Optional functions Tde Macno

User's manual

Safe torque off (STO) case 1C23

Cod. MF00101E00 V_2.2

SUMMARY

KEY TO SYMBOLS

Caution

Danger

1. INTRODUCTION

This manual provides instructions for the installation and the use of only the STO safety function of the OPD EXP **(OPDE)** in sizes CASE1-C, CASE 2 and CASE 3.
CASE1-C includes the following models: OPDE 70A, OPDE 90A, OPDE 110A, OPDE 150A
CASE 2 includes the following models: OPDE 175A, OPDE 220A, OPDE 250A
CASE 3 includes the following models: OPDE 310A, 370A OPDE, OPDE 460A, OPDE 570A
For all other instructions for installation and operation, please refer to "Installation Manual" and the "user" of OPDE.

2. GENERAL DESCRIPTION

The OPEN DRIVE converter implements the Safe Torque Off (STO) according to the EN 61800-5-2 standards. It may be used to avoid unexpected starts in according to EN 60204 standard.
This system prevents the creation of a rotating magnetic field by disconnecting the control of power semiconductors. Thanks to these systems, it will be possible to conduct short operations such as cleaning and/or maintenance work on the non-electrical parts of the machine without disconnecting either the drive power supply or the connection between power and engine. The STO system, therefore, will be managed by components with limited power which means that the cost of the elements used in the switchboards will be reduced.
The STO system is implemented using two redundant channels, each of which has its own feedback signal accessible from the outside. The operating diagram is as follows:

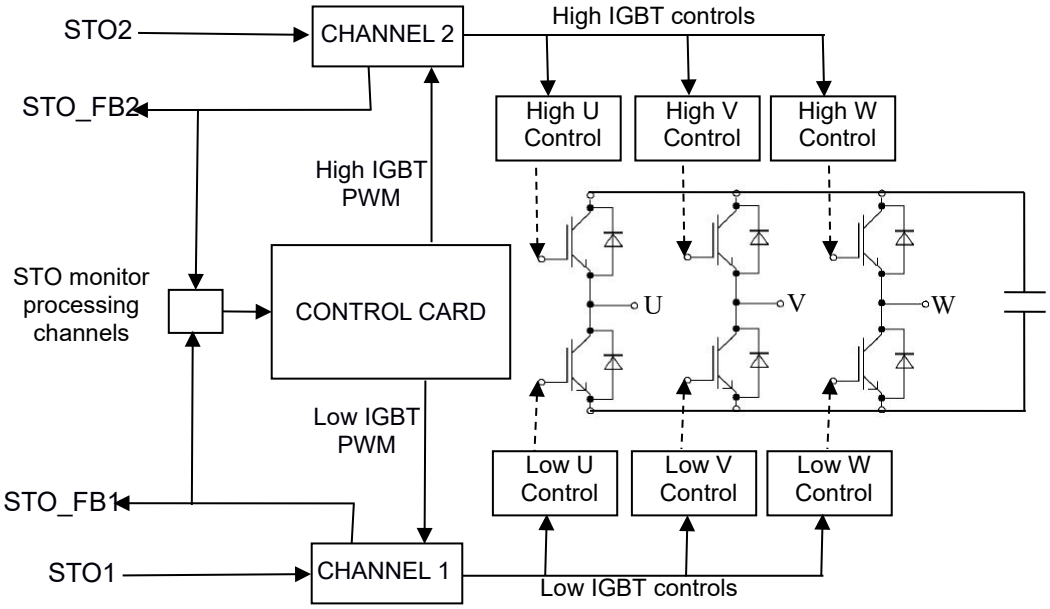


Fig.1 – Operating diagram of STO safety function

The input to channel 1 is STO1 and its feedback signal is STO_FB1. The input to channel 2 is STO2 and its feedback is STO_FB2. Each of the feedbacks refers to a clean N.C. contact which can be read by an external logic managing the STO system at machine level.
The diagnostics of the STO safety function is realized in full autonomy also by the control logic. The customer can access the status of the safety function by some configurable digital outputs, serial communication or fieldbus. There is no need for the end user to use the two feedback STO_FB1 and STO_FB2.

3. USE LIMITATIONS

The environmental constraints of the OPDE converter are listed in a section of the installation manual and refer to its normal operation. In following paragraphs are specified the limits of operation of OPDE in order satisfy the integrity of the safety function STO.

3.1. CLIMATE CLASS

Class 3K3 according to EN 60721-3-3

Environmental parameter	Limits	Unit of measurement
working temperature (1)	0÷40	°C
humidity	5÷85	%
atmospheric pressure	70÷106 (2)	kPa
maximum surrounding air movement	1	m/s
maximum temperature gradient	0.5	°C/min
maximum thermal irradiation	700	W/m^2
condensation	NO	
precipitation with wind	NO (3)	
water other than rain	NO	
ice formation	NO	

Tab.1 – Environmental parameters of 3K3 climatic class

(1) The climate class 3K3 includes a 5÷40°C use limitation, but the converter can work also if the environmental temperature is 0°C. The maximum operating temperature of OPDE is 45°C. In this case, declass the rated current to 88%.
(2) The atmospheric pressure limitations correspond to a 0÷3000m a.s.l. operating range. In actual fact, over 1000m of sea level it will be necessary to declass the rated current of the converter by 1% every 100m.
(3) The converter must be installed in a cabinet and not outside.

3.2. RESISTANCE TO CHEMICALLY ACTIVE SUBSTANCES

Class 3C1R according to EN 60721-3-3

Environmental parameter	Maximum value	Unit of measurement
sea salts	NO	-
sulphur dioxide	0,01	mg/m^3
	0,0037	cm^3/m^3
hydrogen sulphide	0,0015	mg/m^3
	0,001	cm^3/m^3
chlorine	0,001	mg/m^3
	0,00034	cm^3/m^3
hydrochloric acid	0,001	mg/m^3
	0,00066	cm^3/m^3
hydrofluoric acid	0,001	mg/m^3
	0,0012	cm^3/m^3
ammonia	0,03	mg/m^3
	0,042	cm^3/m^3
ozone	0,004	mg/m^3
	0,002	cm^3/m^3
nitrogen oxide	0,01	mg/m^3
	0,005	cm^3/m^3

Tab.2 - Resistance to chemically active substances

3.3. RESISTANCE TO VIBRATIONS

As regards vibrations, the OPEN DRIVE has the following use limitations (limits set by IEC EN 61800-5-1):
If vibrations exceeding the limits indicated above, suitable reduction measures will have to be adopted.

10Hz ≤ frequency ≤ 57Hz	0.075	mm (width)
57Hz ≤ frequency ≤ 150Hz	1	g

Tab.3 – Resistance to vibrations

3.4. PROTECTION AND POLLUTION DEGREE

Protection degree	IP20
Pollution degree	2 (1)

Tab.4 – Protection and pollution degree

(1) Non-conductive pollution and – occasionally and temporarily – conductive pollution generated by condensation.

3.5. STORAGE

3.5.1. Environmental Storage Conditions

temperature	-20÷60	°C
humidity	5÷95	%
condensation	NO	

Tab.5 - Storage

CAUTION: Every 6 months/1 year the regeneration of power bus electronic capacitors is necessary: give power supply to OPDE through L1,L2,L3 (for AC version) or + and - (for DC version) for 2h without giving run enable .

3.5.2. Recovery Procedure After Storage

OPDE drive Activation cannot be used immediately after a storage period. In order to avoid faults during activation, the following recovery procedure must be adopted.

PHASE 1:

OPDE storaged		
Temperature	15÷35	°C
Humidity	5÷75	%
Condensation	NO	
Atmospheric pressure	86÷106	kPa
Recovery time (1)	1	h

Tab.6 – Recovery after storage

1) After this recovery time there must be no trace of condensation, both inside and outside activation (well ventilated area).

PHASE 2:

CAUTION: If the time from the last regeneration of the electrolytic capacitors is from 6 months to one year, is necessary to re-run the regeneration of the capacitors. Give power supply to OPDE across terminals L1, L2, L3 (for AC version) or through the + and - terminals (for DC version) for 2 hours without without giving run enable.

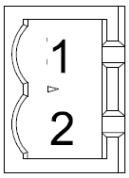
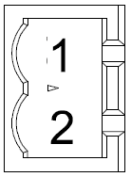
CAUTION: If the time of the purchase or the last regeneration of the electronic capacitors of the power bus is more than 1 year, the regeneration of the same cannot be performed simply supplying the OPDE, but it is necessary to require TDE MACNO the operating procedure to use.

Once the regeneration process is completed, the OPDE drive can work normally.

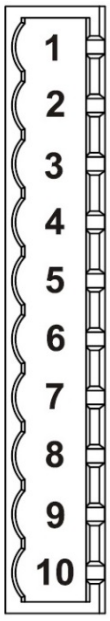
4. ADJUSTMENT AND DRIVERS SUPPLY

4.1. TERMINAL BOARD DESCRIPTION

The following tables list the terminal boards used to feed the OPDE cards and to perform the diagnostic work on the STO system.

Adjustment card feeding			
X3	**Pin**	**Name**	**Description**
	1 2	+24V_IN 0P	Auxiliary power supply +24V (±10%). Through the pins X3-1 and X3-2 is possible to power the control board and motor sensor. The OPDE in sizes CASE1-C, CASE 2 and CASE 3 generates internally an auxiliary supply of +24V from the main power supply. The control board of OPDE can be fed through X3 with an external +24V: there aren't conflict between the voltage generated internally and auxiliary supply provided externally. Infact is used the source with higher voltage level. This allows you to: a) configure the drive without main power supply b) keep alight the control part even if it lacks the main power supply. The currents required from + 24V_IN in the sizes CASE 2 and CASE 3 are as follows: OPDE CASE1-C (70A, 90A, 110A, 150A) max. 1.0A OPDE CASE2 (175A, 220A, 250A) max. 1.0A OPDE CASE3 (310A, 370A, 460A, 570A) max. 1.0A
X6	1 2	+24V_OUT 0P	The voltage + 24V_OUT (22V÷23V) generated within OPDE is available on terminal X6. The output current is internally limited to a 500mA (protection against external over-current and short-circuit). This voltage can be used by the customer **only** for: a) give digital I/O to the OPDE b) give an auxiliary supply for its two channels of the STO function (the auxiliary supply must be interrupted by suitable safety contacts)
			

Tab.7 – Auxiliary power supply terminals board

S1	Pin	Name	Description
	1 2	STO_FB2A STO_FB2B	Clean N.C. contact max. 60Vdc max. 0.5A Monitor of the second STO system channel which indicates if high IGBT controls are powered or not. When input STO2 is powered, the contact is open.
	3	N.C.	No connect
	4 5	STO2 0P_STO2	+24V (±10%) max. 10mA Digital input: second of the two channels of the safety function STO. This channel disables the high IGBT controls (Fig.1).When the drive is working normally, the STO2 input must be provided. On the other hand, to enable the STO system, it is necessary to disconnect STO2.
	6	N.C.	No connect
	7 8	STO_FB1A STO_FB1B	Clean N.C. contact max. 60Vdc max. 0.5A Monitor of the first STO system channel which indicates if low IGBT controls are powered or not. When input STO1 is powered, the contact is open.
	9 10	STO1 0P_STO1	+24V (±10%) max. 10mA Digital input: first of the two channels of the safety function STO. This channel disables the low IGBT controls (Fig.1).When the drive is working normally, the STO1 input must be provided. On the other hand, to enable the STO system, it is necessary to disconnect STO1.

Tab.8 – STO safety function terminal board

4.2. TERMINAL BOARD POSITIONS

The X3, X6 and S1 terminal boards are placed as shown in the figures Fig.2 (for size CASE1-C) and Fig.3 (for sizes CASE2 and CASE3).

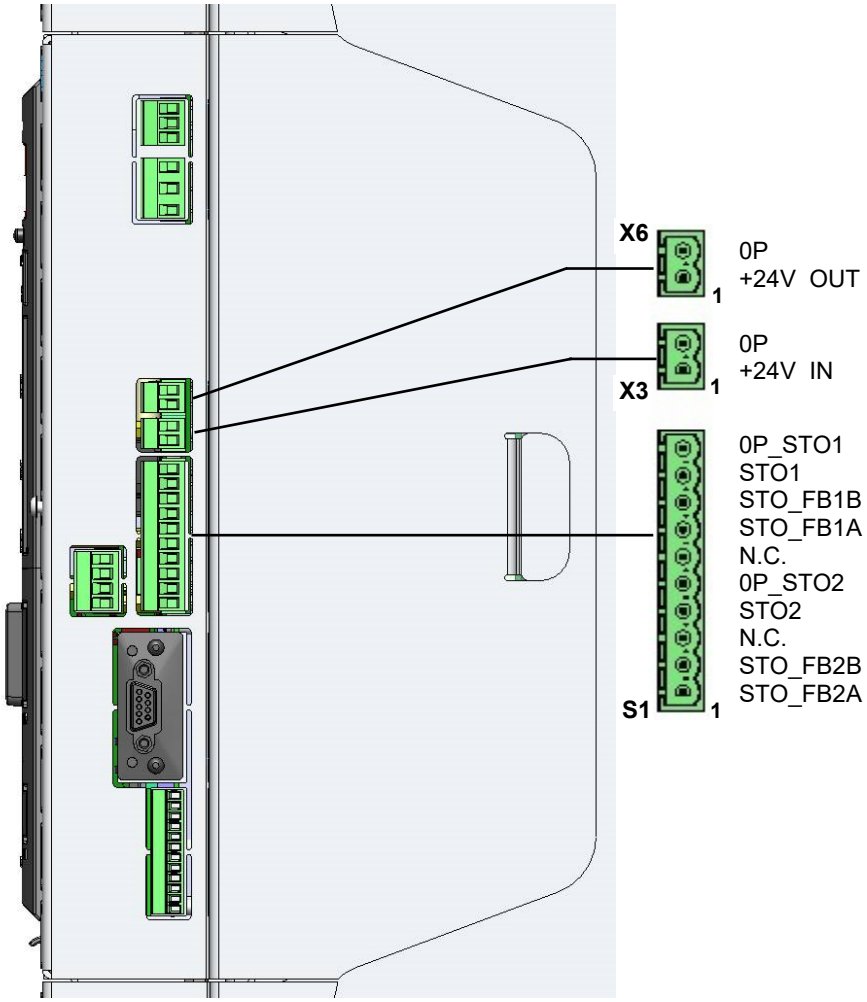


Fig.2 – Positions of terminals board X3, X6, S1 of size CASE1-C

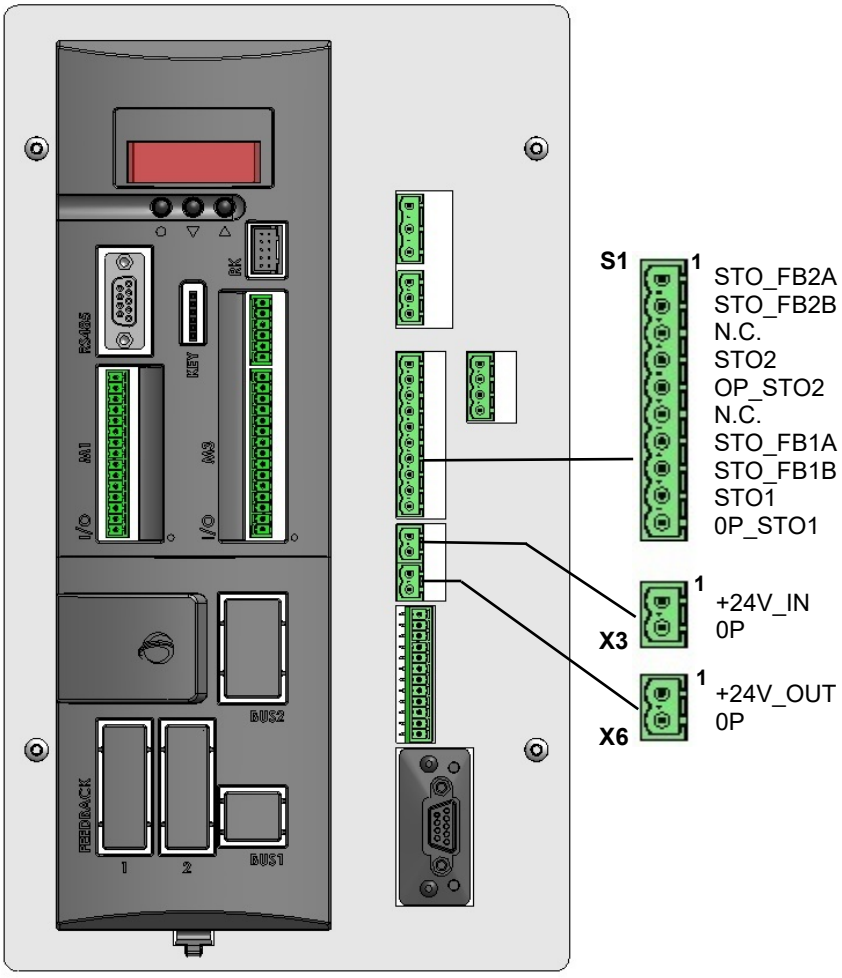


Fig.3 – Positions of terminals board X3, X6, S1 on sizes CASE2 and CASE3

5. EXTERNAL CONNECTIONS

The following paragraphs provide indications about the OPDE connection only as regards the feeding of the adjustment card and STO safety system. For the remaining connections, please refer to the OPDE installation handbook.
As indicated in par. 4.1 “Terminal board description”, on terminal board X3 can be given an auxiliary voltage +24V to supply the control card (+24V_IN). On terminal X6 is available an auxiliary voltage (+ 24V_OUT).
In the terminal S1 signals STO1 (refers to 0P_STO1) and STO_2 (refers to 0P_STO2) refer each to a channel of the safety function STO.
It is particularly important to pay great attention when cabling these signals from the OPDE to the safety module used on the electrical cabinet.

a) If +24V_OUT on this X6 is used to give input voltage to safety channels, use a two-way shielded cable where the shield must be connected to signal 0P. A shielded cable is chosen to make sure that, in the event of failure of the powering cables, the safety system is disconnected. The reason is that:
   - the terminal board X6 is close to the terminal board S1;
   - the powering cables for X6 and those for S1 will reach the converter inside the same conduit.
b) For the connections of first channel (STO1 and 0P_STO1) use a shielded two-way cable whose shield must be connected to the 0P_STO1 signal (S1-10). A shielded cable with the shield connected to 0P_STO1 serves to go to safety status in the event of failure of the cables outside the converter. An example of this is the loss of insulation and subsequent accidental contact between one of the cables connected to +24V on the electrical cabinet and STO1 signal.
c) For the connections of second channel (STO2 and 0P_STO2) use a shielded two-way cable whose shield must be connected to the 0P_STO2 signal (S1-5). A shielded cable with the shield connected to 0P_STO2 serves to go to safety status in the event of failure of the cables outside the converter. An example of this is the loss of insulation and subsequent accidental contact between one of the cables connected to +24V on the electrical cabinet and STO2 signal.
d) For the two monitor connections, if used, the type of cable to be used depends on how the diagnostic test on the safety chain is conducted. Some safety modules do not specify the type of cable to connect the signals used by the diagnostic system. The reason for this is that they are able to determine themselves whether there is a failure in these connections. If the diagnostic test on the safety channels is conducted directly by the manufacturer of the electrical cabinet, it is necessary to determine whether this test is able to detect a failure in the connection cables. Failure of the monitor signal's cables bring the diagnostic test to fail. It is not possible to determine where the failure is: on the safety chain or on the monitor. The use of screened two-way cable for each of the two monitor, therefore, makes it at least possible to rule out a failure of the monitor signal connections.

6. DESCRIPTION OF STO OPERATION ON OPDE

6.1. ENABLING THE STO SYSTEM

If the converter is working normally, that is to say the STO system is disabled, it is necessary to power the two input sognals STO1 and STO2. In this situation the clean monitor contacts (STO_FB1 and STO_FB2) will both have to be open. To enable the safety system follow this procedure:
a) stop the motor
b) disable run command [1] [2]
c) disconnect STO1 and STO2 on the same time[3]
[1] it is possible to carry out operations a) and b) only by disable run command if the converter settings include “stop at minimum speed” (C28=1). In this case the converter brings the motor to the minimum speed (set to zero through the parameter P50) then disable run command.
[2] in the presence of external influences (for example falling suspended loads), it might be necessary to take extra precautions (for example mechanical brakes) to prevent any risk.
[3] diagnostics allows a maximum delay of 70ms between the activations of two channels (if the delay time is higher than 70ms, the drive goes to alarm as described in cap. 8).

CAUTION: enabling the STO system while the machine is running causes total loss of motor control.
Enable the STO system only after its operation has been stopped following the procedure described above.

DANGER: the terminal boards +, -, U, V, W, F remain live. No maintenance work must be conducted and electrical component must not be touched.

CAUTION: after power has been disconnected (STO1 and STO2), both channels take time to return to a safe condition. The times are indicated below.

CHANNEL 1	Maximum activation time of the first STO channel	5ms
CHANNEL 2	Maximum activation time of the second STO channel	5ms

Tab.9 – Activation timeof STO function

DANGER: on brushless motors with permanent magnets, in the event of simultaneous failure of the two power switches, motor movement is possible up to 180° electrical equal to [180/n° polar motor couples] mechanical degrees.

The diagnostics of the STO safety function is realized by:
a) Hardware monitor for each of the two safety channels (STO_FB1 and STO_FB2)
b) the control board
Diagnostics, performed via the hardware monitor of the two safety channels (STO_FB1 and STO_FB2) and through the control board, presents a delay with respect to the falling edge of the input signals STO1 and STO2. The times are shown below

CHANNEL 1	Maximum delay of first HW monitor	10ms
CHANNEL 2	Maximum delay of second HW monitor	10ms
CHANNEL 1 and CHANNEL 2	Maximum delay of control board diagnostics	80ms

Tab.10 – Diagnostic delay of STO function

In this situation the feedback contacts (STO_FB1 and STO_FB2) will both have to be closed. Any discrepancy in only one of the monitor contacts compared to the converter status indicate a failure. In this case the safety system might not work correctly and needs to be immediately repaired.
In this situation, if there aren't dangerous alarms (codes alarm A03.0, A13.3, A13.4, A13.5, A13.6 are considered dangerous), the logic output o23 ”STO: not dangerous failure” is high and logic output o17 ”Safe Torque OFF Active” is brought to high level.
C73=0
When the connection “enable safety stop only as signal” is disabled (C73=0 which is the default configuration), the converter indicates this status with the alarm presence A13.1 (STO function activated). In this situation the logic output o00 “Drive ready” passes to low level.

C73=1
With the C73=1 connection, the converter still brings to a high level the logic output o17 “Safe Torque OFF Active”, but no specific alarm is generated and the logic output o00 “Drive ready” remains on high, that is to say the drive ready remains active (if no other alarms are present).

6.2. DISABLING THE STO SYSTEM

To disable the STO system it is sufficient to power again STO1 and STO2 at same time.
NOTE: diagnostics allows a maximum delay of 70ms between the disactivations of two channels (if the delay time is higher than 70ms, the drive goes to alarm as described in cap. 8).

CAUTION: From the moment the machine is powered, it takes time to disable the safety systems on both channels. The times are indicated below

CHANNEL 1	Maximum deactivation time of the first STO channel	5ms
CHANNEL 2	Maximum deactivation time of the second STO channel	5ms

Tab.11 – deactivation time of STO function

The diagnostics of the STO safety function is realized by:
a) Hardware monitor for each of the two safety channels (STO_FB1 and STO_FB2)
b) the control board
Diagnostics, performed via the hardware monitor of the two safety channels (STO_FB1 and STO_FB2) and through the control board, presents a delay with respect to the rising edge of the input signals STO1 and STO2. The times are shown below

CHANNEL 1	Maximum delay of first HW monitor	10ms
CHANNEL 2	Maximum delay of second HW monitor	10ms
CHANNEL 1 and CHANNEL 2	Maximum delay of control board diagnostics	80ms

Tab.12 - Diagnostic delay of STO function

In this situation the feedback contacts (STO_FB1 and STO_FB2) will both need to be open. Any discrepancy in only one of the monitor contacts with respect to the converter status means that there is a failure. In this case the safety system might not be working properly and it needs to be repaired immediately.
If there aren't dangerous alarms (codes alarm A03.0, A13.3, A13.4, A13.5, A13.6 are considered dangerous), the logic output o23 ”STO: not dangerous failure” is high.
To return to the normal operation conditions it is necessary to do the following.

C73=0
Wait at least 80ms after introducing of two safety input (STO1 and STO2), then enable the alarm reset. In this condition the o17 logic output “Safe Torque OFF Active” reaches a low level. The o00 logic output “Drive ready” is on high which means that the converter is ready to work.
The control board switches from alarm A13.1 to fixed “stop” status.

CAUTION: From the moment both signals STO1 and STO2 are given, it is important to wait the maximum delay time reported in Tab.4 before to give reset command. Control board ignores a reset command if it is given before this delay time.

C73=1
The converter behaves in the same way as with C73=0 except that it is not necessary to enable the alarm reset (logic output o00 “Drive ready” is already to high level).

CAUTION: Before giving the run command is necessary to wait for the delay time of the diagnosis reported in Tab. 4. If run command is given too early, the converter ignores it until the control board recognizes that the safety function is disabled.

7. DIAGNOSTIC SYSTEM

When the safe function is active, the feedback signals(STO_FB1 and STO_FB2) and control board indicate if the safe function has been executed correctly or if there is a dangerous failure. The activation of the safety function allows to perform a diagnostic test on the integrity of the two safety channels. The safety function STO must therefore be activated periodically.
NOTE: The diagnostics realized by the control logic is sufficient to identify the correct functionality of the two safety channels. It is therefore not necessary to perform the diagnostic test using two HW monitors. In the paragraphs that follow are however related to the sequences to be followed to perform the test procedures using the two types of diagnostics.
The diagnostic test is to be performed every time machine is started.

WARNING: The maximum length of time of diagnosis of the safety function STO (Diagnostic Test Interval) must be 2160h (3 months work). If the safety function is never turned on by 2160h the drive trips to alarm (alarm code A13.6 diagnostic test necessary). For alarm management see section 8.6.

WARNING: If the diagnostic test detects a fault, the drive is to be subjected to immediate repair: it is possible a malfunction of the safety function in the next demand.

WARNING: After 720 hours (1 month work) since the last activation of the safety function, the converter activates the logical output o27 "New STO: Diagnostic tests suggested." The logic output is intended to alert the end user that, subject to the requirements of Directive 2006/42/CE, a diagnostic test must be performed.

7.1. DIAGNOSTIC TEST

The start conditions to perform the diagnostic test are the following:

a) Control logic supplied
b) STO Safety Channels inactive (STO1 and STO2 present)
c) No alarm present
The sequence to be adopted is shown in Fig.4. The diagnostic test, if the converter continues to operate normally after the sequence described, does not provide for verification by the user. Only if the drive remains in alarm it is necessary to verify the code to see if it is or not an alarm related to the safety function STO. The fault codes related to safety function STO are given in Chapter 8.
To quickly understand if the drive does not work because there is a failure of the safety function, it is possible to use the logical output o23 "STO: not dangerous failure". This configurable logic output indicates the presence of a dangerous failure in the channels of the safety function and it is the synthesis of the alarm codes A03.0, A13.3, A13.4, A13.5 and A13.6 (for their description see Chapter 8). In the absence of faults on safety channels, the logic output is active.

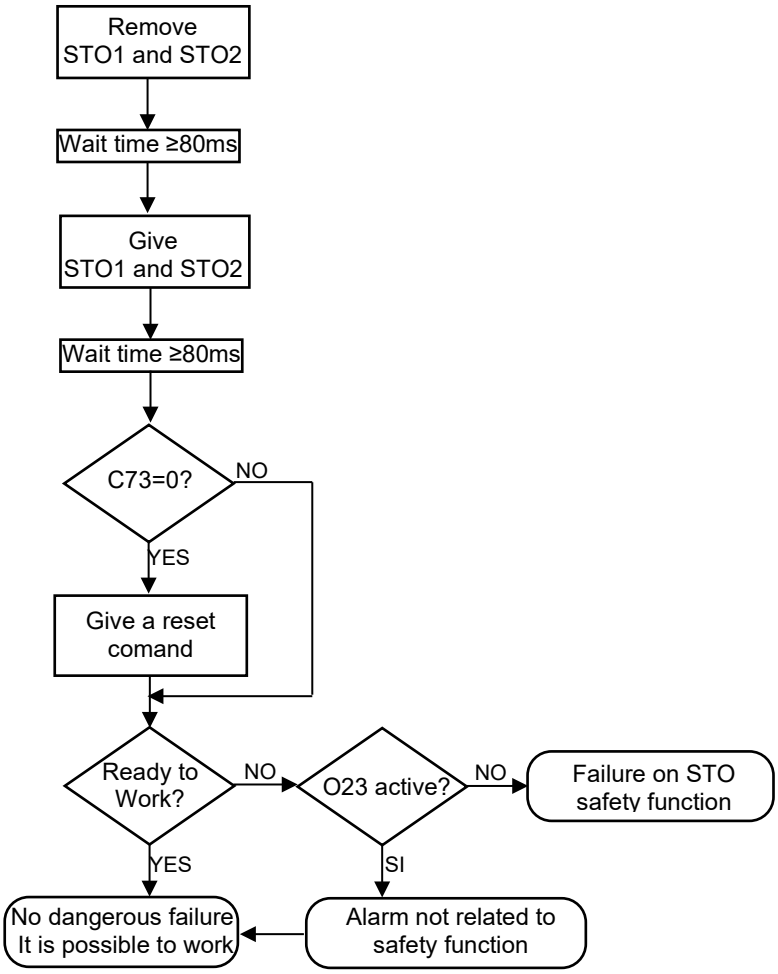


Fig.4 – Sequence to be adopted for diagnostic test

7.2. Diagnostic test with HW monitor STO_FB1 and STO_FB2

The diagnostic test made using only the contacts of the monitor STO_FB1 and STO_FB2 is not able to detect all the faults of the safety function STO. It is also necessary to use the logic output o23 "STO: not dangerous failure". This configurable logic output indicates the presence of a dangerous failure in the channels of the safety function and is the synthesis of the alarm codes A03.0, A13.3, A13.4, A13.5 and A13.6 (for their description see chapter 8).
The start conditions to perform the diagnostic test are the following:
a) Control logic fed
b) Channels Safety inactive (+24V on STO1 and STO2 input)
c) No alarm present
The sequence to be adopted is shown in Fig.5.

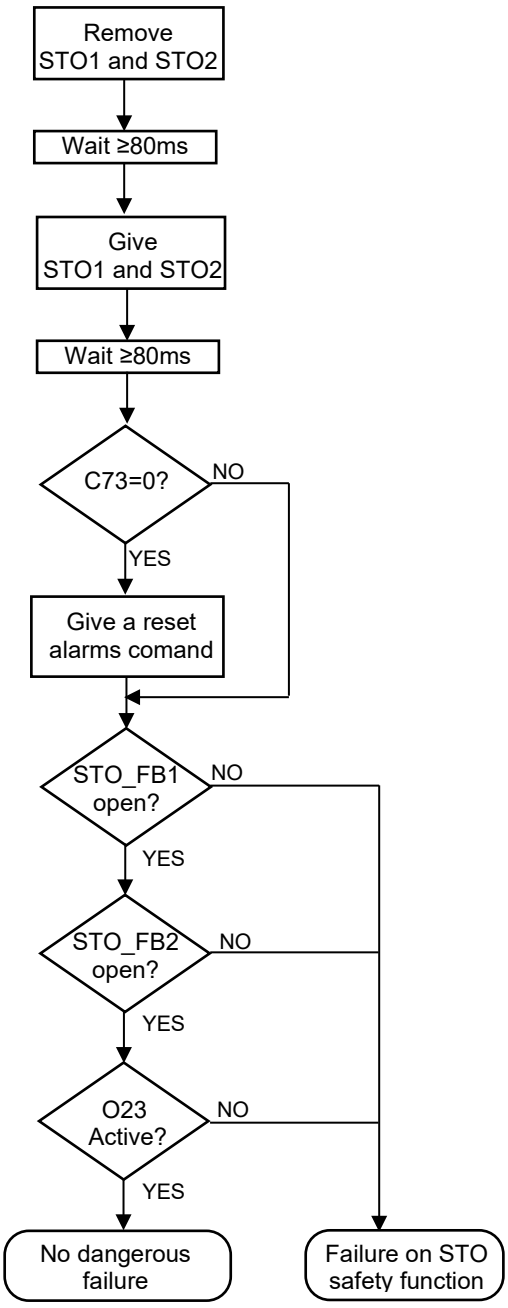


Fig.5 – Sequence to be adopted for diagnostic test with STO_FB1 and STO_FB2 contacts

8. CONTROL BOARD DIAGNOSTICS

The control board of OPDE knows the status of the STO safety function. For each of the possible states is associated an alarm and a reaction of the control board. The following table lists the status acknowledged.

STO status	Alarm code (without other alarms)	Drive status
STO not active	No alarms	Ready to work / running
STO active	A13.1	STO function active
Only an active channel / switching time between the two channels exceeds 70ms / fault on one or both channels	A13.3	Only one STO channel is activacted
Failure of at least one STO channel	A13.4	Failure of at least one STO channel
Interruption of the communication channel between the control board and STO board	A13.5	Internal communication channel damaged
Time since the last activation of the safety function STO excessive (2160h).	A13.6	Diagnostic test necessary

Tab.13 – Status of sfety STO function

8.1. STO FUNCTION NOT ACTIVE

When the STO safety function is not active, in the absence of other alarms, the control board:

a) There aren't any kind of alarm
b) Enables the logic output o00 "Drive ready"
c) Enables the logic output o23 "STO: not dangerous failure"
d) Disables the logic output o17 "Safe Torque OFF Active"
e) Allows the transfer of the PWM commands to the electronic card that performs the safety function STO (if run command HW input is enabled).

The drive can works.

8.2. STO FUNCTION ACTIVE

When the STO safety function is active, in the absence of other alarms, the control board:

a) Gives alarm A13.1 (STO active)
b) Disables the logic output o00 "Drive ready"
c) Enables the logic output o23 "STO: not dangerous failure"
d) Enables the logic output o17 "Safe Torque OFF Active"
e) Disables the transfer of PWM commands to electronic card which realizes the safety function STO

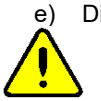
8.3. ONLY ONE STO CHANNEL ACTIVATE

When:

- only one of the two STO channels is active
- the switching time between the two channels exceeds 70ms
- there is a failure in one of two safety channel

the control board:

a) Gives alarm A13.3 (only one STO channel active)
b) Disables the logic output o00 "Drive ready"
c) Disables the logic output o23 "STO: not dangerous failure"
d) Disables the logic output o17 "Safe Torque OFF Active"
e) Disables the transfer of PWM commands to electronic card which realizes the safety function STO



This alarm code can't be reset via logic input or serial line or field bus because it indicates that there might be a fault on the safety function STO.
It is necessary to remove the supply voltage to OPDE and check if the fault is external to the converter. Otherwise replace the drive.

8.4. FAILURE OF AT LEAST ON STO CHANNEL

In case of a failure of one of the two safety channels, the control board is not able to understand which of the two channel is faulty. Likewise it is not able to distinguish a failure of a single channel from a failure on both channels. The control board only recognizes that at least one of the two safety channels is faulty and reacts in the following way:

a) Gives alarm A13. 4 (failure on at least one STO channel)
b) Disables the logic output o00 "Drive ready"
c) Disables the logic output o23 "STO: not dangerous failure"
d) Disables the logic output o17 "Safe Torque OFF Active"
e) Disables the transfer of PWM commands to the electronic card which realizes the safety function STO

Is not important how many or what are the safety channels in failure: the reaction to the failure of the control board is always the same.

This alarm code can't be reset via logic input or serial line or field bus because it indicates that there might be a fault on the safety function STO.
It is necessary to remove the supply voltage to OPDE and check if the fault is external to the converter. Otherwise replace the drive.

8.5. INTERRUPTION OF INTERNAL COMMUNICATION CHANNEL

The control board know the status of the safety function. This is possible thanks to a channel of communication with the board that manages the STO safety function. In the case in which this communication channel is interrupted, the control board:

a) Gives alarm A13.5 (Failure of internal communication channel)
b) Disables the logic output o00 "Drive ready"
c) Disables the logic output o23 "STO: not dangerous failure"
d) Disables the logic output o17 "Safe Torque OFF Active"
e) Disables the transfer of PWM commands to the card which realizes the safety function STO

This alarm code can't be reset via logic input or serial line or field bus because it indicates that there might be a fault on the safety function STO.
It is necessary to remove the supply voltage to OPDE and check if the fault is external to the converter. Otherwise replace the drive.

8.6. DIAGNOSTIC TEST RECOMMENDED / MANDATORY

8.6.1 Diagnostic Test Mandatory

In the control logic there is a counter that indicates the elapsed time since the last activation of the safety function. This counter indicates also the time elapsed since the last diagnostic test. When the counter arrives to 2160 h since the last activation of the safety function the control board:

a) Provides the alarm A13.6 (Diagnostic Test required)
b) Disables the logic output o00 "Drive ready"
c) Disables the logic output o23 "STO: not dangerous failure"
d) Disables the output o17 "Safe Torque Off Active"
e) Disables the transfer of PWM commands to the card which realizes the safety function STO

This alarm code can be reset via logic input or serial line or field bus only after the safety function is activated.

8.6.2 Diagnostic Test Recommended

In the control logic there is a counter that indicates the elapsed time since the last activation of the safety function. This counter indicates also the time elapsed since the last diagnostic test. When the counter arrives to 720 h since the last activation of the safety function the control board:

a) Enables the logic output o27 "new STO: Diagnostic test suggested"
b) Doesn't change the logic output o00 "Drive ready"
c) Doesn't change the logic output o23 "STO: not dangerous failure"
d) Doesn't change the output o17 "Safe Torque Off Active"
e) Enables the transfer of PWM commands to the card which realizes the safety function STO

The drive can works.

WARNING: The activation of the logic output O27 "New STO: Diagnostic tests suggested" is intended to alert the end user that should make a diagnostic test. This in order to satisfy the requirements of Directive 2006/42/CE.

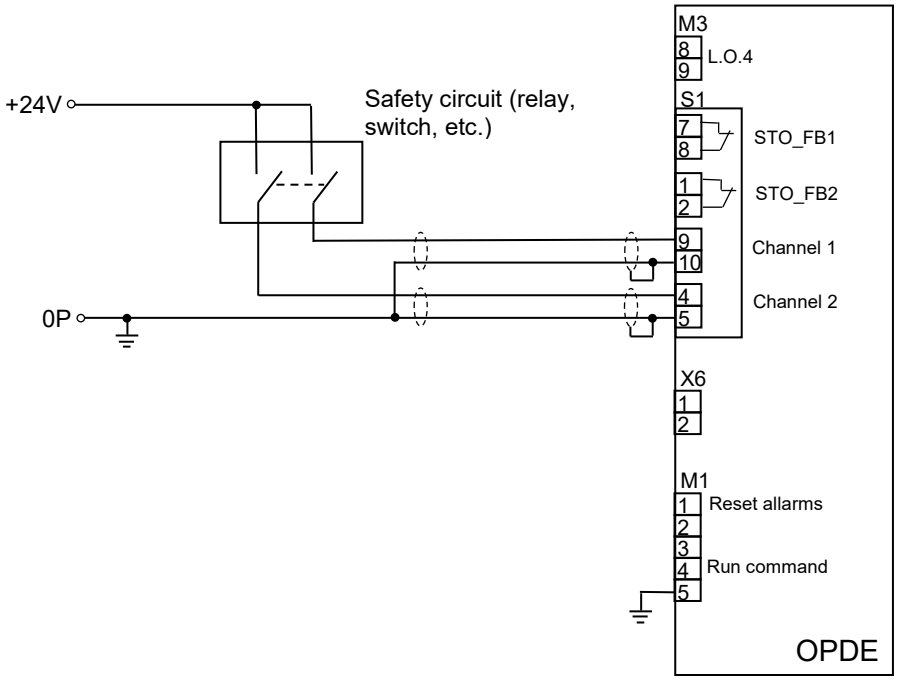
9. APPLICATION EXAMPLES

The following are some application examples of the STO system.
For the correct use of feedback related to the digital output o23 "STO: not dangerous failure" one of the four logic outputs available must be configured as a logic output o23.
There is the possibility to use one of two clean contacts present in the drive: logic outputs L.O.2 or L.O.4. In this case configure the physical digital output associating to o23 direct logical output (the logical output o23 is associated with the physical logic output LO4 in MACNO TDE). As an alternative it is possible to connect one of the digital output LO1 and LO3 to an external relay whose contact will be used as feedback. In this case, if the relay contact is N.C., configure the physical digital output associating to o23 denied logical output ; if instead the relay contact is N.A., configure the physical digital output associating to o23 direct logical output.

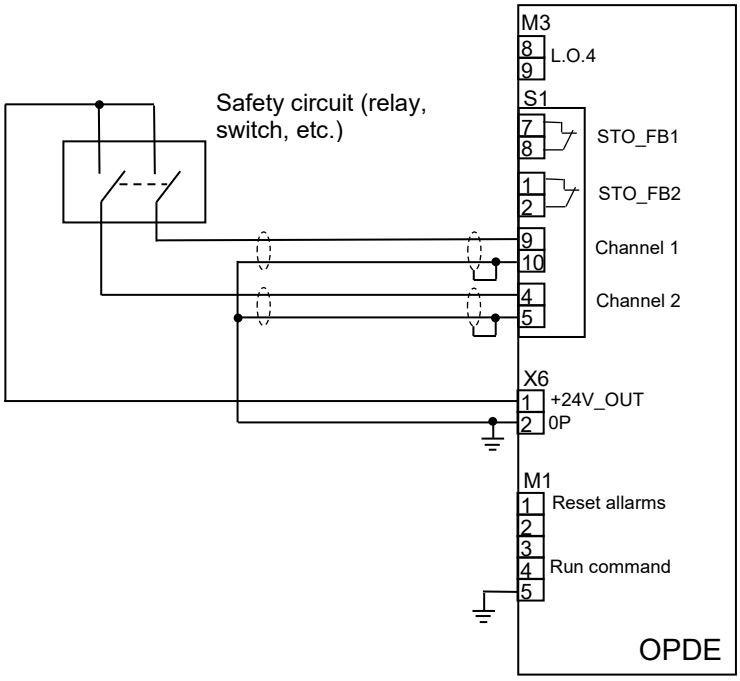
In example 1 it is shown the connection of the two safety channels to a safety circuit (realized for example by a relay, a switch, etc.). In the example it is used an external + 24V. No monitor HW contacts and no logic output LO4 configured with the meaning o23 "STO: not dangerous failure" are used. The sequence of the diagnostic test is the one shown in Fig.3.

The example 2 is similar to Example 1. The only difference is that the auxiliary output present in the terminal X6 of the drive is used to give the +24V to STO channels.

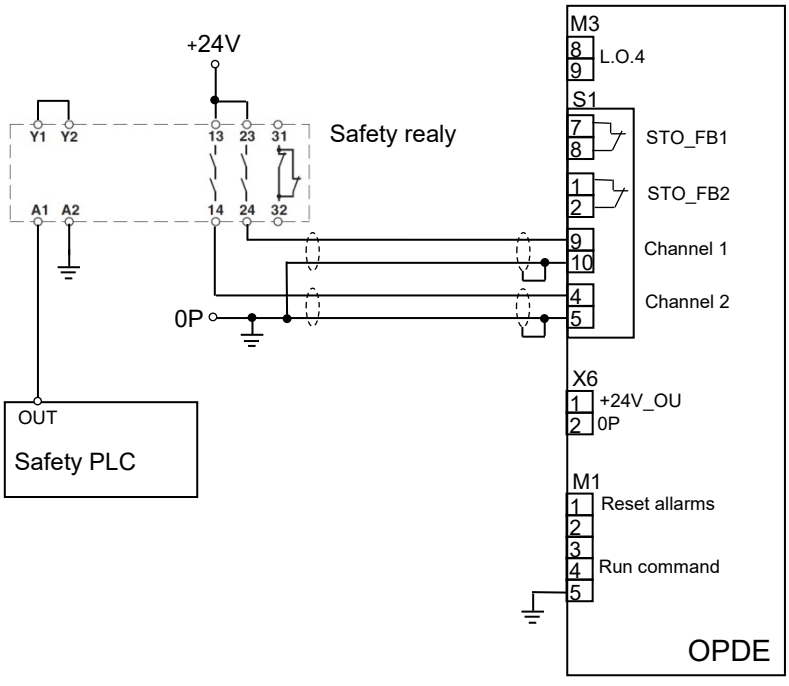
The connection scheme described in Example 3 is the same of Example 1. The security generic circuit has been replaced with a safety relay controlled by a safety PLC.



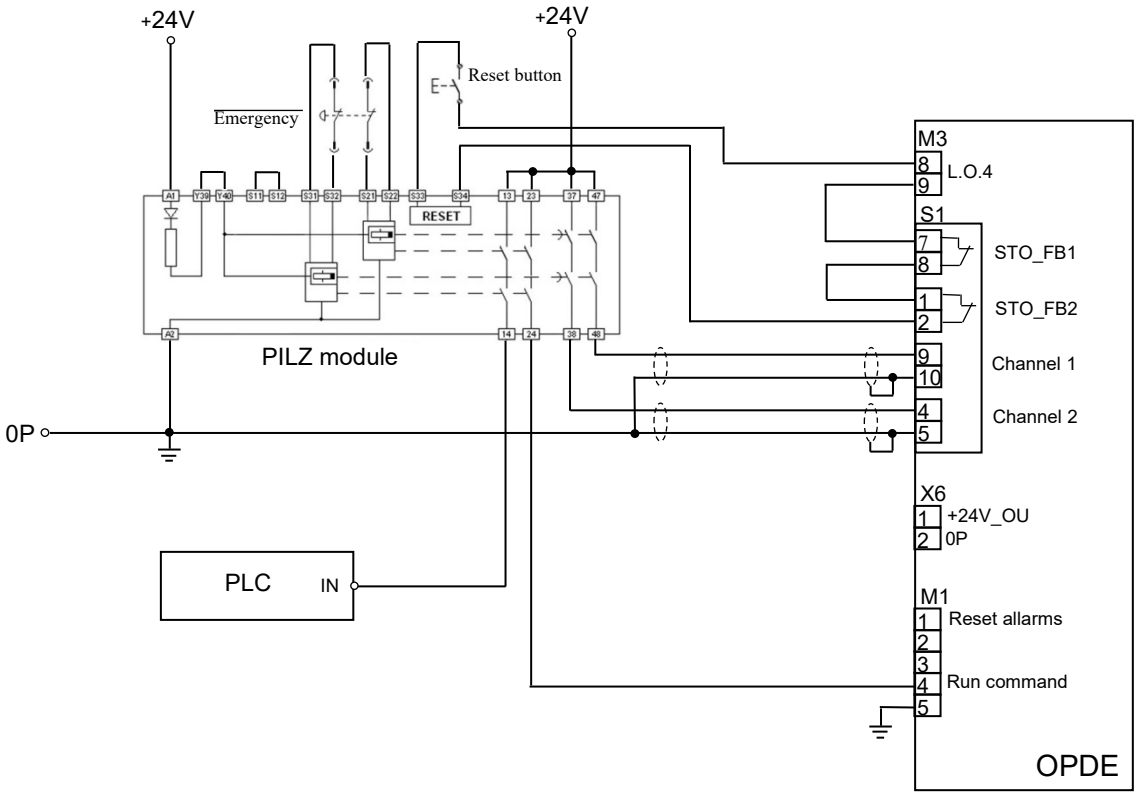
Example 1



Example 2



Example 3



Example 4

In Example 4 the converter OPDE is connected to a safety module. The safety relay should be set to have a manual reset with monitoring and not an automatic start. Are also used both the feedback contacts and the logical output L.O.4 configured with the meaning o23 "STO: failure not dangerous" . All these contacts are placed in series with the reset button. In this way the start of machine and of the drive will be in safety condition and will require to press the reset button. This is necessary in order to make a test upon STO channels and their feedback signals before every starting of machine.
In Example 4 was used a safety Pilz PNOZ XV2 which has two relays. Every relay has two contacts immediate and two timed contacts that trigger after an adjustable delay. In the drive must be activated the "stop with minimum speed" function (set the connection C28 = 1). After the emergency button activation, the drive removes immediately the run command causing a controlled stop. PLC is informed that the emergency button was pressed by its digital input. After a delay time also the timed contacts of the Pilz module open. This brings to the activation of the STO function, activation that occurs when the motor is already halted. The delay time must be greater than the controlled stop time.
The feedback contacts of the STO function are placed in series with the reset button. The reset button allows to exit from the condition of the emergency stop. The restart will then only be enabled if the feedback contacts are closed at the activation of the STO. If it does not, it means that there is a fault within the converter and the feedback contact will remain open. This connection scheme can be used to perform a feedback control of the STO function at every restart.

WARNING: This example works correctly with the connection C73 = 0. To start to work, give a reset pulse alarms command on terminal M1 pin 1 (eg PLC) to exit the safe condition. Once restored the security module, wait for the time indicated in Tab.12 and then give the reset alarms command.

10. TECHNICAL DATA

EN 61800-5-2	
	OPDE 70A, OPDE 90A, OPDE 110A, OPDE 150A, OPDE 175A, OPDE 220A, OPDE 250A, OPDE 310A, OPDE 370A, OPDE 460A, OPDE 570A
SIL	3
PFH	$4.45 \cdot 10^{-9}$ h^{-1}
Hardware Fault Tolerance	1
Lifetime	20 years

Tab.14 – Technical data in according to EN 61800-5-2

UNI EN ISO 13849-1	
	OPDE 70A, OPDE 90A, OPDE 110A, OPDE 150A, OPDE 175A, OPDE 220A, OPDE 250A, OPDE 310A, OPDE 370A, OPDE 460A, OPDE 570A
PL	e
Category	3
PFH	$4.45 \cdot 10^{-9}$ h^{-1}
$MTTF_d$	100 years

Tab.15 – Technical data in according to EN ISO 13849-1

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