

Optional function Tde Macno

User's manual

Safe torque off (STO) Power Stack



Cod. MF00201E00 V_1.3



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1 ABOUT THIS MANUAL

Power Stack Drive is a compound of two macro elements: the power stage (produced by SECOM SRL) and the control unit (produced by TDE MACNO).
STO optional board is part of the power stage, so all the informations reported in this manual are an extract of the SECOM power stack manual.

2 GENERAL DESCRIPTION

Optional card STO is used in conjunction with the mother card ALIDAN2_Interface when the optional function Safe Torque Off is requested by the Client. The STO function is a safety function according the Machinery Directive 98/23/EC and will be used in electrical equipment such as power drives for sync/async AC motors (low voltage).

The STO function is designed/used according to the following standards:

- EN 61800-5-2:2007 : Sil Capability 3
- EN ISO 13849-1:2008
- IEC 61508
- IEC 61511:2004
- EN 62061:2005

At subsystem level the Safety Function "Safe Torque Off" as defined by IEC 61800-5-2 complies with the requirements for the following functional safety ratings:

- SIL 3 as defined by IEC 61508
- SIL 3 Capability as defined by IEC 61800-5-2
- PL e category 3 as defined by ISO 13849-1
- SIL claim Limit 3 as defined by IEC 62061

Furthermore the following tests have been performed:

- Vibration test according to EN 61800-5-1 Ed.2-2007
- Shock test according to EN 60068-2-27 Ed.4-2008
- Dry heat test according to IEC 60068-2-2 at 50°C "Surrounding Air Temperature"
- Damp heat test according to IEC 60068-2-78

The function is compliant to EN1037:1995: prevention of unexpected start.

The device will disable the semiconductors of the power section in the final output stage of the inverter. In this way, the inverter is inhibited and no output voltage is generated that could cause a movement in the motor.

With this function, short-time operations can be performed, without removing power to the power drive.

Only maintenance tasks on the mechanical parts are allowed however, because the DCBUS voltage remains on and electrocution is possible.



STO function DOES NOT protect the user from unexpected movements of permanent magnets motors, in case of failures on the power output section (short-circuit on the output IGBT).

Power supply is generated by sequential switching of the IGBTs on the inverter bridge.

Figure 1 is a diagram of the inverter.

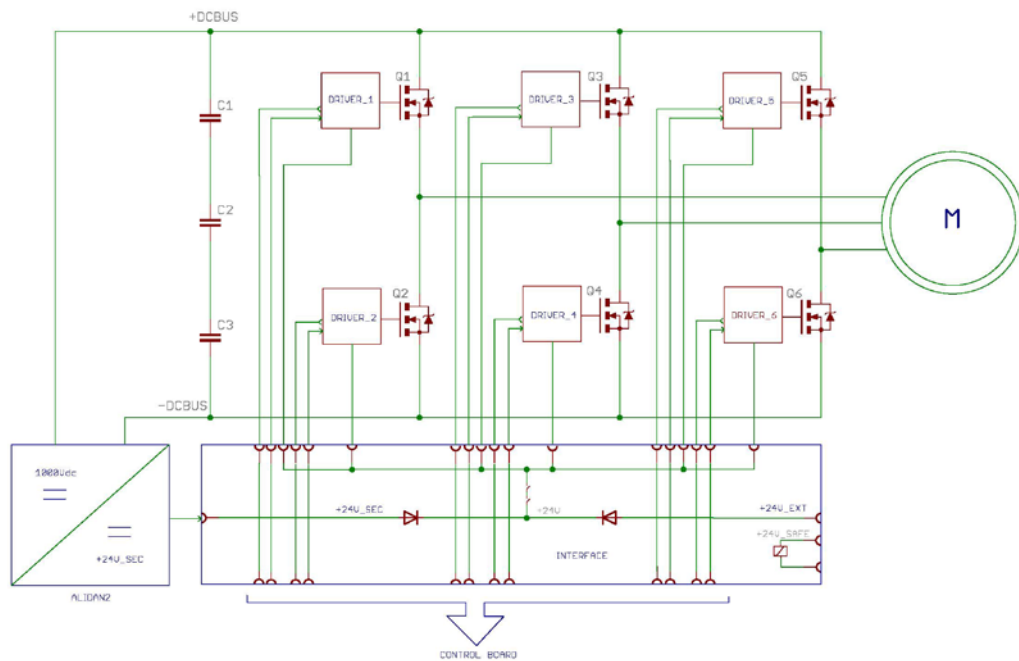


Fig. 1

The main parts are:

- C1-C2-C3 Filter capacitors on the VDCBUS supply (DC).
- Q1-Q6: Power stage, 6 IGBTs on a three-phase bridge configuration.
- Driver 1-6: driver boards for the IGBTs.
- Switching power supply with galvanic insulation 1000Vdc/24Vdc. It generates a backup 24Vdc (“+24V_SEC”) from VDCBUS (which is in the 400-1000VDC range).
- External power supply “+24V_EXT”. This power supply must be present at startup and is necessary for all function of the inverter. When DCBUS is on, “+24V_SEC” is then available as a backup.
- Interface board. It collects the “+24V_SEC” and “+24V_EXT” power supplies and generates the +24V supply for the driver boards. It collects all analog signals related to the operation of the inverters (e.g. output currents to the motor, power supply VDCBUS voltage level. These values are fed by LEM transducer with high insulation level). It includes the optical signals (fiber optics) to switch on/off the inverter bridge, from the control board.

The STO function implemented on the Power Stack inverters doesn't remove primary and secondary power supplies to the inverter but only the tension sent to the driver boards.

Mains must be removed if electrical maintenance is necessary.



STO function can be used only for emergency STOP. For all “normal” operations, the “STOP drive” function must be used.

If a running drive is stopped by using the function, the drive will trip and stop by coasting.

The STO function is implemented by means of an optional board (called “STO_CARD”), connected to the interface board (called “ALIDAN2_INTERFACE”).

The function of the STO_CARD is to switch off, in a failsafe manner, the +24V supply to the IGBTs.

3 MOTHER CARD ALIDAN2_INTERFACE

ALIDAN2_INTERFACE is the card for the signals transfer from and to the main control card. Signals are transferred through the 25 poles cable and can slightly change as depending on the presence of a single power stack, thus without external Parallel Card, or several stacks in parallel, with a Parallel Card.

ALIDAN2_Interface belongs to the second generation cards and has to be used only with the other following electronic cards: ALI_LEM (Voltage transducer) and ALIDAN2 (Switching power supply). ALIDAN2_Interface can work only with the following "daughter" cards:

- STO card cod. 790075P222 when Safe Torque Off functionality is required.
- STO_OFF card cod. 790075P225 in all the other conditions.

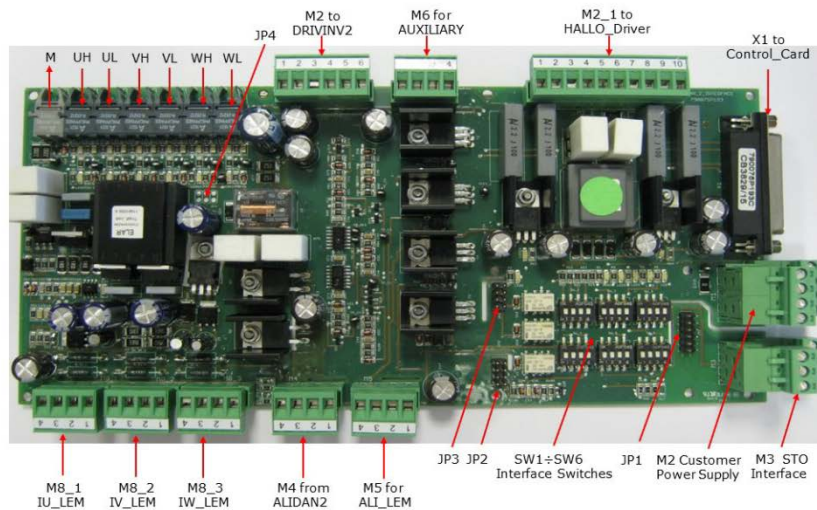


Fig. 2 – ALIDAN2 Interface

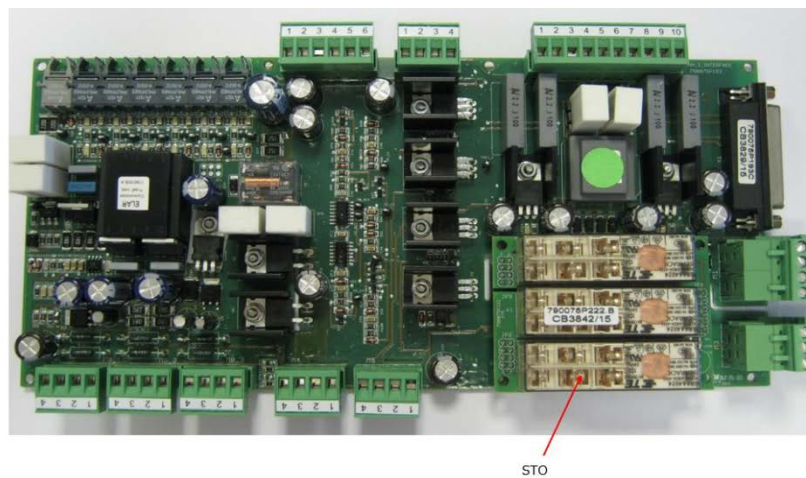


Fig. 3 – ALIDAN2 Interface with STO card

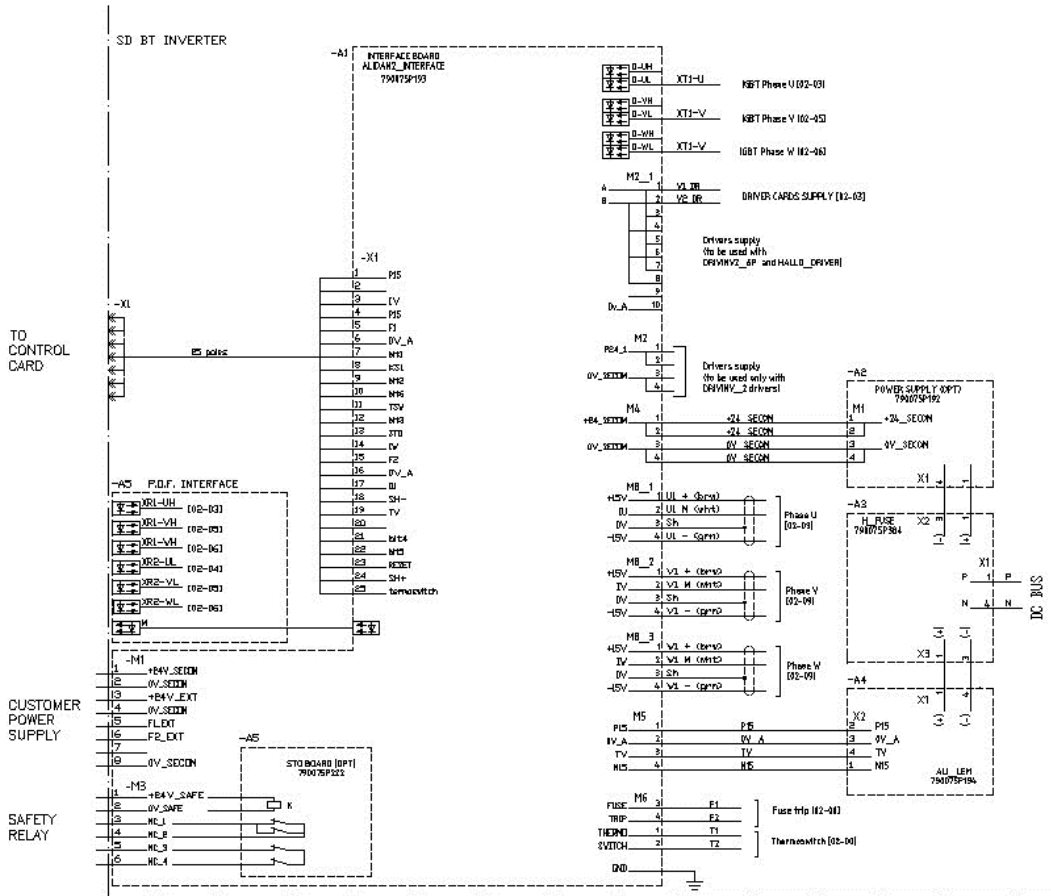


Fig. 4 – ALIDAN2 Interface internal stack connection

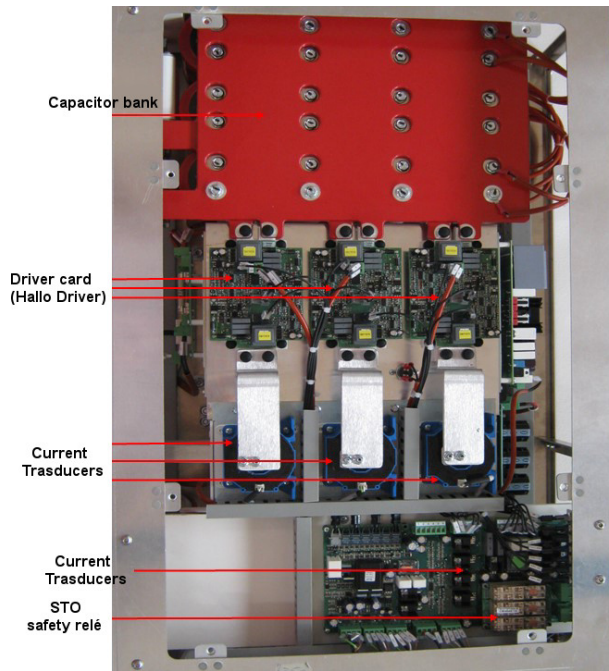



Fig. 5 – ALIDAN2 Interface with STO card mounted in the inverter frame

4 DESCRIPTION OF STO (SAFE TORQUE OFF) OPERATION

Safety Relé Interface M3 (Option) – 6 poles connector, Phoenix MSTB2.5 Type:

M3	Pin	Name	Meaning
	1	+24V_SAFE	+24V of the safety relé
	2	0V_SAFE	0V of the safety relé
	3	NC_1	Safety relé Normally Closed contacts in parallel
	4	NC_2	Safety relé Normally Closed contacts in parallel
	5	NC_3	Safety relé Normally Closed contacts series
	6	NC_4	Safety relé Normally Closed contacts series

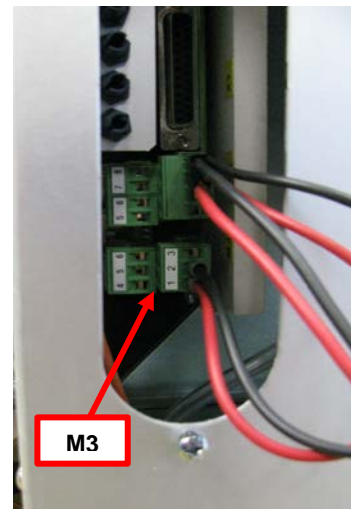
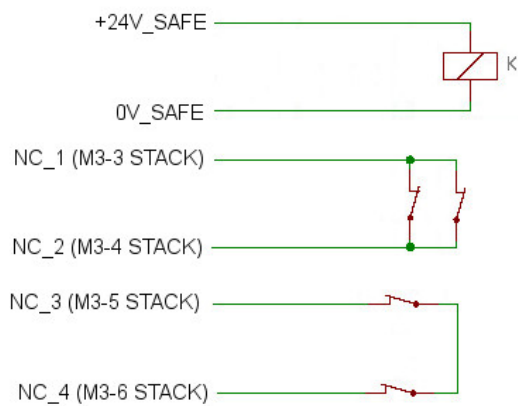


Fig. 6 – STO_1 Circuit

STO_1 circuit is made of 3 safety relays, model SR6A4024.

In case NO contacts remain closed, a dangerous condition could occur. To prevent this, a redundant architecture is adopted.

The operating sequence is as follows:

- If the **+24V_SAFE is NOT present** on M3-1 and M3-2, **relays are idle**. In this case, contacts NC_1-NC_2 and NC_3-NC_4 stay close and +24V to the driver boards is off

STO Function ACTIVE → Power Stack CAN'T WORK

- If the **+24V_SAFE is present** on M3-1 and M3-2, **relays are on**. Now, contacts NC_1-NC_2 and NC_3-NC_4 are open and +24V is on and send to the driver boards

STO Function NOT ACTIVE → Power Stack CAN WORK

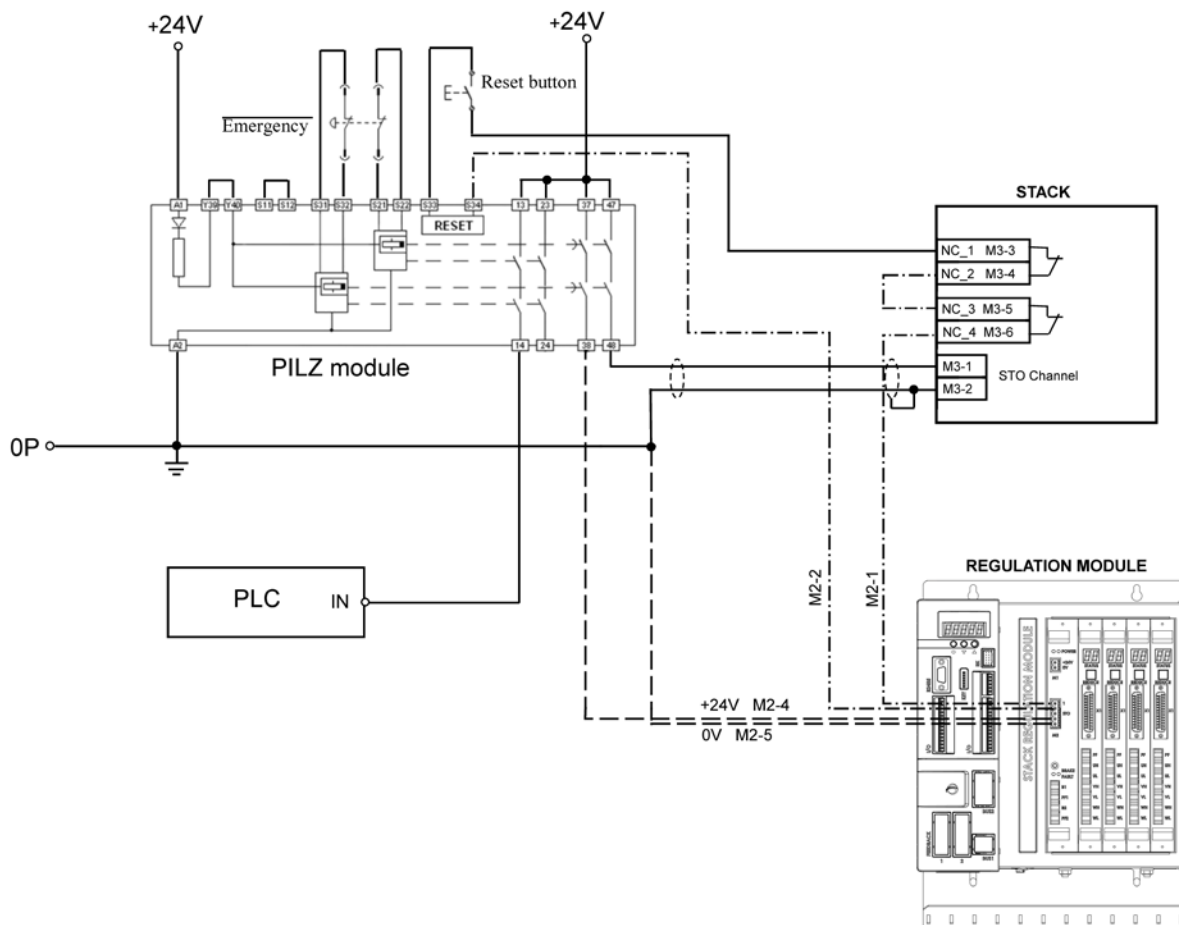


Fig. 7 – STO connection example

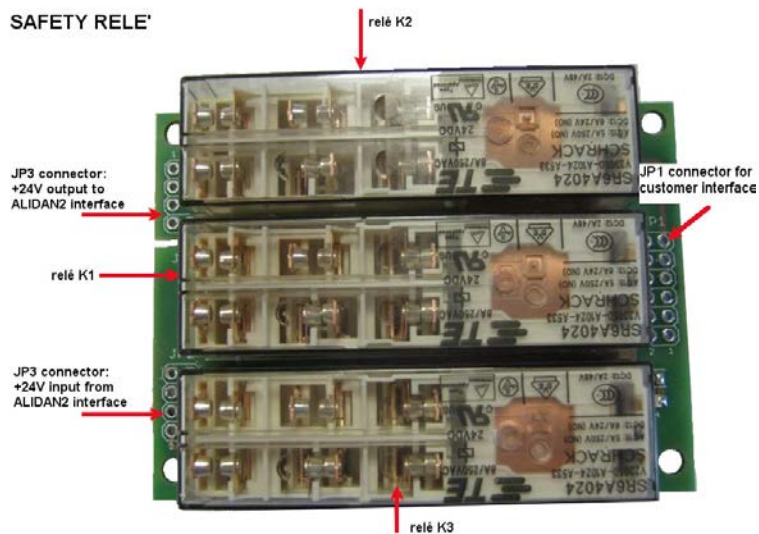


Fig. 8 – STO card

4.1 STO Connector Position



Fig. 9 – STO connector position

4.2 Sto OFF

When Optional functionality isn't requested the STO_OGG card is used in conjunction with the mother card ALIDAN2_Interface.



Fig. 10 – STO OFF card

5 IMPORTANT SAFETY NOTICE

The following notes are related to important consequences in terms of safety level.

1. Performance Level (PL) E or SIL Category 3 according EN ISO 13849-1 can be ensured by means the STO card. For a complete and reliable safety level of the machinery the Client must design and arrange all the external safety devices according to the same coordination level.

The final safety coordination in under the Client responsibility.

A circuitual example with STO_card and an external Safety Device is represented in Fig.2. Safety device and external circuitry must have the same SIL level.

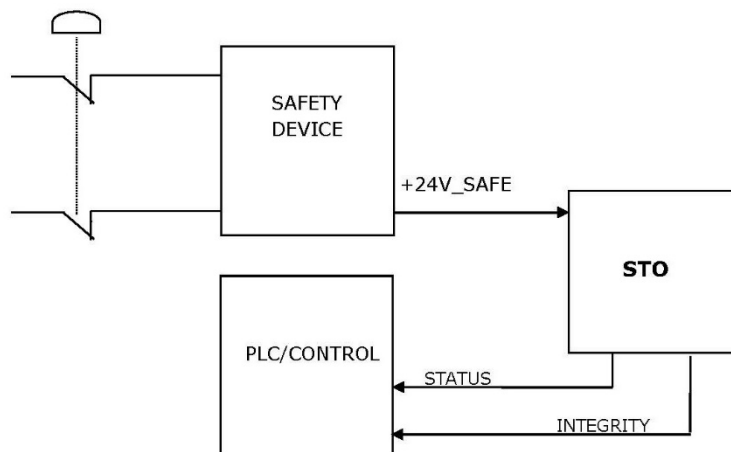


Fig. 11

2. In case of STO fault detected by the feedback status interface connector M3 on ALI-DAN2_Interface card it is compulsory to replace the damaged card with another one and re-test the correct functionality of the STO.
3. Screws and wires on the external connectors have to be tightened with the correct torque or up to their limit switch.

5.1 STO OPTION SAFETY REMARKS



- STO functionality can only de-energized IGBT driver cards: dangerous voltage is still present in the power converter. Electrical maintenance are not permitted with this condition.



- With STO activated DC terminals P–N, AC terminals U-V-W and R remain at working voltages: electrical maintenance are not permitted with this condition.



- When STO is activated a delayed time of at least 100msec is necessary to reach the safety condition.



- When STO is de-activated a delayed time of at least 200msec is necessary to leave the safety status. When the DC bus voltage is out a precharge time is necessary.



- For brushless motors with permanent magnets care should be taken in case of short circuit of two power IGBT as a partial mechanical rotation is possible in this condition.



- STO functionality can only de-energized IGBT driver cards. Anyway the motor can freely rotate. In case of hanging loads it's not electrically blocked. STO functionality can't be used in such type of application without any additional mechanical brake (cranes, lift etc).



- When abnormal condition or fault happens, the STO device itself doesn't permit any repowering after its de-activation (internal auto protection feature). It is strongly necessary to replace the damaged device or dispatch the whole converter to TDE MACNO for repairing. All the maintenance actions or activities are under the responsibility of the end user.



- Any unsuitable use of the STO device is under the end user responsibility.

CERTIFICATE OF COMPLIANCE

Certificate Number 20151016_4786891114 |
Report Reference 20151016_4786891114_FSCER
Issue Date 2015-October-16th

Issued to: SECOM SRL |
Via Archimede 18
Sesto S.Giovanni (MI) 20099, Italy |

**This is to certify that
representative samples of**

Power Drive Systems Safety Related: |
Complete Drive Modules of Size 400V, single stack
Complete Drive Modules of Size 400V, multi stack (each
module containing the STO board)
Complete Drive Modules of Size 690V, single stack
Complete Drive Modules of Size 690V, multi stack (each
module containing the STO board) |

Have been investigated by UL in accordance with the
Standards indicated on this Certificate.

Standard(s) for Safety:

IEC 61800-5-2: 2007, "Adjustable Speed Electrical Power
Drive Systems - Part 5-2: Safety Requirements -
Functional", 1st Edition
IEC 61508: 2010, "Functional safety of
electrical/electronic/programmable electronic safety-related
systems", 2nd Edition
ISO 13849-1&2: 2006/2009, "Safety of machinery - Safety-
related parts of control systems", 2nd Edition
IEC 62061:2015, "Safety of machinery – Functional safety
of safety-related electrical, electronic and programmable
electronic control systems" – 1.2 Edition |

Bruce A. Mahrenholz, CPO Director, North American Certification Programs
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Additional Information:

Safety function «Safe Torque Off (STO)» as defined by IEC 61800-5-2, complies with the requirements for the following functional safety ratings:

- SIL Capability 3, as defined by IEC 61800-5-2:2007
- SIL 3, as defined by IEC 61508:2010
- PL e, Category 3 as defined by ISO 13849-1:2006
- SIL Claim Limit 3 as defined by IEC 62061

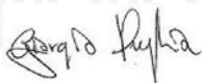
Further safety-related data :

- PFH (as defined in IEC 61508:2010): 1.05E-09/h
- MTTFd (as defined in ISO 13849-1:2006): 1195 years

The product must be installed, operated, and maintained, in accordance with the instructions for use.

Please note that the Functional Safety Certificate (in accordance with UL's product category FSCO) will not imply that UL has Listed, Classified or Recognized the product nor will the attached Report authorize the use of Listing, Classification, or Recognition Marks or other references to UL, on these products.

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