



Answer Drives 1000

USER AND MAINTENANCE MANUAL

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Contact us for information and comments at: nidec-industrial.com

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MANUFACTURER

Your Answer Drives 1000 was manufactured at the Nidec ASI S.p.A. factory in Montebello (VI) - Italy



MANUFACTURER'S ADDRESS

Any request for after-sales support at the Buyer/Customer or any request for clarification regarding technical aspects contact the nearest Nidec Technical Service Center.

For any kind of information or clarification regarding use, maintenance, installation, etc., the Manufacturer is always available to meet the requests of the Purchaser/Customer.

When asking for clarifications please make sure you have the data from the nameplate available as it will be required to correctly identify the product. The nameplate is located on the back of the product.

Additional information on the product can be found at nidec-industrial.com

WARRANTY AND LIMITATIONS OF LIABILITY

For the warranty period and the conditions, refer to the Order Acceptance.

The manufacturer is not liable for damage caused during transport, receiving, installation or commissioning.

The manufacturer is not liable for damage or consequences resulting from inappropriate, negligent or incorrect installation of the drive, incorrect setting of the operating parameters of the drive, installation in dusty environment, with corrosive substances, excessive vibrations or operating temperature outside the rated data.

The customer is obliged to buy original spare parts, otherwise the guarantee will be void.

The manufacturer declines all responsibility for any damage caused by the AD1000 to people, animals or objects in the following cases:

- Incorrect use or for purposes other than those for which it was made
- Incorrect incorporation/installation in the machine, system or equipment to which it is intended
- Failure to follow the installation/incorporation rules given in this Manual
- Use and/or implementation of tasks by unqualified or unauthorized personnel
- Defects in electrical, hydraulic, pneumatic, water supplies (if present)
- Failure to comply with the technical specifications related to the supplies listed in Chapter 2 of this Manual
- Lacking or insufficient periodic maintenance
- Modifications or interventions on equipment not agreed and not authorized by the Manufacturer
- Use of spare parts that are not original or other than those specified
- Total or partial non-compliance with the instructions contained in this manual.

Compliance with the safety rules in this manual is the responsibility of those who organize and manage the tasks planned for the AD1000 who must ensure that the personnel involved:

- is qualified to perform the required tasks
- knows and observes with due attention the rules contained in this Manual
- knows and applies all the general and specific safety rules applicable to the AD1000.

Failure to follow the safety rules can result in injury to people and damage to the AD1000.

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INTRODUCTION AND WARNINGS FOR THE BUYER

This manual contains all the information related to Medium Voltage variable frequency drives of the product family AD1000, with power from 0.75-5800kW and voltage of 380/460V, 500V and 525/690V.

The User and Maintenance Manual, along with the Declaration of Incorporation, is an integral part of the AD1000 equipment and must always accompany it; the user or the operator who incorporates this device is responsible to keep these documents in order and in good condition throughout the duration of use of the AD1000.

The consultation of the manual is mandatory prior to any operation among those listed below:

- Lifting, transport, positioning, moving, storage;
- Installation, commissioning, operation, use;
- Maintenance, cleaning, adjustments and calibrations;
- Repair, spare parts, consumables, technical assistance;
- Scrapping.



DANGER

Before starting up, use and carry out any type of maintenance on the AD1000, read this manual very carefully in order to be able to closely follow the instructions contained therein.

All users must read and understand all instructions in this manual.



DANGER

The AD1000 provided by the Manufacturer is designed to be incorporated in a complete equipment/system.

Refer to the manual of the equipment/system to obtain all the information about it and the safety rules concerning the use of the complete equipment/system.

It is absolutely forbidden to use the AD1000 before having read and understood the instructions in this manual and the manual of the equipment/system in which the AD1000 is incorporated.



NOTE

This manual must remain with the equipment for the duration of its life. Keep this manual and all accompanying documentation in a place accessible to all personnel in charge of the system operation and maintenance.

This manual is an integral part of the system and provides information to ensure that all staff members who use it can operate safely and can guarantee a perfect efficiency throughout its lifetime.

In case of loss or destruction, you can request a copy of the Operation and Maintenance Manual to the Manufacturer, specifying the exact model, serial number and year of manufacture.

This manual reflects the state of the art at the time of delivery; the Manufacturer reserves the right to change the product without having to upgrade the previous Equipment and production Manual.

The manual is intended for personnel in charge of the incorporation/ installation, commissioning, operation and maintenance of the AD1000. Carefully read this manual in all its parts before proceeding to the incorporation/installation, commissioning, operation, use and maintenance of the AD1000.

The user and/or operator who incorporates the AD1000 and its Operation and Maintenance Manual must know and be able to use the basic principles of electrical engineering and physics, the electrical wiring practice, the symbols used in wiring diagrams, the safety rules and must be skilled in using Low and Medium voltage electrical equipment.

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THE USER AND MAINTENANCE MANUAL

Reading, even if exhaustive, this manual can not replace in any case the fact that the authorized personnel who is in charge of the incorporation/ installation, use and maintenance of the AD1000, has adequate experience and has been trained.

The user and/or operator who incorporates the device can, at any time, contact the manufacturer to request additional information to that contained in this manual or to suggest improvements.

This manual, together with the Programming Manual and contract documentation, constitutes the entirety of the documentation that the User or operator who incorporates the device must know and apply. In order to ensure the maximum reliability of operation, the Manufacturer has made a careful selection of materials and components used in the construction of the AD1000, performing a series of strict checks and tests before shipment.

The proper operation over time of the AD1000 depends on its proper use and its proper maintenance, in accordance with the instructions listed in this manual and other documents required and provided.

The instructions in this manual are intended for qualified technical and skilled personnel, with adequate knowledge in the electrical, electronic and mechanical fields.

For more details regarding the definition of skilled person and designated person refer to EN 50110-1.

For proper integration and for proper use of the AD1000 provided by the Manufacturer inside the equipment/machine/final system (not supplied by the Manufacturer and not described in this manual) in which it will be incorporated, it is assumed that the working environment is appropriate and complying with the laws in force regarding safety and hygiene.

The information contained in this manual should be used for guidance purposes only and do not constitute part of any contract.

The latest version of the manual will be available at:
nidec-industrial.com

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SAFETY REGULATIONS CONTAINED IN THIS MANUAL

The purpose of the safety rules, instructions and notes described in the various chapters of this Manual is to define a set of behaviours and obligations to be met in the execution of various tasks in order to work in conditions of safety for personnel, the equipment and the surrounding environment.

The written safety rules are intended to all authorized and trained personnel who will perform the different tasks and operations related to the AD1000 in the different steps of its use:

- transport;
- incorporation / installation;
- operation;
- use;
- maintenance;
- cleaning;
- disassembly and dismantling.



DANGER

Reading this manual, although exhaustively, can not in any case replace adequate experience and proper training of staff who is in charge of the tasks on the AD1000.



ADDITIONAL INFORMATION

Only suitably qualified personnel in accordance with EN 50110-1 can perform tasks on the AD1000.



ADDITIONAL INFORMATION

Chapter 4 of this manual contains safety instructions for personnel who must operate on the AD1000.

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SYMBOLS USED

This manual uses some symbols to draw the reader's attention and to highlight certain aspects of the instructions that are particularly important.

The table below describes the meaning of the different symbols used.



DANGER

It indicates a danger with risk of injury, even fatal, for the user. Pay close attention to the text parts marked with this symbol.



CAUTION

It indicates a warning of possible damage or deterioration of the AD1000, of the equipment or other property of the user. Pay attention to the text parts marked with this symbol.



WARNING, NOTE

Indicates a warning or a note about key functions or useful information. Pay attention to the text parts marked with this symbol.



ADDITIONAL INFORMATION

Indicates a text containing additional information. This information is not directly related to functions or procedures. They may be references to additional documents such as manuals or technical documents or attachments, or to other sections of this manual.



AVOID DAMAGING THE MATERIALS

It indicates high risk of damage of a part, for example due to the incorrect use of a tool or the execution of a task with a wrong procedure.



SPECIAL TOOL

It indicates that it is necessary to use a tool or a special equipment.



VISUAL INSPECTION

It indicates that the user must perform a visual observation: he will be required to read a measured value, check a warning, etc.



HEARING INSPECTION

It indicates that the user must perform a hearing inspection: he will be required, for example, listen to the noise of operation.

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SAFETY SYMBOLS



DANGER OF CRUSHING THE LIMBS

It indicates a danger with risk of injury to the user/operator who incorporates the device or to the personnel in charge. Pay close attention to the signs and areas where this symbol appears.



DANGER FOR MOVING PARTS

It identifies a danger zone(s) where there are moving parts. The operator who incorporates the device/user or the personnel in charge must pay close attention to the signs and areas where this symbol is present and comply with the safety distances.



RISK OF DANGEROUS VOLTAGE PRESENCE

It indicates a danger with risk of injury, even death, for the operator who incorporates the device/user or to the personnel in charge. Pay close attention to the signs and the areas where these signs are present and do not access the marked areas if you have not previously de-energized the area or the components covered by the sign.



DO NOT REMOVE THE PROTECTIVE CASINGS

It indicates a ban for the operator who incorporates the device/ user or to the personnel in charge to remove the casings installed on the partly completed machinery. It is strictly prohibited to operate the partly completed machinery without the protective casings provided. Pay close attention to the signs and areas where this symbol appears.



DO NOT SMOKE OR USE OPEN FLAMES IN THE VICINITY OF THE PARTLY COMPLETED MACHINERY OR MOTORS, ELECTRIC POWER UNITS.

It indicates a prohibition for the operator who incorporates the device/ user, or for the personnel in charge, to smoke or use open flames near the partly completed machinery, motors or electrical power units and in any case in every area in which this sign is present. All the prohibitions in force in the country of use of the partly completed machinery and internal regulations of the plant or facility established by the employer remain valid.



NO ACCESS FOR UNAUTHORISED PERSONS

It indicates the prohibition for the operator who incorporates the device/ user or the personnel in charge to approach and pass the area where there is this sign. Pay close attention to the signs and areas where this symbol appears.



PROHIBITION OF MAKING OPERATIONS FOR WORK IN PROGRESS

It indicates the prohibition for the operator who incorporates the device/ user or to the personnel in charge for carrying out any type of activation/power on operation of the partly completed machinery for works in progress on the partly completed machinery or on its components. Pay close attention to the signs and areas where this symbol is present.



DO NOT DIRECT WATER JETS TO THE ELECTRICAL EQUIPMENT

It indicates the prohibition of using or directing jets of water towards electric equipment and in any case in all areas where this sign is present.

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ENTANGLEMENT HAZARD

It indicates a danger with risk of injury to the user/operator who incorporates the device or to the personnel in charge. It is compulsory to use appropriate clothing such as shoes, overalls, gloves etc. Pay close attention to the signs and areas where this symbol appears.



DANGER OF SHEARING, CUTTING

It indicates a danger with risk of injury to the user/operator who incorporates the device or to the personnel in charge. It is compulsory to use appropriate clothing such as shoes, overalls, gloves etc. Pay close attention to the signs and areas where this symbol appears.



DANGEROUS TEMPERATURE

It indicates a danger with risk of injury to the user/operator who incorporates the device or to the personnel in charge. It is compulsory to use appropriate clothing such as shoes, overalls, gloves etc. Pay close attention to the signs and areas where this symbol is present.



HIGH TEMPERATURE DANGER

It indicates a danger with risk of injury to the user/operator who incorporates the device or to the personnel in charge. It is compulsory to use appropriate clothing such as shoes, overalls, gloves etc. Pay close attention to the signs and areas where this symbol is present.



DEVICES SENSITIVE TO ELECTROSTATIC DISCHARGES

It indicates a danger with risk of damage to equipment and/or persons as a result of the presence of electrostatic discharge. It is compulsory to wear PPE (such as grounding cuffs) when handling boards or electrical/electronic equipment where this symbol appears. However avoid touching frequently the boards, unless it is strictly necessary.

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TERMS AND ACRONYMS USED

EXPOSED PERSON: (Annex I, 1.1.1-c Directive 2006/42/EC).

Any person wholly or partially in a danger zone.

INTENDED USE: (Annex I, 1.1.1 h-Directive 2006/42/EC).

The use of partly completed machinery in accordance with the information provided in the instructions for use.

DANGER ZONE: (Annex I, 1.1.1-b Directive 2006/42/EC).

Any zone within and/or around the partly completed machinery where the presence of an exposed person constitutes a risk to the safety and health of that person.

RISK: (Annex I, 1.1.1-and Directive 2006/42/EC).

Combination of the probability and severity of an injury or damage to health that can arise in a dangerous situation.

RESIDUAL DANGER: (Ref. EN 12100)

Danger that has not been possible to eliminate or reduce by design, against which the protections are not (partially or totally) effective. The Manual (Chap.4) shows the residual risks and the information, instructions and warnings/requirements for the management of Residual Risks that should be borne by the user.

PROTECTION DEVICE: (Annex I, 1.1.1-g Directive 2006/42/EC).

A device (other than a guard) which reduces the risk, either alone or associated with a guard.

GUARD: (Annex I, 1.1.1-f Directive 2006/42/EC).

element of the partly completed machinery used specifically to provide protection by means of a physical barrier.

PARTLY COMPLETED MACHINERY (Article 2 g-Directive 2006/42/EC).

An assembly which is almost a machinery but which cannot in itself perform a specific application. A drive system is a partly completed machinery.

A partly completed machinery is only intended to be incorporated or assembled with other machinery or other partly completed machinery or equipment, thereby forming a machinery in accordance with Directive 2006/42/EC.

WARRANTY

The general conditions are reported in detail in the Sale Contract.

In more general terms and however valid in any case it is emphasized that:

- Nidec ASI SpA. is not responsible for damage or malfunction in the event of lack of maintenance, unauthorized replacement of parts of equipment with non-original parts and use of the AD1000 other than as stated in this User and Maintenance Manual.
- The guarantee does not include any liability for any direct or indirect damages to persons and property resulting from misuse, from an installation/integration that does not comply with instructions in this Manual and in the regulations referred to in this manual and in case of wrong or lack of maintenance of the AD1000.

AD1000 MANAGEMENT

The AD1000 management, which includes incorporation/installation, operation, use, maintenance, cleaning, disassembly and dismantling, can be carried out only by skilled and specialized personnel, who has adequate knowledge in the electrical, electronic and mechanical field that has been authorized and is duly trained and aware of all the risks related to medium-voltage equipment.

The personnel in charge of the incorporation/installation, operation and maintenance of the AD1000 should be aware that the knowledge and application of safety rules is an integral part of their tasks. The definition of expert person and of person designated to the management of electrical systems is contained in the standard EN 50110-1 to which refer for further details.



DANGER

Unauthorized and unqualified personnel in accordance with EN 50110-1 can not access the area where the AD1000 is installed.

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Before using the AD1000 carry out the following operations:

- Read this Operation and Maintenance Manual and related documentation
- Make sure the AD1000 has been completely incorporated/ installed in the equipment or system to which it is intended
- Make sure all the necessary safety devices are installed in such a way that the equipment/system complies with the instructions of the applicable Directives
- Knowing what protections and safety devices have been provided and are available in the AD1000 with their position and function within the equipment.

It is not allowed to operate the AD1000, before the equipment / plant / machinery in which it must be incorporated or in which it must be installed is declared complying with the rules of the Machinery Directive 2006/42/EC and of the Guidelines applicable to the equipment / system / machinery as a whole.



WARNING

The various systems and safety devices are listed in [chapter 4](#).



DANGER

It is forbidden to disconnect or partially remove the safety guards placed to protect against dangerous parts.
It is forbidden to remove any danger, precaution or prohibition label or sign.
It is strictly forbidden to open the electronic equipment during their operation or immediately after power is removed.
Wait at least 10 minutes before opening the electrical panels after removing power.
All protection and safety devices must be maintained in good operating order to ensure proper operation. In case of damage or malfunction they must be immediately repaired or replaced from the service centre.

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1 OVERVIEW AND INSTALLATION DIAGRAM

1.1 OVERVIEW

AD1000 is a high-performance variable frequency drive that can reduce energy demand significantly by automatically adjusting pumps' operating conditions to meet system demands in a wide range of water, wastewater, irrigation and other pump applications.

The AD1000 drive is designed with today's pump system requirements in mind. Developed by pump automation experts at Nidec, the versatile and reliable AD1000 is designed for optimum performance and reliability with minimal maintenance. While virtually 'plug and play' for standard applications, the AD1000's flexible, modular design can also be easily configured to meet the most challenging applications.

Its highly responsive, built-in intelligence enables it to continuously monitor operating conditions and adjust automatically to changes to ensure safe operation and optimal water flow control.

A wide range of communications features help expand the AD1000's capabilities and functionality. These features make it easy for systems integrators to customize solutions to meet their customers' precise requirements.

Programming can be performed either onsite or remotely from your PC.

Set up is simple when you use the AD1000's easy-to-read keypad. Short-cut options, simple navigation, and a large backlight graphic LCD display help make the set up process quick and straightforward. For those requiring advanced configurations or who want to use the drive to control pump operations, the AD1000 offers many advanced customization options. The Pump-Ready menu gives users access to the complete list of operating parameters for special applications.

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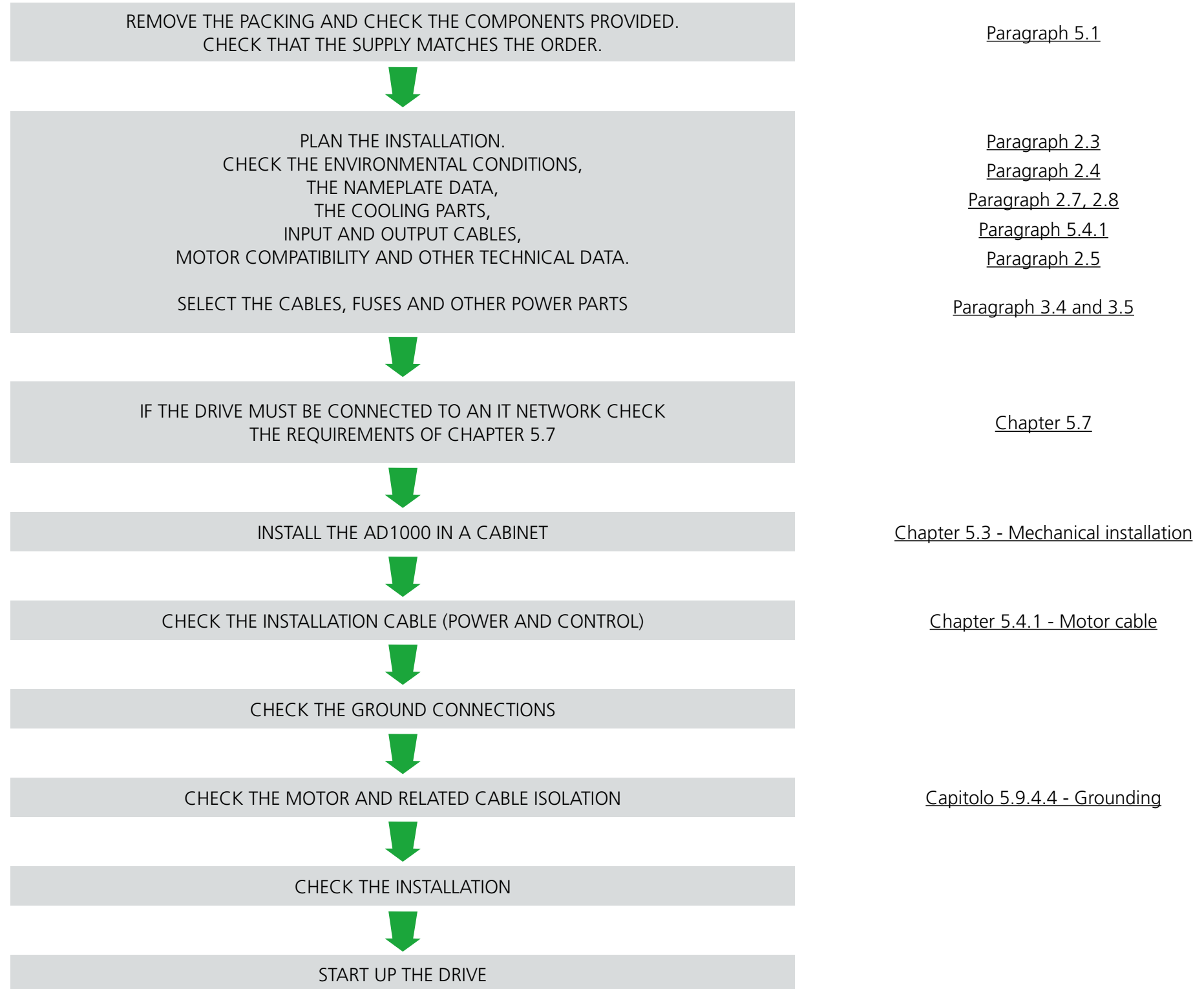
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1.2 INSTALLATION DIAGRAM



PREVIOUS VIEW

2 TECHNICAL DATA

2.1 NOTES ON CONTROL METHODS

Scalar control V/f	Scalar control with Sensorless performance: Vector V/f
Voltage-frequency adjustment with constant or variable ratio	Voltage-frequency adjustment with constant or variable ratio, with torque current control
Voltage boost	Excellent static and dynamic performance
Open loop adjustment	Open loop adjustment (closed simulated)
Speed adjustment range: 1:15	Speed adjustment range: 1:15
Speed resolution: 0.1Hz	Speed resolution: 0.1 Hz
Sliding compensation	Static accuracy of typical speed: 0,4 x sliding frequency %
Output current control	Output current control
	Torque control response: < 10 ms

The Drive AD1000 can control the motor in two different modes:
 c. Scalar V/f: for simple applications and no speed feedback
 d. Sensorless Vector V/f: for applications that require greater dynamic performance and accuracy and no speed feedback.

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2.2 IDENTIFICATION INITIALS

AD1000												
AD1	A	XXX	F	B	N	F	H	N	N	N	00	NN
1, 2, 3	4	5, 6, 7	8	9	10	11	12	13	14	15	16, 17	18, 19
Product series												
Cooling A = Air												
Rated power in kVA (See electrical data table)												
Input Voltage F = 380-480Vac												
Board Microprocessor B = Basis board												
Dynamic braking N = Not installed B = Installed												
RFI filter N = Not installed F = Installed												
Keypad N = Not installed H = Installed												
Communications expansion N = Not installed P = Profibus and Ethernet (ETHPROFI board)												
Expansion board N = Not installed A = Expansion input and Real Time Clock (GIABA) B = I / O expansion and Real Time Clock (GIABB)												
"Safe Torque Off" function N = Not installed T = STO board installed												
External power supply 00 = Not installed 10 = Control board external power supply (24Vdc)												
Cart (only for Frame VIII) NN = Not installed CN = Trolley installed CR = Trolley with output reactor installed												

NOTES:

- Each configuration different from the identification code corresponds to a different SAP code.
- STO function: for sizes up to 028F the STO function requires an external contactor on the main AC line.
- Dynamic Braking:
 - The braking switch is always integrated for sizes up to 036F;
 - For sizes from 045F to 290F the braking switch is available as an option;
 - For sizes from 350F to 520 F the internal braking switch is not available

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2.3 NAMEPLATE

The following figure shows an example of the nameplate, present on all drives of the AD1000 family, which contains the rated data of the drive.

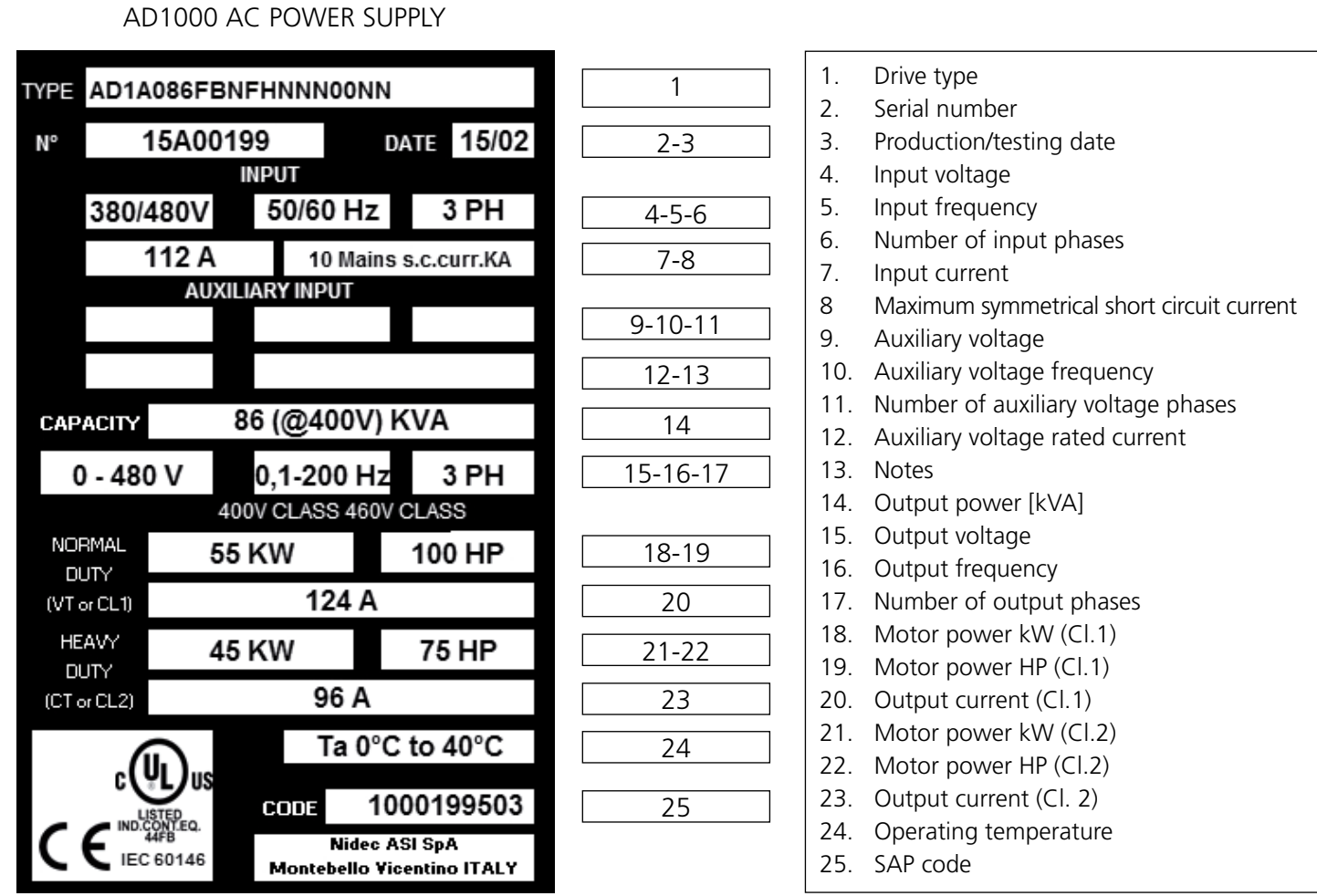


Figure 2.1 Nameplate

◀ PREVIOUS VIEW

2.4 ALLOWABLE AMBIENT CONDITIONS

Table 2.4.1 Allowable ambient conditions

Operation: Operate in a stable place protected from weather according to IEC 721-3-3.

Environmental temperature	From 0 to 40 °C. (from 32 to 104 °F) – If the ambient temperature exceeds + 40°C (104 °F), reduce the rated output temperature of 1% every °C (1.8°F). (max. 55°C – max. 131°F)
Relative humidity	From 5 to 95% without condensation
Contamination levels	(Coated boards) – Chemical gases: IEC 721-3-3, Class 3C2 Solid parts: IEC 721-3-3, Class 3S2
Altitude	Up to 1000 m (3280 ft) above sea level. Above 1000 m (3280 ft) above sea level, the rated output current is reduced by 1% for every 100 m (328 ft) additional. Maximum height of 3000 m (9840 ft)
Vibrations	Max. 0.3 mm/0.012in (from 2 to 9 Hz), max. 1 m/s ² /3.28ft/s ² (from 9 to 200 Hz) sinusoidal (Class 3M1)
Environmental considerations	<ul style="list-style-type: none"> • Avoid exposure to corrosive gases - including hydrogen sulphide • Avoid exposure to strong magnetic fields, nuclear radiation and high levels of RFI from communication transmitters

Storage: Store in a protective packaging and in a protected environment in accordance with IEC 721-3-1.

Environmental temperature	From -25°C to +70°C (From -13°F to +158°F)
Relative humidity	Max 95% to 40 °C. – Max. 95% to 104 °F
Altitude	Up to 3300 feet (or 1000 meters)
Atmospheric pressure	From 70 to 106 kPa
Vibrations	Max 1.5 mm / 0.06in. (from 2 to 9 Hz), max. max 5 m/s ² /16.4 ft/s ² (from 9 to 200 Hz) sinusoidal (class 1M3)
Shock	Max 100 m/s ² (330ft/s ²), 11 ms (36fts) (class 1M3)
Contamination levels	Coated boards – Chemical gases: IEC 721-3-3, class 1C2 Solid parts: IEC 721-3-3, class 1S3
Environmental considerations	<ul style="list-style-type: none"> • Avoid exposure to corrosive gases - including hydrogen sulphide. • Avoid exposure to strong magnetic fields, nuclear radiation and high levels of RFI from communication transmitters

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Table 2.4.1 Allowable ambient conditions

Transport: Transport the drive in its protective packaging according to IEC 721-3-2.

Environmental temperature	From -25°C to +70 °C (From -13°F to +158°F)
Relative humidity	Max. 95% to 40 °C. – Max. 95% to 104 °F
Atmospheric pressure	From 60 to 106 kPa
Vibrations	Max 3.5 mm / 0.14 in. (from 2 to 9 Hz), max 10m/s ² /32.85 ft/s ² (from 9 to 200 Hz) sinusoidal (class 2M1)
Shock	Max 100 m/s ² (max 330ft/s ²), 11 ms. (36fts)
Free fall	250 mm, 0.82 ft (weight less than 100 kg / 220lb) 100 mm, 0.33 ft (weight less than 100 kg / 220lb)

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2.5 ELECTRICAL DATA

Table 2.5.1 Electrical data - Three-phase power supply network 380V, 400V, 415V, 440V, 460V, 480V±10%

AD1000 – AC 6 pulse version - 380/480Vac											
Type	Size	Cl.1 – Overload: 110% for 1 min, every 10 min					Cl.2 - Overload: 150% for 1min, every 10 min				
		$^1I_{N1}(*)$	motor (4p)'@400V		motor (4p)'@460V		$^2I_{N2}(*)$	motor (4p)'@400V		motor (4p)'@460V	
		A	kW	A	HP	A	A	kW	A	HP	A
AD1A0P3FBBNH	I	3.8	1.5	3.6	2	3.4	2.1	0.75	2	1.5	2
AD1A0P4FBBNH	I	5.6	2.2	5	3	4.8	3.8	1.5	3.6	2	3.4
AD1A0P6FBBNH	I	9.5	4.0	8.6	5	7.6	5.6	2.2	5	3	4.8
AD1A008FBBNH	II	12	5.5	11.5	7.5	11	9.5	4.0	8.6	5	7.6
AD1A011FBBNH	III	16	7.5	15.5	10	14	12	5.5	11.5	7.5	11
AD1A015FBBNH	III	21	9.0	18.4	15	19.7	16	7.5	15.5	10	14
AD1A018FBBNH	IIIX	25	11	22.5	20	25	21	9	18.4	15	19.7
AD1A022FBBNH	IIIX	32	15	30.2	25	30.5	25	11	22.5	20	25
AD1A028FBBNH	IIIL	40	18.5	37	30	36	32	15	30.2	25	30.5
AD1A030FBBFH	IIIN	40	18.5	37	30	36	32	15	30.2	25	30.5
AD1A036FBBFH	IIIN	52	22	43	40	49	40	18.5	37	30	36
AD1A045FBNFH	IVN	65	30	58	50	62	52	22	43	50	49
AD1A053FBNFH	IVN	77	37	69	60	71	65	30	58	50	62
AD1A066FBNFH	IVN	96	45	84	75	86	77	37	69	60	71
AD1A086FBNFH	VN	124	55	100	100	109	96	45	84	75	86
AD1A108FBNFH	VN	156	75	135	125	139	124	55	100	100	109
AD1A125FBNFH	VIN	180	90	160	150	173	156	75	135	125	139
AD1A150FBNFH	VIN	210	110	195			180	90	160	150	173

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AD1000 – AC 6 pulse version - 380/480Vac

Type	Size	Cl.1 – Overload: 110% for 1 min, every 10 min					Cl.2 - Overload: 150% for 1min, every 10 min				
		¹ I _N 1(*)	motor (4p)'@400V		motor (4p)'@460V		² I _N 2(*)	motor (4p)'@400V		motor (4p)'@460V	
		A	kW	A	HP	A	A	kW	A	HP	A
AD1A166FBNFH	VIN	240	132	239	200	226	200	110	195		
AD1A210FBNFH	VII	300	160	287	250	281	240			200	226
AD1A260FBNFH	VII	370	200	356	300	333	285	132	239		
AD1A290FBNFH	VII	410	225	395	350	388	320	160	287	250	281
AD1A350FBNFH	VIII	510	280	480	400	477	385	200	356	300	333
AD1A370FBNFH	VIII	540	280	480	450	501	410	225	395	350	388
AD1A440FBNFH	VIII	640	355	616	550	605	510	280	480	400	477
AD1A480FBNFH	VIII	690	400	690	600	676	530	280	480	450	501
AD1A520FBNFH	VIII	750	450	750	650	725	585	315	551	500	556

(*) ¹I_N1 is the rated output current of the drive in class 1

(*) ²I_N2 is the rated output current of the drive in class 2

NOTES

1. The braking switch is integrated for sizes up to 036F.
For sizes between 045F and 290F the braking switch is optional.
2. The RFI filter is optional for drives up to size 028F.
3. The RFI filter is standard for drives up to size 030F.

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2.6 SWITCHING FREQUENCY

Table 2.6.1 Current derating according with the switching frequency

AD1000	CLASS 1						CLASS 2					
	1,5 kHz	2 kHz	3 kHz	4 kHz	6 kHz	8 kHz	1,5 kHz	2 kHz	3 kHz	4 kHz	6 kHz	8 kHz
AD1A0P3-0P4F		100%	100%	100%	85%	75%		100%	100%	100%	100%	100%
AD1A0P6F		100%	100%	100%	100%	88%		100%	100%	100%	100%	100%
AD1A008F		100%	100%	100%	100%	100%		100%	100%	100%	100%	90%
AD1A011F		100%	100%	100%	93%	87%		100%	100%	100%	100%	90%
AD1A015F		100%	100%	90%	80%	71%		100%	100%	100%	93%	87%
AD1A018F		100%	100%	100%	90%	81%		100%	100%	100%	93%	90%
AD1A022F		100%	100%	100%	90%	81%		100%	100%	100%	93%	84%
AD1A028F		100%	100%	100%	100%	84%		100%	100%	100%	93%	84%
AD1A030F		100%	100%	100%	92%	84%		100%	100%	100%	100%	84%
AD1A036F		100%	100%	100%	90%	80%		100%	100%	100%	90%	80%
AD1A045F		100%	100%	100%	100%	90%		100%	100%	100%	100%	90%
AD1A053F		100%	100%	100%	90%	80%		100%	100%	100%	90%	80%
AD1A066F		100%	100%	100%	85%	70%		100%	100%	100%	85%	70%
AD1A086F		100%	100%	100%				100%	100%	100%		
AD1A108F		100%	100%	85%				100%	100%	80%		
AD1A125F		100%	100%	85%				100%	100%	85%		
AD1A150F		100%	100%	85%				100%	100%	85%		
AD1A166F		100%	90%	80%				100%	90%	80%		

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AD1000	CLASS 1						CLASS 2					
	1,5 kHz	2 kHz	3 kHz	4 kHz	6 kHz	8 kHz	1,5 kHz	2 kHz	3 kHz	4 kHz	6 kHz	8 kHz
AD1A210F		100%	80%	65%				100%	80%	65%		
AD1A260F		100%	80%	65%				100%	80%	65%		
AD1A290F		100%	80%	65%				100%	80%	65%		
AD1A350F		100%	80%					100%	80%			
AD1A370F		100%	80%					100%	80%			
AD1A440F		100%	80%					100%	80%			
AD1A480F		100%	80%					100%	80%			
AD1A520F		100%	80%					100%	80%			

The default switching frequency is shown in bold.

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2.7 GENERAL DATA

STANDARDS			
EN61800-2 (LOW VOLTAGE ELECTRIC DRIVES: GENERAL REQUIREMENTS)		 	
EN61800-3 (ELECTRIC DRIVES: EMC REQUIREMENTS)			
EN61800-5-1 (SAFETY REQUIREMENTS: ELECTRICAL, THERMAL AND ENERGY)			
EN 50178 (ELECTRONIC EQUIPMENT IN POWER PLANTS)			
ENVIRONMENTAL CONDITIONS (*)		CONNECTING TO THE POWER SUPPLY NETWORK	
Working temperature:	0-40°C (derating of 1% for every °C, 55°C max)	Three-phase voltage:	F=380-480V ±10%
Storage temperature:	from -25 to +70°C	Frequency:	48-63Hz
Relative humidity:	95% (non-condensing)		
Altitude above sea level:	1000m. (derating of 1% for every 100m, 3000m max)	Total power factor:	0.93 to 0.96
		riferito alla fondamentale:	>0,98 (with line reactor)
Degree of protection:	IP20 Sizes I-VIN IP00 Sizes VII-VIII	Efficiency:	0.98 max (50Hz- rated load) (with output reactor)
Cooling:	with integrated fan		

(*) For detailed information see [paragraph 2.4](#)

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PROTECTIONS	CONNECTIONS TO THE MOTOR	
Overcurrent	Three-phase voltage:	from 0 to the power supply network voltage
Over voltage	Output frequency:	0.1-200Hz
Under voltage	Switching frequency:	1.5-8 kHz
Drive overtemperature	Frequency resolution (V/Hz):	0.1Hz
Motor overload	Frequency precision (V/Hz):	0.1% (analogue control)
Engine overspeed		0.01% (digital control)
Ground fault	Speed resolution:	1:5000 (Sensorless)
Serial tear	Static accuracy rate:	0,01% (Sensorless)
Watchdog	Response time of the torque controller	5ms (Sensorless)
External Fault		
	Overload:	cl.1: 110% X60s every 10 min
		cl. 2: 150% X60s every 10 min

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BASIS BOARD CONTROL CONNECTIONS

2 configurable differential analogue inputs (12 bit + sign)
(max +/- 12.5 V): $\pm 10V$, 0 (4) $\div 20mA$

2 calibrable and configurable opto-isolated analogue outputs (10Bit + sign):
Voltage 0 -10V (2mA), current 4-20mA

1 relay output (NO-C-NC) 250V 2A: DRIVE OK

6 digital inputs (24VDC) opto-isolated (4 configurable)

2 configurable opto-isolated digital outputs (24Vdc)

1 configurable relay output (NO) 1A 250Vac

2 channel + zero pulse encoder input (optional)

1 output for reference + 10V 10mA protected against short circuit

1 output for reference + -10V 10mA protected against short circuit

1 asynchronous serial port RS232 (ANSI protocol)

1 asynchronous serial port RS485 (Modbus RTU)

BASIS CONTROL BOARD

Control for asynchronous motors

◀ PREVIOUS VIEW

2.8 LEAKS AND VENTILATION DATA

The drives AD1000 (AD1A0P3-0P6 excluded) are provided with an internal fan, with the flow of the incoming air positioned downward.

Table 2.8.1 Ventilation data

AD1000	Output current		Leaks			Ventilation		Fan data	
	CI.1	CI.2	CI.1	CI.2	Control	Capacity		Voltage	Current
	A	A	W	W	W	m ³ /h	ft ³ /s	V	A

Three-phase power supply network 400 - 480V ±10%

AD1A0P3F	3.8	2.1	45	22	40	NA	NA	NA	NA
AD1A0P4F	5.6	3.8	66	45	40	NA	NA	NA	NA
AD1A0P6F	9.5	5.6	120	66	40	NA	NA	NA	NA
AD1A008F	12	9.5	165	120	40	66	36	Internal Power Supply	NA
AD1A011F	16	12	225	165	40	100	59	Internal Power Supply	NA
AD1A015F	21	16	276	225	40	100	59	Internal Power Supply	NA
AD1A018F	25	21	330	276	40	100	59	Internal Power Supply	NA
AD1A022F	32	25	450	330	40	100	59	Internal Power Supply	NA
AD1A028F	40	32	555	450	40	100	59	Internal Power Supply	NA
AD1A030F	40	32	555	450	40	100	59	Internal Power Supply	NA
AD1A036F	52	40	660	555	40	100	59	Internal Power Supply	NA
AD1A045F	65	52	900	660	50	280	164	Internal Power Supply	NA
AD1A053F	77	65	1100	900	50	280	164	Internal Power Supply	NA
AD1A066F	96	77	1350	1100	50	280	164	Internal Power Supply	NA

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Table 2.8.1 Ventilation data

AD1000	Output current		Leaks			Ventilation		Fan data	
	Cl.1	Cl.2	Cl.1	Cl.2	Control	Capacity		Voltage	Current
	A	A	W	W	W	m ³ /h	ft ³ /s	V	A

Three-phase power supply network 400 - 480V ±10%

AD1A086F	124	96	1650	1350	60	280	164	Internal Power Supply	NA
AD1A108F	156	124	2250	1650	60	280	16	Internal Power Supply	NA
AD1A125F	180	156	2700	2250	60	500	293	230V 50/60Hz	0,9
AD1A150F	210	180	3300	2700	80	500	293	230V 50/60Hz	0,9
AD1A166F	240	200	3300	2700	80	500	293	230V 50/60Hz	0,9
AD1A210F	300	240	3350	2550	90	800	471	230V 50/60Hz	1,2
AD1A260F	370	285	4000	2900	90	800	471	230V 50/60Hz	1,2
AD1A290F	410	320	4350	3250	90	800	471	230V 50/60Hz	1,2
AD1A350F	510	385	5500	3950	100	1400	824	230V 50/60Hz	2,2
AD1A370F	540	410	5800	4150	100	1400	824	230V 50/60Hz	2,2
AD1A440F	640	510	6600	5100	100	1400	824	230V 50/60Hz	2,2
AD1A480F	690	530	7450	5500	100	1400	824	230V 50/60Hz	2,2
AD1A520F	750	585	7900	5850	100	1400	824	230V 50/60Hz	2,2



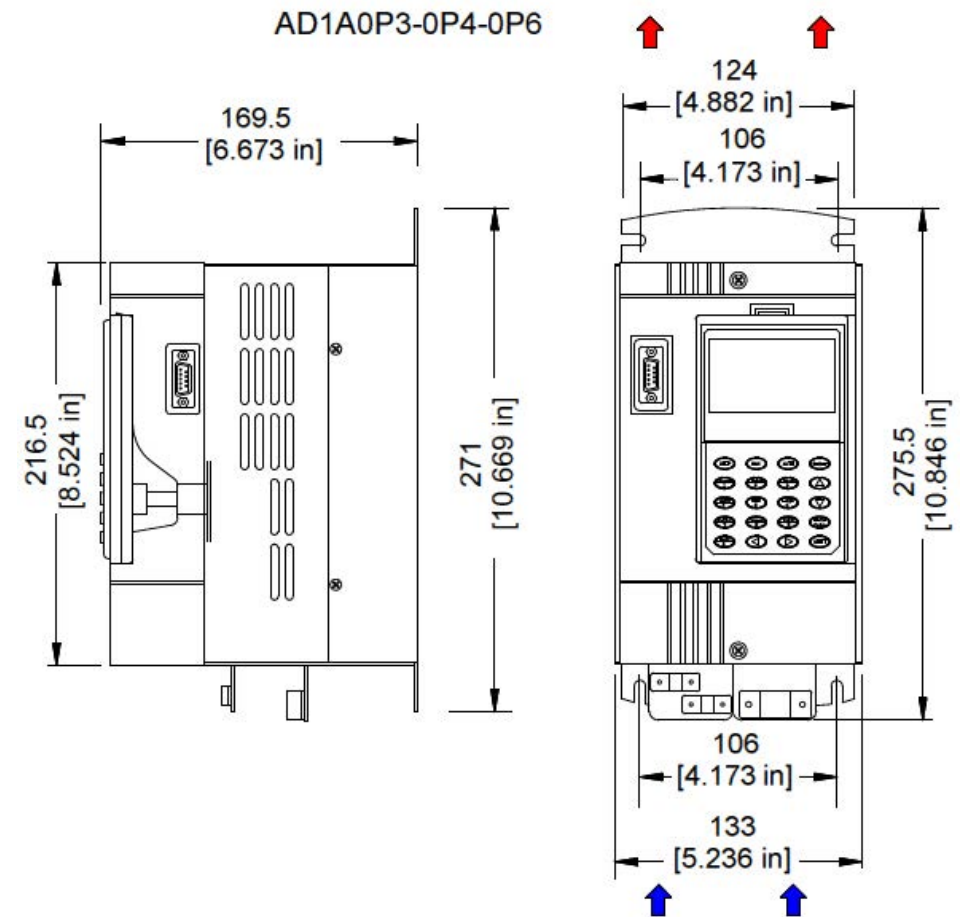
- The Fans of the AD1000 are designed exclusively to meet the losses of the drive. For installation in a panel, it is necessary to consider also the additional loss of pressure.
- AD1A125F and superior. The user must provide a protection device for the fan.

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2.9 OVERALL DIMENSIONS AND WEIGHTS

2.9.1 SIZE I

SIZE		DIAGRAM
		Par.
AD1A0P3/0P4/0P6	Size I	2.9.1
AD1A008	Size II	2.9.2
AD1A011/015	Size III	2.9.2
AD1A018/022	Size IIIX	2.9.2
AD1A028	Size IIIL	2.9.2
AD1A30/036	Size IIIN	2.9.3
AD1A045/053	Size IVN	2.9.4
AD1A066	Size IVN	2.9.4
AD1A086/108	Size VN	2.9.4
AD1A125/166	Size VIN	2.9.4
AD1A210/260/290	Size VII	2.9.5
AD1A350/370/440/480/520	Size VIII	2.9.6



Net	Weight
KG 4	Lbs 8.8

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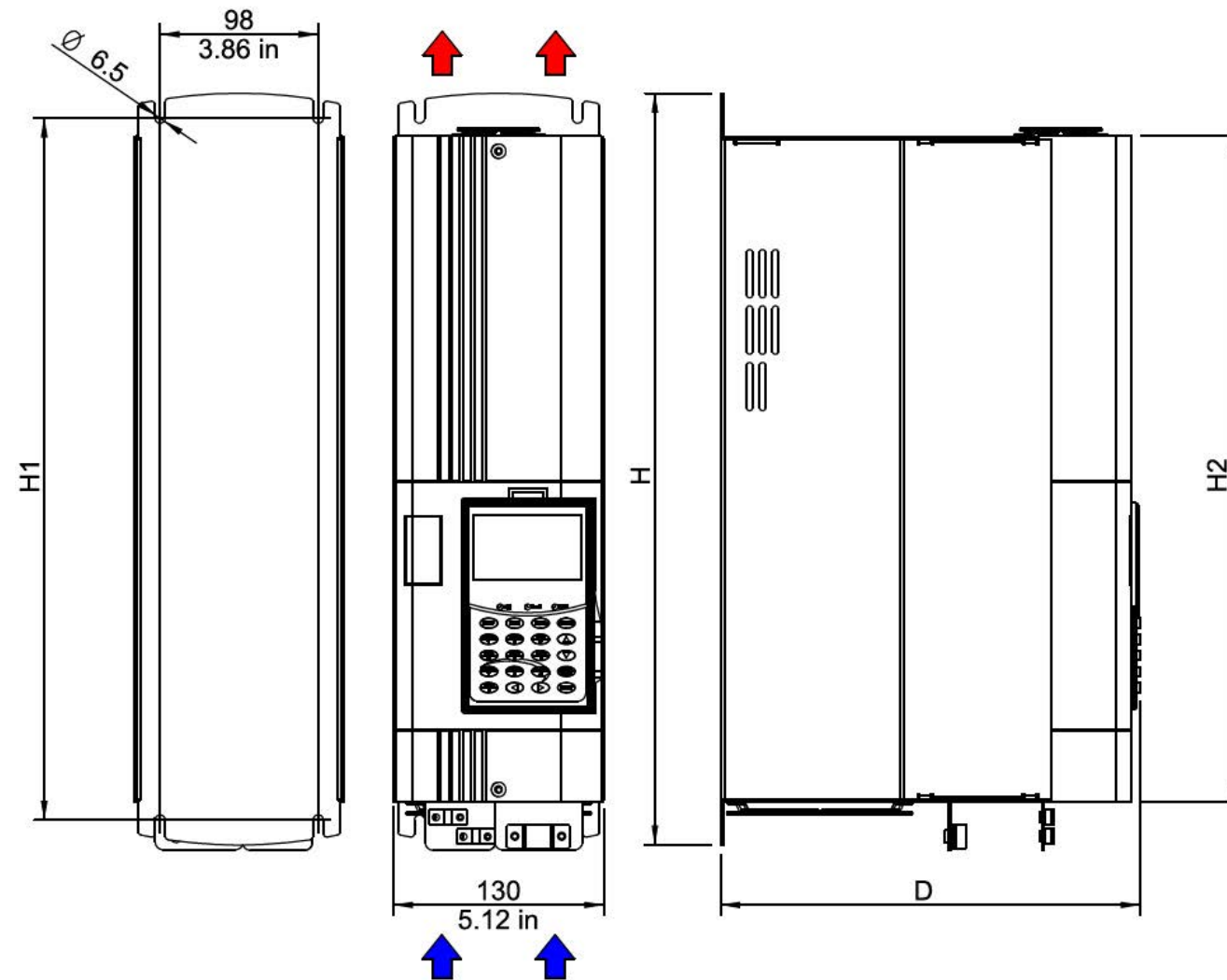
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2.9.2 SIZES II-III-IIIX-IIIL - BASIS CONTROL BOARD



Type	Taglia Taille Frame	D		H		H1		H2		Peso Poids	Weigth
		mm	in	mm	in	mm	in	mm	in	Kg	Lbs
AD1A008F	II	223,5	8.8	341,5	13.44	310,5	12.22	288	11.34	5,5	12.1
AD1A011/15F	III	223,5	8.8	441,5	17.38	410,5	16.16	388	15.28	8	17.6
AD1A018/22F	IIIX	245,5	9.67	466,5	18.37	435,5	17.15	417,5	16.44	8	17.6
AD1A028F	IIIL	260	10.24	466,5	18.37	435,5	17.15	417,5	16.44	10,5	23.1

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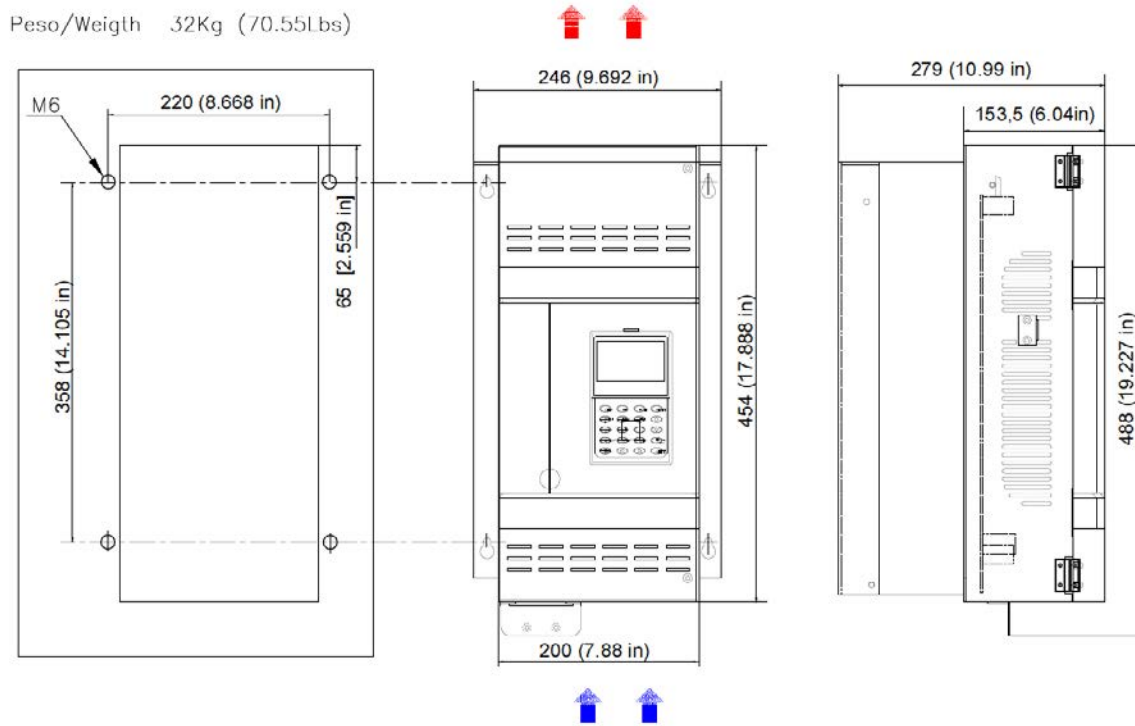
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2.9.3 SIZE IIIN

AD1A030-036 IP20
Peso/Weight 32Kg (70.55Lbs)



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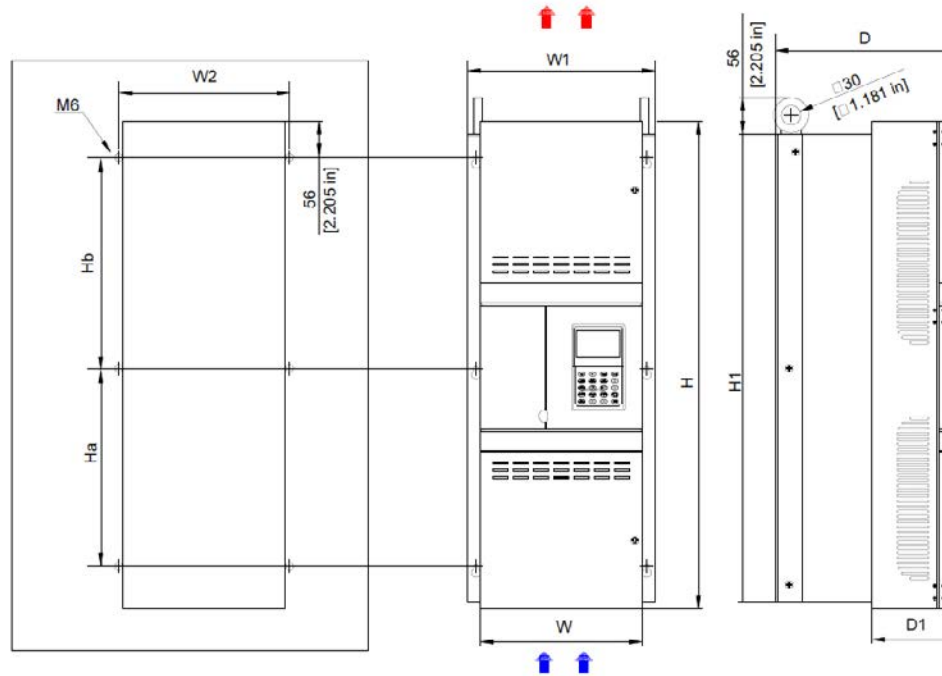
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2.9.4 SIZES IV-V-VIN

AD1A045-166 IP20



	W		H		D		W1		H1		D1	
	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
AD1A045-066	250	9.84	675	26.57	289	11.37	290	11.41	645	25.39	151	5.94
AD1A086-108	250	9.84	755	29.72	304,5	11.99	290	11.41	753	29.63	156	6.14
AD1A125-150-166	260	10.24	1000	39.37	334,5	13.16	300	11.81	959	37.77	170	6.71

	W2		Ha		Hb		Peso-Poids	Weigth
	mm	in	mm	in	mm	in	Kg	Lbs
AD1A045-053	264	10.39	286.5	11.28	286.5	11.28	36	79.37
AD1A066	264	10.39	286.5	11.28	286.5	11.28	40	88.19
AD1A086-108	264	10.39	306.5	12.06	326.5	12.85	52	114.64
AD1A125	274	10.78	326.5	12.85	326.5	12.85	88	194
AD1A150-166	274	10.78	326.5	12.85	326.5	12.85	96	211.64

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2.9.5 SIZES VII

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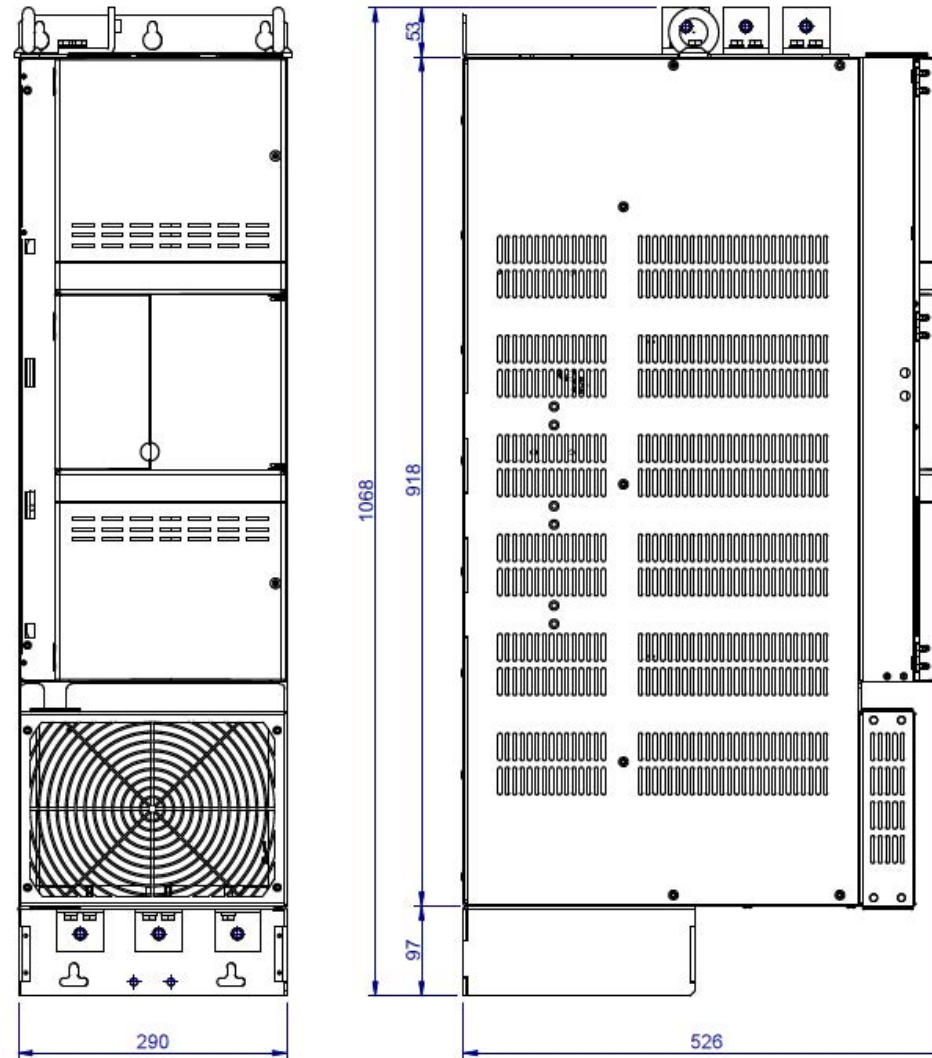
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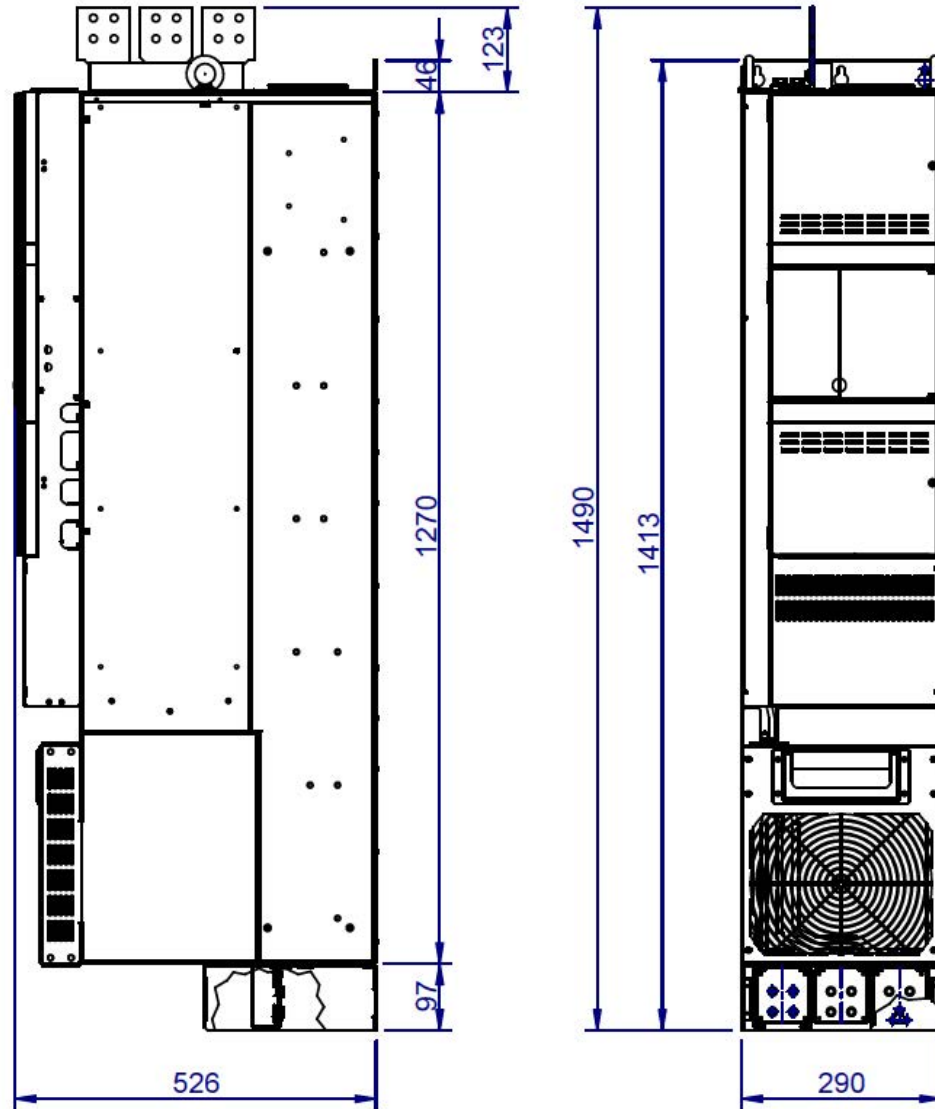
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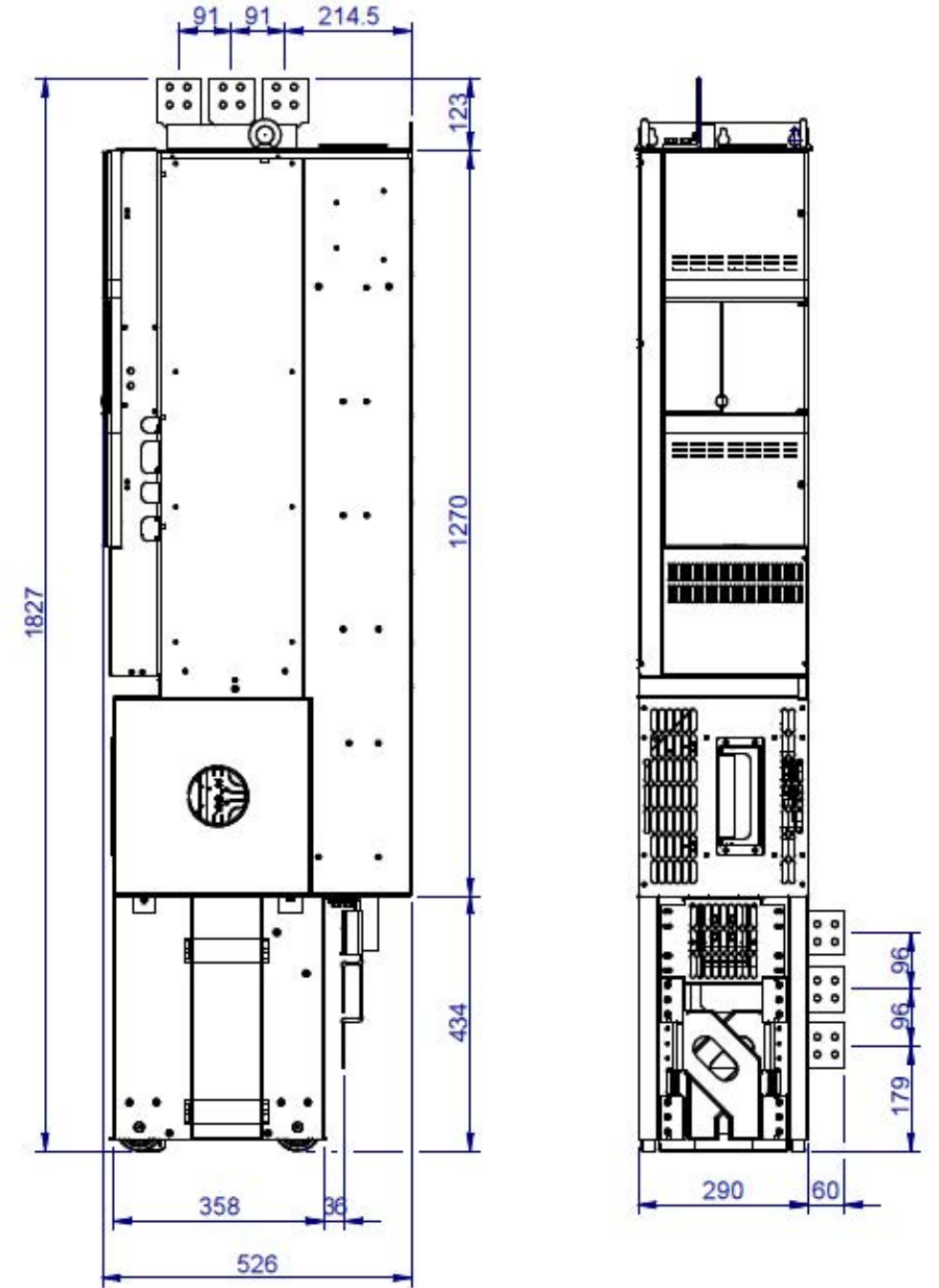
Net		Weight	
KG	120	Lbs	265

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2.9.6 SIZES VIII



Version with Cart (Option)



Net		Weight	
KG		Lbs	
200		441	

The Cart is an option indicated by the 18th and 19th character of the identification code (see Chapter 2):

AD1	A	XXX	F	B	N	F	H	N	N	N	00	CR
-----	---	-----	---	---	---	---	---	---	---	---	----	----

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2.10 TERMINAL BOARD AND POWER DIAGRAMS

SIZE		DIAGRAM
		Par.
AD1A0P3/0P4/0P6	Size I	2.10.1
AD1A008	Size II	2.10.2
AD1A011/015	Size III	2.10.3
AD1A018/022	Size IIIX	2.10.4
AD1A028	Size IIII	2.10.5
AD1A30/036	Size IIIIN	2.10.6
AD1A045/053	Size IVN	2.10.7
AD1A066	Size IVN	2.10.8
AD1A086/108	Size VN	2.10.9
AD1A125/166	Size VIN	2.10.10
AD1A210/260/290	Size VII	2.10.11
AD1A350/370/440/480/520	Size VIII	2.10.12

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Symbols used to identify the auxiliary and power terminals:

Power terminals	L1	network input	
	L2	network input	
	L3	network input	
	PE	ground / Screens	
	U	Phase output - U - MOTOR	
	V	Phase output - V - MOTOR	
	W	Phase output - W - MOTOR	
	RE +	External braking resistor	
	RE -	External braking resistor	
	+	Positive DC BUS	
	-	Negative DC BUS (IGBT)	
	Auxiliaries terminals	XM2V-1	Auxiliaries 230V-50/60 Hz
		XM2V-2	Auxiliaries 230V-50/60 Hz
PE		Ground	

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2.10.1 SIZE I AD1A0P3-0P4-0P6

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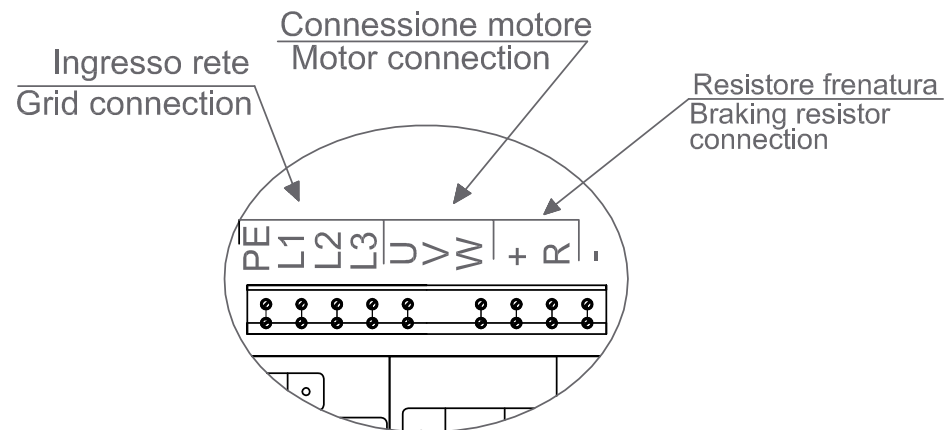
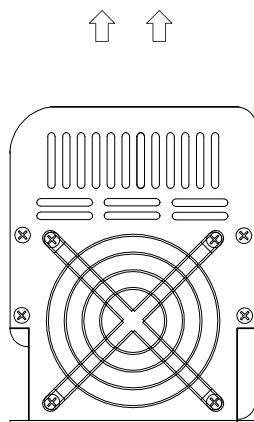
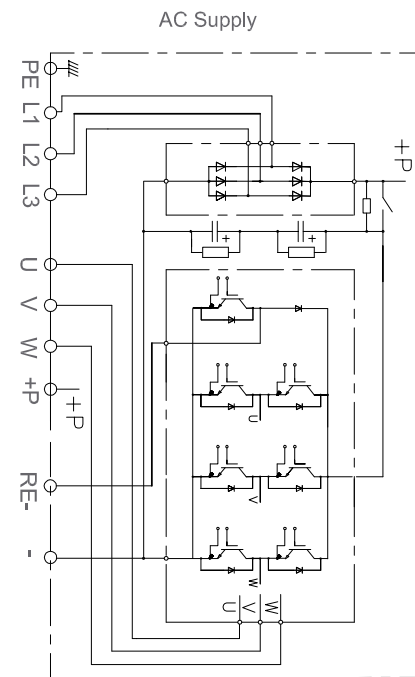
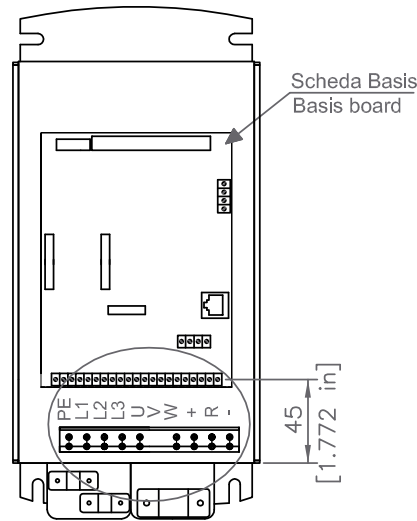
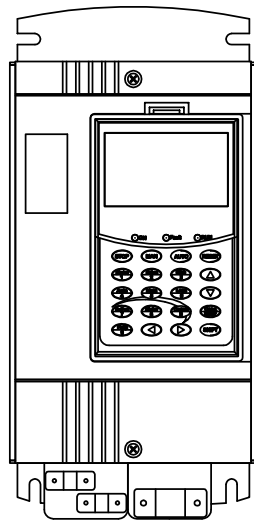
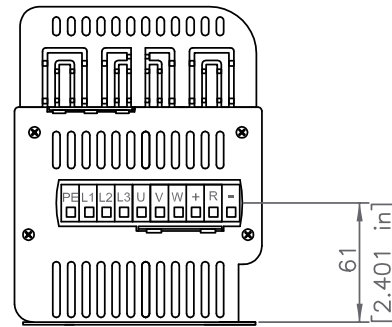
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2.10.2 SIZE II AD1A008

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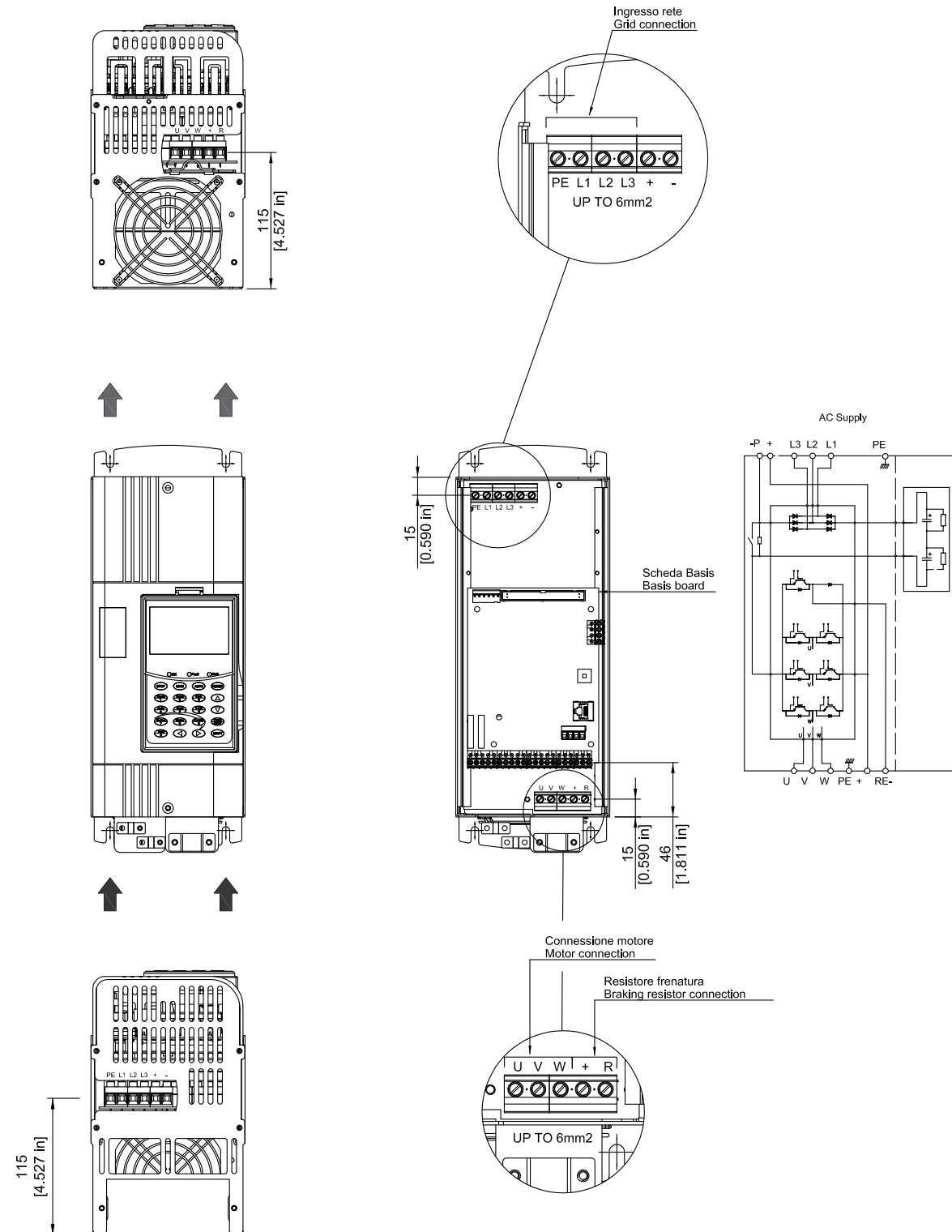
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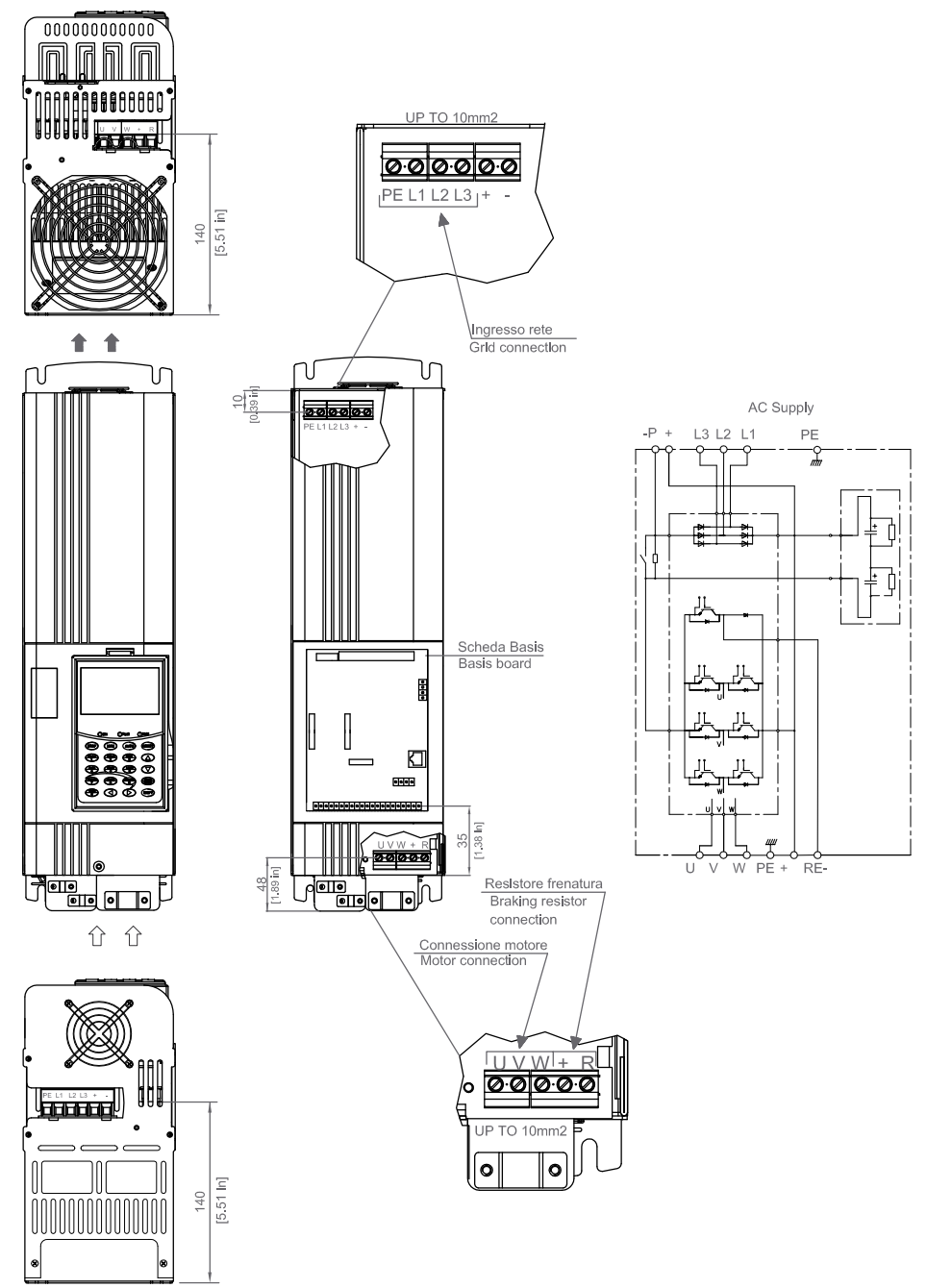
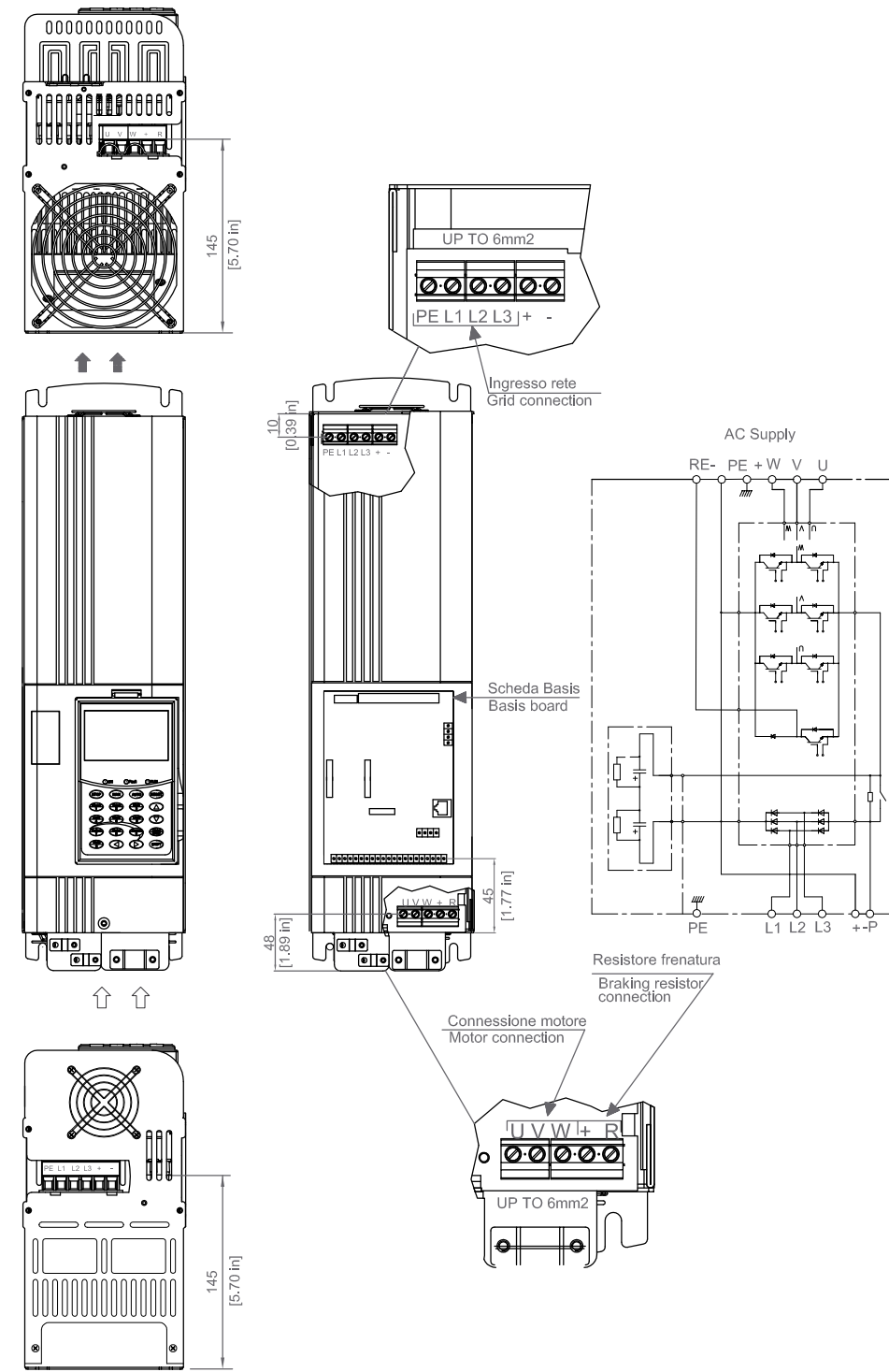
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2.10.3 SIZE III AD1A011-015

2.10.4 SIZE IIIX AD1A018-022



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2.10.5 SIZE IIIL AD1A028

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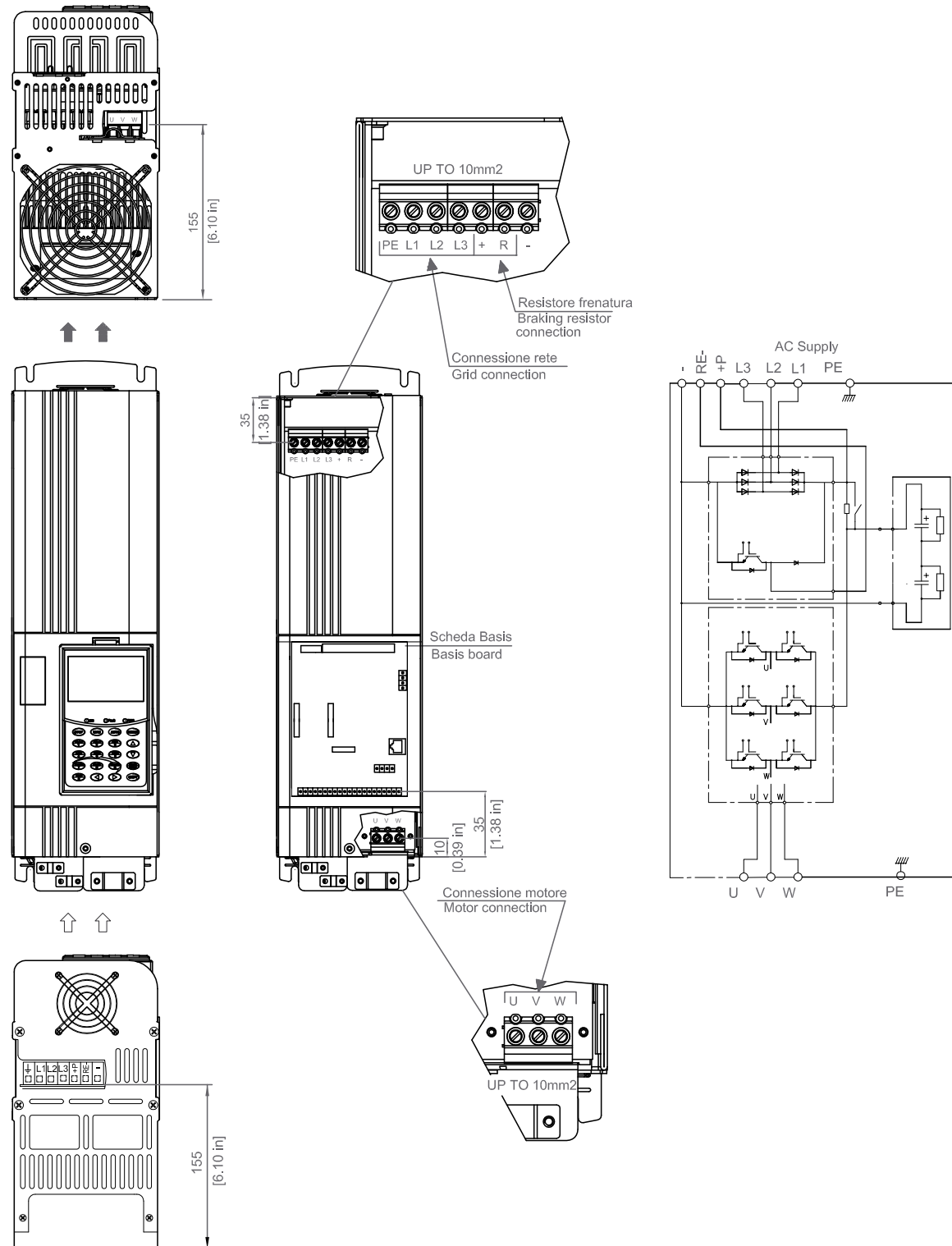
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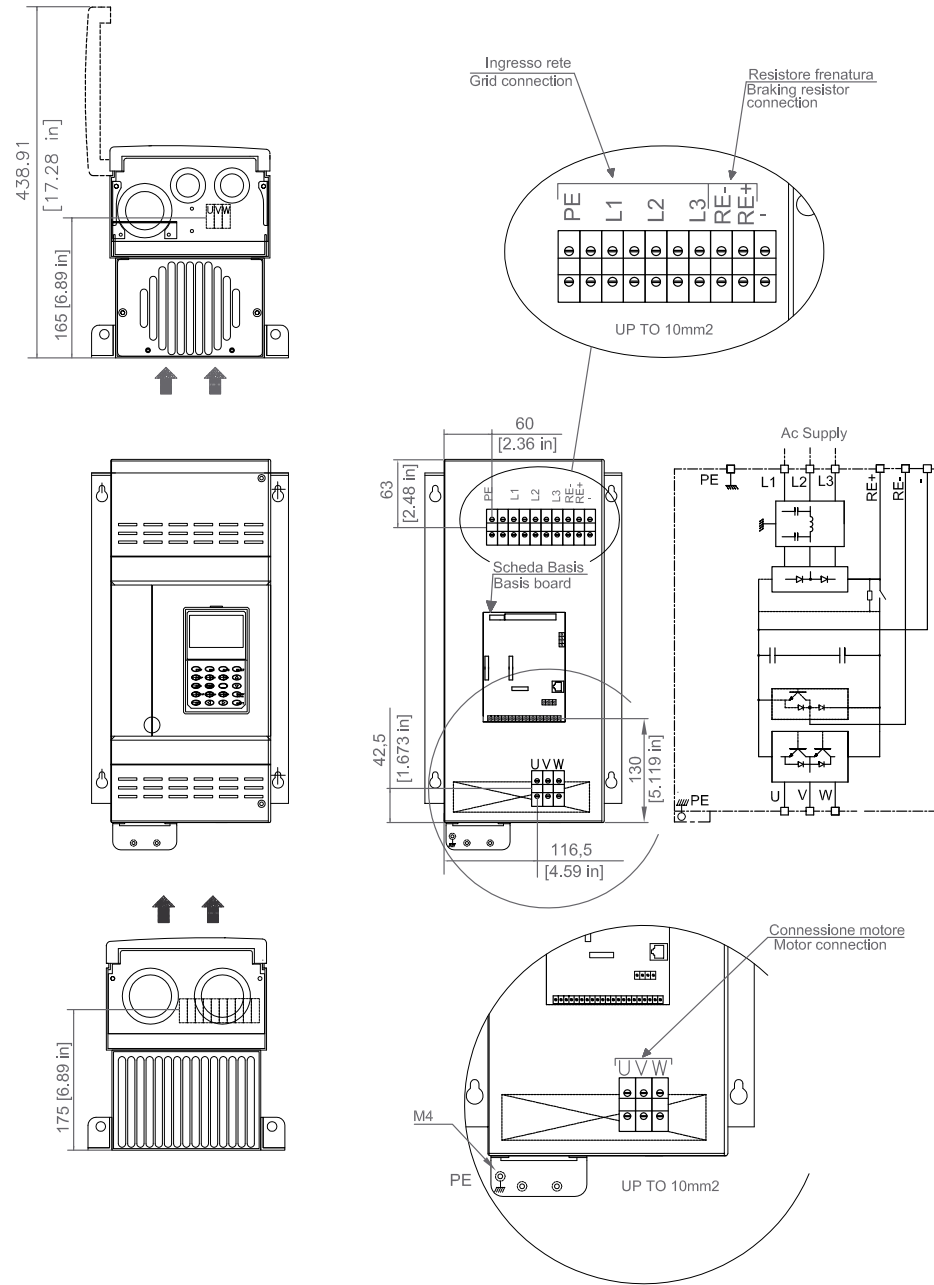
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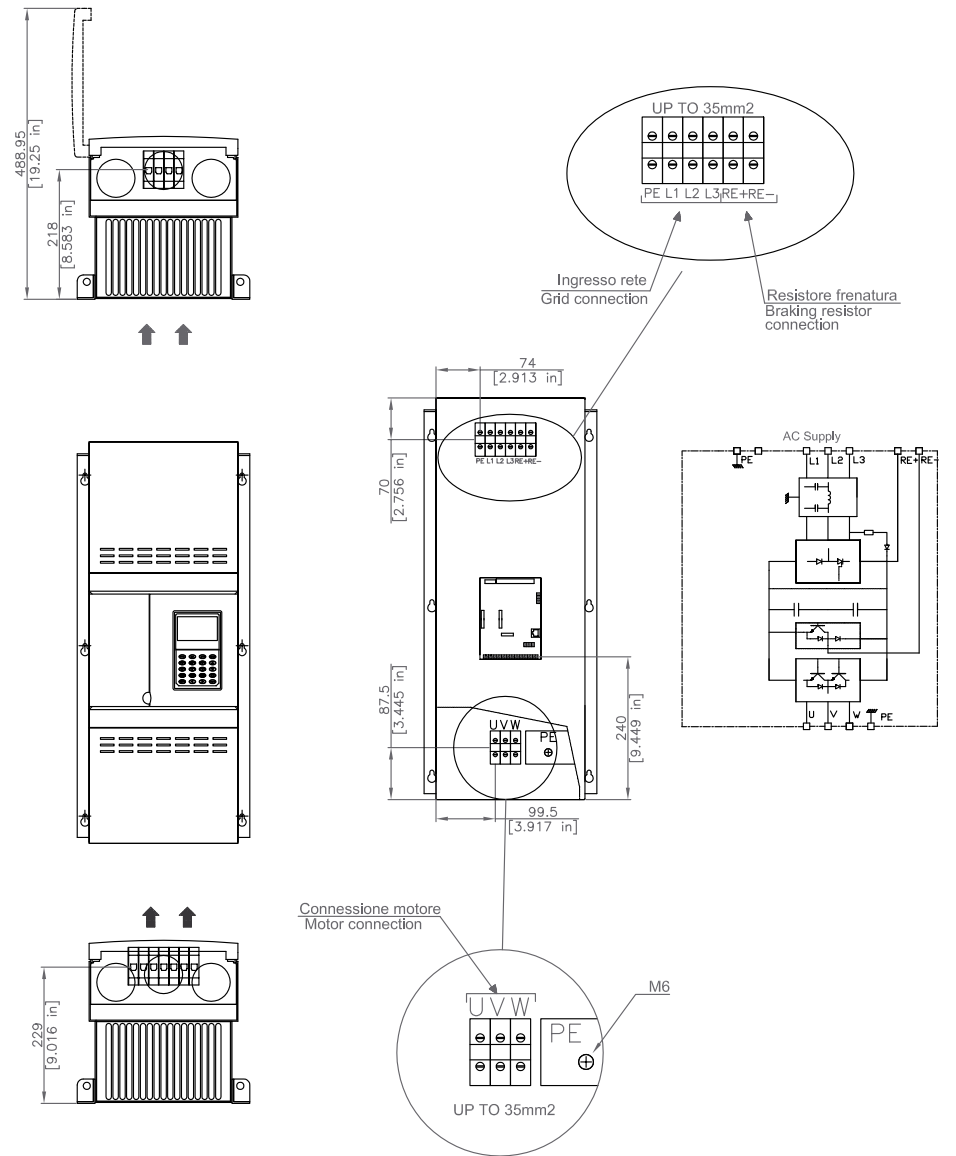


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2.10.6 SIZE IIIN AD1A30-036



2.10.7 SIZE IVN AD1A045-053



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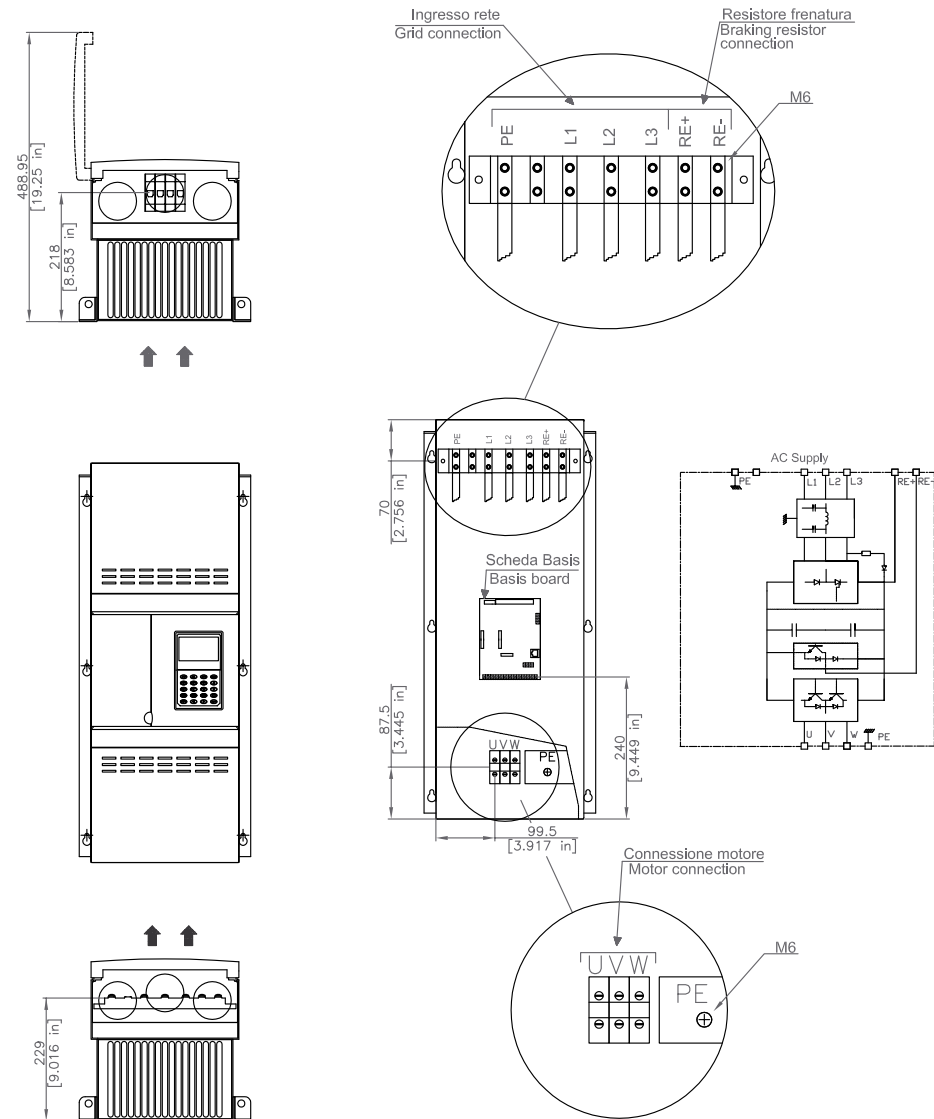
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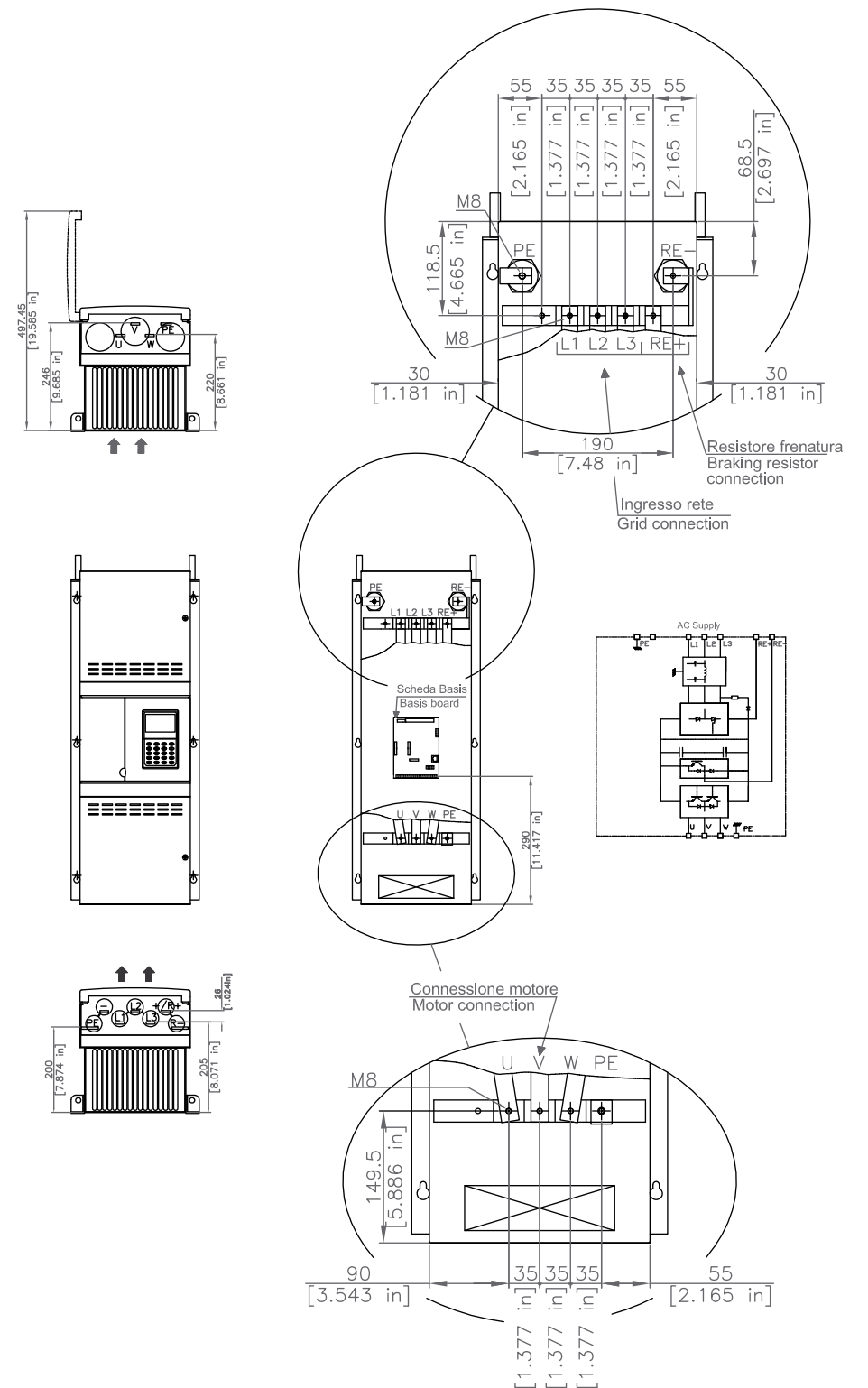
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2.10.8 SIZE IVN AD1A066



2.10.9 SIZE VN AD1A086-108



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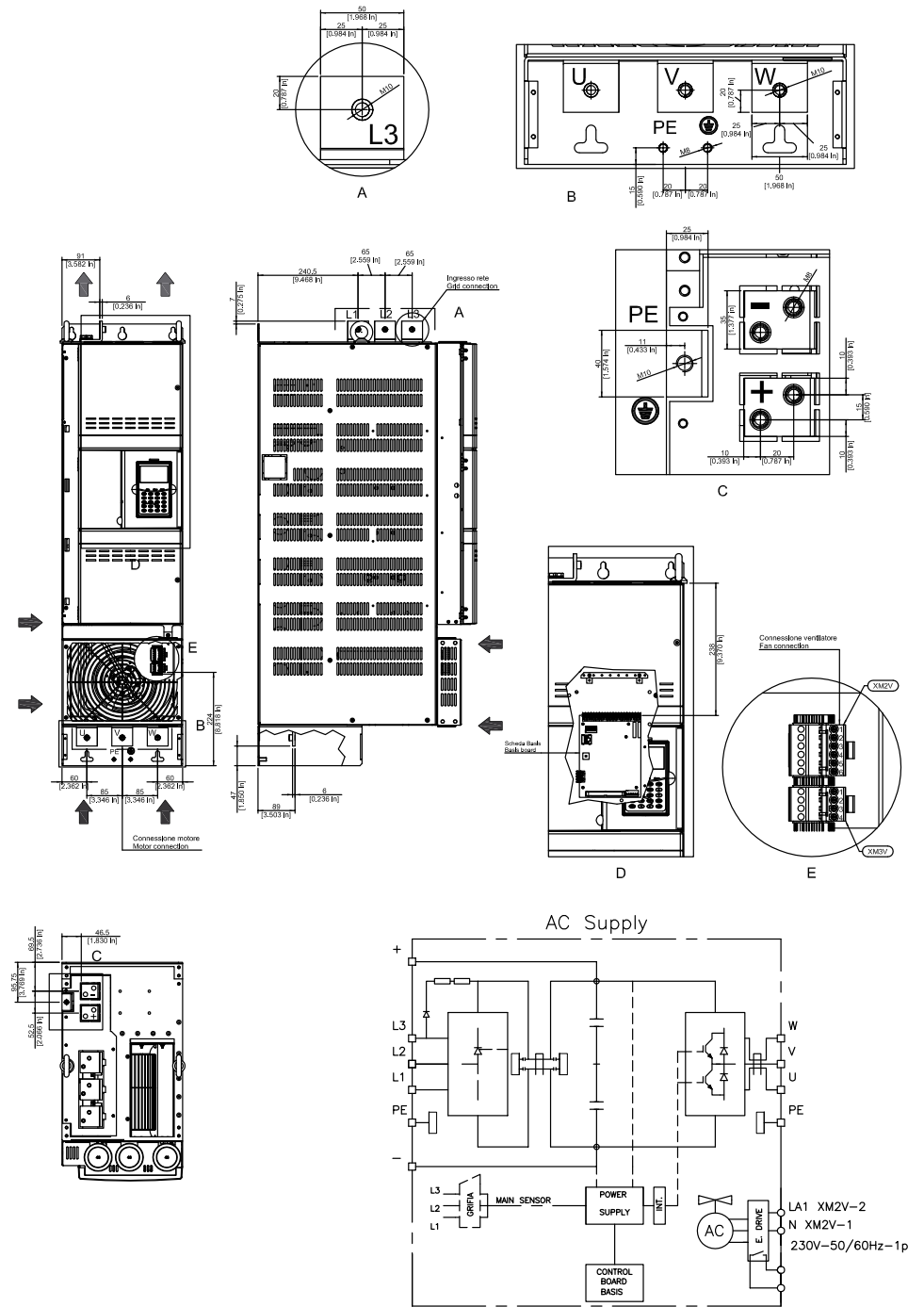
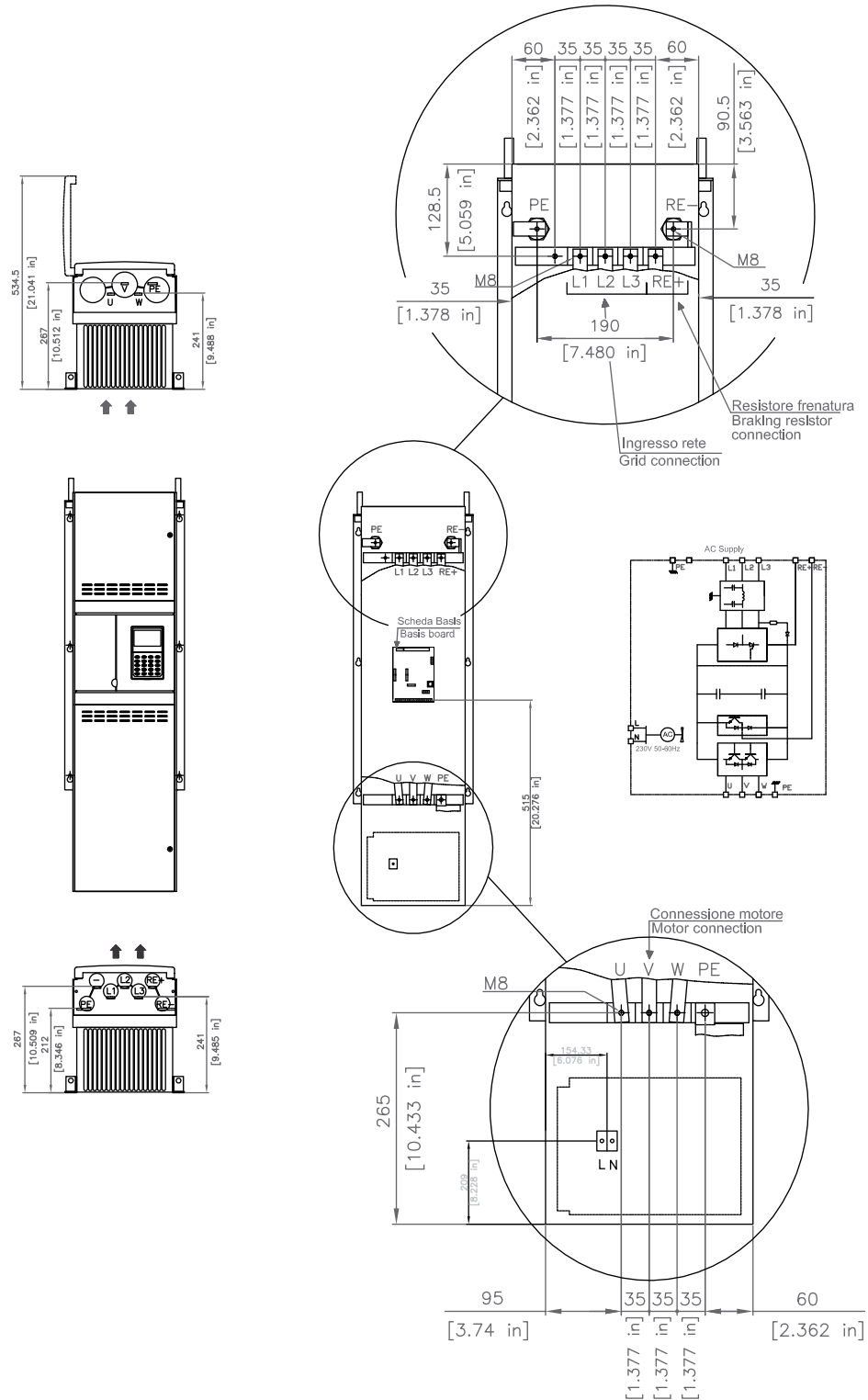
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2.10.10 SIZE VIN AD1A125-166

2.10.11 SIZE VII AD1A210-260-290



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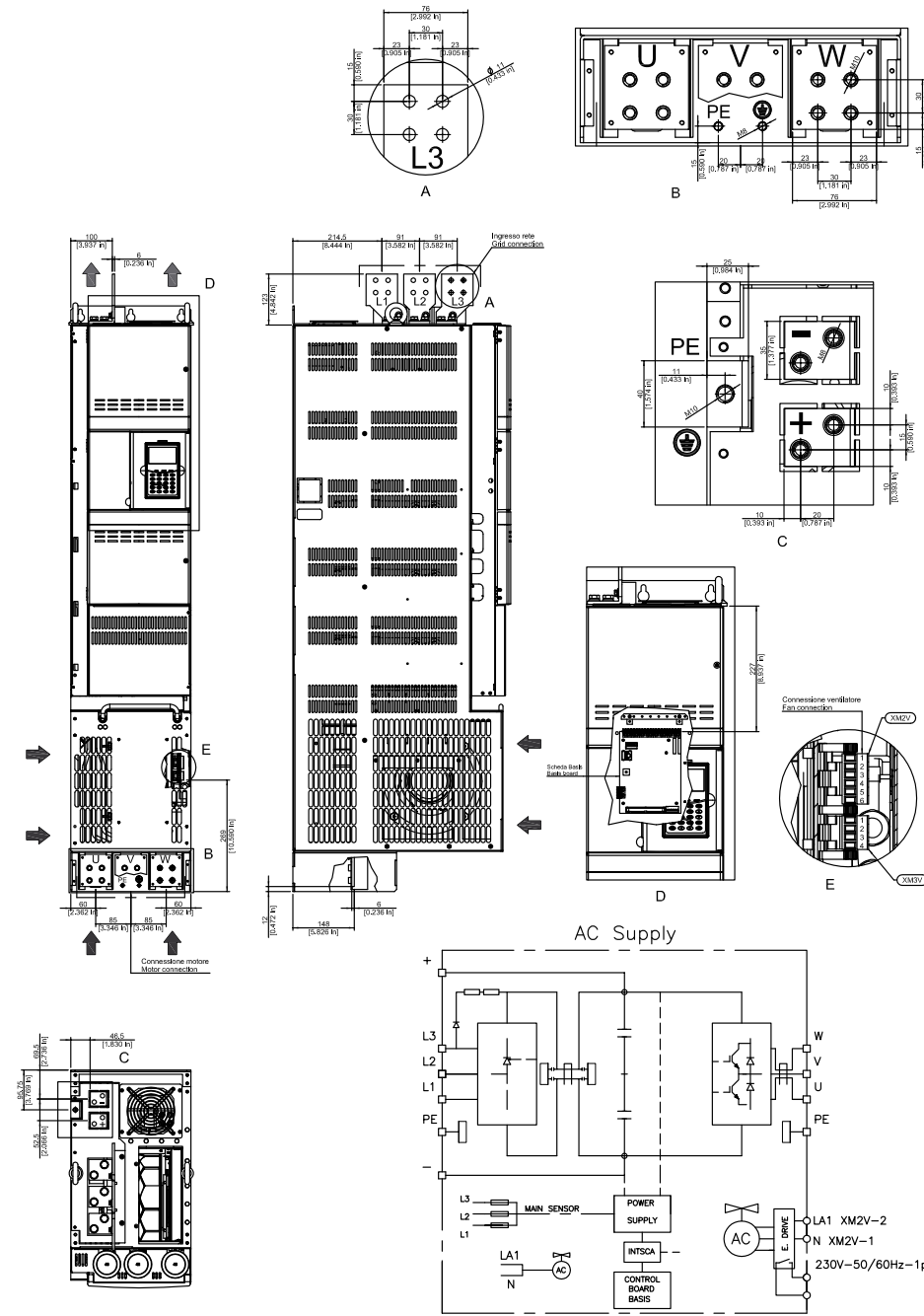
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2.10.12 SIZE VIII AD1A350-370-440-480-520



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3 APPLICATION NOTES

3.1 PRINCIPLE OF OPERATION

The main components of AD1000 are the following:

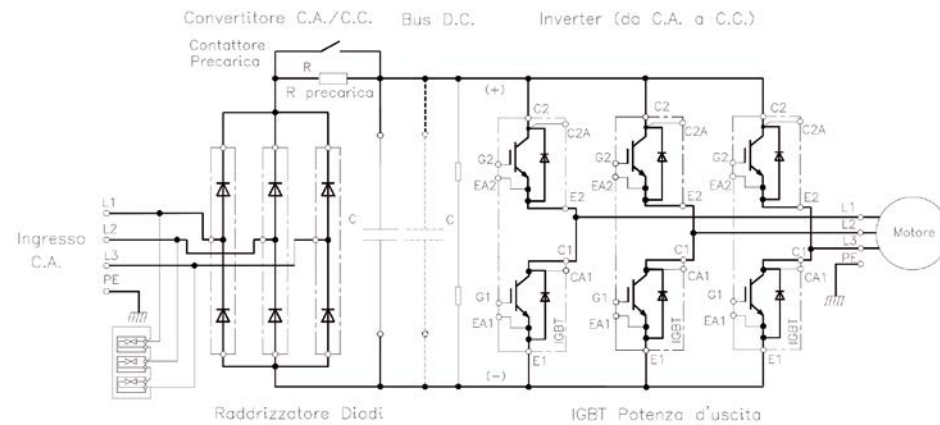
- Input power terminals
- Input rectifier circuit
- Pre-charge
- DC bus capacitors
- Power terminals output
- Microprocessor board
- Keypad display module
- Power and drive board
- IGBT power modules

Figures 3.1.1 / 3.1.2 show a wiring diagram of the AD1000.

The drive consists of three main sections:

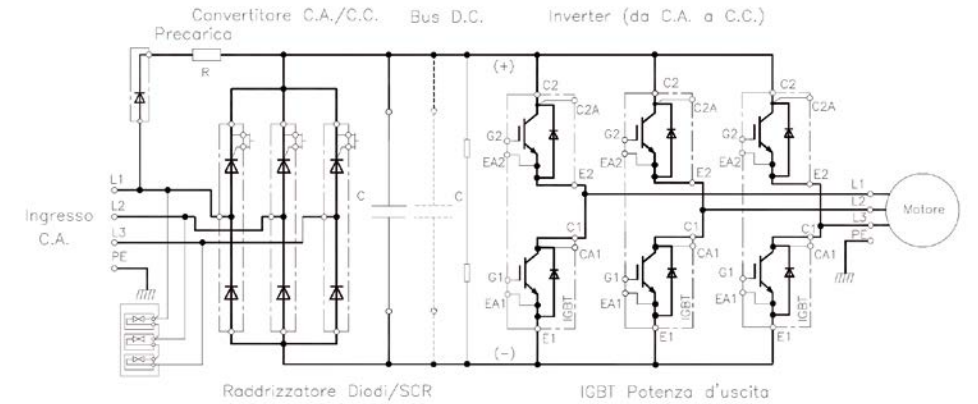
- Drive section: converts the input AC voltage at fixed frequency into a DC voltage
- DC Bus: consists of a bank of capacitors used to filter the line ripple and store energy.
- Drive section: provides the IGBT modules controlled to convert the DC voltage into a three-phase AC output voltage, which varies in frequency and amplitude, used to control the connected motor.

Figure 3.1.1 - Diagram of the AD1000 (0P3F – 036F)



NOTE
the pre-load contactor in some sizes is placed on the DC bus negative.
Refer to the power diagrams in [Chapter 2](#).

Figure 3.1.2 - Diagram of the AD1000 (045F – 520F)



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3.2 GENERAL FORMULAS THAT DESCRIBE THE OPERATION OF AN DRIVE

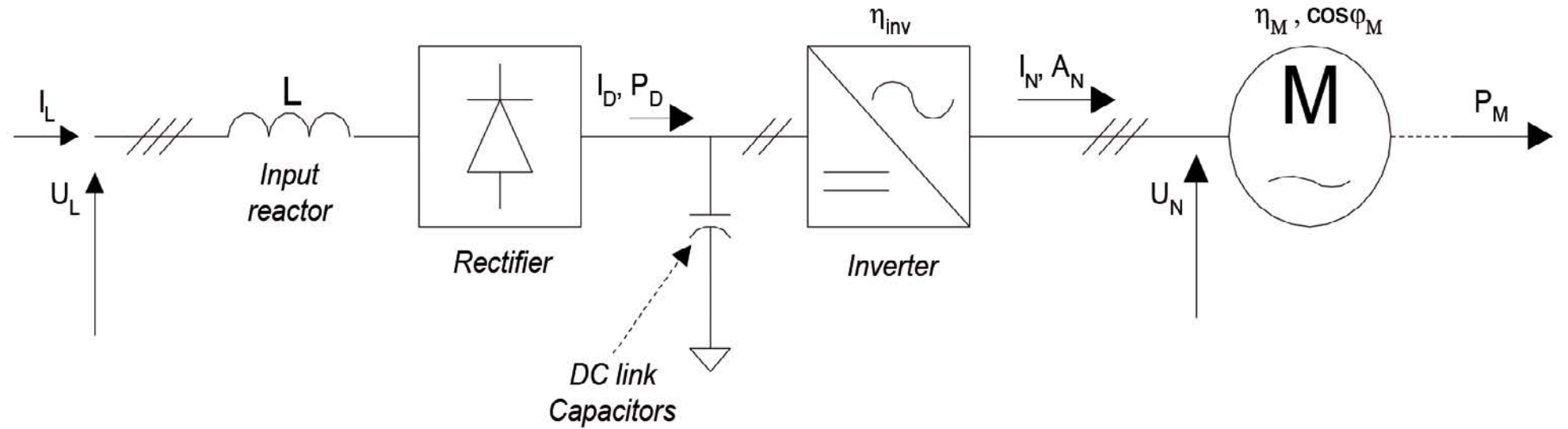


Figure 3.2.3 Single-line diagram of an drive with an induction motor

$$A_N = \sqrt{3} \cdot U_N \cdot I_N$$

$$P_M = A_N \cdot \eta_M \cdot \cos \varphi_M$$

$$P_D = \frac{P_M}{\eta_M \cdot \eta_{inv}}$$

$$I_D = \frac{P_D}{1.35 \cdot U_L}$$

$$I_L = 0.87 \cdot I_D$$

$$I_L = 1.25 \cdot I_D$$

$$I_D = 1.32 \cdot I_M \cdot \cos \varphi_M$$

$$I_L = 1.15 \cdot I_M \cdot \cos \varphi_M$$

$$I_L = 1.65 \cdot I_M \cdot \cos \varphi_M$$

- A_N = APPARENT DRIVE POWER
- I_N = DRIVE RATED OUTPUT CURRENT (RMS)
- U_N = DRIVE RATED OUTPUT VOLTAGE (RMS)
- P_M = MECHANICAL POWER AVAILABLE AT MOTOR SHAFT
- η_M = MOTOR EFFICIENCY
- $\cos \varphi_M$ = MOTOR POWER FACTOR
- P_D = POWER ON THE DC LINK
- η_{inv} = DRIVE EFFICIENCY
- I_D = AVERAGE CURRENT VALUE ON THE DC LINK
- U_L = INPUT VOLTAGE (RMS)
- INPUT RMS CURRENT (ASSUMING A 3% INPUT REACTANCE)
- INPUT RMS CURRENT (WITHOUT INPUT REACTANCE)
- ASSUMING $\eta_{inv} = 0.97$ AND $U_N = U_L$
- INPUT RMS CURRENT (ASSUMING 3% INPUT REACTANCE & $U_L = U_N$)
- INPUT RMS CURRENT (ASSUMING 0% INPUT REACTANCE & $U_L = U_N$)

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Table 3.2.1 - Useful conversion factors

Category	Multiply	By	To obtain
Length	metres	3.281	feet
	metres	39.37	inches
	inches	0.0254	metres
	feet	0.3048	metres
	millimetres	0.0394	metres
Torque	Newton-metre	0.7376	lb/ft
	lb-ft	1.3558	Newton-metre
	lb-in	0.0833	lb-ft
	lb-ft	12.00	lb-in
Rotation	RPM	6.00	degrees/sec
	RPM	0.1047	rev/sec
	degrees/sec	0.1667	RPM
	rev/sec	9.549	RPM
Moment of inertia	Newton-metres ²	2.42	lb-ft ²
	oz-in ²	0.000434	lb-ft ²
	lb-in ²	0.00694	lb-ft ²
	mass-ft ²	32.17	lb-ft ²
	oz-in-sec ²	0.1675	lb-ft ²
	lb-in-sec ²	2.68	lb-ft ²
Power	watt	0.00134	HP
	lb-ft/min	0.0000303	HP
	HP	746.00	watt
	HP	33000.00	lb-ft/min
	BTU/hour	0.293	watt
Temperature	degrees C = (degrees F-32) x 5/9		
	degrees F = (degrees C x 9/5) + 32		

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3.3 DRIVE SELECTION

- The AD1000 size choice has to be based on the drive rated current, rather than on its power.
The drive output current must be greater than the rated current of the controlled motor.
- The motor rated voltage must be greater than 1/2 of the input voltage and the motor rated current must be 1/3 greater than the output current of the AD1000.
- If a single drive feeds several motors, it is necessary to choose a AD1000 with a 10% greater output current compared to the sum of the motor currents. Provide an independent hardware thermal protection for each motor; the thermal protection software inside the AD1000 is not effective for multi-motor applications.
- The vector control cannot be used in applications with multiple motors in parallel. Use the vector V/f control.
- If the multi-motor application requires to enable and disable some motors during the drive operation, choose a AD1000 with a current rated value adequate to handle the sum of the maximum current values of all motors connected and of the starting current of the motor(s) that have to be enabled.
- The starting and acceleration torque of a motor controlled by an drive is limited by the maximum current of the drive. Select an oversized drive if a high starting torque is required.

3.4 APPLICATION NOTES

- If the application requires a contactor on the motor side, the contactor should be switched only when the drive is disabled. The contactor must be interlocked with the drive running logic
- In case of failure of the AD1000, the driving shaft rotates freely; if this is not permissible, it is necessary to install a mechanical brake.
- With power supply from a generator set, make sure that the generator is able to counteract the harmonic distortion produced by the drive.
- The AD1000 includes the "dynamic braking" function; its use can cause high motor temperatures. If this function is used frequently, check that the motor is adequately dimensioned or contact the manufacturer.

3.5 APPLICATIONS WITH SPECIAL MOTORS

- Motors with brakes. The brake must have an independent power supply. When the brake is engaged, the drive must be disabled.
- Motors with conical rotor. The brake is controlled by the magnetic field of the motor; if necessary introduce or adjust the boost; in some cases it is necessary to use an drive of greater size.
- Motors with double winding. The output current of the drive must be higher than the rated current of each motor winding. The winding can be switched with motor off and drive disabled.
- Classified motors. The drive cannot be operated in environments with danger of explosion or fire. If the motor and the drive must be operated in this type of environment, they must be provided both in explosion-proof version.
- Transmission couplings. The lubrication system and the rotation limits vary from manufacturer to manufacturer; with lubricating oil, frequent operations at low speeds may cause overheating due to insufficient lubrication. Check with the manufacturer the possibility of prolonged operation at these speeds.
- Synchronous motors. It is advisable to provide an output reactance to compensate for the insufficient inductance in the motor.
- Submersible pumps. The rated current of these motors is higher than the standard.
- Single-phase motors. The AD1000 is not designed to control single-phase motors.

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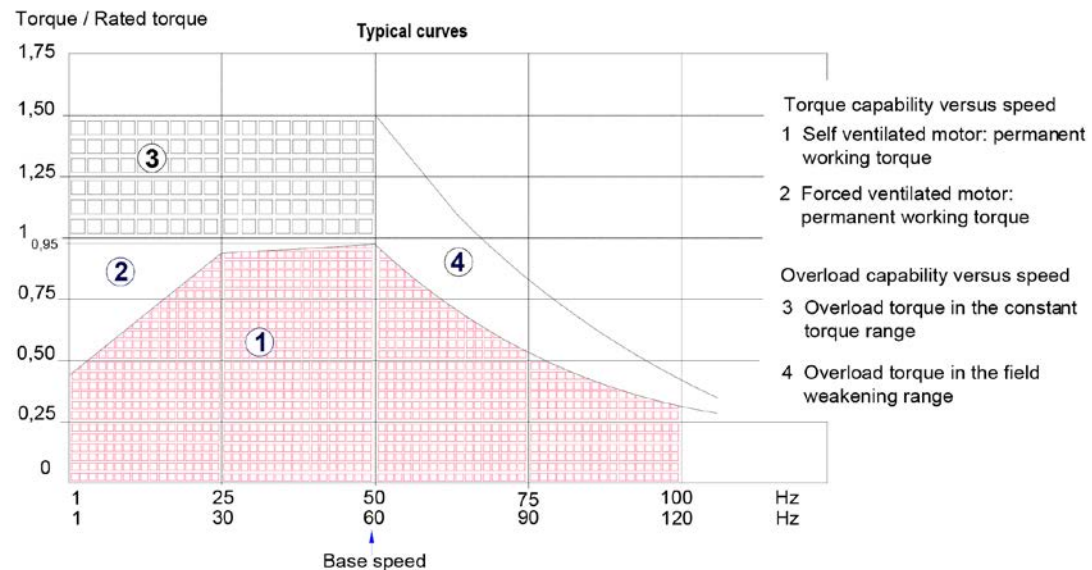
3.6 MOTOR SELECTION

When selecting a motor, check:

- **Natural Resonance.** The vibration can be minimized by using a flexible coupling or by placing a rubber shock absorber under the motor base. With the drive it is possible avoid critical frequencies.
- **The AD1000** provides a control of the variable frequency. The motors and the loads must be able to operate over the speed and power range supplied by the drive.
- **Noise** The noise of the motor operated by an drive is higher than a motor operated by the power supply network (Drive switching frequency = 1.5kHz). The use of the output reactor or of the sinusoidal filter reduces or deletes the noise increase.
- **Protect the windings and the motor bearings.** The output voltage of modern IGBT drives, in relation to the output frequency, are featured by pulses with a value of approximately 1.35 the power supply network voltage with a very short rising edge. The voltage of the pulses can be, depending on the characteristics of cables, of a double value at the motor terminals; this can cause additional stress to the motor insulation.

The modern PWM drive with their high rising edge pulses and high switching frequencies can cause shaft currents through the bearings of the motors which can gradually erode the balls of the bearing. Motor insulation stress can be avoided with the use of dv/dt filters. The dv/dt filters also reduce shaft currents on the bearings. To avoid damage to motor bearings it is necessary to provide insulated bearings (NDE, non-driving end) and output filters according to the table of the next page. It is also necessary to choose the cables and install them according to the instructions of this manual.

- **Ventilation.** The ventilation of the motor is appropriate for the envisaged operating speed range. Prolonged operation at low speed requires an auxiliary cooling of the motor (see diagram section ① - ②).
- **Overload.** The motor is able to provide adequate overload torque in the operating speed range (see section diagram ③-④).



- For a higher speed than standard, contact the manufacturer of the motor to check its operation.
- In overspeed operation, vibrations can occur due to the rotor imbalance or vibrations of the load. The noise of the motor powered by drive may increase.

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• **Motor self-excitation.** The phenomenon is destructive and dangerous, it causes damage to the machine and it can occur if a LC-filter is connected to the output of the drive and is not properly sized.

When using an LC filter before connecting the drive to the motor, check that the current drawn by the capacitor bank of the LC filter to the drive output (detect the capacitance value from the functional diagram of the panel) is less than 90 % of the no-load current of the motor.

It is necessary to check this condition to avoid the possibility of self-excitation of the motor, with consequent serious damage to both the machine and the operator.

• **Insulation of the motor.** Table 3.6.1 shows how to select the motor insulation system and, when necessary, the dv/dt filters and insulated bearings on the opposite side of the coupling. Regarding the insulation it is necessary to consult the motor manufacturer. If the motor fails to comply with the requirements of the table or improper installation may reduce the life time of the motor or damage the bearings.

Table 3.6.1

Motor type	Power supply network rated voltage	Requirement for	
		Motor insulation system	DV/DT filter, isolated bearing
Random winding and Pattern winding	500 V < UN < 600 V	Reinforced: $\hat{U}_{LL} = 1600 \text{ V}$ or Reinforced: $\hat{U}_{LL} = 1800 \text{ V}$	PN > 350 kW o size > IEC 400
	600 V < UN < 690 V	Reinforced: $\hat{U}_{LL} = 1800 \text{ V}$	PN > 469 HP + dv/dt + N + LCMF + N + CMF
Pattern winding	600 V < UN < 690 V	Reinforced: $\hat{U}_{LL} = 2000 \text{ V}$, rise time 0.3 μs	+ dv/dt + N + LCMFF N + CMF

NOTE 1
The abbreviations used in the table are defined below.

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Abbreviation	Definition
U_N	rated voltage of the power supply network
\hat{U}_{LL}	peak to peak voltage at the motor terminals to which the motor insulation must withstand
P_N	motor rated power
dv/dt	filter dv/dt at the drive output
CMF	common mode filter (3 ferrite toroidals)
LCMF	light common mode filter (1 ferrite toroidal)
N	insulated bearing, non-drive end
N.A.	Motors of this power range are not available as standard units. Consult the motor manufacturer

NOTE 2 - EXPLOSION-PROOF MOTORS (EX).

Consult the motor manufacturer for motor insulation problems and additional requirements for explosion-proof motors (EX).

NOTE 3 - LARGE MOTORS AND IP 23 MOTORS

For motors with rated power greater than that prescribed for a particular shaft height by EN 50347 (2001) and for motors with protection degree IP 23:

- apply to motors of the 40 kW < P_N < 100 kW range the same criteria of the "100 kW < P_N < 350 kW" range.
- apply to motors of the "100 kW < P_N < 350 kW" range the same criteria of the " P_N < 350 kW" range.

NOTE 4 - OPERATION IN BRAKING

When the drive is in braking, for most part of this operation, the DC intermediate circuit voltage increases; the resulting effect is equivalent to a 20% increase of the network voltage. This increase must be considered in establishing the isolation requests.

Example: For a 400V motor it is necessary to adopt the insulation criteria for 480V power supply.

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4 GENERAL INFORMATION

The customer is responsible to instruct the personnel on the risks of accidents, the safety devices and the general prevention and protection rules provided by the EC directives and current legislation.



The operating personnel must be aware of the location and operation of all commands and the characteristics of the drive.

The operator must also have fully read this manual and reference documentation of the machines that make up the system.

4.1 TECHNICAL STANDARDS APPLIED

The AD1000 drive is designed, manufactured and tested in accordance with the "ESSENTIAL SAFETY REQUIREMENTS" mentioned in Annex I of the European Directive 2006/42 EC.

The following table shows the Technical Standards used as a reference for the design, construction and testing of the drive.

4.2 REFERENCE STANDARDS

IEC CEI EN 61800-2 ED.1 (1999-09)	Adjustable speed electrical power drive system – Part 2: General requirements – Rating specification for low voltage adjustable frequency a.c. power drive systems.
IEC CEI EN 61800-3 ED.2 (2005-04)	Adjustable speed electrical power drive systems – Part 3: EMC requirements and specific test methods
IEC CEI EN 61800-5-1 ED.2 (2009-04)	Adjustable speed electrical power drive system – Part 5-1: Safety requirements – Electrical, thermal and energy.
IEC CEI EN 60529 ED.2.1 (2001-02)	Consol. with Amd1 Degrees of protection provided by enclosures (IP).

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4.2.1 CE MARKING

On AD1000 drives there is the CE mark to certify that the product complies with the requirements of the Low Voltage European Directives (Directive 73/23/EEC amended by Directive 98/68/EEC) and Electromagnetic Compatibility (EMC) (Directive 89/336/EEC amended by Directive 93/68/EEC)

The validity of the CE mark for EMC is subject to the use of the AD1000 in accordance with the recommendations of this manual.



4.2.2 UL CERTIFICATION

The AD series is certified for the US and Canada markets.

The AD1000 meets the requirements of UL certification if the following is observed.

1. Use cables or copper bus bars in Class 1 65 / 75°C (140/167°F) with the cross-section mentioned in this manual in accordance with the drive size.
2. The power supply network capacity must not exceed the values shown on [Tables 5.4.1.1](#) and [5.4.1.2](#)
3. The tightening torque and the cables cross-section relative to the terminals are shown in [chapter 5](#).
4. The distribution fuses size is indicated in [chapter 5](#).
5. The cable connections must be made with ring cable lugs UL marked and CSA certified. The cable lugs must be fixed by the clamp specified by the manufacturer.
For the type of cable lugs see [chapter 5](#).
6. The AD1000 drive provides motor overload protection adjustable between 30% and 105% of motor rated current at full load.
For information about the setting of the tripping threshold at the time of overload, etc. see [paragraph 2.5 table 2.5.1](#).
7. The AD1000 drive provides overcurrent static protection at the drive output and short-circuit on the DC side.



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4.3 GENERAL INFORMATION

4.3.1 GENERAL SAFETY REQUIREMENTS

This section contains information about the safety measures necessary and useful for personnel working with the AD1000.

The information is general and applies to the risks, both for operators and for the maintenance staff, relating to the operation and maintenance of the drive.



All work related to electrical maintenance and installation on the AD1000 must be performed by qualified technicians.

All standard electrical safety procedures must be complied with:

- Do not touch anything inside the drive, except after making sure that there is no high temperature and/or live parts.
- Always wear insulated or rubber safety shoes and protective goggles.
- Never work alone.
- Never connect measuring devices or grounded oscilloscopes to the system.
- Never remove the safety screens.
- Always take extreme care when handling components or taking measurements inside the electrical panel.

DANGER!

- The AD1000 and all other connected devices **MUST BE PROPERLY GROUNDED**.
- The voltage values on the output terminals of the AD1000 are hazardous both when the drive is disabled and when it is not in operation. Consider, also, that the motor may rotate at any time as soon as power is connected and the capacitor battery is charged.
- If the drive is installed in an electrical panel, never operate it with the panel doors open.

DANGER! RISK OF FIRE, SERIOUS DAMAGE!

- The drive does not have internal fuses, provide adequate fuses (see Chapter 5, paragraph 5.4.1 for size and type) immediately upstream of the drive. Do not use fuses other than those specified: incorrect fuses can cause fire, serious injury to personnel, connected equipment and/or parts in the vicinity.

Some units require auxiliary fuses for the separated lines related to the fan and to the auxiliary circuits.

Failure to comply with these regulations can result in serious physical injury or death of the operator and damage to the drive, the motor or the operating machine.

Before working with the unit read the safety instructions.

- Do not apply power to the drive if it is assumed that moisture, dust or caustic/corrosive chemicals have penetrated inside the container or components.

DANGER! RISK OF FIRE, SERIOUS DAMAGE OR INJURIES!

- The AD1000 are open type devices and must be installed strictly in accordance with the instructions in this MANUAL and in full compliance with existing rules and regulations.
- Never store flammable materials in, on or near the drive.

IT IS STRICTLY FORBIDDEN TO



Run the drive with voltage 10% higher than the rated value.

- Apply power to the output terminals of the AD1000.
- Connect the AD1000 in parallel, directly on the output terminals
- Connect capacitive loads to output terminals of the AD1000
- Connect the drive input at the output (bypass)
- If the drive is not powered on within two years, it may be necessary to reformat the electrolytic capacitors. Do this by powering the not-enabled AD1000 (Drive Enable open) for at least two hours. (see chapter 7.6).

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DANGER! RISK OF DEATH OR ELECTRIC SHOCK!

Before performing maintenance on the unit it is necessary to strictly observe the following safety points:



- Perform the block/exclusion procedure of the power supply and open the main disconnecter of the electrical panel.
- Make sure that all power supplies to the AD1000 (main and auxiliary power) are disconnected before performing maintenance on the drive.
- Wait at least ten (10) minutes after disconnecting the power supply before performing maintenance on the unit. Before accessing the motor terminals ensure that the DC bus capacitors are discharged: checking with a calibrated multimeter for 1000Vdc or above, that the DC voltage is less than 40V. Refer to the safety label present on all drives.
- The output terminals of the braking switch present hazardous DC tension (greater than 500V).
- The AD1000 is supplied with many automatic reset and restart functions that can automatically restart the unit. Do not activate these functions if dangerous situations can occur.

- Do not change the insulation distances or remove insulation roofing and materials.
- The AD1000 provides a variable frequency control. The motors and the loads must be able to function in the speed and power range supplied by the drive.
- Coordinate the voltage and rated current of the motor and the drive. The motor rated voltage must be greater than 1/2 of the input voltage and the motor rated current must be 1/3 greater than the output current of the AD1000.
- The AD1000, regardless of the output frequency, produces a pulse output voltage with a peak value of about 1.4 times the AC input voltage and with very short rise times. The voltage of these pulses can nearly double, according to the characteristics of the cable, on the motor terminals: make sure that the output cables and the motor insulation are designed to withstand additional stresses.
- If it is necessary to perform the insulation tests on the motor and on the cables, first disconnect the cables from the drive. It is not necessary to carry out high potential tests on the AD1000 components.
- Be careful not to damage any part of the AD1000 during handling.
- Protect the drive from weather and adverse environmental conditions (temperature, humidity, vibration, collision, etc.). If it is necessary to temporarily store the drive outdoors, it is necessary to take special precautions (see Chapter 5).

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The **AD1000** contains components sensitive to electrostatic discharge; these components may be damaged if handled improperly. During maintenance or replacement of the electronic boards, it is necessary to take adequate protection against electrostatic discharge (ESD):



Use a maintenance kit for electrostatic charges.

- Wear properly grounded static straps.
- Handle the boards by the edges.
- Boards must not come into contact with highly insulating materials such as plastic sheets, insulating surfaces, parts of synthetic fabrics.
- The boards will be placed on conductive surfaces.
- The boards must be packaged in conductive sheets before shipment.



- The IGBT modules are sensitive to electrostatic charges. Handle with care to avoid damage. Do not leave open the gate-emitter control terminals. Short circuit these pins with anti-static sponge or with a metal jumper terminal when they are not connected to the control board. Remove the short circuit, when reconnecting the control board. Do not touch the pins of the device with your fingers.

PREVIOUS VIEW

4.3.2 REQUIREMENTS IN CASE OF ELECTRICAL INSTALLATION

ELECTRICAL INSTALLATION

Maintenance and installation operations on the AD1000 must be performed by qualified technicians.



It is mandatory to follow the standard electrical protection procedures:

- Do not touch anything inside the drive without first verifying that it is not thermally hot or electrically powered
 - Always wear isolated or rubber safety shoes and wear eye protection.
 - Never work alone.
 - Never connect grounded counters or oscilloscopes to the system.
 - Never remove the safety screens.
 - Always take extreme care when handling components or taking measurements inside the electrical panel.
- The drive does not have internal fuses. It is necessary to provide adequate fuses immediately upstream of the drive. See table 5.4.1.1 for the fuses selection.
 - **DANGER! RISK OF FIRE, SERIOUS DAMAGE OR INJURY!**
Never use fuses different from those indicated or operate drives without line fuses. Incorrect fuses can cause fire, serious damage to equipment and/or connected parts in the vicinity, as well as possible injuries. Some units (see Table 2.8.1) require separate line fuses for fans and auxiliary circuits.
 - Do not supply power to the drive if moisture, dust or caustic/corrosive chemicals can penetrate inside the electrical panel or internal components.
 - **DANGER! RISK OF FIRE, SERIOUS DAMAGE OR INJURY!**
The AD1000 drives are devices of open type and must mandatorily be installed according to the instructions of the MANUAL, in full compliance with standards and regulations in force.

- **DANGER!** The AD1000 and all connected devices **MUST BE PROPERLY CONNECTED TO GROUND.**
- **DANGER! RISK OF DEATH OR ELECTRIC SHOCK!**
It is necessary to take the following mandatory safety measures, before performing the installation.
- Perform the power supply block/exclusion procedure and open the main disconnecter of the drive.
- Do not change the insulation distances of the material and of the removed covers.
- If it is necessary to perform insulation tests on the motor and cables, before proceeding first disconnect the cables from the drive. It is not required to run high potential tests on the components of the drive.
- Repeated operations with rapid intervals of drive power on and power off through the line contactor reduce the lifetime of the filter capacitors. Cycles with more than 10 operations per hour can cause the burning of the pre-charge resistor and will seriously damage the drive. Never use this system to start and restart the drive.
- Power supply from the generator set. The harmonics generated by the drive may deform the generator voltage and cause its overheating. It is recommended to provide a generator with a capacity equal to approximately 5 times the drive power in kVA.
- If a contactor has been installed on the drive output make sure that the opening and closing occur with disabled drive.
- Do not supply power to the output terminals.

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The **AD1000** contains components sensitive to electrostatic discharge; these components may be damaged if handled improperly. During maintenance or replacement of the electronic boards, it is necessary to take adequate protection against electrostatic discharge (ESD):



- Use a maintenance kit for electrostatic charges.
- Wear properly grounded static straps.
- Handle the boards by the edges.
- Boards must not come into contact with highly insulating materials such as plastic sheets, insulating surfaces, parts of synthetic fabrics.
- The boards will be placed on conductive surfaces.
- The boards must be packaged in conductive sheets before shipment.



- The IGBT modules are sensitive to electrostatic charges. Handle with care to avoid damage. Do not leave open the gate-emitter control terminals. Short circuit these pins with anti-static sponge or with a metal jumper terminal when they are not connected to the control board. Remove the short circuit, when reconnecting the control board. Do not touch the pins of the device with your fingers.

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4.3.3 REQUIREMENTS IN CASE OF MAINTENANCE

SAFETY REQUIREMENT



All maintenance and installation operations on the AD1000 must be performed by qualified technical personnel. Nidec ASI S.p.A. is not responsible for damage due to improper or unauthorized maintenance.

DANGER! RISK OF DEATH OR ELECTRIC SHOCK! It is necessary to take the following compulsory measures before the maintenance of this unit:

- Perform the power supply locking/disabling procedure and open the main disconnect on the electrical panel that contains the AD1000.
- Make sure that all power supplies that come to the drive (main power supply, auxiliary power supply) are disconnected before performing maintenance on the drive
- Before performing any maintenance on the machine wait 10 minutes after disconnecting all power sources and ensure that the DC voltage is less than 50V. Use a 1000 V DC multimeter or higher. Refer to the safety label placed on each drive.

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The **AD1000** contains components sensitive to electrostatic discharge; these components may be damaged if handled improperly. During maintenance or replacement of the electronic boards, it is necessary to take adequate protection against electrostatic discharge (ESD):



- Use a maintenance kit for electrostatic charges.
- Wear properly grounded static straps.
- Handle the boards by the edges.
- Boards must not come into contact with highly insulating materials such as plastic sheets, insulating surfaces, parts of synthetic fabrics.
- The boards will be placed on conductive surfaces.
- The boards must be packaged in conductive sheets before shipment.



- The IGBT modules are sensitive to electrostatic charges. Handle with care to avoid damage. Do not leave open the gate-emitter control terminals. Short circuit these pins with anti-static sponge or with a metal jumper terminal when they are not connected to the control board. Remove the short circuit, when reconnecting the control board. Do not touch the pins of the device with your fingers.

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4.3.4 GENERAL INFORMATION - REGULATIONS

The AD1000 equipment provided by Nidec ASI S.p.A. is intended for professional use.

It is the responsibility of the customer, the integrator/user or of the person making the incorporation, installation, commissioning, operation and maintenance of the AD1000 to ensure that all persons involved in various operations are properly educated about accident risks, safety devices and general accident prevention rules provided by the Community directives and by the law of the country where the AD1000 is installed, incorporated and used.

The incorporation/integration/installation, commissioning, operation and maintenance of the AD1000 must only be performed by qualified, experienced and educated personnel that has technical expertise and appropriate qualifications (according to EN50110-1 and/or any instructions applicable in the country of use of the AD1000) for low and medium voltage electrical systems and equipment.

The personnel involved must have fully read this manual and the User and Maintenance Manuals of the machine/system/assembly where the AD1000 is incorporated/installed; in particular the operator must know and have experience of the operating characteristics and location of all the commands of the AD1000.



CAUTION

The AD1000 provided by Nidec ASI S.p.A. is intended for professional use by trained, informed, educated personnel and suitable to its correct incorporation, installation and use.



DANGER

Tampering or unauthorized substitution of one or more parts of the AD1000, the adoption of accessories that modify its use and the use of spare materials other than those specified, may cause injury.

4.3.5 GUIDELINES APPLIED AND DECLARATION OF INCORPORATION

The AD1000 is designed, manufactured and tested in compliance with the following directives:

- Machinery Directive 2006/42/EC.
- Electromagnetic Compatibility Directive 2004/108/EC.
- Low Voltage Directive 2006/95/EC (referred only to the use of compliant material)

The following is a facsimile of the Declaration of Incorporation.

DICHIARAZIONE DI INCORPORAZIONE
(ai sensi dell'allegato II B della Direttiva Macchine 2006/42/CE)

La Sottoscritta **Nidec ASI S.p.A.** con sede in Viale Sarca, 336 - 20126 Milano (MI) - ITALIA dichiara in qualità di costruttore sotto la propria responsabilità che il prodotto, oggetto della seguente dichiarazione costituito da:

N. XX convertitori elettronici di potenza, così individuati:

Modello: **SILCOVERT**
 Tipo: **SV**
 N° di serie: **AV72** **2FN1000**
 Anno di Costruzione: **20...**

è conforme alle direttive applicabili vigenti.

I requisiti essenziali di sicurezza (RES) applicati rispettando i seguenti:
 1.1.2 - 1.1.3 - 1.1.5 - 1.2.1 - 1.2.2 - 1.2.3 - 1.2.4 - 1.2.4.2 - 1.2.4.3 - 1.3.1 - 1.3.2 - 1.3.3 - 1.3.4 - 1.3.6 - 1.3.7 - 1.3.8.1 - 1.4.1 - 1.4.2.1 - 1.5.1 - 1.5.2 - 1.5.4 - 1.5.9 - 1.5.9 - 1.6.1 - 1.6.3 - 1.7.1 - 1.7.2 - 1.7.4

Tale prodotto è destinato ad essere integrato/assembleato in un'altra macchina/impianto.

E' fatto divieto al prodotto oggetto della presente dichiarazione, di essere messo in servizio prima che la macchina/impianto in cui sarà incorporato o con cui verrà assembleato sia stato dichiarato conforme alle disposizioni della direttiva 2006/42/CE.

La documentazione tecnica pertinente è stata compilata in conformità dell'allegato VII B.

Le istruzioni per l'assemblaggio sono state compilate in conformità all'allegato VI.

Il fabbricante s'impegna a trasmettere, su motivata richiesta delle autorità nazionali, informazioni pertinenti sul Convertitore. La modalità di trasmissione può essere sia in formato elettronico che cartaceo e sarà concordata con l'autorità richiedente.

L'azienda firmataria della presente DICHIARA sotto la sua esclusiva responsabilità che il prodotto a cui la presente dichiarazione si riferisce, è conforme alle prescrizioni:

- della direttiva 2006/95/CE (direttiva bassa tensione) e delle disposizioni nazionali di attuazione per la componentistica e le motorizzazioni presenti.
- della direttiva 2004/108/CE (direttiva compatibilità elettromagnetica) e delle disposizioni nazionali di attuazione.

Dichiara altresì che sono a cura dell'utilizzatore finale la verifica e l'eventuale adeguamento degli equipaggiamenti o attrezzature nuove e/o usate di sua proprietà inserite e/o accessorie e/o comunque connesse al prodotto oggetto della presente dichiarazione.

Il modello, il numero di serie e l'anno di costruzione sono riportati sulla targa in testa del costruttore fissata al Convertitore. La targa è fissata a quest'ultimo tramite rivetti.

La persona giuridica autorizzata a costituire la documentazione tecnica pertinente è:

Nome: **Nidec ASI S.p.A.**
 Indirizzo: **Viale Sarca 336, 20126 Milano (Italy)**

Il PRODUTTORE (firmata per suo conto)

Nome: _____
 Funzione: _____
 Firma: _____
 Milano,

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4.3.6 INTENDED USE AND APPLICATION LIMITS

The AD1000 supplied by Nidec ASI S.p.A. is intended for professional use.

It is designed, built and tested to be integrated or built in electrical systems, installations and equipment of machines.

It is not intended nor permitted to use the AD1000 as finished equipment not incorporated in an installation or machine; in this connection, it is forbidden to start up the AD1000 before the assembly/system/machine in which it is to be incorporated has been declared in conformity with the Machinery Directive 2006/42/EC and the Guidelines for the assembly/system/machine.

The customer and/or integrator/operator is responsible, throughout the relevant period in which he is in charge of the activities related to the AD1000 (for example, but not limited only to this, the system integrator for incorporation and installation, the system or equipment or machine user during operation, the operator in charge of the dismantling during decommissioning), to establish and implement the necessary access restrictions and instruct personnel authorized to access on accidents risks, safety devices and general rules regarding accident prevention in the regulations and laws in force.



DANGER

If the AD1000 is used with power supply values not provided by the manufacturer, it constitutes misuse.

In this case the manufacturer declines all responsibility in case of damage to property and/or persons and any kind of warranty is invalid.



DANGER

If the AD1000 is used for purposes not expressly provided and documented by Nidec ASI S.p.A. or in environmental, electrical, mechanical, physical, hydraulic conditions other than those prescribed by Nidec ASI S.p.A. this constitutes a misuse.

In this case the manufacturer declines all responsibility in case of damage to property and/or persons and any kind of warranty is invalid.



DANGER

The manufacturer declines all responsibility in case of tampering with the AD1000 for changes or maintenance operations not authorized by the manufacturer and/or carried out by unqualified personnel, not duly informed, educated and trained.



DANGER

In case of abnormal behaviour of the AD1000, any type of operation must be carried out only by qualified and properly educated maintenance personnel.

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4.3.7 DANGEROUS ZONES

The AD1000 is designed to be built/installed/assembled in another machine/equipment/assembly/system and used by personnel properly trained and qualified to its incorporation/installation and use and that is aware of the requirements and rules related to electrical work (in low and medium voltage), the laws and technical standards governing such work and the risks present.

The AD1000 is characterized by parts considered dangerous for the presence of electrical, thermal or energy risk; all areas considered dangerous have been segregated in order to prevent access when the AD1000 is in operation, including its power on and power off.

Access to the AD1000 must be prevented to general staff through safety prescriptions set out by the laws in force: it can be allowed only to specifically trained personnel, who demonstrates adequate knowledge of the AD1000 operation, of how to stop and put all the power supplies of the system in which the AD1000 is integrated/built/installed, in safe conditions, of the location and operation of all local and remote controls and must well know the process, the operating sequences and the risks related to them.

It is also essential that the technical personnel authorized to access the AD1000 has full knowledge of this manual and the manuals of the system/equipment/machine of which the AD1000 is part; therefore the operator must have fully read this manual and all the User and Maintenance Manuals of the machine/system/assembly in which the AD1000 is incorporated/installed.



DANGER

To access and operate in dangerous areas, it is necessary to observe the safety regulations contained in this chapter and carry out all operations in accordance with the instructions contained in this manual, following the methods provided and specified herein.

Access to dangerous areas is restricted to personnel authorized and specialized in carrying out these operations, who is provided with adequate electrical qualifications (EN50110-1) and the technical knowledge for low and medium voltage equipment and systems.

Appropriate prevention and protection measures have been established and prescribed in order to limit the risks for interventions in dangerous areas; it is compulsory to comply with the requirements contained in this Manual relating to "personal protective equipment" (PPE), with the procedures and methods to follow for interventions on the AD1000.



DANGER

The various risk factors that may be present in the incorporation, commissioning, operation and maintenance steps, and the relevant prevention and protection measures, have been evaluated during the AD1000 design; these measures are prescribed in this manual and must be observed by all personnel performing work on the AD1000.

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4.4 OPERATING ENVIRONMENTAL CONDITIONS

The environment where the AD1000 is incorporated/installed/integrated must be a machine, a system, a site or premises protected from weather such as rain, hail, snow, fog or airborne dust, combustible dust and must not be a classified environment etc. ...

The AD1000 has to be placed in a non-classified environment equipped with all the safety requirements resulting from the laws of the country where it is used.

The use of the AD1000, control systems and associated equipment operating in environmental conditions other than those specified in this manual is not allowed.

In particular, the AD1000 has to work in specific environmental conditions specified in [2.4](#).

4.4.1 AIR FILTERS

The filters must be checked and cleaned or replaced after one year of operation, or after three years of storage.

Do not try to operate the AD1000 when filters are removed or using filters not approved by Nidec ASI S.p.A.

Wrong filters, or poor maintenance of the filters, shorten the service life of the AD1000 or can generate unwanted system stops.

Different maintenance criteria may be defined with Nidec ASI S.p.A. in the case of different environmental or site conditions, or special installation.

The air cooled compartments are air-tight; do not make changes to the cooling system and make sure to restore the air-tight condition after each service/maintenance procedure. The lack of air-tight condition may result in dust pollution, shorten the equipment life, create malfunctions and generate possible short circuits.

4.4.2 VIBRATIONSX

[See 2.4](#)

4.5 CONDIZIONI AMBIENTALI DI STOCCAGGIO

[See 2.4](#)

4.5.1 STORAGE SITE

The AD1000 is designed for indoor environments with a pollution degree equal to 3 (CEI EN 61800-5-1), in non-aggressive atmosphere, to be installed in an industrial site. Temperature, humidity and vibration must be respected as described in this manual. Standard packaging is not designed for periods longer than the normally expected start-up times.

The equipment must be kept in a clean and dry place in the original packaging. If necessary, special packaging and means of protection may be agreed with Nidec ASI S.p.A. if the storage site is outside the standard specifications.

The equipment must be protected with waterproof cloths/airtight covers; furthermore, it is necessary to check that the environmental parameters (in particular temperature and humidity) remain in the range mentioned above.



CAUTION

Do not try to open the packages during storage.

A loss of integrity or seal, no matter how small, can cause damage to the AD1000.

Any actions including tampering and incorrect use and/or damage to the packaging constitute misuse.

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4.6 FIXED GUARDS

The AD1000 is equipped with fixed guards, which require special tools for their removal.

Protections of fixed type are made by the AD1000 drive panels and covers. The guards are intended to prevent access to the AD1000 parts during operation.



DANGER

It is strictly forbidden to restart the AD1000, after maintenance, without properly restoring the fixed guards.

The AD1000 (air cooled model) is equipped with a ventilation system with fixed guards (grids); these are placed in the suction/discharge zones that are exclusively accessed during maintenance, and require special tools for their removal.



ADDITIONAL INFORMATION

Periodically check the integrity of fixed guards and related fasteners to the structure.

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4.7 PERSONAL PROTECTIVE EQUIPMENT (PPE)

The personnel involved in the incorporation, installation, use and maintenance stages that carries out different activities allowed on the AD1000, must use the personal protective equipment that allow to reduce all possible risks arising from the execution of various activities such as:

- Helmet with a visor to protect the head and face.
- Eye accident prevention goggles or mask to protect from splinters, dust.
- Masks to protect from electrical phenomena, fumes, inhalation etc.
- Safety and insulating gloves and shoes, depending on the need.
- Hearing protection.
- PPE and equipment required for electrical work as prescribed by CEI 11-27 - EN50110-1 such as: Insulating gloves, visor goggles, dielectric helmet, insulating pipes, isolated tools, voltage presence/absence detector, etc.



CAUTION

The clothing of operators who work or perform maintenance on the AD1000 must observe the essential safety requirements set by EU Directives 89/656/EEC and 89/868/EEC and by the laws in force in the country in which it is incorporated/installed.



DANGER

Personnel in charge of management and maintenance must be an experienced and instructed person who received the suitability and authorization by the employer and who must wear suitable work clothing to prevent the occurrence of accidents and who knows the risks and problems in working with low and medium voltage systems. In order to avoid risks of electrical or mechanical type it is prohibited to wear items such as bracelets, watches, scarves, rings or chains during any activity performed (incorporation, installation or maintenance) near the AD1000.

Reference standards: CEI EN60903 for Insulating Gloves
UNI EN 166 – 168 - 170 for Visor-Glasses
CEI EN50365 for Dielectric helmet
UNI EN 340 – UNI EN ISO 11612
CEI EN 614821-1-2 for clothing
CEI EN 50321 for insulating pipes
CEI EN 60743 - CEI EN 60900
CEI EN61243-1-2 for Tools



DANGER

During the execution of works that may lead to flying splinters or hazardous materials (product spurts) or electrical hazards (in low and medium voltage) for the operator or for other people who work at close range, the operator must maintain or ask for screens or other appropriate safety measures (EN50110-1) to the persons in charge.



CAUTION

The integrator/end user is responsible to ensure that the personnel involved is properly trained on residual risks related to the process treated and use the PPE if listed in the safety data sheets of products in addition to those listed here.

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4.7.1 RESIDUAL RISKS

All zones or parts at risk have been evaluated during the design step, and therefore all necessary precautions to avoid risks to persons and damage to the components of the AD1000 have been taken, as indicated in the preceding paragraphs.



CAUTION

Periodically check the operation of all the safety devices.
Do not remove the fixed or movable protections of the AD1000.
Do not insert foreign objects or tools in the operation area of the AD1000.

Although the AD1000 is equipped with the safety systems mentioned above, there are still some risks that cannot be eliminated but that can be reduced by means of corrective actions by the final integrator and by correct operating procedures which are mandatory for anyone working on the AD1000.

The following is a summary of the risks that remain in the AD1000 in the following phases:

- Normal operation.
- Adjustment and tuning.
- Maintenance.
- Cleaning.

4.7.2 IMPACT AND CRUSHING

Do not access the moving parts.
Before enabling the power supplies, make sure that no maintenance operation is being carried out on the AD1000.

4.7.3 SHEARING

Risk of shearing may arise by moving parts, mainly as a result of the operator approaching to the cooling systems area, only if the guards have been removed on moving parts such as couplings, motors and pumps drives or impeller or inlet and outlet fans.
Before enabling the power supplies, make sure that no maintenance operation is being carried out on the AD1000.



CAUTION

It is strictly forbidden to remove the safety guards or open parts of the AD1000 with inspection doors equipped with screws without first disconnecting the electrical panel and all the energy supplies on the AD1000.
Do not insert foreign objects or tools in the operation area of the AD1000.

4.7.4 ELECTROCUTION

- Risk of breakage or damage, with possible safety level decrease, related to the components of the electrical equipment due to short circuit.
- Before connecting the power supply make sure that there are no maintenance works in progress and that no one is working on the AD1000.
- The AD1000 is equipped with warning signs and indication on the manuals that highlight the danger of electrocution and that make mandatory the procedure for setting the AD1000 in safe conditions, before any action on it.



CAUTION

It is strictly forbidden to make any type of electrical changes as they may create additional hazards and unexpected resulting risks.

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4.7.5 FIRE

The plastic materials used (e.g. conduits, electrical cables) are self-extinguishing and comply with the regulations in force.

The AD1000, having to be incorporated/integrated in a machine/system/ installation/assembly, is not supplied with its own fire-fighting system.

- The user must assess the need for an appropriate fire extinguishing system in the site/establishment and/or premises in which the AD1000 is incorporated/installed, in compliance with safety and fire prevention regulations in force in the country where the unit is used and internal factory regulations. Do not use open flames or smoke near the AD1000.



DANGER

In case of fire always immediately switch off the main switch of the main power supply line.



CAUTION

The end user is clearly responsible to install and evaluate the most appropriate fire protection system and in general in accordance with the country where the unit is used, of regulations in force and site/factory conditions.

4.7.6 EXPLOSIVE ATMOSPHERE

The AD1000 is not suitable for working in explosive or classified environments. The AD1000 therefore is not suitable for use in areas:

- explosive or partly explosive;
- classified;
- where there are corrosive atmospheres;
- where there are high concentrations of dust;
- in which there are high concentrations of oily suspension;
- with risk of fire resulting from any ignition materials or source.

It is strictly prohibited to use the unit in all areas listed above or in any case in environments other than those included in this chapter.

4.7.7 BLINDING

Risk present, mainly, in cleaning and maintenance phases and in case of accidental contact with the product in the case of cleaning for removing dust or dirt that has accumulated.

When the AD1000 is cleaned with compressed air, the personnel involved must always wear proper eye protection.



CAUTION

It is mandatory to wear eye protection.

Use goggles to protect the eyes and face even in the case of any electrical/mechanical maintenance task on the AD1000.

4.7.8 FALL AND/OR EJECTION OF OBJECTS

- Do not leave, even temporarily, work tools and objects along and above the AD1000 to prevent their fall or ejection.
- Before opening any door closed with coded keys, removing panels or access to any part of the AD1000, remove and disconnect all the power supplies to the AD1000 (medium and low voltage side) using the operating parts provided for this purpose by the system installer/integrator.

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4.7.9 TRIPPING

The disordered deposit of material can typically create a tripping hazard and partial or total limitation in the escape route in case of need.

- Ensure operational and transit places and escape routes free from obstacles and in compliance with the requirements in force.

4.7.10 CIRCUIT FAILURES

Because of possible failures, the safety circuits, can lose part of their effectiveness with related safety level decrease.

- Make periodic checks on the operating status of the AD1000 safety devices.

4.7.11 LIGHTING

The integrator/end user must prepare an adequate lighting system (in addition to any existing one) of the AD1000 maintenance/operation areas, complying with the laws in force in the country where the devices are used and according to the EC Directives avoiding that there are shadow areas likely to cause nuisance, annoying effects of glare or stroboscopic effects on the elements due to the lighting.

In case of power failure (or in the case of poor lighting) an average illuminance of 500 lux is recommended to be carried out by the user/customer. If additional lighting may be necessary for special and infrequent maintenance, taking into account the extreme rarity of these operations, the user must provided portable safety lamps (24 Vdc power, not included in the supply).

4.7.12 NOISE

All personnel who must access near the AD1000 when it is in operation should be provided with the appropriate hearing protection.

4.7.13 VIBRATION

The AD1000 in its normal operation does not present conditions of dangerous vibrations for the operator.

Any conditions of excessive or abnormal vibration may be due to a malfunction of the rotating devices such as pumps, etc. In these conditions it is necessary to proceed immediately notifying the maintenance personnel and stopping the AD1000 to verify/repair it.

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4.8 ADDITIONAL DANGER REQUIREMENTS



DANGER

- Risk of death or electric shock!
- All work should be performed by qualified personnel.
- The electrical panel is connected to multiple power sources.
- Dangerous residual voltage is also present with open switches. Wait 10 minutes before implementing the procedure for setting the machine in safe conditions.



DANGER

Never change the protection settings determined by the Manufacturer.



DANGER

Never perform ordinary or extraordinary maintenance with the electrical power supply circuits connected.
Always de-energize in advance all the power supply circuits.



DANGER

The AD1000 does not have interruption and/or circuit breaking devices on the motor side and at the internal circuits.
All electrical connection terminals of the AD1000 must always be considered energized except the control devices (not supplied by Nidec ASI S.p.A.) of the installation in which the AD1000 is incorporated and/or integrated, and must guarantee power supply interruption on the motor side, medium voltage power supply side and safety grounding connection.



DANGER

Operate on the motor only after checking that the AD1000 is fully de-energized.



DANGER

The AD1000 does not have interlocks, extraction boxes or other safety devices intended to isolate and ground the conductors coming from outside. The AD1000 is connected to multiple electrical power sources. These power sources can be mutually independent.
Before accessing any part of the AD1000 it is indispensable to stop, disconnect, block and ground all power supplies connected to the AD1000.

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DANGER

The power supplies interruption procedure involves system or machine parts outside the AD1000.

The procedure for disconnecting electricity to the AD1000 must be indicated by another document to be provided by the system integrator and/or by the user/customer who must indicate how to operate on those parts.



DANGER

The system integrator and/or installer is responsible to follow the procedure that describes how to stop and secure the power supplies of the AD1000 and what are the switching and disconnection devices, and where they are positioned on the machine or system.



DANGER

Several actions described in these operating instructions have to be carried out inside the AD1000.

Access is allowed only to qualified technicians, who are aware of the electric shock risks, safety rules and regulatory regulations required. More specifically technicians enabled to these tasks must have specific skills in the electronic power drives sector.

Be authorized by the final system integrator to operate on the AD1000 on site.

- Be familiar with the safety concepts and always work according to the installation site, applicable laws, safety regulations, and standard regulations.
- Know the local power supply system in detail, in particular in input to the AD1000 and output to the motor, the position and operation of the switches (power-off) and of the disconnectors of the site in which the equipment must work, the power sequences and grounding methods.

- Always keep available and have read and understood this manual and wiring diagrams.
- Understand the functional sequences, especially those related to the AD1000 start and stop, power on and power off and the power parts disconnection sequence involving the AD1000



DANGER - RISK OF INAPPROPRIATE USE AND CONNECTION

A) Warning! Do not change any part of the AD1000.

Risk of death, fire, or heavy damage to personnel, may occur if any part of the AD1000 is modified or tampered with.

B) Warning! The AD1000 must be properly grounded before connecting any power source and operating the AD1000 itself.

- Do not disconnect any ground and/or connection wire.
- Regularly check the grounding during maintenance and always in case of doubt.

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4.9 ADDITIONAL WARNINGS REQUIREMENTS



CAUTION
Ensure that all personnel involved in the AD1000 operation are adequately trained in accordance with the correct safety procedures.



CAUTION
Never work on the equipment while it is in operation unless for explicitly permitted operations (air filters change, etc.) always following the guidelines given in this manual or in the manuals supplied.



CAUTION
The AD1000 can not operate with covers removed or open.



CAUTION
Do not remove or change guards, panels or safety devices.



CAUTION
Never work on the equipment when power sources are connected or enabled. When working on the device, turn off the switches and lock them in the open position.



CAUTION
Make sure that all safety devices are connected and in good working order. Never modify or bypass any of the alarm or stop devices.



CAUTION
Both during maintenance phases and during the operational phases it is recommended to pay attention to the temperature of the fan motors that can reach temperatures above 50°C in normal operation.



CAUTION
The fans for cooling the AD1000 generate a large air flow. If these fans are in operation during the filters replacement with one or more panels of the enclosure removed, the maintenance personnel would be exposed to a large air flow and acoustic noise. This operability/functionality is therefore prohibited by the manufacturer. Appropriate PPE (such as ear plugs, earphones and goggles to protect the face) must be prepared by the user/integrator to exposed persons.

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4.10 WARNING PLATES

Depending on the residual risks of various types, identified for the AD1000, Nidec ASI S.p.A. has provided danger, warning and obligation plates on the equipment defined according to European regulations relating to graphical symbols to be used on equipment (Directive 92/58/EEC). The plates in question are located in a visible position.



CAUTION

It is absolutely forbidden to remove the warning plates on the AD1000. Nidec-ASI S.p.A. disclaims any responsibility for the safety of the AD1000 in case of failure to comply with this prohibition.



CAUTION

Following the AD1000 installation into a machine and/or system/machine/assembly, the integrator/user or the end client must install, depending on the residual risks, the required additional plates.



CAUTION

The integrator/user is required to replace the warning plates which, due to wear, are illegible.

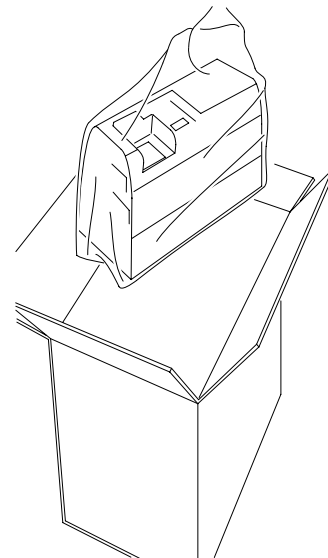
◀ PREVIOUS VIEW

5 RECEPTION, STORAGE AND INSTALLATION

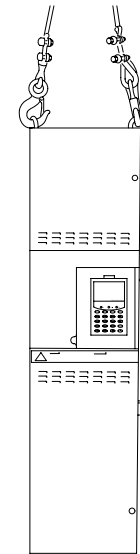
5.1 RECEPTION, UNLOADING, UNPACKING AND INSPECTION OF THE AD1000

All drives are fully inspected and tested before packaging and shipment from the factory. Upon receipt, the equipment must be inspected in order to detect any visible damage that may have occurred during transport.

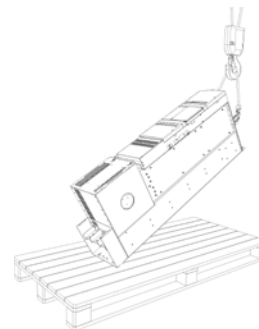
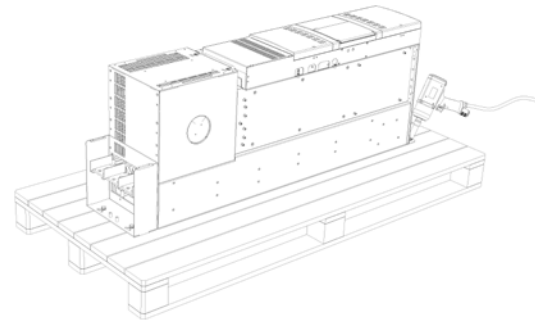
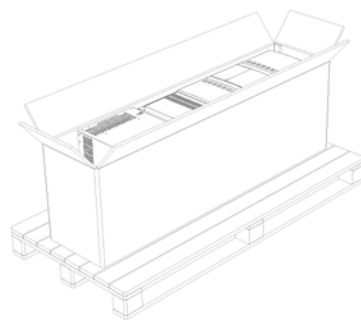
It is necessary to carefully check the bill of materials to make sure to have received all the components, including diagrams and dimension drawings. If any part is damaged or missing, the purchaser must immediately file a claim with the carrier and then give notification to the factory. After making the initial inspections, the drive must be transported quickly in its final installation location or in an appropriate storage area¹. When handling or lifting the units, be careful not to twist or shake the system. It is necessary to protect all metal surfaces to prevent damage.



Handling Size I, II, III, IIIX, III L, III N



Handling Size IV N, V N, VI N



Handling Size VII ÷ VIII

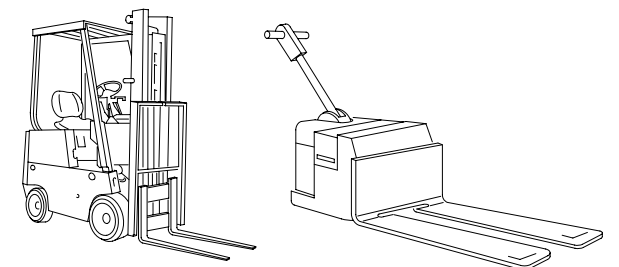


Figure 5.1.1 - Methods of unloading and lifting the AD1000

¹If the drive is delivered on a pallet, use a forklift of proper capacity.

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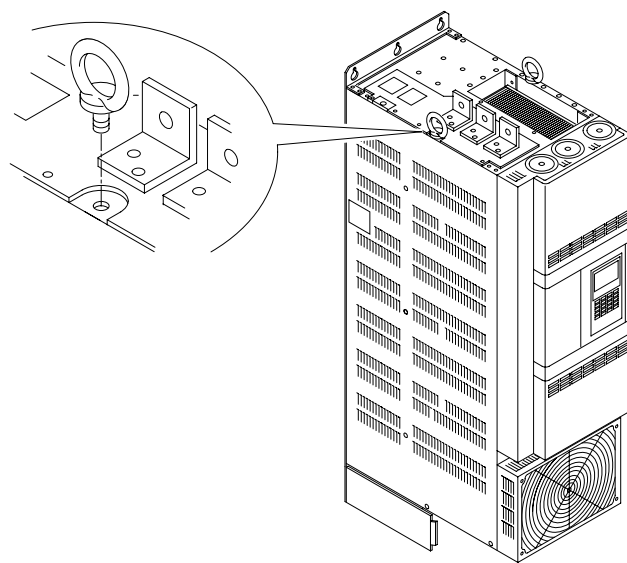
It is necessary to use forklift trucks to transport the units in their proper installation location. The units must be carefully lifted by the pallets up to the final position, using a mechanical lifting device, such as a crane or a forklift.

NOTE 1

Keep the protection packaging until the installation and start-up are completed.

NOTE 2

For sizes AD1A210F to AD1A520F, after the drive has been installed in the electric panel it is compulsory to remove the lifting eyebolts.



5.2 STORAGE

Following the initial inspection, the equipment must be immediately transported into its final installation position or in a dry storage area, protected from weather and with a controlled temperature. Although each drive is adequately protected against environmental and weather conditions, there are environmental conditions that can reduce its performance, operation, and lifetime. The drive is not waterproof and must never be stored outdoors.

The [table 2.4.1](#) shows the rated environmental conditions.

The operator should consult the factory for doubtful matters that may exist in particular places.

5.3 MECHANICAL INSTALLATION

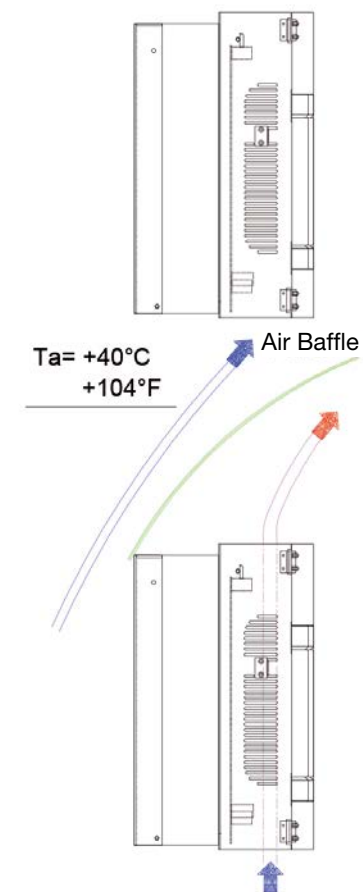
5.3.1 GENERAL PRECAUTIONS

- Do not install the drive on a vibrating surface.
- The environment must be free of dust, metal particles, suspended oil, gas and splashes of corrosive liquids.
- The drive must be installed in a vertical position. Do not install the unit at an angle more than + 30% from the vertical axis.
- If multiple drives are installed in the same electrical panel, they should be placed side by side. When they are installed superimposed prevent the upper module from being affected by the hot air of the underneath module.

NOTE

For sizes AD1A210F to AD1A520F, after the drive has been installed in the electric panel it is compulsory to remove the lifting eyebolts.

Example



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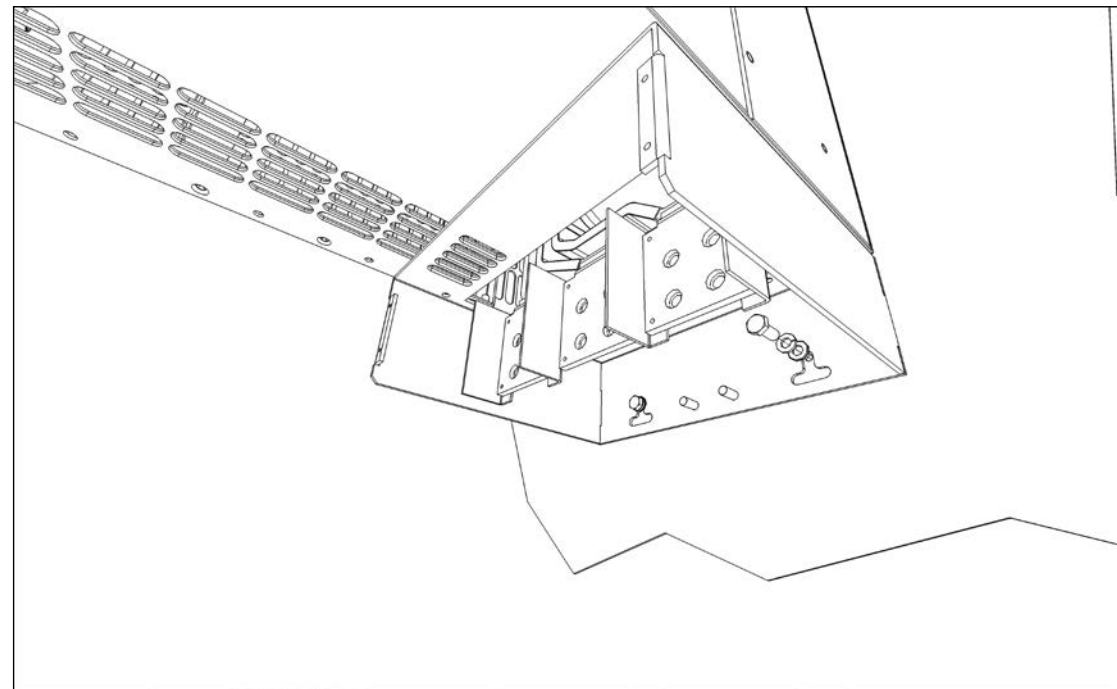
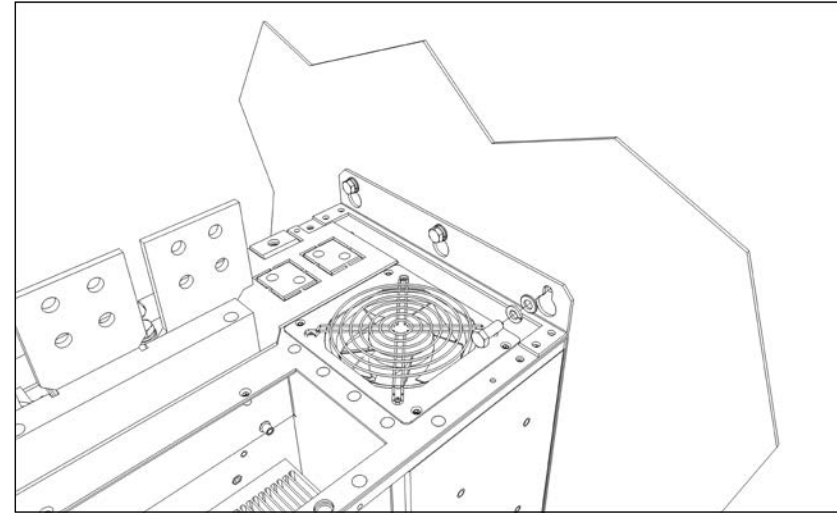
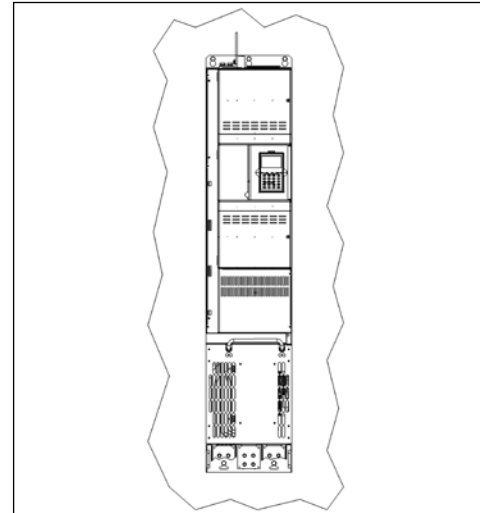
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5.3.2 INSTALLATION SIZES VII VIII



Requirements in case of electrical installation - See [paragraph 4.3.2](#)

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5.3.3 FREE SPACE NEAR THE DRIVE



Figure 5.3.1 Free space near the drive

Free space near the drive

Size	A	B1	B2
	mm / in	mm / in	mm / in
I - II	25 / 1	100 / 3.9	100 / 3.9
III - IIIX	50 / 2	100 / 3.9	100 / 3.9
IIIN - IVN	50 / 2	100 / 3.9	200 / 7.8
VN	50 / 2	100 / 3.9	200 / 7.8
VIN	100 / 3.9	100 / 3.9	200 / 7.8
VIL	100 / 3.9	100 / 3.9	200 / 7.8
VII	50 / 2	100 / 3.9	300 / 11.8
VIII	50 / 2	100 / 3.9	300 / 11.8

The drive power components cooling is made by forced ventilation. It is necessary to provide a space around the drive for air circulation, for electrical cables and for access in case of maintenance interventions.



The fans of the AD1000 are designed in such a way as to provide an adequate flow of air to the drive. Do not block the passage of air flow when installing the unit.

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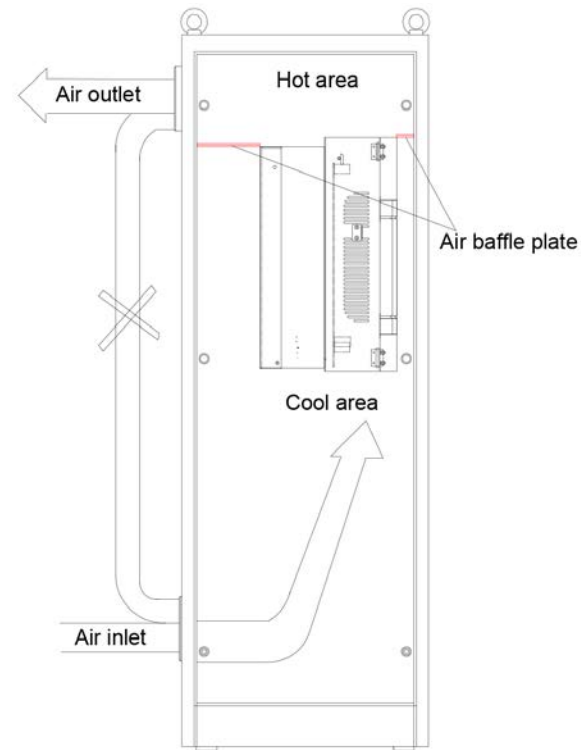
PREVENTION OF HOT AIR RECIRCULATION

Electrical panel exterior

Prevent hot air recirculation on the outer surface of the panel by expelling the outlet hot air away from the area where the inlet air is drawn.

Possible solutions:

- provide guides for the inlet and outlet air flow
- provide air input and output from the different sides of the electrical panel
- cool air inlet in the lower part of the front panel door and an auxiliary fan on the roof of the electrical panel.



Electrical panel interior

Prevent the hot air circulation inside the electrical panel with closing plates as shown on the drawing aside.

Seals are not generally required.

FASTENING POINTS

The figure shows the mounting holes position in a typical size, for details of the various sizes, see [paragraph 2.9](#) "Overall dimensions and weights".

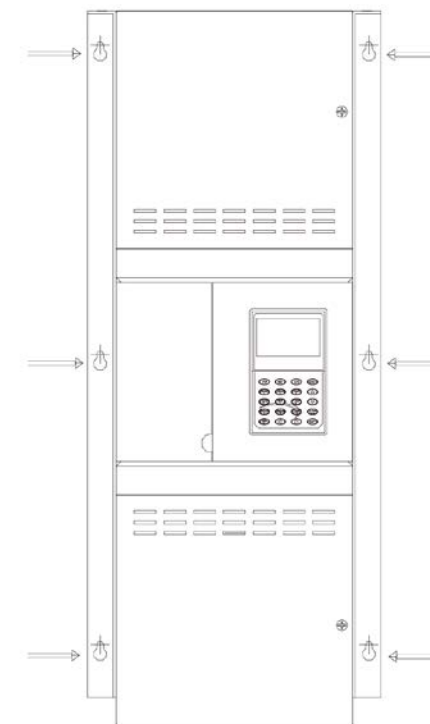


Figure 5.3.2 - mounting holes position

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5.3.4 IPXX DEGREE

The standard degree of protection of AD1A030-166 is IP20. The IP rating of a product indicates the amount of protection against foreign bodies and water entrance and contact. This degree is indicated by an IP XX: the two digits (XX) indicate the degree of protection provided, as shown in Table 5.3.4.1

Table 5.3.4.1 - IP protection degrees

FIRST NUMBER		SECOND NUMBER	
Protection against contact and foreign bodies entrance		Protection against water entrance	
0	No protection	0	No protection
1	Protection against large foreign bodies > 50 mm (hand contact with a large area)	1	
2	Protection against foreign bodies of medium size > 12 mm (finger)	2	-
3	Protection against small foreign bodies > 2.5 mm (tools, wires)	3	Protection against water splashes (up to 60° from vertical)
4	Protection against granular foreign bodies > 1 mm (tools, wires)	4	Protection against water jets (from all directions)
5	Protection against dust deposits, complete protection against accidental contact.	5	Protection against abundant jets of water (from all directions, high pressure)
6	Protection against the entrance of dust, complete protection against accidental contact.	6	Protection against water on the deck (for example in case of heavy seas)
7	-	7	Protection against immersion
8	-	8	Protection against submersion

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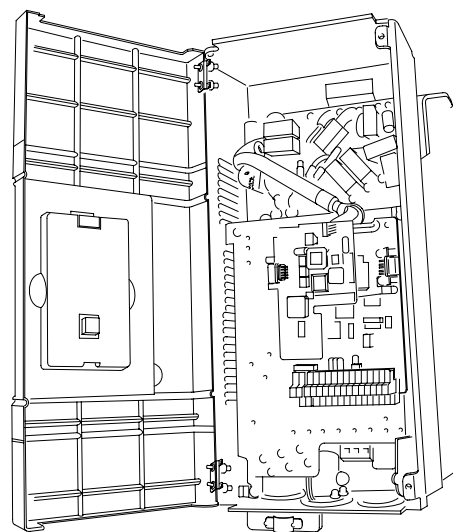
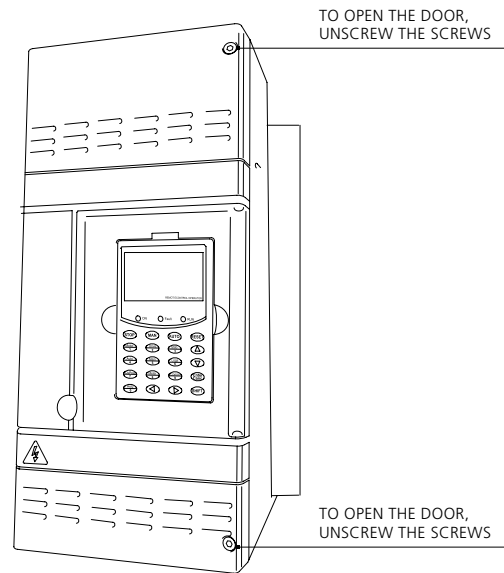
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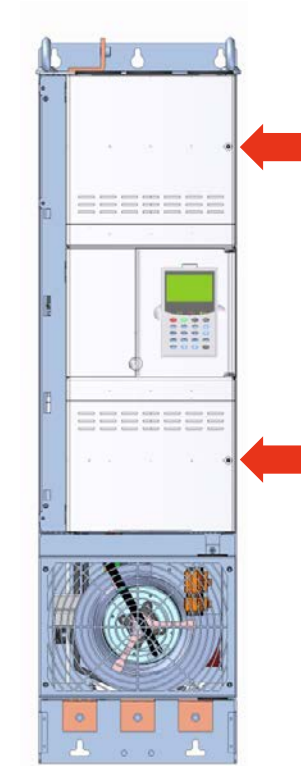
5.3.5 ACCESS TO THE TERMINAL BOARDS



AD1A - sizes IIIN, IVN, VN, VIN



AD1A - sizes I, II, III, IIIX, IIIL



AD1A - sizes VII, VIII

Overall dimensions - See paragraph 2.9

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5.4 ELECTRICAL INSTALLATION

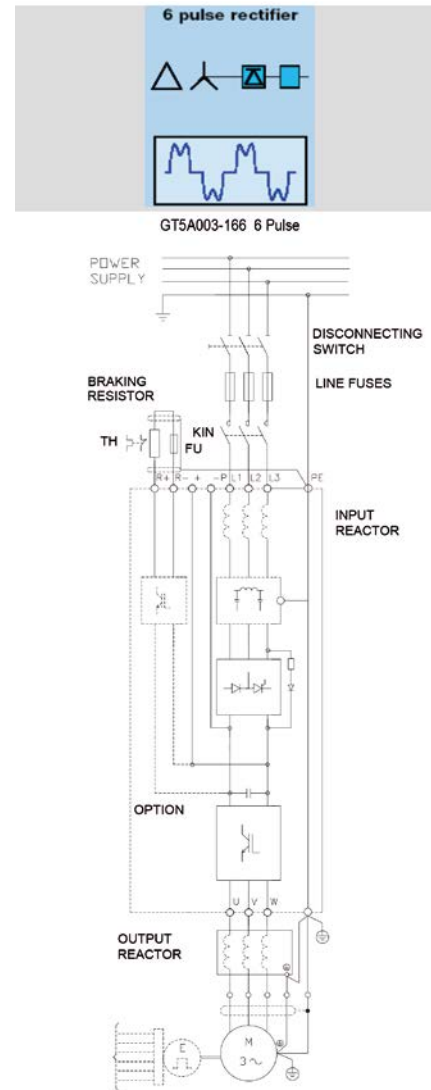


Figure 5.4.1 Power connections

NOTE

The terminals of the control board are shown in [par. 5.6](#), and the auxiliary power supply in [par. 2.10](#).



- In place of the disconnecter and fuses, it is possible to use a circuit breaker with rated current $I_m > _ 1.2 *$ and adjustable magnetic shunt (from 5 to $10I_n$).
- In case of ground protection, use a device which is not so sensitive to high frequencies in order to avoid false interventions. The current threshold should be higher than 200mA and the time interval of at least 0.1s.

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5.4.1 POWER CABLES AND POWER SUPPLY FUSES

The power supply cables and the supply fuses must be chosen according to the following tables.

It is necessary to use copper power input cables and motor cables with rated values of 600-690VAC and 1000VDC for the brake unit connections.

Table 5.4.1.1 Power supply cable and fuses sizes in "Standard" category

Model	Power supply network	Main fuses ¹ [A]	External fuses recommended for SCCR Standard ^(a) (UL)	Cables cross section **		Terminals	Max torque		Standard SCCR (UL) ^(a) kA
				AWG	mm ²		Nm	lbf ft	
F = Three-phase supply voltage 380V, 415V, 440V, 460V, 480V / Y=510-650VDC ±10%									
AD1A0P3F	AC	5x3/2	FWP-15B	14	2,5	10 (AWG max)	0,5	4.425	5
AD1A0P4F	AC	10x3/2	FWP-15B	14	2,5	10 (AWG max)	0,5	4.425	5
AD1A0P6F	AC	15x2	FWP-20B	14	2,5	10 (AWG max)	0,5	4.425	5
AD1A008F	AC	15x3	FWP-20B	14	2,5	4 (AWG max)	2	1.47	5
AD1A011F	AC	20x3	FWH-40B	12	4	10 (AWG max)	0,5	4.425	5
AD1A015F	AC	30x3	FWH-45B	10	6	10 (AWG max)	0,5	0.37	5
AD1A018F	AC	35x3	FWH-45B	10	6	10 (AWG max)	0,5	0.37	5
AD1A022F	AC	50x3	FWH-60B	8	10	6 (AWG max)	1,2	0.88	5
AD1A028FB	AC	50x3	FWH-90B	8	10	6 (AWG max)	1,2	0.88	5
AD1A028YB	AC	60x2	FWP-90B	8	10	6 (AWG max)	1,2	0.88	5
AD1A030F	AC	50x3	FWH-90B	8	10	6 (AWG max)	1,2	0.88	5
AD1A036F	AC	60x3	FWH-90B	6	16	4(AWG max)	2	1.47	5
AD1A045F	AC	70x3	FWH-100B	3	25	35	2,5	1.84	10
AD1A053F	AC	90x3	FWH-150B	2	35	35	2,5	1.84	10
AD1A066F	AC	100x3	FWH-200B	2	35	35	2,5	1.84	10

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Model	Power supply network	Main fuses ¹ [A]	External fuses recommended for SCCR Standard ^(a) (UL)	Cables cross section **		Terminals	Max torque		Standard SCCR (UL) ^(a) kA	
				AWG	mm ²		Nm	lbf ft		
F = Three-phase supply voltage 380V, 415V, 440V, 460V, 480V / Y=510-650VDC ±10%										
						Input	Output			
AD1A086F	AC	125x3	FWH-225A	2/0	70	M6	M8	10	7.37	10
AD1A108F	AC	175x3	FWH-225A	3/0	95,0	M6	M8	10	7.37	10
AD1A125F	AC	200x3	FWH-300A	4/0	35	M8	M8	10	7.37	10
AD1A150F	AC	250x3	FWH-300A	250	120	M8	M8	10	7.37	10
AD1A166F	AC	250x3	FWH-300A	250	120	M8	M8	10	7.37	10
AD1A210F	AC	300x3	3xFWH-450A	2X2/0	2X95	3x1xM10		22.5	16.59	18
AD1A260F	AC	350x3	3xFWH-500A	2X3/0	2X95	3x1xM10		22.5	16.59	18
AD1A290F	AC	500x3	3xFWH-600A	3X3/0	2X95	3x4xM10		22.5	16.59	18
AD1A350F	AC	600x3	3xFWH-700A	3X4/0	3X120	3x4xM10		22.5	16.59	30
AD1A370F	AC	770x3	3xFWH-800A	4X4/0	4X120	3x4xM10		22.5	16.59	30
AD1A440F	AC	800x3	3xFWH-1000A	4X4/0	4X120	3x4xM10		22.5	16.59	30
AD1A480F	AC	800x3	3xFWH-1000A	4X4/0	4X120	3x4xM10		22.5	16.59	42
AD1A520F	AC	850x3	3xFWH-1000A/1200A	4X4/0	4X120	3x4xM10		22.5	16.59	42



The drive is suitable for use in a circuit with short circuit current not greater than the specific Standard Short Circuit Current rating_ (Arms) Symmetrical Amperes value, shown in [Table 5.4.1.1](#), 480 V ac + 10% max, provided that it is protected by the related fuse for semiconductor indicated in [Table 5.4.1.1](#), Brand Bussmann.



** The cables cross-section in the table is indicative. Refer to local wiring rules for correct sizing. In some cases a larger cross-section may be required to prevent excessive voltage drops.

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Table 5.4.1.2 Power supply cable and fuses sizes in "High Fault Short Circuit Current" category.

Model	Power supply network	Main fuses ¹	External fuses supplied with the drive for HSCCR ^(b)	Cables cross section **		Terminals	Max torque		HighSCCR (UL) ^(b)
				AWG	mm ²		Nm	lbf ft	
F = Three-phase supply voltage 380V, 415V, 440V, 460V, 480V / Y=510-650VDC ±10%									
AD1A0P3F	AC	5x3/2	FWP-15B	14	2,5	10 (AWG max)	0,5	4.425	65
AD1A0P4F	AC	10x3/2	FWP-15B	14	2,5	10 (AWG max)	0,5	4.425	65
AD1A0P6F	AC	15x2	FWP-20B	14	2,5	10 (AWG max)	0,5	4.425	65
AD1A008F	AC	15x3	FWP-20B	14	2,5	4 (AWG max)	2	1.47	65
AD1A011F	AC	20x3	FWH-40B	12	4	10 (AWG max)	0,5	4.425	65
AD1A011F	AC	25x2	FWP-40B	12	4	10 (AWG max)	0,5	0.37	65
AD1A015F	AC	30x3	FWH-45B	10	6	10 (AWG max)	0,5	0.37	65
AD1A015F	AC	30x2	FWP-50B	10	6	10 (AWG max)	0,5	0.37	65
AD1A018F	AC	35x3	FWH-45B	10	6	10 (AWG max)	0,5	0.37	65
AD1A022F	AC	50x3	FWH-60B	8	10	6 (AWG max)	1,2	0.88	65
AD1A028FB	AC	50x3	FWH-90B	8	10	6 (AWG max)	1,2	0.88	65
AD1A030F	AC	50x3	FWH-90B	8	10	6 (AWG max)	1,2	0.88	65
AD1A036F	AC	60x3	FWH-90B	6	16	4(AWG max)	2	1.47	65
AD1A045F	AC	70x3	FWH-100B	3	25	35	2,5	1.84	65
AD1A053F	AC	90x3	FWH-150B	2	35	35	2,5	1.84	65
AD1A066F	AC	100x3	FWH-200B	2	35	35	2,5	1.84	65

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Model	Power supply network	Main fuses ¹	External fuses supplied with the drive for HSCCR ^(b)	Cables cross section **		Terminals	Max torque		HighSCCR (UL) ^(b)	
				AWG	mm ²		Nm	lbf ft		
F = Three-phase supply voltage 380V, 415V, 440V, 460V, 480V / Y=510-650VDC ±10%										
		[A]	(UL)			Input	Output			
AD1A086F	AC	125x3	FWH-225A	2/0	70	M6	M8	10	7.37	65
AD1A108F	AC	175x3	FWH-225A	3/0	95,0	M6	M8	10	7.37	65
AD1A125F	AC	200x3	FWH-300A	4/0	35	M8	M8	10	7.37	65
AD1A150F	AC	250x3	FWH-300A	250	120	M8	M8	10	7.37	65
AD1A166F	AC	250x3	FWH-300A	250	120	M8	M8	10	7.37	65
AD1A210F	AC	300x3	3xFWH-450A	2X2/0	2X95	3x1xM10		22.5	16.59	65
AD1A260F	AC	350x3	3xFWH-500A	2X3/0	2X95	3x1xM10		22.5	16.59	65
AD1A290F	AC	500x3	3xFWH-600A	3X3/0	2X95	3x4xM10		22.5	16.59	65
AD1A350F	AC	600x3	3xFWH-700A	3X4/0	3X120	3x4xM10		22.5	16.59	65
AD1A370F	AC	770x3	3xFWH-800A	4X4/0	4X120	3x4xM10		22.5	16.59	65
AD1A440F	AC	800x3	3xFWH-1000A	4X4/0	4X120	3x4xM10		22.5	16.59	65
AD1A480F	AC	800x3	3xFWH-1000A	4X4/0	4X120	3x4xM10		22.5	16.59	65
AD1A520F	AC	850x3	3xFWH-1000A/1200A	4X4/0	4X120	3x4xM10		22.5	16.59	65



The drive is suitable for use in a circuit with short circuit current not greater than the specific High Short Circuit Current rating_ (Arms) Symmetrical Amperes value, shown in [Table 5.4.1.2](#), 480 V ac + 10% max, provided that it is protected by the related fuse for semiconductor indicated in [Table 5.4.1.2](#), Brand Bussmann, supplied with the drive.

The user must also install, upstream of the fuses of [table 5.4.1.2](#), some not resettable cartridge fuses (JDDZ/JDDZ7), Class J, with the right voltage and current gauge.



** The cables cross-section in the table is indicative. Refer to local wiring rules for correct sizing. In some cases a larger cross-section may be required to prevent excessive voltage drops.

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5.4.2 AUXILIARY POWER SUPPLY

Ventilation

The AD1A125-520F drives require an auxiliary power supply to the fan.



Check that the auxiliary power supply is connected with a correct input voltage setting before enabling the drive.

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5.5 REACTORS

5.5.1 INPUT REACTORS

The line reactor protects the drive against network transients and complies with the requirements of the standard IEEE 587. The reactor causes a voltage drop proportional to the supply current and the inductance value.

Select a reactor to have a voltage drop equal to 2÷5 % of the rated input voltage (when the drive is leading the total rated current).

Function of the inlet reactor:

- Reduces the effective current of the drive capacitor bank
- Improves the power factor
- Reduces annoying stops caused by spikes on the line
- Reduces the harmonic content of the input current
- Protects the drive against transient network
- Helps to suppress disturbances in radio frequency
- Protects the drive against the network imbalances and single-phase operating conditions

The input reactor absorbs the disturbances on the power supply line that may otherwise damage or block the drive or other sensitive devices and reduces the harmonic content of the current generated by the drive helping to comply with IEEE-519, 1993 GUIDELINES for the limitation of harmonics. Sizes IIIN, IVN, VN, VIN are fitted with an internal line reactor, for all other sizes provide a reactor between the power supply network and the drive if:

1. a thyristor drive or other drives are operating on the same line.
2. power factor correction capacitors are connected on the same line.
3. the imbalance of supply voltage exceeds 3%.

Example: $V_{rs} = 400V$, $V_{st} = 407V$, $V_{tr} = 390V$.

$$VM = \frac{V_{rs} + V_{st} + V_{tr}}{3} = 399V$$

$$F_s = 100 \cdot \frac{\text{max. deviation from VM}}{VM} = 100 \cdot \frac{9}{399} = 2,3\%$$

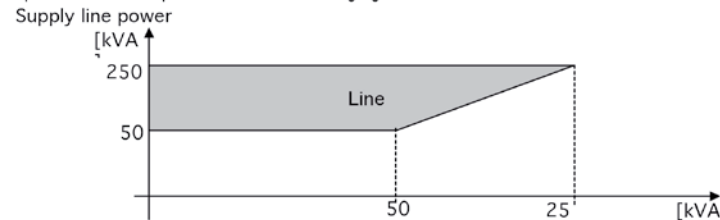
V_{rs} , V_{st} , V_{tr} : rms value of line-to-line voltages

VM : mean value of V_{rs} , V_{st} , V_{tr}

F_s : voltage unbalance

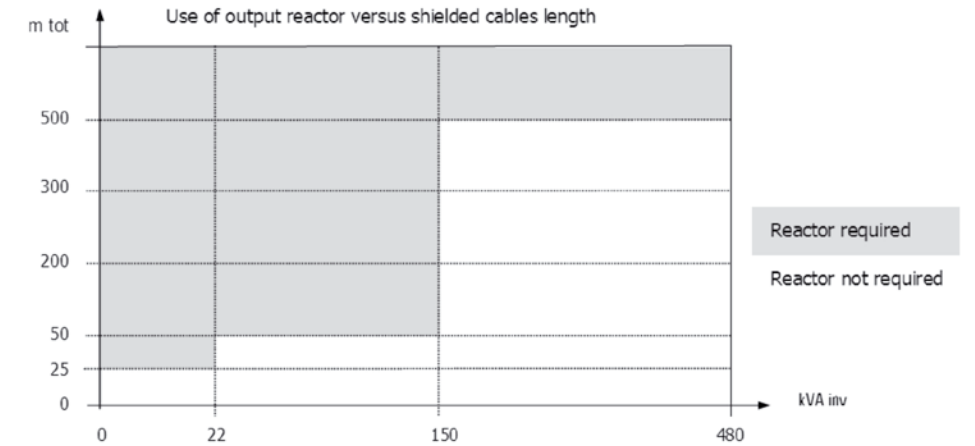
In this example a reactor is not necessary

4. The supply line power and the drive power are included in the highlighted area:



5.5.2 OUTPUT REACTOR

The output reactors are necessary to compensate the capacitive leakage current to the ground, as well as to reduce the voltage gradient on the motor, they, together with the ferrite cores, help to mitigate the RFI phenomenon. The output reactor codes are reported in [Table 5.5.1](#).



Limit the motor cables length so as not to exceed a 3÷5 % voltage drop at rated current.

In case of motors in parallel it is necessary to consider the sum of the length of the various cables.

The codes of the input and output reactors are shown in [Table 5.5.1](#).

PREVIOUS VIEW

Table 5.5.1 Line reactor, RFI filters and output reactor

Type	Line reactors		RFI filters		Output reactors	
	CI.1	CI.2	Category C3	Category C2	Normal duty	Heavy duty
			Internal	Internal		
	CI.1	CI.2	CI.1-CI.2	CI.1-CI.2	CI.1	CI.2
Three-phase supply voltage 380V, 415V, 440V, 460V, 480V ±10%						
AD1A0P3F	ELC22386201	ELC22386201	ELC40969901	ELC40969901	ELC22306602	ELC22306602
AD1A0P4F	ELC22386201	ELC22386201	ELC40969901	ELC40969901	ELC22306602	ELC22306602
AD1A0P6F	ELC22386201	ELC22386201	ELC40969901	ELC40969901	ELC22306602	ELC22306602
AD1A008F	ELC22386201	ELC22386201	ELC40969901	ELC40969901	ELC22306602	ELC22306602
AD1A011F	ELC22386201	ELC22386201	ELC40969902	ELC40969902	ELC22306602	ELC22306602
AD1A015F	ELC22386202	ELC22386201	ELC40969902	ELC40969902	ELC22306603	ELC22306602
AD1A018F	ELC22386203	ELC22386202	ELC40969903	*ELC40923003	ELC22306603	ELC22306603
AD1A022F	ELC22386203	ELC22386203	ELC40969903	*ELC40923003	ELC22306603	ELC22306603
AD1A028F	ELC22386204	ELC22386204	ELC40969903	*ELC40923003	ELC22306603	ELC22306603
AD1A030F	INTEGRATED				ELC22306603	ELC22306603
AD1A036F					ELC22306603	ELC22306603
AD1A045F					ELC22306604	ELC22306604
AD1A053F					ELC22306604	ELC22306604
AD1A066F					ELC22306604	ELC22306604
AD1A086F					ELC22306605	ELC22306604
AD1A108F					ELC22306605	ELC22306605
AD1A125F					ELC22306605	ELC22306605
AD1A150F					ELC22306606	ELC22306605
AD1A166F					ELC22306606	ELC22306606

* External

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Type	Line reactors		RFI filters			Output reactors	
	CI.1	CI.2	Category C3	Category C2		Normal duty	Heavy duty
			Internal	External			
	CI.1	CI.2	CI.1-CI.2	CI.1	CI.2	CI.1	CI.2
Three-phase power supply network 380V, 415V, 440V, 460V, 480V ±10%							
AD1A210F	1000203895	1000203894	INTEGRATED	ELC40821102	ELC40821101	1000203880	1000203875
AD1A260F	1000203896	1000203895		ELC40821107	ELC40821102	1000203882	1000203880
AD1A290F	1000203897	1000203896		ELC40821103	ELC40821102	1000203884	1000203882
AD1A350F	1000203898	1000203897		ELC40821103	ELC40821107	1000203885	1000203884
AD1A370F	1000203899	1000203898		ELC40821103	ELC40821103	1000203886	1000203885
AD1A440F	1000203900	1000203899		ELC40821104	ELC40821103	1000203887	1000203886
AD1A480F	1000203911	1000203900		ELC40821104	ELC40821103	1000203888	1000203887
AD1A520F	1000203912	1000203911		ELC40821104	ELC40821103	1000203889	1000203888

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5.6 CONTROL SECTION

5.6.1 BASIS BOARD

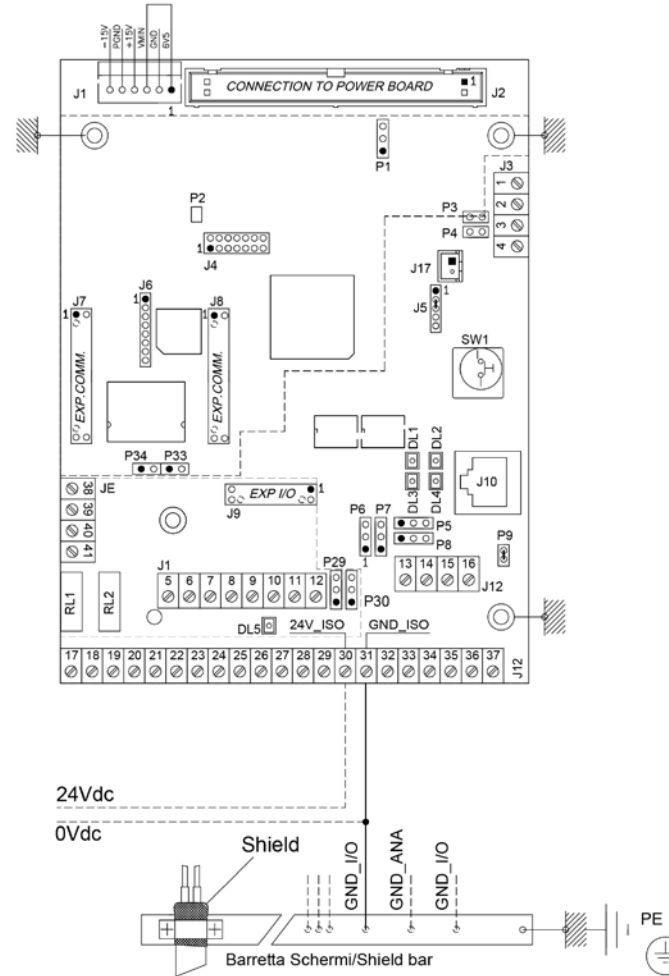


Figure 5.6.1

LED

Initials	Colour	Function	Description	
DL1	Yellow	DSP DRIVE OK	Drive OK of the DSP	ON = DRIVE OK
DL2	Red	DSP PROTHW	Used by the DSP to indicate an alarm/fault status	ON = Alarm/fault status
DL3	Red	WATCHDOG	Used by the EPLD to indicate a watchdog status	ON = Watchdog status
DL4	Green	Power supply 6.5V	6.5Vdc power supply	ON = 6.5Vdc present
DL5	Green	24V I/O	Digital I/O interface 24V power supply	ON = 24V present

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JUMPER AND DIP-SWITCH

P1	● ● ■	1-2	Iu current from power board	
	3 2 1	2-3	Iu current recreated on the control board (only for drive <166)	
P2		OFF	Reserved (D.O.C. filtering)	
P3		ON	P3=ON, P4=ON: connection of 220Ω termination resistor between TXRX+ and TXRX- P3=OFF, P4=OFF: termination resistor between TXRX+ and TXRX-not connected	Modbus TXRX
P4		ON		
P5	● ● ■	1-2	Analogue output in 0(4)-20mA current	Analogue output 2 AO 2
	3 2 1	2-3	Analogue output in ±10V (2mA) voltage (Default)	
P6	● ● ■	1-2	500Ω ballast resistor, analogue input 1, connected	Analogue input 1 AI 1
	3 2 1	2-3	500Ω ballast resistor, analogue input 1, not connected (Default)	
P7	● ● ■	1-2	500Ω ballast resistor, analogue input 2, connected	Analogue input 2 AI 2
	3 2 1	2-3	500Ω ballast resistor, analogue input 2, not connected (Default)	
P8	● ● ■	1-2	Analogue output in 0(4)-20mA current	Analogue output 1 AO 1
	3 2 1	2-3	Analogue output in ±10V voltage (Default)	
P9		ON	P9=ON: The 24Vdc I / O power supply is available on terminals J12-30 and J12-31. Do not connect any other external power supply. P9 = OFF: it is necessary to connect to terminals J12-30 and J12-31 a 24Vdc external power supply to power the I/O.	
P29	● ● ■	1-2	Not used	
	3 2 1	2-3	Not used	
P30	● ● ■	1-2	Pull-up excluded (Default)	Analogue input 2 AI 2
	3 2 1	2-3	Pull-up (2K2) on AI2 input (+) at +10V (for PTC)	
P33		OFF	Open (Reserved)	
P34		OFF	Open (Reserved to firmware installation)	
SW1			Reset button	

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NOTE

If the Encoder expansion board is installed, the P30 of the Basis board is no longer accessible. In this case, it must be left open, using, if necessary, the P30 of the encoder expansion board.

CONNECTORS

J1	Boards power supply
J2	Power board
J3	RTU Modbus terminal board
J4	Reserved
J5	Reserved (Jumper between 2-3)
J6	Reserved
J7	Communication expansion
J8	Communication expansion
J9	Inputs expansion or I/O expansion
J10	Keypad
J12	Control terminal board

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CONTROL TERMINAL BLOCK

Function	Terminal	Initials	Description	
Modbus	J3-1	TXRX+	MODBUS TXRX+	
	J3-2	TXRX-	MODBUS TXRX-	
	J3-3	GND	GND isolated power supply	
	J3-4	SH	MODBUS communication cable screen ground connection	
Programmable analogue outputs	J12-13	AO 1	Programmable opto-isolated analogue outputs: ±10V - (2mA) voltage, 0(4)-20mA (max 8V) current see jumper P5-P8	
	J12-14	AO 2		
Analogue references	J12-15	POT -10V	Output for -10VDC - 10mA potentiometer	
	J12-16	POT +10V	Output for +10VDC - 10mA potentiometer	
Programmable relays	J12-17	RL1 Fault N	NO	Fault relay normally energized in condition of not locked drive 1A - 250Vac - 24Vdc
	J12-18	RL1Fault C	C	
	J12-19	RL1 Fault NC	NC	
	J12-20	RL2 DO3 PROG	NO	Programmable relay 1A - 250Vac - 24Vdc
	J12-21	RL2DO3 PROG	C	

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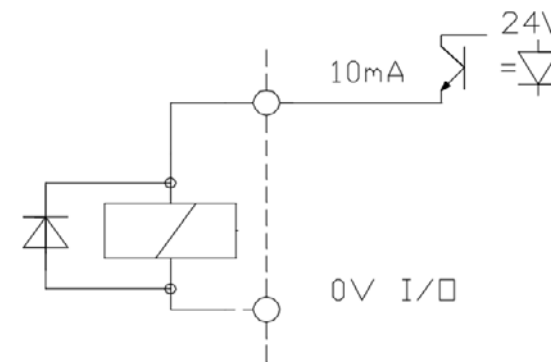
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Function	Terminal	Initials	Description	
Programmable opto-isolated digital inputs	J12-22	DI 3 Prog	Programmable opto-isolated digital inputs voltage excursion 0 ÷ 36Vdc rated voltage 24Vdc rated current 5mA minimum trigger voltage 20Vdc release voltage < 16Vdc	
	J12-23	DI 4 Prog		
	J12-24	DI 5 Prog		
	J12-25	DI 2 Prog (RV)		
	J12-26	DI 1 Start/Stop FW		
	J12-27	DI 0 Drive Enable		
	J12-28	DO1 Progr (see Note)*		Digital static output 1 24Vdc 10mA
	J12-29	DO2 Progr (see Note)*		Digital static output 2 24Vdc 10mA
Power supply I/O (see jumper P9)	J12-30	I/O supply +24Vdc	24Vdc-100mA, digital and analogue I/O power supply. (See jumper P9)	
	J12-31	DI / DO ground	Always connect to the screen bar	
Programmable opto-isolated analogue inputs (referred to AI/AO ground)	J12-32	AI/AO ground	analogue 0V I/O	
	J12-33	AI 1-	Programmable opto-isolated analogue inputs ±10V (±20mA) differential configuration (Rin=33KΩ) See Jumper P6-P7	
	J12-34	AI 1+		
	J12-35	AI 2-		
	J12-36	AI 2+		
J12-37	AI/AO ground	analogue 0V I/O		

*Note: with inductive load (relay coil) connect a suitable diode in parallel.



PREVIOUS VIEW

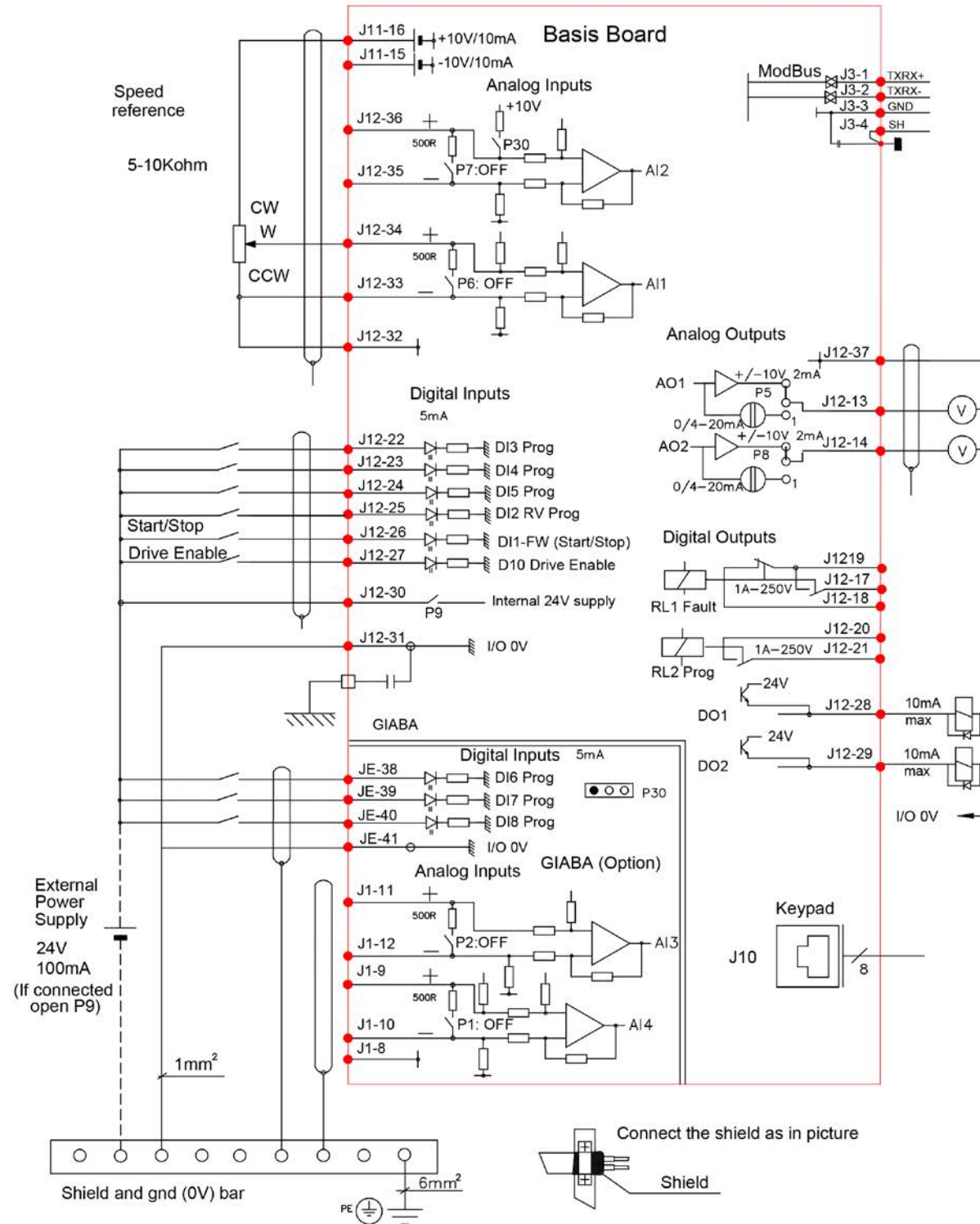


Figure 5.6.2 Control terminal block

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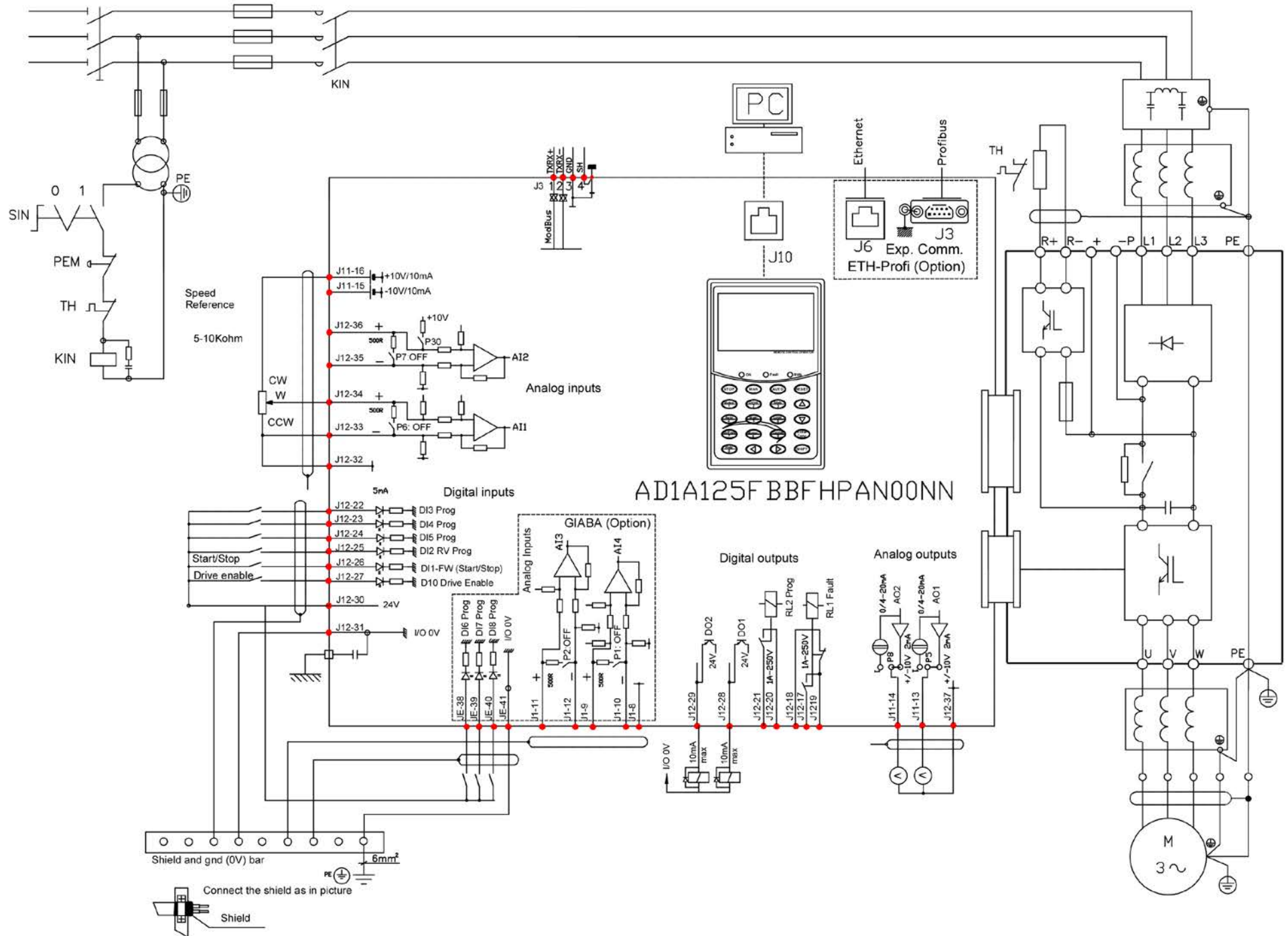


Figure 5.6.3 Example of AD1000 Connection with Basis board

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5.7 EXPANSION BOARDS

5.7.1 INPUTS EXPANSION BOARD (GIABA)

The Inputs Expansion board (GIABA) provides two additional analogue inputs and three additional digital inputs. It is connected to the Basis board through the connectors J9, P29 and P30.

Technical data

Operating temperature, -20° C - +50°C
Storage and transport temperature, -20° C - +70 °C

Analogue inputs

The two additional configurable analogue inputs are identified by AI3+ [J1-11], AI3- [J1-12] and AI4+ [J1-9], AI4- [J1-10]. The input range is ±10V (±20mA), in differential configuration. See the jumpers P1 and P2 of the expansion board.

Digital inputs

The three additional configurable and opto-isolated digital inputs are identified by DI6 [JE-38], DI7 [JE-39] and DI8 [JE-40]. Voltage range 0+36Vdc, Rated voltage 24Vdc, Inputs rated current 5mA
Input voltage < 16Vdc = 0; > 20 Vdc = 1
The voltage input range is 0+36Vdc, with 24Vdc rated voltage, and 5mA rated input current
With an input voltage lower than 16Vdc the logic value is 0; with an input voltage greater than 20 Vdc the logic value is 1.

Jumpers

Inputs Expansion Board				
P1		ON	500Ω ballast resistor, analogue input 4, connected	Analogue input 4 AI4
P2		ON	500Ω ballast resistor, analogue input 3, connected	Analogue input 3 AI3
P30		1-2	Pull-up excluded (Default)	Analogue input 2 AI 2
	3 2 1	2-3	Pull-up (2K2) on AI2 input (+) at +10V (for PTC)	



if the Inputs Expansion is installed, the jumper P30 of the Basis board is no longer accessible. In this case it must be open and, if necessary, the jumper P30 of the expansion board can be used.

The board is an option indicated by the letter A in the 14th character of identification code (see Chapter 2):

AD1	A	XXX	F	B	N	F	H	N	A	T	00	NN
-----	---	-----	---	---	---	---	---	---	----------	---	----	----

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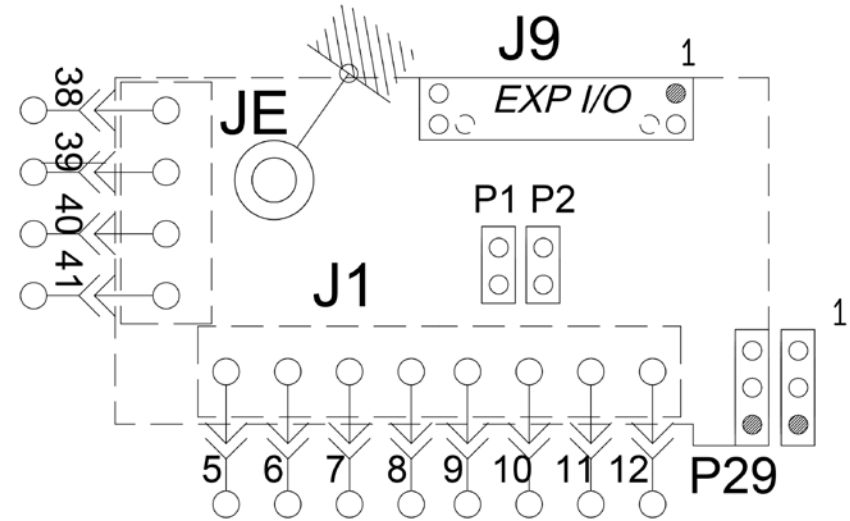
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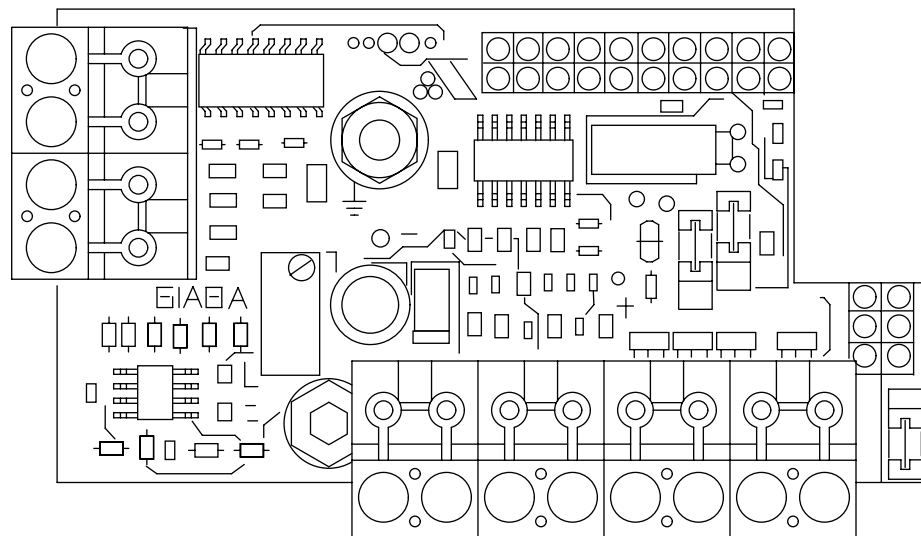
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GIABA BOARD CONNECTORS

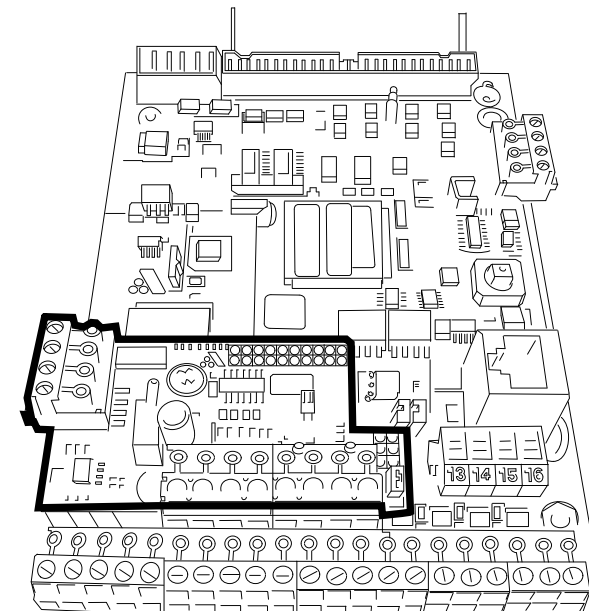
J1-5		Do not connect
J1-6	AGND	
J1-7		Do not connect
J1-8	AGND	analogue 0V I/O
J1-9	AI4+	Programmable and opto-isolated analogue inputs ± 10 V (± 20 mA) Differential configuration (Rin=33K)
J1-10	AI4 -	
J1-11	AI3+	
J1-12	AI3 -	
JE-38	DI6	Programmable and opto-isolated digital inputs Voltage range 0+36Vdc 24 Vdc-5mA <16V=0, >20V=1
JE-39	DI7	
JE-40	DI8	
JE-41	GND	Reference for digital inputs



GIABA board:



GIABA board installed on BASIS board



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5.7.2 INPUTS/OUTPUTS EXPANSION BOARD (GIABB)

The I/O Expansion board (GIABB) provides two additional analogue inputs and the connection for a digital outputs with additional relays expansion board. It is connected to the Basis board through the connectors J9, P29 and P30.

Technical data

Operating temperature, -20° C - +50°C
Storage and transport temperature, -20° C - +70 °C

Analogue inputs

The two additional configurable analogue inputs are identified by AI3+ [J1-11], AI3- [J1-12] and AI4+ [J1-9], AI4- [J1-10]. The input range is ±10V (±20mA), in differential configuration. See the jumpers P1 and P2 of the expansion board.

Digital outputs

The connector for the three configurable digital outputs with additional relays is identified with J10

Jumpers

I/O Expansion Board				
P1		ON	500Ω ballast resistor, analogue input 4, connected	Analogue input 4 AI4
P2		ON	500Ω ballast resistor, analogue input 3, connected	Analogue input 3 AI3
P30		1-2	Pull-up excluded (Default)	Analogue input 2 AI 2
	3 2 1	2-3	Pull-up (2K2) on AI2 input (+) at +10V (for PTC)	



if the I/O Expansion is installed, the jumper P30 of the Basis board is no longer accessible. In this case it must be open and, if necessary, the jumper P30 of the expansion board can be used.

The board is an option indicated by the letter B in the 14th character of identification code (see Chapter 2):

AD1	A	XXX	F	B	N	F	H	N	B	T	00	NN
-----	---	-----	---	---	---	---	---	---	----------	---	----	----

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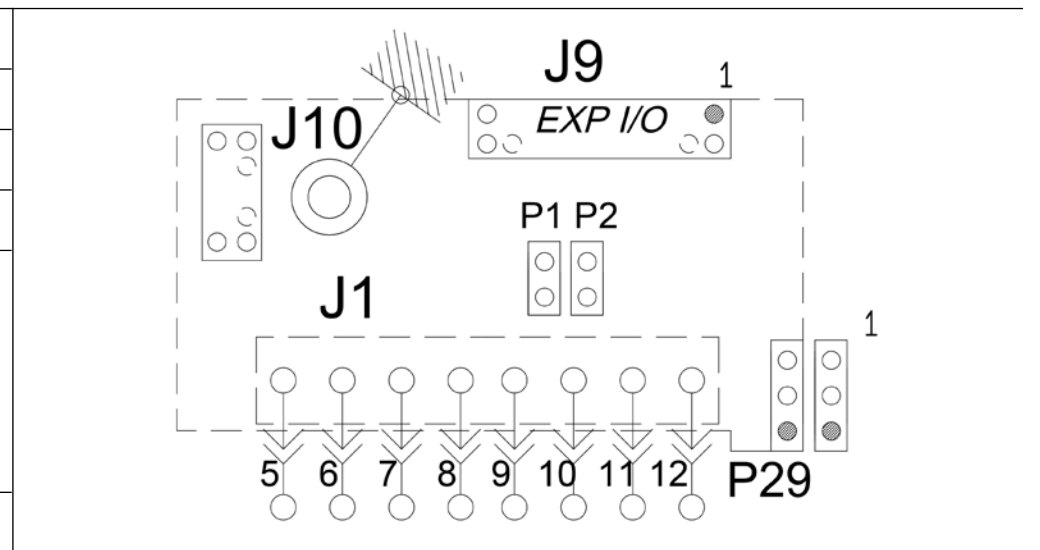
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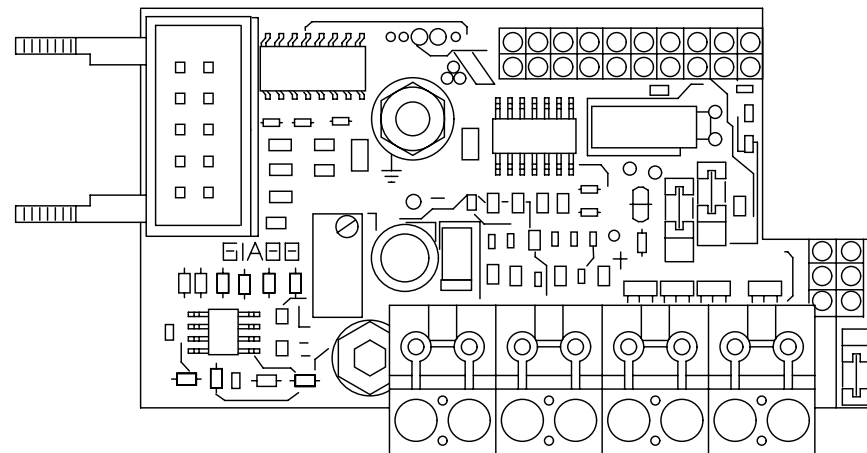
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GIABB BOARD CONNECTORS

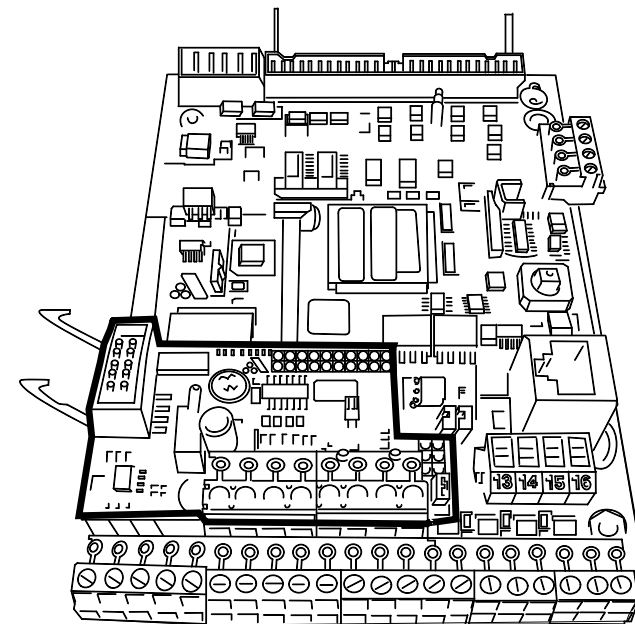
J1-5		Do not connect
J1-6	AGND	
J1-7		Do not connect
J1-8	AGND	analogue 0V I/O
J1-9	AI4+	Programmable and opto-isolated analogue inputs ± 10 V (± 20 mA) Differential configuration (Rin=33K)
J1-10	AI4 -	
J1-11	AI3+	
J1-12	AI3 -	
J10		Connection for expansion board with relays



GIABB board:



GIABB board installed on BASIS board:



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5.7.3 ETHERNET AND PROFIBUS EXPANSION BOARD (ETH-PROFI)

The Ethernet and Profibus expansion board provides the Profibus DP and Modbus TCP slave communication buses; it is connected to the Basis board through J7 and J8.

Technical data

Operating temperature, -20° C - +50°C

Storage and transport temperature, -20° C - +70 °C

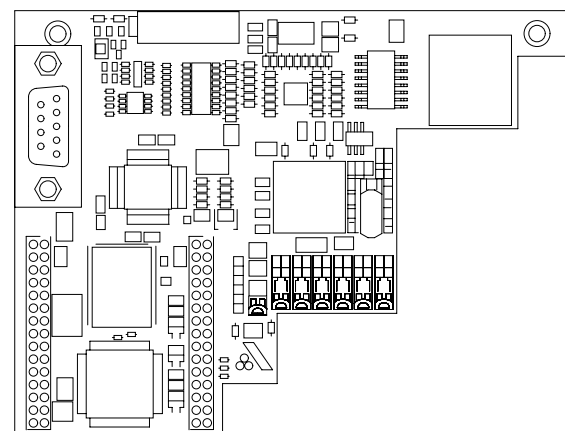
LED

Initials	Colour	Function	Description	
DL1	Green	Profibus	Profibus Communication	ON = Communication active
DL2	Green	Ethernet	Line activity	Flashing = Communication active
DL3	Green	Ethernet	Line status	ON = Connection OK

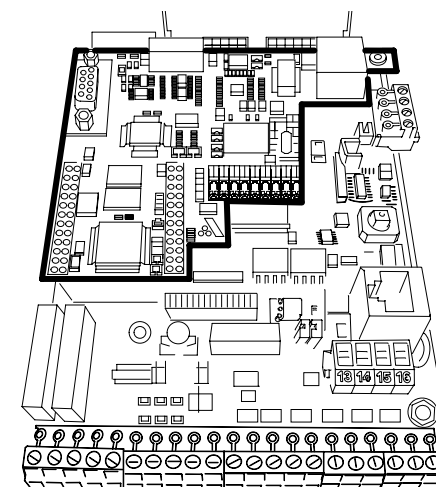
The board is an option indicated by the letter P in the 13th character of the identification code (see Chapter 2):

AD1	A	XXX	F	B	N	F	H	P	A	T	00	NN
-----	---	-----	---	---	---	---	---	----------	---	---	----	----

ETH-PROFI board:



ETH-PROFI board installed on BASIS board:



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5.8 INSTALLATION CHECK LIST

The mechanical and electrical installation must be checked before commissioning.

MECHANICAL INSTALLATION CHECKLIST

- Ambient temperature and humidity comply with the specifications.
- The unit is properly fixed on a vertical non-flammable surface.
- Cooling passage unobstructed.

ELECTRICAL INSTALLATION CHECKLIST

- Drive adequately grounded.
- The power supply network voltage corresponding to the rated input voltage of the frequency drive.
- Network connections properly:
 - connected
 - tight
- Input connections properly:
 - connected
 - tight
- Control connections properly:
 - connected
 - tight
- Appropriate input fuses installed.
- There are no compensation capacitors in the motor connections.
- There are no tools or other foreign objects inside the enclosure.

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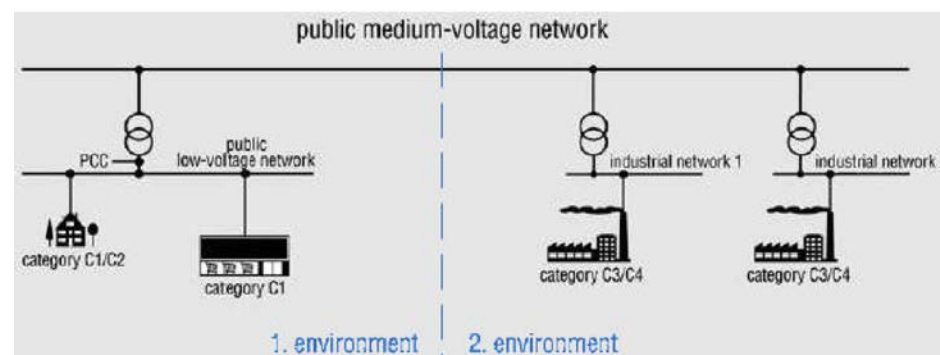
5.9 INSTALLATION INSTRUCTIONS ACCORDING TO EMC

5.9.1 EN61800-3 EMC PRODUCT STANDARD FOR VARIABLE-SPEED ELECTRIC DRIVES

EN 61800-3:2004 Adjustable speed electrical drive systems. Part 3: It is the EMC regulation for standard product including specific test methods. The transition period from the existing standard EN 61800-3:1996 ended on October 1, 2007.

The EN 61800-3 includes the drive from the network connection to the drive shaft, defines four different categories C1 - C4, different types of installation environment (residential/industrial), external doors and internal interfaces.

It defines the evaluation criteria for the operating characteristics in the event of interference to the external ports and internal interfaces according to the place of installation.



5.9.1.1 INSTALLATION ENVIRONMENT (DEFINITIONS)

First environment (residential and commercial):

Environment that includes domestic devices. Also it includes industrial devices directly connected without intermediate transformers; to a low voltage network which supplies buildings used for domestic purposes.

Second Environment (industrial area):

Environment that includes all industrial users other than those directly connected to a low voltage network which supplies buildings used for domestic purposes.

NOTE

For PDS installed in the second environment, the user must ensure that excessive disturbance is not induced in the network, even if the propagation is through a medium voltage network.

Private network

The private network is characterized to be powered by a dedicated medium voltage network and does not supply residential areas. Typically, private networks feed commercial buildings, offices in residential buildings, shopping malls, etc. The operator can decide whether to create the network according to the first or second environment as defined by the standard. A private low voltage network can be considered as a system in accordance with EMC rules. The EMC standard is evaluated in accordance with the physical limits of the system; the emission and immunity to radiated RF are evaluated according to the space limits and conducted disturbances are evaluated based on the input to the power supply network.

5.9.1.2 CATEGORIES OF EN 61800-3

Category C1: PDS with rated voltage less than 1000 V, designed for unlimited use in the first environment.

Category C2: PDS with rated voltage less than 1000 V, designed for use in the second environment. It can be used in the first environment according to the following criteria:

- Rated voltage <1000 V.
- It is not a socket device.
- It is not a removable device.
- Installation and maintenance only by a qualified technician (a person/organization with the necessary knowledge in the installation and/or management of power drives including their EMC aspects).
- Warnings for use are specified.

Notes on the instructions for use:

"This is a product of category C2 according to IEC 61800-3. In a domestic environment this product may cause radio interference in which case additional measures may be required to reduce interference.

Category C3: PDS with rated voltage <1000 V, designed for exclusive use in the second environment.

Notes on the instructions for use:

This type of PDS is not intended to be used on a public low voltage power supply network that supplies domestic devices. If used on such power supply network it causes interference to radio frequency.

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Category C4: For use in the second environment, which meets at least one of the following points:

- Rated voltage ≥ 1000 V
- Rated current ≥ 400 A
- Connection to an IT network
- The required dynamic performance will be limited as a result of filtering. An EMC plan must be prepared!

5.9.1.3 SOLUTIONS USED TO ENSURE COMPLIANCE WITH EMISSIONS

Emissions can be divided into two types: radiated and conducted. The disturbances can be emitted in different ways. Conducted disturbances can propagate to other equipment through all the conductive parts, including cables, grounding and the metal frame of the cabinets.

Conducted emissions: They can be reduced in the following way: With RFI filters for high frequency disturbance Using surge suppressors to the coils of relays, contactors, solenoid valves, etc. to mitigate the formation of sparks during switching.

Using ferrite rings at the power connection points.

Radiated emissions: In order to prevent disturbance transmitted through the air, all components of the electric drives must constitute a Faraday cage to counteract radiated emissions.

Electrical drives include also cabinets, auxiliary boxes, cabling, motors, etc. The following is a list of some methods to ensure the continuity of the Faraday cage:

Cabinets:

- The cabinet must have an unpainted corrosion finish at all points of contact with other plates, doors, etc.
- All contacts between metals must be free of paint, with conductive gaskets if necessary.
- Use unpainted installation plates, connected to the common grounding point, ensuring that all of the individual metal components are firmly connected, in a single grounding path.
- Use conductive gaskets in correspondence of doors and covers. It is appropriate to fix the covers at intervals not exceeding 100 mm in the points where radiation could escape.
- Separate the "dirty side" from the "clean side" relative to the radiation disturbance using metal covers and a specific design.
- Minimize the presence of openings in the cabinet.
- Use materials with good attenuation properties, for example plastic material with conductive coating if it is impossible to use a metal cabinet.

Wiring:

- Use special HF cable inputs for high frequency grounding of cable screens.
- Use conductive gaskets for HF grounding of the control cable screens.
- Screen all cables of the power supply and control unit. Observe the specific manuals of the individual products.
- Position the power supply and control unit cables separately.
- Use twisted pairs to avoid common mode disturbances.
- Use ferrite rings for common mode disturbances, according to the need.
- Select and position the internal wires correctly.

Installation:

- The auxiliaries used with complete drive modules must be produced with CE marking in accordance with the EMC directive and the Low Voltage Directive, NOT ONLY with reference to the latter, unless they are exempt, for example, when used with a component with no direct function.
- Select and install accessories in accordance with the manufacturer's instructions.
- Ground to 360° on the motor axis. See the specific manuals of the individual products
- Correct internal wiring methods.
- Special attention must be given to grounded.

5.9.2 RFI FILTERS FOR RADIO FREQUENCY INTERFERENCE

The EMC emission limits for PDS depend on the installation environment, on the type of power supply network and on the drive power.

RFI filters are used to attenuate conducted disturbances in a connection point of the line where the filter grounds all disturbances.

RFI filters are required when the electric drive is connected to a public low-voltage power supply network (first environment).

If there is the possibility that the neighbourhood equipment could be damaged by emissions, it is recommended to use filters in industrial installations (second environment), although the product standard currently does not impose any limits on emissions.

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RFI FILTER INSTALLATION:

To ensure that the filter is working properly, it is necessary to ensure reliable connections with low impedance/HF, and therefore it is necessary to comply with the following guidelines.

- Assemble the filter on a metal plate with unpainted connection points in accordance with the instructions provided by the manufacturer of the filter.
- Bolt the filter cabinet frame at several points (if separate) to the drive cabinet. Remove paint, if any, from all points of connection.
- The filter input and output cables must not be placed in parallel and must be separated from each other.
- The maximum cable length between the filter and the drive should be less than 0.3 m; for greater lengths use screened cable.
- Position the filter so as not to obstruct the ventilation channel of the drive.
- The filter must be grounded in accordance with the instructions of the manufacturer. It should be noted that the cable type and size are critical factors.

NOTE

It is not possible to use filters in floating networks (IT systems) where there is a high impedance, or there are no physical links between the phases and the ground.

Provide surge suppressors to the coils of relays, contactors, solenoid valves, even when they are installed outside the cabinet.

5.9.2.1 RFI FILTER
(see table 5.5.1 for the filters codes)

RFI in networks with grounded neutral (TN or TT)

The filters are suitable only for networks with grounded neutral (e.g. European public 400 V network). According to EN 61800-3, the filters are not compatible with floating networks (IT).

Control and insulation devices

The filters (with their internal discharge resistors), cables, drive and motor have an overall considerable capacity to ground which causes an increase in current leakage to ground (>30mA).

The ground protection device must be suitable for these values.

IT floating networks

For floating networks, also referred to as IT networks, ungrounded, or with impedance/resistance greater than 30.Ω to ground if equipped with RFI filter:

- Disconnect the filter before connecting the drive to the network.
- If EMC requirements are needed, check for excessive emission to the neighbouring low-voltage network. In some cases, the natural suppression in transformers and cables is sufficient. When in doubt, use a transformer with a screen between primary and secondary.

NOTE

Refer to [Chapter 5.9.2.2](#) for the removal of the filter inside the drive and [figure 5.6.3](#) for the connection between filter and drive.



The filter must be grounded before applying power to the drive and may only be used with balanced networks. Do not install or remove the RFI filter when the drive terminal are under voltage.

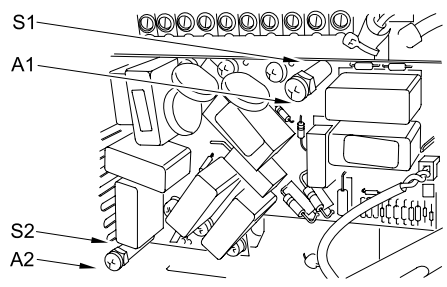
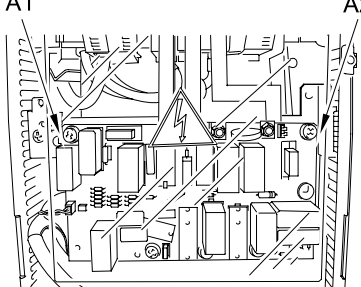
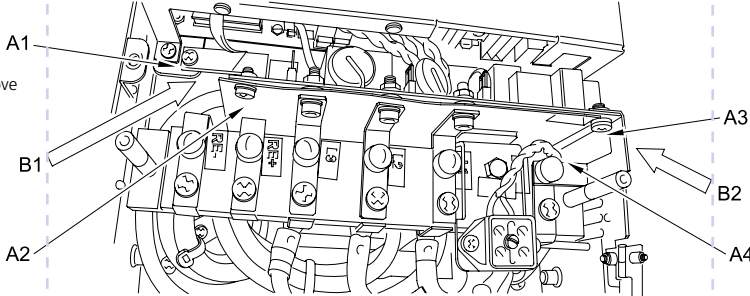
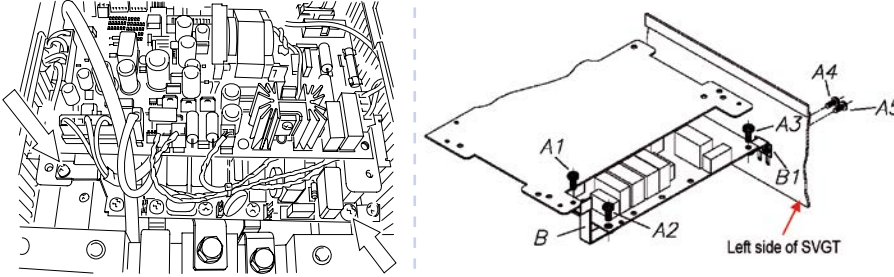
If an drive with related RFI filter is installed on an IT system [network insulated from ground or network connected to the ground with a high resistance (> 30.Ω), the network will be connected to the ground potential through the EMC filter capacitors of the drive. This may cause danger or damage the unit.

The filter must not be connected to the output terminals (motor side).

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5.9.2.2 REMOVING THE RFI FILTER ON DRIVE AD1A030-166F

The AD1A030-036-045-053-066-86-108-125-150-166F are equipped as standard with a RFI filter.

<p>AD1A030-036F: unscrew and remove the screws A1-A2, the insulation and the support turrets (S1-S2). Unscrew and remove the six screws on the board and remove the turrets (S1a-S1b) under the board. Replace the turret S1a with a screw. Reinstall the supports S1 and S2 on the board with two nuts then carefully screw the six screws on the board. At the end reinstall the insulation protection.</p>	<p>AD1A030-036F: To disconnect the RFI filter, unscrew and remove the screws A1-A2 and remove the bars underneath.</p>
	
<p>AD1A066F To disconnect the RFI filter, unscrew and remove the screws A1-A4, remove the bars B1 and B2.</p> 	
<p>AD1A088-108-125-150-166F: To disconnect the RFI filter, unscrew and remove the screws A1A3, remove the bar B, unscrew screws A4-A5, push down and remove the bar B1 and screw A4-A5.</p> 	

IT network (floating): If the drive is equipped with an EMC filter, disconnect the ground connections of the filter as shown in the following figures, before connecting the drive to the power supply.



If a drive with related RFI filter is installed on an IT network insulated from ground or network connected to ground with a high resistance ($>30.\Omega$), the network will be connected to ground potential through the drive EMC filter capacitors. This may cause danger or damage the unit.

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Networks with asymmetric ground connection

(defined in the table below)

In these applications, the internal RFI filter must be disconnected.

If the ground configuration of the power supply network is unknown, disconnect the internal RFI filter.

Unsymmetrically Grounded Networks – RFI filter must be disconnected			
Ground at the mid point of a leg		Ground at the corner of the delta	
Three phase "Variac" without solidly grounded neutral		Single phase grounded at an end point	

5.9.3 COMPLIANCE OF AD1000 TO IEC 61800-3

The AD1000, with RFI filter, comply with the requirements defined in EN 61800-3 for the second environment category C3 and C4.

The AD1000, with optional filter class B, also meet the narrow limits of the first environment category C2 with motor cable lengths less than 25 meters.

CAUTION!: "This is a product of category C2 according to IEC 61800-3. In a domestic environment this product may cause radio interference in which case additional measures may be required to reduce interference. The installation warnings and recommendations in this manual must be observed.

To limit emissions the AD1000 units are provided with EMC filter (installed inside or outside of the drive according to its size).

Optional RFI filters are available for using the drive in the first environment.

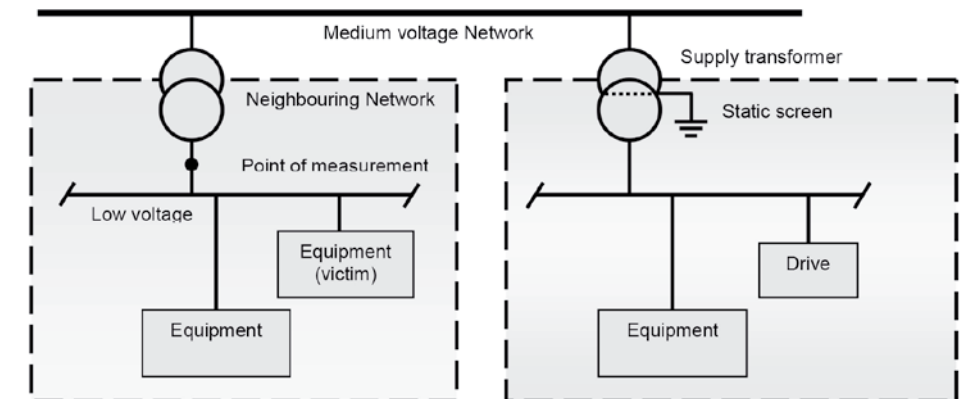
NOTE

- If the drive is installed on a floating network (IT), the standard EMC filter must be disconnected. The network should be connected to ground potential through the EMC filter capacitors with consequent possible damage to the unit. EMC filters suitable for IT network are available on request.
- Refer to [paragraph 5.4](#) for connecting the RFI filter to the drive.
- The codes of the RFI filters are shown in [Table 5.5.1](#).

NOTE

If the above mentioned provisions cannot be observed, (e.g. the drive cannot be equipped with EMC filter as it is installed on a floating network (IT)), the requirements of the EMC Directive for restricted distribution can be met as follows:

- Make sure that no excessive emission is generated to neighbouring low voltage power supply network. In some cases, the natural suppression in transformers and cables is sufficient. When in doubt, use a transformer with a screen between primary and secondary.



- An EMC plan for preventing disturbance has been defined for this particular installation.
- Power and control cables have been provided as required in this Manual.
- The drive is installed according to the instructions in the manual.

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5.9.4 MOTOR CABLES

5.9.4.1 CONNECTION CABLES BETWEEN THE DRIVE AND MOTOR

NOTE

The power cables of the motor must be screened. Problems could arise to the RFI if screened cables are not used.

Screened cables ensure high immunity against disturbance generated by the drive. The high-frequency current through the screen returns directly to the drive, instead of flowing through the motor housing.

The cable screening must be continuous and must be grounded on both terminals: on the ground terminal of the motor and on the ground terminal PE of the drive. In general, always provide a dedicated cable, with a minimum section equal to 50% of the phase cable, which connects the drive PE terminal directly with the corresponding terminal of the motor. This cable has the function of providing a preferential way of closing in order to return to the drive the disturbances generated by itself, avoiding them to propagate to the ground system of the equipment. The ground connection of the motor must be made locally directly to the equipment ground system.

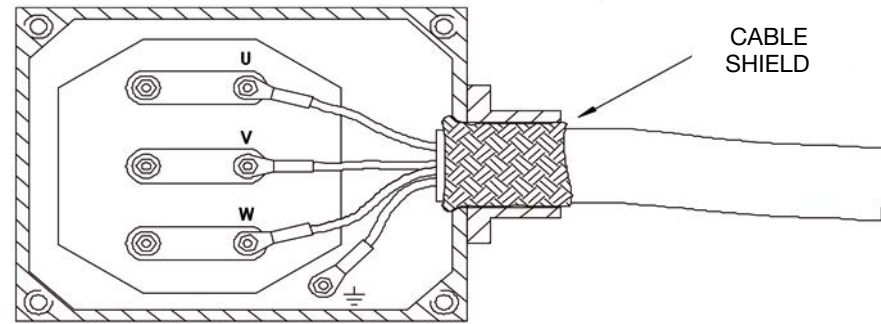


Figure 5.9.4.1
Typical connection on the motor

5.9.4.2 TYPES OF CONNECTION CABLES BETWEEN DRIVE AND MOTOR FOR COMPLIANCE WITH THE EMC DIRECTIVE AND FOR CONTAINMENT OF EDDY CURRENTS

<p>a) Recommended cable Symmetrical screened cable - 3 phase conductors arranged symmetrically - Single an unscreened conductor - 3 PE conductors arranged in symmetrical way - External screen for phase and Pe conductors</p>	
<p>b) Recommended cable Symmetrical screened cable: same as above but with a single PE cable positioned at the centre of the cable.</p>	
<p>c) Recommended cable Symmetrical screened cable: screen with section 50% greater than the section of each conductor to make, (a separate PE conductor is required only if the conductivity of the cable screen is not sufficient.).</p>	

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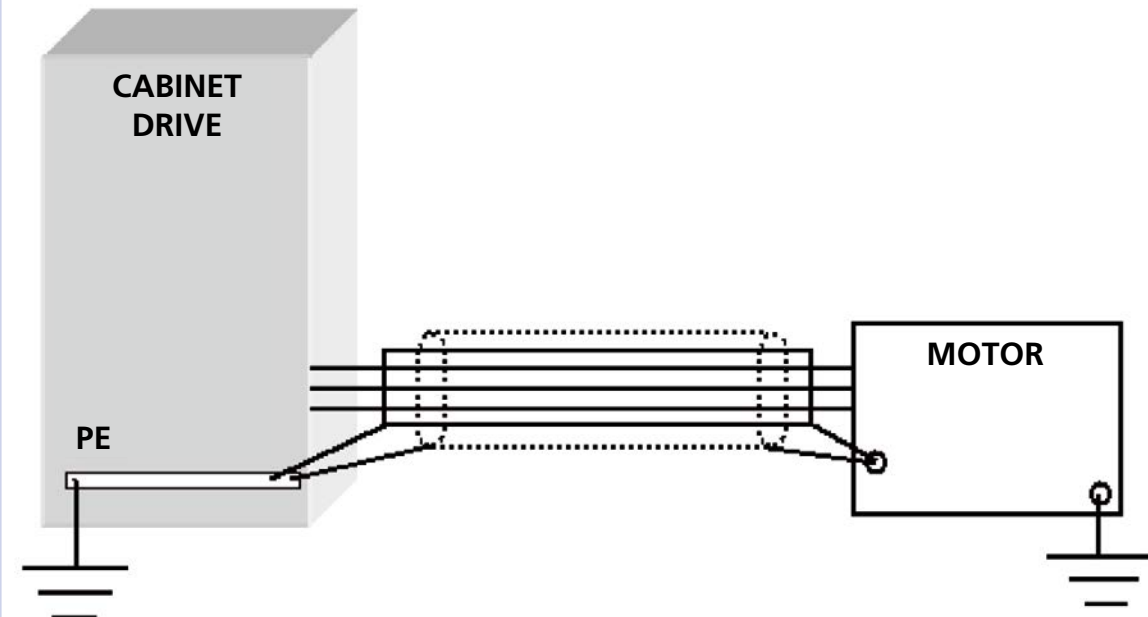
Connections on drive side:

- a. The PE conductors and the screens must be connected to the ground bus bar of the drive electrical panel;
- b. If for reasons of current capacity it is necessary to use more cables in parallel, it is necessary to connect the three conductors of each three-pole cable to the three phases U, V, W.

Motor connection:

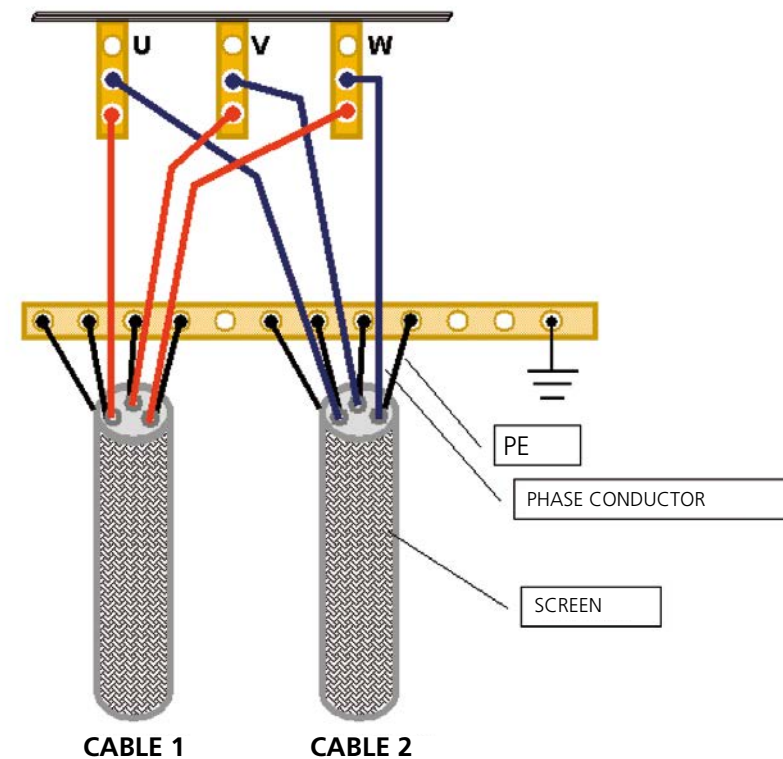
- c. The PE conductors and the screens must be connected to the motor housing; for this purpose the motor terminal box must be provided with an appropriate fixing plate;
- d. If for reasons of current capacity it is necessary to use more cables in parallel, it is necessary to connect the three conductors of each three-pole cable to the three phases U, V, W.

Drive connections - Motor with symmetrical schematic cable



The figure schematically shows the connection between drive and motor; it points out the connection between the motor housing and the drive electrical panel ground bus bar made by drive-motor connecting cables (screen and PE conductors).

Drive-motor connections with two screened cables



NOTE

Very long motor cables, due to the leakage current to ground and the high switching frequency, can cause the intervention of the ground fault relief device. Replace the device with a less sensitive one or power the drive with a dedicated transformer.

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GROUNDING

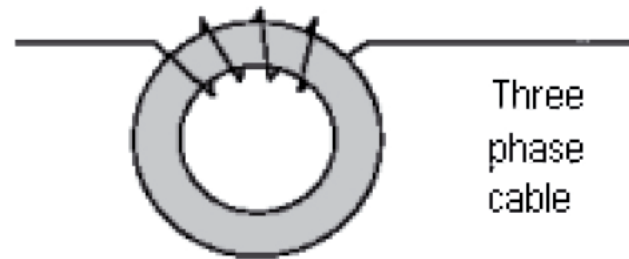
The Drive electrical panel and Motor are individually connected to the same ground system; the connection cables between the drive and motor are grounded on both sides (both PE conductors and the screens of such cables).

FERRITES

For applications in which more motors are connected to one drive and is not possible to completely screen the cables due to a junction terminal board of the individual motor cables, it is necessary to provide ferrite cores at the drive output. For the correct use it is necessary to wrap the three cables (2 to 5 times) through the ferrite, leaving the grounding cable outside.

The cable that goes from the drive to the junction terminal board, without screening, must be as short as possible.

The AD1A030-166 units have an internal ferrite core at the output.



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5.9.4.3 SIGNAL CABLES SCREENING

The cables for digital signals longer than 3 metres and all cables for analogue signals must be screened. The screen must not be interrupted and, normally, must be connected at both ends by metal clamps or similar devices, placed directly on clean metal surfaces, provided that the grounding points are part of the same ground line. Otherwise, it is necessary to connect a capacitor (10 nF-2 KV) to the ground line on one end. In the rare cases in which the current flowing in the screen interferes with the signals to be screened, the screen must be connected only on the drive side.

In the drive cabinet, it is necessary to make this type of connection directly on the sheet near the terminals and if the cable comes from outside, also on the PE bus bar; at the other end of the cable, the screen must be firmly connected to the housing of the transmitting or receiving unit. When grounding screened cables, use a 360° connection and avoid the pigtail connection, i.e. connect the screen to ground via a cable or use the screen rolled up and connected to ground. Use a screened twisted pair for the analogue signals. This type of cable is recommended also for encoder signals. Use a twisted pair for each signal.



A double shielded twisted pair cable



A single shielded twisted multipair cable

A screened twisted pair is the best solution for low voltage digital signals but also multi-core screened twisted pair cables can be used. Using digital signal cables separated from the analogue signal cables. Use twisted cables for the relay, such cables (with voltage not exceeding 48 V) can travel together with digital signals. Do not mix 24 VDC wires and 115 / 230 VAC wires in the same cable. Control cables maximum cross-section: 1.5mm² (AWG16)

The control cables must be kept at a distance greater than 0.3 m (1 foot) from the power cables.

Install the power cables and the signal cables in separate cable-ducts. If it is necessary to cross the power and signal cables carry out the intersection with a 90° angle.

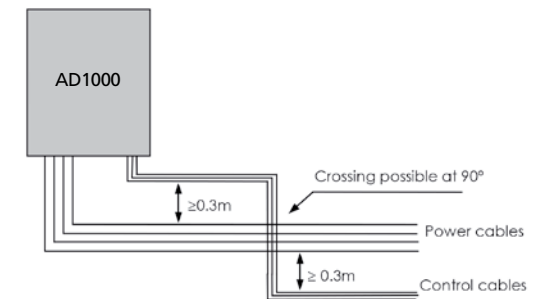


Figure 5.9.4.3.1 Cables path

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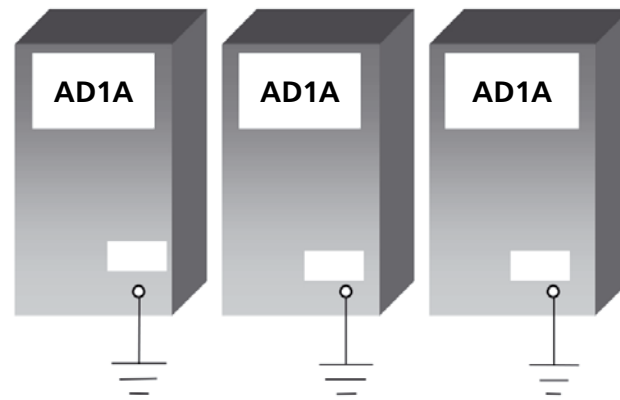
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5.9.4.4 GROUNDING

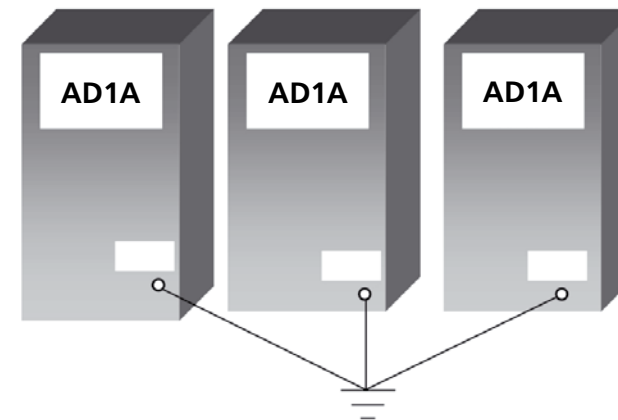
For safety reasons, proper operation and to reduce electromagnetic emission, the drive and the motor must be grounded on the installation location. A star connection is acceptable but it is not the preferred system.

- The cross-section of the ground cable must be suitable to the regulations of the country in which the drive will be installed.
- The screen of the power cables must be connected to the PE terminal of the drive to meet the safety requirements.
- In multi-motor applications do not connect the grounding cables of the drives in series.

- The electrical panel must include its own ground bus bar, connected to the ground system, to which connect all the devices.
- The ground connection must be as short as possible.
- The ground of the drive must be separated from the ground of other devices.
- The RFI disturbances require a large ground bus bar because of the skin effect.
- The screen of the power cables can be used as ground cable only if it has an adequate cross section complying with safety standards.



a) Preferred connection



b) Acceptable connection

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6 OPTIONS

6.1 INTRODUCTION

The AD1000 has several options. Some of the most requested are described in this chapter; contact Nidec-Asi for special needs.

6.2 DYNAMIC BRAKING

6.2.1 BRAKING UNIT

The **AD1000** series "F" (excluding sizes AD1A350-520), if required, can be equipped with an internal braking unit installed at the factory. The product code identifies the braking unit with the 10th character; the letter "B" in the 10th position indicates that the brake is mounted inside, while the letter "N" indicates that the **AD1000** has no braking unit installed (See Chapter 2 for further details).

The braking unit is required when the braking torque requested exceeds 15% than the rated torque of the motor provided in the "Electrical data" table in [chapter 2.5](#). The maximum braking torque allowed using the braking unit cannot exceed 150% of the rated torque of the motor.

The braking unit is supplied without resistor that can be calculated using the formulas in [section 6.2.3](#).

The braking device is able to handle a continuous calculated braking power equal to 50% of the motor rated power (see [paragraph 2.5](#) "Electrical data").

NOTE:

For critical yield cycles (e.g. lifting applications) consult the manufacturer.

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Table 6.2.1 Braking unit: Resistors and fuses for drives with rated voltage 380V-480V ± 10%

Drive type	Resistor * minimum value Rb		Continuous power Switch KW	Typical resistor @ 400V			⁽¹⁾ External fuses			
	@400V	@480V		KW	Ω	SAP Code	Data (A-V)	Bussmann BSS88....	Ferraz -	Code -
AD1A0P3	200 Ω	315 Ω	1	0,6	3X110 in series	ELC40949901	10-690	10CT-	-	-
AD1A0P4	200 Ω	315 Ω	1,5	0,6	3X110 in series	ELC40949901	10-690	10CT-		
AD1A0P6	100 Ω	110 Ω	3	1,3	2X55 in series	ELC40950001	10-690	10CT-		
AD1A008	80 Ω	86 Ω	3	1,3	2X55 in series	ELC40950001	30-690	30CT		
AD1A011	60 Ω	65 Ω	4	1,3	2X55 in series	ELC40950001	30-690	30CT	-	-
AD1A015	40 Ω	44 Ω	5	2,2	55	ELC40950201	30-690	30CT		
AD1A018	40 Ω	44 Ω	5	2,2	55	ELC40950201	30-690	30CT		
AD1A022	30 Ω	33 Ω	7,5	4	55	ELC40950301	40-690	40FE	6,6URS7/40	ELC402439
AD1A028	20 Ω	33 Ω	9	4	28	ELC40950302	40-690	40FE	6,6URS7/40	ELC402439
AD1A030	20 Ω	33 Ω	9	4	28	ELC40950302	40-690	40FE	6,6URS7/40	ELC402439
AD1A036F	20 Ω	33 Ω	9	4	28	ELC40950302	40-690	40FE	6,6URS7/40	ELC402439
AD1A045F	13 Ω	14 Ω	11	8	15	ELC40950403	80-690	80FE	6,6URS17/80	ELC402433
AD1A053F	10 Ω	11 Ω	15	8	15	ELC40950403	80-690	80FE	6,6URS17/80	ELC402433
AD1A066F	10 Ω	11 Ω	15	8	15	ELC40950403	80-690	80FE		ELC402433
							Internal fuses			
AD1A086F	7 Ω	8 Ω	35	16	2x15 in parallel	ELC40950403	140-690	140EET		ELC402446
AD1A108F	7 Ω	8 Ω	35	16	2x15 in parallel	ELC40950403	140-690	140EET		ELC402446
AD1A125F	5 Ω	5,5 Ω	40	16	2x15 in parallel	ELC40950403	140-690	2x140EET		ELC402446
AD1A150F	3,3 Ω	3,6 Ω	50	32	4x15 in parallel	ELC40950403	140-690	2x140EET		ELC402446
AD1A166F	3,3 Ω	3,6 Ω	50	32	4x15 in parallel	ELC40950403	140-690	2x140EET		ELC402446
AD1A210F	3,3 Ω	3,6 Ω	50	32	4x15 in parallel	ELC40950403	140-690	2x400/00T		ELC20653310
AD1A260F	2,2 Ω	2,4 Ω	70	15+15	2x5 in parallel	ELC40672204	140-690	2x400/00T		ELC20653310
AD1A290F	1,65 Ω	1,8 Ω	3 x 70	20+20	2x5 in parallel	ELC40672205	140-690	2x400/00T		ELC20653310

¹⁾ At user's responsibility
* Sized for emergency braking (1.5 IN –Cl.2 for 60 s)

Braking units for drive external installation called "GTBU .. F/K" are available (See the Manual IMGT30006EN/IT)

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6.2.2 RESISTOR INSTALLATION AND CONNECTION



The resistors must be installed outside of the drive in a position in which they can dissipate heat
The resistor reaches high temperatures, therefore, avoid installing it in the vicinity of the drive or of any other device which could be damaged by the heat emission.
Protect the resistor against accidental contact. The resistor must be protected by a suitable thermal protector that opens the network remote control switch in case of intervention.
Use the same type of cable used at the drive power input (see Chapter 5) to make sure that the input fuses will also protect the resistor cables.
Alternatively, it is possible to use two screened cables with the same cross section of input cables. The maximum cable length of the resistor is 5 m (16.5 ft). For connection, see the drive connection example.

The rated power of the resistor is not calculated to operate with duty-cycle = 1. In case of failure of the power braking switch, the resistor is directly connected on the network via the rectifier jumper. In a similar situation, the resistor heats up to a high temperature and a failure of the resistor itself may occur.
To avoid this situation, the resistor must be protected by an adequate temperature relay: its intervention must open the main switch that protects the input line.
The cables of the thermal device must be screened and of a length not exceeding the resistor cables length
It is compulsory, for safety problems, to provide a contactor on the drive power supply input and make sure that it opens in case of over-temperature of the resistor.
Figure 6.2.2.1 shows a simple example of connection.

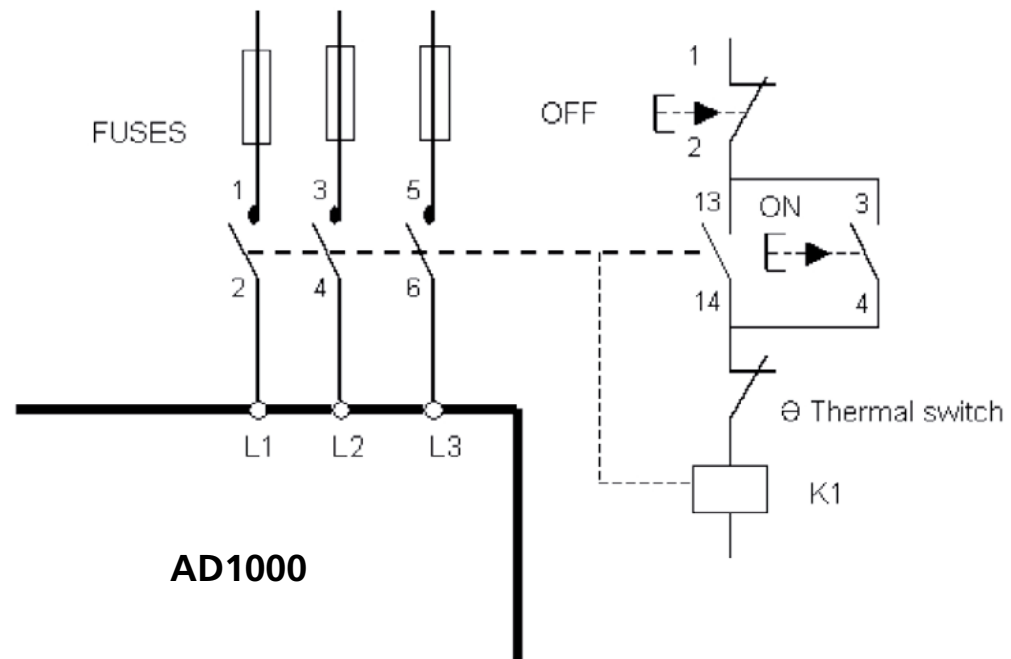


FIGURE 6.2.2.1 EXAMPLE OF CONTACTOR CONNECTION

PREVIOUS VIEW

6.2.3 RESISTOR SELECTION

When the speed (frequency) of an asynchronous motor is reduced rapidly, the motor acts as an asynchronous generator re-applying power to the drive.

Some of the energy is dissipated in the motor (with torque corresponding to approximately 10-20% of the rated torque of the motor), the rest is stored on the capacitors of the drive intermediate circuit with a voltage increase at their terminals. A dynamic brake is used to prevent it from reaching too high voltage values and to avoid the intervention of the drive maximum voltage protection.

An electronic circuit detects the voltage on the capacitor bank of the drive and, when its voltage exceeds a predefined value, it enables the power transistor of the braking unit that inserts the braking resistor in parallel to the capacitor bank.

As soon as the DC voltage returns to its normal values, the power transistor is disabled.

The ohmic value of the resistor and its power depend on the type of drive, the inertia of the moving masses, the load torque and the deceleration time.

The figure below provides definitions for the terms used when a motor is braked from an initial speed $N1$, to a final speed $N2$. In case of failure of the power braking switch, the resistor is directly connected on the network via the rectifier jumper. In a similar situation, the resistor heats up to a high temperature and a failure of the resistor itself may occur. To avoid this situation, the resistor must be protected by an adequate temperature relay: its intervention must open the main switch that protects the input line.

The cables of the thermal device must be screened and of a length not exceeding the resistor cables length

It is compulsory, for safety problems, to provide a contactor on the drive power supply input and make sure that it opens in case of over-temperature of the resistor.

The figure below shows a simple connection example.

The formulas for the resistors power calculation are given below.

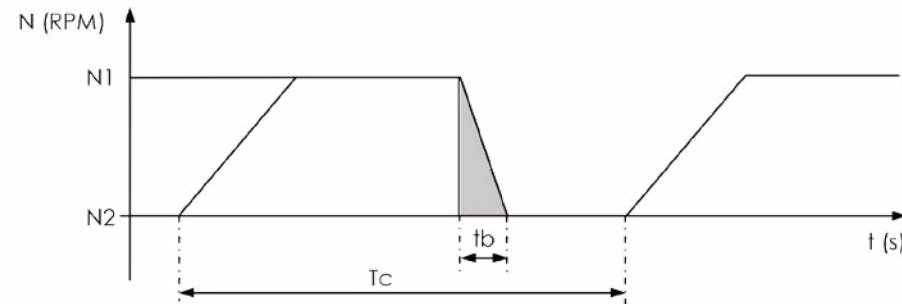


FIG. 6.2.2.2

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Terms and symbols used:

MB =	braking torque of the motor speed from N1 to N2 in a time tb.	Nm
J =	total inertia of the motor shaft.	Kgm2
ML =	load torque to the motor shaft.	Nm
PR =	resistor average power.	W
WB =	braking energy.	J
MN =	Motor rated torque = $\frac{60 \cdot P}{2\pi \cdot N}$ (Nm)	Nm
N =	Motor rated speed.	RPM
P =	Motor rated power.	W
V =	Rated braking DC voltage (See the values in the table 6.1-3)	
	$M_B = \frac{2\pi \cdot J \cdot (N1 - N2)}{60 \cdot tb} - M_L$ In the worst case $M_B = 1.5 M_N$	NM
	$R_B = \frac{V^2}{0.10472 \cdot M_B \cdot N1} \cdot \frac{1}{1.2}$	Ω
	$W_B = \frac{0.10472 \cdot (M_B - 0.2 \cdot M_N) \cdot (N1 + N2)}{2} \cdot tb$	J
	$P_R = \frac{W_B}{T_c}$	W

The ohmic value of RB must be greater or equal to the value shown in [Table 6.2.1](#).

The braking voltage must be selected according to the voltage class of the drive, as shown in the following table

Table 6.2.3 Braking Voltage for drives voltage class

AC voltage class of the AD1000		DC voltage to be used in the formula
F	from 380 to 480V	750

After calculations the braking resistor can be selected using the following values:

- ohm value (Ω),

- braking energy (J)
- working cycle,
- peak voltage to ground 1200 Volt.

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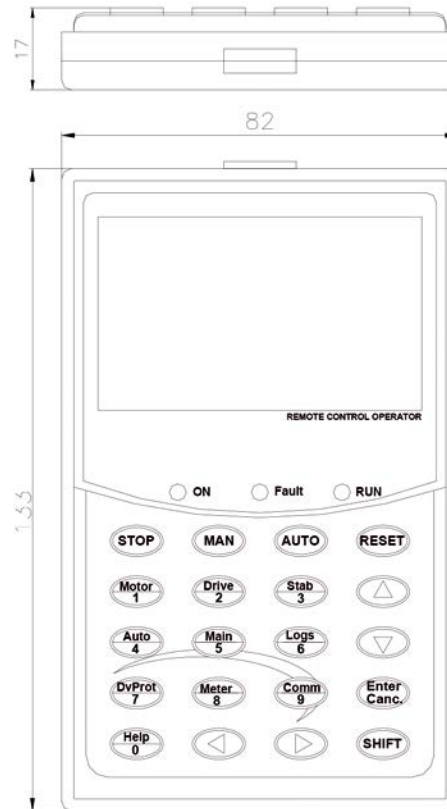
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6.3 KEYPAD

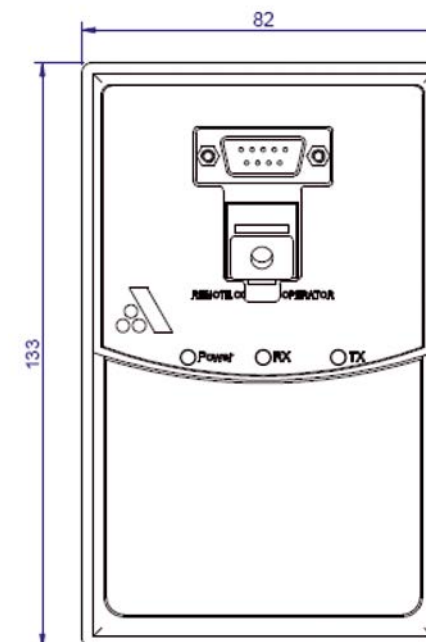
See Programming Manual for use code 8000001597



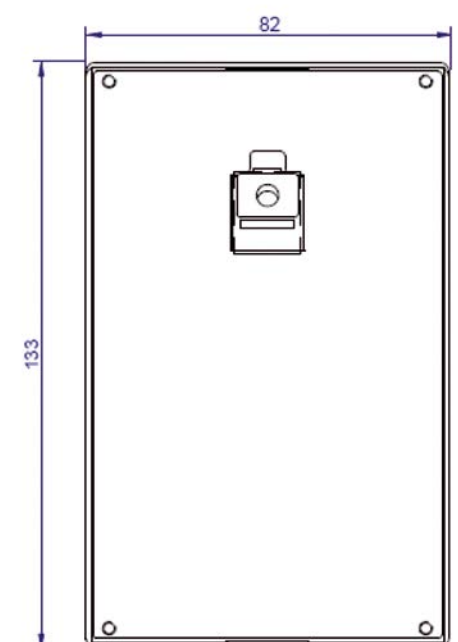
6.3.1 INSTALLATION ON THE PANEL DOOR

The following optional kits are available for remote-control of the keypad on the door

GTRK	ELC452936	Keypad remote-control kit for AD1A0P3-028F	<ul style="list-style-type: none"> Keypad installation shell Connection cable (length ≈ 2m) to AD1000 Mounting supports
GTRKB	1000087515	Basic keypad remote-control kit for all sizes, excluding AD1A0P3-028F	<ul style="list-style-type: none"> Keypad installation shell Connection cable (length ≈ 2m) to AD1000 Mounting supports Adapter that, installed on the door of the drive instead of the keypad, makes the control board connector accessible
GTRKA	1000094381	Advanced keypad remote-control kit (with PC connector) for all sizes, excluding AD1A0P3-028F	



Adattatore avanzato / Advanced adapter



Adattatore base / Basic adapter

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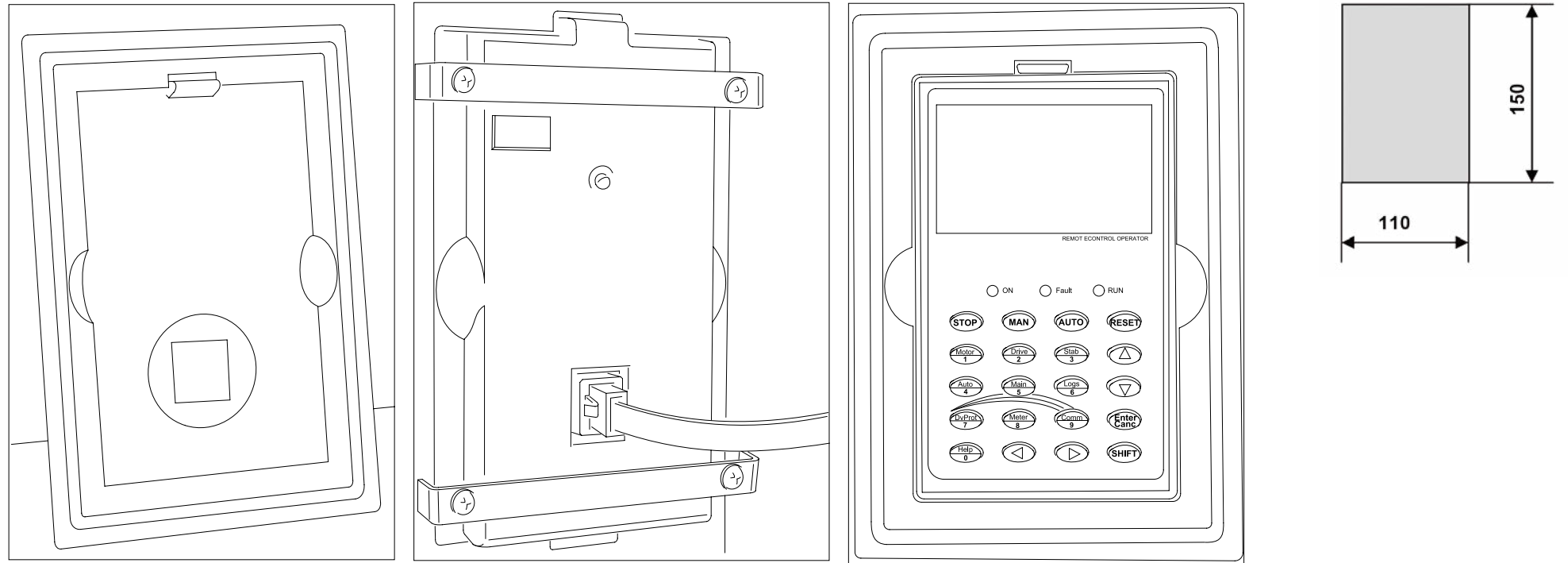
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Figure 6.3.1

Keypad installation shell.
The installation of the shell requires this slot on the electrical panel door.



Keypad degree of protection: IP54
Shell degree of protection: IP54 (with gaskets on the slot - code 1000072882 and on the connector hole - code 1000072881)

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6.4 STO (SAFE TORQUE OFF) FUNCTION

PRELIMINARY REMARKS

The STO function, certified with test report RP09DM4SN02 of 29/12/2009, is available for AD1000 both with System and Basis control board (excluding sizes AD1A0P3-022).

For a detailed description and instructions for use of the function to refer to the document:

SAFETY FUNCTION USER MANUAL INSTRUCTION:
"STO" SAFE TORQUE OFF FOR DRIVE GT3000/5000 AND GT LARGE

Number	Rev.	Date
MIM046	21	31/07/13

The conditions of use of the STO safety function are described in the above mentioned document, in accordance with IEC 60204-1 "Safety of machinery - Electrical equipment of machines" (EN 60204-1:2006-06), at paragraph 7 of IEC 61800-5-2: 2007 and in paragraph 11 of UNI EN ISO 13849-1:2008.

The "CE Declaration of Conformity" supplied with the safety function described above is valid only if all the conditions of use described in this document are observed.

This document is part of the "accompanying documentation" in compliance with the "Machinery Directive" 2006/42/EC and "Low Voltage" Directive 2006/95/EC and will be considered as part of the safety function itself.

6.5 IDENTIFICATION OF THE SAFETY FUNCTION

The components related to the "STO" function are factory-installed in the drive and their presence is identified by the suffix in the drive identification initials:

AD1	A	XXX	F	B	N	F	H	N	N	N	00	NN
1, 2, 3	4	5, 6, 7	8	9	10	11	12	13	14	15	16, 17	18, 19

Safe Torque Off Function

N = Not Installed
T = STO board installed



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6.5.1 FIELD OF APPLICATION

The STO safety function is designed to ensure the "SAFE TORQUE OFF" with asynchronous motors supplied by drive. If this function is active, in fact, the motor connected to the drive is no longer powered. The safety function is activated by two independent channels of different technology.

A first channel, via a safety relay, off the power of the electronic devices (drivers, photocouplers, optical fibres, buffers) that send the control pulses to the power section and in these conditions, even if the control electronics should generate command pulse, the power unit could no longer move the connected motor.

A second channel inhibits both the generation of the pulses by the microprocessor and their propagation to the control part.

The safety relay (RL1) has two contacts, one closing and one opening, mechanically connected to each other in such a way that also the fault status (e.g. welded contacts for closing and/or opening) cannot be closed or open at the same time. The NO (Normally Open) contact feeds the drivers and the NC (Normally Closed) acts as a signalling of the safety STO status by an external system.

The activation status of the second channel is signalled via a digital output of the microswitch that controls the relay RL2.

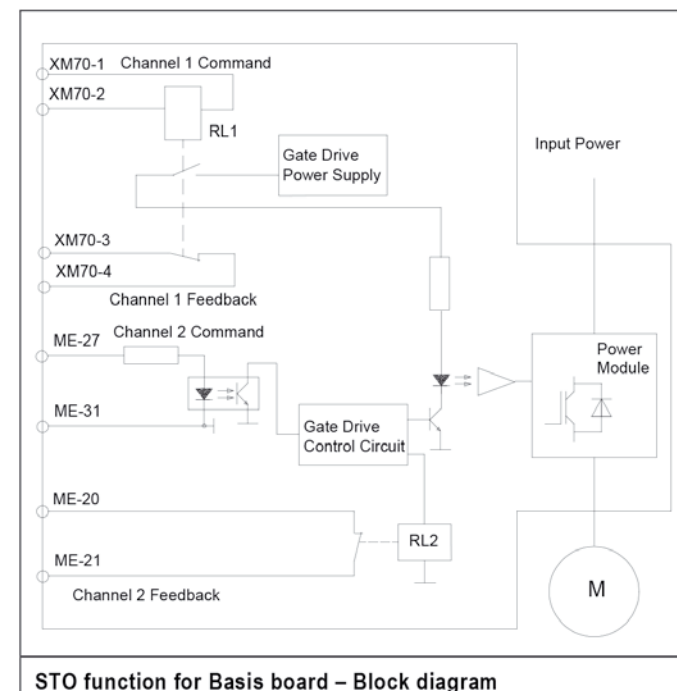
6.5.2 SAFETY FUNCTIONS AND RELATED LEVEL

The "STO" safety function is designed to prevent an unexpected motor starting. A motor stopped through the "STO" safety function can be put in the "SAFE TORQUE OFF" status. In this condition, even without electrical isolation between the motor and drive or between the network and the drive it is possible to perform mechanical work on the drive.



CAUTION!

- The terminals of the motor in the "SAFE TORQUE OFF" status are not isolated from the network and can be under hazardous voltage!
- The "STO" is expected to prevent the unexpected motor start-up, not to carry out the stop procedure: if activated with the motor rotation determines an uncontrolled stop. If an uncontrolled stop is not desired, it will be necessary, before activating the "STO", to make a stop sequence. The motor in the "SAFE TORQUE OFF" mode cannot generate torque. To ensure the blocking of the rotation with the load torque applied to the axis it is necessary to provide a mechanical brake.



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- There is a residual risk: with simultaneous fault of two IGBT units, the motor can be affected, until the intervention of the drive protections or the fuses, from a small rotation angle (corresponding to $360^\circ/2P$ P = number of pole pairs in the case of brushless motors, or to one slot pitch in the case of induction motors) despite the "SAFE TORQUE OFF" mode is active.

The STO function integrated in the subsystem represented by the PDS:

- complies with EN 60204-1:2006, paragraph 5.4 "Switch-off devices for prevention of unexpected start-up", but not with paragraph 5.3 "Power supply disconnecting device (insulation)";
- is suited for the realization of the stop function according to the second category stop 0 and 1 according to EN 60204-1, paragraph 9.2.2;
- can meet the safety requirements of the harmonized standard EN ISO 13849-1:2008 Category 3 PL "d" with regard to the restart interlock depending on the configuration shown in paragraph 2.4 of the document MIM046 rev.21;
- can meet the safety requirements of IEC 61800-52:2007 SILCL 2 in respect of the restart interlock depending on the configuration shown in paragraph 2.4 of the document MIM046.

To meet the safety requirements

- of UNI EN ISO 13849-1:2008 Category 3 PL d and IEC 61800-5-2:2007 SILCL 2 it is necessary to create an external safety circuit that respects:
 - the redundancy principle relatively to the activation inputs of the two channels in such a way that the single fault in any of these parts does not lead to loss of the safety function taking into consideration failures of common type; for this reason there are two separate and independent inputs;
 - the monitoring of the correct intervention of both channels; two external feedback contacts were provided for the two independent relays RL1 (safety) and RL2. Both are in the "open" status in normal operation and in the "closed" status when the STO function is activated: is it possible to control the external parity which provides the comparison between the two outputs. In case a fault is identified, it must be impossible to restore the circuit.

See paragraph 2.4 "Configuration" of the document MIM046 rev.21, for more information about:

- actions to be taken if a fault is detected;
- operation times;

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6.6 SINUSOIDAL FILTER

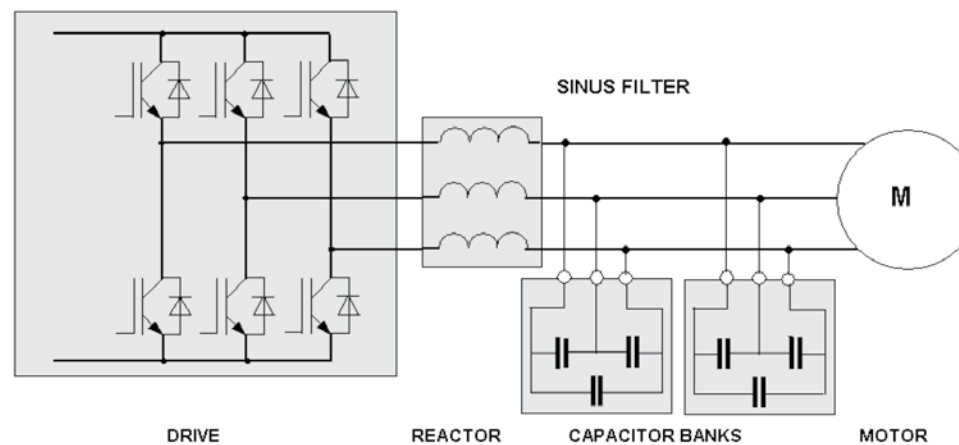
The sinusoidal filter, eliminating the high frequency components of the output voltage, allows to obtain an almost sinusoidal and without peaks voltage on the motor and, moreover, reduces the acoustic noise increase of the motor powered by the drive.

The sinusoidal filter is particularly suitable with motors that do not have a suitable degree of insulation for the drive power supply, motors of submersible pumps with long cables, motors in classified environment and applications with a transformer at the drive output.

It can be used only with scalar control (V / Hz) and is dimensioned for a switching frequency of 2 KHz (1.5 KHz for AD1A470F and AD1A940M) and for a maximum output frequency equal to 50Hz



Before connecting the drive to the motor, check that the current drawn by the capacitor bank of the LC filter to the drive output (detect the capacitance value from the functional diagram of the electrical panel) is less than 90% of the no-load current of the motor. It is necessary to check this condition to avoid the possibility of self-energizing of the motor, resulting in serious damage to both the machine and the operator.



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AD1000		Reactor							Capacitor bank
Series F		SAP code	Rated current	Leaks	Dimensions (mm)			Weight	SAP code
Cl.1	Cl.2		A	W	L	P	H	Kg	
	AD1A0P3F	1000075293	2,1	20	120	77	115	2,7	*3xELC20545904
AD1A0P3F	AD1A0P4F	1000075294	3,8	30	150	82	147	3,8	*3xELP20545901
AD1A0P4F	AD1A0P6F	1000075295	5,6	40	150	98	147	5,6	*3xELP20545902
AD1A0P6F	AD1A008F	1000075296	9,5	55	180	120	175	8	*3xELC20545903
AD1A008F	AD1A011F	1000075298	12	62	180	120	175	8,5	*3x2xELP20545902
AD1A011F	AD1A015F	1000075299	16	75	180	130	175	10,2	*3x2xELC20545903
AD1A015F	AD1A018F	1000075300	21	95	180	130	180	11	*3x4xELP20545902
AD1A018F	AD1A022F	1000075301	27	140	240	150	240	16	1x1000081653
AD1A022F	AD1A028FB/030F	1000075302	34	135	240	150	215	23	1x1000081653
AD1A28FB/030F	AD1A036F	1000075303	40	140	240	170	215	24,6	1x1000081652
AD1A036F	AD1A045F	1000075304	52	180	300	170	250	34	1x1000081651
AD1A045F	AD1A053F	1000075305	65	235	300	175	265	34,5	1x1000081651
AD1A053F	AD1A066F	1000075306		260	300	185	265	36	1x1000081651
AD1A066F	AD1A086F	1000075307	96	300	300	195	290	43	2x1000081652
AD1A086F	AD1A108F	1000075308	124	330	300	210	335	61	2x1000081652
AD1A108F	AD1A125F	1000075309	156	450	300	240	355	68	2x1000081651
AD1A125F	AD1A150F	1000075310	180	500	390	245	360	75	2x1000081651
AD1A150F	AD1A166F	1000075311	240	600	390	265	360	95	3x1000081651
AD1A166F	AD1A210F	1000075311	240	600	390	265	360	95	3x1000081651
AD1A210F	AD1A260F	1000075312	302	790	420	305	445	130	4x1000081651

* It is necessary to provide three resistors for the capacitors discharge.

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AD1000		Reactor							Capacitor bank
Series F		SAP code	Rated current	Leaks	Dimensions (mm)			Weight	SAP code
Cl.1	Cl.2		A	W	L	P	H	Kg	
AD1A260F	AD1A290F	1000075313	370	920	420	325	450	139	5x1000081651
AD1A290F	AD1A350F	1000075314	420	1020	480	330	480	155	5x1000081651
	AD1A370F	1000075314	420	1020	480	330	480	155	5x1000081651
AD1A350F	AD1A440F	1000075315	510	1160	480	345	480	175	7x1000081651
AD1A370F	AD1A480F	1000205149	540						7x1000081651
	AD1A520F	1000075316	620	1320	480	380	490	188	9x1000081651
AD1A440F		1000205150	640						10x1000081651
AD1A480F		1000205152	750						20x1000081652
AD1A520F		1000205152	750						20x1000081652

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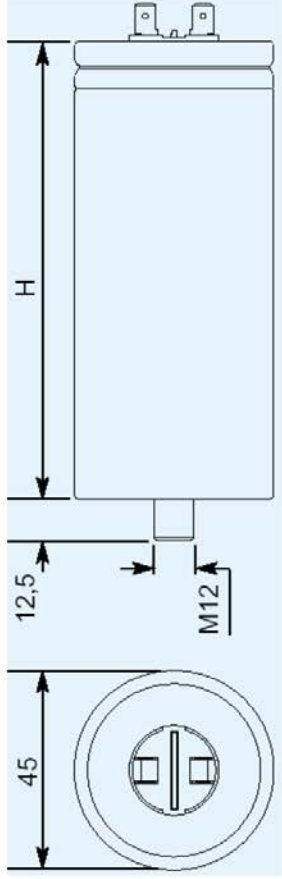
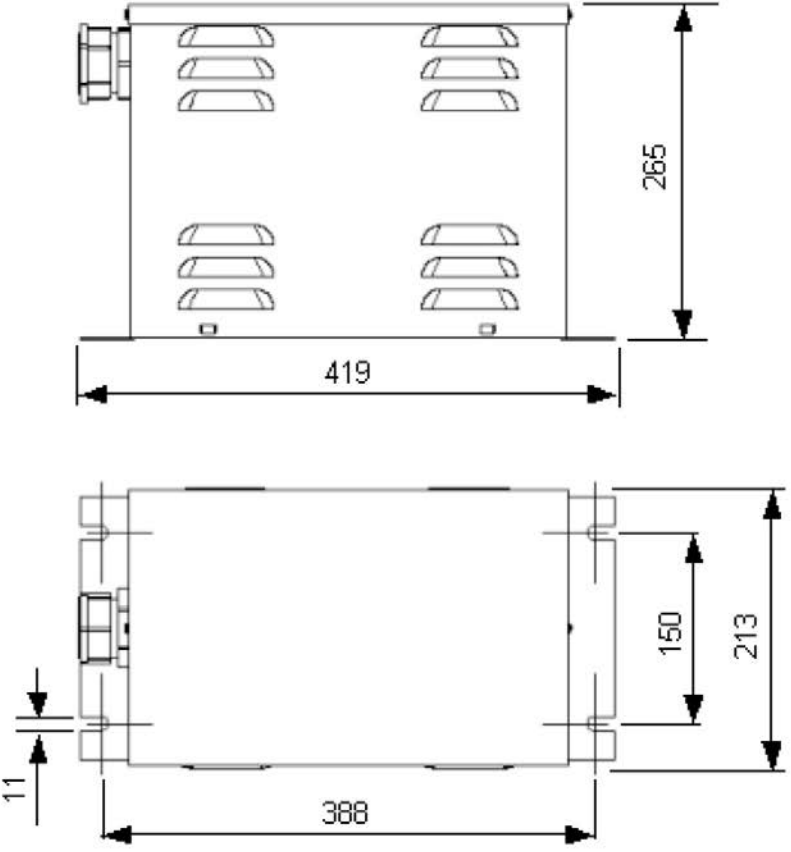
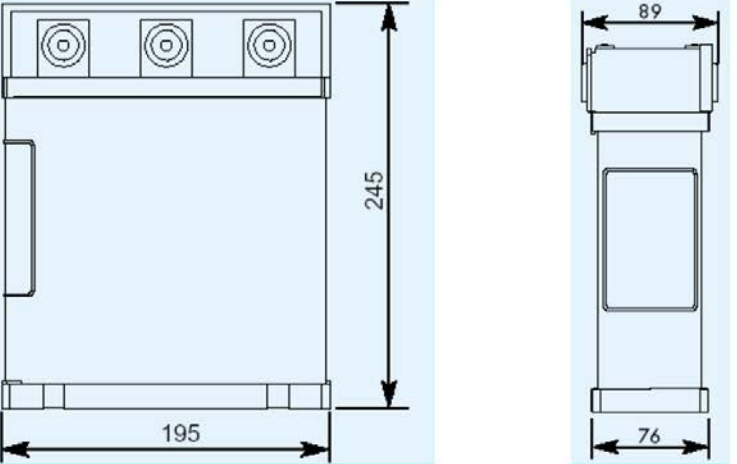
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Capacitor bank dimensions

<p>SAP Code ELC20545904 1 μF 1200V H = 72 SAP Code ELC20545901 1,5 μF 1200V H = 92 SAP Code ELP20545902 2,2 μF 1200V H = 100 SAP Code ELP20545903 3,3 μF 1200V H = 112</p>	<p>SAP code 22703505 3x70 μF 750V SAP code 22703504 3x56 μF 750V SAP code 22703503 3x42 μF 750V</p>
	
<p>SAP code 1000081651 26,3 μF 550V SAP code 1000081652 14,1 μF 750V SAP code 1000081653 11 μF 850V</p> <p>NOTE: The bank is made up of three-phase capacitor. Every bank is equipped with bars for connection with an other bank and resistors for capacitors discharge. These bars are suitable for a maximum of five parallel bank. If the capacitor bank is greater than five it is necessary to compose more group.</p>	

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7 PREVENTIVE MAINTENANCE

Preventive maintenance is the set of operations to preserve the AD1000 drive against wear phenomena and premature ageing. The criteria that inspires these operations programming are independent from preventing random failures, which still can occur.

The table lists the maintenance sheets, time intervals, and the operation to be performed.

TABLE 7.1.1 MAINTENANCE OPERATIONS SUMMARY

SYSTEM	SUBGROUP	OPERATION	CODE	TIME INTERVALS
Drive AD1000	-	Cleaning	AD1000-PM001	1 month
Drive AD1000	Boards	Cleaning	AD1000-PM002	1 month
Drive AD1000	Jumper	Check	AD1000-PM003	6 months
Drive AD1000	Radiator	Cleaning	AD1000-PM004	1 month
Drive AD1000	Fans	Cleaning	AD1000-PM005	3 years after first installation and then every year
Drive AD1000	Capacitors	Formatting	AD1000-PM006	-

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7.1 AD1000 - PM001 DRIVE

SUBGROUP	OPERATION	SPECIAL TOOLS, INSTRUMENTS AND MATERIALS	PRESCRIPTIONS	TIME INTERVALS	PRECEDENCE
	Cleaning	Vacuum cleaner	Carry out the safety operation specified in chapter 4	1 month	



The drive must be kept clean, dry and with tight connections. Dust on the drive hardware can cause insufficient ventilation resulting in reduced performance of the heat sink and fans. Dust in an electronic device can cause malfunctions and even failures. Dust absorbs moisture which increases the chances of failure. The air used to remove dust must be free of oil and dry.

1. Temperature changes and mechanical vibrations may cause a poor tightening of the connections.

2. A screw has a maximum clamping capacity in correspondence to a tightening torque value, determined by its size, shape and material; overcoming such a torque value permanently reduces the elasticity of the screw deforming it and reducing its clamping capacity.

3. Check that:

- the cables are not damaged;
- the terminals are tight;
- the ambient temperature of the drive and of the motor do not exceed the recommended specifications;
- the boards are free from dust and condensation;
- the insulation is not damaged or discoloured;
- vents or areas close to the drive fans are not blocked.

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7.2 AD1000 - PM002 DRIVE

SUBGROUP	OPERATION	SPECIAL TOOLS, INSTRUMENTS AND MATERIALS	PRESCRIPTIONS	TIME INTERVALS	PRECEDENCE
Boards	Cleaning	Vacuum cleaner	Carry out the safety operation specified in chapter 4	1 month	

The electronic boards do not require particular maintenance interventions.

Periodically remove dust without using compressed air as components sensitive to electrostatic discharge are installed on the boards.

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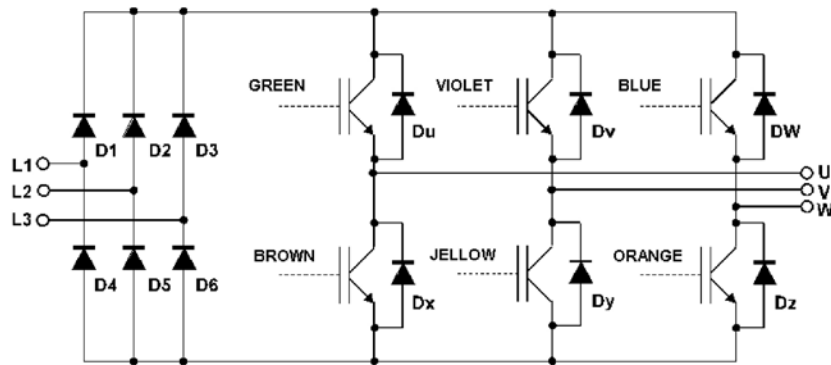
7.3 AD1000 - PM003 DRIVE

SUBGROUP	OPERATION	SPECIAL TOOLS, INSTRUMENTS AND MATERIALS	PRESCRIPTIONS	TIME INTERVALS	PRECEDENCE
Jumper	Check	Digital multimeter	Carry out the safety operation specified in chapter 4	6 months	

The tool required for this operation is a digital multimeter set to "diodes test"

Check the diodes and the IGBTs after disconnecting the power supply cables to prevent false readings due to external components.

Multimeter + test prod	IGBTs						INPUT BRIDGE					
	U	V	W	-Vc	-Vc	-Vc	L1	L2	L3	-Vc	-Vc	-Vc
Multimeter - test prod	+Vc	+Vc	+Vc	U	V	W	+Vc	+Vc	+Vc	L1	L2	L3
Device	Du	Dv	Dw	Dx	Dy	Dz	D1	D2	D3	D4	D5	D6
Correct value	0.25 ± 0.4 Vdc						0.35 ± 0.5 Vdc					



The first operation is a visual check, then follow this sequence:

Optical fibers cable test

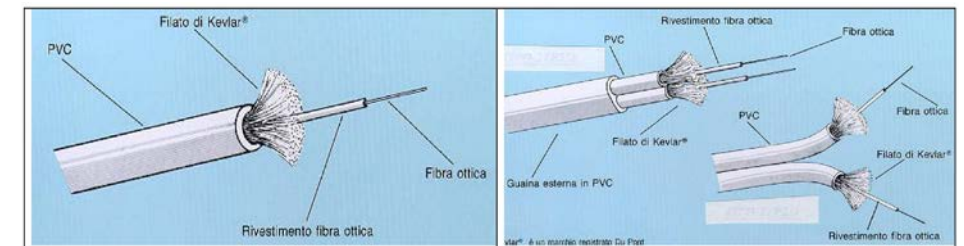
If there is a malfunctioning of the data transmission by optical cable, two situation are possible:

- Optical cable broken
- Malfunctioning of the data transmitter/receiver

To verify the optical cable it is necessary to do the following test:

Remove the optical cable connection and light one end by a flash-light or similar device, if the light is visible on the other end, the optical cable is not interrupted.

NOTE The above-mentioned test may be not enough, in this case a dedicated device is necessary.



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7.4 AD1000 - PM004 DRIVE

SUBGROUP	OPERATION	SPECIAL TOOLS, INSTRUMENTS AND MATERIALS	PRESCRIPTIONS	TIME INTERVALS	PRECEDENCE
Radiator	Cleaning	Vacuum cleaner	Carry out the safety operation specified in chapter 4	1 month	

1. Shut down the equipment by removing the power supply.
2. Access the radiator.
2. Remove dirt on the outside.
3. Remove dirt from the radiator using an industrial vacuum cleaner.
4. Remove obstructions and/or impurities.
6. Restore the power supply.

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7.5 AD1000 - PM005 DRIVE

SUBGROUP	OPERATION	SPECIAL TOOLS, INSTRUMENTS AND MATERIALS	PRESCRIPTIONS	TIME INTERVALS	PRECEDENCE
Fan	Cleaning	Vacuum cleaner	Carry out the safety operation specified in chapter 4	1 month	

1. Shut down the equipment by removing the power supply.
2. Access the radiator.
2. Remove dirt on the outside.
3. Remove dirt from the radiator using an industrial vacuum cleaner.
4. Remove obstructions and/or impurities.
6. Restore the power supply.

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7.6 AD1000 - PM006 DRIVE

SUBGROUP	OPERATION	SPECIAL TOOLS, INSTRUMENTS AND MATERIALS	PRESCRIPTIONS	TIME INTERVALS	PRECEDENCE
Capacitor	Cleaning	Vacuum cleaner	Carry out the safety operation specified in chapter 4	1 month	

1. Shut down the equipment by removing the power supply.

NOTE

The **F series** is fitted with electrolytic filter capacitors. Assuming that there is an average temperature of 35°C with 20 hours of operation per day, the average life of the electrolytic capacitors is about 5-6 years.

The **K series** is fitted with maintenance-free metallized polypropylene capacitors. Assuming an average temperature of 35°C and a working time of 20 hours a day, the average life of these capacitors is about 100,000 hours. In general capacitors (rated voltage = 900Vdc) may be stored for three years at temperatures up to 50°C without any reduction of their reliability. After a prolonged storage period, the leakage current value can exceed the rated value and a re-anodizing procedure is required prior to its use. It can be performed by applying the rated voltage, at room temperature, for one hour.

In any case it is advisable to use a maximum charging current value of 5mA or equal to two times the typical value specified for each series. The CAPACITORS FORMATTING procedure is explained below: Electrolytic capacitors retain their original features only if they are powered up within 1 year from the date of delivery. Yearly reformatting guarantees the immediate availability of the drive stored and, therefore, its prompt replacement in case of a possible drive failure. The use of an drive with unformatted capacitors can cause the capacitors and drive failure. The reformatting methods and the following instructions assume that the drive has been stored in a clean environment with no humidity. To determine the age of the drive, see the test date on the label of the drive as shown below.

<table border="1" style="width: 100%;"> <tr> <td style="width: 20%;">TYPE</td> <td style="width: 80%;"></td> </tr> <tr> <td>N°</td> <td style="text-align: right;">DATE</td> </tr> </table>	TYPE		N°	DATE	<p>Test date (Month – Fiscal year)</p> <p>A= Genuary 08=2008</p> <p>B= February</p> <p>.....</p> <p>G= August</p>
TYPE					
N°	DATE				

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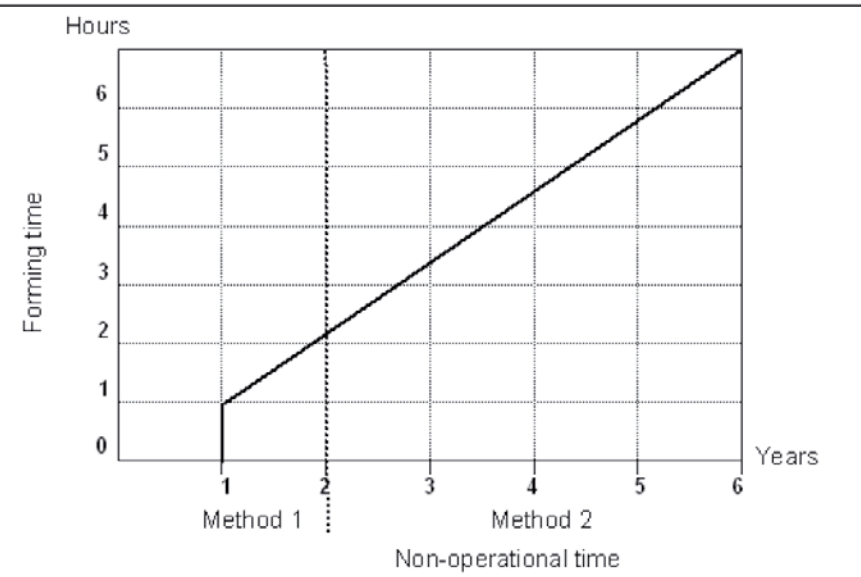
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7.6 AD1000 - PM006 DRIVE

Reforming time

The converter is kept at a safe voltage during the reforming time required to “wake up” the capacitors. The reforming time required depends on how long the converter has been stocked (non-operational):

Figure 7.1



METHOD 1

Drive stored (not operating) for less than two (2) years: Supply power to the drive for the time shown in Figure 7.1. The drive reformats its capacitors by itself.

Drives stored (not operating) for more than two (2) years: Use the method 2A or 2B (see figures below).

METHOD 2A

Power the DC bus of the drive with a three-phase diode jumper in series with a charge resistor as shown in Figure 7.2. (P = Rectifier; R = Charge resistor ; C = Capacitor). Refer to Figure 7.1 for the formatting time.



In the formatting phase the drive must be disconnected from the power supply network.

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METHOD 2B

A DC power supply source is required to be connected to the DC bus of the drive. The suitable reformatting voltage value is $(1.35 \dots 1.41) \times V_x$. The DC source charges the capacitors of the drive and must be able to limit the current to values $\leq 500\text{mA}$; if not, it is necessary to install a resistor (R) for limiting the charging current. Refer to [Figure 7.1](#) for the formatting time.

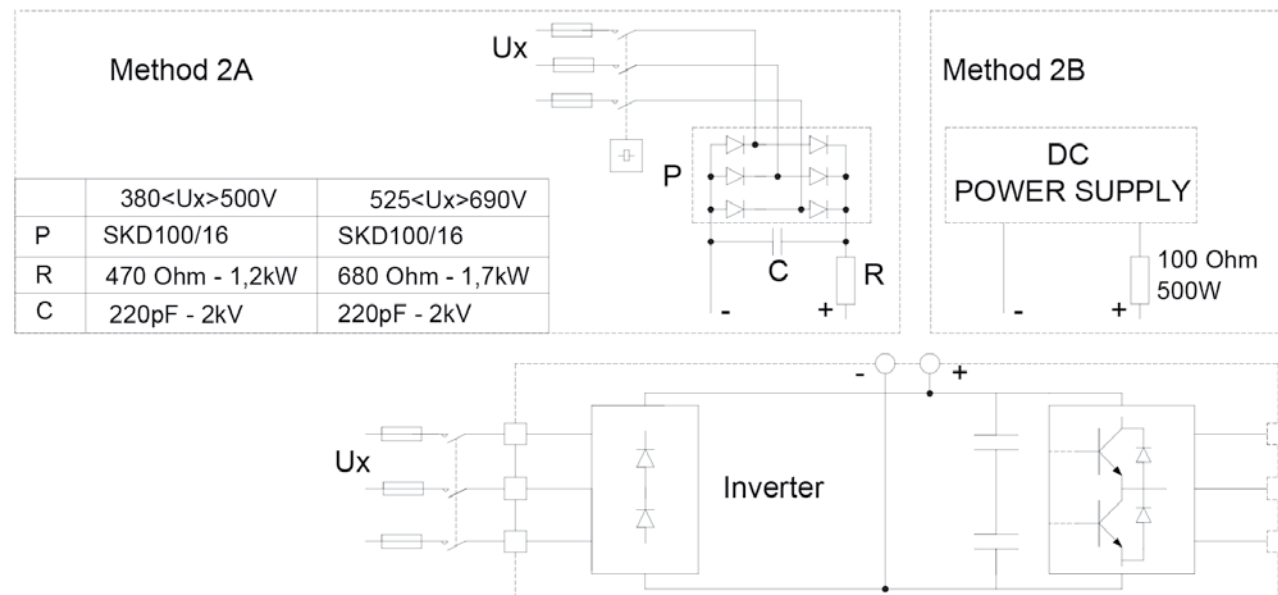
MAINTENANCE OF DRIVES READY FOR PRODUCTION

The annual formatting process of the drives in stock or not used ensures that they are always ready to deliver the maximum performance and provide the operating parameters originally set in the drive. Failure to carry out this maintenance procedure may, in the worst case, lead to the failure of the capacitors and of the drive. For more information, contact the Service department of Nidec ASI S.p.A.



In the formatting phase the drive must be disconnected from the power supply network.

Figure 7.2



Nidec
All for dreams