF or equivalent according to ISO 13849-1 category 3 PLe, IEC 62061 and 60204-1 stop category 0.

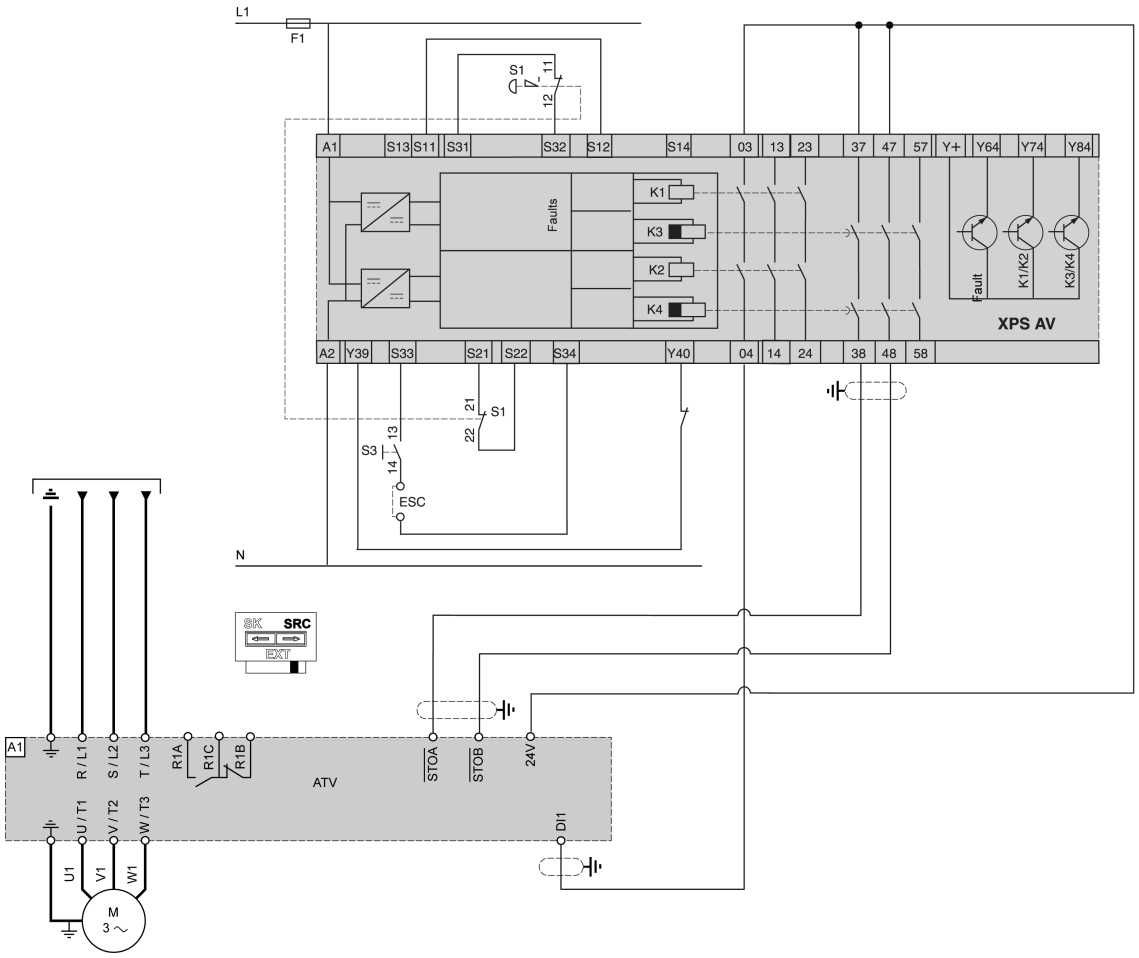
NOTE: The +24 Vdc power supply must meet the requirements of IEC 61131-2 (PELV standard power supply unit).



Process System SF - Case 3 - Suitable for Altivar Process drives and modular offer

Connection Diagram For Single Drive with Safety Module Type Preventa XPSAV or Equivalent

This Connection diagram applies for a single drive configuration with the Safety Module Type Preventa XPSAV or equivalent, according to ISO 13849-1 category 3 PLe and IEC 60204-1 stop category 1.

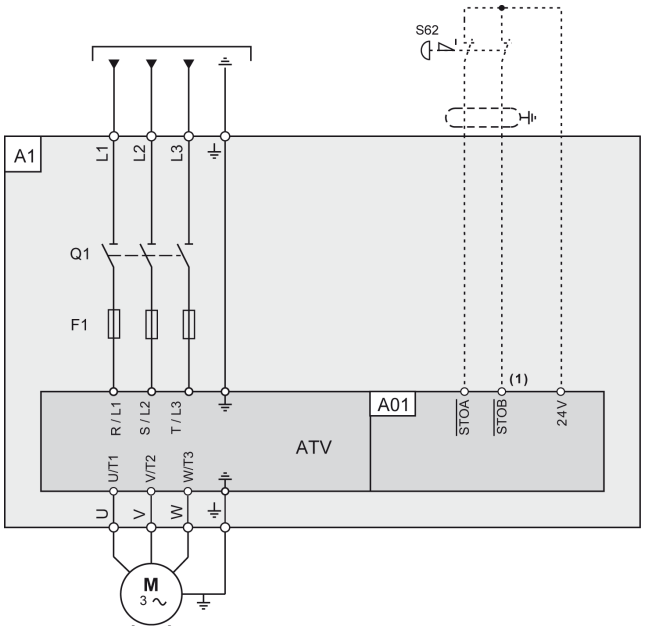


NOTE: This diagram is a wiring configuration using DI1 assigned to forward operation.

Process System SF - Case 4 - Only suitable for drive systems and Modular Liquid Cooled Offer (ATV9L0)

Single Drive Systems Connection Diagram

This connection diagram applies for a single Altivar Process Drive Systems configuration, without options according to IEC 61508 capability SIL3, ISO 13849-1 category 3 PL e, IEC 60204-1 stop category 0 without protection against supply interruption or voltage reduction and subsequent rotation.



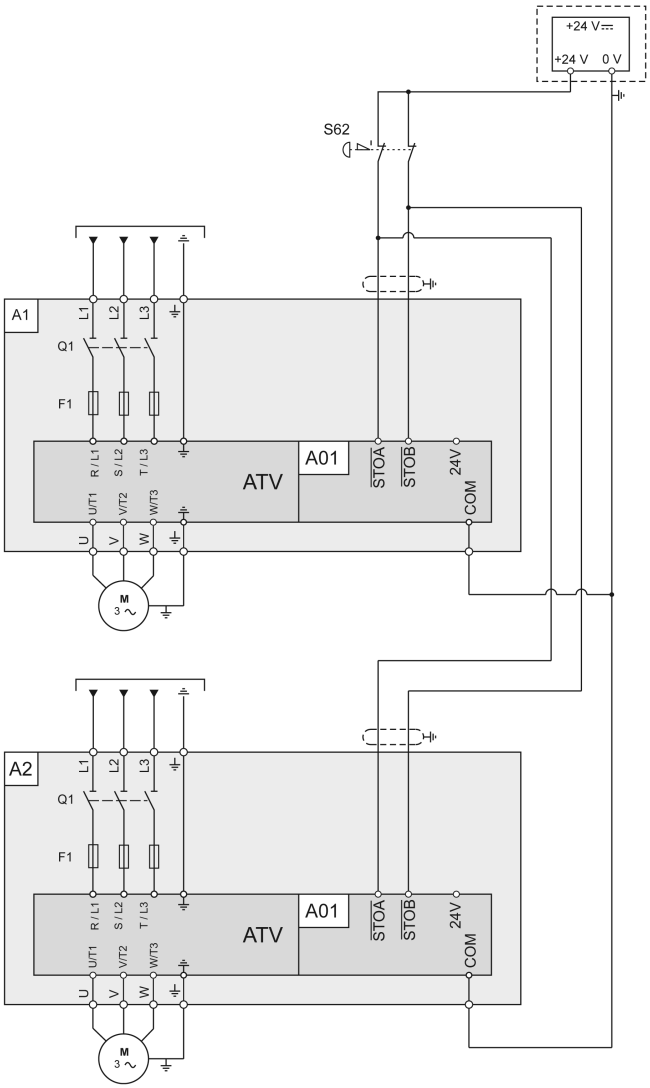
Legend:

- A: Drive Systems enclosure with certified Drive Systems components assembly
  - A01: Control block of the Drive System
- S62: External Emergency Stop button (not included within the certification)
- (1): If S62 external emergency stop is installed, the link between terminals STOA and +24V, and between terminals STOB and +24V has to be removed.

  NOTE: An EMERGENCY STOP is requested. This request leads to a category 0 stop. The power stage is immediately disabled via the inputs $\overline{\text{STOA}}$ and $\overline{\text{STOB}}$ of the safety function STO. Power can no longer be supplied to the motor. If the motor has not yet stopped at this point in time, it coasts down in an uncontrolled way (uncontrolled stop).

Multi drive Drive Systems Connection Diagram

This connection diagram applies for multidrive Altivar Process Drive Systems configuration, without options, according to IEC 61508 capability SIL 3, ISO 13849-1 category 3 PL e, IEC 60204-1 stop category 0 without protection against supply interruption or voltage reduction and subsequent rotation.



Legend:

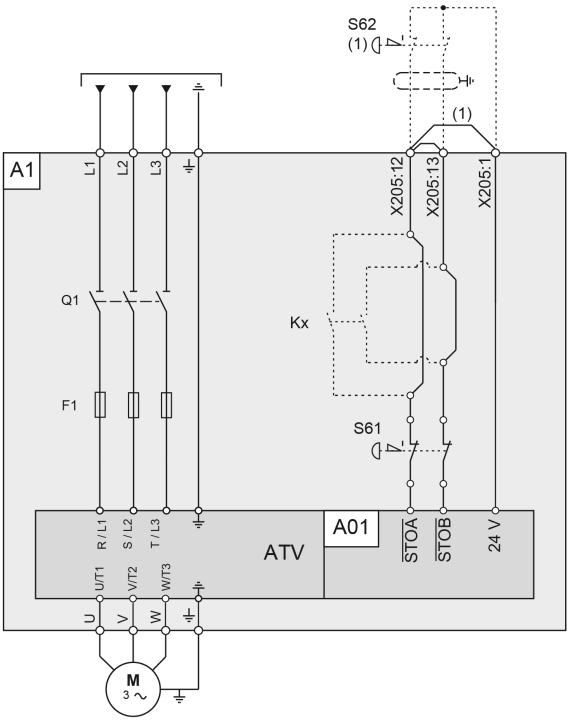
- A1, A2: Drive Systems enclosures with certified Drive Systems components assembly
  - A01: Control block of the Drive System
- S62: External Emergency Stop button (not included within the certification)

  NOTE: An EMERGENCY STOP is requested. This request leads to a category 0 stop. The power stage is immediately disabled via the inputs $\overline{\text{STOA}}$ and $\overline{\text{STOB}}$ of the safety function STO. Power can no longer be supplied to the motor. If the motor has not yet stopped at this point in time, it coasts down in an uncontrolled way (uncontrolled stop).

Process System SF - Case 5 - Only suitable for drive systems and Modular Liquid Cooled Offer (ATV9L0)

Single Drive Systems Connection Diagram with Option Safe Torque Off STO - SIL3 Stop category 0

This connection diagram applies for a single Altivar Process Drive Systems configuration, with option VW3AP1502 (Safe Torque Off STO - SIL 3 Stop Category 0) according to IEC 61508 capability SIL3, ISO 13849-1 category 3 PL e, IEC 60204-1 stop category 0 without protection against supply interruption or voltage reduction and subsequent rotation.



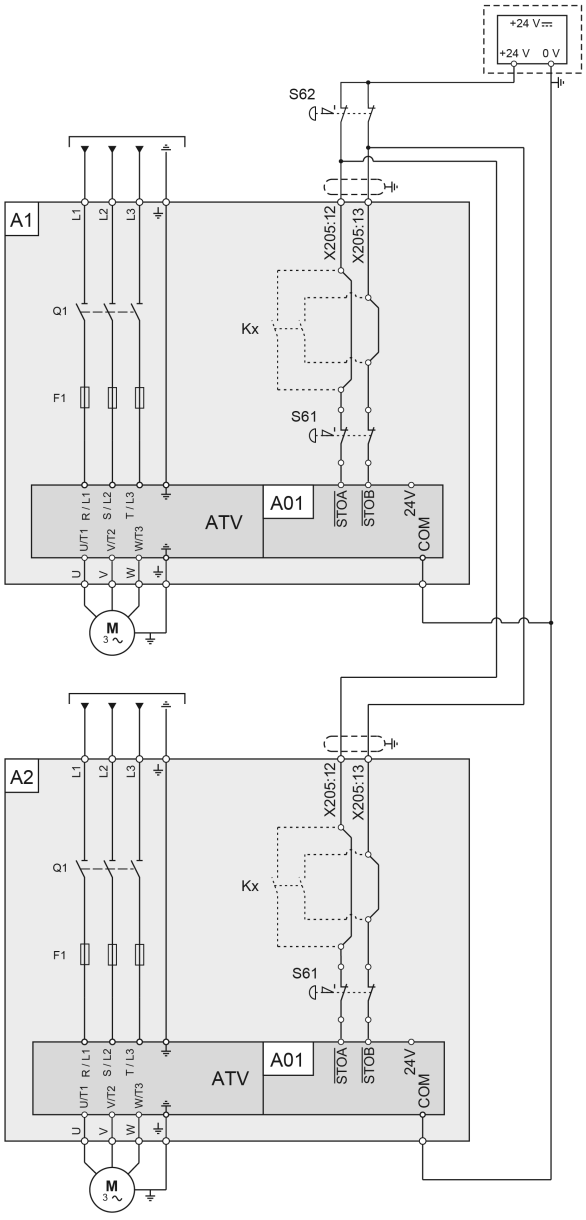
Legend:

- A1: Drive Systems enclosure with certified architecture, with built-in Drive Systems components assembly and with option VW3AP1502.
  - A01: Control block of the Drive System
  - S61: Emergency Stop button mounted in the enclosure door
- S62: External Emergency Stop button (not included within the certification)
- (1): If S62 external emergency stop is installed, the wire link between terminals X205:12 and X205:1, and between terminals X205:12 and X205:13 has to be removed.
- Kx: optional additional contacts within the safety path (not included within the certification). These contacts have to be taken into account separately for the safety path calculation

  NOTE: An EMERGENCY STOP is requested. This request leads to a category 0 stop. The power stage is immediately disabled via the inputs $\overline{\text{STOA}}$ and $\overline{\text{STOB}}$ of the safety function STO. Power can no longer be supplied to the motor. If the motor has not yet stopped at this point in time, it coasts down in an uncontrolled way (uncontrolled stop).

Multi drive Drive Systems Connection Diagram

This connection diagram applies for multidrive Altivar Process Drive Systems configuration, with option VW3AP1502 (Safe Torque Off STO - SIL 3 Stop Category 0) according to IEC 61508 capability SIL 3, ISO 13849-1 category 3 PL e, IEC 60204-1 stop category 0 without protection against supply interruption or voltage reduction and subsequent rotation.



Legend:

- A1: Drive Systems enclosure with certified architecture, with built-in Drive Systems components assembly and with option VW3AP1502.
  - A01: Control block of the Drive System
  - S61: Emergency Stop buttons mounted in the enclosure door
- S62: External Emergency Stop button (not included within the certification)
- Kx: optional additional contacts within the safety path (not included within the certification). These contacts have to be taken into account separately for the safety path calculation.

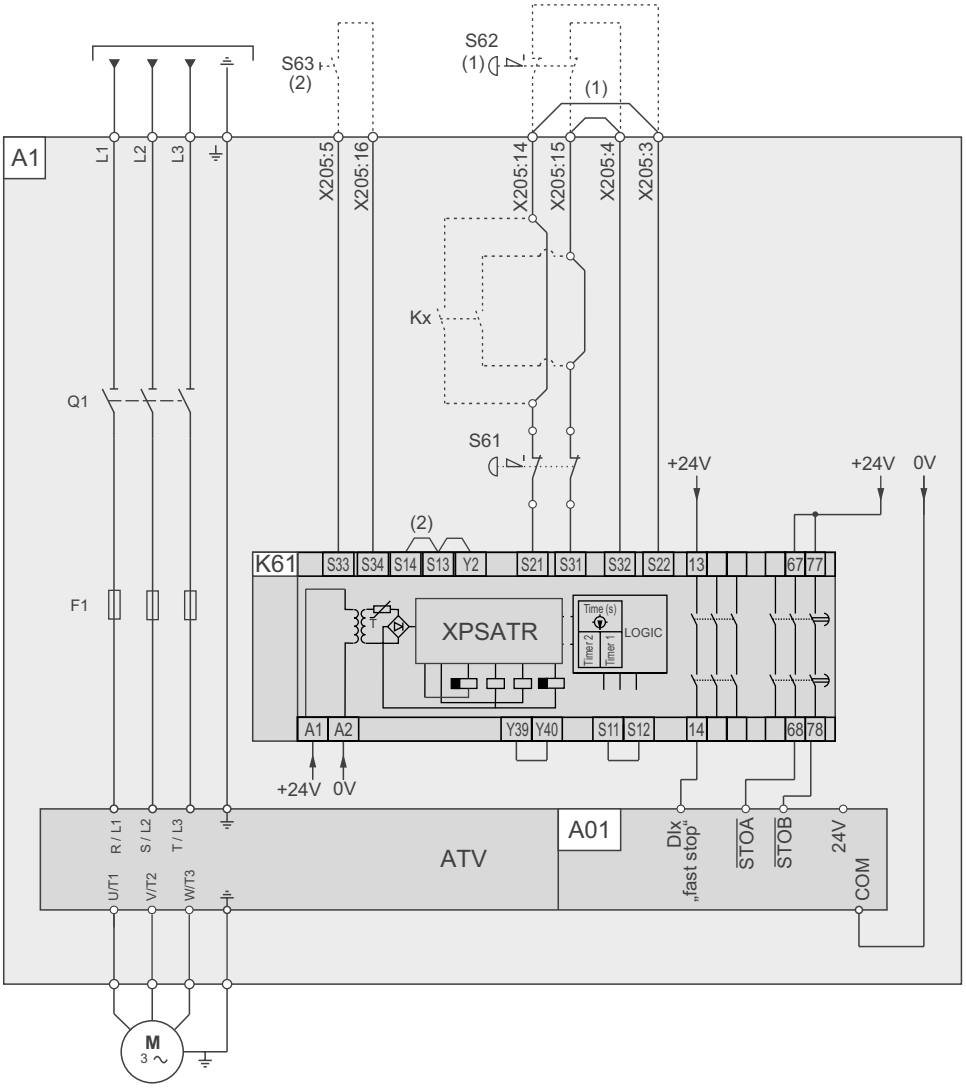
  NOTE: An EMERGENCY STOP is requested. This request leads to a category 0 stop. The power stage is immediately disabled via the inputs $\overline{\text{STOA}}$ and $\overline{\text{STOB}}$ of the safety function STO. Power can no longer be supplied to the motor. If the motor has not yet stopped at this point in time, it coasts down in an uncontrolled way (uncontrolled stop).

Process System SF - Case 6 - Only suitable for drive systems and Modular Liquid Cooled Offer (ATV9L0)

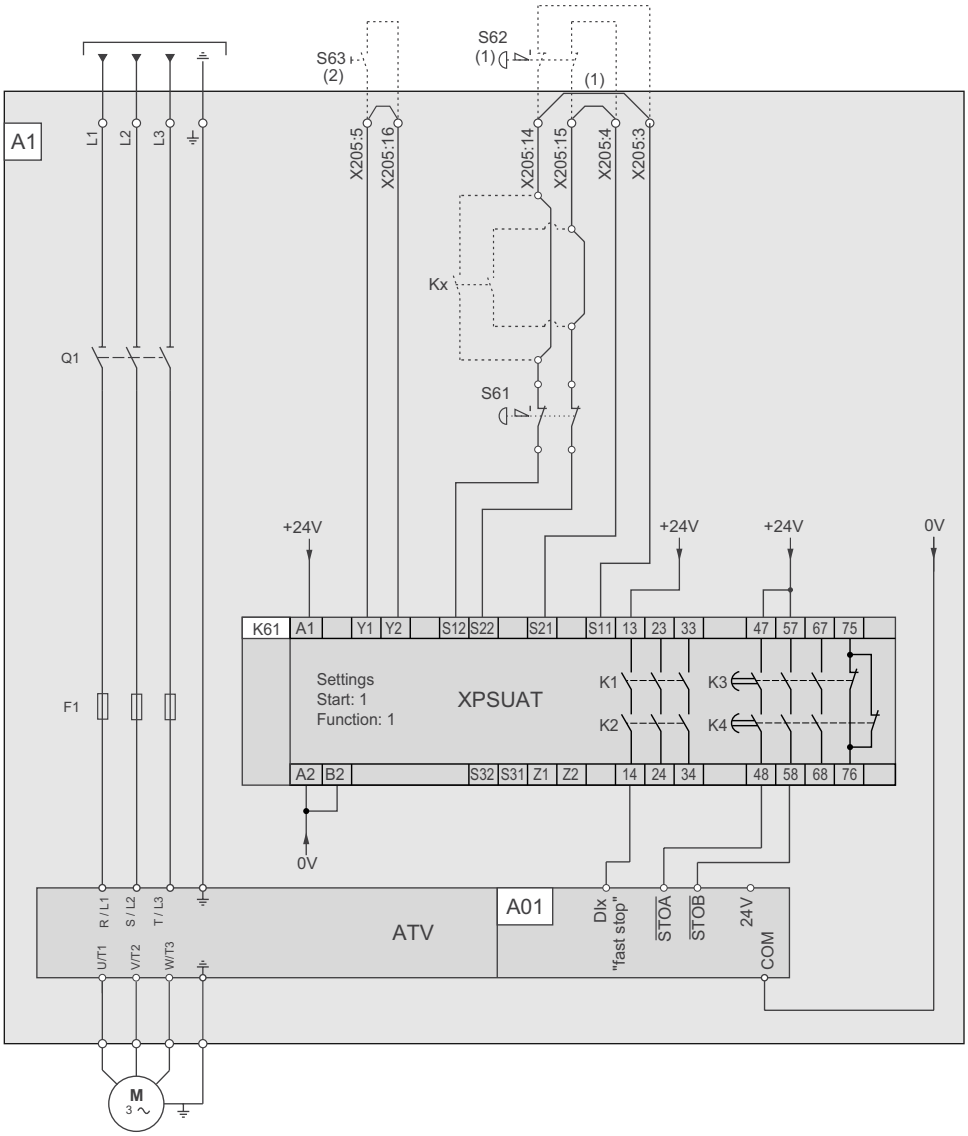
Single Drive Systems Connection Diagram with Option Safe Torque Off STO - SIL3 Stop category 1

This connection diagram applies for a single Altivar Process Drive Systems configuration, with option VW3AP1503 (Safe Torque Off STO - SIL 3 Stop Category 1) according to IEC 61508 capability SIL 3, ISO 13849-1 category 3 PL e, IEC 60204-1 stop category 1.

Circuit diagram with XPSATR module



Circuit diagram with XPSUAT module



Legend:

- A1: Drive Systems enclosure with certified architecture, with built-in Drive Systems components assembly and with option VW3AP1503.
  - A01: Control block of the Drive System
  - K61: Safety relay for monitoring the Emergency Stop circuit: Preventa XPSATR or XPSUAT safety module or equivalent
  - S61: Emergency Stop buttons mounted in the enclosure door
  - DIx: Internal I/O set to “fast stop”
- S62: External Emergency Stop button (not included within the certification)
- (1): If S62 external emergency stop is installed, the wire link between terminals X205:14 and X205:3, and between terminals X205:15 and X205:4 has to be removed.
- Kx: optional additional contacts within the safety path (not included within the certification). These contacts have to be taken into account separately for the safety path calculation.
- S63: Manual reset button
- (2): If a manual reset button is installed the wire link between the terminals S13/S14 on the safety relay has to be removed.

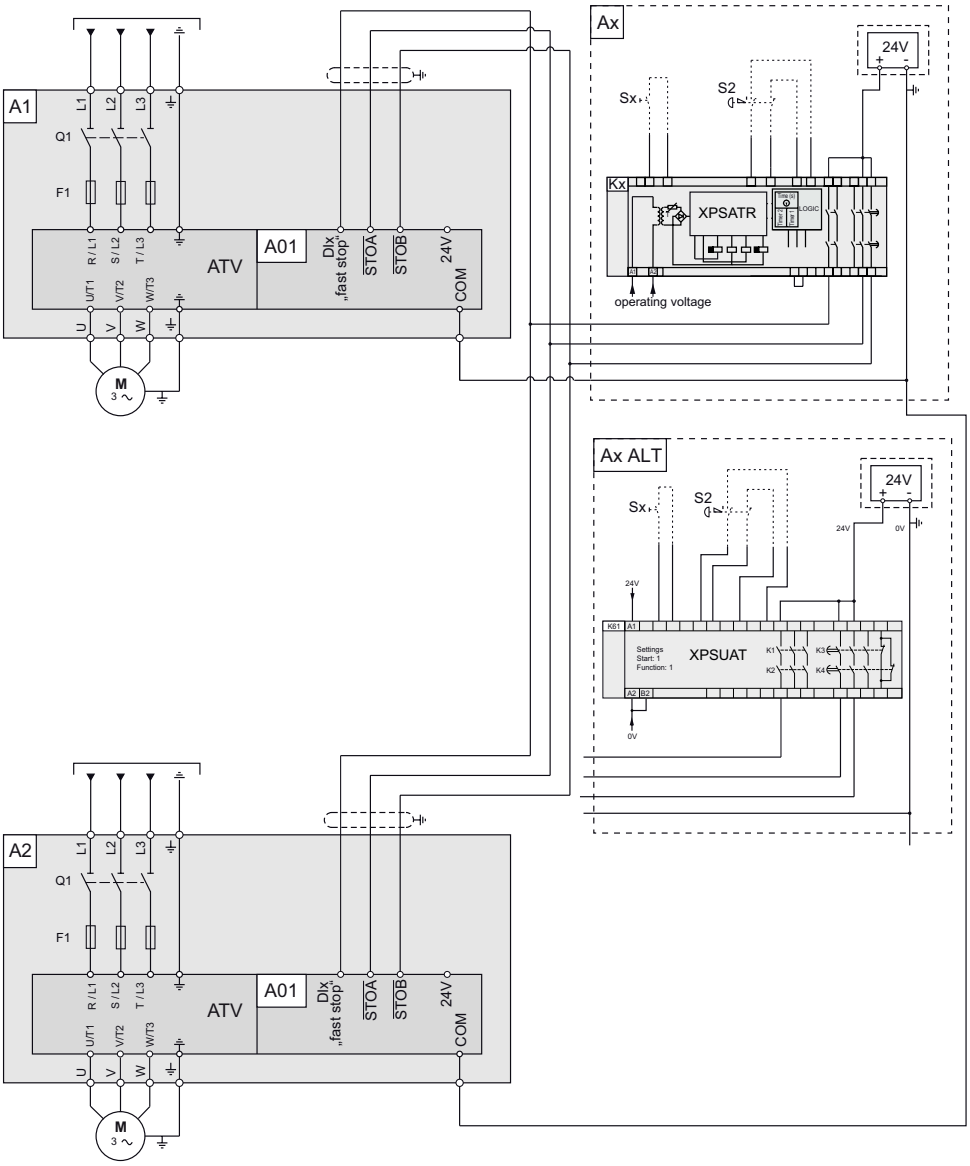
Example

An Emergency Stop is requested. This request leads to a stop category 1:

- The function "fast stop" is immediately started (undelayed) via the digital input DIx (single-channel, not monitored). Any active movement is decelerated via the adjusted ramp.
- The power stage is disabled via the inputs STO_A and STO_B of the safety STO function after the delay time set in the Emergency Stop Safety Module has elapsed. Power can no longer be supplied to the motor. If the motor has not stopped yet when the delay time has elapsed, it coasts down in an uncontrolled way (uncontrolled stop).

Multidrive Drive Systems Connection diagram with Safety Module

This connection diagram applies for a multidrive Altivar Process Drive Systems configuration with a safety module stop category 1.



Legend:

- A1, A2: Drive Systems enclosure without options (certified - see case 4), with certified Drive Systems components assembly.
  - A01: Control block of the Drive System

- Ax: External functional safety path (not included within the certification) with following components:
  - S2: External Emergency Stop button
  - Kx: Safety module XPSATR or equivalent
  - Sx: Manual reset button
- Ax ALT: External functional safety path (not included within the certification) with following components:
  - S2: External Emergency Stop button
  - K61: Safety module XPSUAT or equivalent
  - Sx: Manual reset button

Example

An Emergency Stop is requested if an Emergency Stop Safety Module, with stop category 1 is used. This request leads to a stop category 1.

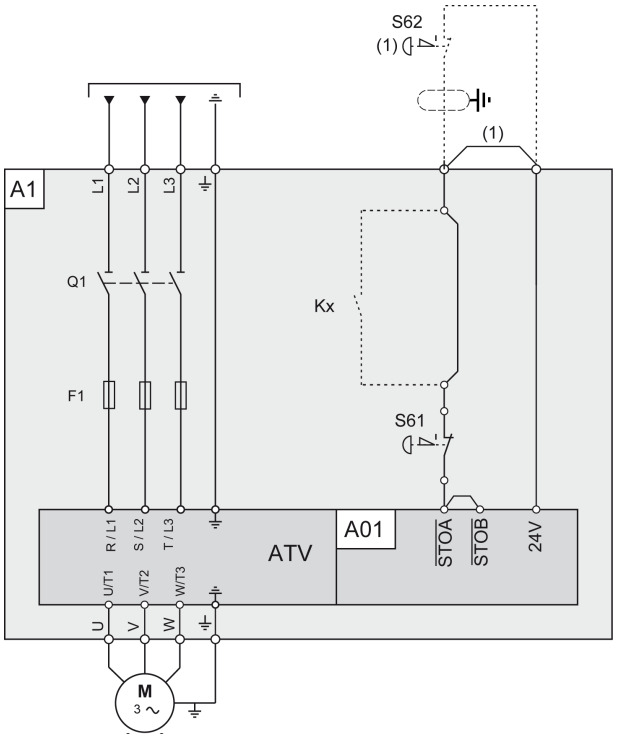
- The function "fast stop" is immediately started (undelayed) via the digital input DIx (single-channel, not monitored). Any active movement is decelerated via the adjusted ramp.
- The power stage is disabled via the inputs STO_A and STO_B of the safety STO function after the delay time set in the Emergency Stop Safety Module has elapsed. Power can no longer be supplied to the motor. If the motor has not stopped yet when the delay time has elapsed, it coasts down in an uncontrolled way (uncontrolled stop).

  NOTE: The specified minimum current and the permissible maximum current of the relay outputs of the Emergency Stop Safety Module must be observed.

Process System SF - Case 7 - Only suitable for drive systems and Modular Liquid Cooled Offer (ATV9L0)

Single Drive Systems Connection Diagram for STO Single (SIL1)

This connection diagram applies for a single Altivar Process Drive Systems configuration. The connection diagram applies according to IEC 61508 capability SIL 1, ISO 13849-1 category 1 PL c, IEC 60204-1 stop category 0 without protection against supply interruption or voltage reduction and subsequent rotation.



Legend:

- A1: Drive Systems enclosure with certified architecture for STO Single (SIL1) with built-in Drive Systems components assembly.
  - A01: Control block of the Drive System
  - S61: Emergency Stop button mounted in the enclosure door
- S62: External Emergency Stop button (not included within the certification)
- Kx: Optional additional contacts within the safety path (not included within the certification) These contacts have to be taken into account separately for the safety path calculation.
- (1): If S62 external emergency stop is installed, the wire link has to be removed.

Glossary

A

AC:

Alternating Current

AFE :

Active Front End

APM :

Altivar Process Modular

D

DC:

Direct Current

E

ELV:

Extra-Low Voltage. For more information: IEC 60449

Error :

Discrepancy between a detected (computed, measured, or signaled) value or condition and the specified or theoretically correct value or condition.

F

Factory setting:

Factory settings when the product is shipped

Fault Reset:

A function used to restore the drive to an operational state after a detected error is cleared by removing the cause of the error so that the error is no longer active.

Fault:

Fault is an operating state. If the monitoring functions detect an error, a transition to this operating state is triggered, depending on the error class. A "Fault reset" is required to exit this operating state after the cause of the detected error has been removed. Further information can be found in the pertinent standards such as IEC 61800-7, ODVA Common Industrial Protocol (CIP).

G

GP:

General-Purpose

H

HHP:

High Horse Power (75 kW...800 kW)

HiPot test:

High Potential Test.

L

L/R:

Time constant equal to the quotient of inductance value (L) over the resistance value (R).

LHP:

Low Horse Power (< 15 kW)

M

MHP:

Medium Horse Power (15 kW...75 kW)

N

NC contact:

Normally Closed contact

NO contact:

Normally Open contact

O

OEM:

Original Equipment Manufacturer

OVCII:

Overvoltage Category II, according IEC 61800-5-1

P

PA/+:

DC bus terminal

PC/-:

DC bus terminal

PELV:

Protective Extra Low Voltage, low voltage with isolation. For more information: IEC 60364-4-41.

PLC:

Programmable logic controller.

Power stage:

The power stage controls the motor. The power stage generates current for controlling the motor.

PRM:

Partner Relationship Management

PTC:

Positive Temperature Coefficient. PTC thermistor probes integrated in the motor to measure its temperature

PVZ:

.PVZ is a Creo View Express™ software file format used to display the integration sequences to build Altivar Process Modular drives

R

REACh:

Registration, Evaluation, Authorisation and restriction of Chemicals regulation

RoHS:

Restriction of Hazardous Substances

S

SCPD:

Short-Circuit Protective Device

STD:

Standard

STO:

Safe Torque Off: No power that could cause torque or force is supplied to the motor

T

TVS Diode:

Transient Voltage Suppression Diode

V

VHP:

Very High Horse Power (> 800 kW)

W

Warning:

If the term is used outside the context of safety instructions, a warning alerts to a potential error that was detected by a monitoring function. A warning does not cause a transition of the operating state.

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As standards, specifications, and design change from time to time, please ask for confirmation of the information given in this publication.

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