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TOSHIBA

# TOSVERT VF-AS3

## ATEX Guide

ATEX applications in explosive gas atmosphere
or in the presence of combustible dust

TOSHIBA INDUSTRIAL PRODUCTS AND SYSTEMS CORPORATION

NOTICE

1. Read this manual before installing or operating the inverter. Keep it in a safe place for reference.
2. Original instructions and information given in this manual have been written in English (before optional translation).
3. All information contained in this manual will be changed without notice.

# Contents

# 1. Functional Safety and ATEX applications

## 1.1 General

The variable speed drive TOSVERT VF-AS3 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-AS3 to control and command motors installed in explosive atmospheres (ATEX).
The STO safety function is an ATEX certified function, according ATEX 94/9/EC directive and forthcoming 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 3 capability in compliance with IEC 61800-5-2 and IEC 61508 series
- Performance Level PL e 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(s) is (are) 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-AS3 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.

TOSVERT VF-AS3 listed on table 1 integrates the “Safe Torque Off” function.

Table 1

| Input voltage class | Inverter type |
|---|---|
| 3-phase 200V to 240V (IP20) | VFAS3-2004P |
| | VFAS3-2007P |
| | VFAS3-2015P |
| | VFAS3-2022P |
| | VFAS3-2037P |
| | VFAS3-2055P |
| | VFAS3-2075P |
| | VFAS3-2110P |
| | VFAS3-2150P |
| | VFAS3-2185P |
| | VFAS3-2220P |
| | VFAS3-2300P |
| | VFAS3-2370P |
| 3-phase 200V to 240V (IP00) | VFAS3-2450P |
| | VFAS3-2550P |
| 3-phase 380V to 480V (IP20) | VFAS3-4004PC |
| | VFAS3-4007PC |
| | VFAS3-4015PC |
| | VFAS3-4022PC |
| | VFAS3-4037PC |
| | VFAS3-4055PC |
| | VFAS3-4075PC |
| | VFAS3-4110PC |
| | VFAS3-4150PC |
| | VFAS3-4185PC |
| | VFAS3-4220PC |
| | VFAS3-4300PC |
| | VFAS3-4370PC |
| | VFAS3-4450PC |
| | VFAS3-4550PC |
| | VFAS3-4750PC |

| Input voltage class | Inverter type |
|---|---|
| 3-phase 380V to 480V (IP00) | VFAS3-4900PC |
| | VFAS3-4110KPC |
| | VFAS3-4132KPC |
| | VFAS3-4160KPC |
| | VFAS3-4200KPC |
| | VFAS3-4220KPC |
| | VFAS3-4280KPC |
| 3-phase 380V to 480V (IP55) | VFAS3-4004PCE* |
| | VFAS3-4007PCE* |
| | VFAS3-4015PCE* |
| | VFAS3-4022PCE* |
| | VFAS3-4037PCE* |
| | VFAS3-4055PCE* |
| | VFAS3-4075PCE* |
| | VFAS3-4110PCE* |
| | VFAS3-4150PCE* |
| | VFAS3-4185PCE* |
| | VFAS3-4220PCE* |
| | VFAS3-4300PCE* |
| | VFAS3-4370PCE |
| | VFAS3-4450PCE |
| | VFAS3-4550PCE |
| | VFAS3-4750PCE |

* Any combination of letters and numbers.

# 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-AS3 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 with the use of motors in ATEX zones 2/22.

The table below summarizes characteristics related to each ATEX zone

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

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

## 2.2 General

The European directive 94/9/EC and forthcoming 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 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-AS3. 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-AS3.

## 2.3 Identification of the ATEX marking

The variable speed drive TOSVERT VF-AS3, ATEX certified, can be recognised by the specific marking reproduced hereafter:


is the logo related to the identification of an ATEX product

**II** 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-AS3 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-AS3 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.

**Shielded Cables on I/O:**

**⚠ WARNING**

Mandatory action

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.

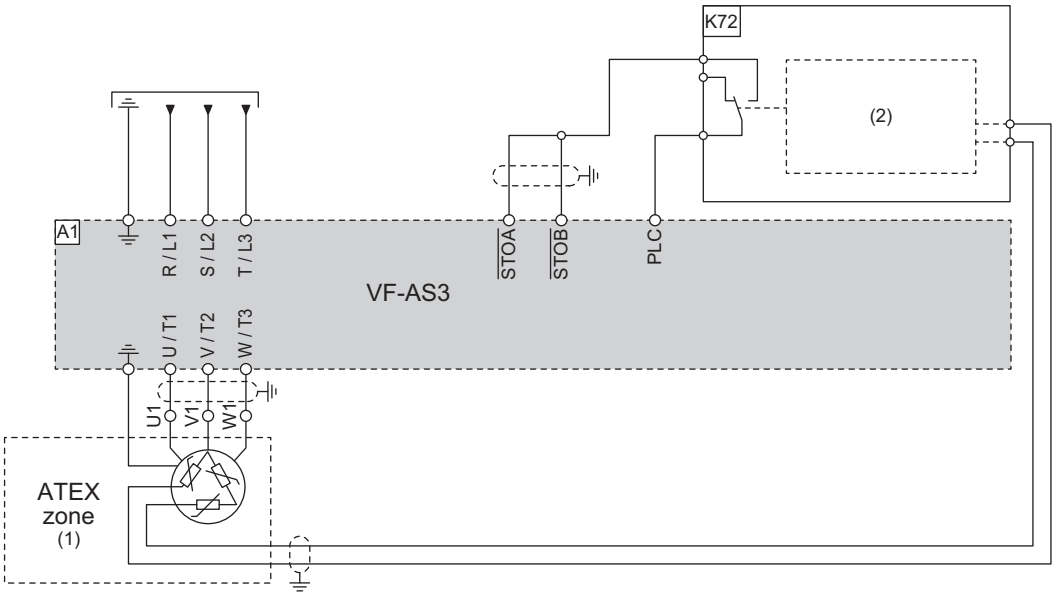
## 3.2 ATEX periodic test

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 2 or 22
- STO inputs used for protection of the ATEX motor sensor only, SIL1 capability according to IEC 61508, stop category 0 according to IEC 60204-1 without protection against supply interruption or voltage reduction and subsequent rotation.
- 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.

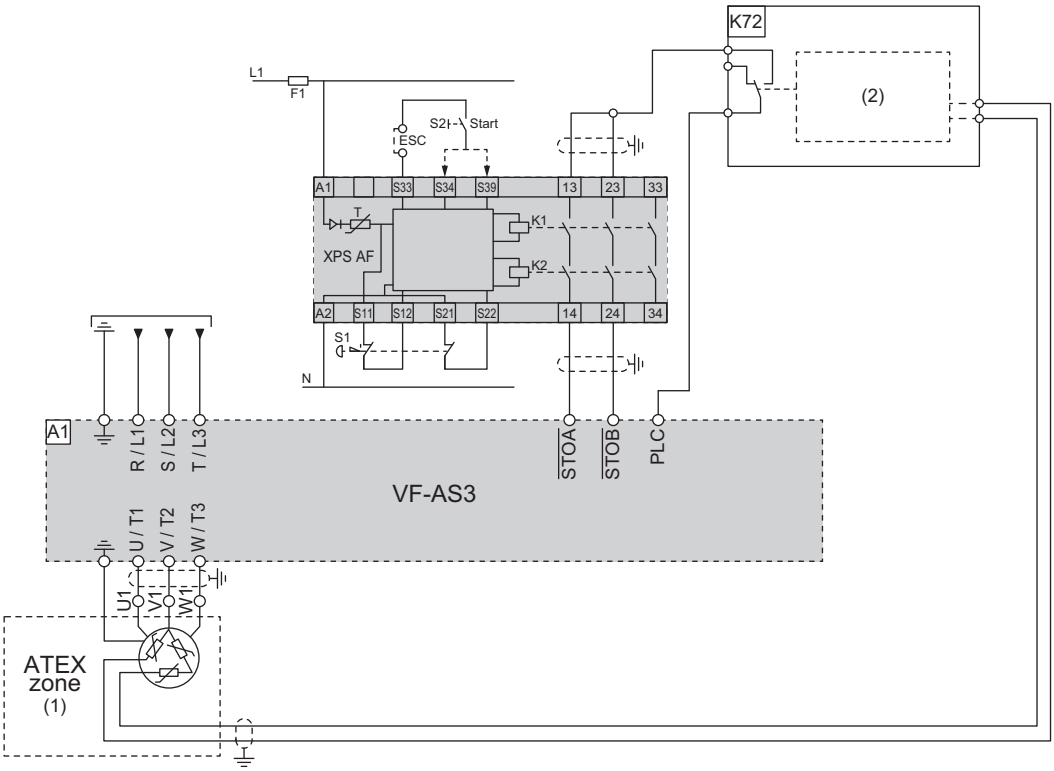



**(1)** ATEX Zone 2 or 22 with at least 1 thermal sensor PTC type
**(2)** ATEX certified Control unit conversion / insulation / switching system with Level of protection intrinsic safety "i".
**(K72)** ATEX certified PTC relay

## 3.4 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 2 or 22
- STO input used for protection of the ATEX motor, SIL 1 capability according to IEC 61508 and for functional safety SIL3 capability according to IEC61508, stop category 0 according to IEC 60204-1, and category 3 PL e according to ISO 13849-1.
- 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
**(K72)** ATEX certified PTC relay