

Products Tde Macno

Installation

OPDE DC-DC



Cod. MP01200E00 V\_1.0





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# 1 INTRODUCTION

This manual contains the necessary instructions for installing the OPDE DC-DC equipment.  
For other product information please refer to the "User's Manual" for the specific type of converter.

## 1.1 SYMBOLS USED IN THE CONVERTER MARKING

The OPDE DC-DC converter bears - outside and inside (in the accessible parts for wiring) - **labels** that indicate the presence of danger for people. Here below, there is a legend with the meaning of the symbols used:

SYMBOL	DESCRIPTION
	Caution, risk of danger
	Caution, risk of electric shock
	Caution, risk of electric shock. Accumulation of energy, wait for the time indicated close to the symbol.
	Caution, hot surface
	Protective conductor fastening terminal
	Refer to the installation manual

TAB. 1 – Symbols

## 1.2 WARRANTY

- 1) Within the limits set forth in this warranty, the undersigned manufacturer undertakes to repair any and all manufacturing defects that occur during the warranty period.
- 2) The warranty becomes void if the purchaser does not properly follow all the instructions described in these "Installation Instructions".
- 3) In order to take advantage of the right of warranty, the purchaser, upon occurrence of the fault, shall timely notify it to the manufacturer and allow the same, if necessary, to carry out the related inspections and repairs.
- 4) The purchaser shall bear the transport charges to send the defective part covered by warranty to the manufacturer and then back to the purchaser, in order to allow the repair or replacement of the same. The warranty obligation, as provided in this clause, shall be deemed fulfilled with the delivery to the purchaser of the part properly repaired or replaced.
- 5) During the warranty period referred to in clause 1), labor costs for the repair will be borne by the manufacturer. If repairs or replacements have to be made at the customer's premises, the costs of travel and lodge of the personnel shall be borne by the purchaser.
- 6) The guarantee does not include breaks caused by wrong operation, incompetence, accident or otherwise attributable to the user, both due to himself and to third parties, or when the user has made modifications or repairs without the written consent of the manufacturer, regardless of the connection between such changes or repairs and the detected defects.
- 7) It is expressly agreed that the manufacturer will be relieved from any responsibility for any damages caused to the purchaser by a loss of or decreased production, resulting from manufacturing faults or defects.

## 1.3 CE MARKING / RATING PLATE

The CE marking certifies the conformity of the equipment with the essential safety and health requirements set forth by the European Directives mentioned on the Declaration of CE Conformity.

The rating plate consists of a silver polyester adhesive label with black print, having the following dimensions: L= 102 mm - H= 50 mm (**FIG. 1**). It is applied externally on one side or on the front panel. The rating plate bears the logo, CE marking, type, serial number, main rating data, and power supply voltages.

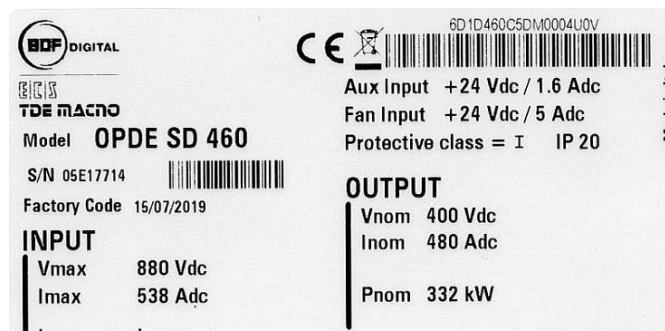


FIG. 1 – CE marking and rating plate

## 1.4 IMPORTANCE OF THE MANUAL



**BEFORE USING THE EQUIPMENT, THE AUTHORIZED OPERATORS MUST MANDATORY READ AND UNDERSTAND THIS MANUAL IN ALL ITS PARTS.**

This technical installation manual was drawn in order to assure an easy and correct understanding of the covered contents by the operators entrusted with the use and maintenance of the involved equipment.

If, despite the attention paid by the manufacturer in drawing up this document, the above mentioned operators should have any doubts concerning the understanding of the document, in order to avoid misinterpretations that may jeopardize safety, they are kindly requested to promptly ask for correct explanations and further information to the manufacturer.

Before using the involved equipment, the authorized operators must mandatory read and understand this technical manual of "Instructions for installation" in all its parts and strictly follow the instructions herein described in order to assure one's own safety and that of others, attain better equipment performance, and assure maximum efficiency and duration of all machine components.

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This manual shall be available for the authorized operators at any time and shall always be well stored and protected close to the equipment.



**THIS MANUAL SHALL ALWAYS BE AVAILABLE FOR THE AUTHORIZED OPERATORS AND SHALL ALWAYS BE CLOSE TO THE EQUIPMENT, WELL STORED AND PROTECTED.**



**THE MANUFACTURER SHALL NOT BE MADE LIABLE FOR ANY DAMAGES TO PEOPLE, ANIMALS AND/OR THINGS CAUSED BY THE INOBSERVANCE OF THE INSTRUCTIONS AND WARNINGS HEREIN CONTAINED.**

**IN CASE OF TRANSFER OF THE EQUIPMENT TO ANOTHER USER, IT IS COMPULSORY FOR THIS MANUAL TO BE HANDED OUT TOGETHER WITH THE EQUIPMENT.**

**THIS MANUAL COMPLIES WITH THE STATE OF THE ART OF TECHNOLOGY AT THE TIME OF THE TRADING OF THE EQUIPMENT AND SHALL NOT BE CONSIDERED INAPPROPRIATE IF, DUE TO NEW EXPERIENCES, IT MAY BE UPDATED LATER ON.**

**IN CASE OF LOSS OR DETERIORATION OF THE MANUAL REQUEST A COPY FROM THE MANUFACTURER SPECIFYING THE IDENTIFICATION DATA OF THE EQUIPMENT (SEE CE MARKING / RATING PLATE) AND THE REVISION.**



**IF THE INVOLVED EQUIPMENT IS USED IN A DIFFERENT WAY THAN THAT SPECIFIED BY THE MANUFACTURER, THE SAFETY GIVEN BY THE EQUIPMENT COULD BE LOST.**

## **1.5 READING HINTS**



**THE GENERIC HAZARD SIGN AND THE FRAMED TEXT IN CAPITAL LETTERS FOCUSES THE ATTENTION OF THE USER ON THE WARNINGS CONTAINED IN THIS MANUAL.**

**Bold:** It highlights some meaningful sentences in the text.

## 2 INTENDED USE

The **OPDE DC-DC converter** has been designed and implemented for the following intended use:

Field of use	DC/DC power conversion
Place of use	<p>In a close, covered, and dry environment showing the temperature and humidity values indicated under <b>TAB. 7, TAB. 8, TAB. 9, TAB. 10</b> and complying with the law provisions in force in the country of use concerning occupational safety and health in the place of work. The converter OPDE DC-DC must be fixed to a wall that assures its stability in relation to the involved overall dimensions and weight (<b>TAB. 3A, TAB 3B, TAB 3C</b>), and respecting the minimum positioning measures.</p> <p><b>N.B.: IN THE PLACE OF USE OF THE ENERGY OPDE CONVERTER, THE PRESENCE OF WATER OR HUMIDITY ABOVE 95% THAT CAN EASE OR INCREASE THE RISK OF ACCIDENTAL ELECTRIC SHOCK AND/OR CAUSE DAMAGE TO THE SAME IS STRICTLY FORBIDDEN.</b></p>
Entrusted operator (suitable person)	<p>This technical manual is intended exclusively for the authorized operators entrusted with the use and maintenance of the equipment according to the specific technical and professional skills required by the type of works.</p> <p><b>THE AUTHORIZED OPERATORS SHALL PERFORM ON THE EQUIPMENT EXCLUSIVELY THE INTERVENTIONS INCLUDED IN THEIR SPECIFIC AREA OF COMPETENCE. BEFORE PERFORMING ANY INTERVENTION ON THE EQUIPMENT, THE AUTHORIZED PEOPLE SHALL MAKE SURE TO BE IN SUCH A MENTAL AND PHYSICAL CONDITION AS TO ASSURE THE OBSERVANCE OF SAFETY CONDITIONS AT ANY TIME.</b></p> <p>The entrusted operator is a qualified technician (a suitable person meeting the technical and professional requirements required by current standards), authorized to install and use the equipment operating even in the presence of voltage and with disabled protections (with the consent of the Safety Manager) in strict compliance with the instructions contained in this manual or any other document, which is provided exclusively by the manufacturer.</p>

### 2.1 STATE OF “SWITCHED OFF” DEVICE

Before performing any type of maintenance and/or adjustment on the equipment, it is compulsory to disconnect the power source. The converter can be considered turned off when at least one of the following conditions is met:

- the main switches on the DC mains side are disconnected;
- the fuses series connected to the DC mains and DC bus are removed;
- not any power supply is provided.

Moreover, it is necessary to wait at least minimum 8 minutes to be sure that all the live parts are discharged as indicated in the adhesive labels applied to the **OPDE DC-DC (FIG. 2)** converter.



FIG. 2 – Sign labels

### 3 NAME OF THE DEVICE

The device in question is called as follows: **OPDE DC-DC**

The code OPDE-SD DC-DC that is shown on the device label is described below.

	<b>6</b>	Level	<b>6</b> = level 6
<b>D</b>	<b>1</b>	OPDE	<b>D1</b> = OPDE
	<b>D</b>	Type	<b>D</b> = OPDE-SD DC-DC
		Size	<b>022</b> = 22A - <b>032</b> = 32A - <b>040</b> = 40A - <b>048</b> = 48A - <b>060</b> = 60A - <b>070</b> = 70A - <b>090</b> = 90A - <b>110</b> = 110A - <b>150</b> = 150A (CASE1 C) - <b>175</b> = 175A - <b>220</b> = 220A - <b>250</b> = 250A (CASE2) - <b>310</b> = 310A - <b>370</b> =370A - <b>460</b> = 460A (CASE3)
		Overload	<b>X</b> = Standard (5kHz PWM) (All possible overloads) <b>C</b> = 3 kHz PWM
<b>5</b>	<b>D</b>	Mains voltage	<b>5D</b> = 560V VDC
	<b>M</b>	Drive	<b>M</b> = Drive + Reg. → 24V external (case1C, 2, 3)
	<b>0</b>	Brake	<b>0</b> = NO BRAKE
	<b>0</b>	Speed sensor 1	<b>0</b> = no feedback
	<b>0</b>	Speed sensor 2	<b>0</b> = no feedback
		Fieldbus	<b>0</b> = No fieldbus <b>1</b> = Profibus <b>3</b> = Can Bus <b>4</b> = Ethercat <b>5</b> = Hsc (high speed communication)
		I/O	<b>0</b> = No <b>U</b> = Display + I/O + RS485 serial line OPTO + USB port <b>X</b> = Display + I/O + RS485 serial line OPTO
	<b>0</b>	Field	<b>0</b> = Standard
	<b>V</b>	Customization	<b>V</b> = standard BDF Digital (a different letter refers to a specific customization)



## 4 NAME OF THE COMPONENTS AND MECHANICAL DIMENSIONS

FIG. 3, FIG. 4, FIG. 5, FIG. 6, FIG. 7, TAB. 3A, TAB. 3B, TAB. 3C, TAB. 3D, TAB. 3E represent and show the names of the main components and the overall dimensions of the OPDE DC-DC converter.

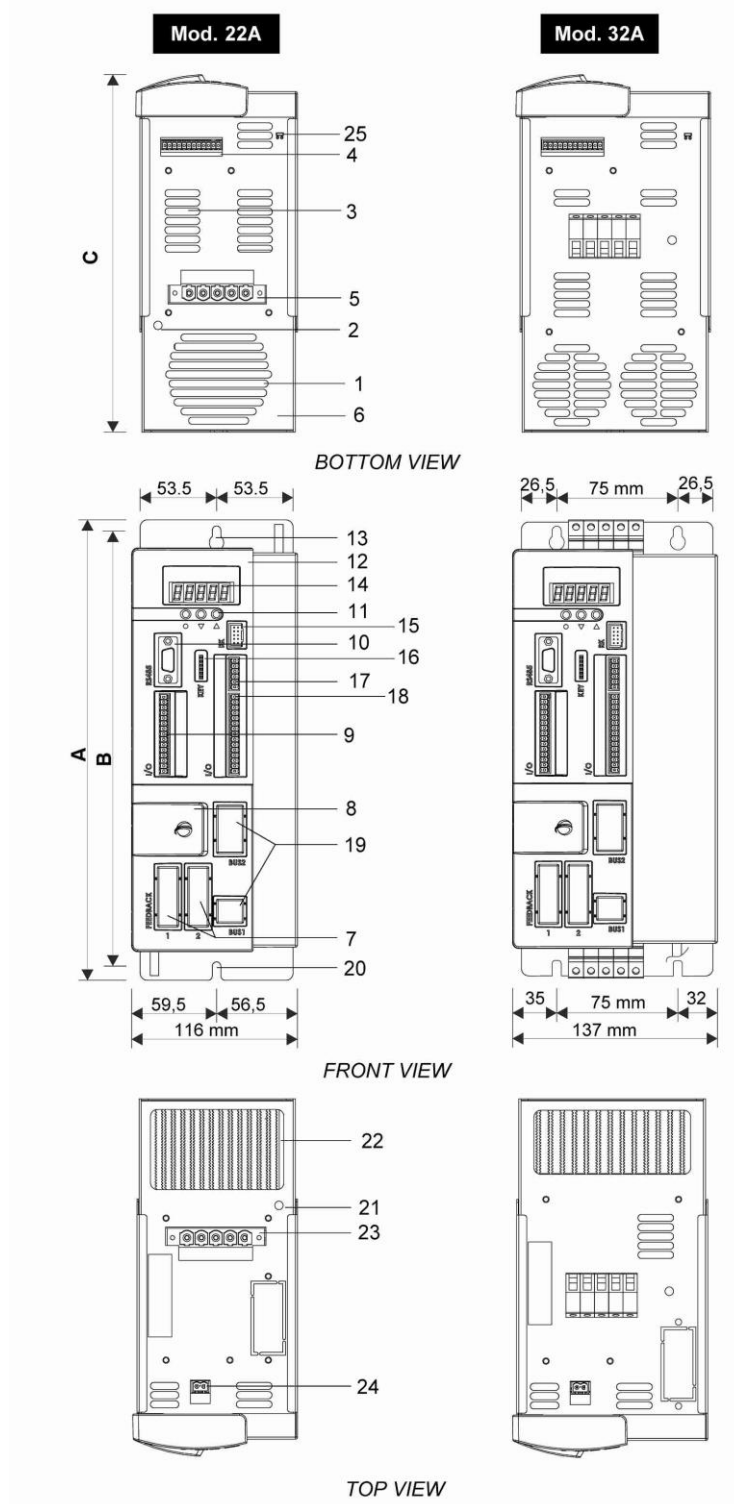


FIG. 3 – Name of the components OPDE SD 22 and 32

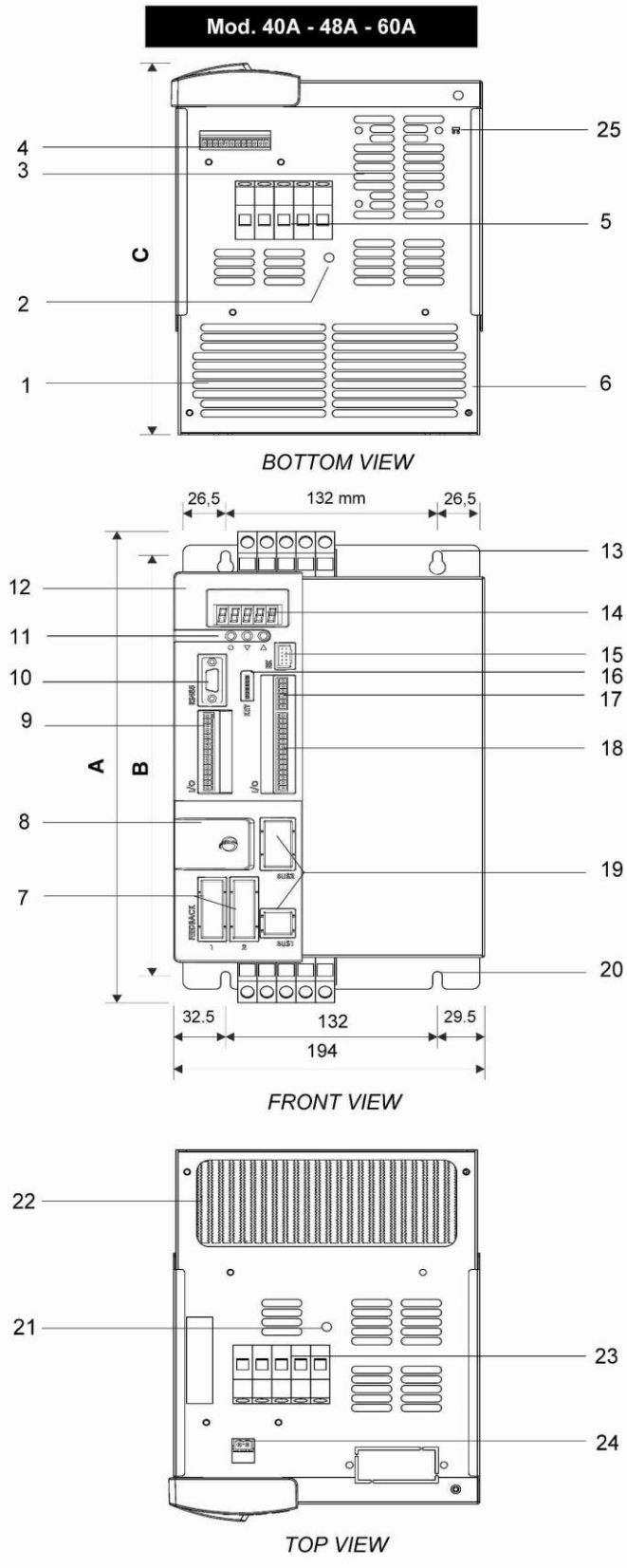
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**LEGEND 3:**

1. Bottom ventilation openings
2. Ground terminal for motor cable
3. Ventilation openings
4. Connector for management of motor thermal probes and simulated encoder (M4)
5. Terminal board for motor and braking resistor connection
6. Case
7. Feedback boards (option)
8. Removable plastic cover
9. Digital and analog I/O connector (M1)
10. Serial port 485/422 (J1)
11. Push buttons to set and display the parameters
12. Fixed plastic cover
13. Upper mounting bracket
14. Drive status parameters and display
15. Connector for hand-held or remote keypad
16. Connector for parametrization key
17. Frequency input connector (M2)
18. Digital and analog I/O connector (M3)
19. Fieldbus connector (option)
20. Lower mounting bracket
21. Ground terminal
22. Top ventilation openings
23. Line input terminal
24. Power connector for regulation board or output +24V (X3)
25. +24V power supply connector for cooling fans (X8)

<b>MOD. OPDE-SD DC-DC</b>		<b>22</b>	<b>32</b>
Height [mm]	A	303	322
	B	287	287
Width [mm]		116	137
Depth [mm]	C	253	253
Fastening screws		M4	M4
Weight [kg]		5,5	6,4

**TAB. 2A – Mechanical dimensions and weight of OPDE SD 22 and 32**



**FIG. 4 – Name of the components OPDE SD 40, 48 and 60**

**LEGEND FIG. 4:**

1. Bottom ventilation openings
2. Ground terminal for motor cable
3. Ventilation openings
4. Connector for management of motor thermal probes and simulated encoder (M4)
5. Terminal board for motor and braking resistor connection
6. Case
7. Feedback boards (option)
8. Removable plastic cover
9. Digital and analog I/O connector (M1)
10. Serial port 485/422 (J1)
11. Push buttons to set and display the parameters
12. Fixed plastic cover
13. Upper mounting bracket
14. Drive status parameters and display
15. Connector for hand-held or remote keypad
16. Connector for parametrization key
17. Frequency input connector (M2)
18. Digital and analog I/O connector (M3)
19. Fieldbus connector (option)
20. Lower mounting bracket
21. Ground terminal
22. Top ventilation openings
23. Line input terminal
24. Power connector for regulation board or output +24V (X3)
25. +24V power supply connector for cooling fans (X8)

<b>MOD. OPDE-SD DC-DC</b>		<b>40-48</b>	<b>60</b>
Height [mm]	A	322	322
	B	287	287
Width [mm]		194	194
Depth [mm]	C	273	273
Fastening screws		M4	M4
Weight [kg]		9,3	10

**TAB. 3B – Mechanical dimensions and weight of OPDE SD 40, 48 and 60**

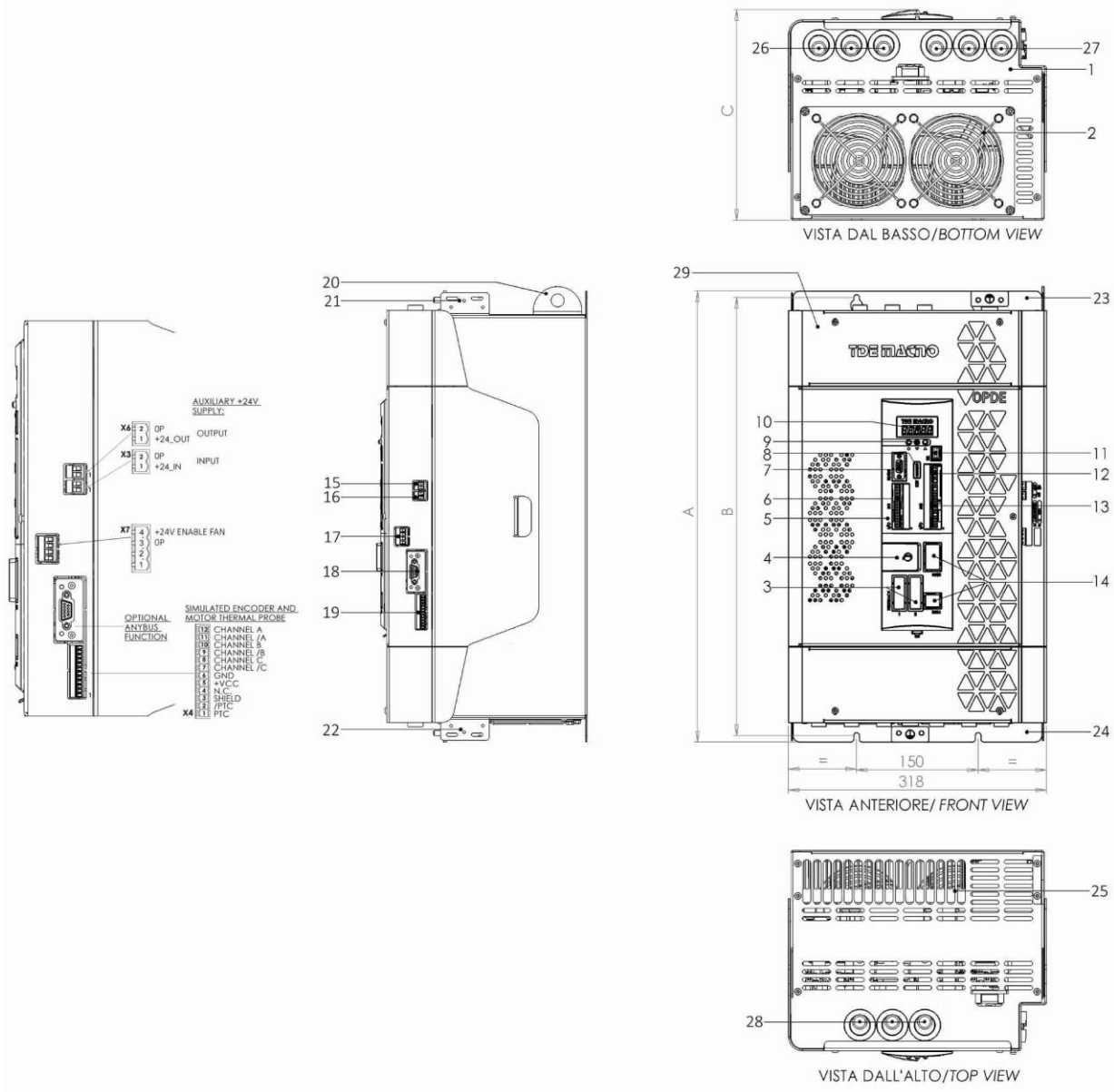


FIG. 5 – Name of the components OPDE SD 70, 90, 110 and 150

**LEGEND FIG. 5:**

26. Case
27. Extractable cooling fan
28. Feedback boards (option)
29. Removable plastic cover
30. Fixed plastic cover
31. Digital and analog I/O connector (M1)
32. Serial port 485/422 (J1)
33. Connector for parameterization key
34. Push buttons to set and display the parameters
35. Drive status parameters and display
36. Connector for hand-held or remote keypad
37. Frequency input connector (M2)
38. Digital and analog I/O connector (M3)
39. Fieldbus connector (option)
40. +24 VDC output connector (X6)
41. +24 VDC regulation board power supply (X3)
42. +24VDC connector for enabling cooling fans supply (X7)
43. Anybus connector (X5) (option)
44. Connector for management of motor thermal probes and simulated encoder (X4)
45. Lifting eyebolts
46. Upper shield bracket
47. Lower shield bracket
48. Upper mounting bracket
49. Lower mounting bracket
50. Top ventilation openings
51. Grid input power connections
52. Output power connections (motor side)
53. Positive and negative DC bus and braking power connections
54. Internal +24V power supply connector for cooling fans (X8)

<b>MOD. OPDE-SD DC-DC</b>		<b>70, 90, 110, 150</b>
Height [mm]	A	556
	B	540
Width [mm]		318
Depth [mm]	C	259
Fastening screws		M6
Weight [kg]		24

**TAB. 4C – Mechanical dimensions and weight of OPDE SD 70, 90, 110 and 150**

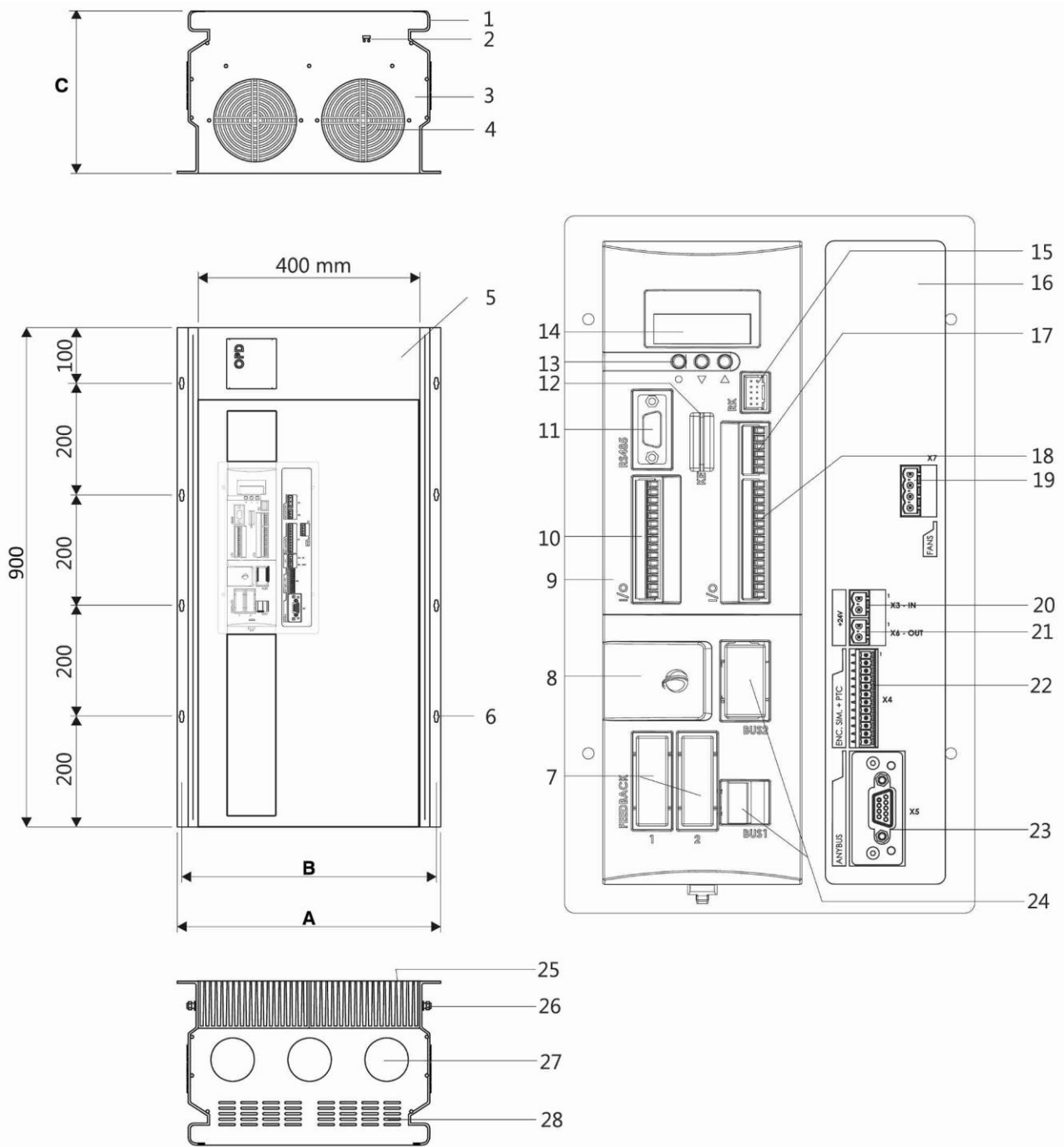


FIG. 6 – Name of the components OPDE SD 175, 220 and 250

**LEGEND FIG. 6:**

1. Case supporting shoulders or wall hooking
2. +24V power supply connector for cooling fans (X8)
3. Case
4. Cooling fans of the power module
5. Panel covering the power terminals
6. Mounting holes
7. Feedback boards (option)
8. Removable plastic cover
9. Fixed plastic cover
10. Digital and analog I/O connector (M1)
11. Serial port 485/422 (J1)
12. Connector for parameterization key
13. Keys for setting and displaying the parameters
14. Display for converter status and parameter display
15. Connector for handheld or remote keypad
16. Fixed cover
17. Frequency input connector (M2)
18. Digital and analog I/O connector (M3)
19. +24VDC connector for enabling cooling fans supply (X7)
20. +24 VDC regulation board power supply (X3)
21. +24 VDC output connector (X6)
22. Connector for the management of the temperature sensors of the motor and simulated encoder (X4)
23. Anybus connector (X5)
24. Fieldbus connector (option)
25. Cooling heat sink fins
26. Ground terminal
27. Holes for cable/bar passage
28. Upper side venting openings

<b>MOD. OPDE AFE ENERGY</b>		<b>175, 220, 250</b>
Height [mm]		900
Width [mm]	A	478
	B	462
Depth [mm]	C	296
Fastening screws		M6
Weight [kg]		65

**TAB. 3D – Mechanical dimensions and weight of OPDE SD 175, 220, 250**



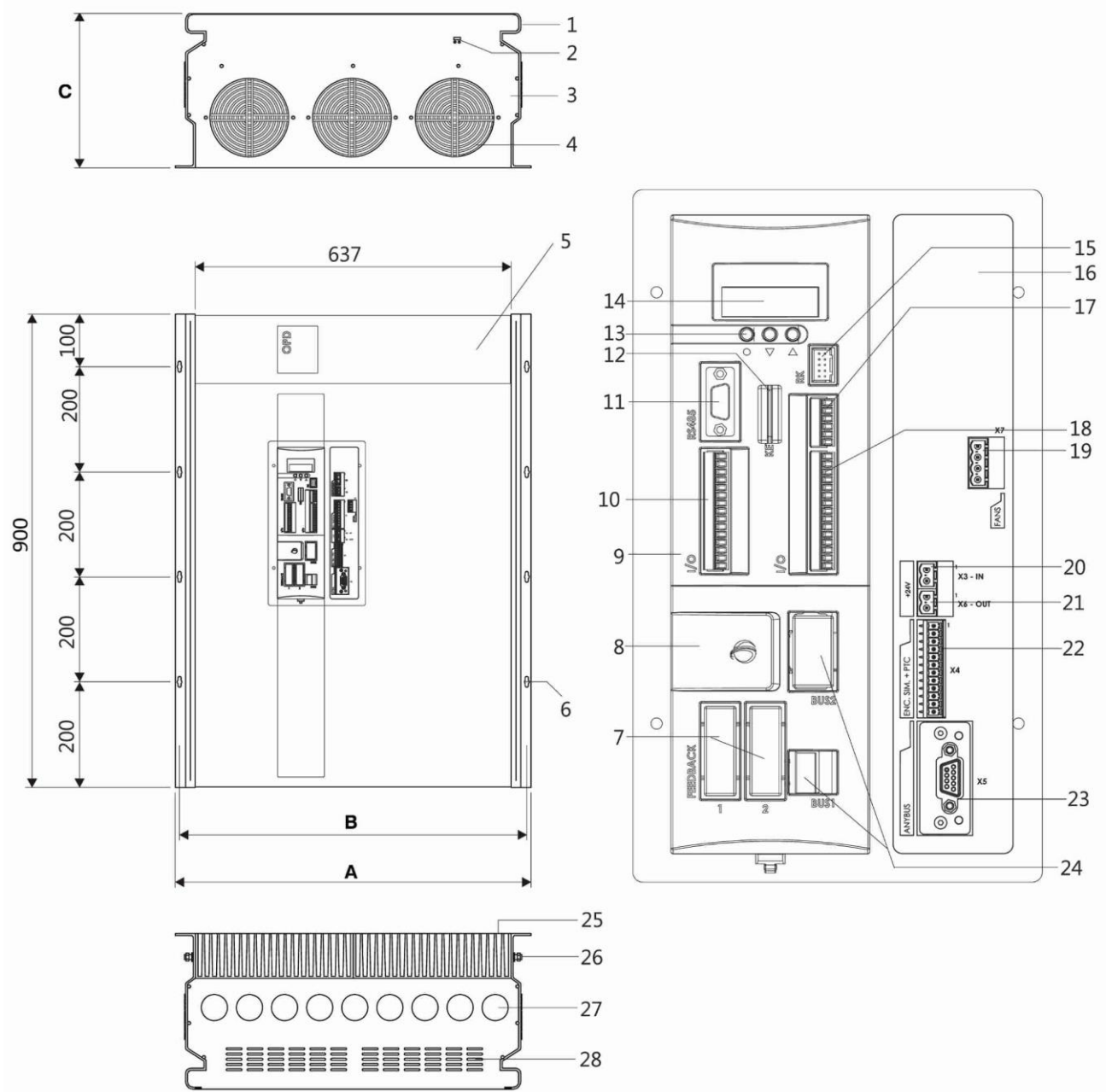


FIG. 7 – Name of the components OPDE SD 310, 370 and 460

**LEGEND FIG. 7:**

1. Case supporting shoulders or wall hooking
2. +24V power supply connector for cooling fans (X8)
3. Case
4. Cooling fans of the power module
5. Panel covering the power terminals
6. Mounting holes
7. Feedback boards (option)
8. Removable plastic cover
9. Fixed plastic cover
10. Digital and analog I/O connector (M1)
11. Serial port 485/422 (J1)
12. Connector for parameterization key
13. Keys for setting and displaying the parameters
14. Display for converter status and parameter display
15. Connector for handheld or remote keypad
16. Fixed cover
17. Frequency input connector (M2)
18. Digital and analog I/O connector (M3)
19. +24VDC connector for enabling cooling fans supply (X7)
20. +24 VDC regulation board power supply (X3)
21. +24 VDC output connector (X6)
22. Connector for the management of the temperature sensors of the motor and simulated encoder (X4)
23. Anybus connector (X5)
24. Fieldbus connector (option)
25. Cooling heat sink fins
26. Ground terminal
27. Holes for cable/bar passage
28. Upper side venting openings

<b>MOD. OPDE AFE ENERGY</b>		<b>310, 370, 460</b>
Height [mm]		900
Width [mm]	A	678
	B	662
Depth [mm]	C	296
Fastening screws		M6
Weight [kg]		80

**TAB. 3E – Mechanical dimensions and weight OPDE SD 310, 370 and 460**

## 5 STORAGE - HANDLING

### 5.1 STORAGE ENVIRONMENTAL CONDITIONS

If the **OPDE DC-DC converter** has to remain stored for a long time, it is necessary to store it in a safe environment with an adequate temperature and humidity degree, and protected against dust.

Temperature	-20÷60	°C
Humidity	5÷95	%
Condensation	NO	

TAB. 5 – Storage



**EVERY 6 MONTHS – 1 YEAR, IT IS NECESSARY TO REGENERATE THE POWER BUS CAPACITORS. FIRST IMPLEMENT THE RECOVERY PROCEDURE AFTER STORAGE (PAR. 5.2) WITH SWITCHED OFF CONVERTER. THEN, FEED THE OPDE ENERGY THROUGH X3 (AUXILIARY POWER SUPPLY FOR THE ADJUSTMENT SIDE) AND THE + AND - BARS (POWER SUPPLY OF THE POWER SIDE) FOR AT LEAST 2 HOURS WITHOUT GIVING THE RUNNING CONSENT.**

### 5.2 RECOVERY PROCEDURE AFTER THE STORAGE

The converter cannot be used immediately after a storage period. To prevent faults, it is necessary to adopt the following recovery procedure.

PHASE 1: Let the converter stay for an hour under the environmental conditions specified in TAB. 6

Not powered converter		
Temperature	15÷35	°C
Humidity	5÷75	%
Condensation	NO	
Atmospheric pressure	86÷106	kPa
Recovery time <sup>(1)</sup>	1	h

<sup>(1)</sup>After this recovery time, there should be no trace of condensation inside or outside the converter (well ventilated environment).

TAB. 6 – Recovery after storage

PHASE 2: If the time since the last regeneration of the electrolytic capacitors in the power bus is included between 6 months and one year, it is necessary to perform the regeneration once again: feed the OPDE DC-DC through the terminal X3 (24 Vdc auxiliary power supply for the regulation side) and the + and - bars (560 Vdc power supply of the power side, by means of external precharge) for at least 2 hours without giving the running consent.

Once the regeneration process has ended, the converter can work normally.



**THE REGENERATION PROCEDURE OF THE POWER BUS ELECTROLYTIC CAPACITORS GIVEN ABOVE IS NO MORE VALID IF:**

- **THE TIME ELAPSED SINCE THE LAST REGENERATION IS GREATER THAN 1 YEAR**
  - **THE TIME ELAPSED SINCE THE PURCHASE IS GREATER THAN 1 YEAR AND THE REGENERATION PROCEDURE HAS NEVER BEEN DONE**
- IN THESE CASES, IT IS NECESSARY TO REQUEST FROM BDF DIGITAL WHICH IS THE OPERATING PROCEDURE TO BE ADOPTED.**

### 5.3 HANDLING

The OPDE DC-DC converters size 175, 220, 250, 310, 370 and 460, after unpacking, are easily transportable with a forklift truck or a crane equipped with suitable lifting hooks to be attached to the lifting brackets applied on the sides of the converters. Dimensions and weights are given in Chapter 4. For OPDE DC-DC converters size 70, 90, 110 and 150, instead, there are no brackets for lifting. Given their limited size and weight, the converters can be transported directly by the entrusted personnel.

Protect the equipment against bumps during handling.

## 6 LIMITS OF USE

OPDE DC-DC has to be installed inside an electrical panel, which can also not be conditioned. In this case, the environmental limits of use are given below.

### 6.1 CLIMATIC CONDITIONS

Environmental parameter	Limits	Measurement unit
Operating temperature	-20÷50	°C
Humidity	5÷95	%
Atmospheric pressure	70÷106 <sup>(1)</sup>	kPa
Maximum movement of the surrounding air	1	m/s
Maximum temperature gradient	0.5	°C/min
Maximum thermal radiation	700	W/m <sup>2</sup>
Condensation	NO	
Rainfall with wind	NO <sup>(2)</sup>	
Water of different origin from rain	NO	
Icing	NO	

<sup>(1)</sup>The air pressure limits correspond to an operating field of 0÷2000m a.s.l. In fact, over 1000 m above sea level, it is necessary to derate the rated current of the converter by 1% per 100 m.

<sup>(2)</sup>The converter must be installed inside an electrical panel and, therefore, not outdoor.

TAB. 7 – Climatic conditions

### 6.2 RESISTANCE TO CHEMICALLY ACTIVE SUBSTANCES

3C1R class according to EN 60721-3-3

Environmental parameter	Maximum value	Measurement unit
Sea salts	NO	-
Sulfur dioxide	0.01 0.0037	mg/m <sup>3</sup> cm <sup>3</sup> /m <sup>3</sup>
Hydrogen sulfide	0.0015 0.001	mg/m <sup>3</sup> cm <sup>3</sup> /m <sup>3</sup>
Chlorine	0.001 0.00034	mg/m <sup>3</sup> cm <sup>3</sup> /m <sup>3</sup>
Hydrochloric acid	0.001 0.00066	mg/m <sup>3</sup> cm <sup>3</sup> /m <sup>3</sup>

Environmental parameter	Maximum value	Measurement unit
Hydrofluoric acid	0.001 0.0012	mg/m <sup>3</sup> cm <sup>3</sup> /m <sup>3</sup>
Ammonia	0.03 0.042	mg/m <sup>3</sup> cm <sup>3</sup> /m <sup>3</sup>
Ozone	0.004 0.002	mg/m <sup>3</sup> cm <sup>3</sup> /m <sup>3</sup>
Nitrogen oxide	0.01 0.005	mg/m <sup>3</sup> cm <sup>3</sup> /m <sup>3</sup>

TAB. 8 – Resistance to chemically active substances

### 6.3 RESISTANCE TO VIBRATIONS

As regards vibrations, the limits of use are the following:

10Hz ≤ frequency ≤ 57Hz	0,075	mm (amplitude)
57Hz ≤ frequency ≤ 150Hz	1	G

TAB. 9 – Vibrations

In the case of vibration above the indicated limits, it is necessary to adopt suitable damping solutions.

### 6.4 PROTECTION AND POLLUTION DEGREE

Protection degree	IP00
Pollution degree	2

TAB. 10 – Protections

## 7 INSTALLATION INSTRUCTIONS

OPDE DC-DC has to be installed under the ambient conditions specified in the section "Limits of use" and in compliance with the following instructions:

- 1) Position the **OPDE DC-DC** converter observing the minimum positioning measures.
- 2) Connect the **OPDE DC-DC** converter to the wall using screws, according to the dimensions shown.
- 3) Prevent metallic residues resulting from drilling or works performed on connection electrical cables from falling into the converter.
- 4) In no case, the converter has to be mounted close to easily flammable materials.



**IT IS COMPULSORY TO HAVE AUTHORIZED OPERATORS PERFORM THE INSTALLATION OF THE OPDE DC-DC CONVERTER**

**IT IS COMPULSORY TO INSTALL THE OPDE DC-DC CONVERTER BEING SURE THAT THE ELECTRICAL PANEL TO WHICH IT IS GOING TO BE CONNECTED DOES NOT SHOW ANY POWER SUPPLY.**

**ANY OPERATION WITHIN THE OPDE DC-DC CONVERTER MUST BE DONE WITHOUT VOLTAGE PRESENCE AND, IN ANY CASE, WAIT FOR AT LEAST 8 MIN. BEFORE ACCESSING THE SAME (FIG. 2).**

**IT IS COMPULSORY TO INSTALL THE OPDE DC-DC CONVERTER ONLY IN VERTICAL POSITION BECAUSE ONLY IN THIS WAY HEAT CONVECTION IS NOT HINDERED, WHICH WOULD CAUSE DAMAGES. IF IT IS NECESSARY TO INSTALL THE CONVERTER IN NON VERTICAL POSITION CONTACT THE TECHNICIAN OF BDF DIGITAL TO EVALUATE THE SITUATION CASE BY CASE.**

**IT IS COMPULSORY TO ASSURE A GOOD ACCESS TO ALL THE CONTROL ELEMENTS.**

**OPDE DC-DC MUST NECESSARILY BE INSTALLED CLOSE TO THE SUPPORT WALL IN ORDER TO PROPERLY CHANNEL THE AIR FLOW IN THE HEAT SINK.**

**IT IS COMPULSORY TO INSTALL SEVERAL OPDE DC-DC DRIVES SIDE BY SIDE TO ASSURE A GOOD VENTILATION AND PREVENT THE COOLING AIR FLOW OF A CONVERTER FROM AFFECTING THE OTHER.**

**THE CONVERTER INSTALLATION SHALL NOT HINDER ACCESS TO DISCONNECTING AND CUTTING-OFF TOOLS.**

**IF THE CONVERTER IS USED IN A DIFFERENT WAY THAN THOSE SPECIFIED BY THE MANUFACTURER, THE PROTECTIONS PROVIDED BY THE CONVERTER ARE NOT GUARANTEED.**

### 7.1 CLOSED ENVIRONMENT: DISSIPATED POWER

**TAB. 11** indicates the power dissipated by the converter operating at rated current, including adjustment, ventilation and power IGBT losses. During an installation in a closed environment, e.g. in a cabinet, it is necessary to make sure that the inner temperature does not exceed the ambient temperature permissible for the converter. The environment has to be ventilated with a sufficient air quantity as to remove the heat generated by the same and by the other components.

Size	Dissipated power [W]	Air flow rate [m <sup>3</sup> /h]
70	800	308
90	1100	360
110	1200	460
150	1500	820
175	1900	820
220	2500	1080
250	2700	1080
310	3300	1620
370	3900	1620
460	3500	1620

**TAB. 11 – Dissipated power**



SOME PARTS OF THE CONVERTER METAL CASE MAY EXCEED 70 °C DURING OPERATION. THEY ARE MARKED BY THE SPECIAL LABEL "CAUTION, HOT SURFACE" SHOWN HERE ON THE SIDE.

## 7.2 ELECTRIC CONNECTIONS



ALL THE FOLLOWING OPERATIONS ARE NECESSARY TO PREPARE THE ELECTRIC CONNECTION OF OPDE DC-DC CONVERTER.

DC INPUT VOLTAGE AND DC OUTPUT VOLTAGE SHALL SATISFY THE TECHNICAL FEATURES SHOWN IN THE TAB. 24A, 24B, 24C, 24D AND MEET THE REQUIREMENTS SET FORTH BY THE REGULATIONS IN FORCE IN THE COUNTRY OF USE THEREOF.

ANY TYPE OF ELECTRICAL EQUIPMENT (CABLES, OUTLETS, PLUGS, ETC.) USED FOR THE CONNECTION MUST BE SUITABLE FOR USE, "CE" MARKED - IF SUBJECT TO THE LOW VOLTAGE DIRECTIVE 2006/95/EC, AND COMPLY WITH THE REQUIREMENTS SET FORTH BY THE APPLICABLE LAW IN FORCE IN THE COUNTRY OF USE OF THE OPDE DC-DC CONVERTER.

THE MANUFACTURER DENIES ALL LIABILITY FOR FAULTS OR MALFUNCTIONS OF THE OPDE DC-DC CONVERTER DUE TO SUDDEN VOLTAGE CHANGES EXCEEDING THE TOLERANCES SET BY THE POWER DISTRIBUTION COMPANY (VOLTAGE  $\pm 10\%$ ).

FAILURE TO FOLLOW THE ABOVE PRECAUTIONS MAY RESULT IN PERMANENT DAMAGES TO THE ELECTRICAL EQUIPMENT OF THE OPDE DC-DC CONVERTER, AND IN THE FOLLOWING VOIDNESS OF THE WARRANTY.

THE MANUFACTURER DENIES ALL LIABILITY FOR ANY DAMAGES TO PEOPLE, ANIMALS AND/OR PROPERTY CAUSED BY THE INCORRECT ELECTRICAL CONNECTION OF THE OPDE DC-DC CONVERTER AND ITS COMPONENTS.

Here below, there is the list of the main power and input/output ports of OPDE DC-DC:

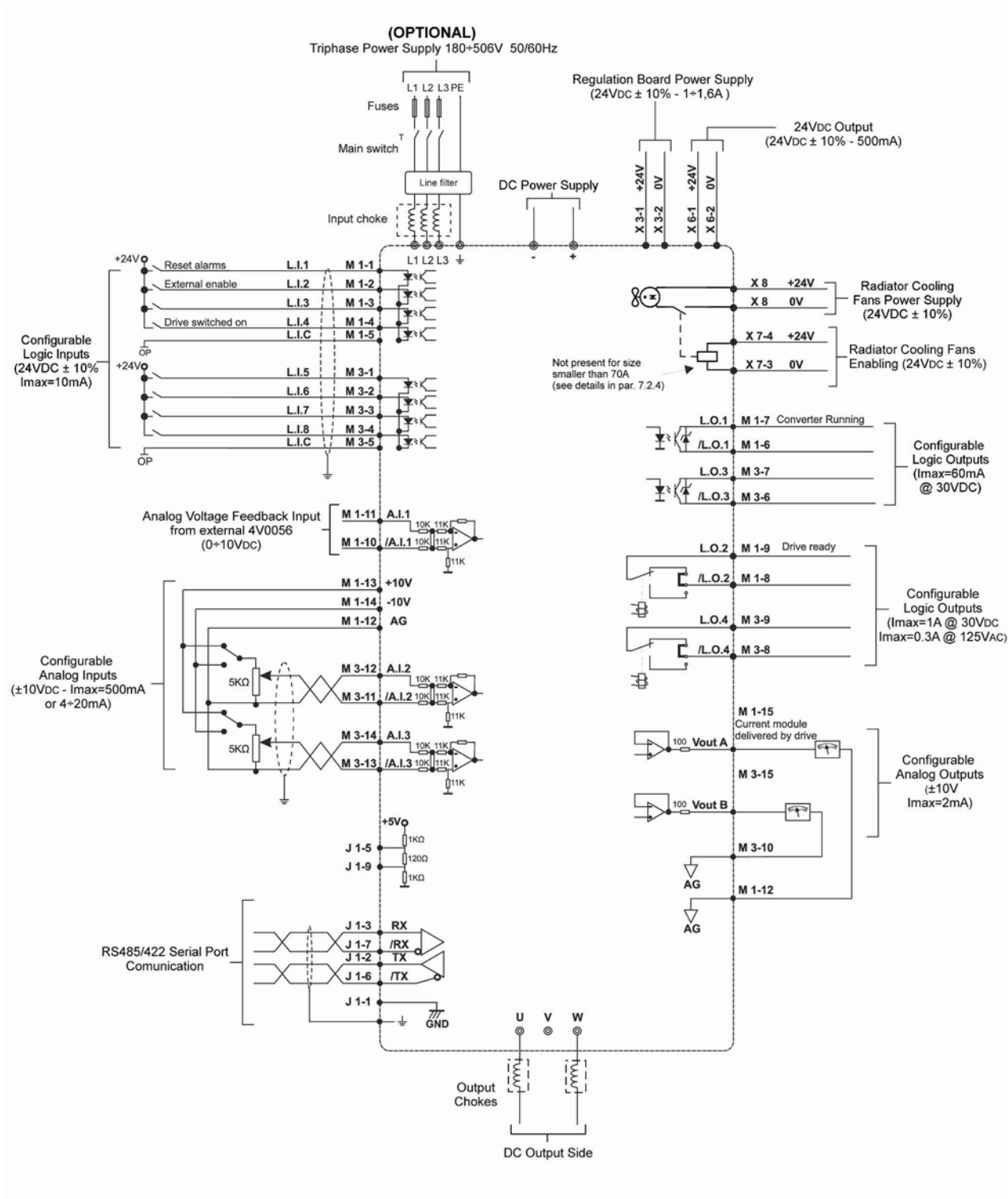


FIG. 8 – Electric connections

### 7.2.1 Power side

The OPDE SD converter is a two legs DC/DC converter with four IGBT bridge, it is bidirectional and operates in two quadrant mode. DC input power supply is the standard configuration. Three phase AC input power supply can be required as an option, in this case the unit become an AC/DC converter with diode input bridge and unidirectional operation mode. The power stage is shown in the following figure.

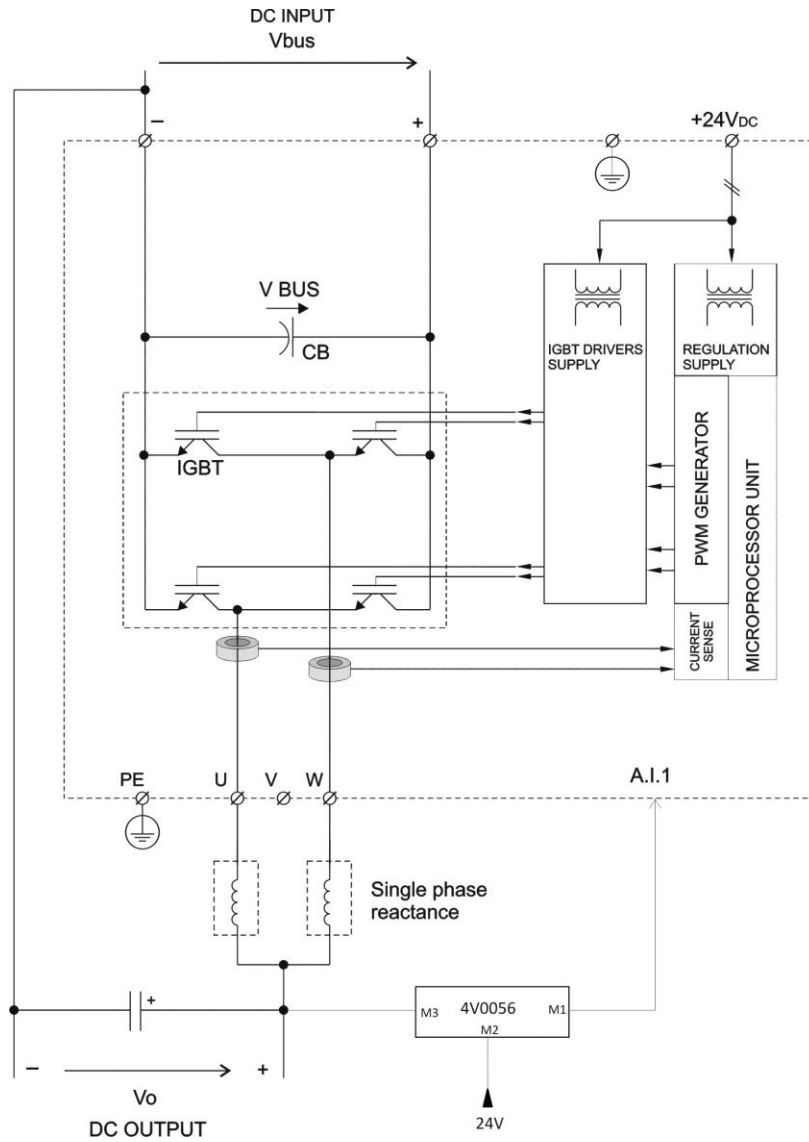


FIG. 9 – Power stage with DC input (standard)



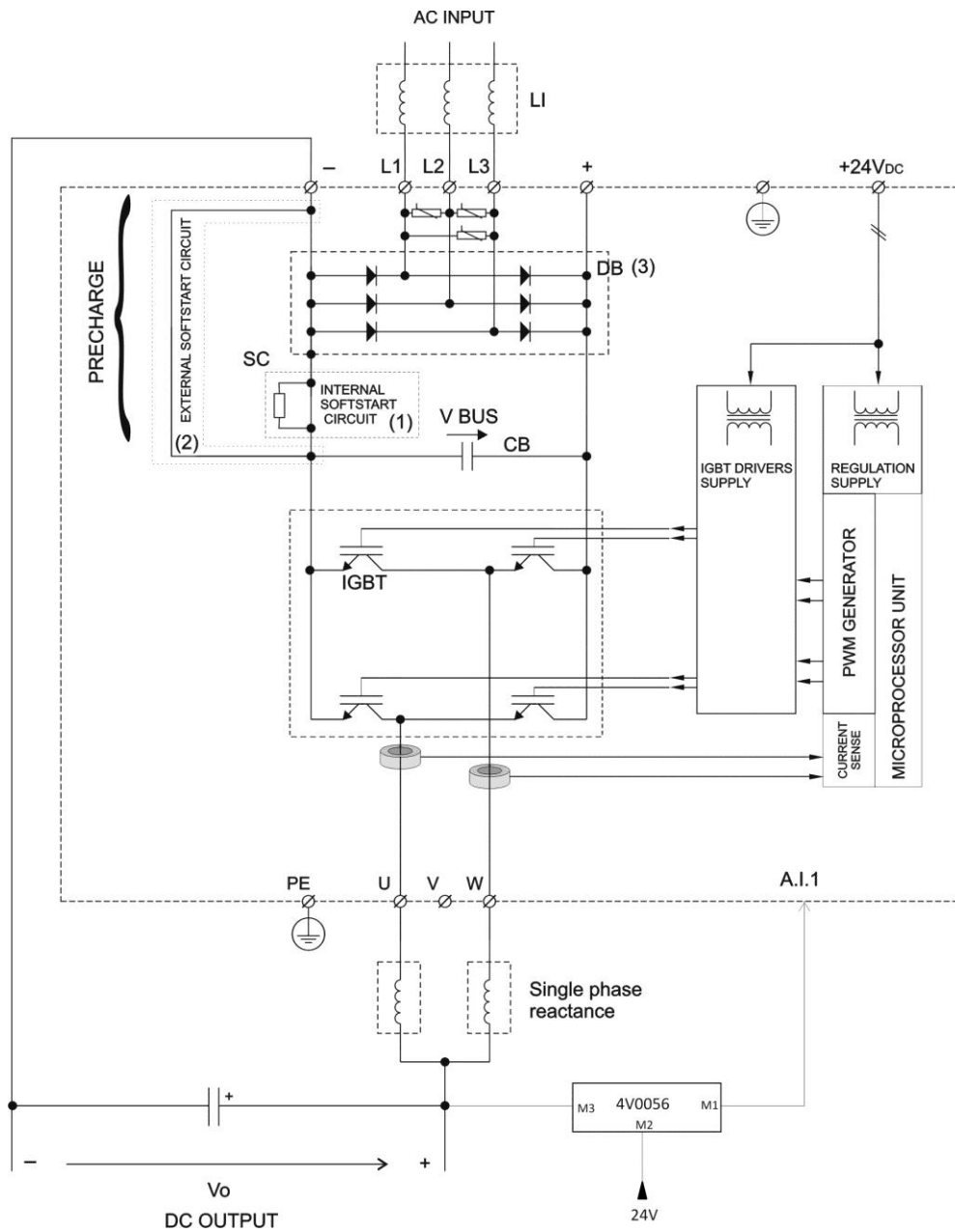


FIG. 10 – Power stage with AC input (optional)

---

## 7.2.2 EXAMPLES OF CONNECTION

In order to be used in energy conversion applications, the OPDE DC-DC converter must be connected to other additional components necessary for its proper operation, in fact the OPDE DC-DC converter is a power and control unit of a four-IGBT bridge.

Externally, it is necessary to connect:

- an LC filter;
- a precharge circuit (optional);
- electromechanical devices for disconnecting and/or protecting the DC input and DC output side;
- other control devices if required (including insulation controllers and Residual Current Devices);
- EMC filters.

Normally, the OPDE DC-DC converter and the other external components are installed inside an electric cabinet that will be the final and complete electrical equipment.

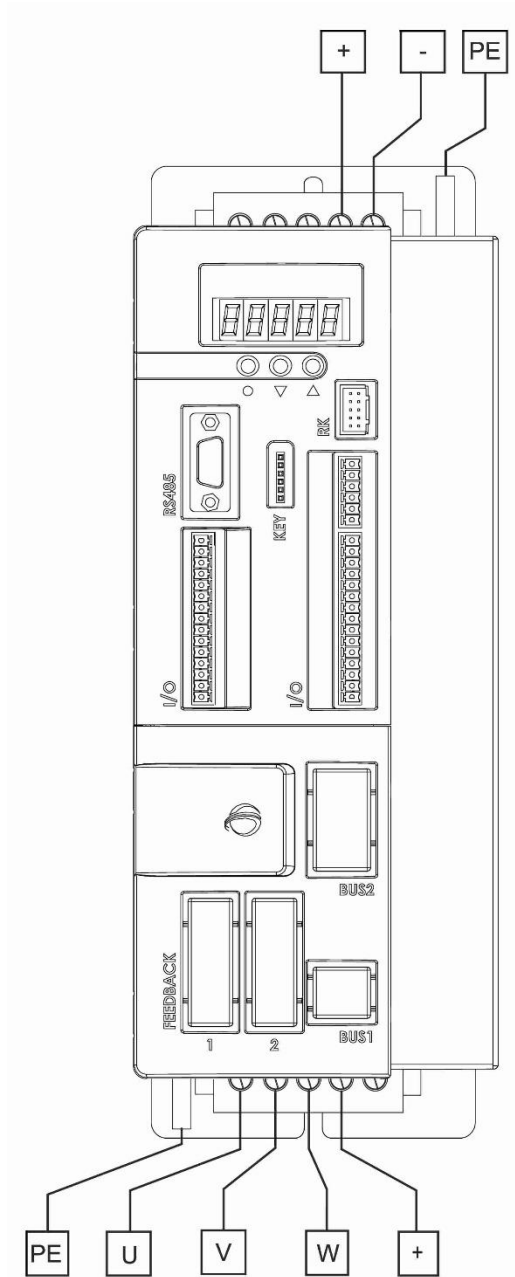
Please refer to the **chapters** **Errore. L'origine riferimento non è stata trovata.** for examples for the correct connection of the OPDE DC-DC converter.

### 7.2.3 AVAILABLE POWER CONNECTIONS

The following figures show the arrangement of the power connections.

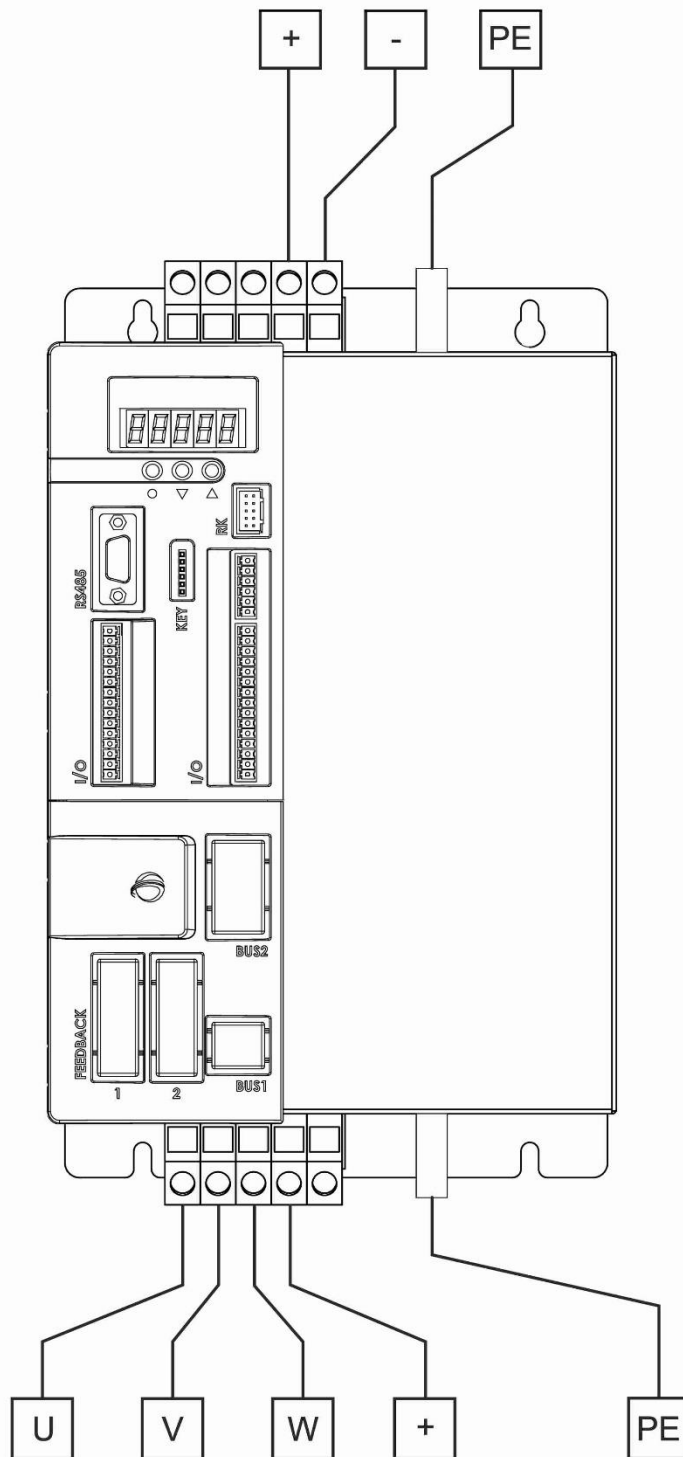


TO ACCESS POWER CONNECTIONS, IT'S COMPULSORY TO DISCONNECT THE DC SIDE VOLTAGE, WAIT FOR A DISCHARGE TIME EQUAL TO 8 min AND THEN REMOVE THE REMOVABLE PANEL THAT COVERS THE CONNECTIONS.



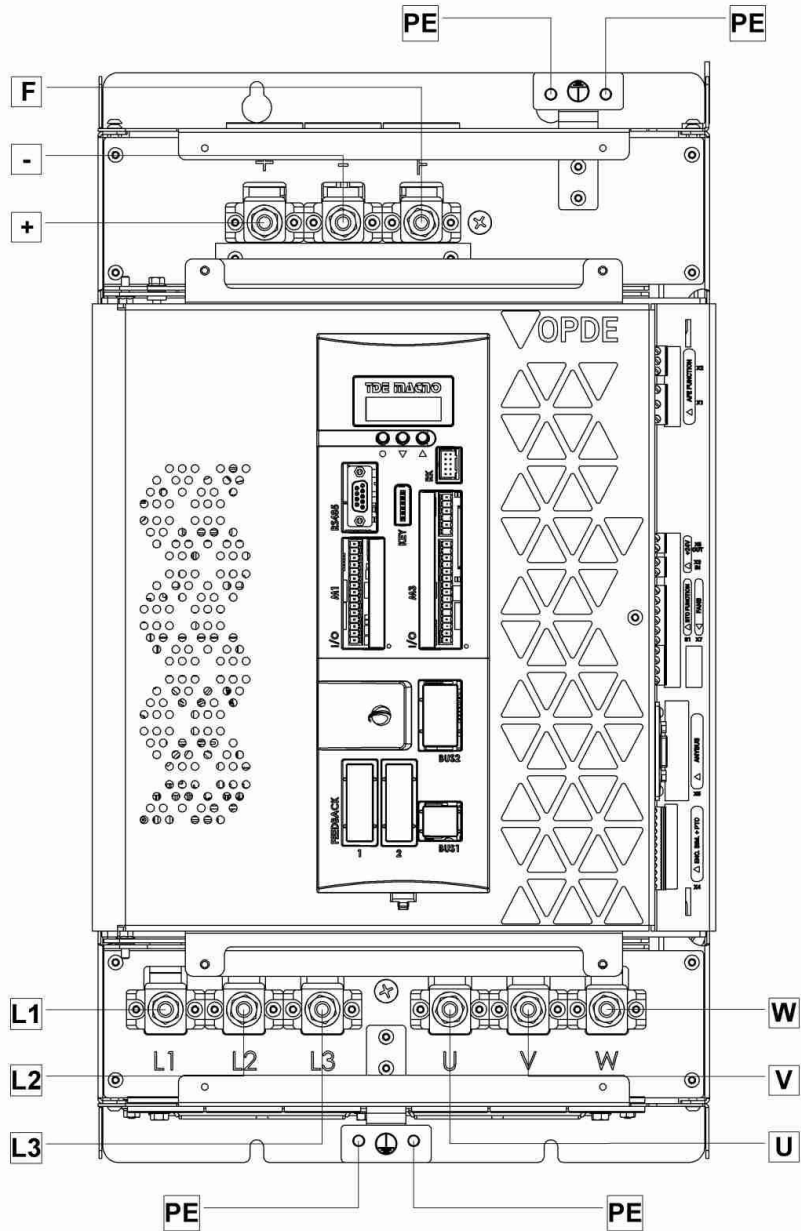
“+” “-“: DC side input                      “U” “W”: DC side output  
“PE”: protective conductor connection

FIG. 11 – Power connections OPDE SD 22



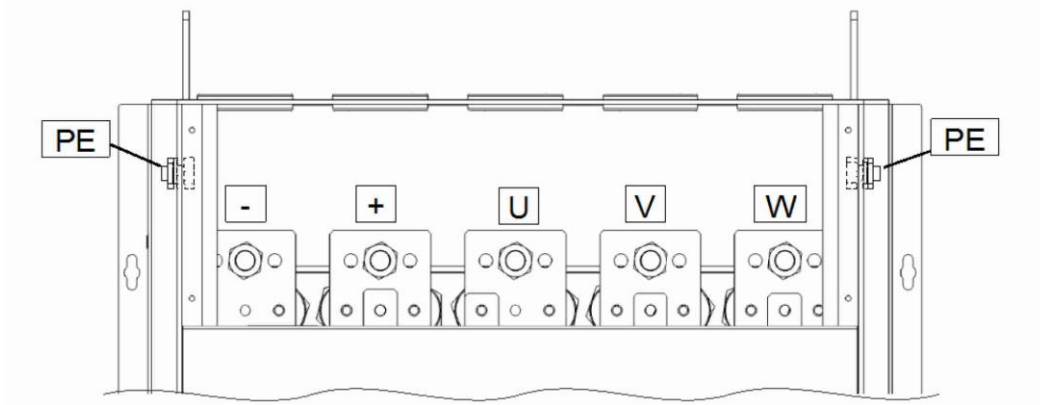
“+” “-“: DC side input                      “U” “W”: DC side output  
 “PE”: protective conductor connection

**FIG. 12 – Power connections OPDE SD 32, 40, 48, 60**



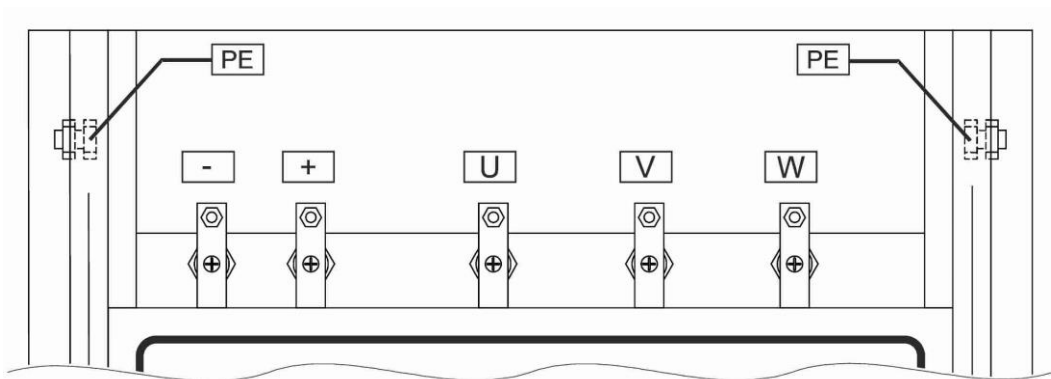
“+” “-“: DC side input                      “U” “W”: DC side output  
 “PE”: protective conductor connection

**FIG. 13 – Power connections OPDE SD 70, 90, 110, 150 (CASE 1C)**



“+” “-“: DC side input                      “U” “W”: DC side output  
 “PE”: protective conductor connection

**FIG. 14 – Power connections OPDE SD 175, 220, 250 (CASE 2)**

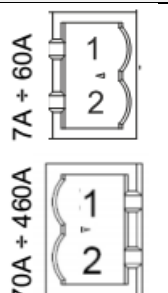


“+” “-“: DC side input                      “U” “W”: DC side output  
 “PE”: protective conductor connection

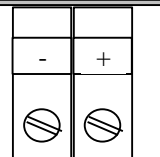
**FIG. 15 – Power connections OPDE SD 310, 370, 460 (CASE 3)**

## 7.2.4 POWER SUPPLIES

OPDE DC-DC requires two auxiliary power supply voltages: one for the power supply of the control (adjustment) side and driver, and one for the power supply of the cooling fans. The adjustment and driver power supply must be provided through the removable terminal X3, which is located on the front of OPDE DC-DC. The power supply of the fans, instead, must be provided through the bulkhead terminals on the bottom side of the converter.

X3	PIN	FUNCTION	DESCRIPTION
	1	+24V	Control side and drivers power supply. Power supply voltage: 24Vdc (22÷26Vdc).  7A – 60A            Maximum absorbed current 1 A 70A – 460A        Maximum absorbed current 1.6 A
	2	0V	

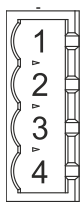
TAB. 12 – Connector X3

X8	PIN	FUNCTION	DESCRIPTION
	+	+24V_F	Heat sink cooling fans power supply. Power supply voltage: 24Vdc (22÷26Vdc). Maximum absorbed current: OPDE SD 7, 15, 22      0.2 A OPDE SD 32              0.4 A OPDE SD 48, 60        0.6 A OPDE SD 70, 90, 110   1.5 A OPDE SD 150, 175      2.5 A OPDE SD 220, 250      3.5 A OPDE SD 310, 370, 460 5.0 A
	-	0V_F	

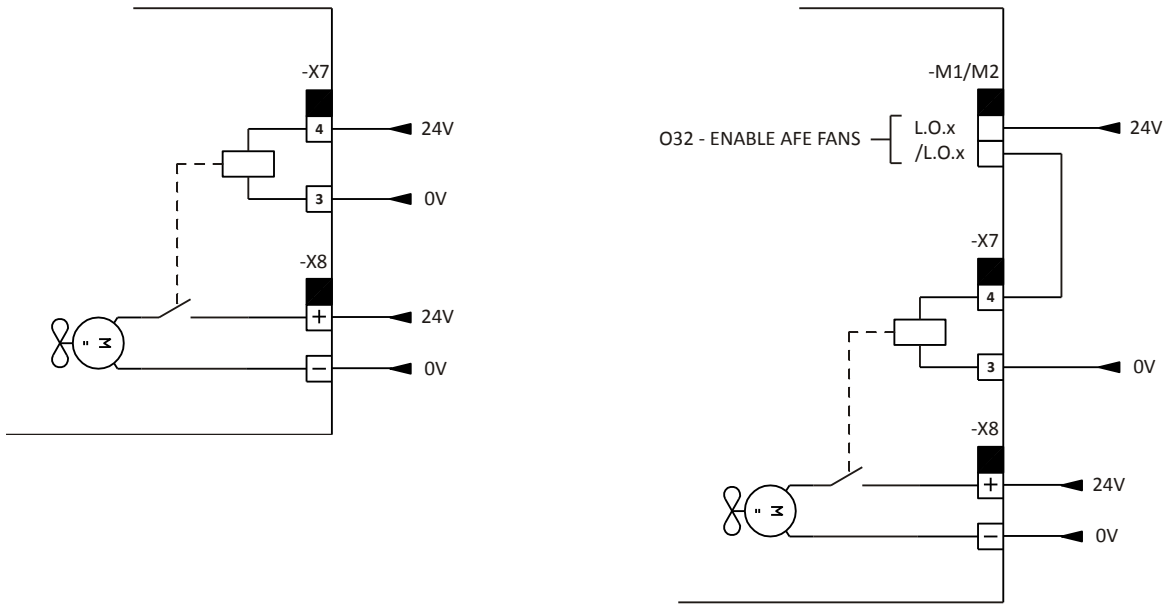
TAB. 13 – Fan terminal

X8 is just the power supply terminal of the fans. To enable the operation of the fans, it is necessary to connect a voltage of 24V between the terminals 3 and 4 of connector X7 (fig.15 left side).

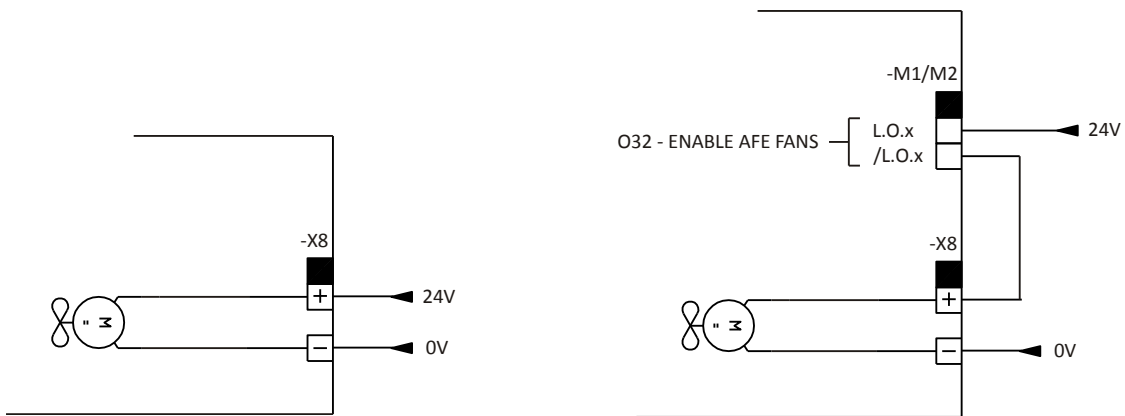
Using a generic logical output LOx set as "O32 - Enable DC-DC fans" and following the connection of (fig.15 right side) it is possible to control the switching on of the fans based on the temperature of the heat sink.

X7	PIN	FUNZIONE	DESCRIZIONE
	1	N.C.	Not connected
	2	N.C.	Not connected
	3	0V ENABLE AFE FAN	Enabling input of the ventilation fan.  +24V ±10% - min. 200mA
	4	+24V ENABLE AFE FAN	

TAB. 14 – Internal fans enabling input



**FIG. 16 – Example of connection of the fans power terminal (X8) and fans enabling terminal (X7). On the left, connection with fans always on. On the right, connection with fans controlled via L.O.x logical output set as "O32 – Enable DC-DC fans" (automatic switching-on depending on the heat sink temperature).**



**FIG. 17 – Example of connection of the fans power terminal (X8) and fans enabling terminal (X7) for size 22 ÷ 60A. On the left, connection with fans always on. On the right, connection with fans controlled via L.O.x logical output set as "O32 – Enable DC-DC fans" (automatic switching-on depending on the heat sink temperature). Use only digital output with relay L.O.2 or L.O.4.**



## 7.2.5 LOGICAL CONNECTIONS

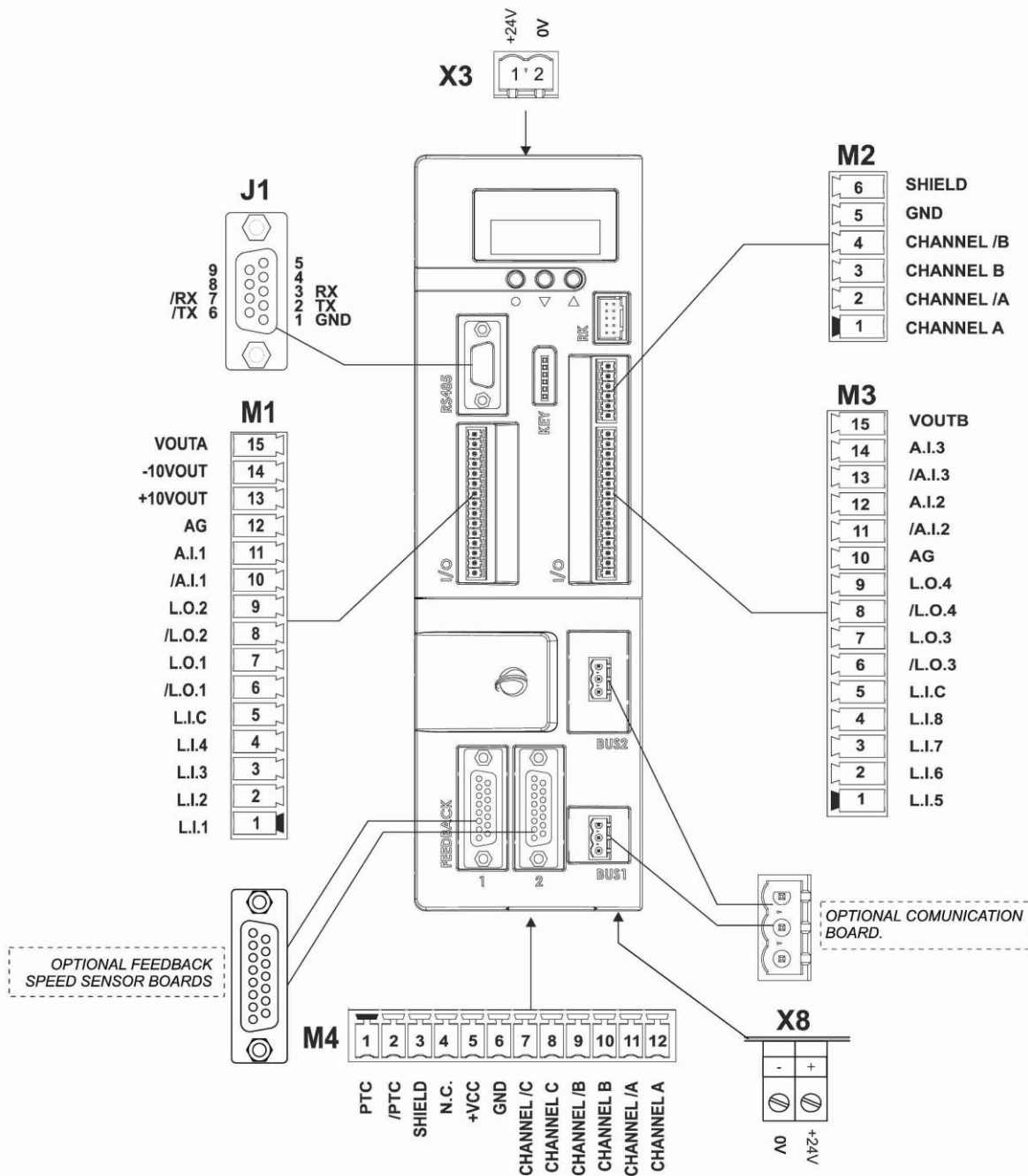


FIG. 18A – Logical Connections OPDE SD 22-150

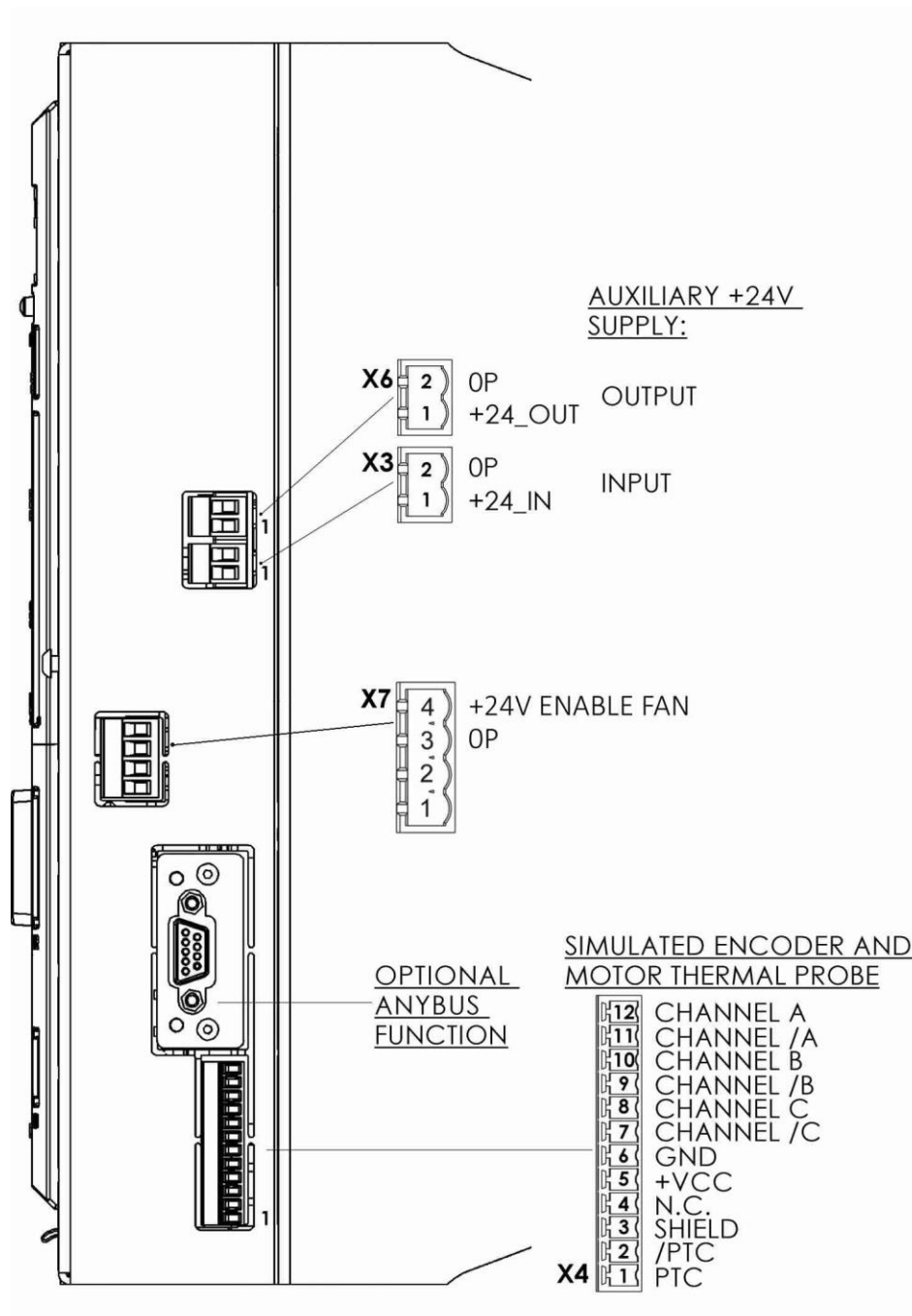


FIG. 17B – Logical Connections OPDE SD 70÷150 (side view)

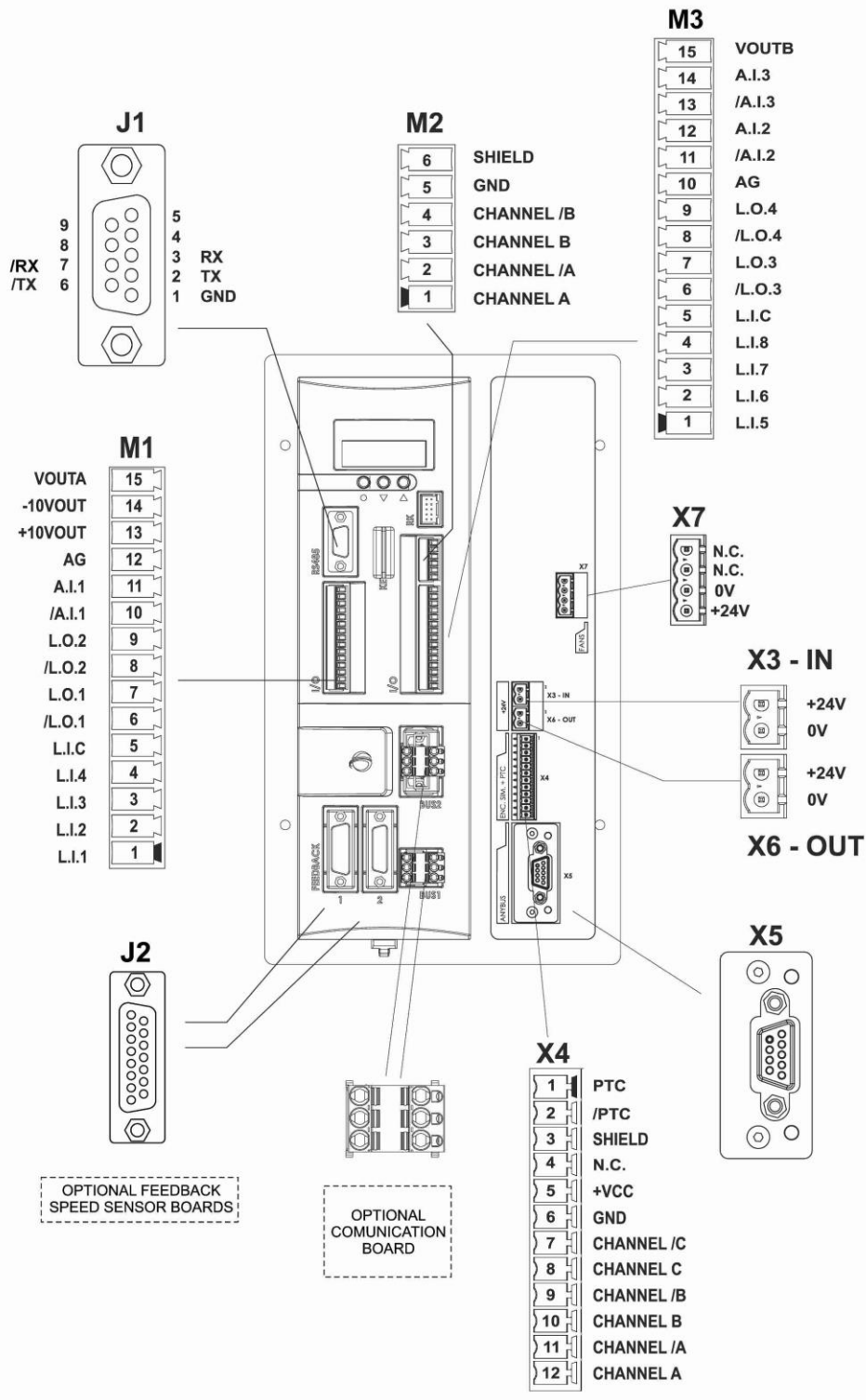


FIG. 17C – Logical Connections OPDE SD 175:460

### 7.2.5.1 Digital and Analog Logical Connections

M1	PIN	FUNCTION	DESCRIPTION
	1	L.I.1	Configurable logical inputs ( <b>see FIG. 18A</b> ) All inputs are optically isolated from the internal regulation. L.I.C. is the common of the inputs L.I.1, L.I.2, L.I.3, L.I.4. 24Vdc $\pm$ 10% I <sub>max</sub> =10mA
15	2	L.I.2	
14	3	L.I.3	
13	4	L.I.4	
12	5	L.I.C	Common of the logical inputs to be connected to the negative of the input power supply.
11	6	/L.O.1	Configurable optically isolated logical output ( <b>see FIG. 18C</b> ) The transistor is conductive when the output is ON. I <sub>max</sub> = 60 mA @ 30Vdc
10	7	L.O.1	
9	8	/L.O.2	Configurable logical output with relay contact. The contact is normally open. I <sub>max</sub> = 1A @ 30VDC / 0.3A @ 125VAC
8	9	L.O.2	
7	10	/A.I.1	<b>Analog Voltage Feedback Input from External 4V0056 (see FIG. 18B).</b> Input: +/-10V (max. 0.5 mA)
6	11	A.I.1	
5	12	AG	0V
4	13	+10VOUT	Stabilized power supply - 10mA maximum (ref. PIN 12).
3	14	-10VOUT	
2	15	VOUTA	Configurable analog output ( <b>see FIG. 18D</b> ). Output: $\pm$ 10V /2mA.
1			

TAB. 15 – Connections: Digital and analog I/O

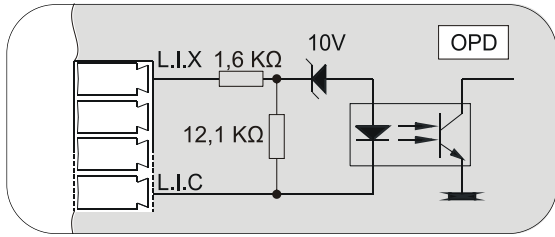


FIG. 18A – Configurable logical inputs

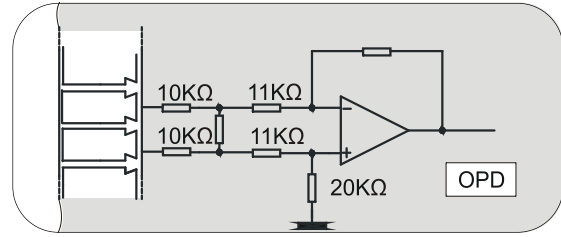


FIG. 18B – Configurable analog input

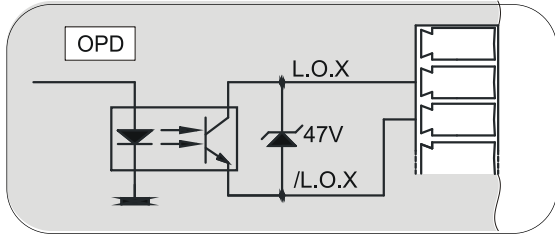


FIG. 18C – Configurable logical outputs

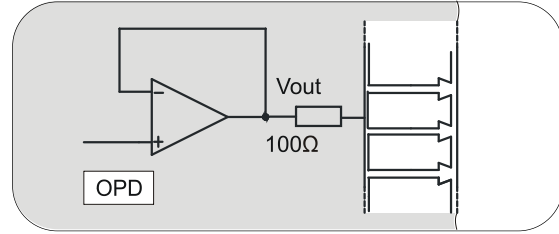


FIG. 18D - Configurable analog output

### 7.2.5.2 Frequency Input

M2	PIN	FUNCTION	DESCRIPTION
	1	E-A	Channel A input, if differential (otherwise not connected). <i>f max 300 kHz - 5÷24V</i>
	2	E-/A (F)	Channel /A frequency input or frequency input. <i>f max 300 kHz - 5÷24V</i>
	3	E-B	Channel B input, if differential (otherwise not connected). <i>f max 300 kHz - 5÷24V</i>
	4	E-/B (UP)	Channel /B frequency or direction input. (UP/DOWN). <i>f max 300 kHz - 5÷24V</i>
	5	GND	0V
	6		Shield

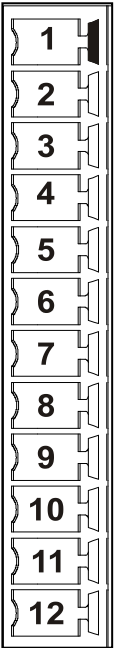
TAB. 16 – Frequency input

### 7.2.5.3 Digital and Analog Logical Connections

M3	PIN	FUNCTION	DESCRIPTION
	1	L.I.5	Configurable logical inputs ( <b>see FIG. 18A</b> ) All inputs are optically isolated from the internal regulation. L.I.C. is the common of the inputs L.I.5, L.I.6, L.I.7, L.I.8. 24Vdc ±10% I <sub>max</sub> =10mA
	2	L.I.6	
	3	L.I.7	
	4	L.I.8	
	5	L.I.C	Common of all logical inputs to be connected to the negative of the input power supply.
	6	/L.O.3	Fast configurable logical outputs (max. 5 kHz) ( <b>see FIG. 18C</b> ). All outputs are optically isolated from the internal regulation. The transistor is conductive when the output is ON. I <sub>max</sub> = 60 mA @ 30Vdc
	7	L.O.3	
	8	/L.O.4	Configurable logical outputs with relay contact. The contact is normally open. I <sub>max</sub> = 1A @ 30VDC / 0.3A @ 125VAC
	9	L.O.4	
	10	AG	0V
	11	/A.I.2	Configurable analog inputs ( <b>see FIG. 18B</b> ). Inputs: +/-10V (max. 0.5 mA) or 4 ÷ 20 mA, settable with the appropriate jumpers.
	12	A.I.2	
	13	/A.I.3	
	14	A.I.3	
	15	VOUTB	Configurable analog output ( <b>see FIG. 18D</b> ). Output: ± 10V /2mA.

TAB. 17 – Connections: Digital and analog I/O

### 7.2.5.4 Management of the Resistor Thermal Sensor

M4 / X4	PIN	FUNCTION	DESCRIPTION
	1	PTC Bimetallic	Resistor thermal probe input (PTC or NTC or KTY84).
	2	/PTC Bimetallic	
	3	PE	
	4	N.C.	
	5	+Vcc	Vmax = 27Vdc
	6	GND	
	7	CHANNEL /C	Connections for Simulated Encoder (NOT MANAGED)
	8	CHANNEL C	
	9	CHANNEL /B	
	10	CHANNEL B	
	11	CHANNEL /A	
	12	CHANNEL A	

TAB. 18 – Management of the thermal sensor

## 7.3 Vo OUTPUT VOLTAGE FEEDBACK BOARD 4V0056

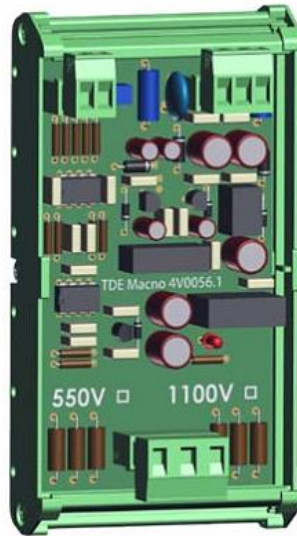


FIG. 19 – Isolated Voltage Transducer

The 4V0056 board is a voltage transducer that converts a DC/AC High Voltage into  $-10V \div 10V$  normalized signals, with galvanic isolation between input and output. There are different versions according to the Full Scale value and hardware filter.

4V0056 CODE VERSIONS (*)	FULL SCALE	HW FILTER
374V005610V	550 Vdc	7 kHz
374V005611V	1100 Vdc	7 kHz
374V005612V	550 Vdc	700 Hz
374V005613V	1100 Vdc	700 Hz

(\*) Other versions with F.S. custom range are available as optional

TAB. 19 – 4V0056 versions



THE BOARD IS SUPPLIED WITH IP00 PROTECTION. THE CUSTOMER MUST PROVIDE SUITABLE IP PROTECTION AGAINST ELECTRIC SHOCK

### Main Characteristics:

- **Galvanic isolation:** 2.5kV between input and output power
- **Input Voltage (M3):**
  - with  $-550..+550Vdc / 0..385Vac$ ,  $V_o = 0.01818 * V_i$  range
  - with  $-1100..+1100Vdc / 0..770Vac$ ,  $V_o = 0.0909 * V_i$  range
  - with custom range (optional)
- **Output Voltage (M1):**  $-10..+10Vdc$  (protected against short-circuit)
- **Minimum load in output:** 2KOhm
- **Accuracy:** 1% FS
- **Non-linearity:**  $< 0.1\%$
- **Offset:**  $< 50mV$
- **Band:** 3.2kHz @ -3dB (with 7 kHz hw filter)
- **Supply Voltage (M2):**  $8..30Vdc$  (protected against reverse polarity)
- **Power Consumption:**  $< 1W$
- **Environment temperature range:**  $0..50^{\circ}C$  (operation) /  $-20..70^{\circ}C$  (magazine/transport) non-condensing





**OUTPUT AND SUPPLY ARE NOT ISOLATED: THE INPUT GROUND HAS THE SAME VOLTAGE POTENTIAL OF THE OUTPUT GROUND**

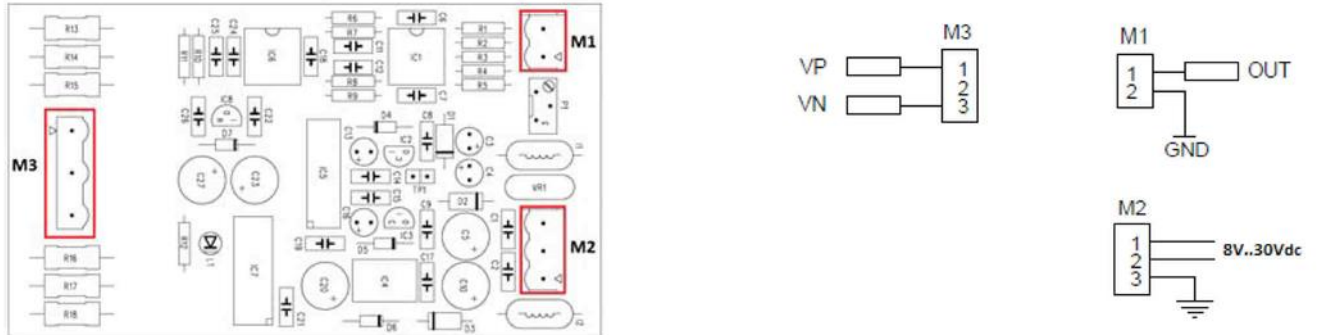


FIG. 20 – 4V0056 connections

M1	PIN	FUNCTION	DESCRIPTION
	1	OUT	Output voltage -10..+10 Vdc (protected against short-circuit)
	2	GND	Output voltage reference

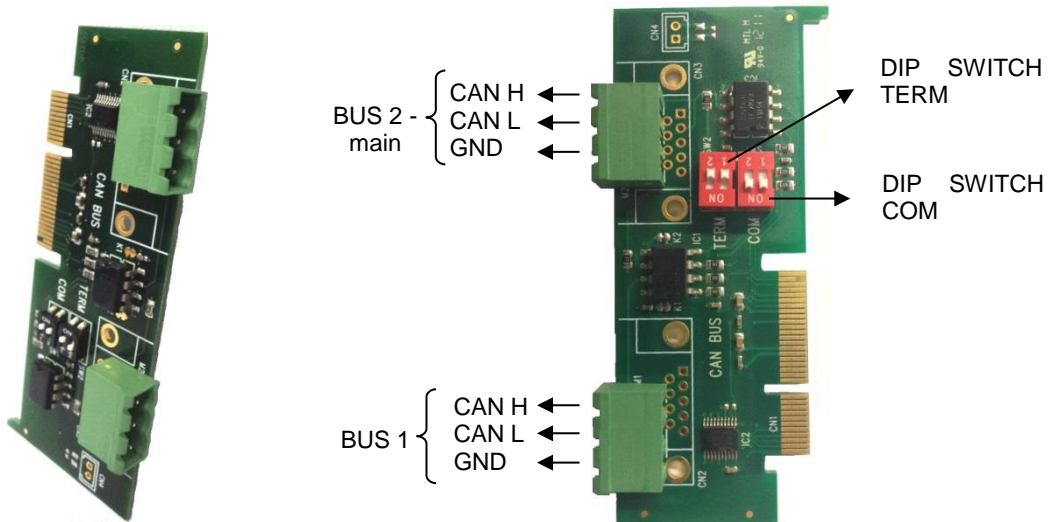
M2	PIN	FUNCTION	DESCRIPTION
	1	VIN	Power supply: +24V 5mA rated Range 8..30Vdc (protected against reverse polarity)
	2	GND	Negative of power supply
	3	PE	Protection Earth

M3	PIN	FUNCTION	DESCRIPTION
	1	VP	Positive high voltage input
	2	n.c.	not connected
	3	VN	Negative high voltage input

## 7.4 CONNECTION OF OPTIONAL CARDS

### 7.4.1 CAN BUS

The pin assignment of the optional card for CAN BUS communication is given here below.



Code 274B000110VV

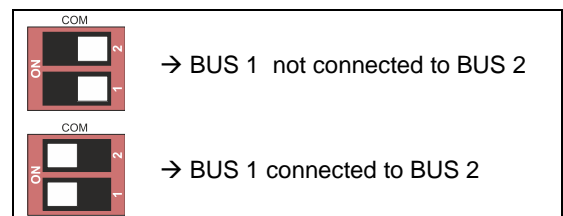
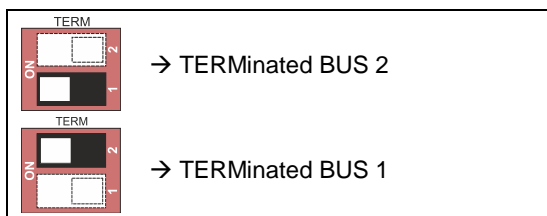
FIG. 21 – CAN bus card

On the card there are 2 double dip switches identified as:

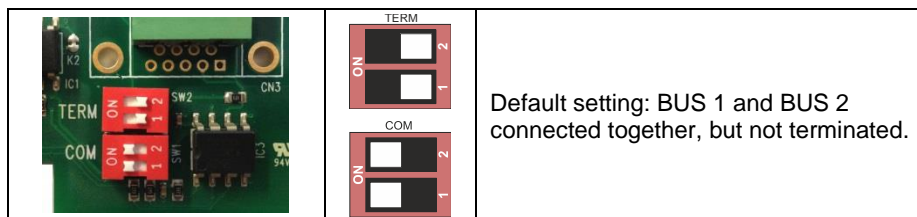
- TERM
- COM

The contacts of the dip switch "TERM" (one for each CAN connector), if set to ON, enable the terminating resistor (120 Ω) between CAN H and CAN L.

The contacts of the dip switch "COM" join the signals CAN L and CAN H of the two Buses so that the two connectors can be used one as input and one as output. The two dip switches shall always be positioned in pairs.



**IF BUS 1 AND BUS 2 ARE CONNECTED TOGETHER, NEVER CONNECT BOTH THE TERMINATION RESISTORS (TERM dip switches).**



**ANY OPERATION MUST BE MADE ONLY WITH CONVERTER NOT POWERED.**

## 7.4.2 PROFIBUS

The pin assignment of the optional card for PROFIBUS – CAN BUS communication is given here below.

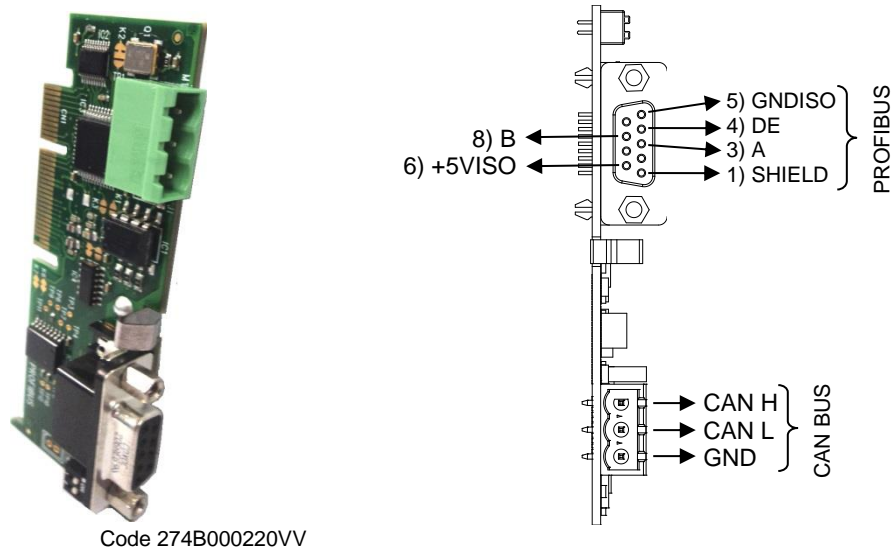
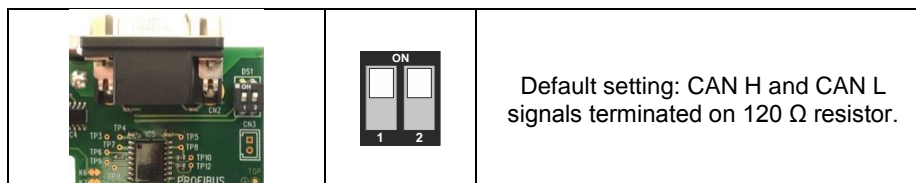
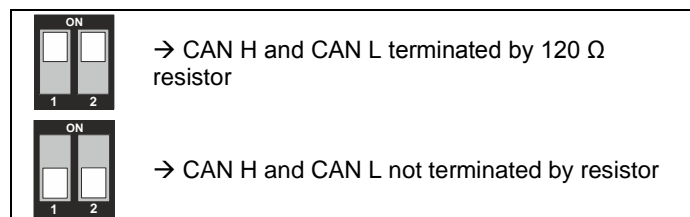


FIG. 22 – Profibus card

PIN n°	NAME	DESCRIPTION
1	Shield	Protective shield
2	-	-
3	A	Rx/Tx positive data
4	DE	Control signal for repeater
5	GNDISO	0V of +5V supply
6	+5VISO	Output supply +5V
7	-	-
8	B	Rx/Tx negative data
9	-	-

TAB. 20 – Profibus connections

On the card there is a double dip switch referred to as DS1 that, if closed, connects the signal CAN H and CAN L by means of a 120  $\Omega$  resistor for the line termination.



**ANY OPERATION MUST BE MADE ONLY WITH CONVERTER NOT POWERED.**

### 7.4.3 ETHERCAT AND PROFINET

ETHERCAT



FIG. 23 – Ethercat card

PROFINET



FIG. 24 – Profinet card

The card is equipped with two interfaces 10/100 Base-T RJ45. The individual contacts of the RJ45 port are assigned according to the "T 568-B" standard.

Ethernet patch or crossover cables in **CAT5e** quality or better can be used as the connection cable. CAT5e is an Ethernet network cable standard defined by the EIA/TIA. CAT5e cable runs are limited to a maximum recommended run length of 100m.

BDF Digital recommends shielded cables for environments where proximity to power cable, high power or RF equipments may introduce crosstalk.

Note that in the Ethercat there is an input and an output connector, while in the Profinet their order connection is free.



FIG. 25 - Type of cables



**ANY OPERATION MUST BE MADE ONLY WITH CONVERTER NOT POWERED.**

## 7.4.4 ANYBUS

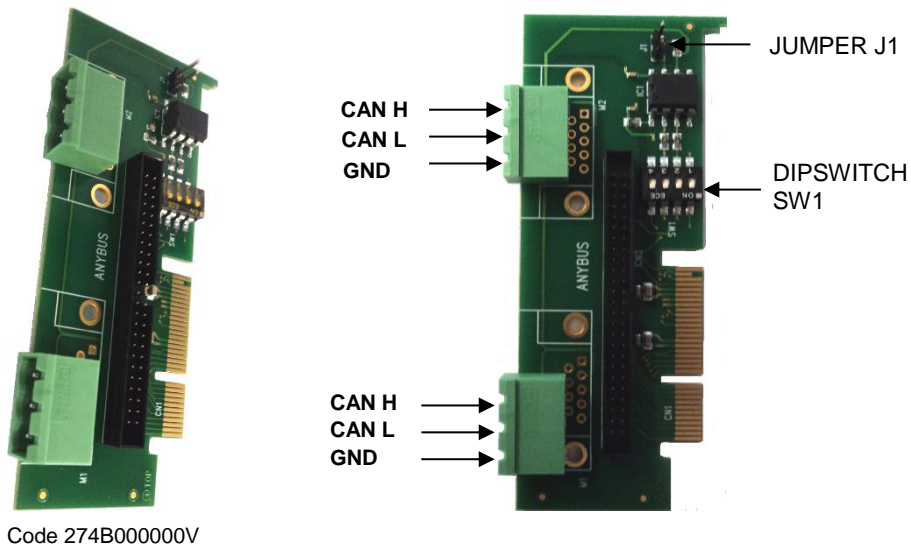


FIG. 26 – Anybus card

This board accommodates in slot3 of the drive, in addition to acting as an interface for ANYBUS communication, on request, can provide two connectors for a CAN single channel output ( CAN A and CAN B). The selection of CAN channel can make it through the SW1 dipswitch. J1 jumper when closed, connects the CAN signal chosen, with a 120Ω resistance for termination of the line output.

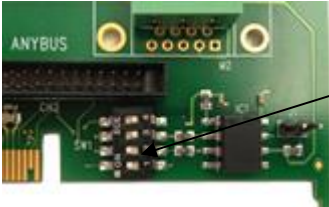
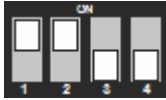
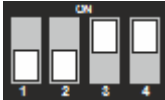
		
	Closed 1 and 2 dip (ON) CAN A channel chosen (default).	Closed 3 and 4 dip (ON) CAN B channel chosen.



FIG. 27 – Anybus example



**ANY OPERATION MUST BE MADE ONLY WITH CONVERTER NOT POWERED.**

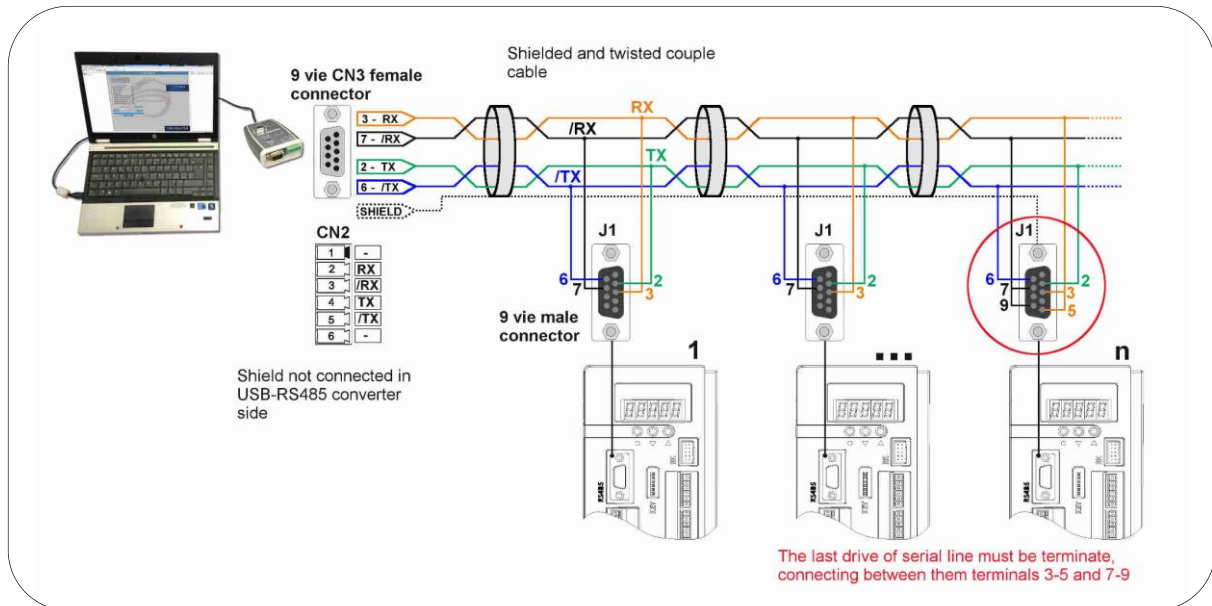
## 7.5 CONNECTION OF THE RS422/485 SERIAL LINE

The serial line present on the OPDE DC-DC drives foresees the connection for the "4-wire" transmission of data and, therefore, it has the ability to communicate in full-duplex mode. In fact, by virtue of the protocol used (MODBUS RTU) it always communicates in "half-duplex" mode. Therefore, it is possible to perform the connection with only **"two wires"** by connecting to one another **RX with TX and /RX with /TX**.

In the J1 connector, the RX and /RX signals are the signals received by the converter; while the TX and /TX signals are transmitted signals.

Here below there is an example of connection with a USB port using a suitable USB-RS422/485 converter.

FIG. 28 - Example of connection with USB port



Inside the converter there are the impedances to "terminate" the connection ( $120\Omega$ ) and polarize the line, as indicated in **FIG. 29**. To use such termination connect the terminals **5-3** and **9-7** of connector **J1** to one another (only for the last converter of the line).

**The communication wires must be twisted.**

**The screen must be connected to the DB9 metal cap, because through the converter, the metallic cap is connected to ground.**

Upon request, BDF Digital supplies a "serial package" consisting of the supervisor software and a cable with RS232/RS485 adapter. For further information consult the **OPDE booklet of the MODBUS RTU serial protocol**.

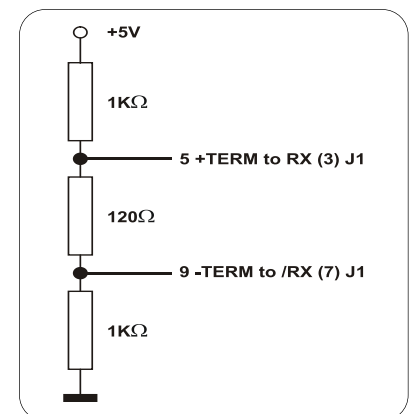


FIG. 29 –  $120\Omega$  Connections

## 8 TECHNICAL DATA

This chapter contains all the information for the correct use of the OPDE DC-DC.

MOD. OPDE DC/DC ENERGY		OPDE SD 22	OPDE SD 32	OPDE SD 48	OPDE SD 60
<b>DC input data (Vbus)</b>					
Maximum input voltage	[V d.c.]	780			
Operating voltage	[V d.c.]	200÷730			
Maximum operating current	[A d.c.]	22	32	48	60
Intermediate circuit capacity	[µF]	1010	1230	1640	2400
Oversvoltage category	OVC	III			
<b>Input data for auxiliary power supplies</b>					
Auxiliary power for regulation card and drivers	[V d.c.]	24Vdc (22÷26Vdc) 1.6A			
Auxiliary power for the cooling fans	[V d.c.]	24Vdc (22÷26Vdc) 0.4A	24Vdc (22÷26Vdc) 0.4A	24Vdc (22÷26Vdc) 1i0.5A	24Vdc (22÷26Vdc) 0.5A
<b>DC output data (Vo)</b>					
Operating voltage	[V d.c.]	0÷Vbus			
Output continuous current <sup>(1)</sup>	[A d.c.]	22	32	48	60
Maximum output fault current	[A]	100 duration 2µs	145 duration 2µs	208 duration 2µs	260 duration 2µs
Maximum output protection current	[A]	100	145	208	260
Connection type		DC(+/-)			
Oversvoltage category	OVC	III			
<b>Other data</b>					
Operating temperature	[°C]	-20 ÷ +50			
Maximum altitude <sup>(2)</sup>	[m]	2000			
Insulation protection class		I			
Protection degree		IP20			
PWM frequency	[kHz]	10 (for each leg)			
Life <sup>(3)</sup>	[kh]		30	30	30

<sup>(1)</sup> Total current (leg U + leg W). Calculated @ Fpwm=10 kHz, Vbus=650Vdc, no overload. For Vbus input voltage above 650 Vdc, derate output current.

<sup>(2)</sup> For altitudes above 1000 m above sea level, derate the current by 1% per 100 m.

<sup>(3)</sup> Calculated with converter running at maximum continuous current and at the maximum expected ambient temperature.

**TAB. 21A – Technical data Book Size**

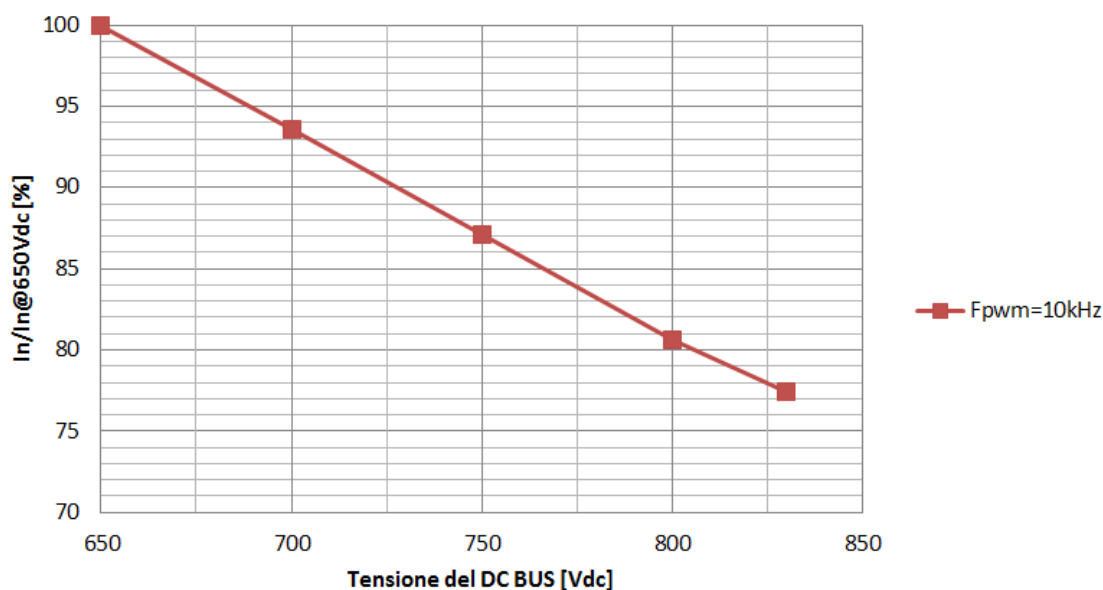
MOD. OPDE DC/DC ENERGY		OPDE SD 70	OPDE SD 90	OPDE SD 110	OPDE SD 150
<b>DC input data (Vbus)</b>					
Maximum input voltage	[V d.c.]	880			
Operating voltage	[V d.c.]	200÷830			
Maximum operating current	[A d.c.]	73	95	109	155
Intermediate circuit capacity	[ $\mu$ F]	2050	2870	3280	3280
Oversvoltage category	OVC	III			
<b>Input data for auxiliary power supplies</b>					
Auxiliary power for regulation card and drivers	[V d.c.]	24Vdc (22÷26Vdc) 1.6A			
Auxiliary power for the cooling fans	[V d.c.]	24Vdc (22÷26Vdc) 1.5A	24Vdc (22÷26Vdc) 1.5A	24Vdc (22÷26Vdc) 1.5A	24Vdc (22÷26Vdc) 2.5A
<b>DC output data (Vo)</b>					
Operating voltage	[V d.c.]	0÷Vbus			
Output continuous current <sup>(1)</sup>	[A d.c.]	73	95	109	155
Maximum output fault current	[A]	303 duration 5 $\mu$ s	394 duration 5 $\mu$ s	453 duration 5 $\mu$ s	640 duration 5 $\mu$ s
Maximum output protection current	[A]	303	394	453	640
Connection type		DC(+/-)			
Oversvoltage category	OVC	III			
<b>Other data</b>					
Operating temperature	[°C]	-20 ÷ +50			
Maximum altitude <sup>(2)</sup>	[m]	2000			
Insulation protection class		I			
Protection degree		IP20			
PWM frequency	[kHz]	10 (for each leg)			
Life <sup>(3)</sup>	[kh]	65	75	75	30

<sup>(1)</sup> Total current (leg U + leg W). Calculated @ Fpwm=10 kHz, Vbus=650Vdc, no overload. For Vbus input voltage above 650 Vdc, derate output current according to Fig 30.

<sup>(2)</sup> For altitudes above 1000 m above sea level, derate the current by 1% per 100 m.

<sup>(3)</sup> Calculated with converter running at maximum continuous current and at the maximum expected ambient temperature.

**TAB. 22B – Technical data Case1/Case1-C**



**FIG. 30 – Case1/Case1-C current derating as function of Vbus**



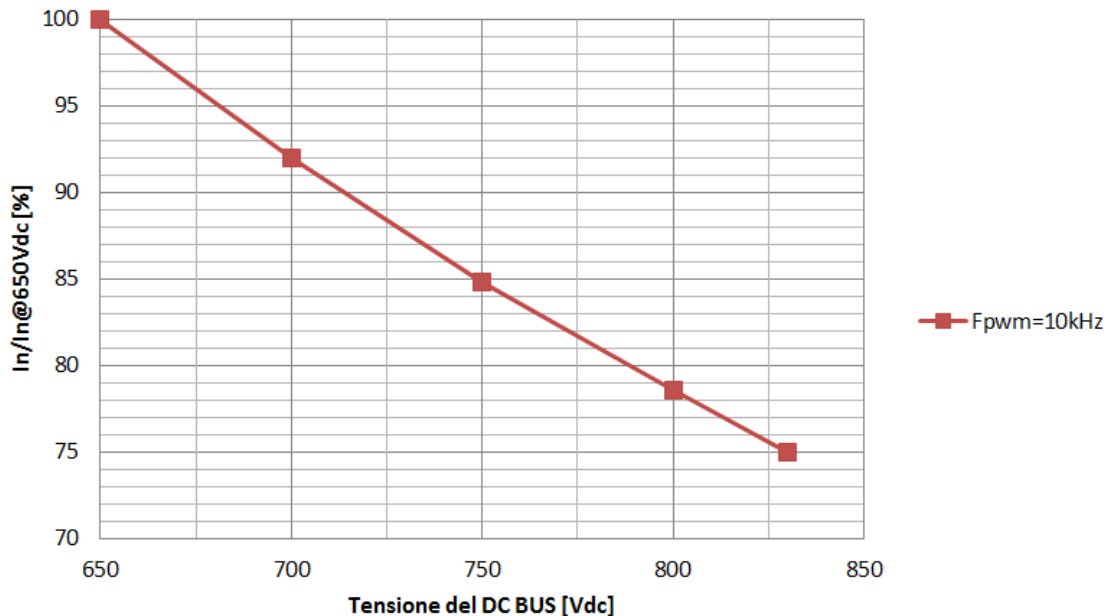
MOD. OPDE DC/DC ENERGY		OPDE SD 175	OPDE SD 220	OPDE SD 250
<b>DC input data (Vbus)</b>				
Maximum input voltage	[V d.c.]	880		
Operating voltage	[V d.c.]	200÷830		
Maximum operating current	[A d.c.]	209	267	302
Intermediate circuit capacity	[μF]	13600	13600	13600
Overvoltage category	OVC	III		
<b>Input data for auxiliary power supplies</b>				
Auxiliary power for regulation card and drivers	[V d.c.]	24Vdc (22÷26Vdc) 1.6A		
Auxiliary power for the cooling fans	[V d.c.]	24Vdc (22÷26Vdc) 2.5A	24Vdc (22÷26Vdc) 3.5A	24Vdc (22÷26Vdc) 3.5A
<b>DC output data (Vo)</b>				
Operating voltage	[V d.c.]	0÷Vbus		
Output continuous current <sup>(1)</sup>	[A d.c.]	209	267	302
Maximum output fault current	[A]	582 duration 5μs	740 duration 5μs	839 duration 5μs
Maximum output protection current	[A]	582	740	839
Connection type		DC(+/-)		
Overvoltage category	OVC	III		
<b>Other data</b>				
Operating temperature	[°C]	-20 ÷ +50		
Maximum altitude <sup>(2)</sup>	[m]	2000		
Insulation protection class		I		
Protection degree		IP20		
PWM frequency	[kHz]	10 (for each leg)		
Life <sup>(3)</sup>	[kh]	75	45	30

<sup>(1)</sup> Total current (leg U + leg W). Calculated @ Fpwm=10 kHz, Vbus=650Vdc, no overload. For Vbus input voltage above 650 Vdc, derate output current according to Fig 31.

<sup>(2)</sup> For altitudes above 1000 m above sea level, derate the current by 1% per 100 m.

<sup>(3)</sup> Calculated with converter running at maximum continuous current and at the maximum expected ambient temperature.

**TAB. 24C – Technical data Case2**



**FIG. 31 – Case2/Case3 current derating as function of Vbus**

MOD. OPDE DC/DC ENERGY		OPDE SD 310	OPDE SD 370	OPDE SD 460
<b>DC input data (Vbus)</b>				
Maximum input voltage	[V d.c.]	880		
Operating voltage	[V d.c.]	200÷830		
Maximum operating current	[A d.c.]	373	444	550
Intermediate circuit capacity	[μF]	20400	20400	20400
Overvoltage category	OVC	III		
<b>Input data for auxiliary power supplies</b>				
Auxiliary power for regulation card and drivers	[V d.c.]	24Vdc (22÷26Vdc) 1.6A		
Auxiliary power for the cooling fans	[V d.c.]	24Vdc (22÷26Vdc) 5.0A	24Vdc (22÷26Vdc) 5.0A	24Vdc (22÷26Vdc) 5.0A
<b>DC output data (Vo)</b>				
Operating voltage	[V d.c.]	0÷Vbus		
Output continuous current <sup>(1)</sup>	[A d.c.]	373	444	550
Maximum output fault current	[A]	1036 duration 5μs	1233 duration 5μs	1560 duration 5μs
Maximum output protection current	[A]	1036	1233	1560
Connection type		DC(+/-)		
Overvoltage category	OVC	III		
<b>Other data</b>				
Operating temperature	[°C]	-20 ÷ +50		
Maximum altitude <sup>(1)</sup>	[m]	2000		
Insulation protection class		I		
Protection degree		IP20		
PWM frequency	[kHz]	10 (for each leg)		
Life <sup>(2)</sup>	[kh]	50	30	30

<sup>(1)</sup> Total current (leg U + leg W). Calculated @ Fpwm=10 kHz, Vbus=650Vdc, no overload. For Vbus input voltage above 650 Vdc, derate output current according to Fig 31.

<sup>(2)</sup> For altitudes above 1000 m above sea level, derate the current by 1% per 100 m.

<sup>(3)</sup> Calculated with converter running at maximum continuous current and at the maximum expected ambient temperature.

**TAB. 24D – Technical data Case3**

## 8.1 ELECTRIC CONNECTIONS

### 8.1.1 EXAMPLES OF CONNECTION

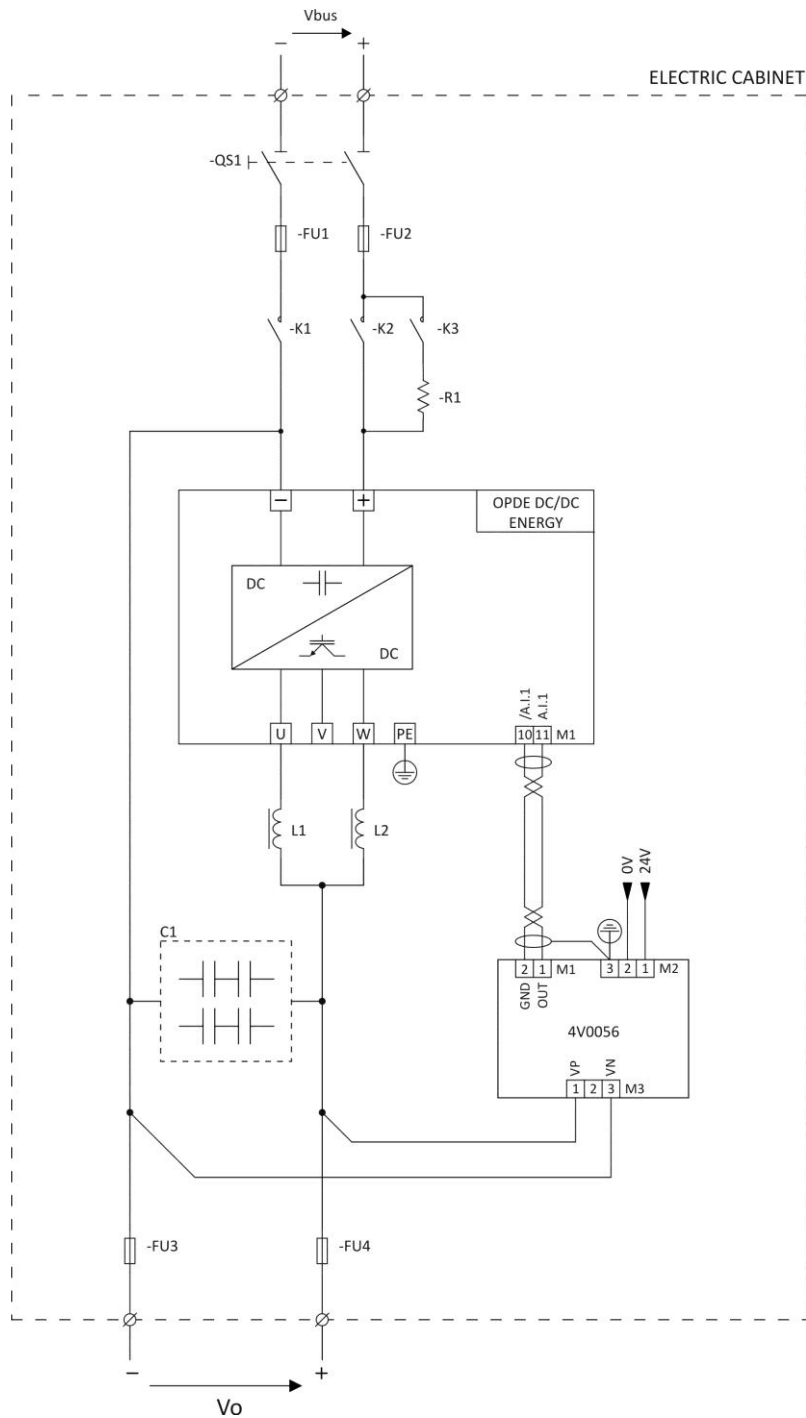


FIG. 32 - Example of connection with DC power supply (standard)

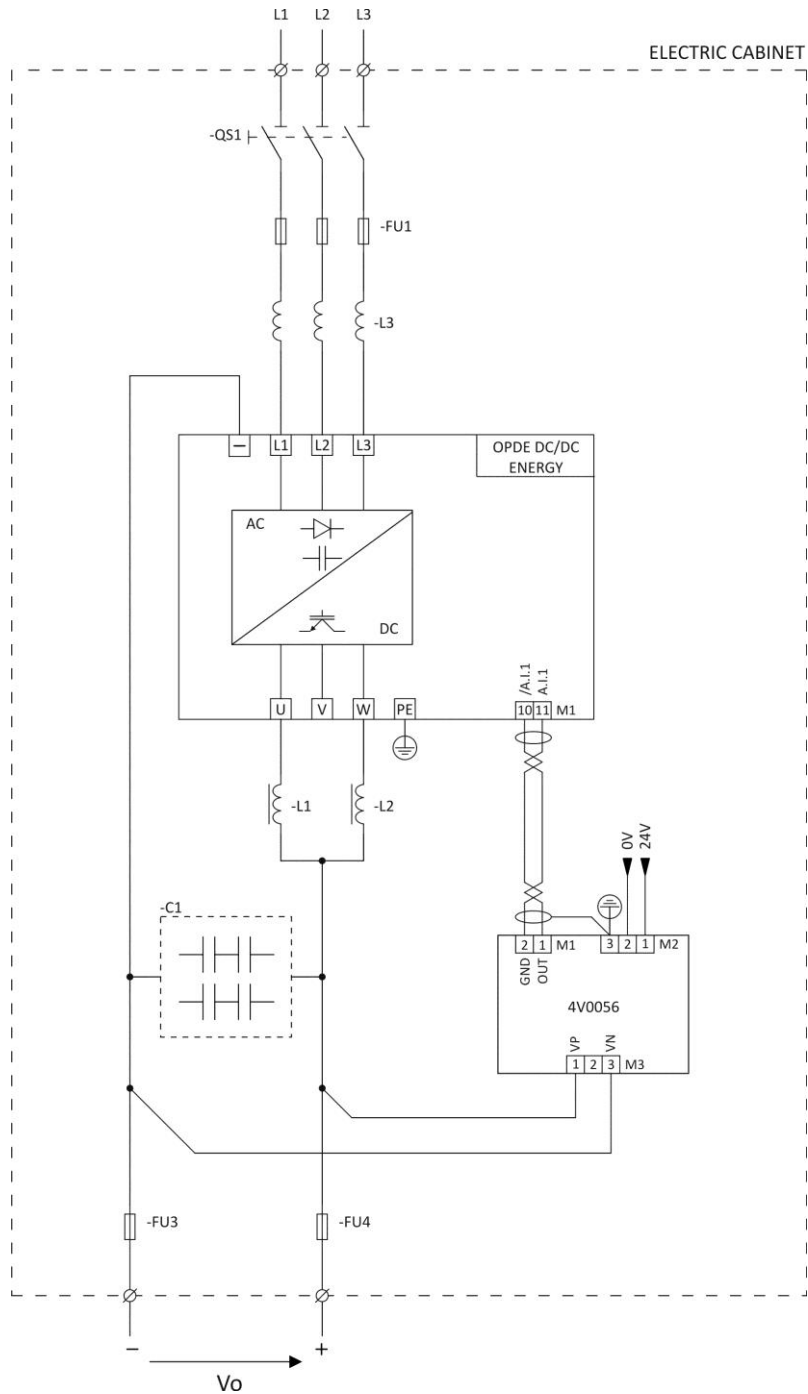


FIG. 33 - Example of connection with AC three-phase power supply (optional).

## 8.1.2 COMPONENTS FOR THE CONNECTION TO OUTPUT Vo

The OPDE DC/DC ENERGY require an external LC filter on output terminals U/W in order to generate the output voltage Vo. The filter is made by:

- Inductors L1-L2;
- capacitors bank C1.

Other components can be connected depending on the application:

- DC contactor K1 K2;
- pre-charge DCcontactor K3;
- protection fuse FU1;
- EMC filter.

The following section shows the features of the external components on the Vo side.

### 8.1.2.1 Output inductors

Size OPDE SD		Output inductors L1-L2				
		OPDE SD 15	OPDE SD 22	OPDE SD 32	OPDE SD 48	OPDE SD 60
Inductance	[mH]	10.940	7.460	5.130	3.420	2.730
Effective thermal current	[Arms]	7.9	11.6	16.8	25.2	31.5
Effective overload current	[Arms]	9	13.2	19.2	28.8	36
Overload		120% 30s				
Rated voltage	[Vdc]	830				
Rated frequency	[Hz]	0				
Current THD	[%lth]	7.3				
Switching frequency	[kHz]	10				
Ambient temperature	[°C]	50				
Cooling		Natural ventilation				
Over temperature class		F				
Insulation class of materials		H				
Insulation voltage	[kV]	1.1 / 3 for 30s				
BDF Digital code		054R48020	054R48021	054R48022	054R48023	054R48024

TAB. 23A - Output inductors

Size OPDE SD		Output inductors L1-L2			
		OPDE SD 70	OPDE SD 90	OPDE SD 110	OPDE SD 150
Inductance	[mH]	2.250	1.730	1.510	1.060
Effective thermal current	[Arms]	38.3	49.9	57.2	81.4
Effective overload current	[Arms]	43.8	57.0	65.4	93.0
Overload		120% 30s			
Rated voltage	[Vdc]	830			
Rated frequency	[Hz]	0			
Current THD	[%lth]	7.3			
Switching frequency	[kHz]	10			
Ambient temperature	[°C]	50			
Cooling		Natural ventilation			
Over temperature class		F			
Insulation class of materials		H			
Insulation voltage	[kV]	1.1 / 3 for 30s			
BDF Digital code		054R47007	054R47008	054R47009	054R47010

TAB. 24B - Output inductors

		Output inductors L1-L2		
Size OPDE SD		OPDE SD 175	OPDE SD 220	OPDE SD 250
Inductance [mH]	[mH]	0.785	0.614	0.543
Effective thermal current [Arms]	[Arms]	109.7	140.2	158.6
Effective overload current [Arms]	[Arms]	125.4	160.2	181.2
Overload		120% 30s		
Rated voltage [Vdc]	[Vdc]	830		
Rated frequency [Hz]	[Hz]	0		
Current THD [% of thermal current]	[%lth]	7.3		
Switching frequency [kHz]	[kHz]	10		
Ambient temperature [° C]	[°C]	50		
Cooling		Natural ventilation		
Overtemperature class		F		
Insulation class of materials		H		
Insulation voltage [kV]	[kV]	1.1 / 3 for 30s		
BDF Digital code		054R47011	054R47012	054R47013

TAB. 25B - Output inductors

		Output inductors L1-L2		
Size OPDE SD		OPDE SD 310	OPDE SD 370	OPDE SD 460
Inductance [mH]	[mH]	0.440	0.369	0.298
Effective thermal current [Arms]	[Arms]	195.8	233.1	288.8
Effective overload current [Arms]	[Arms]	223.8	266.4	330
Overload		120% 30s		
Rated voltage [Vdc]	[Vdc]	830		
Rated frequency [Hz]	[Hz]	0		
Current THD [% of thermal current]	[%lth]	7.3		
Switching frequency [kHz]	[kHz]	10		
Ambient temperature [° C]	[°C]	50		
Cooling		Natural ventilation		
Overtemperature class		F		
Insulation class of materials		H		
Insulation voltage [kV]	[kV]	1.1 / 3 for 30s		
BDF Digital code		054R47014	054R47015	054R47016

TAB. 26B - Output inductors

### 8.1.2.2 Output capacitor bank

Size OPDE SD	Capacitor bank for LC filter (Ft = 100 Hz / Start-up time = 12.8 ms @ Io=In Vo=415V)						
	Capacity [μF]	Current @Fpmw [Arms]	Peak Current [A]	Minimum voltage [Vdc]			
OPDE SD 22	680	0.4	22	800			
OPDE SD 32	988	0.6	32				
OPDE SD 40	1 236	0.7	40				
OPDE SD 48	1 482	0.9	48				
OPDE SD 60	1 852	1.1	60				
OPDE SD 70	2 254	1.3	73				
OPDE SD 90	2 934	1.7	95	900			
OPDE SD 110	3 366	2.0	109				
OPDE SD 150	4 788	2.8	155				
OPDE SD 175	6 454	3.8	209				
OPDE SD 220	8 246	4.9	267				
OPDE SD 250	9 326	5.5	302				
OPDE SD 310	11 520	6.8	373				
OPDE SD 370	13 712	8.1	444				
OPDE SD 460	16 986	10.0	550				
<i>Examples of usable capacitors</i>							
	Capacity [μF]	MODEL	Supplier code	Ipk [A]	Ft [Hz]	BDF Digital code	Quantity
OPDE SD 22	3400	B43584 EPCOS 6800uF 450V		57		06B7A5680T1	2: 1 string of 2 cap in series
OPDE SD 32	3400	B43584 EPCOS 6800uF 450V		57		06B7A5680T1	2: 1 string of 2 cap in series
OPDE SD 40	3400	B43584 EPCOS 6800uF 450V		57		06B7A5680T1	2: 1 string of 2 cap in series
OPDE SD 48	3400	B43584 EPCOS 6800uF 450V		57		06B7A5680T1	2: 1 string of 2 cap in series
OPDE SD 60	6 800	B43584 EPCOS 6800uF 450V		114		06B7A5680T1	4: 2 string of 2 cap in series
OPDE SD 70	6 800	B43584 EPCOS 6800uF 450V		114		06B7A5680T1	4: 2 string of 2 cap in series
OPDE SD 90	6 800	B43584 EPCOS 6800uF 450V		114		06B7A5680T1	4: 2 string of 2 cap in series
OPDE SD 110	6 800	B43584 EPCOS 6800uF 450V		114		06B7A5680T1	4: 2 string of 2 cap in series
OPDE SD 150	10 200	B43584 EPCOS 6800uF 450V		171		06B7A5680T1	6: 3 string of 2 cap in series
OPDE SD 175	13 600	B43584 EPCOS 6800uF 450V		228		06B7A5680T1	8: 4 string of 2 cap in series
OPDE SD 220	17 000	B43584 EPCOS 6800uF 450V		285		06B7A5680T1	10: 5 string of 2 cap in series
OPDE SD 250	20 400	B43584 EPCOS 6800uF 450V		342		06B7A5680T1	12: 6 string of 2 cap in series
OPDE SD 310	23 800	B43584 EPCOS 6800uF 450V		399		06B7A5680T1	14: 7 string of 2 cap in series
OPDE SD 370	27 200	B43584 EPCOS 6800uF 450V		456		06B7A5680T1	16: 8 string of 2 cap in series
OPDE SD 460	34 000	B43584 EPCOS 6800uF 450V		570		06B7A5680T1	20: 10 string of 2 cap in series

TAB. 27 – Output capacitors



**FOR THE SIZING OF THE OPTIONAL PRECHARGE RESISTORS AND OF THE RELATED PRECHARGE CONTACTOR, CONTACT BDF DIGITAL.**







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**ECS**  
**TDE MACNO**

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