ATEX Guide

TOSVERT VF-AS3J

Toshiba Industrial Products and Systems Corporation

Note

- 1. Read this manual carefully before using the inverter. After reading, the user should keep this manual at hand to use it for maintenance and inspection in the future.
- 2. Please be informed that the contents of this document may be changed without notice.

Contents

Important information	1
I. Safety Information	
II. About the book	
Functional Safety and ATEX applications	8
1.1 General	8
2. Applications for explosive atmosphere (ATEX)	g
2.1 Classification of ATEX Zones	g
2.2 General	g
2.3 Identification of the ATEX marking	10
3. Schemes of cabling for ATEX applications	11
3.1 General	11
3.2 ATEX periodic test	11
3.3 Scheme for ATEX installation No.1	12
3.4 Scheme for ATEX installation No.2	13
3.5 Scheme for ATEX installation No.3	14
3.6 Scheme for ATEX installation No.4	15

Important information

The information provided in this documentation contains general descriptions and/or technical characteristics of the performance of the products contained herein. This documentation is not intended as a substitute for and is not to be used for determining suitability or reliability of these products for specific user applications. It is the duty of any such user or integrator to perform the appropriate and complete risk analysis, evaluation and testing of the products with respect to the relevant specific application or use thereof. Neither Manufacture nor any of sales or distributors shall be responsible or liable for misuse of the information contained herein. If you have any suggestions for improvements or amendments or have found errors in this publication, please notify us.

No part of this document may be reproduced in any form or by any means, electronic or mechanical, including photocopying, without express written permission.

All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components. When devices are used for applications with technical safety requirements, the relevant instructions must be followed.

Failure to use Toshiba software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

I. Safety Information

Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, 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.

A DANGER

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

A 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 Toshiba 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 a drive for three-phase synchronous and asynchronous motors and intended for industrial use according to this manual. The product may only be used in compliance with all applicable safety regulations and directives, the specified requirements and the technical data. 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. Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel.

Product Related Information

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

A A DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Only appropriately trained persons who are familiar with and understand the contents of this manual and all other pertinent product documentation and who have received safety 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.
- The system integrator is responsible for compliance with all local and national electrical code requirements as well as all other applicable regulations with respect to grounding of all equipment.
- Many components of the product, including the printed circuit boards, operate with mains voltage. Do not touch. Use only electrically insulated tools.
- Do not touch unshielded components or terminals with voltage present.
- Motors can generate voltage when the shaft is rotated. Prior to performing any type of work on the drive system, block the motor shaft to prevent rotation.
- AC voltage can couple voltage to unused conductors in the motor cable. 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.
- Before performing work on the drive system:
 - Disconnect all power, including external control power that may be present.
 - Place a **Do Not Turn On** label on all power switches.
 - Lock all power switches in the open position.
 - Wait 15 minutes to allow the DC bus capacitors to discharge. The DC bus LED is not an indicator of the absence of DC bus voltage that can exceed 800 Vdc.
 - Measure the voltage on the DC bus between the DC bus terminals (PA/+, PC/-) using a properly rated voltmeter to verify that the voltage is <42 Vdc.
 - If the DC bus capacitors do not discharge properly, contact your Toshiba distributor. Do not repair or operate the product.
- Install and close all covers before applying voltage.

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

M WARNING

UNEXPECTED MOVEMENT

Drive systems may perform unexpected movements because of incorrect wiring, incorrect settings, incorrect data or other errors.

- 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.

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

A A 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 Toshiba sales office if you detect any damage whatsoever.

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.

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.

The metal surfaces of the product may exceed 100 °C (212 °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 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.

II. About the book

At a Glance

Document Scope

The purpose of this document is to provide information about the safety function incorporated in VF-AS3J drive.

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

The STO safety function is an ATEX certified function, according to 2014/34/EU directive.

Validity Note

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

This documentation is valid for the VF-AS3J drives described in the Installation manual.

Related Documents

Title of Documentation	Reference Number
VF-AS3J Instruction manual (Standard model)	E6582247 (Japanese)
, , , , , , , , , , , , , , , , , , ,	E6582248 (English)



1. Functional Safety and ATEX applications

1.1 General

The variable speed drive TOSVERT VF-AS3J integrates the STO (Safe Torque Off) safety function which shuts off the motor torque safely. The use of the STO safety function allows the drive to be installed as a part of the safety-related electrical, electronic and programmable electronic control systems, dedicated to the safety of a machine or an industrial process.

The integrated safety function is compatible and certified following the information given in the Certification for Functional Safety section (see below). It complies also with the EN 50495 (2010): Safety devices required for the safe functioning of equipment with respect to explosion risks.

The use of the STO safety function is required for the variable speed drive TOSVERT VF-AS3J to control and command motors installed in explosive atmospheres (ATEX).

The STO safety function is an ATEX certified function, according to 2014/34/EU directive.

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.

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, IEC 60204-1, IEC 62061 and ISO 13849-1 & ISO 13849-2 for process-systems and machinery.

The defined safety function is

- SIL 2 capability in compliance with IEC 61800-5-2 and IEC 61508 series
- Performance Level PL d in compliance with ISO 13849-1
- · Category 3 in compliance with ISO 13849-1

Also refer to Safety function capability.

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

Monitoring Of the ATEX Motor:

The STO input is connected to the switching system which is embedded in the thermal sensor of the ATEX motor (or connected to the switching system of the control system if ATEX sensors of PTC type are used).

The variable speed drive TOSVERT VF-AS3J intended to be used to command and control asynchronous motors shall be installed only outside potentially explosive atmospheres for the protection of explosion-protected motors.



2. Applications for explosive atmosphere (ATEX)

2.1 Classification of ATEX Zones

The European directive 1999/92/EC (also called ATEX 137, or directive for protection of workers) classifies the ATEX zones and the type of products that they are compatible with. The user should define the ATEX zone in which the ATEX motor will be installed.

The variable speed drives TOSVERT VF-AS3J must always be installed in a safe area, outside the hazardous ATEX zone. Different wiring diagrams for installation are suggested in this document. They are compatible for the use of motors in ATEX zones 1/21 or 2/22. The table below summarises characteristics related to each ATEX zone.

The table below summarizes characteristics related to each ATEX zone

Atmosphere	Atmosphere Zone	Definition	Presence of explosive atmosphere per year
Gas	0	Explosive atmosphere is present continuously, for long	> 1000 h
Dust	20	periods or frequently due to malfunctions	
Gas	1	Explosive atmosphere is likely to occur due to expected	101000 h
Dust	21	malfunctions	101000 11
Gas	2	Explosive atmosphere is unlikely to occur or, if	
Dust	22	occurring, is likely to only be of short duration and not in normal duty	< 10 h

NOTE: Neither electrical equipment nor motors can be installed in ATEX zone 0 or 20.

2.2 General

The European directive 2014/34/EU (also called ATEX 95, or product directive) defines applicable requirements for ATEX products and requirements for procedure of certification.

OEMs, installers, users are responsible for the choice and the commissioning of the products they use in order to realize the ATEX protection of systems that they design or systems that they implement.

- The motor needs to be ATEX certified EX "d" and compatible for use in zone 1/21 or 2/22.
- The motor shall be equipped with thermal sensor(s) with embedded switching system ATEX certified, or shall be equipped with thermal sensor(s) ATEX certified, associated to a control unit (Level of protection intrinsic safety "i"), which is to be also ATEX certified.

NOTE: Usually, the control unit is designed to be used outside the hazardous ATEX zone. Then it is possible to install the control unit near the variable speed drive, in the safe area.

The switching system, embedded into the thermal sensor, or included into the control unit of the thermal protection of the ATEX motor, shall be connected to the STO input of the variable speed drive TOSVERT VF-AS3J. When the excessive temperature of the ATEX motor is reached, the control system triggers the STO safety function. The electrical power of the motor is removed to help to ensure a temperature of the motor frame below the maximum temperature depending on the gas or the dust atmosphere in which the ATEX motor is installed.

When the ATEX application needs to apply the STO safety function, and prevent automatic restart, then a safety module (type Preventa) is to be used. The suggested wiring diagrams describe how the switching system, embedded into the thermal sensor or included into the control unit, is connected to the safety module. The output of the safety module must be connected to the STO input of the variable speed drive TOSVERT VF-AS3J.

2.3 Identification of the ATEX marking

The variable speed drive TOSVERT VF-AS3J, ATEX certified, can be recognised by the specific marking reproduced hereafter:





is the logo related to the identification of an ATEX product

is related to the use of products for ATEX application in surface industries. (ATEX applications for mines industries are prohibit)

- (2) Parenthesis identify the variable speed drive VF-AS3J as a product associated with the control & command of an ATEX motor installed into a hazardous zone. The number 2 identifies the ATEX motor as a product of category 2 for use into ATEX zones 1 or 21. Motors of category 3 for use into ATEX zones 2 or 22 are also covered by this marking.
- **G** for Gas, is related to ATEX applications into atmospheres with explosive gas.
- **D** for Dust, is related to ATEX applications into atmospheres with a mixture of explosive dust.



3. Schemes of cabling for ATEX applications

3.1 General

Requirements:

Requirements provided by the ATEX standards for installation should be fulfilled. Also follow the requirements below:

- IEC 60079-14 Electrical installations design, selection and erection, for applications in atmospheres with explosive gas,
- local regulation, cabling rules for applications in atmospheres with presence of gas or dust.

Wiring Diagrams Presentation:

Schemes suggested in this document for installation and commissioning of variable speed drives TOSVERT VF-AS3J for ATEX applications are based on thermal sensors (for example a PTC sensor) embedded in the ATEX motor and an intrinsic safety "i" control unit. The control unit is a device which converts in a switching function the variation of the characteristic of a thermal sensor.

If the ATEX motor, installed into a hazardous zone 1 or 21, includes at least two thermal detector without any embedded switching system (for example a PTC sensor), then these two thermal detector shall be connected to a control unit (as defined in 3.1.15 of the IEC/EN 60947-8 standard). The control unit is a device which converts into a switching function the variation of the characteristic of thermal detectors. See Scheme for ATEX installation No.1 page 12 and Scheme for ATEX installation No.2 page 13.

If the ATEX motor, installed into a hazardous zone 2 or 22, includes at least one thermal detector without any embedded switching system (for example a PTC sensor), then this one thermal detector shall be connected to a control unit (as defined in 3.1.15 of the IEC/EN 60947-8 standard). The control unit is a device which converts into a switching function the variation of the characteristic of a thermal detector. See Scheme for ATEX installation No.3 page 14 and Scheme for ATEX installation No.4 page 15.

Shielded Cables on I/O:

WARNING



To prevent from unexpected equipment operation

- Use shielded cables for all digital and analog I/O and communication signals.
- Ground cable shields at a single point.
- Route communication and I/O cables separately from power cables.

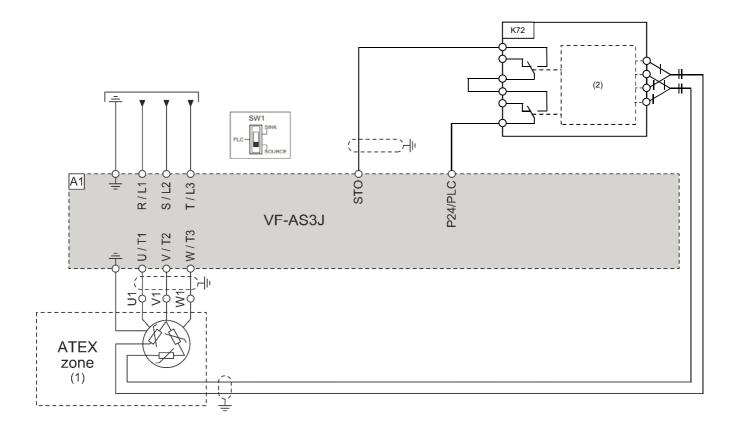
If you do not follow these instructions can result in death, serious injury, or equipment damage.

3.2 ATEX periodic test

The complete functional safety loop (which starts from the ATEX motor thermal sensor up to the STO safety function embedded in the drive), shall be activated at least once a year for preventive maintenance purposes, in order to check that the electrical power is always automatically removed from the motor in case of excessive temperature.

3.3 Scheme for ATEX installation No.1

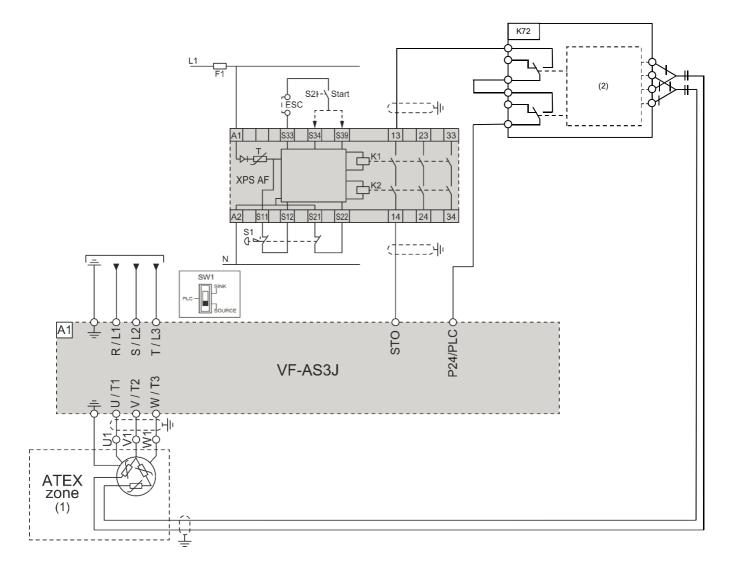
- Single drive with PTC and control unit
 - ATEX motor in Zone 1 or 21
 - STO inputs used for protection of the ATEX motor sensor only, SIL2 capability according to IEC 61508.
 - Thermal protection of the ATEX motor by using an ATEX thermal sensor (PTC type, without embedded switching system), and a control unit for the PTC conversion, including the switching system.



- (1) ATEX Zone 1 or 21 with at least 2 thermal sensors PTC type
- (2) ATEX certified Control unit conversion / insulation / switching system with Level of protection intrinsic safety "i". (K72) ATEX certified PTC relay

3.4 Scheme for ATEX installation No.2

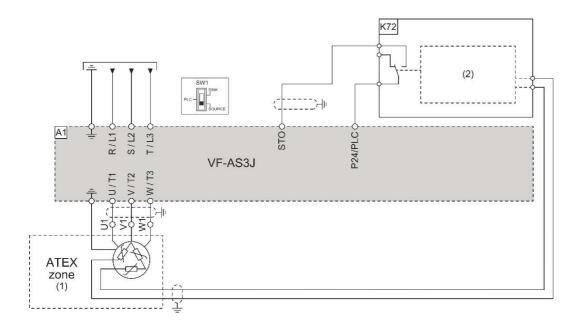
- Single drive with PTC and control unit and with Safety Module Type Preventa XPS-AF
 - ATEX motor in Zone 1 or 21
 - STO input used for protection of the ATEX motor, SIL 2 capability according to IEC 61508.
 - Thermal protection of the ATEX motor by using an ATEX thermal sensor (PTC type, without embedded switching system), and a control unit for the PTC conversion, including the switching system



- (1) ATEX Zone 1 or 21 with at least 2 thermal sensors PTC type
- (2) ATEX certified Control unit conversion / insulation / switching system with Level of protection intrinsic safety "i". (K72) ATEX certified PTC relay

3.5 Scheme for ATEX installation No.3

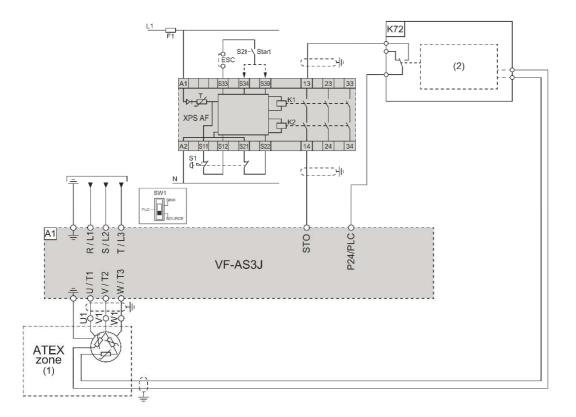
- Single drive with PTC and control unit
 - ATEX motor in Zone 2 or 22
 - STO inputs used for protection of the ATEX motor sensor only, SIL2 capability according to IEC 61508.
 - Thermal protection of the ATEX motor by using an ATEX thermal sensor (PTC type, without embedded switching system), and a control unit for the PTC conversion, including the switching system.



- (1) ATEX Zone 2 or 22 with at least 1 thermal sensor PTC type
- (2) ATEX certified Control unit conversion / insulation / switching system with Level of protection intrinsic safety "i". (K72) ATEX certified PTC relay

3.6 Scheme for ATEX installation No.4

- Single drive with PTC and control unit and with Safety Module Type Preventa XPS-AF
 - ATEX motor in Zone 2 or 22
 - STO input used for protection of the ATEX motor, SIL 2 capability according to IEC 61508.
 - Thermal protection of the ATEX motor by using an ATEX thermal sensor (PTC type, without embedded switching system), and a control unit for the PTC conversion, including the switching system



- (1) ATEX Zone 2 or 22 with at least 1 thermal sensor PTC type
- (2) ATEX certified Control unit conversion / insulation / switching system with Level of protection intrinsic safety "i". (K72) ATEX certified PTC relay