

AD1000

User and Maintenance Manual



AD1000

Answer Drives 1000 Voltage Source Drive

User and Maintenance Manual

Code: IMAD10002EN
Revision: Rev. 01
Date: 1st June 2016
Language: English
Translation of the Original
Instructions

DOCUMENT REVISIONS

Revision	Date	Notes
00	30th July 2015	First issue
01	1st June 2016	General update

For further information, go to: nidec-answerdrives.com

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MANUFACTURER

ANSWER DRIVES 1000 was built at the Nidec ASI S.p.A. plant in Montebello (VI) - Italy



MANUFACTURER'S ADDRESS

For any type of information regarding use, maintenance, installation, customer assistance at the customer's premises, ordering spare parts, etc. contact the closest Nidec customer assistance centre.

The manufacturer is always available to satisfy the purchaser/customer's requests for any type of information or clarification on use, maintenance, installation, etc.

It is important for the purchaser/customer to ask questions referencing this manual, always indicating the data found on the AD1000 identification plate.

Further information on the product can be found at nidec-answerdrives.com

WARRANTY AND LIMITATION OF LIABILITY

Refer to the order acceptance for the warranty period and conditions.

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

The manufacturer is not liable for damages or consequences due to inappropriate, negligent or improper drive installation, incorrect drive operating parameter setting, installation in a dusty location, with corrosive substances, with excessive vibrations or operating temperatures exceeding the nominal data.

The customer must always purchase original spare parts, under penalty of voiding the warranty.

The manufacturer declines all liability due to incorrectly or improperly using the system, using non-recommended spare parts and tampering with the circuits and system components.

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

- Incorrect use or for different purposes to those for which it was built
- Incorrect incorporation/installation in machine, system or equipment for which it was intended.
- Failure to comply with the installation/incorporation rules stated in this Manual
- Use by unqualified or unauthorised personnel
- Defects in the electrical, hydraulic, pneumatic and water supplies (if any)
- Failure to comply with the technical specifications concerning the power supplies listed in chapter 2 of this Manual
- Missing or insufficient periodic maintenance
- Modifications or interventions on the equipment not agreed upon with or authorised by the Manufacturer
- Using non-original spare parts or, in any case, different spare parts to those specified
- Total or partial non-compliance with the instructions contained in this Manual.

Following the safety rules listed hereinafter is the responsibility of whoever plans and manages the tasks expected for the AD1000, who must make sure that authorised personnel:

- are qualified to perform the requested activities
- know and carefully follow the rules in this Manual
- know and apply all general and specific safety rules applicable to the AD1000.

Failure to follow the safety rules may cause injuries to personnel and damage the AD1000.

INTRODUCTIONS AND WARNINGS FOR THE PURCHASER

This manual contains all the information regarding the Low Voltage variable frequency Drives of the AD1000 product family, with 0.75-450kW power and 380/480V voltages.

The User and Maintenance Manual, along with the Declaration of Incorporation, is an integral part of the AD1000 and must always accompany it; it is the integrator and user's duty to keep these documents in order and in good condition throughout the entire lifespan of the AD1000.

The manual must be consulted before any of the operations listed below:

- Lifting, transport, positioning, moving, storage;
- Installation, first start-up, commissioning, use
- Maintenance, cleaning, adjustments and calibrations;
- Repairs, replacements, consumables, technical support;
- Demolition.

**HAZARD**

Read this Manual very carefully before commissioning, using and performing any type of maintenance on the AD1000, in order to be able to strictly follow the instructions herein. All users must read and understand the instructions in this Manual.

**HAZARD**

Answer Drives 1000 is designed to be incorporated into a complete equipment/system. Refer to the equipment/system manual to obtain all the information relating to it and the safety rules on using the complete equipment/system. Using the AD1000 before having read and understood the instructions in this manual and the manual of the equipment/system incorporating the AD1000 is strictly prohibited.

Customers can request training courses for their personnel from Nidec ASI, with the purpose of guaranteeing appropriate knowledge of the AD1000 and of the rules for proper incorporation, integration, use and maintenance.

**NOTE**

This manual must stay with the system for its entire life cycle. Keep this manual and all the attached documents in place that can be accessed by all personnel in charge of running and servicing the system. This manual is an essential part of the system and contains information to ensure that all personnel that use it can work safely and ensure it functions efficiently for its entire life cycle.

You can ask the manufacturer for a copy of the User and Maintenance Manual in case of loss or destruction, specifying the exact model, serial number and year of manufacture.

This manual reflects the state-of-the-art at time of supply. The manufacturer reserves the right to modify the product without having to upgrade the previous Equipment and Production manual.

This manual provides all information necessary to incorporate/install, commission, use and service the AD1000.

The manual is intended for personnel in charge of incorporating/installing, commissioning, using and servicing the AD1000.

USER AND MAINTENANCE MANUAL

Read this manual carefully in full before incorporating/installing, commissioning, using and servicing the AD1000.

The user and/or integrator of the AD1000 and of its User and Maintenance Manual must know and be able to use the basic principles of electrical engineering and physics, the practice of electrical wiring, the symbols used in wiring diagrams, the safety rules and must be experienced in using Low and Medium Voltage electrical equipment.

Even thoroughly reading this manual cannot, in any way, replace the fact that authorised personnel in charge of incorporating/installing, using and servicing the AD1000 must have adequate experience and have been properly trained.

The user and/or integrator can contact the manufacturer at any time to request further information to what is contained in this manual or to propose improvements.

This manual, along with the programming manual and the job order documents, makes up all the documents that the user or integrator must know and apply.

In order to guarantee maximum operating reliability, the manufacturer has carefully chosen the materials and components used to manufacture the AD1000, performing a series of rigorous checks and tests before shipment.

Proper AD1000 operation over time depends on correct use and on adequate maintenance, following the instructions listed in this manual and in the documents provided.

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

For further details on the definition of experienced person and designated person, refer to the EN 50110-1 standard.

To properly integrate and use the AD1000 inside the final equipment/machine/system (not supplied by the manufacturer and not described in this manual), it is assumed that the work environment is suitable and complies with the laws in force with regard to health and safety.

The information contained in this manual must only be used as a guide and does not constitute any sort of contract.

Manual updates are available at nidec-answerdrives.com

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Duplicating or transmitting this manual in any form or by any means, including photocopies, recordings or using storage or data retrieval systems is prohibited without written consent from the editor.

SAFETY RULES IN THE MANUAL

The purpose of the rules, instructions and notes concerning safety that are described in the different chapters of this Manual is to define a series of behaviours and obligations to respect in executing different activities, in order to work in safe conditions for personnel, the equipment and the surrounding environment.

The written safety rules are intended for all authorised and trained personnel who will perform the various tasks and operations relating to the AD1000 in the different phases of its use:

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



HAZARD

Even thoroughly reading this manual cannot, in any way, replace adequate experience and appropriate training of personnel in charge of tasks on the AD1000.



ADDITIONAL INFORMATION

Only expressly qualified personnel, according to the EN 50110-1 standard, can perform tasks on the AD1000.



ADDITIONAL INFORMATION

Chapter 4 of this manual includes the instructions for personnel operating on the AD1000.

SYMBOLS USED

This Manual uses some symbols to attract the reader's attention and to highlight some particularly important aspects of the instructions.

The following Table describes the meaning of the different symbols used.



HAZARD

Indicates a hazard with a risk of injury, even death, for the user. Pay the utmost attention to the parts of text highlighted by this symbol.



WARNING

Indicates a warning of possible damage or deterioration of the AD1000, the equipment and other objects belonging to the user. Pay attention to the parts of text highlighted by this symbol.



WARNING, NOTE

Indicates a warning or a note regarding key functions or useful information. Pay attention to the parts of text highlighted by this symbol.

**ADDITIONAL INFORMATION**

Indicates the parts of text containing additional information. This information is not directly related to functions or procedures. It can be references to additional documents, such as annexes or Manuals or technical documents, or to other sections in this Manual.

**AVOID DAMAGING THE MATERIALS**

Indicates a high risk of damaging a part, for example, by using an incorrect tool or carrying out an operation with the wrong procedure.

**SPECIAL TOOL**

Indicates that a special tool or equipment is required.

**VISUAL OBSERVATION**

Indicates that the user must perform a visual observation: the user is requested to read a measured value, verify a warning, etc.

**HEARING OBSERVATION**

Indicates that the user must perform an auditory observation: the user is requested to listen to the operating noise.

SAFETY SYMBOLS**DANGER OF CRUSHING LIMBS**

Indicates a hazard with the risk of injury for the integrator/user or personnel in charge. Pay the utmost attention to the signs and areas where this symbol appears.

**DANGER OF MOVING PARTS**

Indicates a hazard in area(s) where there are moving parts.

The integrator/user or personnel in charge must pay the utmost attention to signs and areas where this symbol is present and respect the safety distances.

**DANGER OF DANGEROUS VOLTAGE**

Indicates a hazard with the risk of even fatal injury for the integrator/user or personnel in charge. Pay the utmost attention to signs and areas where said signs are present and do not access the areas so marked unless such area, or the components object of said sign, have been previously de-energised.

**DO NOT REMOVE THE PROTECTIVE GUARDS**

Indicates that the integrator/user or personnel in charge is prohibited from removing the protections installed on the partly-completed machine.

Running the partly-completed machine without the supplied protective guards is strictly prohibited. Pay the utmost attention to the signs and areas where this symbol appears.

**DO NOT SMOKE OR USE OPEN FLAMES NEAR THE PARTLY-COMPLETED MACHINE OR MOTORS, ELECTRICAL CONTROL UNITS.**

Indicates the integrator/user or personnel in charge is prohibited from smoking or using open flames near the partly-completed machine, motors or electrical control units and, in any case, in any area where this sign is present. All prohibitions in force in the country where the partly-completed machine is used and in-house plant or establishment regulations set out by the employer remain valid.

**NO UNAUTHORISED ACCESS**

Indicates the integrator/user or personnel in charge is prohibited from approaching and going past the area where this sign is present. Pay the utmost attention to the signs and areas where this symbol appears.

**NO MANOEUVRES FOR WORK IN PROGRESS**

Indicates the integrator/user or personnel in charge is prohibited from activating/powering the partly-completed machine for work in progress on said machine or on its components.

Pay the utmost attention to the signs and areas where this symbol appears

**DO NOT DIRECT JETS OF WATER TOWARDS ELECTRICAL EQUIPMENT.**

Indicates that using or directing jets of water towards electrical equipment and, in any case, in all areas where this sign is present is prohibited.

**ENTANGLEMENT HAZARD**

Indicates a hazard with the risk of injury for the integrator/user or personnel in charge. Using suitable clothing such as shoes, overalls, gloves, etc. is mandatory.

Pay the utmost attention to the signs and areas where this symbol appears.

**SHEARING, CUTTING HAZARD**

Indicates a hazard with the risk of injury for the integrator/user or personnel in charge. Using suitable clothing such as shoes, overalls, gloves, etc. is mandatory.
Pay the utmost attention to the signs and areas where this symbol appears.

**DANGEROUS TEMPERATURE**

Indicates a hazard with the risk of injury for the integrator/user or personnel in charge. Using suitable clothing such as shoes, overalls, gloves, etc. is mandatory.
Pay the utmost attention to the signs and areas where this symbol appears.

**HIGH TEMPERATURE HAZARD**

Indicates a hazard with the risk of injury for the integrator/user or personnel in charge. Using suitable clothing such as shoes, overalls, gloves, etc. is mandatory.
Pay the utmost attention to the signs and areas where this symbol appears.

**DEVICES SENSITIVE TO ELECTROSTATIC DISCHARGES**

Indicates a hazard with risk of damaging the equipment and/or people as a result of the presence of electrostatic discharges. Using PPE (such as cuffs for grounding) when handling electrical/electronic boards or equipment where this symbol is present is mandatory. However, always avoid touching the boards unless strictly necessary.

TERMS AND ACRONYMS USED

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

Anyone who is entirely or partially in a dangerous area.

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

Using the partly-completed machine in compliance with the information supplied in the instructions for use.

DANGEROUS AREA: (Annex I, 1.1.1-b Directive 2006/42/EC).

Any area inside and/or near the partly-completed machine where the presence of an exposed person constitutes a health and safety risk for that person.

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

Combination of probability and seriousness of an injury or harm to health that could occur in a dangerous situation.

RESIDUAL HAZARDS: (Ref. EN 12100)

Hazard that has not been possible to eliminate or reduce through the design, against which the protections are not (totally or partially) efficient. The Manual (Chap. 4) describes the residual risks and information, instructions and warnings/prescriptions to manage the Residual Risks that must be borne by the user.

PROTECTION DEVICE: (Annex I, 1.1.1-g Directive 2006/42/EC). Device (different from a guard) that reduces the risk, on its own or associated to a guard.

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

Element of the partly-completed machine used specifically to guarantee protection through a physical barrier.

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

Assemblies that almost constitute a machine but that, on their own, are unable to guarantee a well-determined application. A drive system is a partly completed machine.

Partly-completed machines are solely intended to be incorporated or assembled with other machines or other partly-completed machines or appliances to form a machine in accordance with Directive 2006/42/EC.

WARRANTY

The general conditions are stated in detail in the Contract of Sale.

However, in more general and valid terms, it is highlighted that:

- Nidec ASI S.p.A. is not liable for damages or malfunctions in case of lack of maintenance, unauthorised replacement of equipment parts with non-original spare parts and different use of the AD1000 to that set out in this User and Maintenance Manual.
- The warranty does not cover any and all liability for direct or indirect damages to people and property deriving from incorrect use, installation/integration not complying with the instructions in this manual and in the Standards to which this manual refers and in the event of incorrect AD1000 maintenance.

AD1000 MANAGEMENT

Only experienced and qualified personnel with adequate knowledge in the electrical, electronic and mechanical fields, who are authorised and duly trained and are aware of all the risks regarding low and medium voltage equipment can manage the AD1000, which includes incorporation/installation, operation, use, maintenance, cleaning, disassembly and dismantling.

Personnel in charge of incorporation/installation, operation and maintenance of the AD1000 must be aware that knowing and applying the safety rules is an integral part of their tasks.

The definition of an experienced person and of a designated person for managing the electrical systems is as per the EN 50110-1 standard, to which reference must be made for further details.



In accordance with the EN 50110-1 standard, unauthorised and unqualified personnel cannot access the area where the AD1000 is installed

Perform the following operations before starting to use the AD1000:

- Read this User and Maintenance Manual and the related documentation carefully
- Make sure the AD1000 is fully incorporated/installed in the equipment or system for which it is intended
- Make sure all of the necessary safety devices are present to ensure the equipment/system conforms with the instructions of the applicable Directives
- Know which safety devices and protections have been provided and are available in the AD1000, with their position and function inside the equipment.

Do not start the AD1000 unless the equipment/system/machinery into which it must be incorporated or installed has been declared in compliance with the rules of Machinery Directive 2006/42/EC and of the Directives applicable to the equipment/system/machinery in its entirety.



WARNING

The various safety devices and systems are listed in chapter 4.



HAZARD

Disconnecting or partially removing the safety protections positioned to protect against dangerous parts is prohibited.

Removing any danger, caution, prohibition, notice signs is prohibited.

Opening the electrical panels while they are operating or immediately after power has been disconnected is strictly prohibited. Wait at least 10 minutes before opening the electrical panels after having disconnected power.

All of the safety and protection devices must be maintained fully efficient in order to ensure they work properly. They must be immediately repaired or replaced by the after-sales assistance centre in case of damage or malfunction.

1 INSTALLATION OVERVIEW AND DIAGRAM

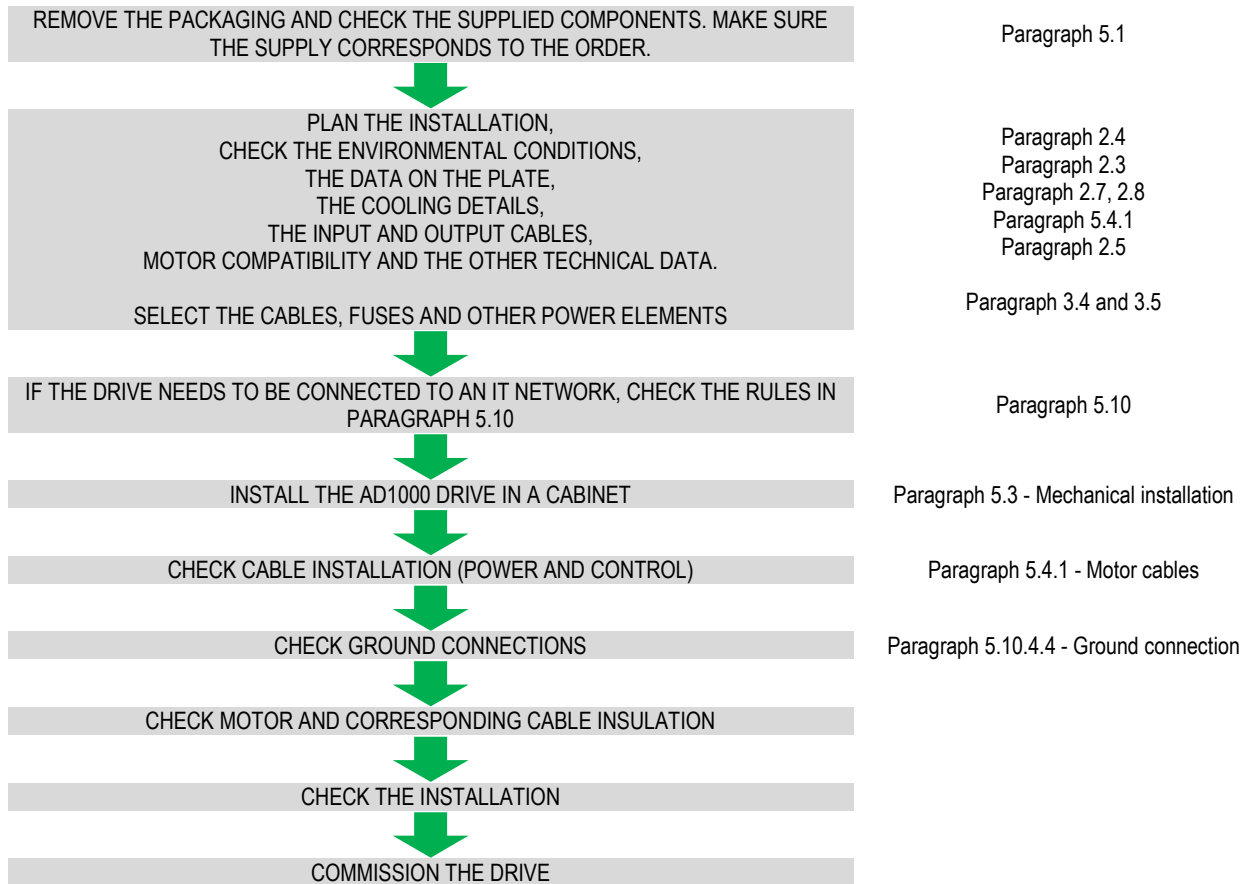
1.1 Overview

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

The AD1000 drive is designed with today's pump system requirements in mind. The AD1000 drive's 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.

1.2 Installation diagram



2 TECHNICAL DATA

2.1 Notes on control methods

V/f Scalar control	Scalar control with Sensorless Vector V/f performance
Voltage-Frequency regulation with constant or variable ratio	Voltage-Frequency regulation with constant or variable ratio, with torque current control
Voltage boost	Good static and dynamic performance
Open loop regulation	Open loop regulation
Frequency regulation field: 1:15	Speed regulation field: 1:15
Frequency resolution: 0.05 Hz (typical)	Speed resolution: 0.05 Hz (typical)
Slip compensation	Static accuracy of typical speed: 0.4 x fslip %
Output current control	Output current control
	Response on torque control: 5 ms

The AD1000 drive can control the motor in two different ways:

- a. Scalar V/f: for simple applications without speed feedback.
- b. Sensorless Vector V/f: for applications that require more dynamic performance and accuracy and without speed feedback.

2.2 Identification abbreviation

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-cooled												
Rated power (kVA) (see electrical data table)												
Input voltage		F = 380-480Vac ±10%										
Control board		B = Basis board										
Dynamic braking		N = Not installed										
		B = Installed										
Internal RFI filter		N = Not installed										
		F = Installed										
Keypad		H = Installed										
Communication expansion		N = Not installed										
		P = Profibus and Modbus TCP (ETH-PROFI)										
Expansion board		N = Not installed										
		A = Analogue input, digital input and Real Time Clock (GIABA) expansion										
		B = Analogue input, digital output and Real Time Clock (GIABB) expansion										
Safe Torque function Off		N = Not installed										
		D = STO Single Channel board installed (up to frame 028F)										
		T = STO board installed (from 030F)										
External power supply		00 = Not installed										
		10 = Control board external power supply (24Vdc)										
Carriage (only for VIII frame)		NN = Not installed										
		CN = Carriage installed										
		CR = Carriage with output reactor installed										

NOTES:

- Each different Identification Code configuration corresponds to a different SAP code.
- STO Function:
 - For frames up to 028F, the STO function requires an external contactor on the main AC line (letter D in field 15).
 - For frames starting from 030F, the function is entirely carried out inside the drive (letter T in field 15).
 - The STO option must be defined before ordering the inverter (factory installed and tested).
 - When the STO function is installed, the DO3 relay programmable digital output is no longer available.
- Dynamic Braking:
 - The braking switch is always integrated from frame 0P3F to frame 036F;
 - From frame 045F to frame 290F the internal braking switch is optional;
 - From frame 350F to frame 520F the internal braking switch is not available.
- Internal RFI filter:
 - The RFI filter is optional for drives up to frame 028F;
 - The RFI filter is standard for drives from frame 030F to 520F;

2.3 Plate

The following figure shows an example of a plate that is on all AD1000 family drives, which shows the nominal drive data.


AD1000 AC POWER SUPPLY			
TYPE	AD1A520FBNFHNNN00NN		1
N°	16A00133	DATE 16/01	2-3
INPUT			
380/480V	50/60 Hz	3 PH	4-5-6
750 A	42kA Mains s.c.curr.		7-8
AUXILIARY INPUT			
230V	50/60 Hz	1 PH	9-10-11
2.5 A	Ext. Mag. Th. Switch		12-13
CAPACITY	520 kVA @400V		14
0 - 480 V	0.1-200 Hz	3 PH	15-16-17
400V CLASS		460V CLASS	
NORMAL DUTY (VT or CL1)	450 kW	650 HP	18-19
	750 A		20
HEAVY DUTY (CT or CL2)	315 kW	500 HP	21-22
	585 A		23
Ta 0°C to 40°C			24
			25
CODE 1000198983			
Nidec ASI SpA Montebello Vicentino ITALY			

Figure 2.1 Plate

- | | |
|----------------------------------------------|-----------------------------|
| 1. Drive type | 14. Output power [kVA] |
| 2. Serial number | 15. Output voltage |
| 3. Production/testing date | 16. Output frequency |
| 4. Input voltage | 17. Number of output phases |
| 5. Input frequency | 18. kW motor power (Cl.1) |
| 6. Number of input phases | 19. HP motor power (Cl.1) |
| 7. Input current | 20. Output current (Cl.1) |
| 8. Maximum symmetrical short circuit current | 21. kW motor power (Cl.2) |
| 9. Auxiliary voltage | 22. HP motor power (Cl.2) |
| 10. Auxiliary voltage frequency | 23. Output current (Cl.2) |
| 11. Number of auxiliary voltage phases | 24. Operating temperature |
| 12. Auxiliary voltage rated current | 25. SAP code |
| 13. Notes | |

2.4 Admissible environmental conditions

Table 2.4.1 Admissible environmental conditions

Operation: Operate in a stable environment that is protected from the elements 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 current by 1% for every °C (1.8°F). (max. 55°C – max. 131°F)
Relative humidity	From 5 to 95% without condensate
Contamination levels	Painted 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. Over 1000 m (3280 ft) above sea level, the rated output current must be reduced by 1% for every additional 100 m (328 ft). Maximum height 3000 m (9840 ft)
Vibrations	Max. 0.3 mm (0.012 in) (from 2 to 9 Hz), max. 1 m/s ² (3.28 ft/s ²) (from 9 to 200 Hz) sinusoidal (Class 3M1)
Environmental notes	<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 protective packaging in a protected location according to IEC 721-3-1.

Environmental temperature	From -25°C to +70°C (From -13°F to +158°F)
Relative humidity	Max. 95% at 40°C (Max. 95% at 104°F)
Altitude	Up to 1000 m (3300 ft)
Atmospheric pressure	From 70 to 106 kPa
Vibrations	Max 1.5 mm (0.06 in) (from 2 to 9 Hz), max. 5 m/s ² (16.4 ft/s ²) (from 9 to 200 Hz) sinusoidal (Class 1M3)
Shock	Max 100 m/s ² (330 ft/s ²), 11 ms (36 fts) (Class 1M3)
Contamination levels	Painted boards - Chemical gases: IEC 721-3-3, class 1C2 Solid parts: IEC 721-3-3, class 1S3
Environmental notes	<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

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

Environmental temperature	From -25 to +70°C (From -13°F to +158°F)
Relative humidity	Max. 95% at 40 °C (Max. 95% at 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 330 ft/s ²), 11 ms (36 fts)
Free fall	250 mm (0.82 ft) (weight less than 100 kg / 220 lb) 100 mm (0.33 ft) (weight more than 100 kg / 220 lb)

2.5 Electrical data

Table 2.5.1 Electrical data - 380V, 400V, 415V, 440V, 460V, 480V $\pm 10\%$ three-phase mains

AD1000 – 380/480V (F)							
Type	Frame	Cl.1 -Overload: 110% for 1 min, every 10 min			Cl.2 -Overload: 150% for 1 min, every 10 min		
		(*) I_{N1}	motor (4p) @400V	motor (4p) @460V	(**) I_{N2}	motor (4p) @400V	motor (4p) @460V
		A	kW	HP	A	kW	HP
AD1A0P3FBBNH	I	3.8	1.5	2	2.1	0.75	1.5
AD1A0P4FBBNH	I	5.6	2.2	3	3.8	1.5	2
AD1A0P6FBBNH	I	9.5	4.0	5	5.6	2.2	3
AD1A008FBBNH	II	12	5.5	7.5	9.5	4.0	5
AD1A011FBBNH	III	16	7.5	10	12	5.5	7.5
AD1A015FBBNH	III	21	9.0	15	16	7.5	10
AD1A018FBBNH	IIIX	25	11	20	21	9	15
AD1A022FBBNH	IIIX	32	15	25	25	11	20
AD1A028FBBNH	IIIL	40	18.5	30	32	15	25
AD1A030FBBFH	IIIN	40	18.5	30	32	15	25
AD1A036FBBFH	IIIN	52	22	40	40	18.5	30
AD1A045FBNFH	IVN	65	30	50	52	22	50
AD1A053FBNFH	IVN	77	37	60	65	30	50
AD1A066FBNFH	IVN	96	45	75	77	37	60
AD1A086FBNFH	VN	124	55	100	96	45	75
AD1A108FBNFH	VN	156	75	125	124	55	100
AD1A125FBNFH	VIN	180	90	150	156	75	125
AD1A150FBNFH	VIN	210	110		180	90	150
AD1A166FBNFH	VIN	240	132	200	200	110	
AD1A210FBNFH	VII	300	160	250	240		200
AD1A260FBNFH	VII	370	200	300	285	132	200
AD1A290FBNFH	VII	410	225	350	320	160	250
AD1A350FBNFH	VIII	510	280	400	385	200	300
AD1A370FBNFH	VIII	540	280	450	410	225	350
AD1A440FBNFH	VIII	640	355	550	510	280	400
AD1A480FBNFH	VIII	690	400	600	530	280	450
AD1A520FBNFH	VIII	750	450	650	585	315	500

(*) I_{N1} is the rated output current of the drive in Class 1

(**) I_{N2} is the rated output current of the drive in Class 2

NOTES

1. The braking switch is integrated for the frames up to 036F.
2. For frames between 045F and 290F, the braking switch is optional.
3. For frames from 350F to 520F the internal braking switch is not available.
4. The RFI filter is optional for drives up to frame 028F.
5. The RFI filter is standard for drives from frame 030F.



2.6 Switching frequencies

Table 2.6.1 Current derating based on 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%	100%	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%		
AD1A210F	100%	100%	100%	87%			100%	100%	100%	83%		
AD1A260F	100%	100%	84%	70%			100%	100%	84%	70%		
AD1A290F	100%	100%	83%	66%			100%	100%	81%	66%		
AD1A350F	100%	100%	88%				100%	100%	91%			
AD1A370F	100%	100%	83%				100%	100%	85%			
AD1A440F	100%	92%	72%				100%	90%	70%			
AD1A480F	100%	86%	67%				100%	87%	68%			
AD1A520F	100%	96%	79%				100%	96%	79%			

The full current switching frequency is highlighted in bold.

2.7 General data

STANDARDS AND CERTIFICATIONS			
EN61800-2 (ELECTRICAL DRIVES IN BT: GENERAL REQUIREMENTS)		 	
EN61800-3 (ELECTRICAL DRIVES: EMC REQUIREMENTS)			
EN61800-5-1 (ELECTRICAL DRIVES: SAFETY REQUIREMENTS)			
EN 50178 (ELECTRONIC EQUIPMENT FOR USE IN POWER INSTALLATIONS)			
ENVIRONMENTAL CONDITIONS (*)		CONNECTION TO THE MAINS	
Operating temperature:	0-40°C (derating by 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% (without condensate)		
Altitude above sea level:	1000m (derating by 1% for every 100m, max 3000m)	Total power factor: referred to the fundamental:	from 0.93 to 0.96 (with line reactor) >0.98 (with line reactor)
Degree of protection:	IP20 Frames I-VIN IP00 Frames VII-VIII	Output:	0.98 max (50/60 Hz- rated load) (with line reactor)
Cooling:	air with integrated fan		

(*) For detailed information, see paragraph 2.4

PROTECTIONS	CONNECTIONS TO THE MOTOR	
Overcurrent	Three-phase voltage:	From 0 to the mains voltage
Surge	Output frequency:	0.1-200Hz
Undervoltage	Switching frequency:	1.5-8 kHz
Drive overtemperature	Frequency resolution (V/Hz):	0.05Hz @50Hz
Motor overload	Frequency accuracy (V/Hz):	0.1% (analogue control)
Motor overspeed		0.01% (digital control)
Ground fault	Speed resolution:	1:5000 (Sensorless)
Serial break	Speed static accuracy:	0.01% (Sensorless)
Watchdog	Torque regulator response time:	5ms (Sensorless)
External fault		
	Overload:	Cl. 1: 110% x60s every 10 min
		Cl. 2: 150% x60s every 10 min

BASIS BOARD CONTROL CONNECTIONS

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

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

1 relay output (NA-C-NC) 2A 250V: DRIVE OK

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

2 configurable opto-isolated digital outputs (24Vdc)

1 configurable relay output (NA-C) 1A 250 Vac

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

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

1 R232 asynchronous serial port (ANSI protocol)

1 RS485 asynchronous serial port (Modbus RTU)

2.8 Losses and ventilation data

AD1000 drives (excluding AD1A0P3-0P4) are equipped with an inner fan with the incoming air flow positioned at the bottom.

Table 2.8.1 Ventilation data

AD1000	Output current		Losses			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 mains 380/480V \pm 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	10	5.9	Internal power supply	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
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

AD1000	Output current		Losses			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 mains 380/480V ±10%

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

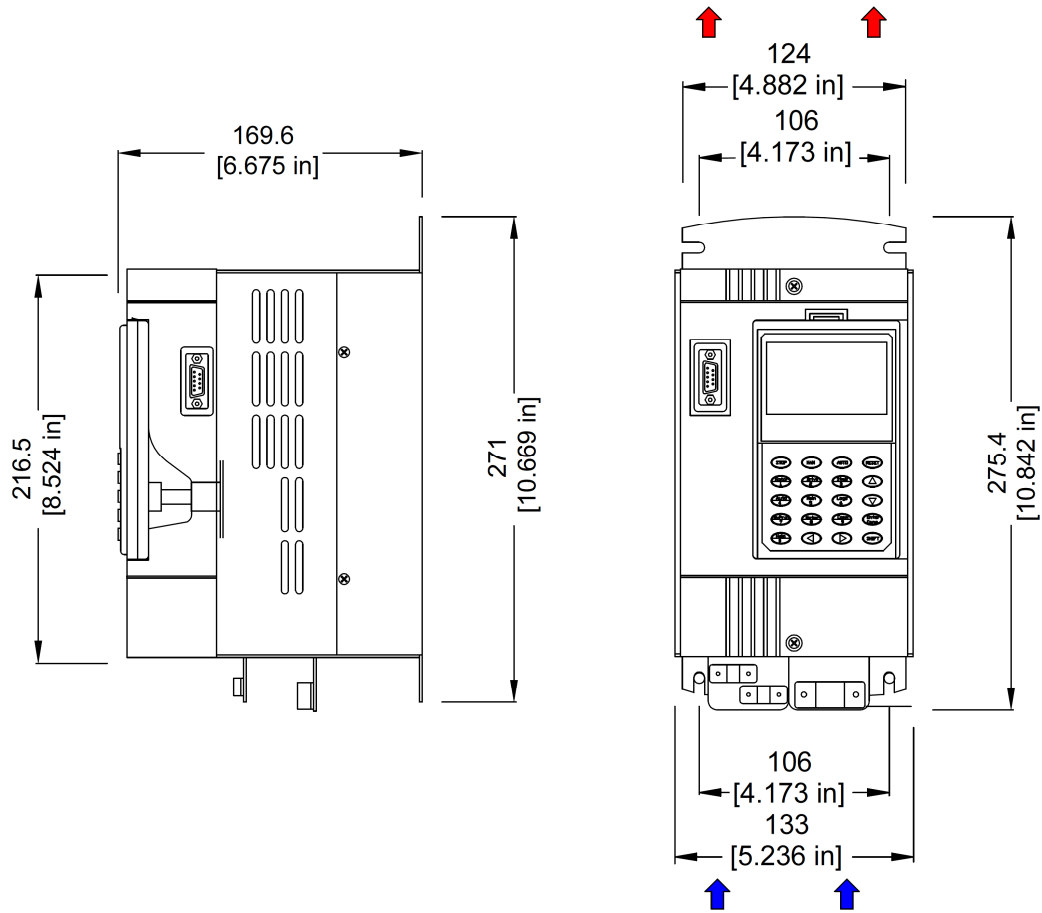


- AD1000 fans are sized exclusively to deal with drive losses. To install them in a panel, supplementary load losses must also be considered.
- For frames starting from AD1A125F and above, the user must provide fan power supply line protection elements.

2.9 Overall dimensions and weights

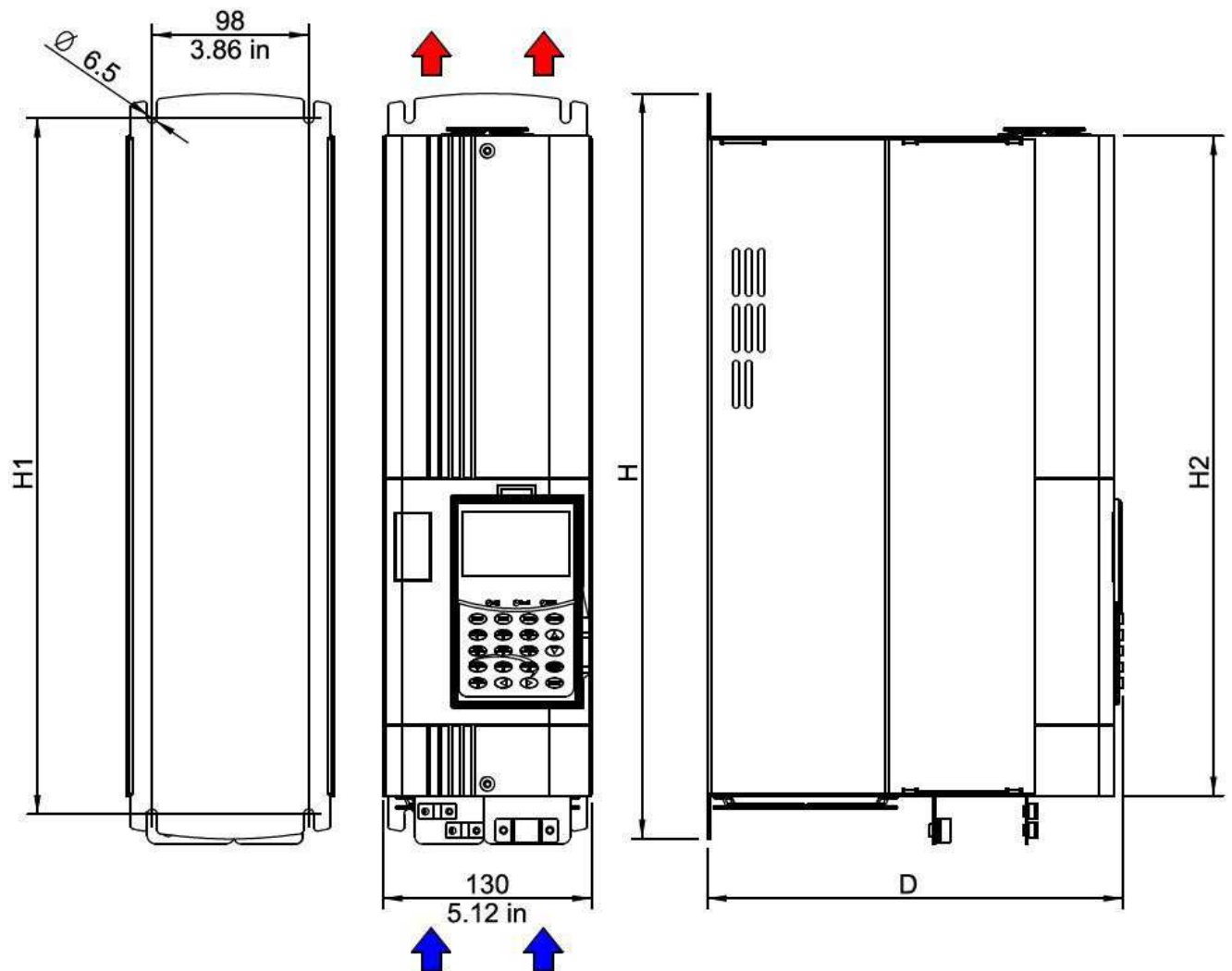
FRAME		LAYOUT
		Par.
AD1A0P3-0P4-0P6F	Frame I	2.9.1
AD1A008F	Frame II	2.9.2
AD1A011-015F	Frame III	2.9.2
AD1A018-022F	Frame III X	2.9.2
AD1A028F	Taglia III L	2.9.2
AD1A30-036F	Frame III N	2.9.3
AD1A045-053-066F	Frame IV N	2.9.4
AD1A086-108F	Frame V N	2.9.4
AD1A125-150-166F	Frame VI N	2.9.4
AD1A210-260-290F	Frame VII	2.9.5
AD1A350-370-440-480-520F	Frame VIII	2.9.6

2.9.1 FRAME I - AD1A0P3-0P4-0P6F



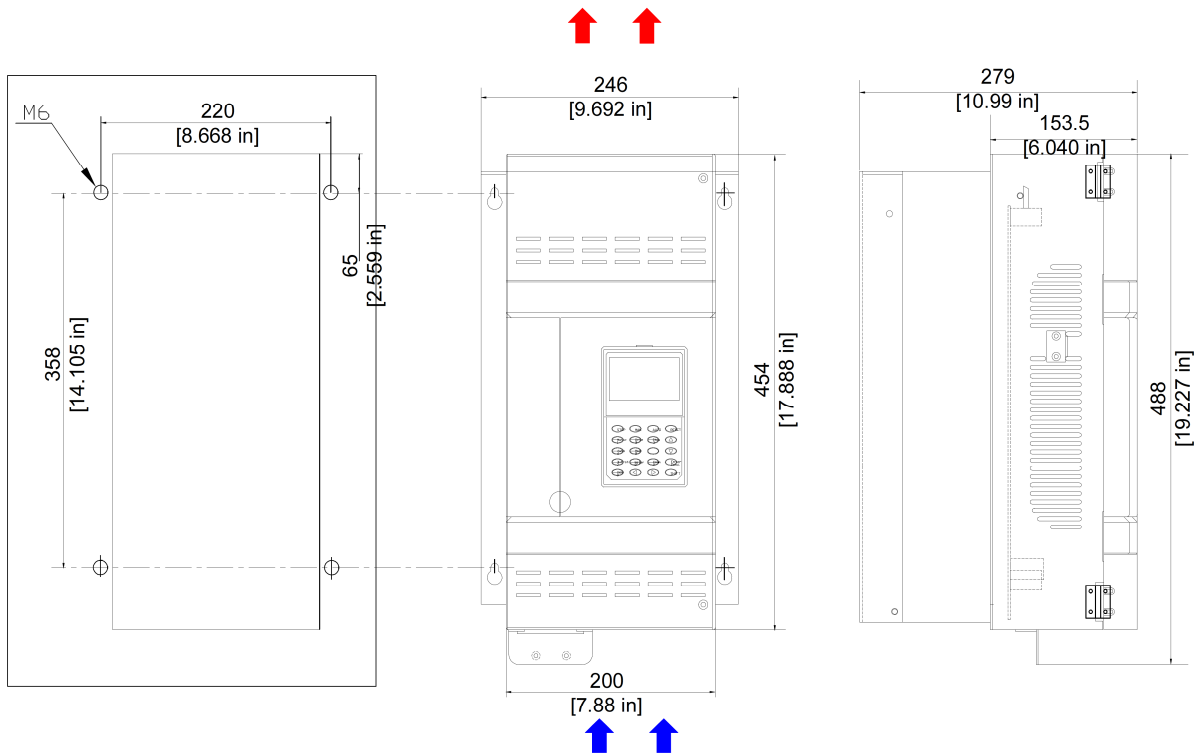
Peso	Weight
kg	lb
4	8.8

2.9.2 FRAMES II-III-III-X-III-L - AD1A008-011-015-018-022-028F



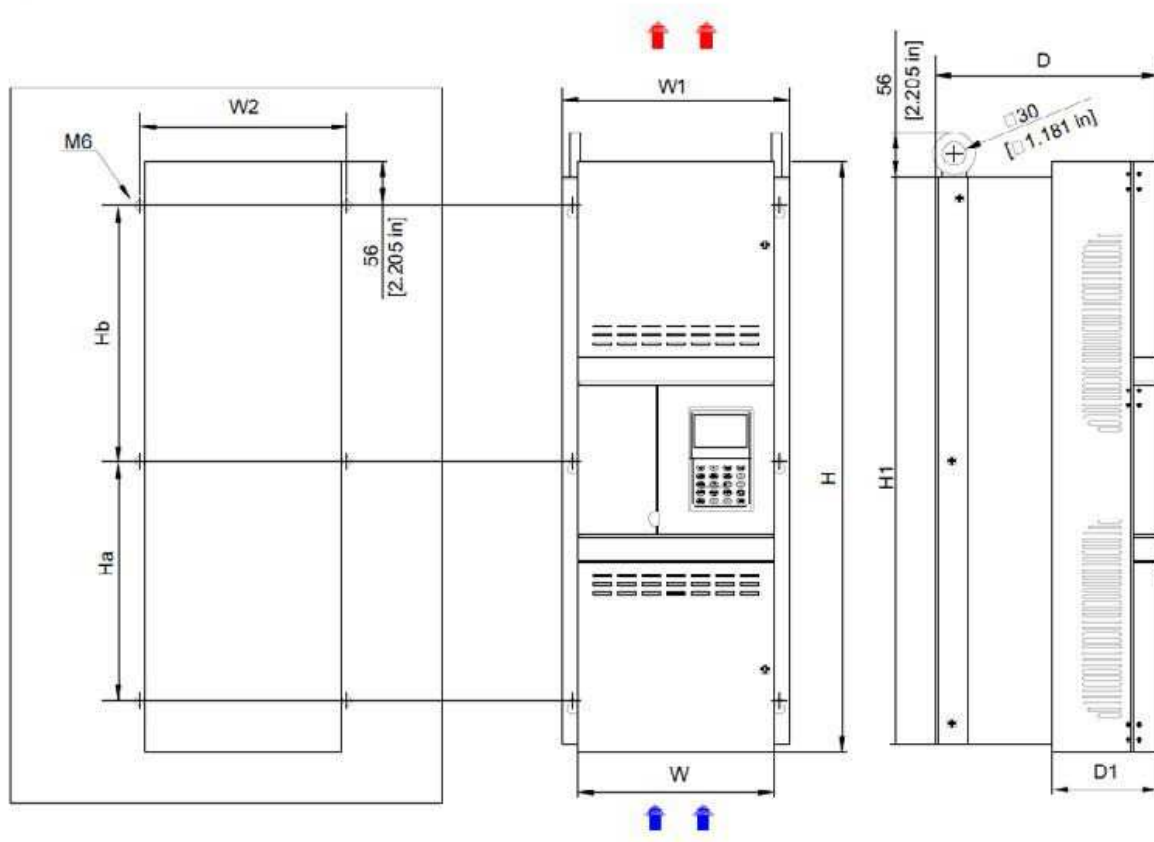
Tipo Type	Taglia Frame	D		H		H1		H2		Peso	Weight
		mm	in	mm	in	mm	in	mm	in	kg	lb
AD1A008F	II	223.5	8.8	341.5	13.44	310.5	12.22	288	11.34	5.5	12.1
AD1A011-015F	III	223.5	8.8	441.5	17.38	410.5	16.16	388	15.28	8	17.6
AD1A018-022F	III-X	245.5	9.67	466.5	18.37	435.5	17.15	417.5	16.44	8	17.6
AD1A028F	III-L	260	10.24	466.5	18.37	435.5	17.15	417.5	16.44	10.5	23.1

2.9.3 FRAME IIIN - AD1A030-036F



Peso		Weight	
kg		lb	
32		70.55	

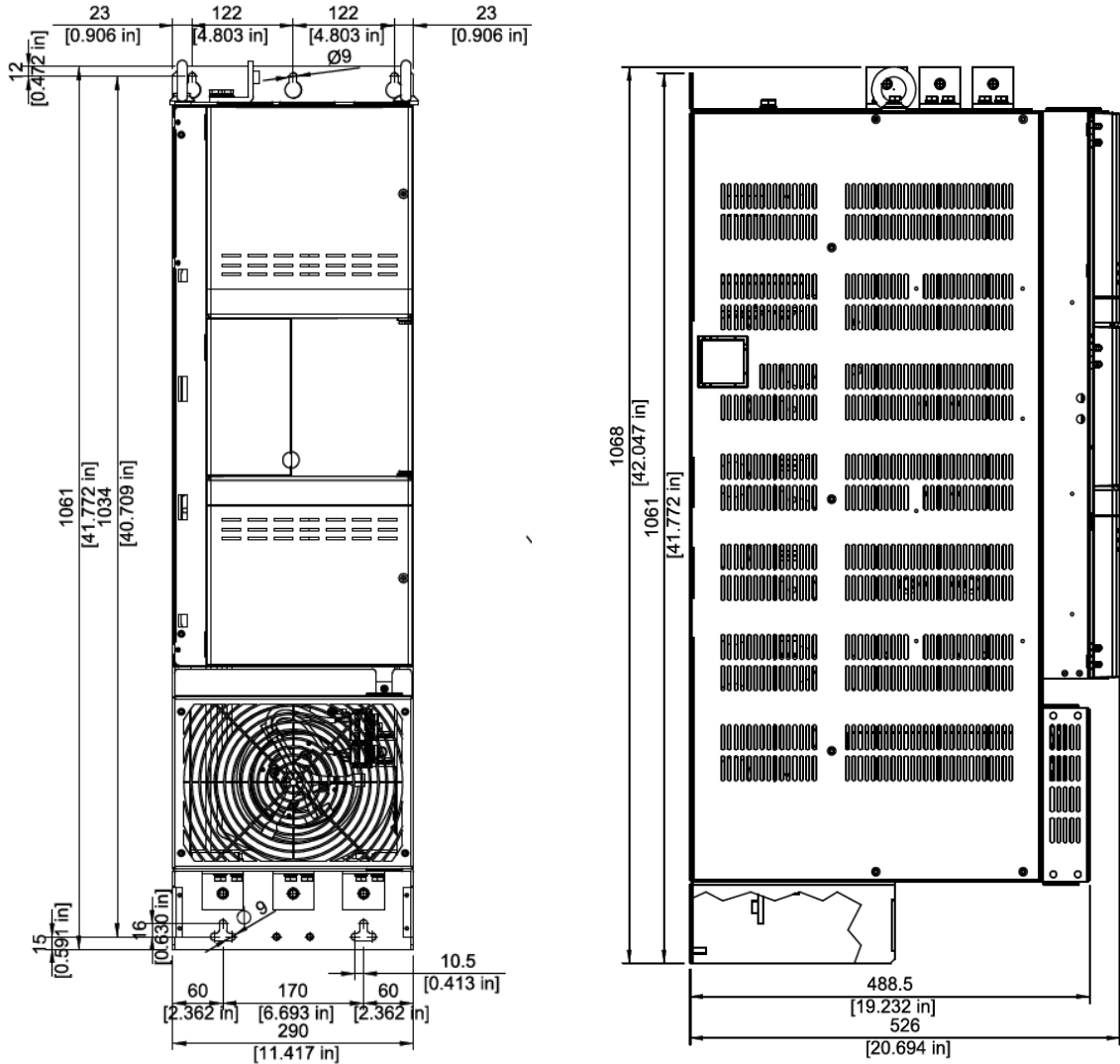
2.9.4 FRAMES IVN-VN-VIN - AD1A045-053-066-086-108-125-150-166F



	W		H		D		W1		H1		D1	
	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
AD1A045-053-066F	250	9.84	675	26.57	289	11.37	290	11.41	645	25.39	151	5.94
AD1A086-108F	250	9.84	755	29.72	304.5	11.99	290	11.41	753	29.63	156	6.14
AD1A125-150-166F	260	10.24	1000	39.37	334.5	13.16	300	11.81	959	37.77	170	6.71

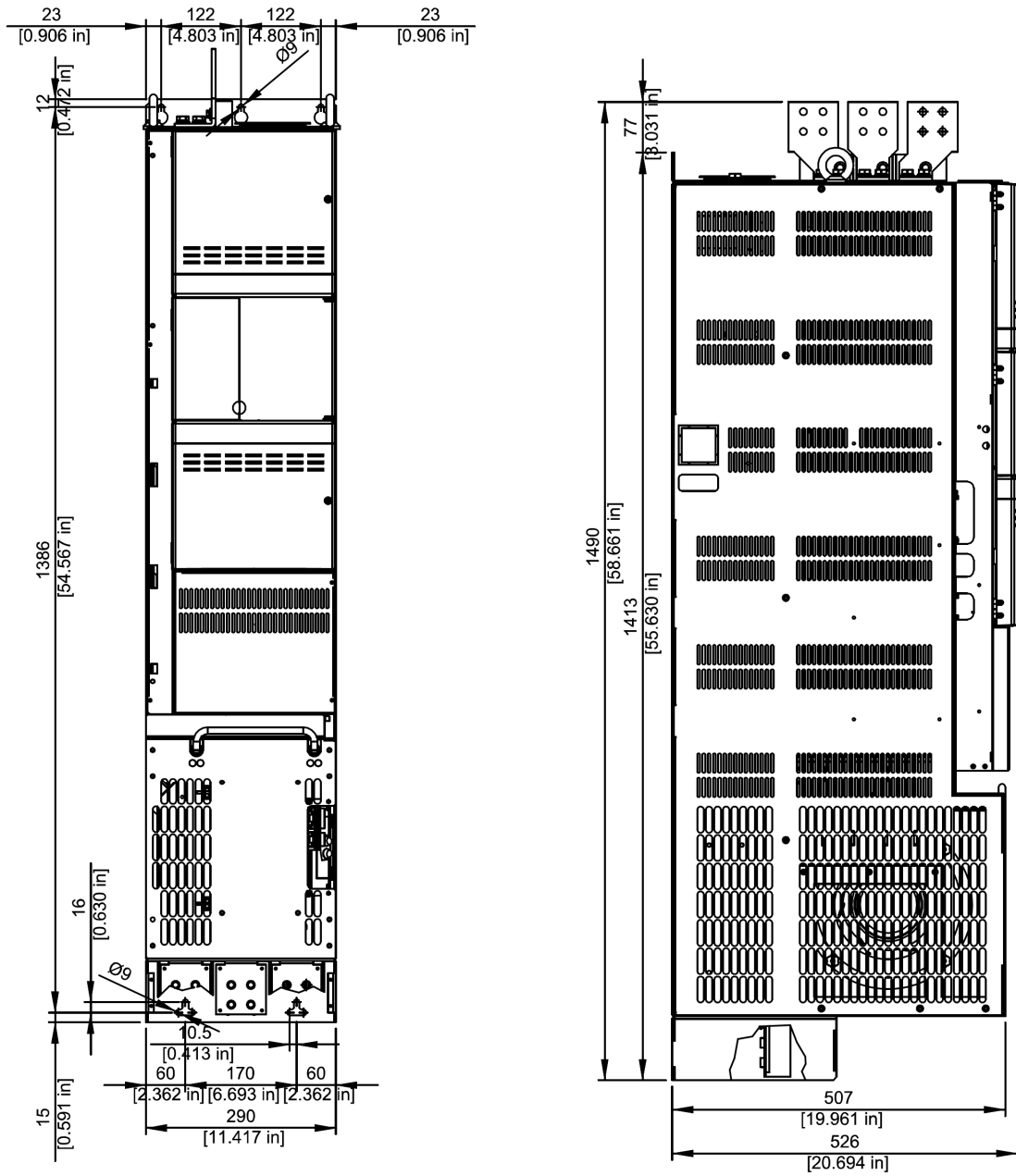
	W2		Ha		Hb		Peso	Weight
	mm	in	mm	in	mm	in	kg	lb
AD1A045-053F	264	10.39	286.5	11.28	286.5	11.28	36	79.37
AD1A066F	264	10.39	286.5	11.28	286.5	11.28	40	88.19
AD1A086-108F	264	10.39	306.5	12.06	326.5	12.85	52	114.64
AD1A125F	274	10.78	326.5	12.85	326.5	12.85	88	194
AD1A150-166F	274	10.78	326.5	12.85	326.5	12.85	96	211.64

2.9.5 FRAME VII - AD1A210-260-290F



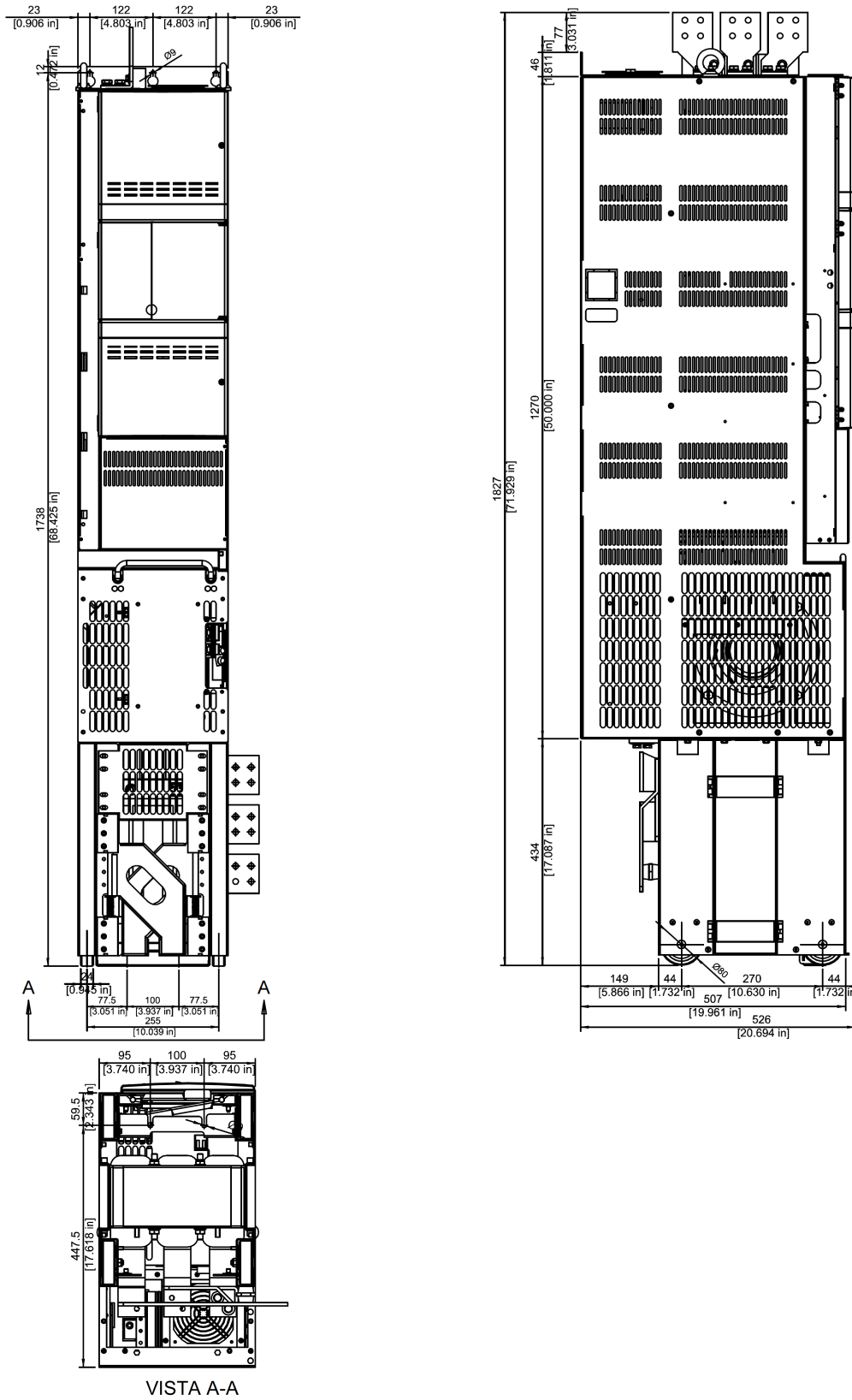
Peso	Weight
kg	lb
120	265

2.9.6 FRAME VIII - AD1A350-370-440-480-520F



Peso	Weight
kg	lb
200	441

Version with carriage (option available only for VIII frames)



The carriage 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
-----	---	-----	---	---	---	---	---	---	---	---	----	----

2.10 Terminal block and power diagrams

FRAME		LAYOUT
		Par.
AD1A0P3-0P4-0P6F	Frame I	2.10.1
AD1A008F	Frame II	2.10.2
AD1A011-015F	Frame III	2.10.3
AD1A018-022F	Frame III X	2.10.4
AD1A028F	Taglia III L	2.10.5
AD1A30-036F	Frame III N	2.10.6
AD1A045-053F	Frame IV N	2.10.7
AD1A066F	Frame IV N	2.10.8
AD1A086-108F	Frame V N	2.10.9
AD1A125-150-166F	Frame VI N	2.10.10
AD1A210-260-290F	Frame VII	2.10.11
AD1A350-370-440-480-520F	Frame VIII	2.10.12

Symbols used to identify the auxiliary and power terminals:

Power terminals	L1	Mains input
	L2	Mains input
	L3	Mains input
	PE	Ground / Shields
	U	Phase output - U - MOTOR
	V	Phase output - V - MOTOR
	W	Phase output - W - MOTOR
	RE +	External braking resistor
	RE -	External braking resistor
	R	External braking resistor
	+	Positive DC BUS
	-	Negative DC BUS (IGBT)
Auxiliary terminals	XM2V-1	230V-50/60 Hz ventilation auxiliaries
	XM2V-2	230V-50/60 Hz ventilation auxiliaries
	L	230V-50/60 Hz ventilation auxiliaries
	N	230V-50/60 Hz ventilation auxiliaries
	PE	Ground

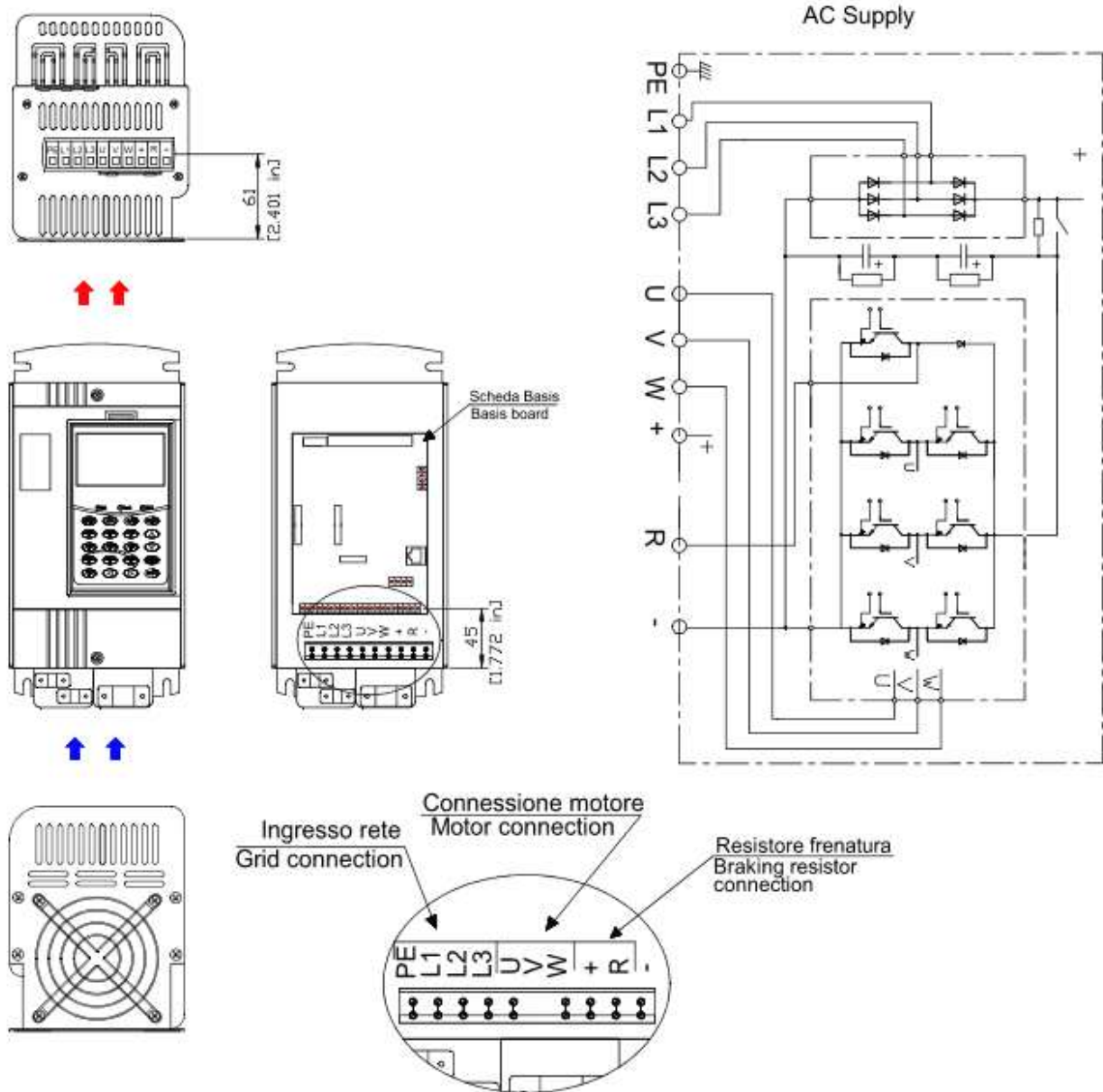
Note:

- XM2V-1,2 auxiliary terminals: frame VII/VIII
- L,N auxiliary terminals: frame VIN

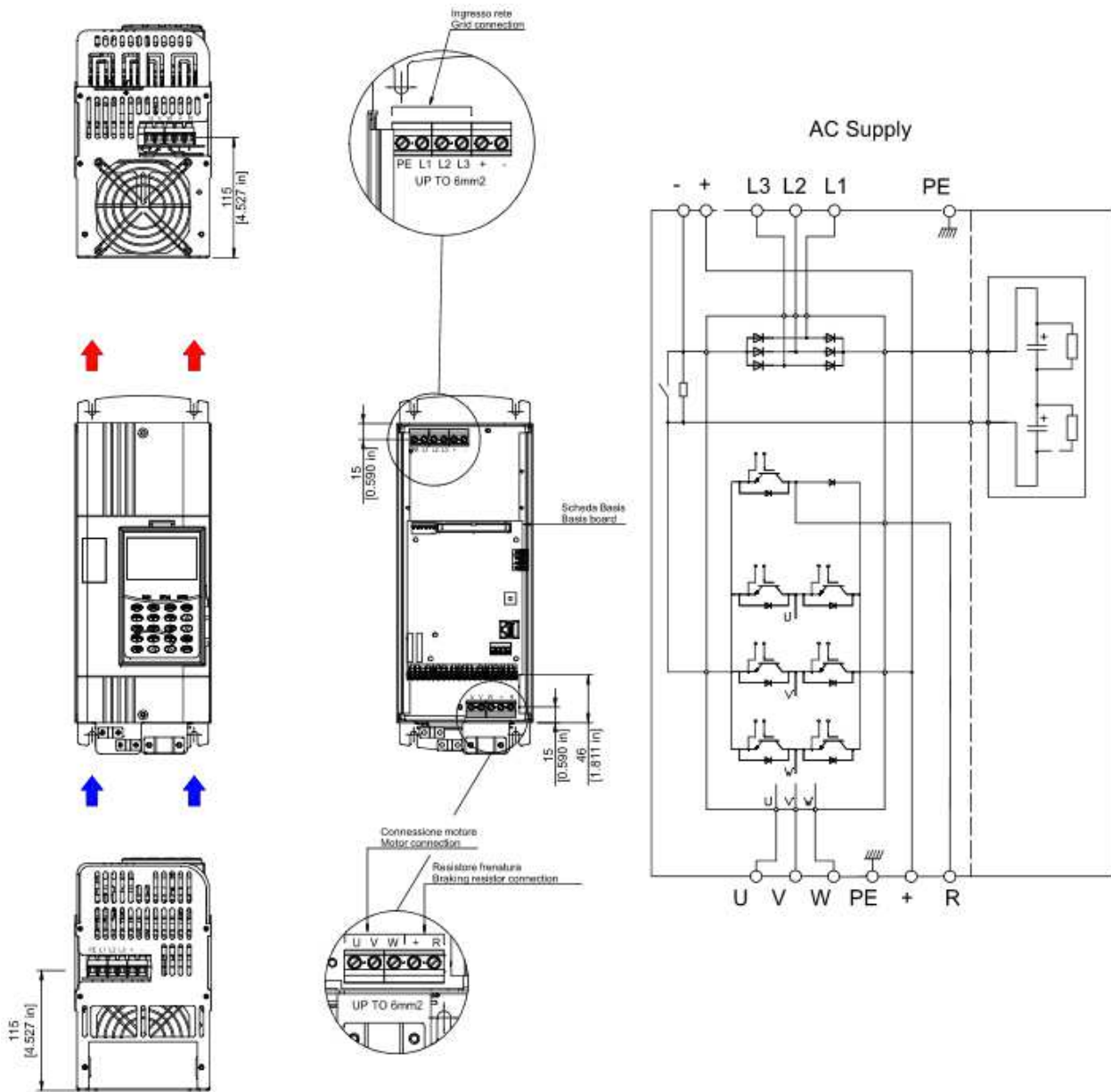
Note:

- From frame I to frame III L, braking resistance must be connected between R and +
- From frame III N to frame VII, braking resistance must be connected between RE + and RE -

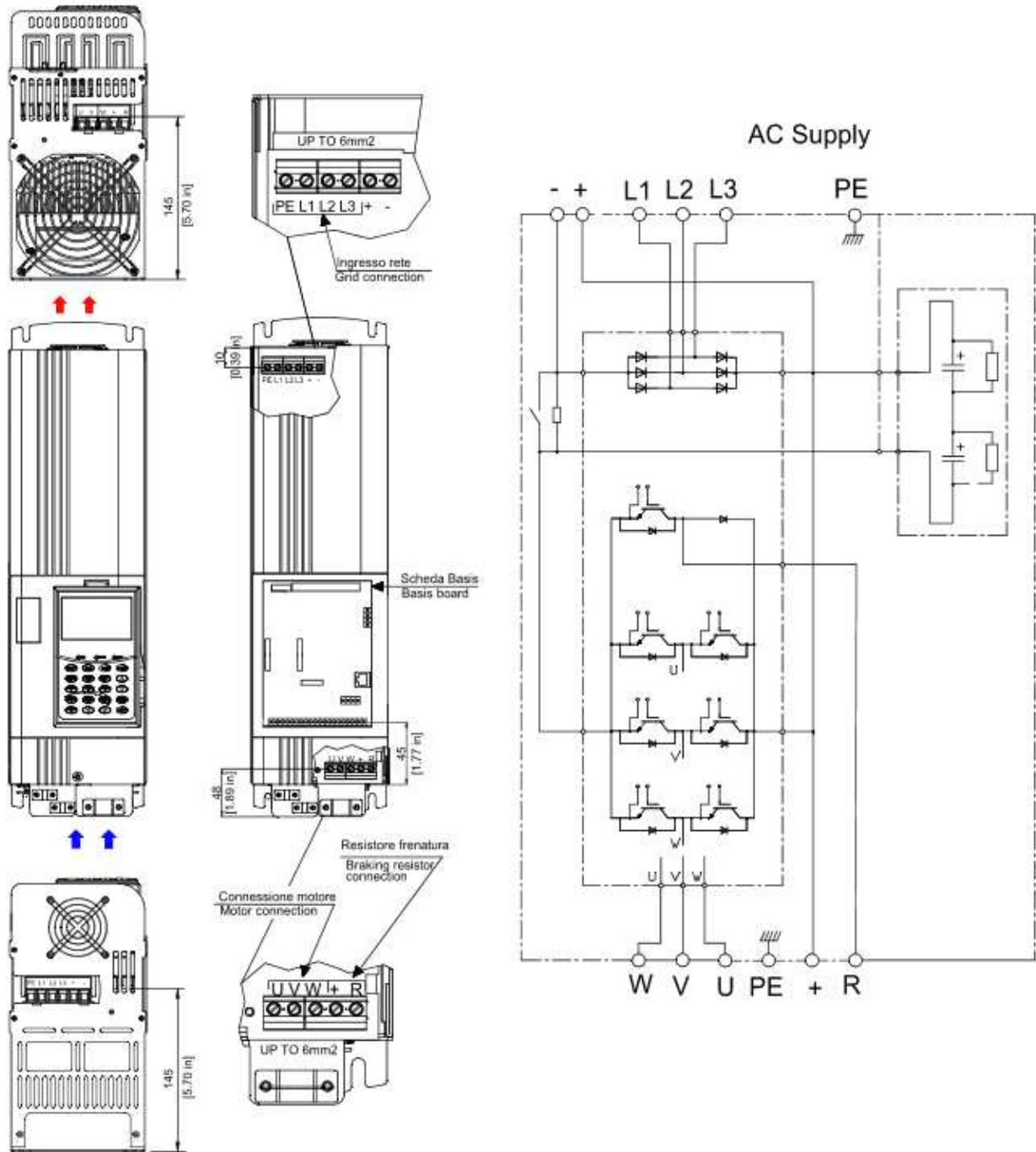
2.10.1 FRAME I - AD1A0P3-0P4-0P6F



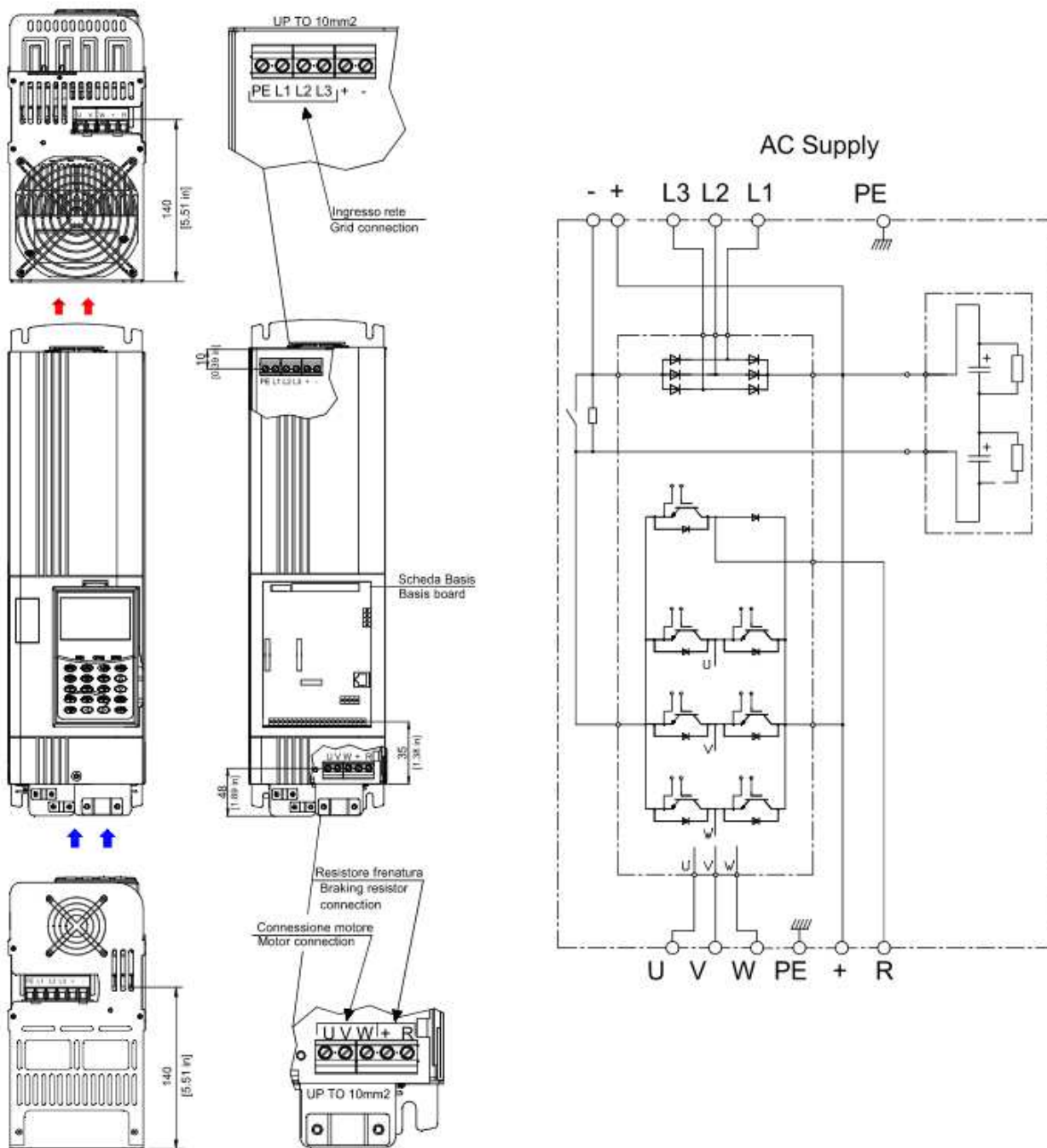
2.10.2 FRAME II - AD1A008F



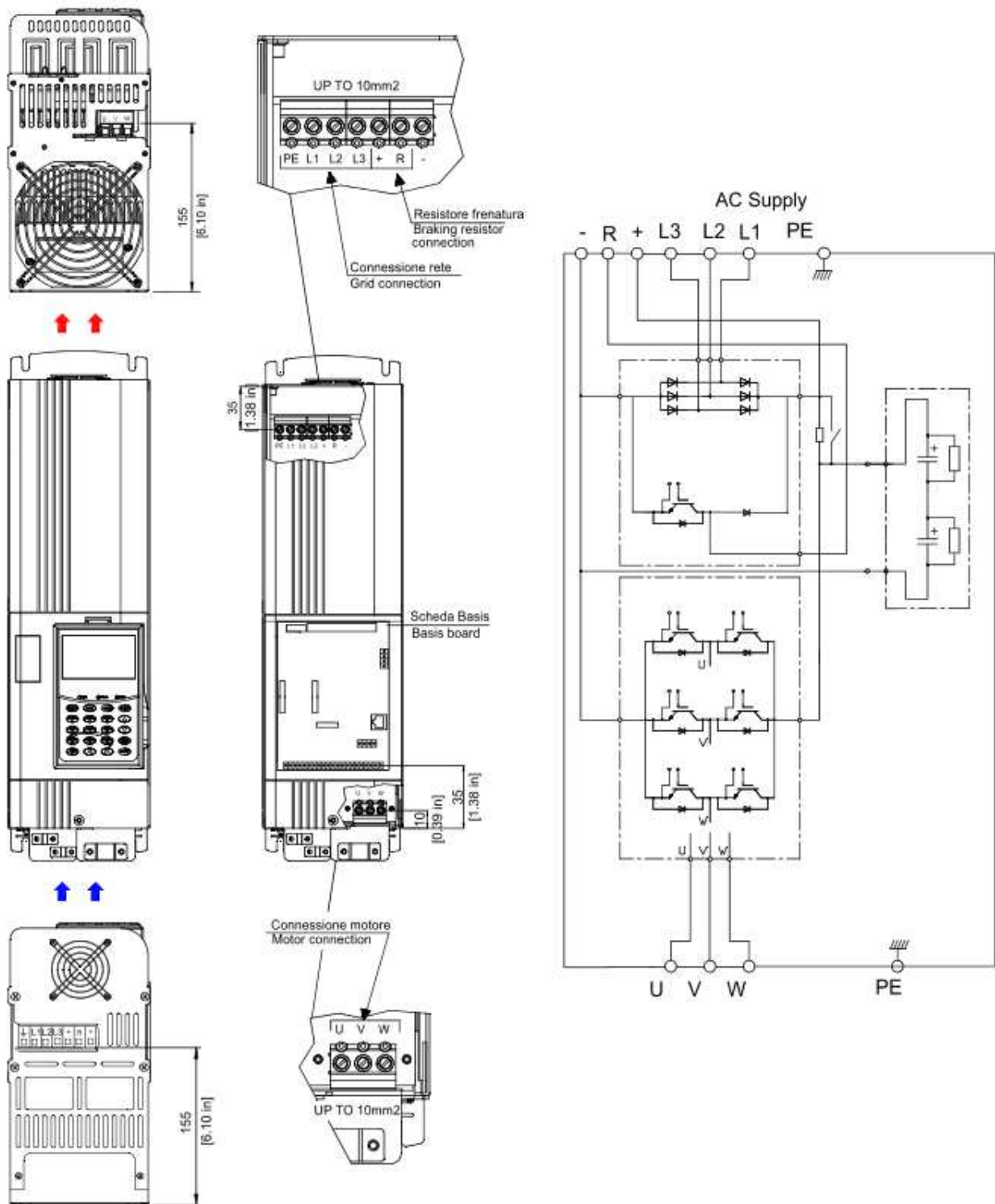
2.10.3 FRAME III - AD1A011-015F



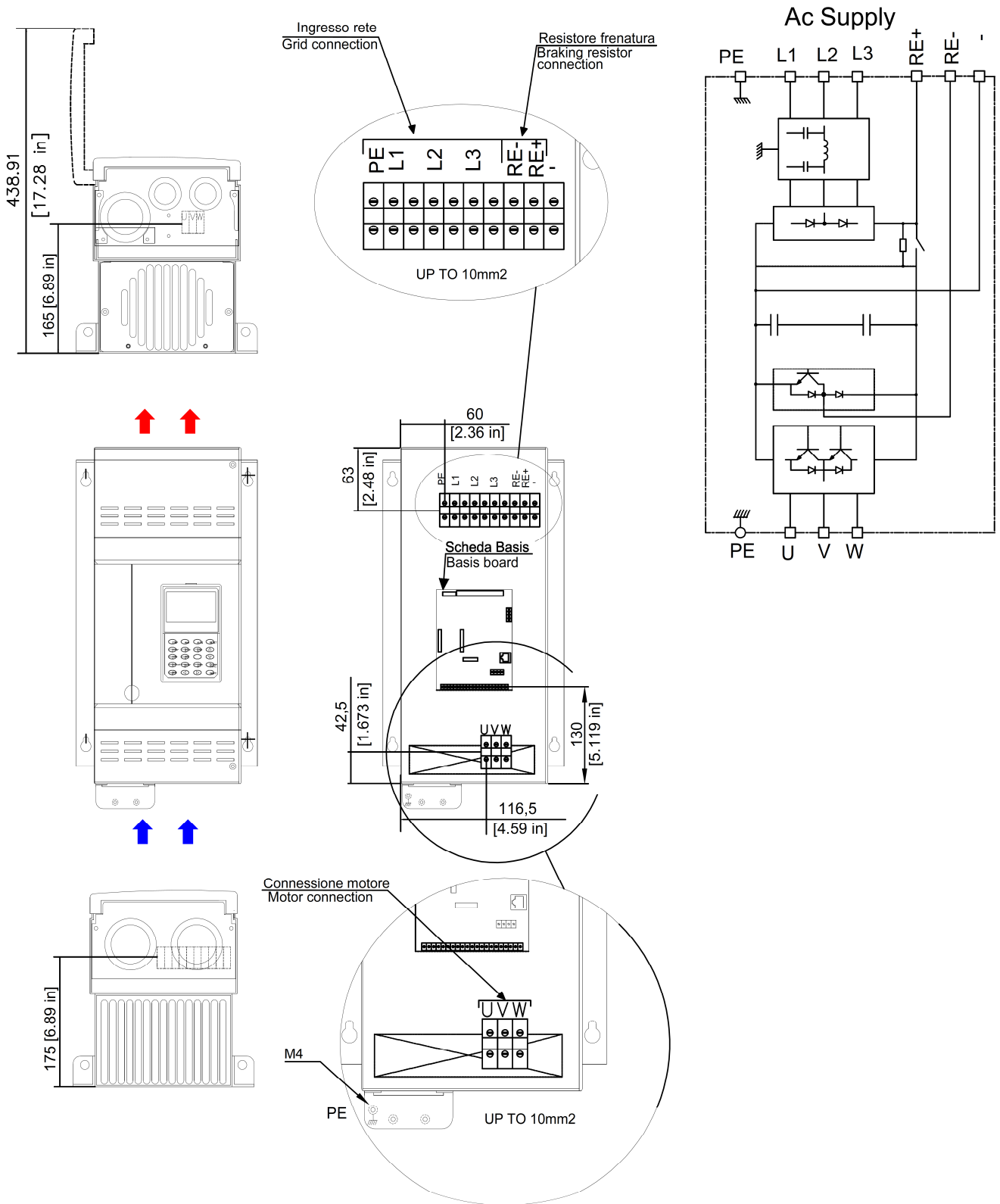
2.10.4 FRAME IIIX - AD1A018-022F



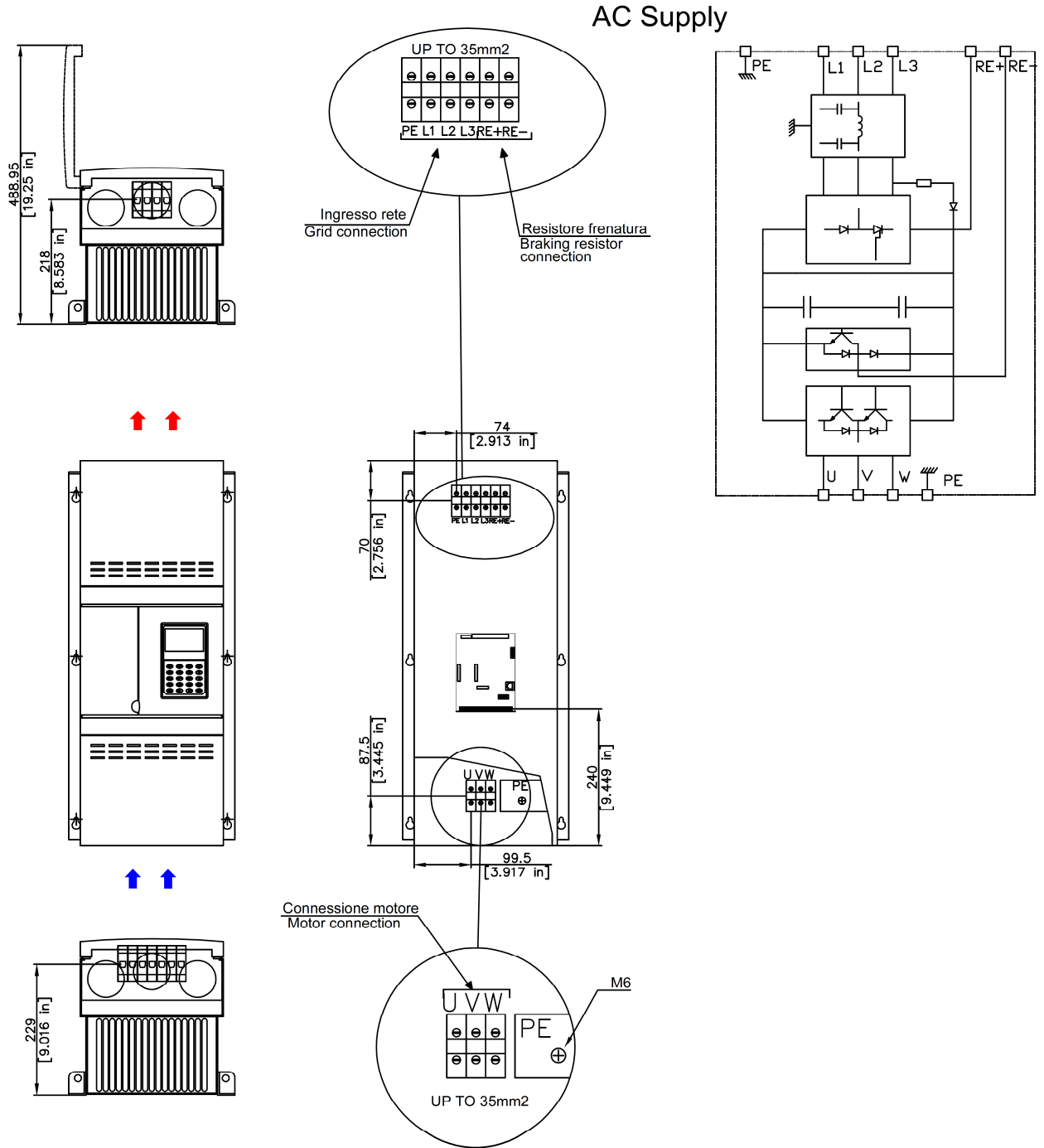
2.1.0.5 FRAME III L - AD1A028F



2.10.6 FRAME IIIN - AD1A030-036F

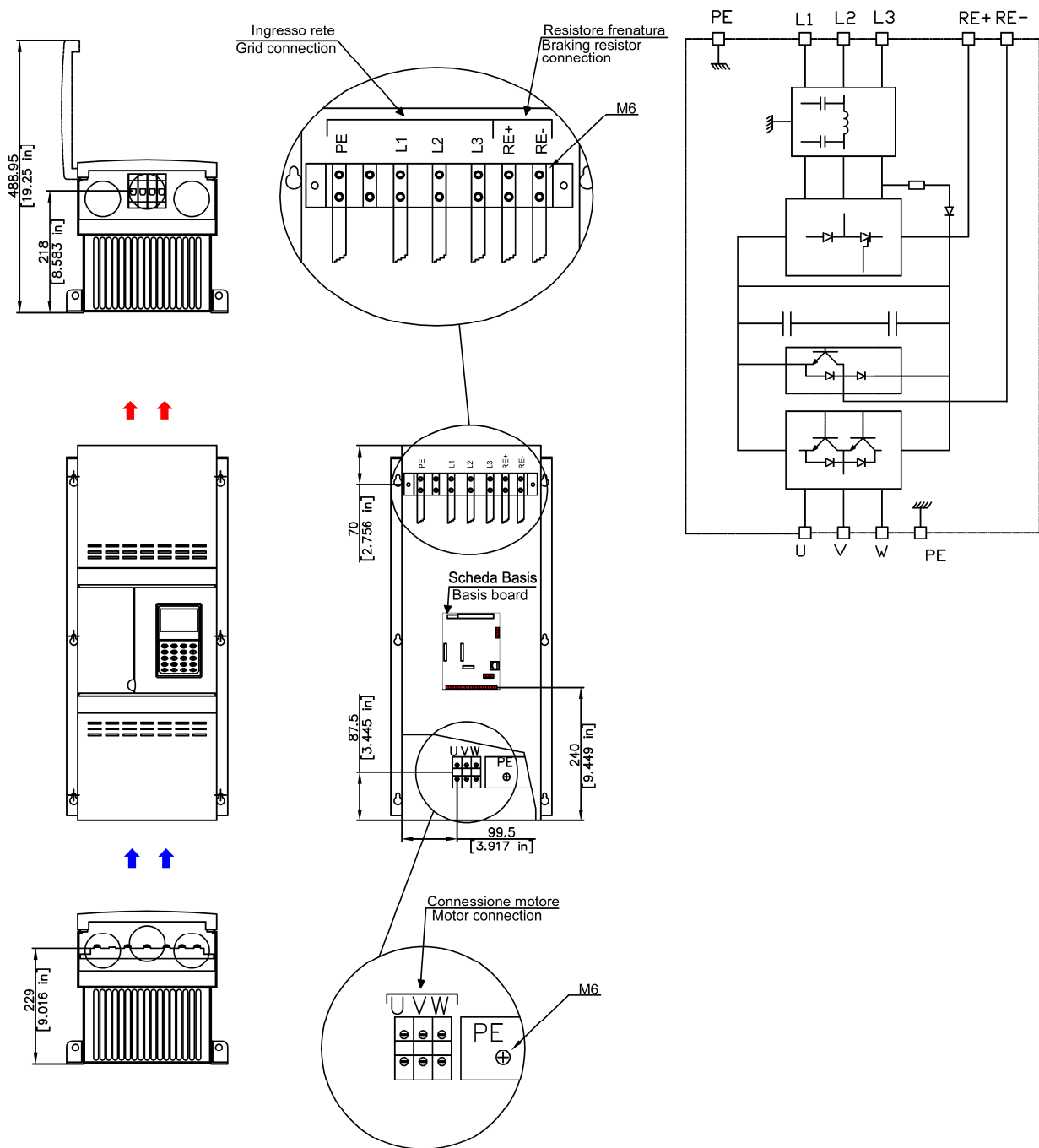


2.10.7 FRAME IVN - AD1A045-053F

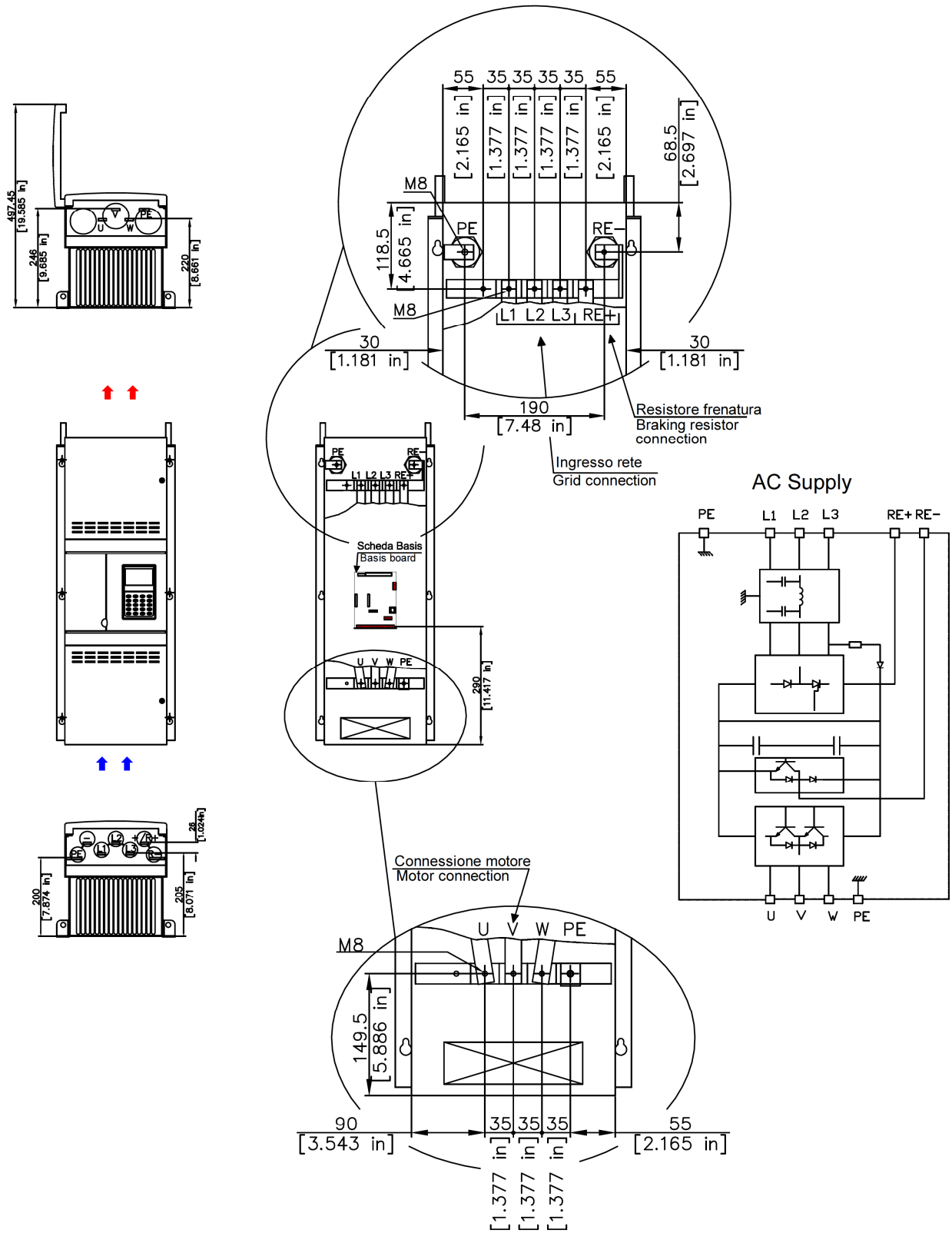


2.10.8 FRAME IVN - AD1A066F

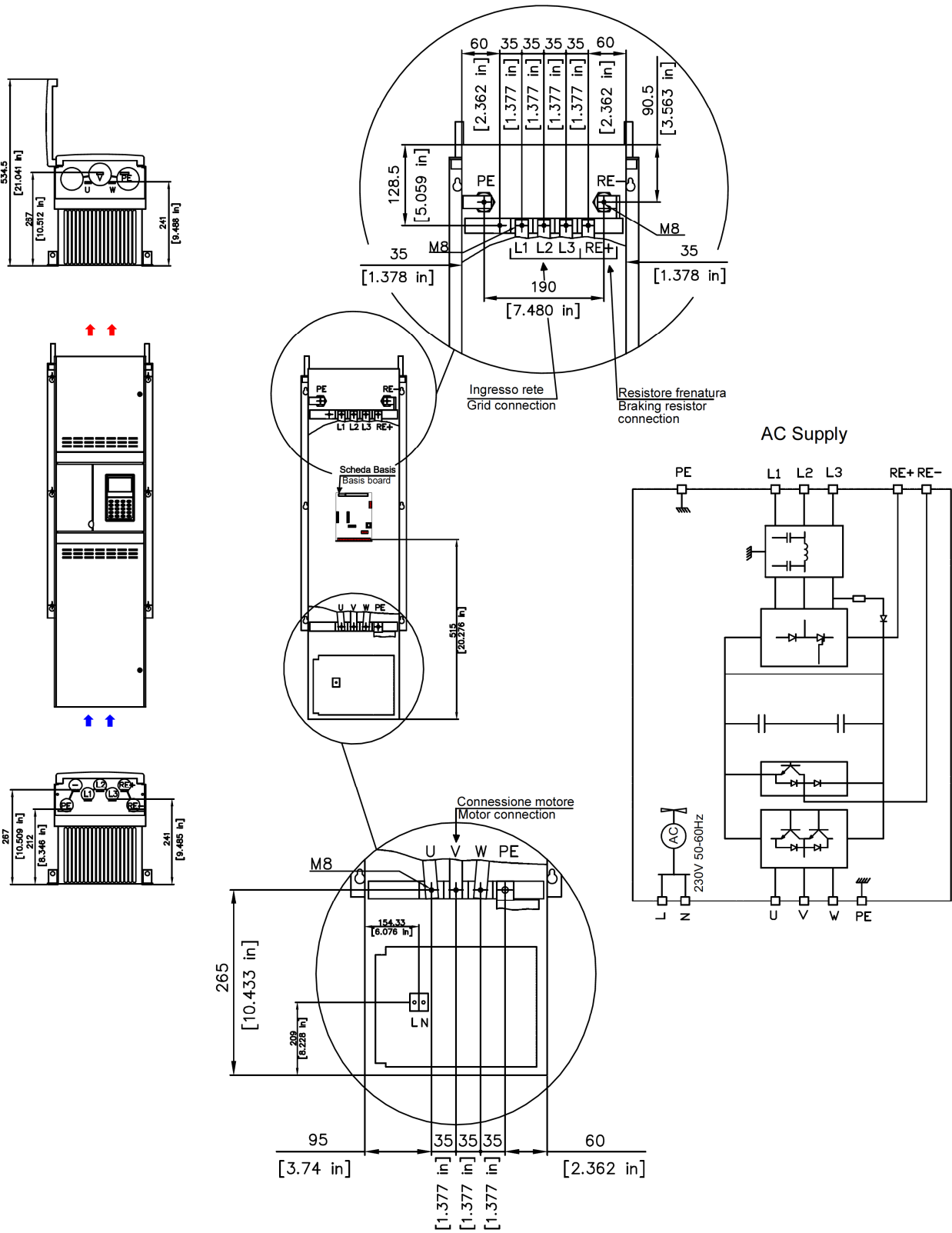
AC Supply



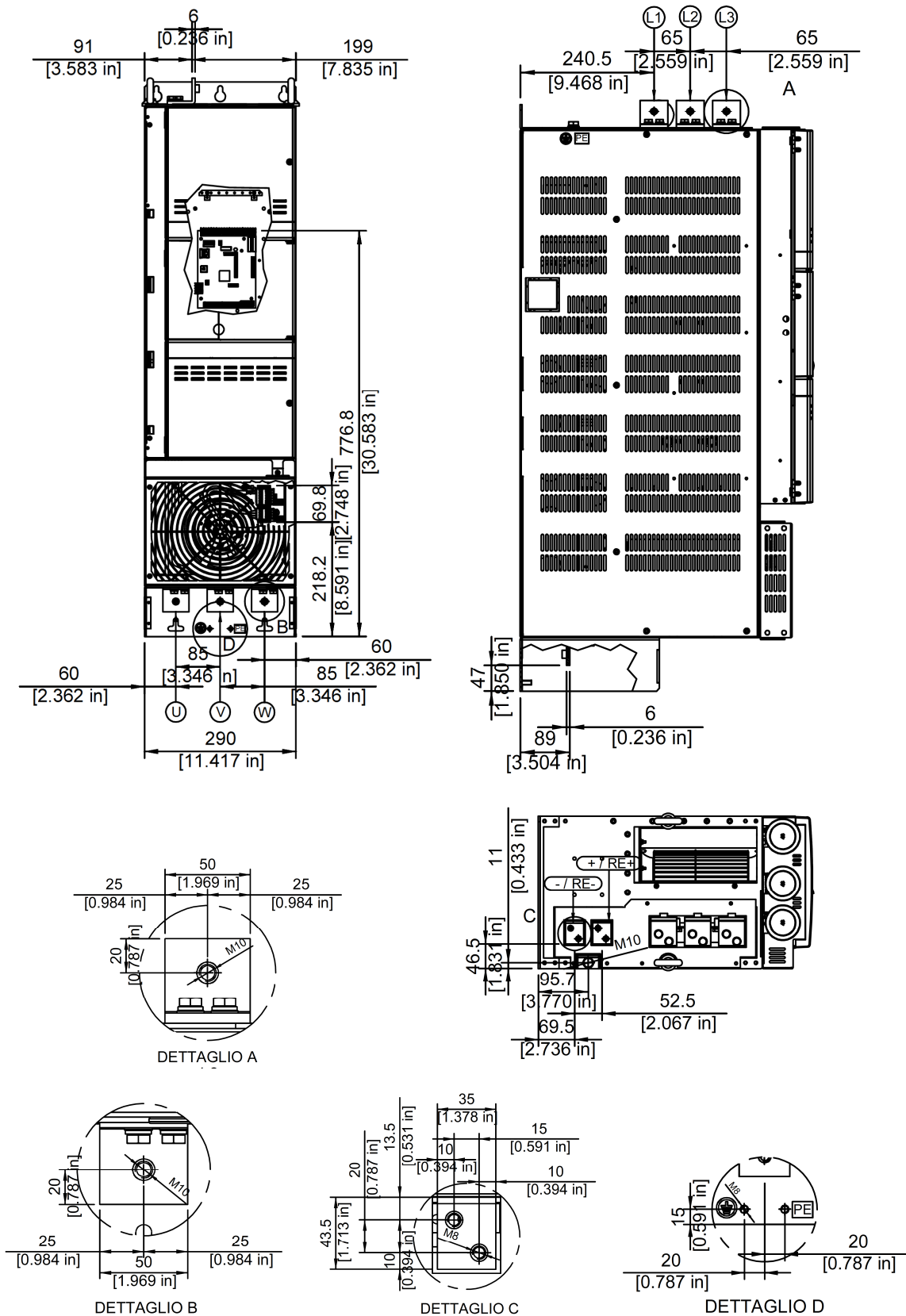
2.10.9 FRAME VN - AD1A086-108F



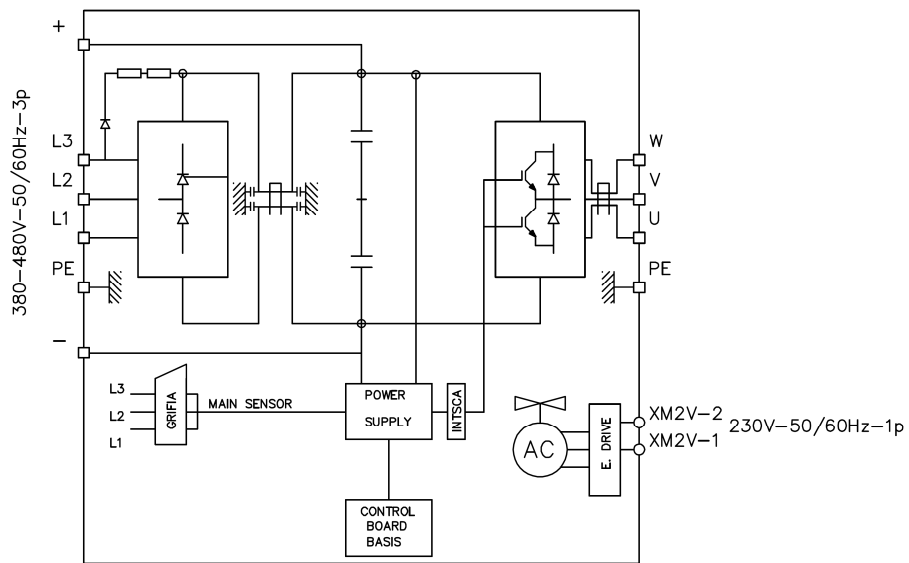
2.10.10 FRAME VIN - AD1A125-150-166F



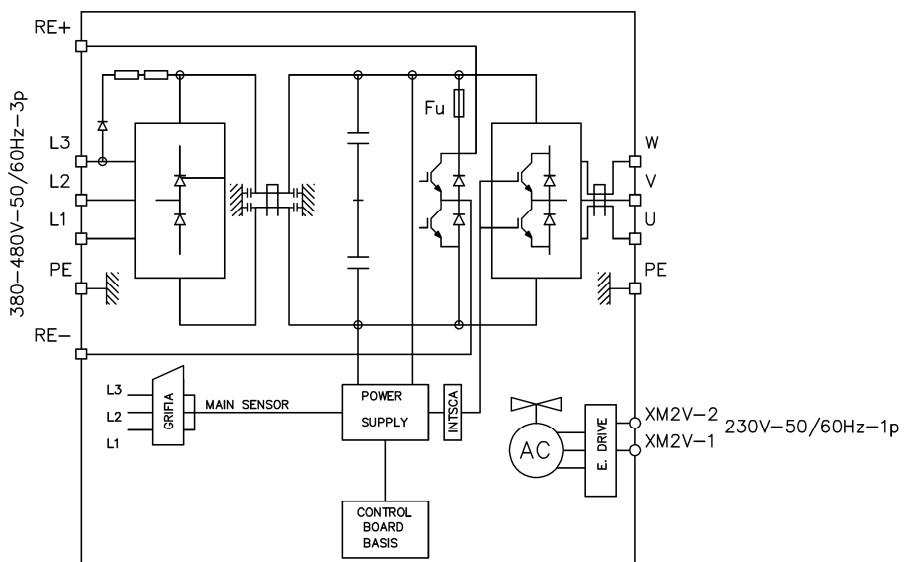
2.10.11 FRAME VII - AD1A210-260-290F



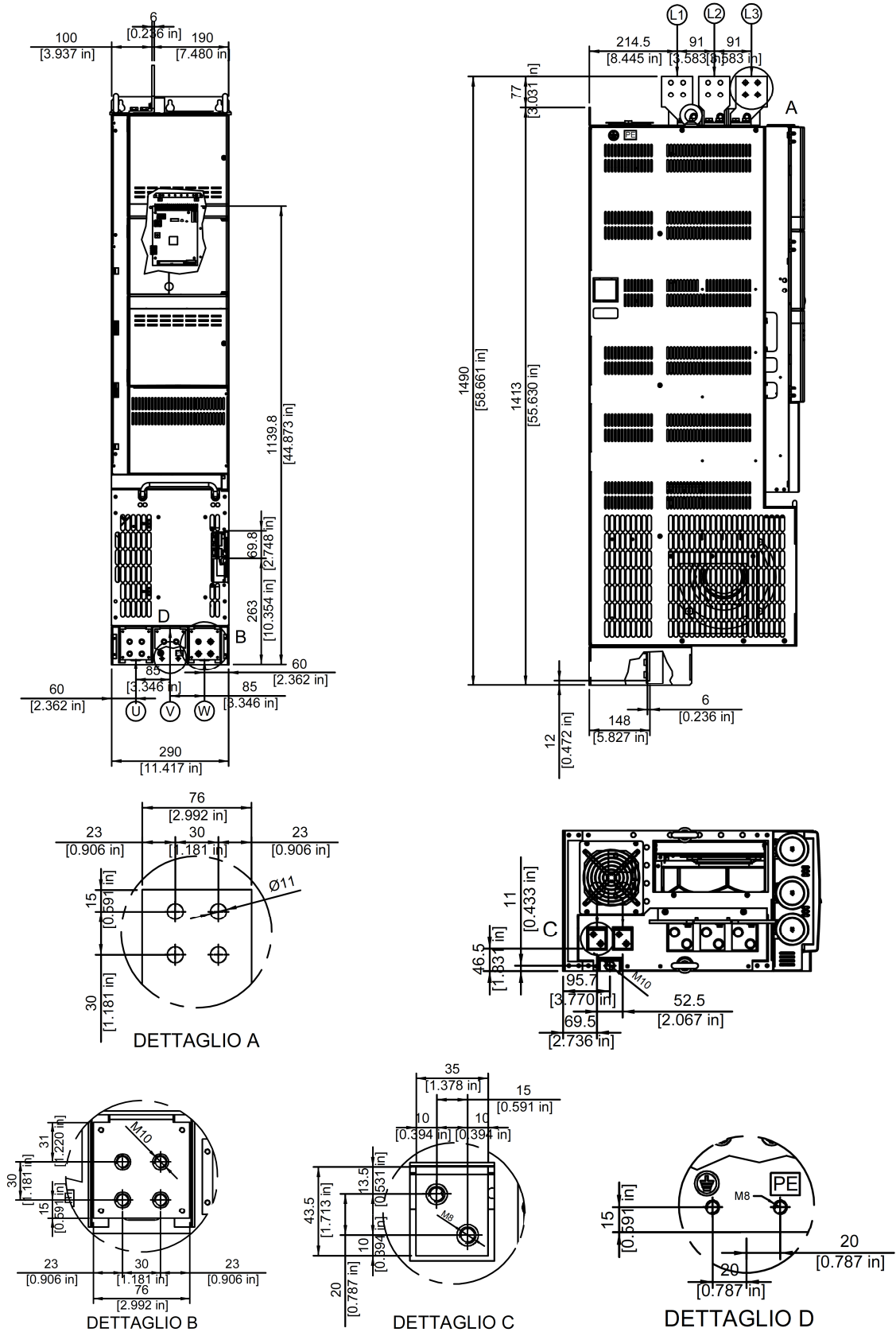
Without dynamic brake

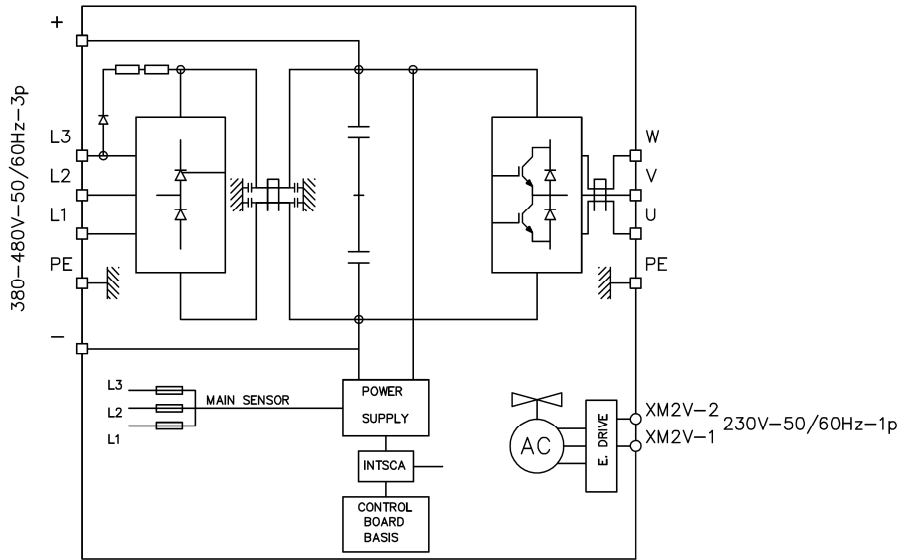


With dynamic brake



2.10.12 FRAME VIII - AD1A350-370-440-480-520F





3 APPLICATION NOTES

3.1 Principle of operation

The main AD1000 components are as follows:

- Input power terminals
- Input rectifier circuit
- Preload
- DC bus capacitors
- Output power terminals
- Control board
- Keypad display module
- Power and pilot board
- IGBT power modules

Figures 3.1.1 / 3.1.2 show an AD1000 wiring diagram.

The drive is composed of three main sections:

- Drive section: converts steady frequency alternating input voltage into direct voltage
- Bus DC: composed of a group of capacitors used to filter line undulations and store power.
- Drive section: controlled IGBT modules to convert DC voltage into AC three-phase output voltage, which varies in frequency and width, used to control the connected motor.

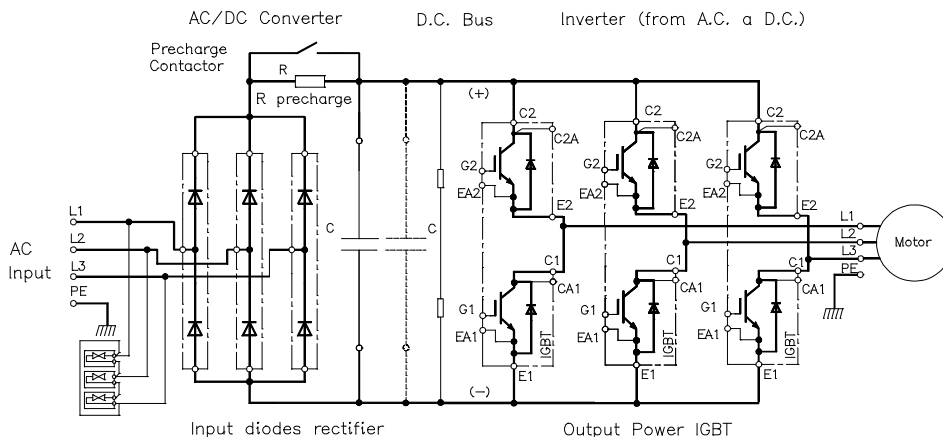


Figure 3.1.1 - AD1000 layout (0P3F - 036F)

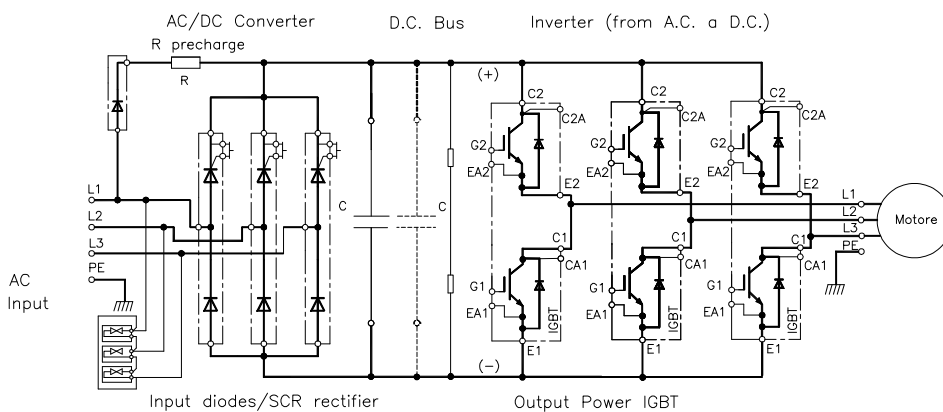


Figure 3.1.2 - AD1000 diagram (045F - 520F)

NOTE

The preload contactor in some frames is positioned on the DC Bus negative. Refer to the power layouts in chapter 2.

3.2 General formulas that describe drive operation

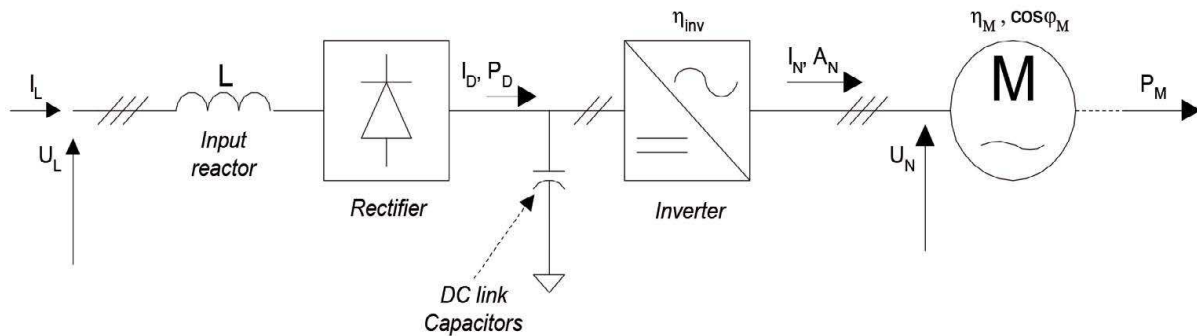


Figure 3.2.3 Single-line diagram of a drive with an induction motor

$$\bar{A}_N = \sqrt{3} \cdot U_N \cdot I_N$$

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

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

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

$$I_L = 0.87 \cdot I_D$$

$$I_L = 1.25 \cdot I_D$$

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

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

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

A_N = POTENZA APPARENTE INVERTER

I_N = CORRENTE NOMINALE D'USCITA INVERTER (RMS)

U_N = TENSIONE NOMINALE D'USCITA INVERTER (RMS)

P_M = POTENZA MECCANICA DISPONIBILE ALL'ALBERO MOTORE

η_M = RENDIMENTO MOTORE

$\cos \varphi_M$ = FATTORE DI POTENZA MOTORE

P_D = POTENZA SUL COLLEGAMENTO DC

η_{inv} = RENDIMENTO INVERTER

I_D = VALORE MEDIO CORRENTE SUL COLLEGAMENTO DC

U_L = TENSIONE D'INGRESSO (RMS)

CORRENTE D'INGRESSO RMS (CON UNA REATTANZA D'INGRESSO DEL 3%)

CORRENTE D'INGRESSO RMS (SENZA REATTANZA D'INGRESSO)

PRESUPPONENDO $\eta_{inv} = 0.97$ E $U_N = U_L$

CORRENTE D'INGRESSO RMS (CON UNA REATTANZA D'INGRESSO DEL 3% E $U_L = U_N$)

CORRENTE D'INGRESSO RMS (SENZA REATTANZA D'INGRESSO)

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	rpm/sec
	degrees/sec	0.1667	RPM
	rpm/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		

3.3 Drive selection

- Choosing the AD1000 frame must be based on the rated current of the drive rather than on its power. The drive output current must be greater than the rated current of the controlled motor.
- The rated motor voltage must be greater than 1/2 of the input voltage and the rated motor current must be 1/3 greater than the AD1000 output current.
- If a single drive supplies several motors, an AD1000 with a 10% greater output current compared to the sum of the motor currents must be chosen. Provide for an independent hardware circuit breaker for each motor; the AD1000 internal software circuit breaker is not effective for multi-motor applications.
- If the multi-motor application requires some motors to be engaged and disengaged during drive operation, choose an AD1000 with an appropriate rated current value to manage the sum of the operating current of all the engaged motors and the start-up current of the motor/s that must be engaged.
- Start-up and acceleration torque of a motor controlled by a drive is limited by the maximum current of the drive. Choose an oversized drive if high initial torque is required.

3.4 Application notes

- If the application requires a motor side contactor, the contactor must only be switched when the drive is disabled. The contactor must be interlocked with the drive run logic.
- In the event of AD1000 failure, the motor shaft turns freely; if this is not permissible, provide a mechanical brake.
- When power is supplied by a generator, make sure that the generator is able to contrast the harmonic distortion generated by the drive.
- The AD1000 has an "OV Control" function; using it can cause extremely high temperatures. If said function must be used frequently, make sure the motor is appropriately sized or contact the manufacturer.

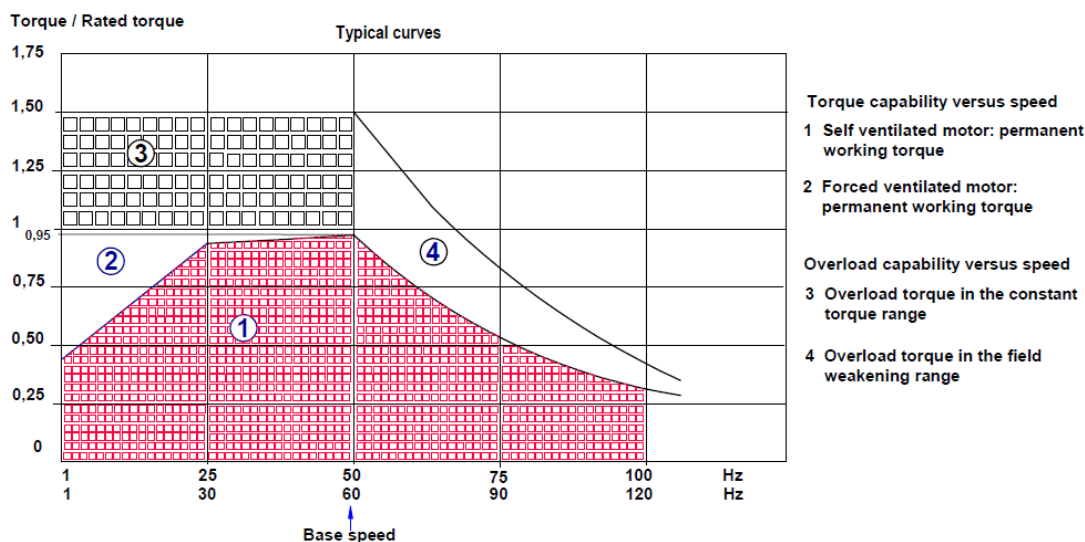
3.5 Applications with special motors

- Motors with brake. The brake must have an independent electrical power supply. When the brake is engaged, the drive must be disabled.
- Motors with conical rotor. The brake is controlled by the motor's magnetic field; if necessary, add or adjust boost; in some cases, it might be necessary to use a larger drive.
- Motors with double winding. The drive output current must be greater than the rated current of every motor winding. Winding can be switched when the motor is stopped and the drive is disabled.
- Classified motors. The drive cannot be used in atmospheres with the risk of explosion or fire. If the motor and the drive must be used in such atmospheres, both must have explosion-proof execution.
- Transmission joints. The lubrication system and the rotation limits vary from manufacturer to manufacturer; with lubricating oil, frequent low speed operation can cause overheating due to insufficient lubrication. Ask the manufacturer about the possibility of prolonged operation at these speeds.
- Submersible pumps. The rated current of these motors is greater than the standard.
- Single phase motors. AD1000s are not designed to control single phase motors.

3.6 Motor selection

When selecting a motor, make sure that:

- **Natural resonance.** The vibration can be minimised by using a flexible coupling or positioning a rubber damper at the base of the motor. The drive can prevent critical frequencies.
- **The AD1000** supplies variable frequency control. The motors and the loads must be able to function beyond the field of speed and power supplied by the drive.
- **Noise** The noise of the motor powered by the drive exceeds the one powered by the mains (Drive switch frequency = 1.5kHz). Using an output reactor or sinusoidal filter reduces or eliminates the noise increase.
- **Protect the motor windings and bearings** The output voltage of modern IGBT drives, in relation to the output frequency, has pulses with a value of about 1.35 the mains voltage with a very brief leading edge. Depending on the cable features, the pulse voltage can be doubled at the extremities of the motor; this can cause additional motor insulation stress. Modern PWM drives, with their high leading edge pulses and the high switching frequencies can cause shaft currents via the motor bearings that can gradually erode the bearing spheres. Using dv/dt filters can prevent motor insulation stress. Dv/dt filters also reduce shaft currents on the bearings. To prevent damage to the motor bearings, there must insulated bearings (side opposite coupling) and output filters per the table on the following page. Furthermore, select the cables and install them according to the instructions in this manual.
- **Ventilation.** Motor ventilation must be suitable for the expected field of operating speed. Prolonged operation at low speed requires additional motor cooling (see diagram section ① - ②).
- **Overload.** The motor must be able to supply adequate overload torque in the field of operating speed (see diagram section ③ - ④).



- For speeds greater than base speed, contact the motor manufacturer to check operation.
- During operation in overspeed, vibrations can occur due to rotor imbalance or load vibrations. When the motor is powered by the drive, noise can increase.



- **Motor self-excitation.** This phenomenon is destructive and dangerous, it damages the machine and can occur if an LC filter is connected to the drive output and is not properly sized.

Should an LC filter be used, before connecting the drive to the motor, make sure that the current absorbed by the group of capacitors of the drive output LC filter is 90% less than the motor empty current (find the capacity value from the panel functional diagram).

This condition must be checked to prevent the motor from self-exciting, with subsequent serious damage both to the machine and the operator.

- **Motor insulation.** Table 3.6.1 illustrates how to choose the motor insulation system and, when necessary, the dv/dt filters and the insulated bearings on the side opposite the coupling.

The motor manufacturer must be consulted as regards insulation. Failure of the motor to meet the requirements in the table or improper installation can reduce motor lifespan or damage the bearings.

Table 3.6.1

Motor type	Rated mains voltage	Requirement for	
		Motor insulation system	Dv/dt filter, insulated bearing
Random winding and Form winding	500 V < UN < 600 V	Reinforced: $\dot{U}_{LL} = 1600$ V or Reinforced: $\dot{U}_{LL} = 1800$ V	+ dv/dt + N + LCMF + N + CMF
	600 V < UN < 690 V	Reinforced: $\dot{U}_{LL} = 1800$ V	+ dv/dt + N + LCMFF
Form winding	600 V < UN < 690 V	Reinforced: $\dot{U}_{LL} = 2000$ V, rise time 0.3 μ s	N + CMF

NOTE 1

The abbreviations used in the table are defined below.

Abbreviation	Definition
UN	Rated voltage of the power supply
\dot{U}_{LL}	Peak-to-peak voltage at the extremities of the motor that the motor insulation must resist
PN	rated motor power
dv/dt	dv/dt filter at drive output
CMF	common mode filter (3 toroidal ferrites)
LCMF	light common mode filter (1 toroidal ferrite)
N	Insulated bearing on the side opposite to the coupling
N.A.	Motors in 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 requests for explosion-proof motors (EX).

NOTE 3 - LARGE MOTORS AND MOTORS IN IP 23

For motors with rated power greater than the one established by the EN 50347 (2001) standards for a particular axis height and for motors with an IP 23 degree of protection:

- apply the same criteria for the "100 kW < PN < 350 kW" range to motors in the 40 kW < PN < 100 kW range.
- apply the same criteria for the "PN < 350 kW" range to motors in the "100 kW < PN < 350 kW" range.

NOTE 4 - OPERATION WHEN BRAKING

When the drive is braking, for a good part of this operation, the voltage of the intermediate circuit in DC increases; the result is equivalent to a 20% increase in the mains voltage. Said increment must be considered when establishing the insulation requirements.

Example: For a 400V motor, insulation criteria for a 480V power supply must be adopted.

4 GENERAL INFORMATION

The customer must see to training personnel on the risks of injury, the safety devices and the general rules of prevention and protection dictated by European directives and legislation in force.



Operating personnel must be aware of the position and function of all the drive controls and features. They must also have thoroughly read this manual and the reference documents of the machines that make up the system.

4.1 Technical standards applied

The AD1000 drive was designed, built and tested in compliance with the "ESSENTIAL SAFETY REQUIREMENTS" contained in Annex I of European Directive 2006/42 EC.

The following table shows the Technical Standards used as references to design, build and test the drive.

4.2 Standard of reference

IEC 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 EN 61800-3 ED.2 (2005-04)	Adjustable speed electrical power drive systems – Part 3: EMC requirements and specific test methods
IEC EN 61800-5-1 ED.2 (2009-04)	Adjustable speed electrical power drive system – Part 5-1: Safety requirements – Electrical, thermal and energy.
IEC EN 60529 ED.2.1 (2001-02)	Consol. with Amd1 Degrees of protection provided by enclosures (IP).

4.2.1 CE marking

AD1000 drives bear the CE marking to certify that the product complies with the requirements of European Directives on low voltage (Directive 73/23/EEC amended by Directive 98/68/EEC) and on electromagnetic compatibility (EMC) (Directive 89/336/EC amended by Directive 93/68/EEC). The validity of the CE marking for EMC is subject to using the AD1000 based on the recommendations in this manual.



4.2.2 UL certification

The AD series is certified for the American and Canadian market.

The AD1000 is compliant with the UL certification requirements if the following is complied with.

1. Use Class 1 65 / 75°C (140/167°) copper cables or rods with the cross-section cited in this manual based on drive frame.
2. The power supply capacity must not exceed the values contained in Tables 5.4.1.1 and 5.4.1.2
3. Terminal tightening torque and cable cross-section are found in chapter 5.
4. Chapter 5 has the calibre of the distribution fuses.
5. The cables must be connected using UL-marked, CSA-certified eyelet crimp terminals. The crimp terminals must be secured using the pliers indicated by the manufacturer. See chapter 5 for the type of crimp terminal.
6. The AD1000 drive requires motor overload protection that can be calibrated between 5% and 150% of the rated motor current at full load. For information on calibrating the trip threshold to overload time etc., see paragraph 2.5, table 2.5.1 and the programming manual.
7. The AD1000 drive requires overload static protection at drive output and DC side short circuit static protection.



4.3 General information

4.3.1 General safety requirements

This section contains information on the required, useful safety for personnel working with the AD1000.

The information is generic and regards the risks, both for operators and for maintenance personnel, of drive operation and maintenance.

Failure to comply with these standards can compromise people's safety, with the risk of death and of damaging the drive, the motor or the operating machine.

Read the safety instructions before working with the unit.



All electrical and installation operations on the AD1000 must be done by qualified technicians.

All the standard electrical safety procedures must be followed:

- Never touch anything inside the drive until you are sure that it is not extremely hot and/or live.
- Always wear insulated or rubber accident-prevention shoes and protective glasses.
- Never work alone.
- Never connect grounded measurement devices or oscilloscopes to the system.
- Never remove the safety screens.
- Always use extreme caution when handling components or working inside the panel.

HAZARD!

- The AD1000 and all other connected devices **MUST BE PROPERLY GROUNDED**.
- The voltage on the AD1000 output terminals are dangerous both when the drive is active and when it is not working.
- Furthermore, consider that the motor can turn at any time as soon as the power supply is connected and the capacitor battery is charged.
- If the drive is installed in the panel, never allow it to run when the panel doors open.

HAZARD! RISK OF FIRE, SERIOUS DAMAGE!

- The drive does not have internal fuses; as such, provide appropriate fuses (see paragraph 5.4.1 for calibre and type) immediately upstream of the drive. Do not use fuses other than those specified: incorrect fuses can cause fires, serious damage to personnel, equipment and/or nearby connected parts. Some units require auxiliary fuses for the separate lines corresponding to the fans and auxiliary circuits.
- Do not power the drive if you think moisture, dust or caustic/corrosive chemical agents have penetrated the container or the components.

HAZARD! RISK OF FIRE, SERIOUS DAMAGE OR INJURY!

- AD1000s are open type devices and must be installed strictly following the instructions in this manual and in total compliance with the existing standards and regulations.
- Never store flammable material inside, on or near the drive.

THE FOLLOWING IS ABSOLUTELY PROHIBITED



- Running the drive with voltage 10% greater than the rated value.
- Applying power to the AD1000 output terminals.
- Connecting the AD1000 in parallel directly on the output terminals.
- Connecting capacitive loads to the AD1000 output terminals.
- Connecting the drive input to the output (Bypass).
- If the drive is not powered within two years, it might be necessary to reformat the electrolytic capacitors. Do so by charging the AD1000 when it is not enabled (Drive Enable open) for at least two hours (see paragraph 7.6).

HAZARD! RISK OF DEATH OR ELECTRIC SHOCK!

The safety points below must be strictly followed before servicing the unit:



- Do the electrical power supply lock/exclusion procedure and open the main panel cut-off switch.
- Make sure that all power supplies feeding the AD1000 (main and auxiliary power supplies) are disconnected before servicing the drive.
- Wait at least ten (10) minutes after having disconnected the power supply before servicing the unit. Before accessing the motor terminals, make sure that the DC bus capacitors are discharged: use a multimeter calibrated for 1000Vdc or greater to make sure the DC voltage is less than 50V. Refer to the safety plate on all the drives.
- The braking switch output terminals have dangerous DC voltages (greater than 500V).
- The AD1000 is equipped with many automatic reset and restart functions that can automatically restart the unit. Do not activate these functions if hazardous situations can arise.
- Do not change the insulation distances or remove insulating materials and coverings.
- The AD1000 supplies variable frequency control. The motors and the loads must be able to function in the field of speed and power supplied by the drive.
- Coordinate the rated voltage and current of the motor and the drive. The rated motor voltage must be greater than 1/2 of the input voltage and the rated motor current must be 1/3 greater than the AD1000 output current.
- Regardless of the output frequency, the AD1000 generates a pulse output voltage with a peak value of about 1.4 times the AC input voltage with very brief rise times. The voltage of said pulses can nearly double, based on the cable features, on the motor terminals: make sure that the output cables and the motor insulation are designed to resist additional stress.
- If insulation tests must be conducted on the motor and the cables, first disconnect the cables from the drive. High potential tests must not be conducted on AD1000 components.
- Take care not to damage any parts of the AD1000 during handling.
- Protect the drive from the elements and adverse environmental conditions (temperature, humidity, vibrations, collisions, etc.). Special precautions must be taken if the drive needs to be temporarily stored outdoors (see Chapter 5).

The AD1000 contains components that are sensitive to electrostatic charges; said components could be damaged if not handled appropriately. Appropriate precautions against electrostatic discharges (ESD) must be taken when servicing or replacing the electronic boards:



- Use a maintenance kit for electrostatic charges.
- Wear appropriately grounded static belts.
- Handle the boards holding them by the edges.
- The boards must not come into contact with highly insulating materials like plastic sheets, insulating surfaces, synthetic fabric parts.
- The boards must only be positioned on conductive surfaces.
- The boards must be packaged in conductive sheets before being shipped.



- The IGBT modules are sensitive to electrostatic charges. Handle with care to prevent damaging them. Do not leave the gate-emitter control terminals open. Short circuit said pins with an antistatic sponge or with a metal bridge when they are not connected to the control board. Remove the short circuit when they are reconnected to the control board. Do not touch the device pins with your fingers.

4.3.2 Requirements in the event of electrical installation

ELECTRICAL INSTALLATION

Electrical maintenance and installation operations on the AD1000 must be done by qualified technicians.



All the standard electrical protection procedures must be followed:

- Never touch anything inside the drive without first having made sure it is not thermally hot or live.
- Always wear insulated or rubber accident-prevention shoes and protective glasses.
- Never work alone.
- Never connect grounded counters or oscilloscopes to the system.
- Never remove the safety screens.
- Always use extreme caution when handling components or taking measurements inside the panel.

HAZARD! RISK OF FIRE, SERIOUS DAMAGE OR INJURY!

- The drive does not have internal fuses. As such, provide appropriate fuses immediately upstream of the drive. See paragraph 5.4.1 for calibre and type. Never use fuses other than those indicated or run the drives without line fuses. Incorrect fuses can cause fires, serious damage to the equipment and/or to nearby connected parts, as well as possible injuries. Some units (see paragraph 2.8 and paragraph 5.4.2) require separate line fuses for fans and auxiliary circuits.
- Do not power the drive if moisture, dust or caustic/corrosive chemical products may have penetrated the panel or the internal components.

HAZARD! RISK OF FIRE, SERIOUS DAMAGE OR INJURY!

- AD1000 drives are open type devices and must necessarily be installed following the instructions in the MANUAL, in full compliance with the standards and regulations in force.

HAZARD!

- The AD1000 and all connected devices **MUST BE APPROPRIATELY GROUNDED**.

HAZARD! RISK OF DEATH OR ELECTRIC SHOCK!

The following safety measure must absolutely be adopted before installing.



- Do the electrical power supply lock/exclusion procedure and open the main drive cut-off switch.
- Do not change the insulation distances of the material and the removed coverings.
- If insulation tests must be conducted on the motor and cables, disconnect the cables first of all from the drive before proceeding. High potential tests must not be conducted on the drive components.
- Repeatedly powering and disconnecting the drive in quick intervals using the line contactor reduces the lifespan of the filter capacitors. Cycles with more than 10 manoeuvres per hour can burn the pre-load resistor and consequently, seriously damage the drive. Never use this system to start and restart the drive.
- Power supply via generator. The harmonics generated by the drive can deform the generator voltage and cause it to overheat. It is advisable to provide a generator with power about 5 times greater than the drive in kVA.
- If a contactor is installed on the drive output, make sure it opens and closes when the drive is disabled.
- Do not power the output terminals.

The AD1000 contains components that are sensitive to electrostatic charges; said components could be damaged if not handled appropriately. Appropriate precautions against electrostatic discharges (ESD) must be taken when servicing or replacing the electronic boards:



- Use a maintenance kit for electrostatic charges.
- Wear appropriately grounded static belts.
- Handle the boards holding them by the edges.
- The boards must not come into contact with highly insulating materials like plastic sheets, insulating surfaces, synthetic fabric parts.
- The boards must only be positioned on conductive surfaces.
- The boards must be packaged in conductive sheets before being shipped.



- The IGBT modules are sensitive to electrostatic charges. Handle with care to prevent damaging them. Do not leave the gate-emitter control terminals open. Short circuit said pins with an antistatic sponge or with a metal bridge when they are not connected to the control board. Remove the short circuit when they are reconnected to the control board. Do not touch the device pins with your fingers.

4.3.3 Regulations in the event of maintenance

SAFETY PRECAUTIONS



All electrical maintenance and installation operations on the AD1000 must be done by qualified technical personnel. Nidec ASI S.p.A. is not liable for damages due to improper or unauthorised maintenance.

HAZARD! RISK OF DEATH OR ELECTRIC SHOCK!

The following safety measure must absolutely be adopted before servicing the unit:

- Do the electrical power supply lock/disabling procedure and open the main cut-off switch of the panel containing the AD1000.
- Make sure that all electrical power supplies feeding the AD300 (main and auxiliary power supplies) are disconnected before servicing the drive.
- Before servicing the machine, wait 10 minutes after having disconnected all the electrical power supplies and make sure the DC voltage is less than 50V. Use a 1000 Volt DC or greater multimeter.

Refer to the safety label located on each drive.

The AD1000 contains components that are sensitive to electrostatic charges; said components could be damaged if not handled appropriately. Appropriate precautions against electrostatic discharges (ESD) must be taken when servicing or replacing the electronic boards:



- Use a maintenance kit for electrostatic charges.
- Wear appropriately grounded static belts.
- Handle the boards holding them by the edges.
- The boards must not come into contact with highly insulating materials like plastic sheets, insulating surfaces, synthetic fabric parts.
- The boards must only be positioned on conductive surfaces.
- The boards must be packaged in conductive sheets before being shipped.



- The IGBT modules are sensitive to electrostatic charges. Handle with care to prevent damaging them. Do not leave the gate-emitter control terminals open. Short circuit said pins with an antistatic sponge or with a metal bridge when they are not connected to the control board. Remove the short circuit when they are reconnected to the control board. Do not touch the device pins with your fingers.

4.3.4 General information - standards

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

It is the responsibility of the customer, the integrator/user or the person incorporating, installing, commissioning, running and servicing the AD1000 to guarantee that personnel in charge of the different operations be adequately trained on the risk of accidents, on the safety devices and on the general accident-prevention rules provided by the European Directives and legislation in the country where the AD1000 is installed, incorporated and used.

Incorporating/integrating/installing, commissioning, running and servicing the AD1000 must only be done by qualified, experienced and trained people, having the technical knowledge and adequate qualifications (in compliance with EN50110-1 and/or any valid regulations in the country where the AD1000 is used) for low and medium voltage electrical equipment and systems.

Personnel in charge must have thoroughly read this manual and all user and maintenance manuals of the machine/system/set in which the AD1000 is incorporated/installed; in particular, personnel must know and have experience with the operating features and position of all the AD1000 controls.



WARNING

The AD1000 supplied by Nidec ASI S.p.A. is exclusively intended for professional use by trained, informed, educated personnel qualified to correctly incorporate, install and use it.



HAZARD

Unauthorised tampering with or replacing one or more parts of the AD1000, using accessories that modify its use and using spare parts other those specified can lead to injuries.

4.3.5 Applied directives and declaration of incorporation

The AD1000 was designed, built and tested in compliance with the following community directives:

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

Below 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:	AV.72
Anno di Costruzione:	20...

è conforme alle direttive applicabili vigenti.

I requisiti essenziali di sicurezza (RES) applicati ripetitivi sono 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 - 1.5.5 - 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'impone 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 intestata 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 (firmato per suo conto)

Nome: _____

Funzione: _____

Firma: _____

Milano,

4.3.6 *Intended use and limits of use*

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

It was designed, built and tested to be integrated or incorporated into electrical systems, installations or equipment of machines. Using the AD1000 as finished equipment not incorporated in an installation or machine is not intended nor permitted; in this regard, it is prohibited to commission the AD1000 before the assembly/system/machine in which it is to be incorporated has been declared in compliance with the provisions of Machinery Directive 2006/42/EC and of the Directives applicable to the assembly/system/machine. It is the responsibility of the customer and/or of the integrator/user, throughout the period in which he/she is in charge of the activities regarding the AD1000 (including, but not limited to, the system integrator for incorporation and installation, the system or plant or machine user during running, the person in charge of dismantling during disposal) to arrange and implement the necessary access restrictions and train the personnel authorised to access on the risks of injury, on the safety devices and on the general rules with regard to accident-prevention provided by the current standards and legislation.



HAZARD

Using the AD1000 with power supplies not provided by the manufacturer constitutes improper use. In this regard, the manufacturer declines all liability in case of damages to property and/or people and voids any warranty.



HAZARD

Using the AD1000 for uses not expressly provided for and documented by Nidec ASI S.p.A. or in environmental, electrical, mechanical, physical, hydraulic conditions different to those prescribed by Nidec ASI S.p.A. constitutes improper use. In this regard, the manufacturer declines all liability in case of damages to property and/or people and voids any warranty.



HAZARD

The manufacturer declines all liability in case the AD1000 is tampered with for modifications or maintenance operations not authorised by the manufacturer and/or performed by unqualified, untrained, uninformed personnel.



HAZARD

Any type of intervention in case of abnormal AD1000 behaviour is the sole competence of qualified operators in charge of maintenance and duly trained.

4.3.7 *Danger zones*

The AD1000 is intended to be incorporated/installed/assembled into another machine/plant/assembly/system and used by qualified personnel who are duly trained to incorporate/install and use it and that know the rules and regulations relating to electrical work (low and medium voltage), the laws and technical rules regulating such work and the risks present.

The AD1000 features groups or parts considered dangerous due to electric, thermal and power hazards; all areas considered dangerous have been isolated and must be kept as such in order to prevent access when the AD1000 is operational, including when switching it on and off.

Access to the AD1000 must be prevented to generic personnel with the means prescribed by the applicable laws in force with regard to safety: it can only be accessed by specifically trained technical personnel with adequate knowledge of AD1000 operation, of how to interrupt and put into safe conditions all of the system's electrical power supplies in which the AD1000 is integrated/incorporated/installed, of the position and operation of all local and remote controls and who thoroughly know the operative process and sequences and the related risks.

It is also essential for the technical personnel authorised to access the AD1000 to have full knowledge of this manual and of all manuals of the system/plant/machine of which the AD1000 is a part; said personnel must have, therefore, thoroughly read this Manual and all User and Maintenance Manuals of the machine/system/assembly in which the AD1000 is incorporated/installed.

**HAZARD**

The safety prescriptions in this chapter must be respected and all operations must be performed following the instructions contained in this manual, as herein provided and specified, in order to be able to access and work in the dangerous areas.

The dangerous areas can only be accessed by personnel authorised and qualified to perform these interventions, with adequate electrical qualifications (EN50110-1) and technical knowledge, and knowledge of low and medium voltage systems and equipment.

In order to limit the risks in dangerous areas, some appropriate prevention and protection measures have been taken; it is mandatory to follow the instructions in this manual, regarding "Personal Protective Equipment" (PPE) and how to operate on the AD1000.

**HAZARD**

When the AD1000 was being designed, the various risk factors that can arise during incorporation, commissioning, operation and maintenance were assessed and corresponding prevention and protection measures were put into place; said measures are prescribed in this manual and all personnel who work on the AD1000 are obliged to follow them.

4.4 Environmental working conditions

The environment where the AD1000 is incorporated/installed/integrated must be a machine, system, site or room sheltered from the elements like rain, hail, snow, fog, suspended dust, combustible dust and must not be a classified environment, etc.

The AD1000 must be positioned in a non-classified environment, equipped with all the safety arrangements deriving from the laws in force in the user's country.

Using the AD1000, the associated control systems and the activation equipment in different environmental conditions to those specified in this manual is not permitted.

Specifically, the AD1000 must work in the specific environmental conditions indicated in 2.4.

4.4.1 Vibrations

See 2.4

4.5 Environmental storage conditions

See 2.4

4.5.1 Storage site

The AD1000 was designed for indoor environments with a degree of pollution less than or equal to 3 (IEC EN 61800-5-1), in a non-aggressive atmosphere, to be installed in an industrial site. Temperature, humidity and vibrations must be respected as set out in this Manual.

Standard packaging is not designed for periods longer than what is normally expected for commissioning.

The equipment must be kept in its original packaging and in a clean dry place. If the storage site does not fall within the standard specifications, special packaging and protective devices can be agreed upon with Nidec ASI S.p.A.

The equipment must always be protected with tarpaulins/air tight covers; also make sure that the environmental parameters (particularly temperature and humidity) remain within the above range.



WARNING

Do not attempt to open the packaging during storage.

Loss of integrity or seal, regardless of how small, can damage the AD1000.

Any actions, including tampering, incorrect use and/or damage to the package, constitute incorrect use.

4.6 Fixed protections

The AD1000 is fitted with fixed guards that require the use of special tools to remove them. The fixed guards consist of panels and doors that are part of the AD1000. The guards prevent access to the internal parts of the AD1000 while it is operating.



HAZARD

Restarting the AD1000 after maintenance without properly replacing the fixed guards is absolutely prohibited.

The AD1000 has a ventilation system fitted with fixed guards (grids); these, positioned in the suction/delivery areas with exclusive access for maintenance, require the use of special tools to remove them.



ADDITIONAL INFORMATION

Periodically check the integrity of the fixed guards and the corresponding fastenings to the structure.

4.7 Personal protective equipment (PPE)

Personnel in charge of incorporation, installation, use and maintenance, who carry out the different tasks allowed on the AD1000 must use the personal protective equipment that decrease any possible risks deriving from doing different tasks, such as:

- Helmet with head and face protective visor.
- Safety goggles or mask to protect from splinters, dust.
- Masks to protect from electrical phenomena, fumes, inhalation, etc.
- Accident-prevention and insulating gloves and shoes, if necessary.
- Hearing protection.
- PPE and equipment provided for electrical work as prescribed by IEC 11-27 – EN50110-1, including: Insulating Gloves, Visor, Goggles, Dielectric Helmet, Insulating Boots, Insulated Tools, voltage tester, etc.



WARNING

The clothing of those operating or servicing the AD1000 must comply with the essential safety requirements of European Directives 89/656/EEC and 89/868/EEC and the laws in force in the country where the AD3000 is incorporated/installed.



HAZARD

During management and maintenance operations, personnel must be experienced, informed, have obtained employer qualification and authorisation, must wear adequate work clothes to be able to prevent accidents from occurring, and must know the risks and problems in working with low and medium voltage systems.

In order to avoid electrical or mechanical risks, wearing bracelets, watches, scarves, rings or chains during any tasks (incorporation, installation or maintenance) near the AD1000 is prohibited.

Reference standards:	IEC EN60903 for Insulated Gloves
	UNI EN 166 – 168 - 170 for Visor-Goggles
	IEC EN50365 for Dielectric helmet
	UNI EN 340 – UNI EN ISO 11612
	IEC EN 614821-1-2 for clothing
	IEC EN 50321 for Insulated blocks
	IEC EN 60743 - IEC EN 60900
	IEC EN61243-1-2 for Tools



HAZARD

In executing work that may give rise to the projection of splinters or dangerous materials (splashing of products) or electrical risks (in Low and Medium Voltage) for themselves or for others working nearby, operators must arrange, or request from those in charge, shields or other adequate safety measures (EN50110-1).



WARNING

It is the specific responsibility of the final integrator/user to make sure that personnel in charge are duly trained on the residual risks related to the treated process and use the PPE listed in the product safety sheets, as well as those listed here.

4.7.1 Residual risks

In the design phase, all risky areas or parts were assessed and, consequently, all necessary precautions were taken in order to avoid risks to people and damage to the AD1000 components, as shown in previous paragraphs.



WARNING

Periodically check operation of all safety devices. Do not dismantle the fixed or mobile guards of the AD1000.
Do not bring outside objects or tools into the AD1000 operating area.

Although the AD1000 is fitted with the above safety systems, there are some risks that cannot be eliminated but can be reduced through corrective actions by the final integrator and proper operating methods that are mandatory for anyone working on the AD1000.

Below is a summary of the risks remaining on the AD1000 during:

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

4.7.2 Impact and crushing

Do not access the moving parts.

Before connecting the electrical power supplies, make sure there is no maintenance in progress on the AD1000.

4.7.3 Shearing

Risk of shearing may occur, mainly following the operator approaching the cooling system area, with parts moving only if the guards on the moving parts have been removed, such as coupling joints, guards of the pump motors motorisations or of the impellers or suction and delivery fans. Before connecting the electrical power supplies, make sure there is no maintenance in progress on the AD1000.



WARNING

Removing the safety protections or opening parts of the AD1000 equipped with inspection hatches with fixing screws without having previously isolated the control panel and all power supplies on the AD1000 is absolutely prohibited.
Do not bring outside objects or tools into the AD1000 operating area.

4.7.4 Electrocutation

- Risk of the electrical equipment components breaking or being damaged following a short circuit, with possible lowering of the safety level.
- Before connecting the power supply, make sure that there is no maintenance in progress and that nobody is working on the AD1000.
- The AD1000 is fitted with warning and indication signs on the manuals that highlight the risk of electrocution and make the procedure for securing the AD1000 mandatory, before doing any work on it.



WARNING

It is strictly forbidden to carry out whatsoever electrical adjustment as it may create unexpected additional dangers and risks.

4.7.5 Fire

The plastic materials used (e.g. sheaths, electric cables) are self-extinguishing and conform with current Standards.

As it must be incorporated/integrated into a machine/system/plant/assembly, the AD1000 is not fitted with its own fire protection system.

- The user must assess the need for a suitable fire protection system in the site/establishment and/or room where the AD1000 is incorporated/installed, in compliance with the fire safety and prevention standards in force in the country of use and with the establishment's in-house regulations. Do not use open flames or smoke near the AD1000.



HAZARD

In case of fire, always disconnect the main power supply line switch.



WARNING

It is the final user's specific responsibility to install and evaluate the most appropriate fire protection system and, overall, depending on the country of use, the regulations in force and the site/establishment conditions.

4.7.6 Explosive atmosphere

The AD1000 is not suited to working in explosive or classified environments. The AD1000 is not, therefore, suited to working in the following environments:

- completely or partially explosive;
- classified;
- where there are corrosive atmospheres;
- where there is a high concentration of dust;
- where there are high concentrations of oil in suspension;
- where there is a risk of fire deriving from any trigger material or source.

Using the drive in all the above described environments or, in any case, in environments different from what is described in this chapter is absolutely prohibited.

4.7.7 Blinding

Risk mainly present during maintenance and cleaning and in case of accidental contact with the product during cleaning, when removing accumulated dust or dirt.

When cleaning the AD1000 with compressed air, personnel in charge must always wear special protective glasses.



WARNING

It is mandatory to use eye protection.

Use visors to protect the eyes and face also when doing any electrical/mechanical maintenance on the AD1000.

4.7.8 Falling and/or expulsion of objects

- Avoid even temporarily leaving work tools and objects along and on the AD1000 in order keep them from falling or being projected.
- Caution: before opening any hatches locked with coded keys, disassembling panels or, in any case, accessing any part of the AD1000, disconnect and cut off all power supplies to the AD1000 (medium and low voltage side) using the operating means specifically provided by the system installer/integrator.

4.7.9 Tripping

Messily storing material can generally constitute a tripping hazard and can partially or totally restrict escape routes, should they be needed.

- Make sure operating spaces, transit paths and escape routes are free from obstacles and in compliance with the current regulations.

4.7.10 Circuit faults

Because of possible damages, the safety circuits may lose part of their efficiency, leading to a lower safety level.

- Periodically check the operating status of the safety devices on the AD1000.

4.7.11 Lighting

The final integrator/user must provide a proper lighting system (in addition to any already in place) in the AD1000 maintenance/operational areas, respecting the applicable regulations in force in the user country and according to the European Directives. There must be no shadowy areas, bothersome blinding effects or stroboscopic effects on the elements as a result of the lighting.

In the event of a power supply shortage (or poor lighting), an average lighting of at least 500 lux, which is the user/customer's responsibility, is advised.

If additional lighting is required for special and infrequent maintenance operations, considering the extreme rarity of such operations, it will be the user's responsibility to take care of it via portable safety lamps (charged at 24 Vdc and not included in the supply).

4.7.12 Noise

Personnel who must access the AD1000 area while the equipment is operational are advised to use the proper hearing protection devices.

4.7.13 Vibrations

During normal operation, the AD1000 does not present dangerous vibration conditions for the operator.

Any excessive or abnormal vibrations may be associated to a malfunction of the rotary part of devices such as pumps, etc.

Should this condition occur, immediately inform the maintenance personnel and stop the AD1000 for testing/repair.

4.8 Additional hazard instructions

**HAZARD**

- Risk of death or electric shock.
- All operations must be performed exclusively by qualified personnel.
- The panel is connected to more than one power source.
- Lethal voltages can exist even if all supplies are disconnected. Wait 10 minutes before beginning to put the machine in safe conditions.

**HAZARD**

Never modify the protection regulations established by the Manufacturer.

**HAZARD**

Never perform any routine or special maintenance operations with live circuits.
Always de-energise all supply circuits beforehand.

**HAZARD**

The AD1000 is not equipped with any cut off and/or isolating devices on the engine side and internal circuits.
All AD1000 electrical connection terminals must always be considered live unless the operating means (not supplied by Nidec ASI S.p.A.) for the installation in which the AD1000 is incorporated and/or integrated ensure the power supply on the motor side and on the low and medium voltage power supply side is cut off.

**HAZARD**

Never work on the motor unless having first verified that the entire AD1000 has been de-energised.

**HAZARD**

The AD1000 does not have interlocks, extractable drawers or other safety devices to isolate and ground conductors coming from the outside.
The AD1000 is connected to more than one power supply. These power supply sources can be independent from each other. Before accessing any part of the AD1000, it is essential to disconnect, cut off, lock and ground all the power supplies connected to the AD1000.

**HAZARD**

Disconnecting the power supplies involves system or machine parts outside the AD1000.
The procedure to disconnect the AD1000 power supply must be indicated by another document drafted by the system integrator and/or user/customer, which must indicate how to work on these parts.

**HAZARD**

It is the task and responsibility of the system integrator and/or installer/user to indicate the procedure describing how to disconnect and secure the AD1000 power supplies and defining the operating and disconnecting means and their position in the machine or system.

**HAZARD**

Many of the actions described in this Instructions manual require operating inside the AD1000.

Access is only admitted to qualified technicians who are aware of the risks of electric shock, of the safety rules and of the normative regulations required. More specifically, technicians enabled to such tasks must:

- Have specific competence in the electronic power drive field.
- Be authorised by the final system integrator to work on the AD1000 on site.
- Be familiar with the safety concepts and always work in accordance with the installation site, the applicable laws, the safety rules and standard regulations.
- Know the local power supply system in detail, particularly at AD1000 input and output to the motor, the position and operation of the switches (switch-off) and of the disconnecting switches of the site where the equipment must work, the power supply sequence and grounding methods.
- Always read, understand and keep this manual and the wiring diagrams on hand.
- Understand the operating sequences, especially Start and Stop, AD1000 power supply and disconnection and the disconnection sequence of the power parts involving the AD1000.

**HAZARD - RISK OF INAPPROPRIATE CONNECTION AND USE**

- A. Caution! Do not modify any AD1000 parts.
Risk of death, fire or serious damage to personnel may occur if any part of the AD1000 is modified or tampered with.
- B. Caution! The AD1000 must be adequately grounded before connecting any power supply sources and operating with the AD1000 itself.
 - Do not disconnect any earthing and/or connection cables.
 - Regularly check earthing during maintenance and whenever there are any doubts.

4.9 Additional warning instructions



WARNING

Make sure all personnel in charge of running the AD1000 are adequately trained in accordance with the correct safety procedures.



WARNING

Never work on this equipment when it is running if not for explicitly permitted operations (air filter change, etc.), always respecting the instructions in this manual or in the attached manuals.



WARNING

The AD1000 cannot operate with the covers disassembled or open.



WARNING

Do not remove or modify the guards, panels or safety devices.



WARNING

Never operate on the equipment when the power sources are connected or engaged. When operating on the equipment, disconnect the switches and lock them in the open position.



WARNING

Make sure that all safety devices are connected and in good operating conditions. Never modify or by-pass any of the alarm or stop devices.



WARNING

Both during maintenance and operation, we recommend paying attention to the temperature of the fan motors that may reach temperatures above 50°C during normal operation.



WARNING

The fans to cool the AD1000 generate a high air flow. If these fans are started during the filter replacement phase, with one or more casing panels removed, maintenance personnel would be exposed to a high air flow and acoustic noise.

Therefore, this task/function is prohibited by the manufacturer.

The user/integrator must provide appropriate "PPE" (such as ear plugs, earmuffs and face protection glasses) for exposed people.

4.10 Warning plates

Based on the various residual risks identified for the AD1000, Nidec ASI S.p.A. has fitted the equipment with hazard, warning and mandatory signs defined in accordance with the European standard on graphic symbols to be used on systems (Directive 92/58/EEC). The plates in question are located in easily visible positions.



WARNING

Removing the warning signs on the AD1000 is absolutely prohibited.

Nidec ASI S.p.A. declines any responsibility regarding AD1000 safety in the event of failure to comply with said prohibition.



WARNING

Following AD1000 installation in a machine and/or system/machine/assembly, the integrator/user or the final customer is responsible for any additional signs required based on the residual risks present.



WARNING

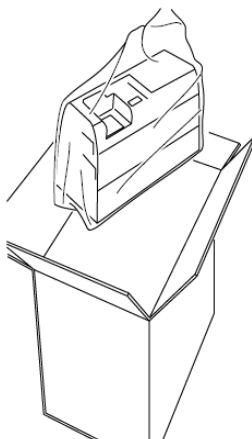
The integrator/user shall replace warning signs that have become illegible due to wear.

5 RECEPTION, STORAGE AND INSTALLATION

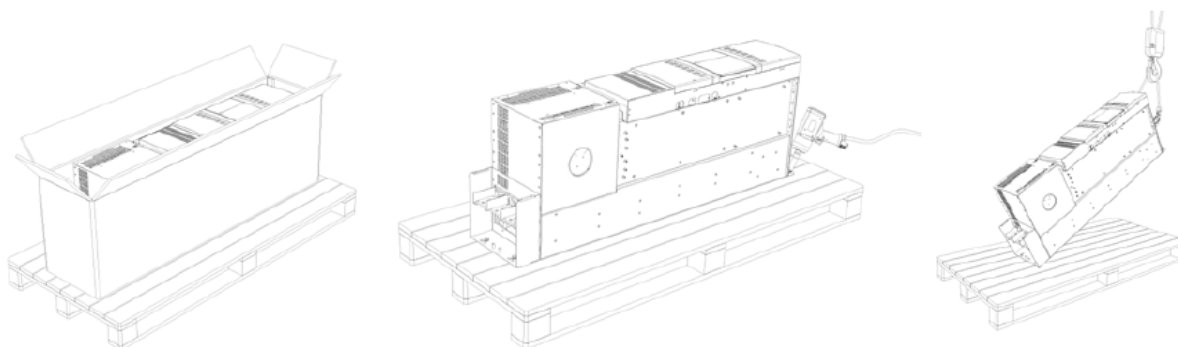
5.1 Receiving, unloading, unpacking and inspecting the AD1000

All the drives are thoroughly inspected and tested before being packaged and shipped from the establishment. Upon reception, the equipment must be inspected in order to find any signs of visible damage that may have occurred during transport.

The bill of materials must be checked carefully to make sure all the components have been received, including layouts and dimensional drawings.



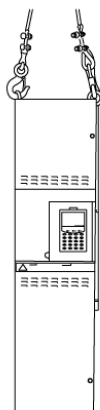
Frame I, II, III, IIIX, IIIL, IIIN handling



Frame VII ÷ VIII handling

Should any parts be damaged or missing, the purchaser must immediately present the courier with a claim and notify the establishment. After the initial inspections, the drive must be quickly transported to its final installation position or to an appropriate storage area. When handling or lifting the units, be careful not to twist or shake the system.

All the metal surfaces must be protected to prevent them from being damaged.



Frame IVN, VN, VIN handling

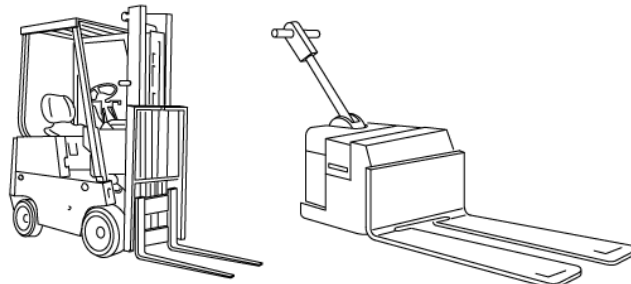


Figure 5.1.1 - AD1000 unloading and lifting methods

If the drive is delivered on a pallet, use a forklift with suitable forks.

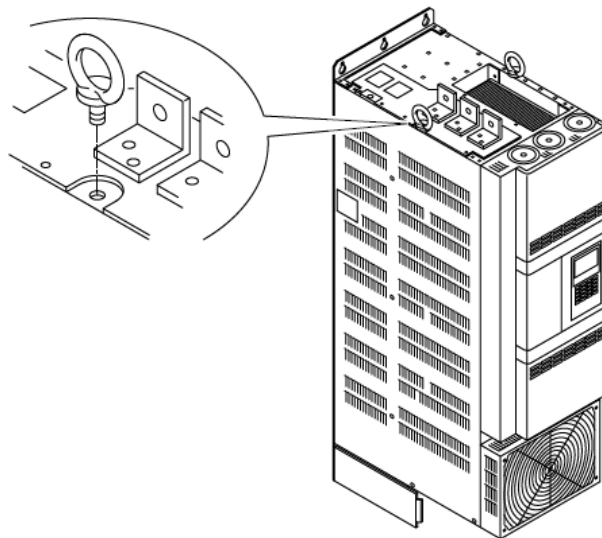
Forklifts must be used to transport the units to their installation position. The units must be lifted carefully from the pallet to the final position using a mechanical lifting device like, for example, a crane or forklift.

NOTE 1

Keep the protective packaging until installation and start-up are complete.

NOTE 2

For frames from AD1A210F to AD1A520F, once the drive has been installed in the panel, the lifting eyebolts must be removed.



5.2 Storage

After the initial inspection, the equipment must be immediately transported to its final installation position or to a dry, temperature-controlled storage area, protected from the elements. Although each drive is adequately protected from environmental conditions and the elements, there are environmental situations that can reduce performance, as well as lifespan. The drives are not waterproof and must never be stored outdoors.

Table 2.4.1 shows the nominal environmental conditions. Operators should contact the Nidec ASI S.p.A. production team with any doubts they might have for particular locations.

5.3 Mechanical installation

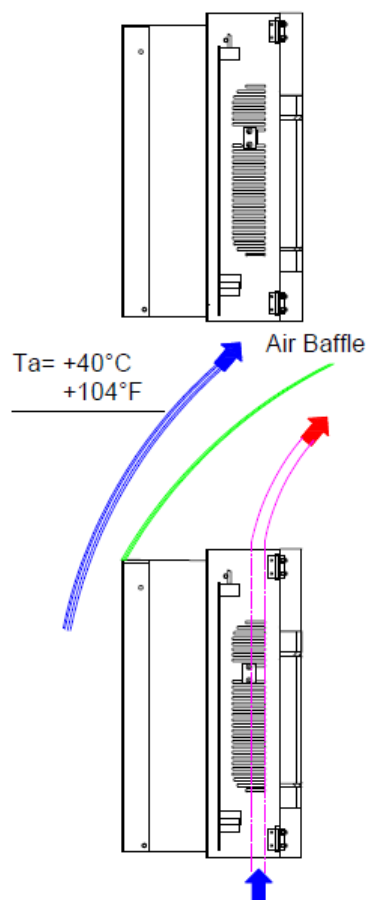
5.3.1 General precautions

- Do not install the drive on surfaces subject to vibrations.
- There must be no dust, metal particles, oil in suspension, gas and jets of corrosive liquids where the drive is installed.
- The drive must always be installed upright. Do not assemble the unit with an incline greater than + 30% with respect to the vertical plane.
- If more than one drive is installed in the same panel, they must be positioned side by side.
Should the drives be assembled stacked, prevent the upper module from being affected by the hot air from the underlying module.

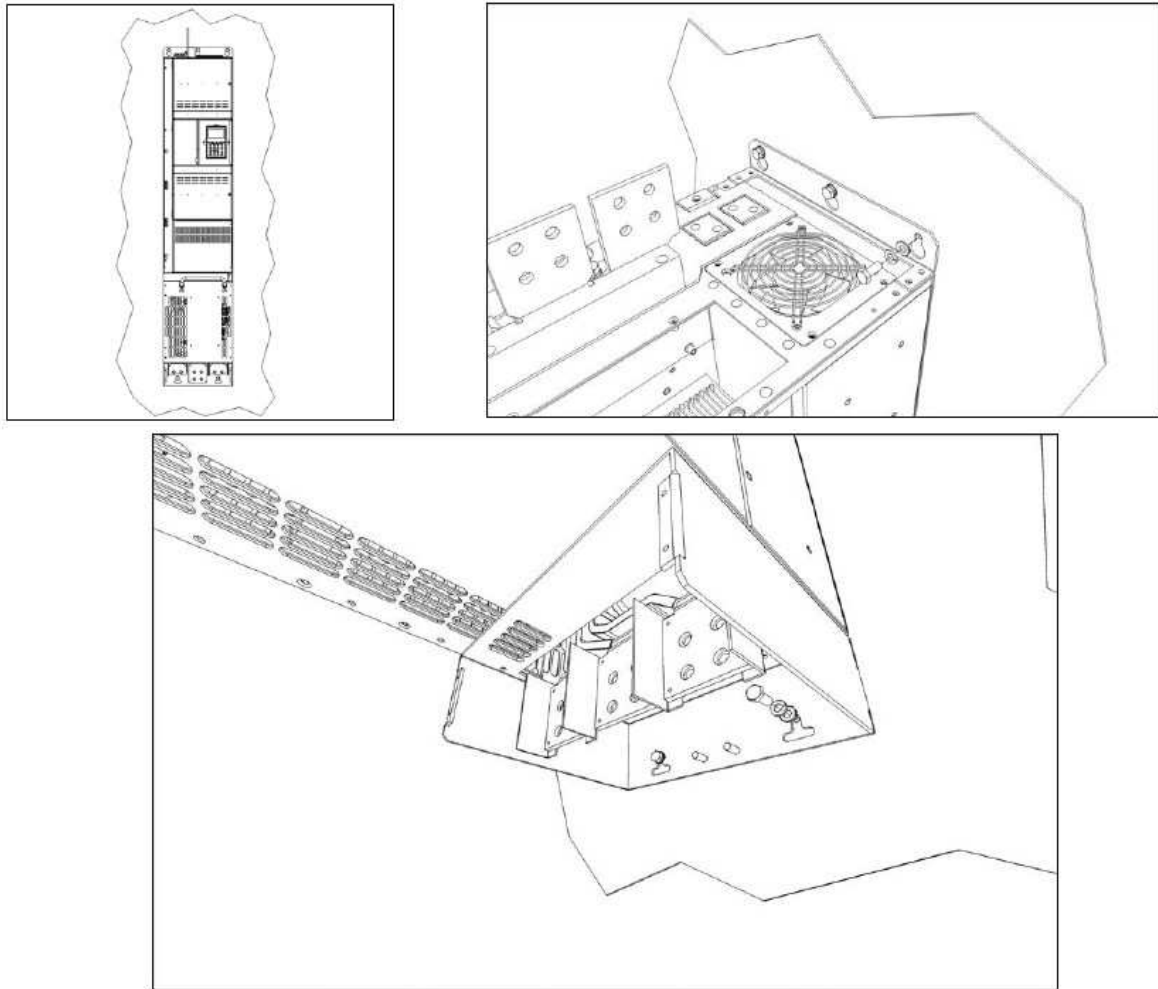
NOTE

For frames from AD1A210F to AD1A520F, once the drive has been installed in the panel, the lifting eyebolts must be removed.

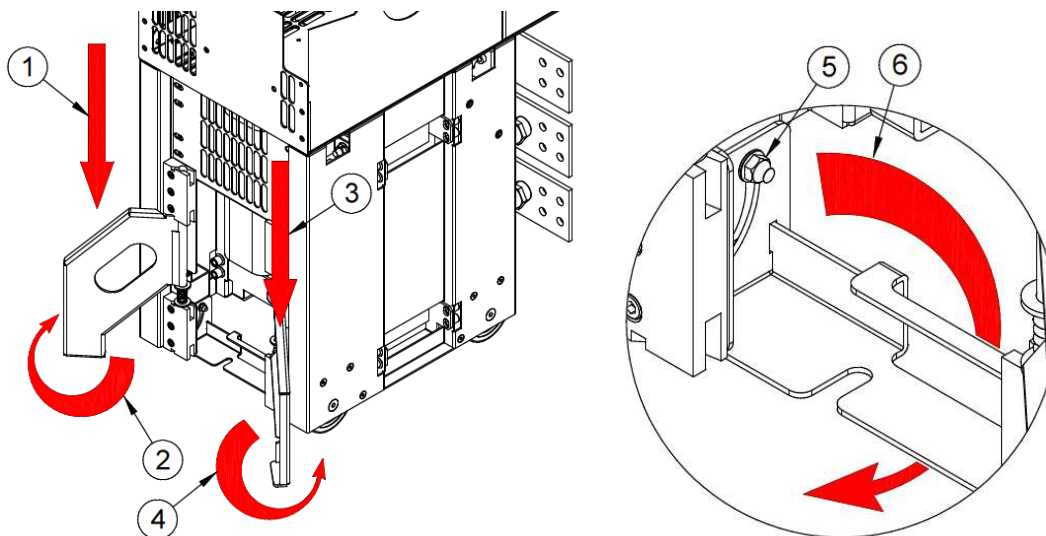
Example



5.3.2 Frames VII and VIII installation



VERSION WITH CARRIAGE



The parking brackets must be opened to handle the inverters fitted with carriage. To open the brackets, the left bracket needs to be moved downwards (1) and then rotated (2). Do the same for the right bracket (3 and 4). Once installed inside the panel, the locking bracket must be rotated, using the specific nut (5 and 6).

5.3.3 Free space near the drive



Figure 5.3.1 - Free space near the drive

The drive power components are cooled via forced ventilation. There must be space provided around the drive for air circulation, the electrical cables and maintenance access.



Free space near the drive

Frame	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

PREVENTING HOT AIR FROM RECIRCULATING

Panel exterior

Prevent hot air from recirculating outside the panel by channelling the hot discharge air away from the area where intake air is drawn.

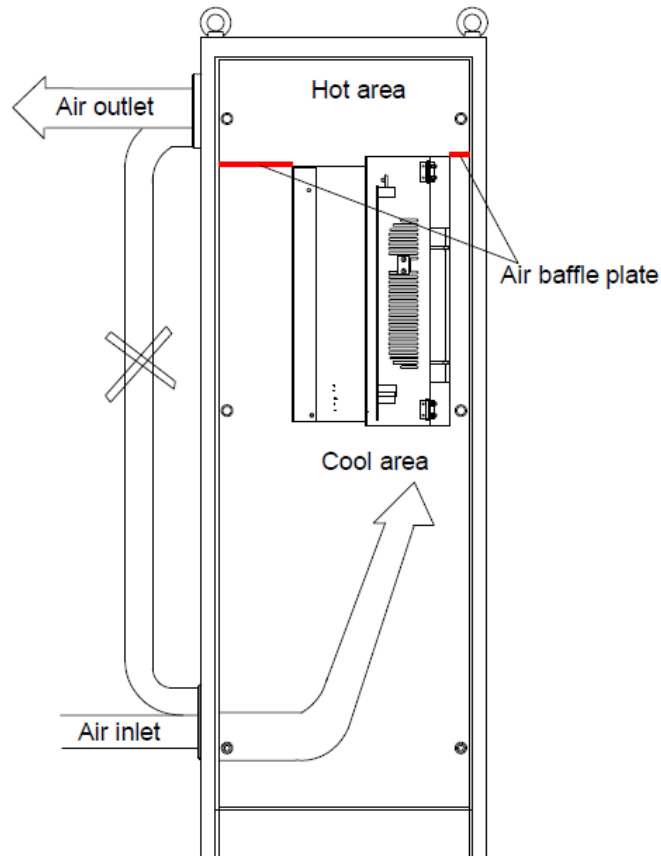
Possible solutions:

- arrange guides for intake and discharge air flow
- arrange air intake and discharge on different sides of the panel
- cold air intake on the lower part of the panel front door and an auxiliary fan on the panel roof.

Panel interior

Prevent hot air from circulating inside the panel with closing plates as illustrated in the drawing.

Gaskets are usually not required.



FASTENING POINTS

The figure shows the position of the installation holes for a typical frame; for details on the various frames, see paragraph 2.9 "Overall dimensions and weights".

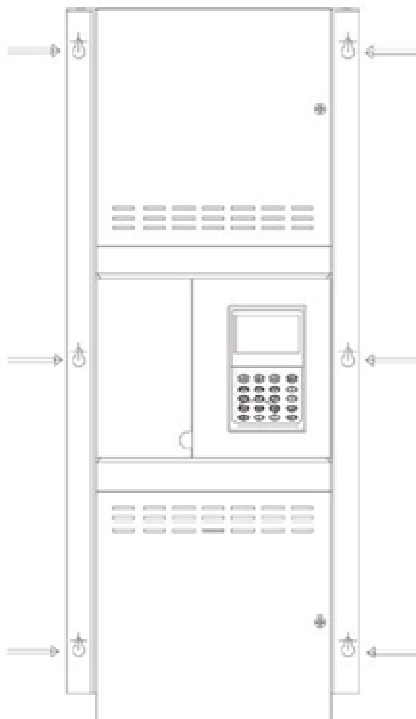


Figure 5.3.2 - position of the installation holes

5.3.4 IPXX degree

The standard AD1A030-166 degree of protection is IP20.

The IP degree of a product represents the extent of protection against contact with solid objects and the ingress of water. Said degree is indicated by 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 degree of protection

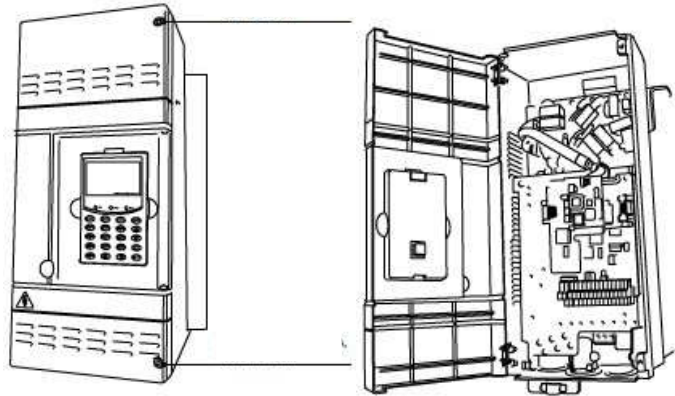
FIRST DIGIT		SECOND DIGIT	
Protection against contact with solid objects		Protection against the ingress of water	
0	No protection	0	No protection
1	Protection against large-sized solid objects > 50 mm (hand contact with an extended area)	1	
2	Protection against mid-sized solid objects > 12 mm (fingers)	2	-
3	Protection against small-sized solid objects >2.5 mm (tools, wires)	3	Protection against sprays of water (up to 60° from the vertical)
4	Protection against small-sized solid objects >1 mm (tools, wires)	4	Protection against water splashed (from all directions)
5	Protection against dust deposits, complete protection against accidental contact.	5	Protection against jets of water (from all directions, at high pressure)
6	Dust tight, complete protection against accidental contact.	6	Protection against water projected in powerful jets (for example, in the event of rough seas)
7	-	7	Protection against immersion
8	-	8	Protection against prolonged immersion

5.3.5 Access to the terminal blocks

Frames I, II, III, IIIX, IIIL	Frames IIIN, IVN, VN, VIN, VII, VIII
<ol style="list-style-type: none"> 1. Remove the keypad. 2. Remove the cable connecting the keypad to the control board. 3. Unscrew the screws and remove the front covering of the drive (see image) 	<ol style="list-style-type: none"> 1. Remove the keypad. 2. Unscrew the screws and gently open the front covering of the drive; the covering turns on the side hinges (see image). 3. Remove the cable connecting the covering to the control board.



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



AD1A - frames IIIN, IVN, VN, VIN



AD1A - frames VII, VIII

For the overall dimensions, see paragraph 2.9

5.4 Electrical installation

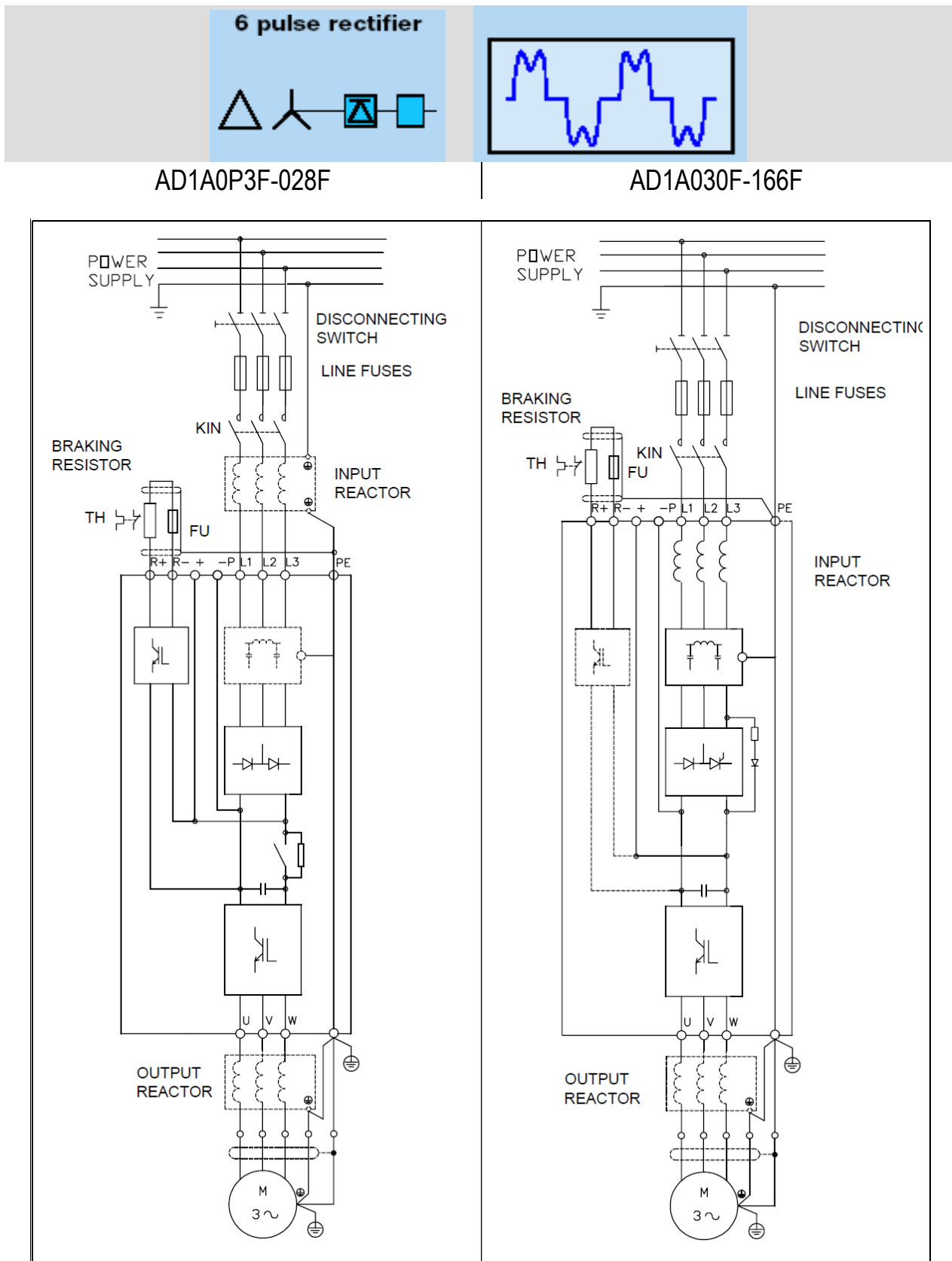
NOTE

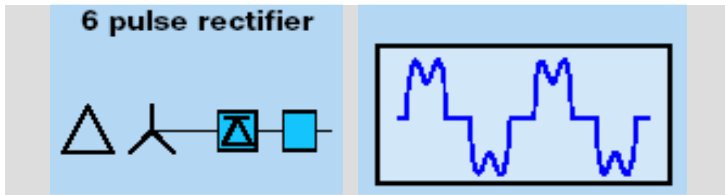
The control board terminals are shown in paragraph 5.6, the ones for the power and for the auxiliary power supply in paragraph 2.10.



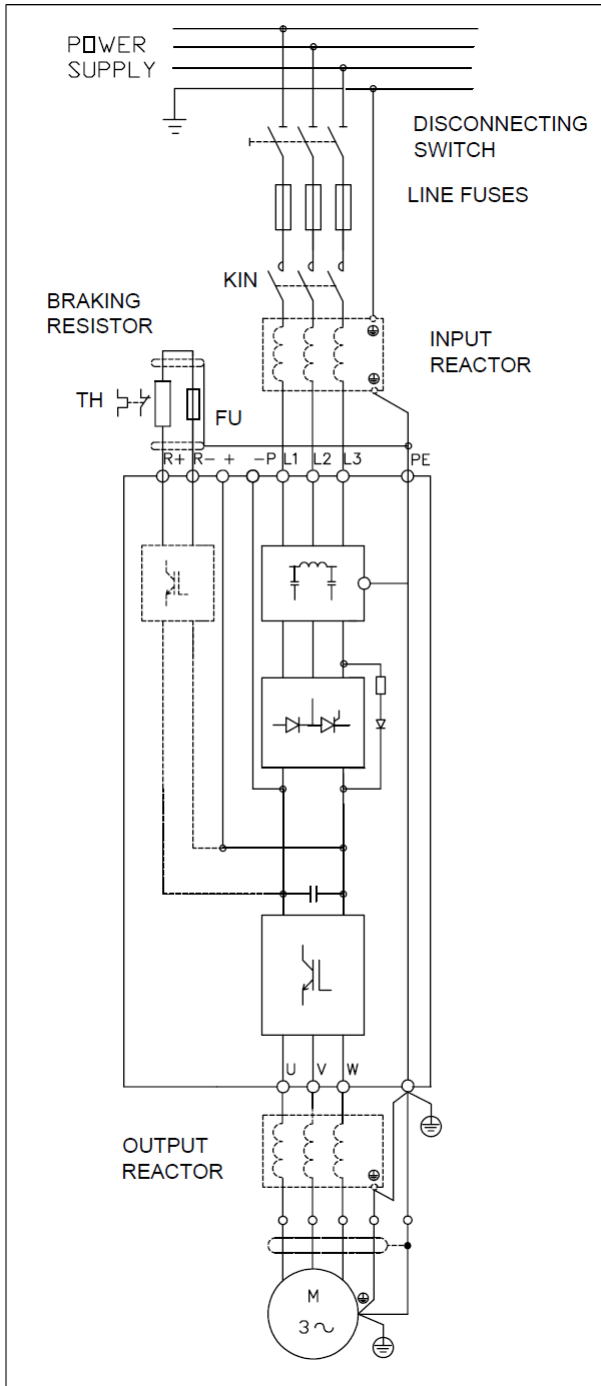
- a) Instead of cut-off switch and fuses, it is possible to use an automatic switch with rated current $I_n > 1.2 \cdot I_m$ and adjustable magnetic release (from 5 to $10I_n$).
- b) In the event of protection towards the ground, use a device that is minimally sensitive to high frequencies so as to prevent false trips. The threshold current should be greater than 200mA and the trip time at least 0.1s.

Figure 5.4.1 Power connections





AD1A210F-520F



5.4.1 Power cables, motor cables and power fuses

Power cables, motor cables and power fuses must be chosen based on the following tables.

Copper input power cables and motor cables with 600-690VAC and 1000VDC rated values must be used for braking unit connections.

Table 5.4.1.1 Power cable and fuse sizing in the "Standard" category

Model	Mains	AC line current	Main fuses (1)	External fuses recommended for Standard SCCR (2)	Cable cross-section **		Terminals	Max. torque		Standard SCCR (UL) (2)	
		Cl.1			AWG	mm2		Nm	lbf ft		kA
F = Three-phase power supply voltage 380-480V ±10%											
AD3A0P3F	AC	4	5x3	FWP-15B	14	2.5	10 (AWG max)	0.5	0.37	5	
AD3A0P4F	AC	5	10x3	FWP-15B	14	2.5	10 (AWG max)	0.5	0.37	5	
AD3A0P6F	AC	9	15x3	FWP-20B	14	2.5	10 (AWG max)	0.5	0.37	5	
AD3A008F	AC	11	15x3	FWP-20B	14	2.5	10 (AWG max)	0.5	0.37	5	
AD3A011F	AC	15	20x3	FWH-40B	12	4	10 (AWG max)	0.5	0.37	5	
AD3A015F	AC	19	30x3	FWH-45B	10	6	10 (AWG max)	0.5	0.37	5	
AD3A018F	AC	23	35x3	FWH-45B	10	6	10 (AWG max)	0.5	0.37	5	
AD3A022F	AC	29	50x3	FWH-60B	8	10	6 (AWG max)	1.2	0.88	5	
AD3A028F	AC	36	50x3	FWH-90B	8	10	6 (AWG max)	1.2	0.88	5	
AD3A030F	AC	36	50x3	FWH-90B	8	10	6 (AWG max)	1.2	0.88	5	
AD3A036F	AC	47	60x3	FWH-100B	6	16	4(AWG max)	2	1.47	5	
AD3A045F	AC	59	70x3	FWH-150B	3	25	35	2.5	1.84	5	
AD3A053F	AC	70	90x3	FWH-200B	2	35	35	2.5	1.84	10	
AD3A066F	AC	87	100x3	FWH-200B	2	35	35	2.5	1.84	10	
							Input	Output			
AD3A086F	AC	112	125x3	FWH-225A	2/0	70	M6	M8	10	7.37	10
AD3A108F	AC	140	175x3	FWH-225A	3/0	95	M6	M8	10	7.37	10
AD3A125F	AC	162	200x3	FWH-300A	4/0	95	M8	M8	10	7.37	10
AD3A150F	AC	193	250x3	FWH-300A	250	120	M8	M8	10	7.37	10
AD3A166F	AC	221	250x3	FWH-300A	250	120	M8	M8	10	7.37	10
AD3A210F	AC	300	300x3	3xFWH-450A	2x2/0	2x95	3x1xM10		22.5	16.59	18
AD3A260F	AC	370	400x3	3xFWH-500A	2x3/0	2x120	3x1xM10		22.5	16.59	18
AD3A290F	AC	410	500x3	3xFWH-600A	2x300KC	2x150	3x4xM10		22.5	16.59	18
AD3A350F	AC	510	600x3	3xFWH-700A	3x4/0	3x120	3x4xM10		22.5	16.59	30
AD3A370F	AC	540	770x3	3xFWH-800A	3x250KC	3x120	3x4xM10		22.5	16.59	30
AD3A440F	AC	640	800x3	3xFWH-1000A	4x4/0	4x95	3x4xM10		22.5	16.59	30
AD3A480F	AC	690	800x3	3xFWH-1000A	4x4/0	4x120	3x4xM10		22.5	16.59	42
AD3A520F	AC	750	850x3	3xFWH-1000A/1200A	4x250KC	4x150	3x4xM10		22.5	16.59	42

(1) - AC side fuses: for the EC market, normal gG fuses can be used with current calibre equal to 1.3 times the AD1000 rated current

(a) - Standard SCCR - Short Circuit Current Rating according to the UL508C standard



The drive is suited for use in a circuit with short circuit current no 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, as long as it is protected by the corresponding Bussmann brand semiconductor fuse shown in table 5.4.1.1.



**Cable cross-sections in the table are approximate. Refer to local wiring rules for proper sizing. In some cases, a larger cross-section may be required to prevent excessive voltage drops.

Table 5.4.1.2 Power cable and fuse sizing in the "High Fault Short Circuit Current" category

Model	Mains	AC line current Cl.1	Main fuses (1)	External fuses recommended for High SCCR (2)	Cable cross-section **		Terminals	Max. torque		High SCCR (UL) (2)	
					AWG	mm2		Nm	lbf ft		kA
F = Three-phase power supply voltage 380-480V ±10%											
AD3A0P3F	AC	4	5x3	FWP-15B	14	2.5	10 (AWG max)	0.5	0.37	65	
AD3A0P4F	AC	5	10x3	FWP-15B	14	2.5	10 (AWG max)	0.5	0.37	65	
AD3A0P6F	AC	9	15x3	FWP-20B	14	2.5	10 (AWG max)	0.5	0.37	65	
AD3A008F	AC	11	15x3	FWP-20B	14	2.5	10 (AWG max)	0.5	0.37	65	
AD3A011F	AC	15	20x3	FWH-40B	12	4	10 (AWG max)	0.5	0.37	65	
AD3A015F	AC	19	30x3	FWH-45B	10	6	10 (AWG max)	0.5	0.37	65	
AD3A018F	AC	23	35x3	FWH-45B	10	6	10 (AWG max)	0.5	0.37	65	
AD3A022F	AC	29	50x3	FWH-60B	8	10	6 (AWG max)	1.2	0.88	65	
AD3A028F	AC	36	50x3	FWH-90B	8	10	6 (AWG max)	1.2	0.88	65	
AD3A030F	AC	36	50x3	FWH-90B	8	10	6 (AWG max)	1.2	0.88	65	
AD3A036F	AC	47	60x3	FWH-100B	6	16	4(AWG max)	2	1.47	65	
AD3A045F	AC	59	70x3	FWH-150B	3	25	35	2.5	1.84	65	
AD3A053F	AC	70	90x3	FWH-200B	2	35	35	2.5	1.84	65	
AD3A066F	AC	87	100x3	FWH-200B	2	35	35	2.5	1.84	65	
							Input	Output			
AD3A086F	AC	112	125x3	FWH-225A	2/0	70	M6	M8	10	7.37	65
AD3A108F	AC	140	175x3	FWH-225A	3/0	95	M6	M8	10	7.37	65
AD3A125F	AC	162	200x3	FWH-300A	4/0	95	M8	M8	10	7.37	65
AD3A150F	AC	193	250x3	FWH-300A	250	120	M8	M8	10	7.37	65
AD3A166F	AC	221	250x3	FWH-300A	250	120	M8	M8	10	7.37	65
AD3A210F	AC	300	300x3	3xFWH-450A	2x2/0	2x95	3x1xM10		22.5	16.59	65
AD3A260F	AC	370	400x3	3xFWH-500A	2x3/0	2x120	3x1xM10		22.5	16.59	65
AD3A290F	AC	410	500x3	3xFWH-600A	2x300KC	2x150	3x4xM10		22.5	16.59	65
AD3A350F	AC	510	600x3	3xFWH-700A	3x4/0	3x120	3x4xM10		22.5	16.59	65
AD3A370F	AC	540	770x3	3xFWH-800A	3x250KC	3x120	3x4xM10		22.5	16.59	65
AD3A440F	AC	640	800x3	3xFWH-1000A	4x4/0	4x95	3x4xM10		22.5	16.59	65
AD3A480F	AC	690	800x3	3xFWH-1000A	4x4/0	4x120	3x4xM10		22.5	16.59	65
AD3A520F	AC	750	850x3	3xFWH-1000A/1200A	4x250KC	4x150	3x4xM10		22.5	16.59	65

(1) - AC side fuses: for the EC market, normal gG fuses can be used with current calibre equal to 1.3 times the AD1000 rated current

(b) - Standard High SCCR - Short Circuit Current Rating according to the UL508A standard and NEC Article 409



The drive is suited for use in a circuit with short circuit current no 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, as long as it is protected by the corresponding Bussmann brand semiconductor fuse shown in table 5.4.1.2, supplied with the drive.

In addition, upstream of the fuses in table 5.4.1.2, the user must install non-renewable cartridge fuses (JDDZ/JDDZ7), class J, with the appropriate voltage and current calibre.



**Cable cross-sections in the table are approximate. Refer to local wiring rules for proper sizing. In some cases, a larger cross-section may be required to prevent excessive voltage drops.

5.4.2 Auxiliary power supplies

Ventilation

AD1A125-520F drives require a 50/60 Hz single phase 230Vac auxiliary power supply for the fan (see table 2.8.1 for absorption data).



Make sure the auxiliary power supply is connected with the proper input voltage setting before enabling the drive.

5.5 Reactors

Input and output reactors are accessories that can be ordered for AD1000 drives. The user is responsible for installation.

5.5.1 Input reactors

The line reactor protects the drive from surges on the mains and fulfils IEEE 587 standard requirements. The reactor causes a voltage drop proportional to the power supply current and to the inductance value. Select a reactor for a voltage drop of 2-5% of the rated input voltage (when the drive is driving the total rated current).

Input reactor function:

- Reduces the effective current in the drive capacitor group
- Improves the power factor
- Reduces bothersome stops due to spikes on the line
- Reduces the harmonic content of the input current
- Protects the drive against surges on the mains
- Helps suppress radio frequency interference
- Protects the drive against mains unbalances and single phase operating conditions

The input reactor absorbs interference on the power supply line that could otherwise damage or freeze the drive or other sensitive devices and reduces the harmonic content of the current generated by the drive, contributing to compliance with IEEE guide-519, 1993 for harmonic limitation.

Frames IIIN, IVN, VN, VIN require an internal line reactor. All the other frames require a reactor between the mains and the drive if:

1. an SCR or other drives are operating on the same line.
2. power factor correction capacitors are connected on the same line.
3. power voltage unbalance exceeds 3%.

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

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

$$F_s = 100 \cdot \frac{\text{max deviation from } V_M}{3} = 100 \cdot \frac{9}{399} = 2.3\%$$

Where:

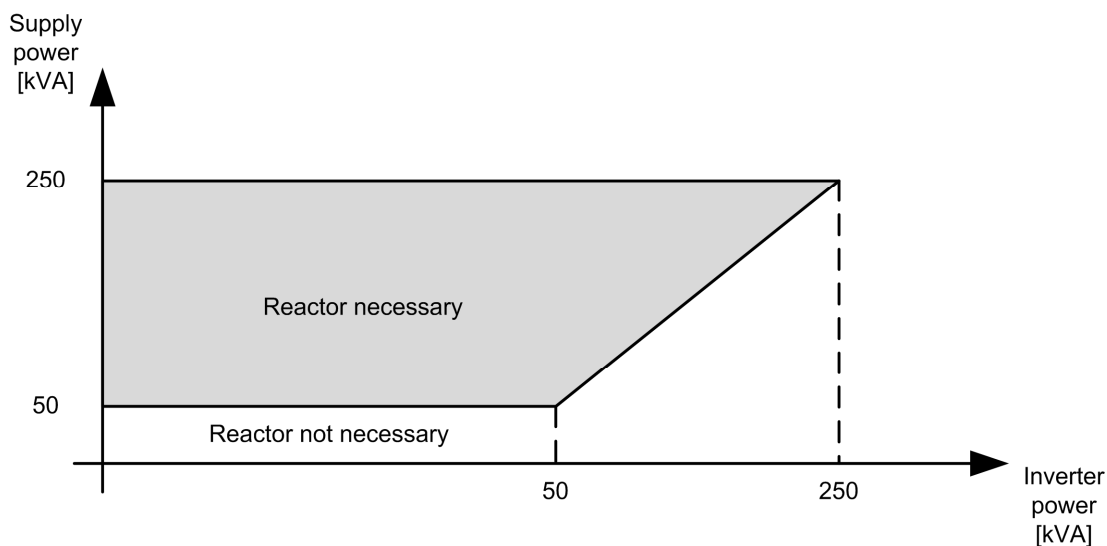
V_{rs} , V_{st} , V_{tr} : rms of the line-to-line voltages

V_M : average value of V_{rs} , V_{st} , V_{tr}

F_s : voltage imbalance

In this example the reactor is not required

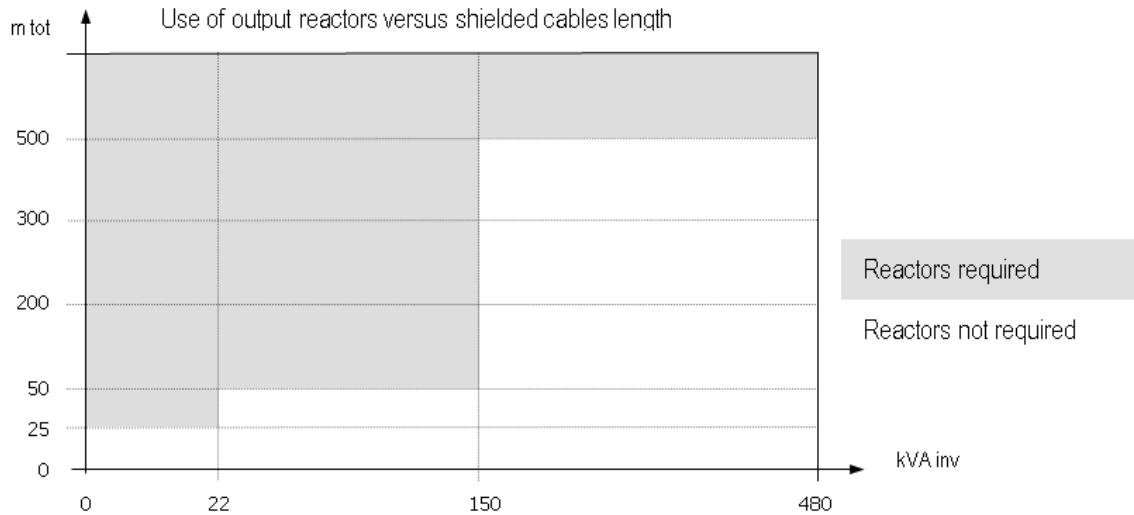
4. The power supply line Power and the inverter Power are included in the highlighted area.



5.5.2 Output reactors

Output reactors are needed to compensate the capacitive ground dispersion current, as well as to reduce the voltage gradient on the motor. Along with the ferrite cores, they help reduce RFI phenomena.

The output reactor codes are shown in Table 5.5.1



Limit the length of the motor cables so as not to exceed a voltage drop of 3-5% to the rated current. In the event of parallel motors, the sum of the length of the various cables must be considered. The input and output reactor codes are shown in Table 5.5.1

5.5.3 RFI filters

For frames from 0P3F to 028F, an RFI filter is an option that must be requested when the drive is ordered and is indicated by the letter F in the 11th position of the identification code.

AD1	A	XXXX	F	B	N	F	H	N	N	N	NN	NN
-----	---	------	---	---	---	---	---	---	---	---	----	----

It can be requested for category C3 or C2 as shown in table 5.5.1.

For frames from 030F to 166F, a category C2 RFI filter is standard and integrated into the drive.

For frames from 210F, a category C3 RFI filter is standard and integrated into the drive. A category C2 filter is available as an external accessory, as shown in table 5.5.1.

For 008F frame drives, the filters marked as internal do not change the overall drive dimensions. If marked as external, they must be installed by the customer

For frames 0P3F, 0P4F and 0P6F, the drive dimensions are as follows.

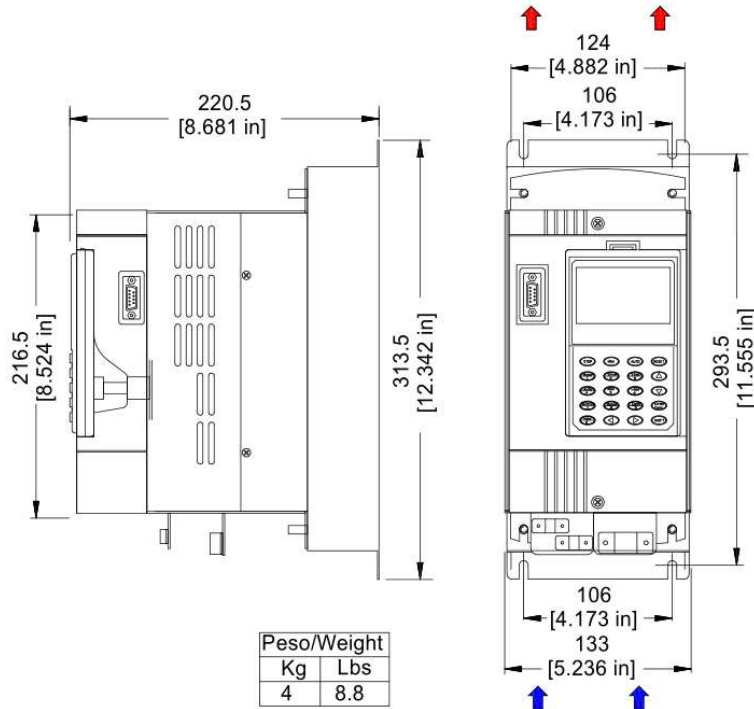


Table 5.5.1 Line reactor, RFI filter and output reactor

Tipo	Line reactors		RFI filters		Output reactors	
			Category C3	Category C2	Normal service	Heavy service
			Internal	Internal		
	Cl.1	Cl.2	Cl.1-Cl.2	Cl.1-Cl.2	Cl.1	Cl.2
Three-phase mains 380V, 415V, 440V, 460V, 480V $\pm 10\%$						
AD1A0P3F	1000248122	10002481220	ELC40969901	ELC40969901	1000248135	10002481354
AD1A0P4F	1000248123	1000248122	ELC40969901	ELC40969901	1000248136	1000248135
AD1A0P6F	1000248125	1000248123	ELC40969901	ELC40969901	1000248137	1000248136
AD1A008F	1000248126	1000248125	ELC40969901	ELC40969901	1000248138	1000248137
AD1A011F	1000248127	1000248126	ELC40969902	ELC40969902	1000248139	1000248138
AD1A015F	1000248128	1000248127	ELC40969902	ELC40969902	1000248140	1000248139
AD1A018F	1000248129	1000248128	ELC40969903	*ELC40923003	1000248141	1000248140
AD1A022F	10002481230	1000248129	ELC40969903	*ELC40923003	1000248142	1000248141
AD1A028F	10002481231	10002481230	ELC40969903	*ELC40923003	1000248143	1000248142
AD1A030F	INTEGRATED		INTEGRATED for category C2		1000248143	1000248142
AD1A036F					1000248144	1000248143
AD1A045F					1000248145	1000248144
AD1A053F					1000248146	1000248145
AD1A066F					1000248147	1000248146
AD1A086F					1000248148	1000248147
AD1A108F					1000248149	1000248148
AD1A125F					1000248150	1000248149
AD1A150F					1000248151	1000248150
AD1A166F					1000248152	1000248151

* External

Tipo	Line reactors		RFI filters			Output reactors	
	CI.1	CI.2	Category C3	Category C2		Normal service	Heavy service
			Internal	External			
	CI.1	CI.2	CI.1-CI.2	CI.1	CI.2	CI.1	CI.2
Three-phase mains 380V, 415V, 440V, 460V, 480V $\pm 10\%$							
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

For further details on RFI filters, see paragraph 5.9

** The output reactors indicated for frames from AD1A350F to AD1A520F are for installing outside the drive. They must not be confused with the reactors engaged in the carriage (see paragraph 6.6).

5.6 Voltage protection

AD1000 inverters are internally equipped with Transient Voltage Surge Suppressors (VZCA2).

To be CSA qualified, the inverter must be equipped with external Transient Voltage Surge Suppressors (VZCA2/VZCA8) with contact for remote signalling.

Tipo	Configuration	Maximum continuative operating voltage	Surge protection	Maximum discharge current
1 CA	L-L/L-PE	1500 V	4000 V	40 kA

5.7 Control section

5.7.1 Basis control board

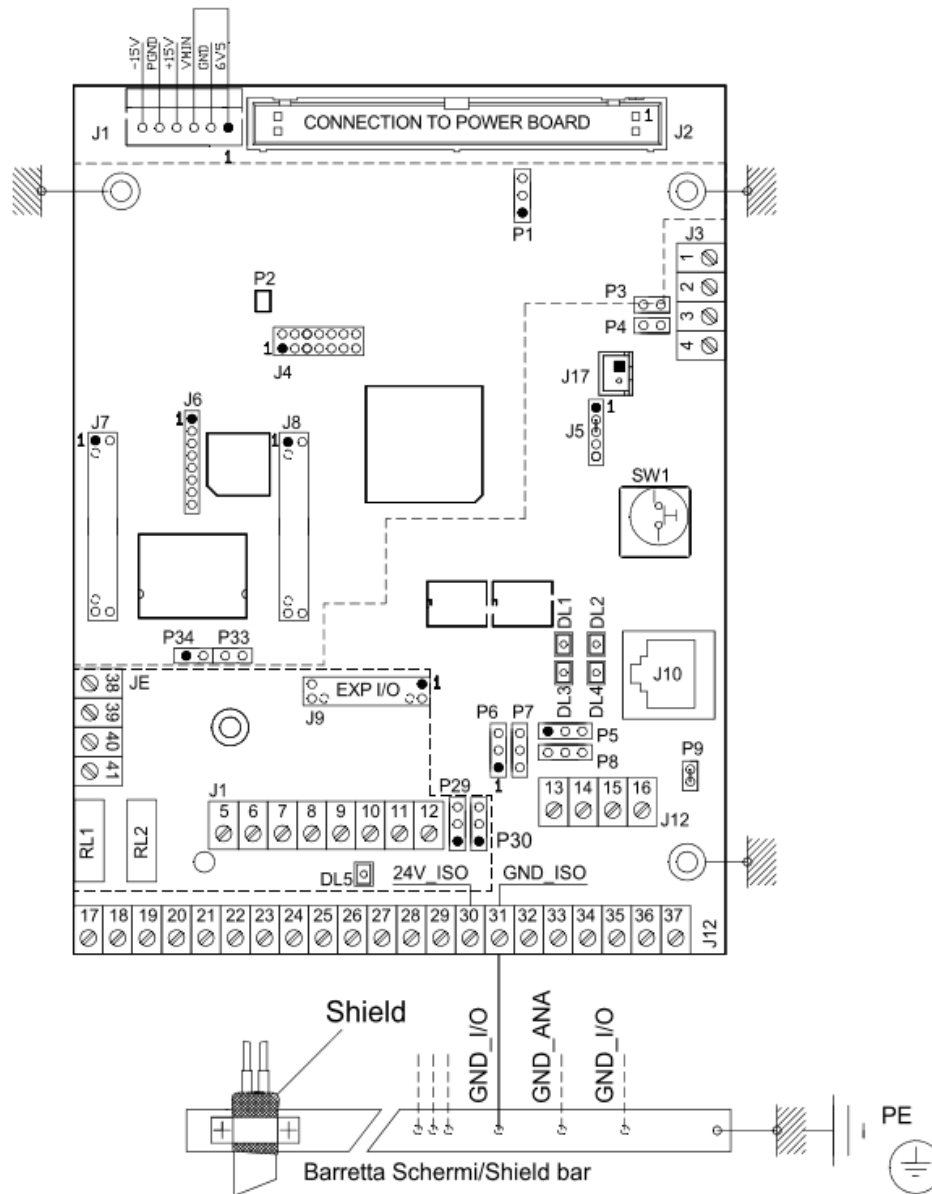
















Figure 5.6.1

LED

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

JUMPER AND DIP-SWITCH

P1		1-2	Lu current from power board	
		2-3	Lu current rebuilt on control board (only for drives ≤166)	
P2		OFF	Reserved (D.O.C. filtering)	
P3		ON	P3=ON, P4=ON: engagement of 220X termination resistor between TXRX+ and TXRX- P3=OFF, P4=OFF: termination resistor between TXRX+ e TXRX- not engaged	Modbus TXRX
P4		ON		
P5		1-2	Analogue output in 0(4)-20mA current	Analogue output 2 AO 2
		2-3	Analogue output in ±10V (2mA) voltage (Default)	
P6		1-2	Ballast resistance 500X, analogue input 1, engaged	Analogue input 1 AI 1
		2-3	Ballast resistance 500X, analogue input 1, not engaged (Default)	
P7		1-2	Ballast resistance 500X, analogue input 2, engaged	Analogue input 2 AI 2
		2-3	Ballast resistance 500X, analogue input 2, not engaged (Default)	
P8		1-2	Analogue output in 0(4)-20mA current	Analogue output 1 AO 1
		2-3	Analogue output in ±10V voltage (Default)	
P9		ON	P9=ON: The 24Vdc power supply of the I/O is available on terminals J12-30 and J12-31. Do not connect any other external feeders. P9=OFF: you must connect a 24Vdc external feeder to terminals J12-30	
29		1-2	Not used	
		2-3	Not used	
P30		1-2	Pull-up excluded (Default)	Analogue input 2 AI 2
		2-3	Pull-up (2K2) on input AI2 (+) at +10V (for PTC)	
P33		OFF	Open (Reserved)	
P34		OFF	Open (Reserved for firmware installation)	
SW1			Reset button	

NOTE

If the analogue input and digital input expansion board (GIABA) or the analogue input and digital output expansion board (GIABB) are installed, the Basis board P30 jumper is no longer accessible. In this case, the expansion board P30 jumper must be opened and, if necessary, used.

CONNECTORS

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

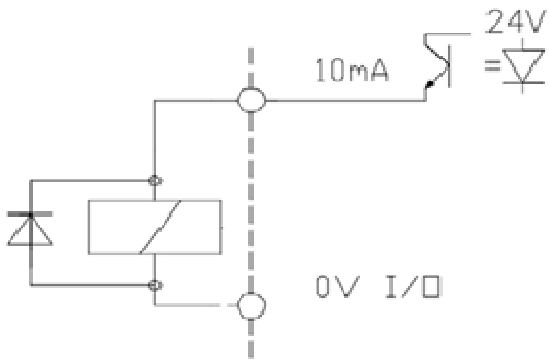
NOTE: The J12 control terminal block is also indicated as an ME (External Terminal Block) in this manual and in the programming manual.

CONTROL TERMINAL BLOCK

Function	Terminal	Abbreviation	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 shielded ground connection	
Programmable analogue outputs	J12-13	AO 1	Programmable opto-isolated analogue outputs: in $\pm 10V$ - (2mA) voltage, in 0(4)-20mA (max 8V) current, see P5-P8 jumpers	
	J12-14	AO 2		
Analogue references	J12-15	POT -10V	Output for potentiometer -10VDC - 10mA	
	J12-16	POT +10V	Output for potentiometer +10VDC - 10mA	
Programmable relays	J12-17	RL1 Fault N	NA	Normally excited fault relay in non-locked drive conditions 1A - 250Vac - 24Vdc
	J12-18	RL1Fault C	C	
	J12-19	RL1 Fault NC	NC	
	J12-20	RL2 DO3 Prog	NA	Programmable relay 1A - 250Vac - 24Vdc
	J12-21	RL2DO3 Prog	C	
Programmable opto-isolated digital inputs	J12-22	DI 3 Prog	Opto-isolated digital inputs (some are programmable) voltage excursion 0 \pm 36Vdc rated voltage 24Vdc rated absorption 5mA minimum trip 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 Prog (see Note)*		
	J12-29	DO2 Prog (see Note)*	Digital static output 2 24Vdc 10mA	
I/O supply (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	0V analogue I/O	
	J12-33	AI 1-	Programmable opto-isolated analogue inputs $\pm 10V$ ($\pm 20mA$) differential configuration ($R_{in}=33K\Omega$) See Jumpers P6-P7	
	J12-34	AI 1+		
	J12-35	AI 2-		
	J12-36	AI 2+		
	J12-37	AI/AO ground	0V analogue I/O	

NOTE: The J12 control terminal block is also indicated as an ME (External Terminal Block) in this manual and in the programming manual.

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



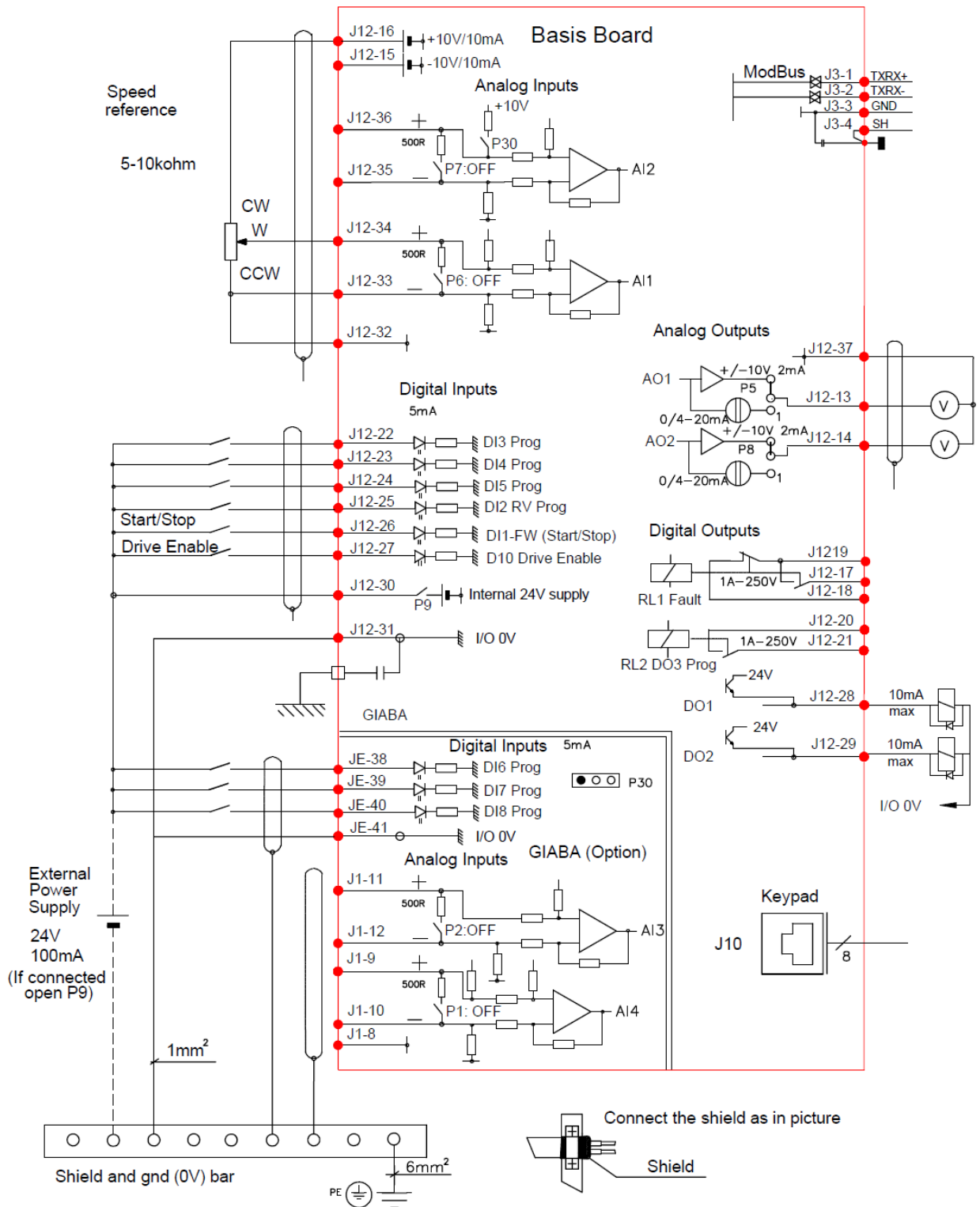


Figure 5.6.2 Control terminal block

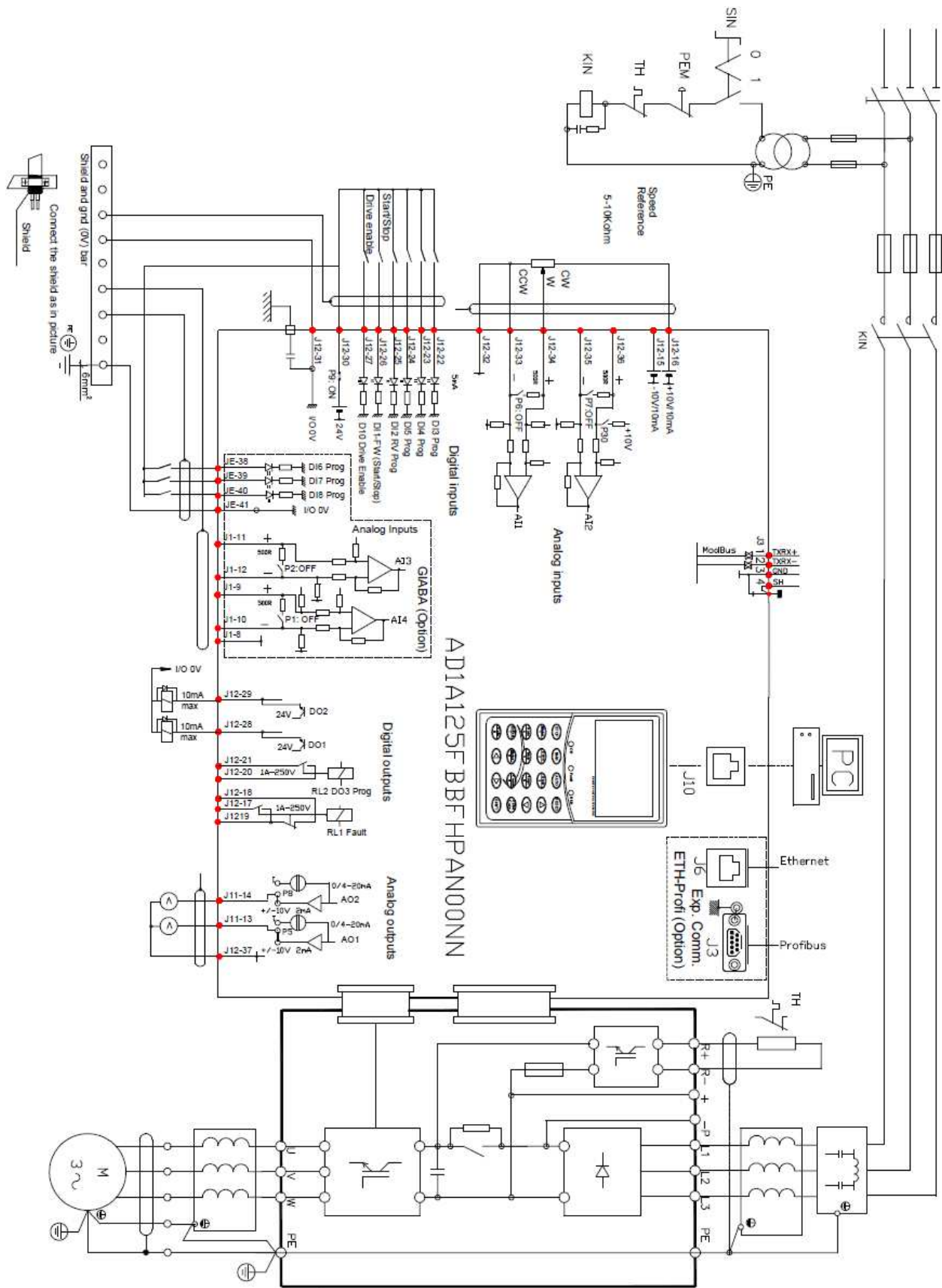


Figure 5.6.3 Example of AD1000 connection with Basis board

5.8 Expansion board

5.8.1 Analogue input and digital input and RTC expansion board (GIABA)

The analogue input and digital input expansion board (GIABA) makes 2 additional analogue inputs and 3 additional digital inputs available. It is connected to the Basis board via 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 expansion board P1 and P2 jumpers.

Digital inputs

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

NOTE: The J1E terminal block is also indicated as an ME (External Terminal Block) in this manual and in the programming manual.

Jumpers

Analogue Input and Digital Input Expansion Board (GIABA)				
P1		ON	Ballast resistance 500X, analogue input 4, engaged	Analogue input 4 AI4
P2		ON	Ballast resistance 500X, analogue input 3, engaged	Analogue input 3 AI3
P30		1-2	Pull-up excluded (Default)	Analogue input 2 AI2
	3 2 1	2-3	Pull-up (2K2) on input AI2 (+) at +10V (for PTC)	



If the analogue input and digital input expansion board (GIABA) is installed, the Basis control board P30 jumper is no longer accessible. In this case, the expansion board P30 jumper must be opened and, if necessary, used.

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

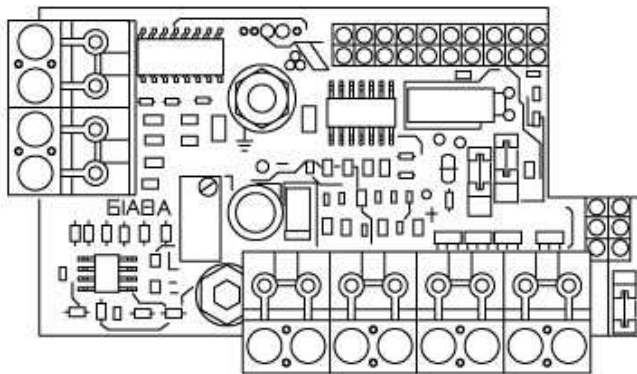
AD1	A	XXX	F	B	N	F	H	N	A	T	00	NN
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GIABA BOARD CONNECTORS

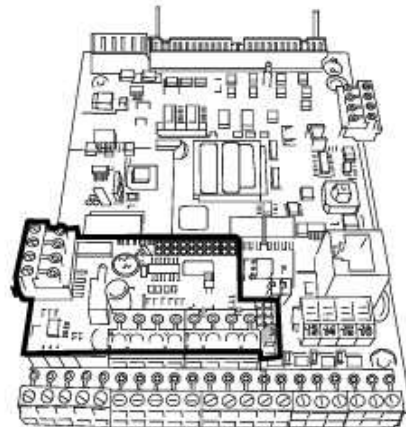
J1-5		Do not connect	
J1-6	AGND		
J1-7		Do not connect	
J1-8	AGND	0V analogue I/O	
J1-9	AI4+	Programmable and opto-isolated analogue inputs ±10 V (±20 mA) Differential configuration (Rin=33kΩ)	
J1-10	AI4 -		
J1-11	AI3+		
J1-12	AI3 -		
JE-38	DI6	0=36Vdc 24 Vdc-5mA voltage range programmable and opto-isolated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

NOTE: The J1E terminal block is also indicated as an ME (External Terminal Block) in this manual and in the programming manual.

GIABA board:



GIABA board installed on the BASIS board:



5.8.2 Analogue input and digital output and RTC expansion board (GIABB)

The analogue input and digital output expansion board (GIABB) makes 2 additional analogue inputs and the connection for an additional relay digital output expansion board available.

It is connected to the Basis board via connectors J9 and P29-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 $\pm 10V$ ($\pm 20mA$) in differential configuration.

See the expansion board P1 and P2 jumpers.

Digital outputs

The connector for the three additional relay configurable digital outputs is identified by J10.

Managing the additional digital outputs requires a 24Vdc power supply connected to the J11 terminals (24Vdc on J11-38 and 0V on J11-39).

The kit to connect to J10 is composed of a relay board that is ready to be installed in a DIN guide (user's responsibility) and a 10-pole flat cable to connect with the GIABB board.

The relay board is equipped with 8 relays (of which 3 are usable) with NA-C-NC contacts, 1 yellow LED that shows the board is powered, 8 yellow LEDs that show the status of the individual relays and a screw terminal block to connect with the field.


250V AC/DC maximum operating voltage, 5A maximum direct current

Dimensions: Width 135mm, height 59mm, length 77mm.

Operating temperature, -20°C - +50°C

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

Jumpers

Analogue input and digital output expansion board (GIABB)				
P1		ON	Ballast resistance 500X, analogue input 4, engaged	Analogue input 4 AI4
P2		ON	Ballast resistance 500X, analogue input 3, engaged	Analogue input 3 AI3
P30		1-2	Pull-up excluded (Default)	Analogue input 2 AI2
	3 2 1	2-3	Pull-up (2K2) on input AI2 (+) at +10V (for PTC)	



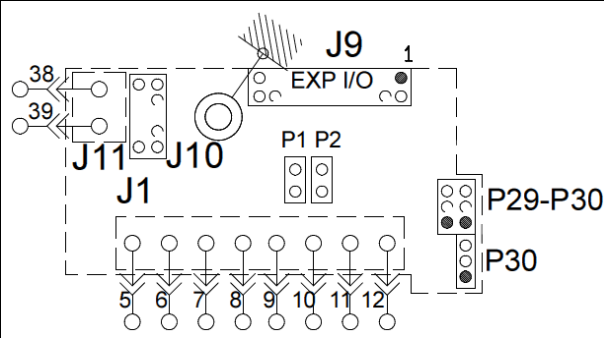
If the analogue input and digital output expansion board (GIABB) is installed, the Basis control board P30 jumper is no longer accessible. In this case, the expansion board P30 jumper must be opened and, if necessary, used.

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

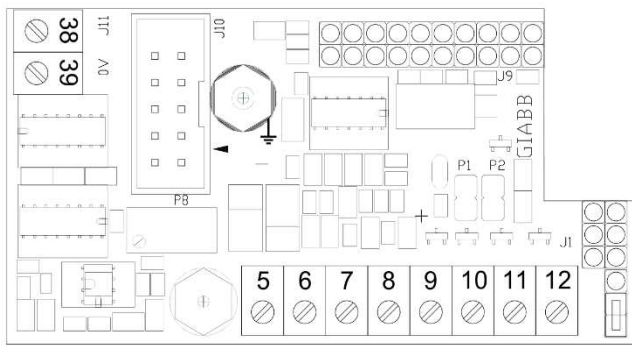
AD3	A	XXX	F	B	N	F	H	N	B	T	00	NN
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GIABB BOARD CONNECTORS

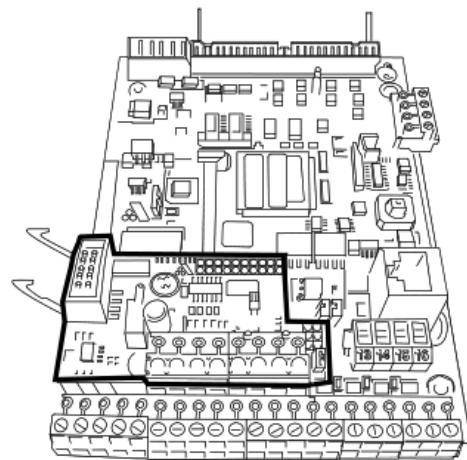
J1-5		Do not connect
J1-6	AGND	
J1-7		Do not connect
J1-8	AGND	0V analogue I/O
J1-9	AI4+	Programmable and opto-isolated analogue inputs ± 10 V (± 20 mA)
J1-10	AI4 -	
J1-11	AI3+	Differential configuration ($R_{in}=33k\Omega$)
J1-12	AI3 -	
J10		Connection for relay expansion board
J11-38	+24V	24V digital outputs
J11-39	0V	0V digital outputs



GIABB board:



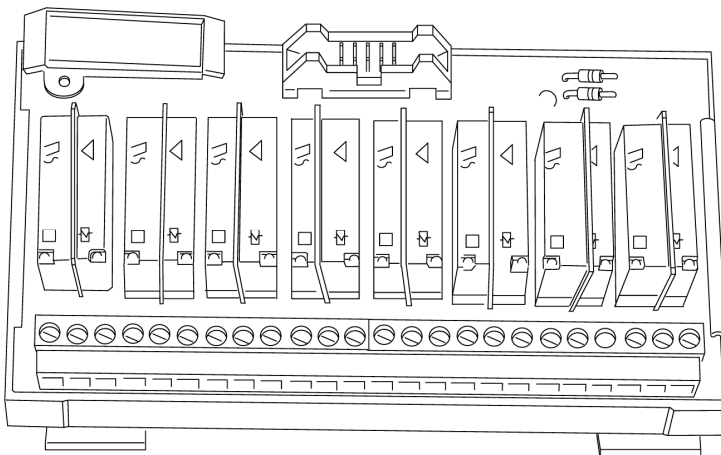
GIABB board installed on the BASIS control board:



RELAY EXPANSION BOARD CONNECTORS

Terminal	Tag	Output	Contact
12	0		Reserved
11	+		Reserved
14	A		Reserved
22	0	Out DO4	NC
21	+		C
24	A		NO
32	0	Out DO5	NC
31	+		C
34	A		NO
42	0	Out DO6	NC
41	+		C
44	A		NO
52	0		Reserved
51	+		Reserved
54	A		Reserved
62	0		Reserved
61	+		Reserved
64	A		Reserved
72	0		Reserved
71	+		Reserved
74	A		Reserved
82	0		Reserved
81	+		Reserved
84	A		Reserved

Relay expansion board



5.8.3 Modbus TCP and Profibus expansion board (ETH-PROFI)

The Modbus TCP and Profibus expansion board makes the Profibus DP and Modbus TCP slave communication buses available; it is connected to the Basis board via J7 and J8.

Technical data

Operating temperature, -20°C - +50°C

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

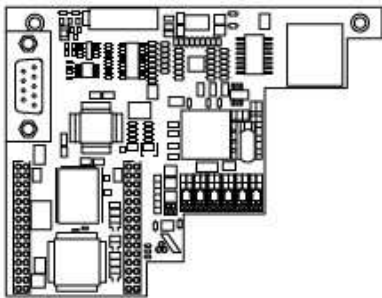
LED

Abbreviation	Colour	Function	Description	
DL1	Green	Profibus	Profibus communication	ON = Communication active
DL2	Green	Modbus TCP	Line activity	Blinking = Communication active
DL3	Green	Modbus TCP	Line status	ON = connection OK

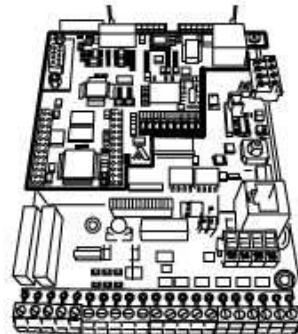
The board is an option indicated by the letter P in the 13th character of the identification code (see Chapter 2):

AD1	A	XXX	F	B	N	F	H	P	A	T	00	NN
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ETH-PROFI board:



ETH-PROFI board installed on the BASIS board:



5.9 Installation check list

The mechanical and electrical installation must be verified before commissioning.

MECHANICAL INSTALLATION CHECK LIST

- Temperature and ambient humidity fall within the specifications.
- The unit is assembled properly on a non-flammable vertical surface.
- Cooling air passage not obstructed.

ELECTRICAL INSTALLATION CHECK LIST

- Drive appropriately grounded.
- Mains voltage corresponds to the rated input voltage of the frequency drive.
- Mains connections appropriately:
 - connected
 - tightened
- Input connections appropriately:
 - connected
 - tightened
- Control connections appropriately:
 - connected
 - tightened
- Suitable input fuses installed.
- There are no compensation capacitors in the motor connections.
- There are no tools or other outside objects inside the casing.

5.10 Installation instructions in compliance with the EMC directive

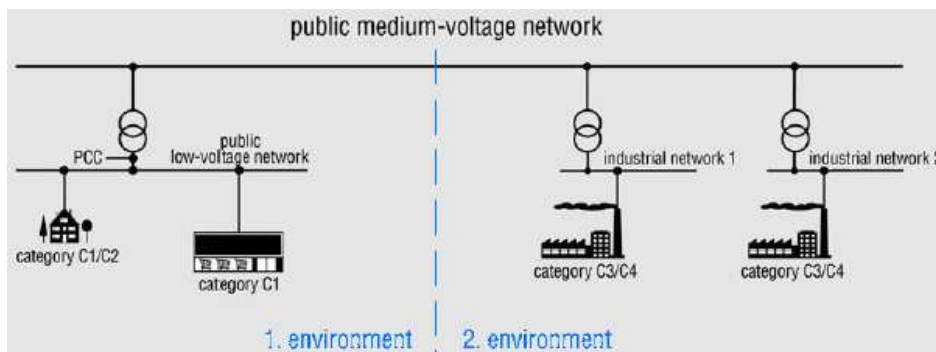
5.10.1 EN61800-3 EMC product standard for variable speed electrical drives

EN61800-3:2004 Adjustable speed electrical power drive systems. Part 3:

This is the EMC standard for standard products that include specific testing methods. The transition period from the existing EN61800-3:1996 standard ends October 1, 2007.

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

It defines the assessment criteria for the operating features in the event of interference to the external doors and the internal interfaces, based on the installation site.



5.10.1.1 INSTALLATION ENVIRONMENT (DEFINITIONS)

First Environment (residential and commercial area):

Environment that includes domestic premises. Also corresponds to industrial premises connected directly without intermediate transformers to a low voltage mains that powers buildings used for domestic purposes.

Second Environment (industrial area):

Environment that includes all the industrial premises other than those connected directly to a low voltage power supply that powers buildings used for domestic purposes.

NOTE

For PDS's installed in the second environment, the user must make sure that excessive interference is not induced in the mains, even if propagation is via a medium voltage power supply.

Private mains

Private mains are structured to be powered by a specific medium voltage power supply and not to power residential areas. Typically, private mains power commercial buildings, offices in residential building, shopping centres, etc. The operator can decide whether to create the mains based on the first or second environment as established by the standard.

A low voltage private mains can be considered a system in compliance with the EMC standards. The EMC standard is assessed based on the physical limits of the system, the emission and immunity to RF interferences are assessed based on space limits, and the conducted interferences are assessed based on the input on the power supply.

5.10.1.2 EN 61800-3 CATEGORIES

Category C1: PDS with rated voltage less than 1000 V, designed for limited 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 if the following criteria are met:

- Rated voltage < 1000 V.
- It is not a device with a plug.
- It is not a removable device.
- It is installed and managed exclusively by a qualified technician (a person/company with the required know-how in installing and/or managing power drives, including their EMC aspects).
- There are user warnings.

Warnings for the user instructions:

This is a C2 category product in compliance with IEC 61800-3. In a domestic environment, this product can cause radio interferences, in which case additional measures to reduce the interferences may be required.

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

Warnings for the user instructions:

This type of PDS cannot be used on a low voltage public mains that powers domestic premises. Use on said mains causes radio frequency interferences.

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

- Rated voltage ≥ 1000 V
- Rated current ≥ 400 A
- Connection to an IT network
- Dynamic performance requirements will be limited as a consequence of the filtering.

There must be an EMC plan in place!

5.10.1.3 SOLUTIONS USED TO ENSURE COMPLIANCE WITH EMISSIONS

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

Conducted emissions: They can be reduced as follows:

- With RFI filters for high frequency interferences
- Using surge suppressors on the relay coils, contactors, solenoid valves, etc. to attenuate the formation of sparks during switching.
- Using ferrite rings in the power connection points.

Radiated emissions: In order to prevent interferences transmitted through the air, all the electrical drive components must make up a Faraday cage to counter radiated emissions.

Electrical drives also include the cabinets, auxiliary boxes, wiring, motors, etc.

Below is a list of some methods that aim to ensure the continuity of the Faraday cage:

Cabinets:

- The cabinet must have an unpainted anti-corrosive finish in all the points of contact with other plates, doors, etc.
- All the contacts between metals must not be painted, with conductive seal gaskets if necessary.
- Use unpainted installation plates connected to the common grounding point, making sure that all the individual metal components are securely connected in a single grounding pathway.
- Use conductive seal gaskets on the doors and covers. It is a good idea to fasten covers at intervals no greater than 100mm in the points where radiation could escape.
- Separate the "dirty" side from the "clean" side regarding the radiated interferences via metal closures and a specific design.
- Reduce openings in the cabinet to a minimum.
- Use materials with good attenuating properties; for example, plastic materials with conductive coating if using a metal cabinet is not possible.

Wiring:

- Use specific HF cable inputs for high frequency grounding of the cable shields.
- Use conductive seal gaskets for HF grounding of the control cable shields.
- Shield all the feeder and control unit cables. Follow the specific manuals for the individual products.
- Separately position the feeder and control unit cables.
- Use braided cables to prevent common mode interferences.
- Use ferrite rings for common mode interferences as needed.
- Select and properly position the inner wires.

Installation:

- The auxiliaries used with complete drive modules must be CE-marked products based on the EMC directive and the Low voltage directive, NOT ONLY with reference to the latter unless they are exempt; i.e. if used with a component that has no direct function.
- Select and install the accessories in compliance with the manufacturer's instructions.
- 360° grounding on the motor axis. See the specific manuals for the individual products.
- Proper inner wiring methods.
- Special attention to the grounding methods.

5.10.2 RFI filters for radio frequency interferences

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

RFI filters are used to attenuate interferences conducted in a connection point on the line where the filter grounds the interferences.

RFI filters are necessary when the electrical drive is connected to a low voltage public mains (First Environment).

It is also advisable to use filters in industrial installations (Second Environment) if there is equipment nearby that could be damaged by the emissions, though the product standard does not currently impose any limits on emissions.

RFI FILTER INSTALLATION:

In order for the filter to work properly, reliable low impedance/HF connections must be ensured. It is also a good idea to follow the instructions below.

- Assemble the filter on a metal plate with unpainted connection points in compliance with the instructions provided by the filter manufacturer.
- Join the filter cabinet frames (if separated) and the drive cabinet in several points using bolts. Remove any paint from all connection points.
- The filter input and output cables must not be positioned in parallel and must be separated from each other.
- The maximum cable length between the filter and the drive must be less than 0.3m; for longer lengths, use shielded cables.
- Position the filter so as not to obstruct the drive ventilation channel.
- The filter must be grounded in compliance with the manufacturer's instructions. Remember that cable type and dimensions are a critical factor.

NOTE

Filters cannot be used on floating networks (IT networks) where there is high impedance or there are no physical connections between the phases and the grounding.

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

5.10.2.1 RFI FILTER

See table 5.5.1 for filter codes.

RFI in mains with grounded neutral (TN or TT)

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

Insulating control devices

Filters (with their internal discharge resistors), cables, the drive and the motor overall present a considerable grounding capacity that causes an increase in the ground leakage current (>30mA).

The grounding protection device must be suited to said values.

Floating IT networks

If an RFI filter is required for floating networks, also known as IT networks, with no grounding or with 30Ω greater ground impedance/resistance:

- Disconnect the filter before connecting the drive to the network.
- If EMC requirements are necessary, check for any excessive emissions towards the nearby low voltage mains. In some cases, the natural suppression in the transformer and the cables is sufficient. When in doubt, use a transformer with shield between primary and secondary.

NOTE

Refer to paragraph 5.10.2.2 on how to remove the filter inside the drive and to figure 5.6.3 on how to connect the filter and drive.



The filter must be grounded before powering the drive and can only be used with balanced mains.

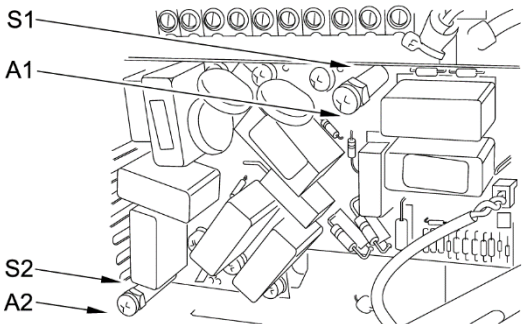
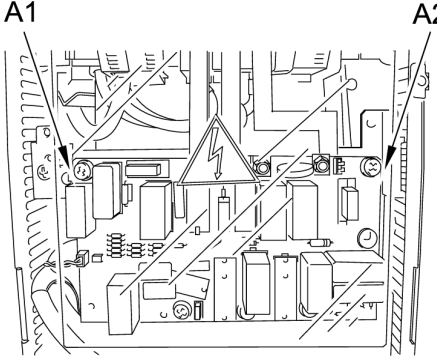
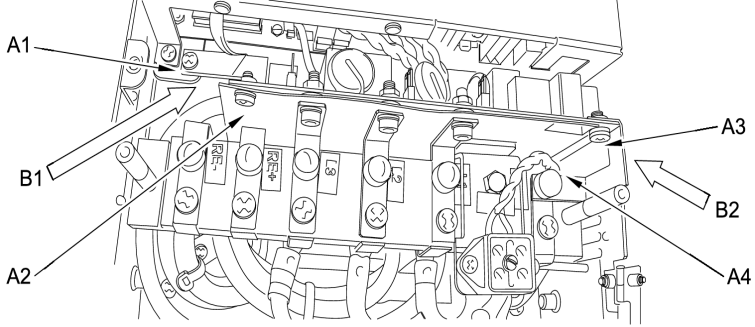
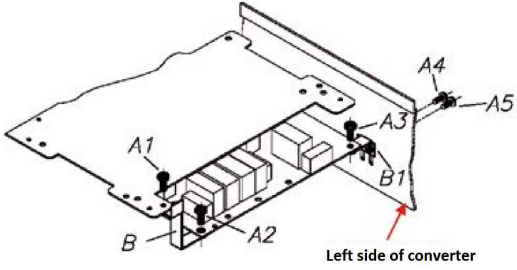
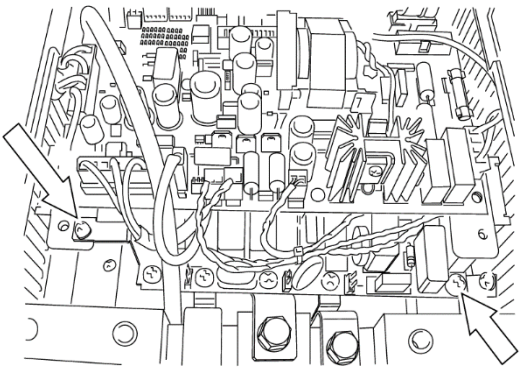
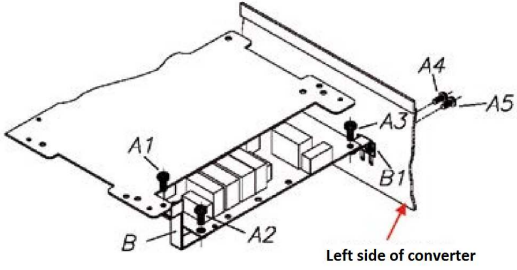
Do not install or disconnect the RFI filter when the drive terminals are powered.

If a drive with corresponding RFI filter is installed on an IT network a network isolated from the ground or a grounded network with high resistance (>30.X), the network will be connected to the ground potential via the drive EMC filter capacitors. This can cause dangerous situations or damage the unit.

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

5.10.2.2 REMOVING THE RFI FILTER ON AD1A030-166F DRIVES

AD1A030-036-045-053-066-086-108-125-150-166F by default require an internal RFI filter.

<p>AD1A030-036F: unscrew and remove screws A1-A2, the insulating protection and the supports (S1-S2). Unscrew and remove the six screws on the board and remove the supports (S1a-S1b) under the board. Replace support S1a with a screw. Reinstall supports S1 and S2 on the board with two nuts, then carefully screw the six screws back onto the board. At the end, reinstall the insulating protection.</p>	<p>AD1A030-036F: To disconnect the RFI filter, unscrew and remove screws A1-A2 and remove the underlying bars</p>
 <p>A technical drawing showing the internal components of the AD1A030-036F drive. Labels S1, A1, S2, and A2 point to various parts. S1 and S2 are insulating supports, while A1 and A2 are screws. Arrows indicate the removal of these components.</p>	 <p>A technical drawing showing the internal components of the AD1A030-036F drive. Labels A1 and A2 point to screws. Arrows indicate the removal of these screws and the underlying bars.</p>
<p>AD1A066F To disconnect the RFI filter, unscrew and remove screws A1-A4, remove bars B1 and B2</p>	 <p>A technical drawing showing the internal components of the AD1A066F drive. Labels A1, A2, A3, A4, B1, and B2 point to various parts. Arrows indicate the removal of screws A1-A4 and bars B1 and B2.</p>
<p>AD1A088-108-125-150-166F: To disconnect the RFI filter, unscrew and remove screws A1-A3, remove bar B, unscrew screws A4-A5, push down and remove bar B1 and retighten screws A4-A5.</p>	 <p>A technical drawing showing the internal components of the AD1A088-108-125-150-166F drive. Labels A1, A2, A3, A4, A5, and B point to various parts. Arrows indicate the removal of screws A1-A3, bar B, and the push-down of bar B1. A red arrow points to the 'Left side of converter'.</p>
 <p>A technical drawing showing the internal components of the AD1A088-108-125-150-166F drive. Arrows indicate the removal of screws A1-A3 and bar B.</p>	 <p>A technical drawing showing the internal components of the AD1A088-108-125-150-166F drive. Labels A1, A2, A3, A4, A5, and B point to various parts. Arrows indicate the removal of screws A4-A5 and bar B1.</p>

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

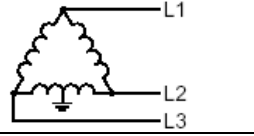
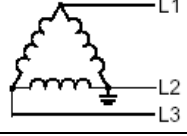
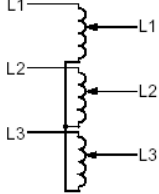
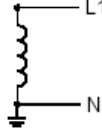


If a drive with corresponding RFI filter is installed on an IT network (network isolated from the ground or a grounded network with high resistance (>30Ω),) the network will be connected to the ground potential via the drive EMC filter capacitors. This can cause dangerous situations or damage the unit.

Mains with asymmetrical ground connection (defined in the following table)

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

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

MAINS WITH ASYMMETRICAL GROUND CONNECTION – the RFI filter must be disconnected.			
Ground on the centre line of a winding		Ground on the angle of the delta winding	
Three-phase variac without a solid ground point		Single-phase mains connected to ground	

5.10.3 AD1000 compliance with IEC 61800-3

AD1000s with RFI filter shown in table 5.5.1 (“Category C3” column) meet the requirements defined in EN 61800-3 for category C3 and C4 second environment.

AD1000s with RFI filter shown in table 5.5.1 (“Category C2” column) with motor cable length less than 25 metres meet the requirements defined in EN 61800-3 for Category C2.

ATTENTION!: This is a C2 category product in compliance with IEC 61800-3. In a domestic environment this product can cause radio interferences. In this case additional measures to reduce the interferences may be required.

The installation warnings and recommendations in this manual must be respected.

Using an optional class B filter is advisable for use in category C2 first environment.

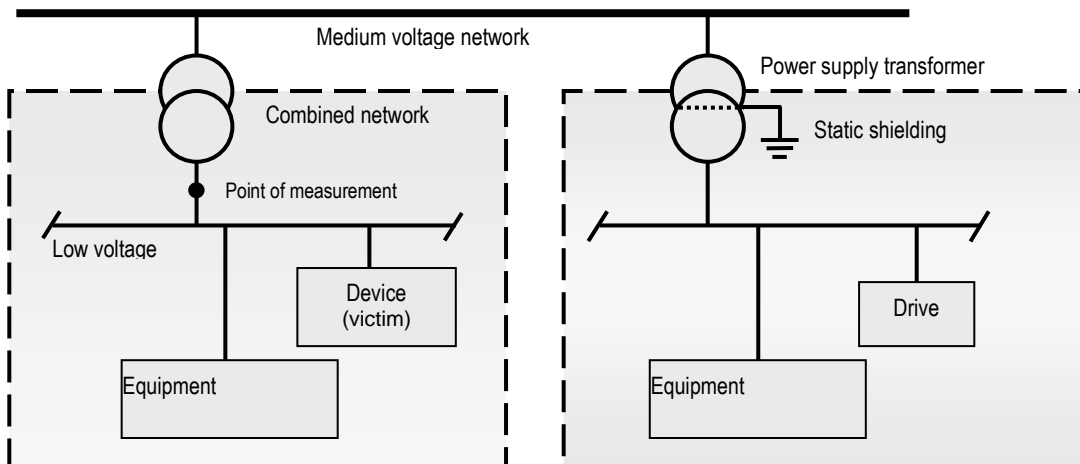
NOTE

- a) If the drive is installed on a floating network (IT), the standard EMC filter must be disconnected. The network would be connected to the ground potential via the EMC filter capacitors, with possible subsequent damages to the unit.
EMC filters suitable for IT networks are available upon request.
- b) Refer to paragraph 5.4 to connect the RFI filter to the drive.
- c) The RFI filter codes are shown in Table 5.5.1.

NOTE

If the above regulations cannot be followed, (i.e. the drive cannot be equipped with EMC filter as it is installed on a floating network (IT)), the EMC directive requirements for limited distribution can be met as follows:

1. Make sure there is no excessive emission towards the nearby low voltage mains. In some cases, the natural suppression in the transformer and the cables is sufficient. When in doubt, use a transformer with shield between primary and secondary.



2. There is an EMC plan to prevent interferences for the specific installation.
3. Power and control cables are provided as required by the Manual.
4. The drive was installed following the instructions in the Manual.

5.10.4 Motor cables

5.10.4.1 CONNECTION CABLES BETWEEN DRIVE AND MOTOR

NOTE

The motor power cables must be shielded. RFI problems could arise if shielded cables are not used. Shielded cables ensure elevated system immunity to interferences generated by the drive. The high frequency current goes back to the drive directly through the shielding rather than flowing through the motor casing.

Cable shielding must be continuous and must be grounded at both ends: both on the motor ground terminal and on the drive PE ground terminal. In general, always provide a specific cable with a minimum cross-section equal to 50% of the phase cable that directly connects the drive PE terminal to the corresponding motor terminal. Said cable has the function of providing a preferential route for closing to bring the interferences generated by the drive back to the drive itself, preventing them from propagating to the plant grounding system. The motor must be grounded directly to the plant grounding system.

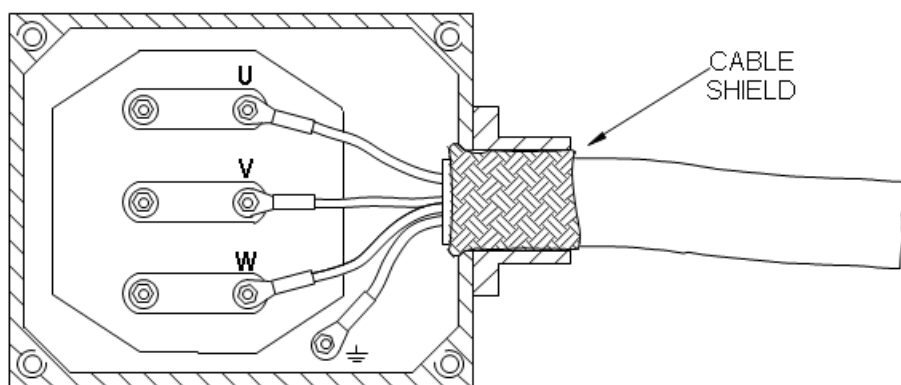
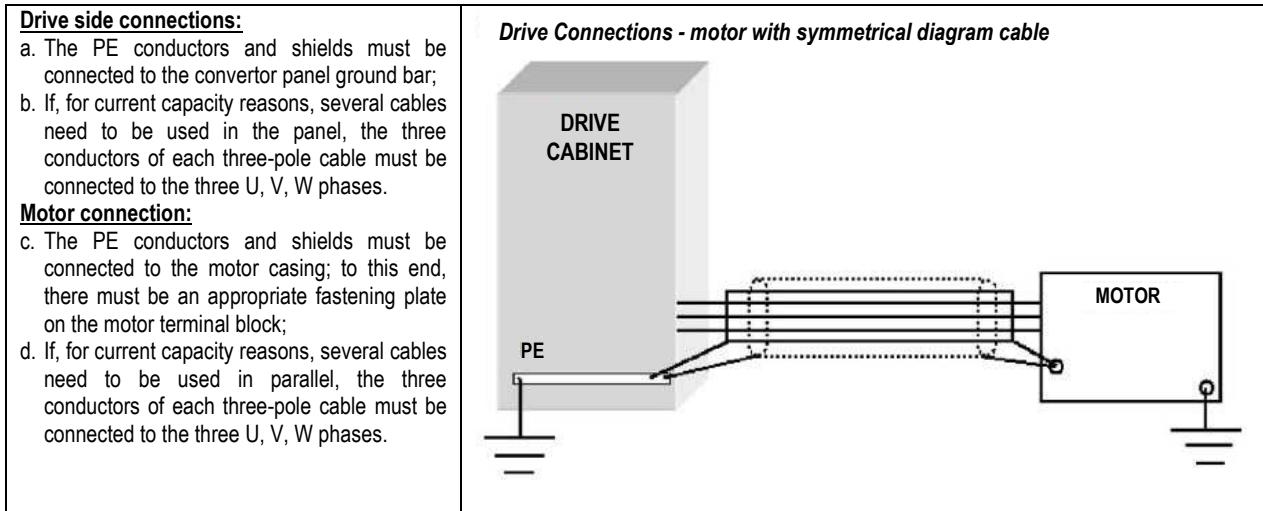


Figure 5.9.4.1 Typical connection on the motor

5.10.4.2 TYPE OF CONNECTION CABLES BETWEEN DRIVE AND MOTOR TO COMPLY WITH THE EMC DIRECTIVE AND TO CONTAIN PARASITIC CURRENTS

<p>a) Recommended cable Symmetrical shielded cable - 3 symmetrically arranged phase conductors - Individual unshielded conductor - 3 symmetrically arranged PE conductors - External shield for phase and PE conductors</p>	
<p>b) Recommended cable Symmetrical shielded cable: same as above but with a single PE cable positioned at the centre of the cable.</p>	
<p>c) Recommended cable Symmetrical shielded cable: shield with 50% greater cross-section than the cross-section of every phase conductor (a separate PE conductor is only necessary if the cable shielding conductivity is insufficient).</p>	

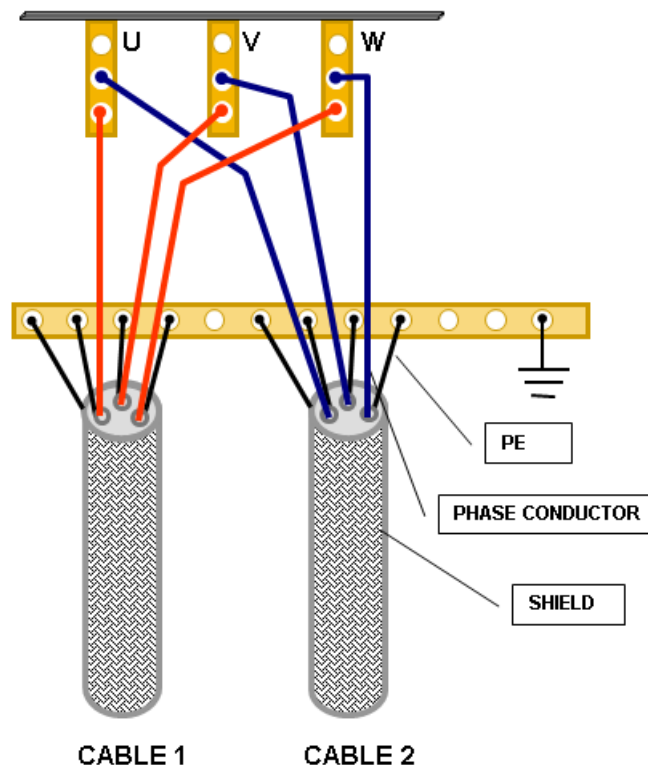


The figure shows the connection between Drive and Motor in diagram form; it highlights the connection between the Motor casing and the Drive panel ground bar via motor drive connection cables (shield and PE conductors).

NOTE

Due to ground dispersion current and high switching frequency, very long motor cables can cause the ground fault detection device to trip. Replace the device with a less sensitive one or power the drive with a specific transformer.

Drive-motor connections with two shielded cables



GROUNDING

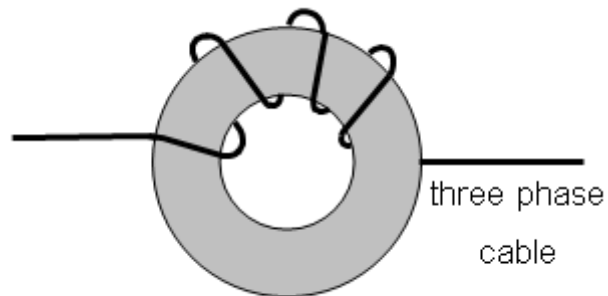
The Drive Panel and Motor are individually connected to the same grounding system; the connection cables between Drive and Motor are grounded on both sides (both the PE conductors and the shields of said cables).

FERRITES

In applications in which several motors are connected to a drive and the cables cannot be completely shielded due to a derivation terminal block of the individual motor cables, ferrite cores must be provided at drive output. For proper use, the three cables must be wound (2 to 5 times) through the ferrite, leaving the ground cable out.

The cable running from the drive to the derivation terminal block without shielding must be as short as possible.



AD1A030-166 drives have an internal ferrite core in output.



5.10.4.3 SIGNAL CABLE SHIELDING

Cables for digital signals with lengths greater than 3 metres and all the cables for analogue signals must be shielded. The shield must not be interrupted and must normally be connected to both ends with metal clamps or similar devices, positioned directly on clean metal surfaces as long as the grounding points are part of the same ground line. Otherwise a capacitor (10 nF-2 kV) must be connected to the ground line at one end. In the rare cases in which the current circulating in the shield causes interference with the signals to shield, the shielding must be connected to only one side of the drive.

In the drive cabinet, this type of connection must be made directly on the sheet metal near the terminals and, if the cable comes from the outside, on the PE bar as well; at the other end of the cable, the shielding must be securely connected to the emitting or receiving unit housing. When grounding shielded cables, use a 360° connection and avoid "pigtail" connections at all costs, that is, grounding the shield using a little cable or using the shield rolled up and connected to the ground. Use a shielded twisted pair for analogue signals. Use a twisted pair for each signal.

Do not use a single common return cable for different analogue signals.		
	Multicore cable with shielded twisted pairs	Shielded multicore cable with twisted pairs

A shielded twisted pair is the best solution for low voltage digital signals but shielded multi-pole cables with twisted pair can also be used. Use separate digital signal cables from analogue signal cables. Use twisted cables for relays. These cables (with voltage no greater than 48 V) can travel along with digital signals. Do not mix 24Vdc cables and 115 / 230Vac cables in the same cable. Maximum control cable cross-section: 1,5 mm² (AWG16)

Control cables must be kept at a distance greater than 0.3 m (1 ft) from power cables.

Install power cables and signal cables in separate raceways. If necessary, cross the power and signal cables using a 90° angle.

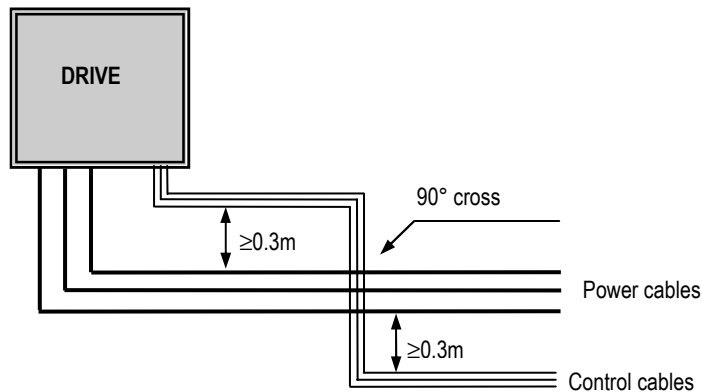
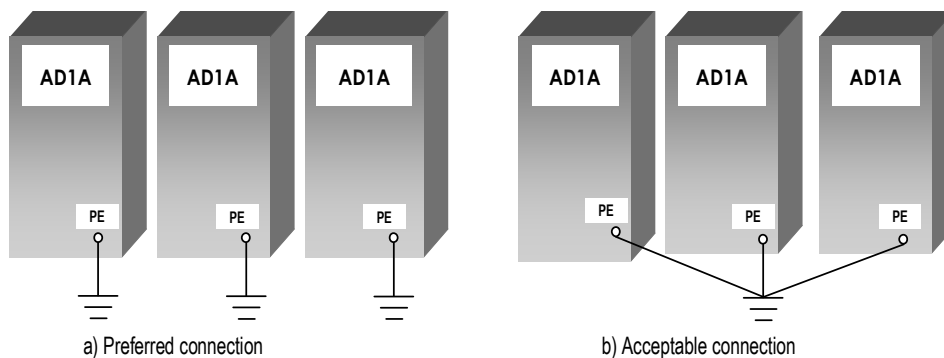


Figure 5.10.4.3.1 Cable route

5.10.4.4 GROUND CONNECTION

For safety issues, proper operation and to reduce electromagnetic emissions, the drive and motor must be grounded at the installation site. A star connection is acceptable but is not the best system.

- The ground cable cross-section must be appropriate to the national regulations in the country where the drive is installed.
- The power cable shield must be connected to the drive PE terminal to meet safety requirements.
- In multi-motor applications, do not connect the drive ground cables serially.
- The panel must have its own ground bar connected to the system ground, to which all the devices are connected.
- The ground connection must be as short as possible.
- The drive ground must be separated from the ground of other devices.
- RFI interferences require a large ground bar due to skin effect.
- The power cable shield can be used as ground cable only if it has a cross-section suited to the safety standards.



6 OPTIONS AND ACCESSORIES

6.1 Introduction

The AD1000 has several options and accessories. Some of the most requested ones are illustrated in this chapter; contact Nidec Asi for special requests.

Options (request when ordering the AD1000):

- Dynamic braking
- STO safety function
- Carriage
- EMC filter for frames up to 028F
- External power supply to the control

Accessories (can be ordered separately, installation is the customer's responsibility)

- Keypad (panel front installation)
- Sinusoidal filter
- Input reactor
- Output reactor
- Category C2 EMC filter (for frames from 210F)

For RFI filters and input and output reactors, see paragraph 5.5.

6.2 Dynamic braking

6.2.1 Braking unit

The AD1000 "F" series (excluding AD1A350-520 frames), if requested, can be equipped with an internal braking unit, an option that is factory assembled. The product code identifies the braking unit with the 10th character; the letter "B" in the 10th position means the brake is installed internally, while the letter "N" means the AD1000 does not have a braking unit installed (See chapter 2 for further details).

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

A braking unit is generally necessary when the required braking torque exceeds the rated motor torque found in the "Electrical data" table in paragraph 2.5 by 15%. The maximum braking torque allowed using the braking unit cannot exceed 150% of the rated motor torque.

The braking unit is supplied without a resistor that can be calculated using the formulas in section 6.2.3.

The braking device is able to manage continuous braking power calculated for 50% of the rated motor power (see paragraph 2.5 "Electrical data").

NOTE:

- For critical performance cycles (i.e. lifting applications), consult the manufacturer.

Table 6.2.1. Braking unit: Resistors and fuses for drives with 380V-480V $\pm 10\%$ rated voltage

Drive type	Minimum resistor value* Rb		Continuous Switch power	Typical resistor @ 400V			⁽¹⁾ External fuses			
	@400V	@480V		kW	kW	Ω	SAP Code	Data (A-V)	Bussmann BSS88....	Ferraz -
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	30	2x5 in parallel	ELC40672204	140-690	2x400/00T		ELC20653310
AD1A290F	1.65 Ω	1.8 Ω	140	40	2x5 in parallel	ELC40672205	140-690	2x400/00T		ELC20653310

1) User's responsibility

* Sized for emergency braking (1.5 I_N –Cl.2 for 60 s)

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

6.2.2 Resistor installation and connection



The resistors must be installed outside the drive in a position where they can get rid of heat. Resistors reach high temperatures; as such, avoid installing them near the drive or any other device that could be damaged by heat emissions. Protect the resistor from accidental contacts. The resistor must be protected by an appropriate thermal protector that opens the mains contactor if it trips. Use the same kind of cable used at drive power input (see Chapter 5) to make sure the input fuses also protect the resistor cables. Alternatively, two shielded cables with the same cross-section as the input cable can be used. The maximum resistor cable length is 5m (16.5 ft). To connect, see the drive connection example.

The resistor rated power is not calculated to work with duty-cycle=1. Should the power braking switch fail, the resistor is directly connected to the mains via the bridge rectifier. In such a situation, the resistor heats up to a high temperature and the resistor itself can fail. To avoid situations like this, the resistor must be protected by a suitable temperature relay: when it trips, the main switch protecting the input line must open.

The thermal device cables must be shielded and must be no longer than the resistor cables.

Due to safety issues, it is mandatory to provide a contactor on the drive power supply input and make sure it opens if the resistor overheats. Figure 6.2.2.1 shows a simple connection example.

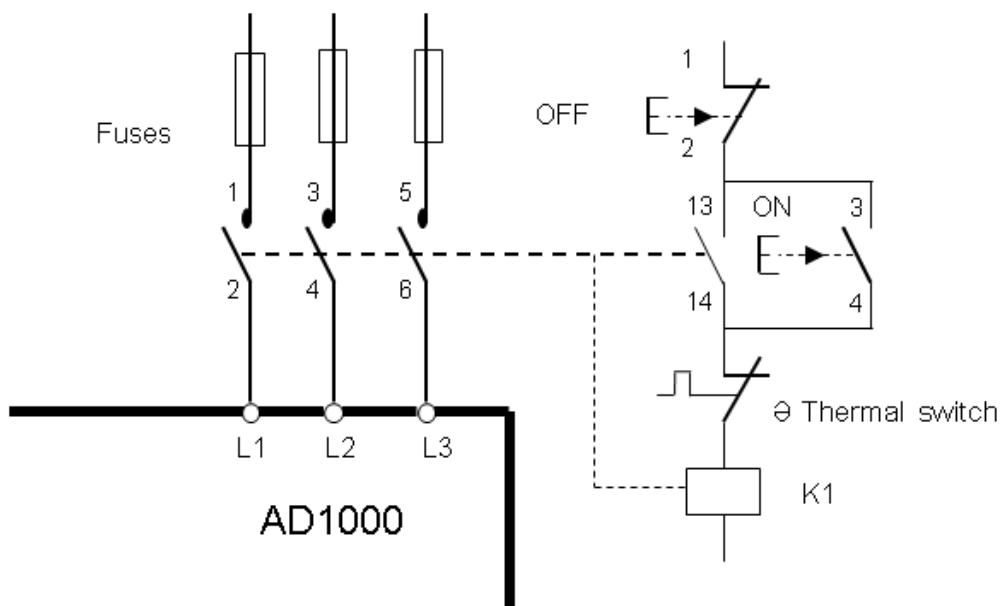


Figure 6.2.2.1 Example of contactor connection

6.2.3 Choosing the resistor

When the speed (frequency) of an asynchronous motor is rapidly reduced, the motor acts like an asynchronous generator, returning power back to the drive.

Part of the power dissipates inside the motor (when torque is about 10-20% of the rated motor torque); the rest is accumulated in the drive intermediate circuit capacitors with increased voltage at their ends. A dynamic braking unit is used to prevent reaching excessively high voltage values with the subsequent tripping of the drive maximum voltage protection.

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

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

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

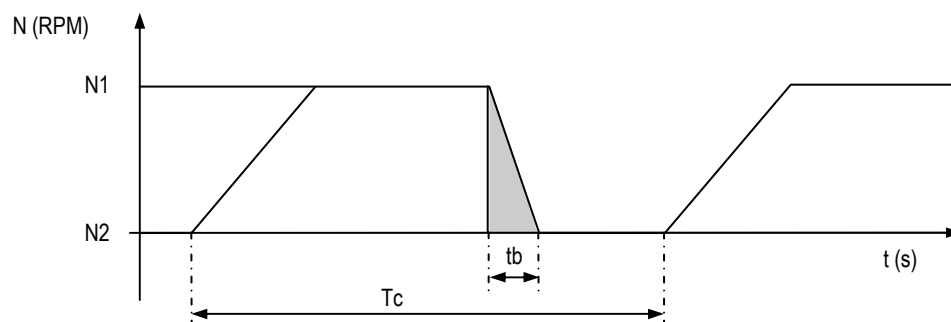
The following figure provides the definitions for the terms used when a motor is braked from an initial speed N1 to a final speed N2. In the event of power braking switch failure, the resistor is directly connected to the mains via the bridge rectifier. In such a situation, the resistor heats up to a high temperature and the resistor itself can fail. To avoid situations like this, the resistor must be protected by a suitable temperature relay: when it trips, the main switch protecting the input line must open.

The thermal device cables must be shielded and must be no longer than the resistor cables.

Due to safety issues, it is mandatory to provide a contactor on the drive power supply input and make sure it opens if the resistor overheats.

Figure 6.2.2.1 shows a simple connection example.

The formulas to calculate resistor power are shown below.



Terms and symbols used:

MB =	motor braking torque from speed N1 to N2 over a time tb	Nm
J =	total inertia to the motor shaft.	Kgm ²
ML =	load torque to the motor shaft.	Nm
PR =	resistor average power.	W
WB =	braking power.	J
MN =	Rated motor torque = $\frac{60 \cdot P}{2\pi \cdot N}$	Nm
N =	Rated motor speed	RPM
P =	Rated motor power	W
V =	Rated braking DC voltage (See the values shown in 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
	$R_B = \frac{V^2}{0.10472 \cdot M_B \cdot N1 \cdot 1.2}$	X
	$W_B = \frac{0.10472 \cdot (M_B - 0.2 \cdot M_N) \cdot (N1 + N2)}{2} \cdot tb$	J
	$P_R = \frac{W_B}{T_c}$	W

The RB ohmic value must be greater than or equal to the value shown in table 6.2.1.
The braking voltage must be selected based on the drive voltage class, as shown in the following table.

Table 6.2.3 Braking voltage by drive voltage class

AD1000 voltage class CA		DC voltage to use in the formula
F	from 380 to 480V	750

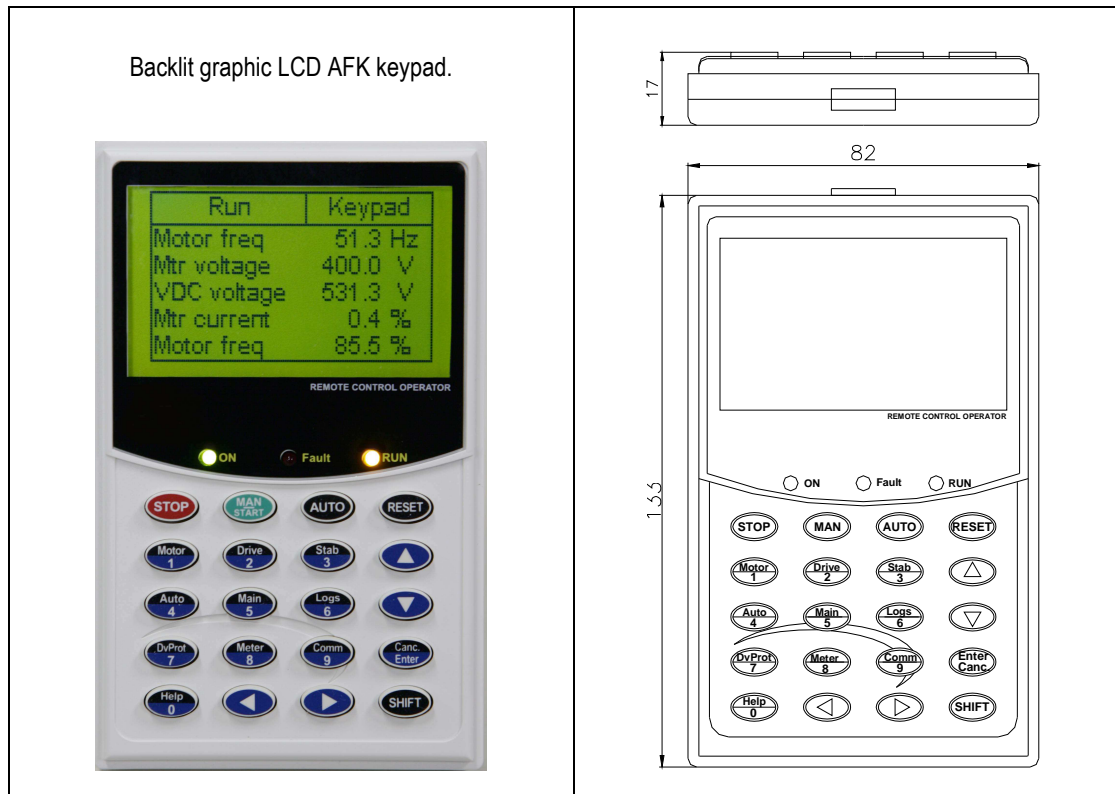
After calculations, the braking resistor can be selected using the following values:

- ohm value (Ω),
- braking power (J),
- work cycle,
- 1200 Volt peak ground voltage.

6.3 Keypad

Code 8000001597.

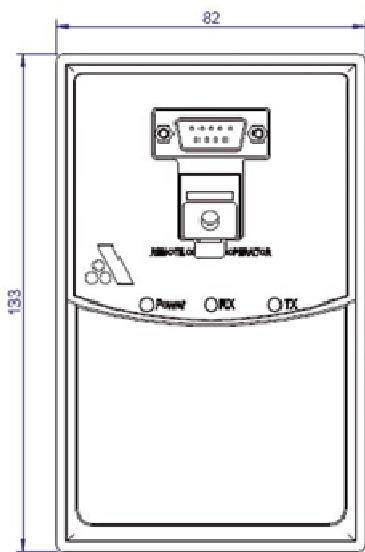
See programming user manual.



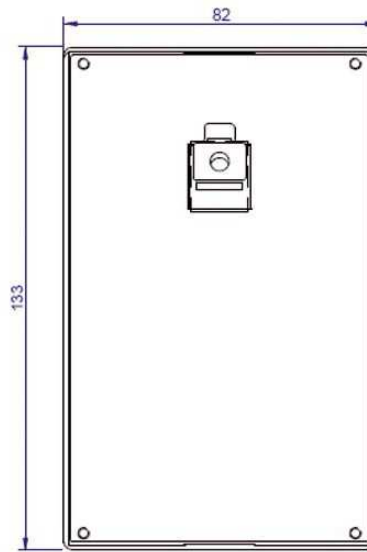
6.3.1 Installation on panel door

The following accessory kits are provided to remote the keypad on the door.

GTRK	ELC452936	Keypad remoting kit for AD1A0P3-028F	<ul style="list-style-type: none"> • Keypad assembly shell • Cable (2m ≈ long) for connecting the AD1000 • Fastening supports
GTRKB	1000087515	Basic keypad remoting kit for all frames, excluding AD1A0P3-028F	<ul style="list-style-type: none"> • Keypad assembly shell • Cable (2m ≈ long) for connecting the AD1000 • Fastening supports
GTRKA	1000094381	Advanced keypad remoting kit (with PC connector) for all frames, excluding AD1A0P3-028F	<ul style="list-style-type: none"> • Adapter that, installed on the drive door in place of the keypad, makes the control board connector accessible



Adattatore avanzato / Advanced adapter

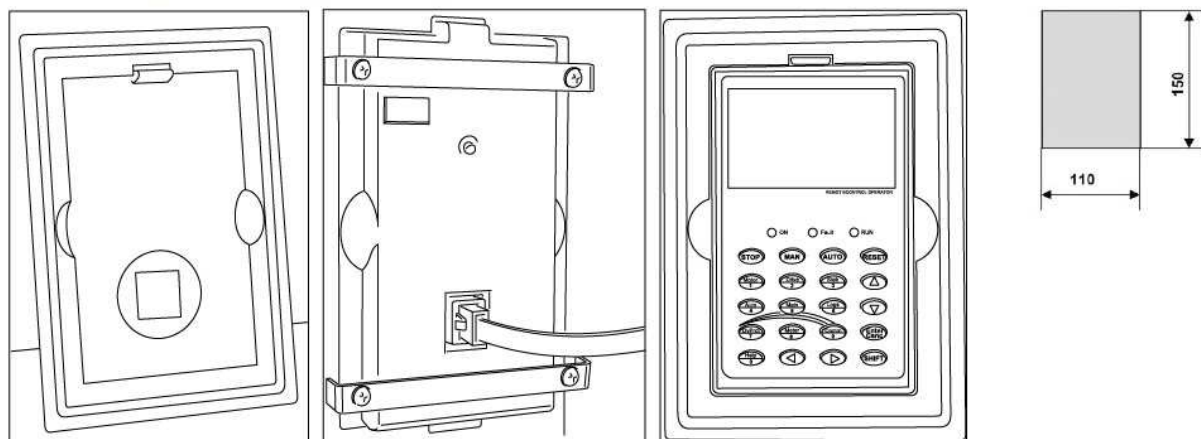


Adattatore base / Basic adapter

Figure 6.3.1

Keypad assembly shell.

Installing the shell requires the following hollow on the panel door.



Keypad degree of protection: IP54

Shell degree of protection: IP54 (with gaskets on the hollow - code 1000072882 and on the connecting hole - code 1000072881)

6.4 STO safety function (Safe Torque Off)

PREAMBLE

The STO function, certified by testing report RP09DM4SN02 dated 29/12/2009, is an option available for AD1000.

For a detailed description and how to use the function, refer to the document:

USER INSTRUCTIONS MANUAL FOR SAFETY FUNCTION:

“STO” SAFE TORQUE OFF FOR GT3000/5000 AND GT LARGE DRIVES

Number	Rev.	Date
MIM046	21	31/07/13

The above document, pursuant to the IEC 60204-1 standard “Safety of machinery - electrical equipment of machines” (EN60204-1:2006-06), point 7 of the IEC 61800-5-2:2007 standard, and point 11 of the UNI EN ISO 13849-1:2008 standard, describes the STO safety function conditions of use.

The “CE Declaration of Conformity” supplied with the above safety function is only valid when all the conditions of use described in the above document are followed.

This document is part of the “accompanying documents” in compliance with Machinery Directive 2006/42/EC and Low Voltage Directive 2006/95/EC and is considered part of the safety function itself.

6.4.1 Safety function identification

The components corresponding to the “STO” function are factory installed in the drive, which is identified by the suffix in the drive identification acronym:

AD1 | A | XXX | F | B | N | F | H | N | N | **T** | 00 | NN

Safe Torque function Off	N = Not installed D = STO Single Channel board installed (up to frame 028F) T = STO board installed (from frame 030F)
--------------------------	-----------------------------------------------------------------------------------------------------------------------------

6.4.2 Field of application

The STO safety function was conceived to ensure the “SAFE TORQUE OFF” function with drive-powered asynchronous motors.

In fact, if the function is active, the motor connected to the drive is not longer powered.

The safety function is activated via two independent channels and different technology.

Using a safety relay, the first channel cuts power to the electronic devices (drivers, optocouplers, optic fibres, buffers) that send control pulses to the power part. In these conditions, even if the regulating electronics should generate control pulses, the power part would no longer be able to move the connected motor.

The second channel inhibits both microprocessor pulse generation and pulse propagation towards the control part.

The safety relay (RL1) has two contacts, one in closing and one in opening, mechanically connected to each other so that even in failure state (i.e. contacts stuck in closing and/or opening), they cannot be closed or opened at the same time. The NO (Normally Open) contact powers the pilots, while the NC (Normally Closed) contact signals the safety STO status via an external system.

A microprocessor digital output that controls the RL2 relay (DO3) signals when the second channel is activated.

NOTE:

The digital output of the RL2 microprocessor (DO3) must be configured in the **DO3 Select [16.05]** parameter by selecting “SW1.11-DE Received”. See the programming manual.

NOTE:

The STO option must be defined before ordering the inverter (factory installed and tested); when the STO function is installed, the DO3 relay programmable digital output is no longer available.

6.4.3 Safety functions and corresponding level

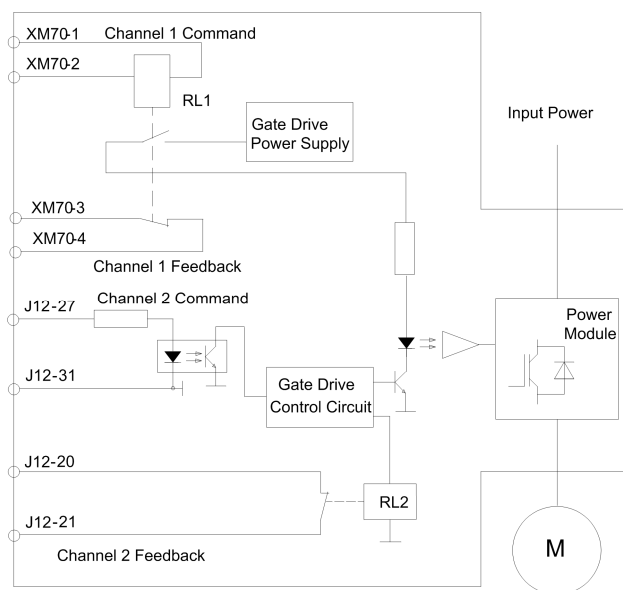
The “STO” safety function was designed to prevent the motor from starting unexpectedly. A motor stopped using the “STO” safety function can be put into “SAFE TORQUE OFF” status. In this condition, mechanical work can be done on the drive even without galvanic separation between motor and drive or between mains and drive.



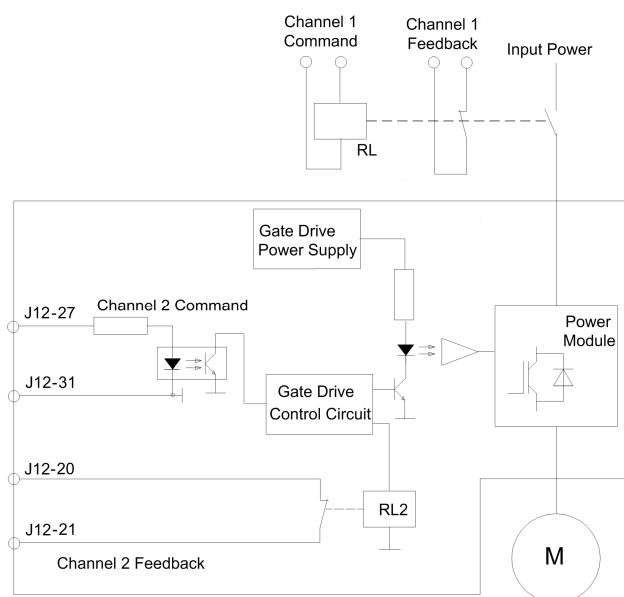
CAUTION!

- Motor terminals in “SAFE TORQUE OFF” status are not cut off from the mains and can be live at a dangerous voltage!
- The “STO” function is provided to prevent the motor from starting unexpectedly, not to stop it: if it is activated with the motor in rotation, it causes an uncontrolled stop. If an uncontrolled stop is not desired, a stop sequence must be run before activating the “STO”.

A motor in “SAFE TORQUE OFF” status cannot generate torque. A mechanical brake must be provided to ensure the rotation with load torque applied to the axis is stopped.



Full STO function (version T) block diagram for Basis control board



Single Channel STO function (version D) block diagram for Basis control board

- There is a residual risk: if two IGBT break simultaneously, the motor can be involved to the point where the drive or fuse protections trip, from a small rotation angle ($360^\circ/2P$ with P = number of pole pairs in the event of brushless motors, to a cable gland in the event of induction motors) even though the "SAFE TORQUE OFF" function is active.

The STO function integrated in the sub-system represented by the PDS:

- fulfils EN 60204-1:2006, paragraph 5.4 "Devices for switching off for prevention of unexpected start-ups" but not paragraph 5.3 "Supply disconnecting (isolating) device";
- adapts to create the stop function according to category 0 and 1 in compliance with EN 60204-1, paragraph 9.2.2;
- can meet the safety requirements of the harmonised UNI EN ISO 13849-1:2008 standard category 3 PL "d" as regards blocking start-up based on the configuration shown in paragraph 2.4 of the MIM046 document rev.21;
- can meet the safety requirements of the IEC 61800-5- 2:2007 SILCL 2 as regards blocking start-up based on the configuration shown in paragraph 2.4 of the MIM046 document.

To meet the safety requirements of the UNI EN ISO 13849-1:2008 category 3 PL d and IEC 61800-5-2:2007 SILCL 2 standards, there must be an external safety circuit that respects:

- both the redundancy principle as regards the activation inputs of the two channels so that an individual failure in any of said parts does not lead to loss of the safety function, considering common type failures; for this reason, two separate and independent inputs are provided;
- as well as monitoring proper function of both the channels; two external feedback contacts are provided that correspond to the two independent relays, RL1 (safety) and RL2. Both are found in the "open" state in normal operating conditions and in the "closed" state when the STO function is activated: this makes an external parity check possible in order to compare the two outputs. Should a failure be identified, it must be impossible to reset the circuit.

See paragraph 2.4 "Configuration" in the MIM046 document rev.21 for further information regarding:

- the actions to take should a failure be identified;
- trip times;

6.5 Sinusoidal filter

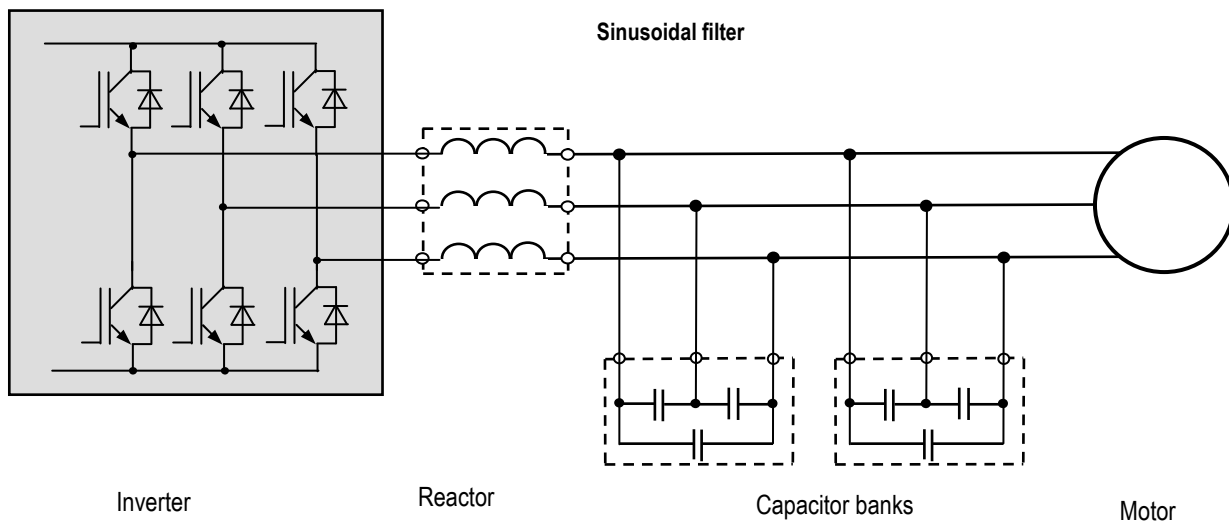
A sinusoidal filter is an accessory that, eliminating the output voltage high frequency components, allows you to obtain nearly sinusoidal and peak-free voltage on the motor and, furthermore, reduces the increase of drive-powered motor noise.

The sinusoidal filter is especially recommended for motors that do not have an appropriate degree of isolation for drive power supply, submersible pump motors with very long cables, motors used in classified environments and applications with a transformer at drive output. It can only be used with scalar control (V/Hz) and is sized for 2kHz switching frequency and for a maximum output frequency of 50/60Hz.



Before connecting the drive to the motor, make sure that the current absorbed by the group of capacitors of the drive output LC filter is 90% less than the motor empty current (find the capacity value from the panel functional diagram).

This condition must be checked to prevent the motor from self-exciting, with subsequent serious damage both to the machine and the operator.



On frames with a default switching frequency of 1.5kHz, remember to reset the frequency at 2kHz (**Switching Freq [06.25]** parameter). See paragraph 2.6 for the switching frequencies and the programming manual.

Model	Frame	Class 1		Class 2	
		Rated current inverter	Sinusoidal filter	Rated current inverter	Sinusoidal filter
Three-phase mains 380V, 415V, 440V, 460V, 480V $\pm 10\%$					
AD3A0P3F	I	3.8	1000249220	2.1	1000249219
AD3A0P4F	I	5.6	1000249226	3.8	1000249220
AD3A0P6F	I	9.5	1000249227	5.6	1000249226
AD3A008F	II	12	1000249228	9.5	1000249227
AD3A011F	III	16	1000249236	12	1000249228
AD3A015F	III	21	1000249237	16	1000249236
AD3A018F	IIIX	25	1000250285	21	1000249237
AD3A022F	IIIX	32	1000250287	25	1000250285
AD3A028F	IIIL	40	1000250289	32	1000250287
AD3A030F	IIIN	40	1000250289	32	1000250287
AD3A036F	IIIN	52	1000250291	40	1000250289
AD3A045F	IVN	65	1000250292	52	1000250291
AD3A053F	IVN	65	1000250293	52	1000250292
AD3A066F	IVN	96	1000250295	77	1000250293
AD3A086F	VN	77	1000250296	65	1000250295
AD3A108F	VN	156	1000250297	124	1000250296
AD3A125F	VIN	96	1000250301	77	1000250297
AD3A150F	VIN	210	1000250302	180	1000250301
AD3A166F	VIN	124	1000250302	96	1000250302
AD3A210F	VII	300	1000250309	240	1000250302
AD3A260F	VII	156	1000250310	124	1000250309
AD3A290F	VII	410	1000250316	320	1000250310
AD3A350F	VIII	510	1000250317	385	1000250316
AD3A370F	VIII	540	1000250318	410	1000250316
AD3A440F	VIII	540	1000250321	410	1000250317
AD3A480F	VIII	690	1000250322	530	1000250318
AD3A520F	VIII	640	1000250322	510	1000250319

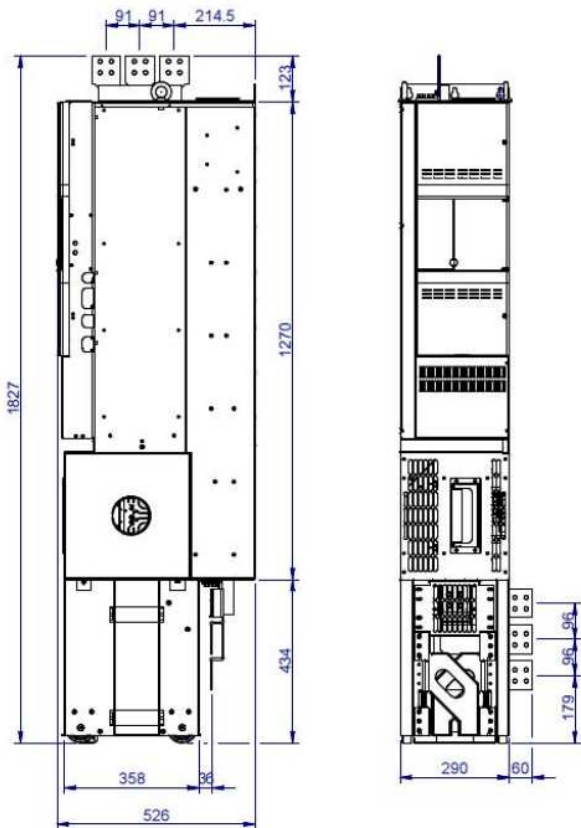
Table 6.5.1 Sinusoidal filters

6.6 Carriage

The carriage is an option, available only for VIII frames, indicated by the 18th and 19th character in the identification code (see Chapter 2) and can be supplied with or without output reactor (CR/CN). See paragraph 2.8 for the full measures.

Example:

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

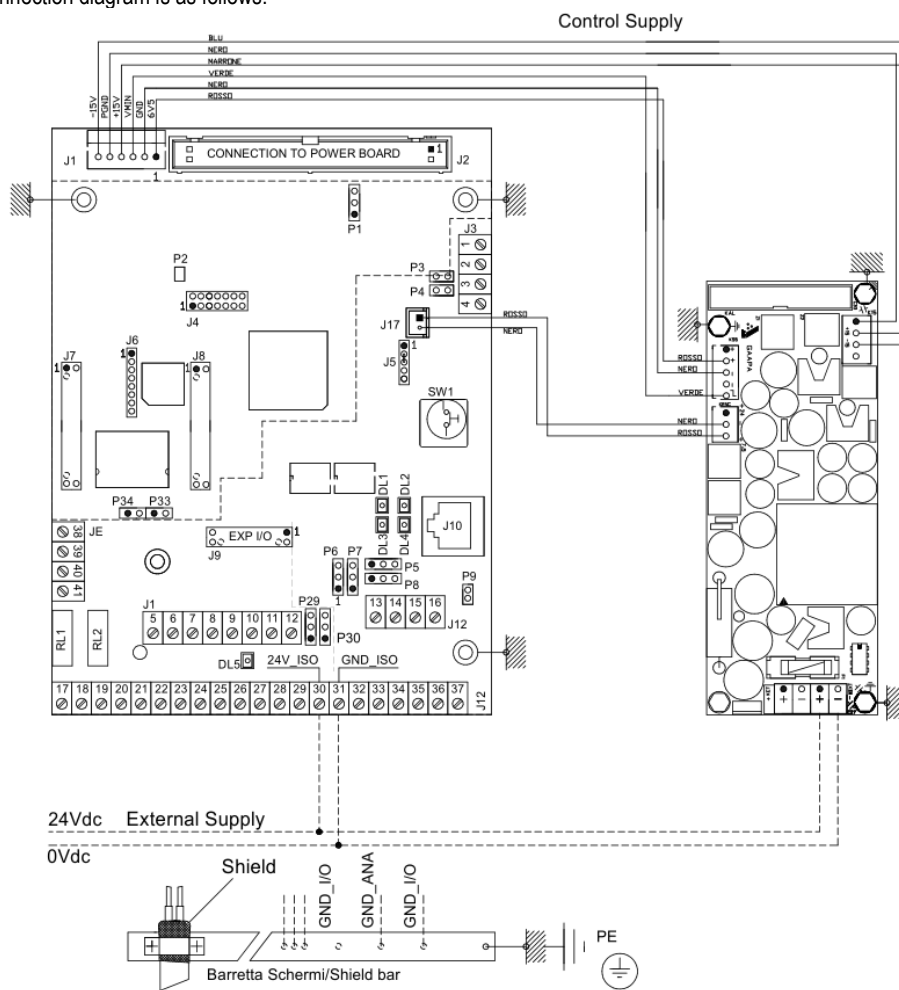


6.7 External power supply to the control

The AD1000 can be ordered with the option of externally powering the control. This option allows the converter control board to be powered by a 24Vdc 2.5A auxiliary power supply, with the option of keeping the control board on (thereby also keeping communications with the field buses open, for example) even when the drive is not powered. The option of externally powering the control is identified by the suffix 10 in fields 16 and 17 of the identification code.

AD1	A	XXX	F	B	N	F	H	N	N	N	10	NN
-----	---	-----	---	---	---	---	---	---	---	---	----	----

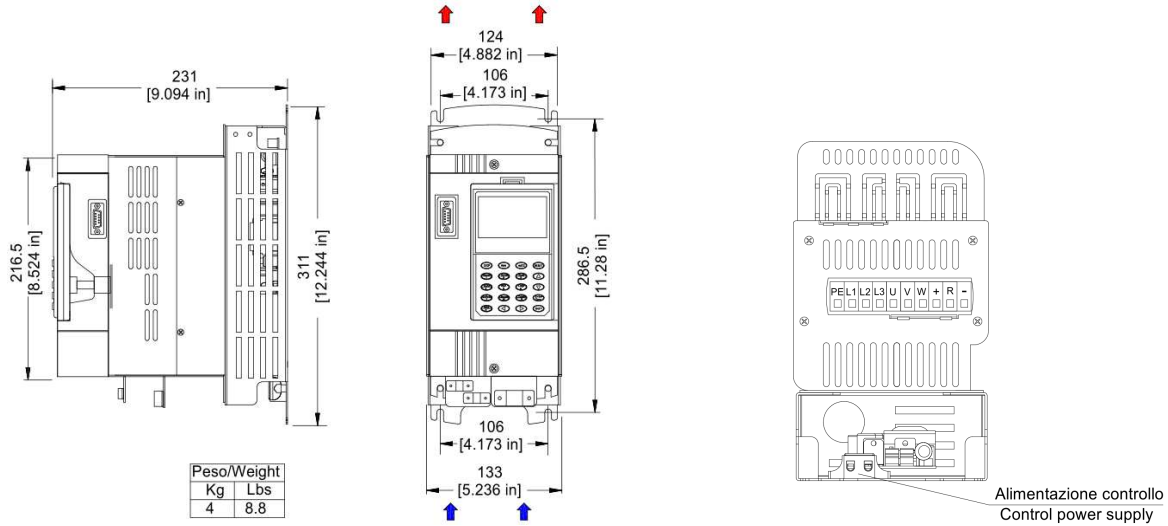
The option requires a feeder board to be added inside the drive. In this case, the connection diagram is as follows.



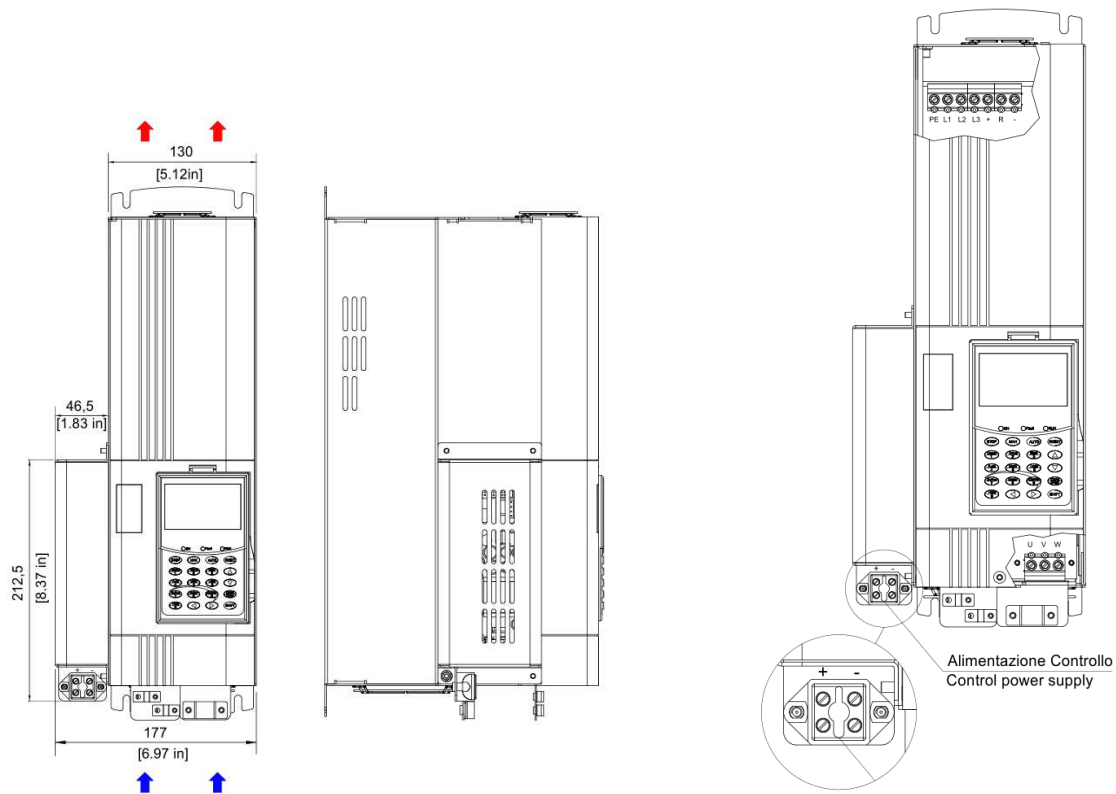
NOTE: The P9 jumper in this configuration must be opened.

The 24Vdc external power supply is brought to control board terminals J12-30 and J12-31 and in parallel to the feeder board terminals. For drives with frame from AD1A030F to AD1A520F, the feeder board is installed inside the converter without changing its physical dimensions. For smaller frame drives, the dimensions and terminal blocks are different to those of standard converters and are shown below.

FRAME I AD1A0P3-0P4-0P6



FRAMES II-III-III-III AD1A008-028



7 PREVENTIVE MAINTENANCE

Preventive maintenance is the combination of all the operations intended to conserve the AD1000 drive from wear and premature ageing. The criteria that dictate scheduling said operations do not include preventing random failures which can, in any case, occur.

The table lists the maintenance boards, the frequency and the operation that must be done.

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	-

7.1 AD1000 – PM001 Drive

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



The drive must be kept clean, dry and the connections tightened. Dust on the drive hardware can cause insufficient ventilation with subsequent reduced dissipater and fan performance. Dust in an electronic device can cause malfunctions and even failures. Dust absorbs moisture, which increases the risk of failure. The air used to remove the dust must be dry and oil-free.

1. Thermal variations and mechanical vibrations can lead to poor connection tightening.
2. A screw has a maximum clamping capacity corresponding to a tightening torque value determined by its dimensions, shape and material. Permanently exceeding said torque limit reduces screw elasticity, deforming it and reducing its clamping capacity.
3. Make sure that:
 - the cables are not damaged;
 - the terminals are tightened;
 - the drive and motor ambient temperature do not exceed the recommended specifications;
 - the boards are dust and condensate-free;
 - the insulation is not damaged or discoloured;
 - the vents or areas near the drive fans are not obstructed.

7.2 AD1000 – PM002 Drive

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

The electronic boards do not require particular maintenance operations.

Periodically remove dust without using compressed air, as there are components that are sensitive to electrostatic loads installed on the boards.

7.3 AD1000 – PM003 Drive

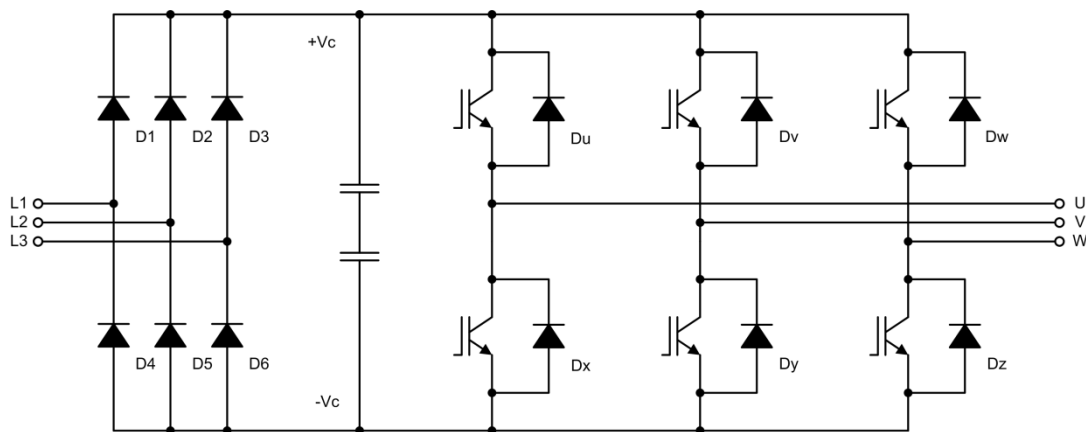
SUBGROUP	OPERATION	SPECIAL TOOLS, INSTRUMENTS AND MATERIALS	PRESCRIPTIONS	TIME INTERVALS	PRECEDENCE
Jumper	Check	Digital multimeter	Carry out the safety operations in chapter 4	6 months	

The instrument needed for this operation is a digital multimeter positioned on "diode check"

Check the diodes and the IGBT after having disconnected the power cables to prevent incorrect measurements due to external components.

The first operation is a visual check. Follow the sequence below:

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



7.4 AD1000 – PM004 Drive

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

1. Power off the devices by disconnecting the power supply.
2. Access the radiator.
3. Remove the dirt outside.
4. Remove the dirt from the radiator using an industrial vacuum cleaner.
5. Remove obstructions and/or impurities.
6. Restore power.

7.5 AD1000 – PM005 Drive

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

1. Power off the devices by disconnecting the power supply.
2. Access the fan.
3. Remove the dirt outside.
4. Remove the dirt from the radiator using an industrial vacuum cleaner.
5. Remove obstructions and/or impurities.
6. Restore power.

7.6 AD1000 – PM006 Drive

SUBGROUP	OPERATION	SPECIAL TOOLS, INSTRUMENTS AND MATERIALS	PRESCRIPTIONS	TIME INTERVALS	PRECEDENCE
Capacitor	Formatting		Carry out the safety operations in chapter 4	1 month	

1. Power off the devices by disconnecting the power supply.

NOTE

The F series uses electrolytic filter capacitors. Assuming an average temperature of 35°C with 20 hours of operation a day, the average electrolytic capacitor lifespan is about 5-6 years.

In general, capacitors can be stored for three years at temperatures up to 50°C without reducing their reliability in any way.

After a prolonged storage period, the dispersion current value can exceed the rated value and requires re-anodising before use. This can be done by applying the rated voltage at ambient temperature for an hour. In any case, it is advisable to use a maximum load current of 5mA or equal to twice the typical value specified for each series.

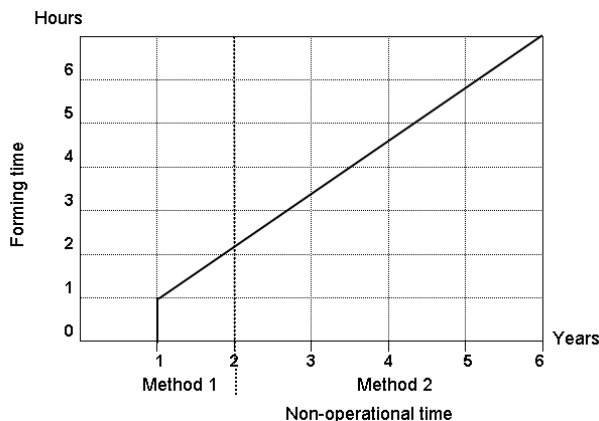
Below is the CAPACITOR FORMATTING procedure: The electrolytic capacitors only conserve their original features if they are powered within 1 year from the supply date. Annual reformatting ensures the stored drive is immediately available and, therefore, can quickly replace a faulty drive.

Using a drive with unformatted capacitors can cause the capacitors and the drive to break. The reformatting methods and instructions below assume that the drive has been stored in a clean, moisture-free room. To determine how old the drive is, look at the test date on the drive plate as illustrated below.

AD1000 plate detail	TYPE AD1A520FBNFHNNN00NN	Test date (Year/Month) Example: 16 = 2016	01 = January
	N° 16A00133	DATE 16/01	

Reformatting time.
The inverter is kept at a safe voltage during the reformatting time.
The reformatting time required depends on how long the inverter is non-operational

Figure 7.1



METHOD 1

Drives stored (inoperative) for less than two (2) years: Power the drive for the time shown in figure 7.1. The drive will reformat its capacitors on its own.

Drives stored (inoperative) for more than two (2) years: Use method 2A or 2B (see figures below).

METHOD 2A

Power the drive DC bus with a diode three-phase bridge with a load resistor in series as illustrated in Figure 7.2.

(P = Rectifier; R = Load resistor; C = Capacitor). Refer to Figure 7.1 for formatting time.



During formatting, the drive must be disconnected from the power supply.

METHOD 2B

A DC power supply source is required to connect to the drive DC bus.

The ideal reformatting voltage value is $(1.35... 1.41) \times V_x$.

The DC source charges the drive capacitors and must be able to limit the current to values $\leq 500\text{mA}$, otherwise a resistor (R) must be installed to limit the load current. Refer to Figure 7.1 for formatting time.



During formatting, the drive must be disconnected from the power supply.

KEEPING THE DRIVES READY FOR PRODUCTION

Annually formatting the drives that are in storage or unused ensures they are always ready to perform at their utmost with their original operating parameters.

Failure to do this maintenance procedure can, in the worst case scenario, lead to capacitor and drive failure.

For further information, contact Nidec ASI S.p.A. Customer Assistance.

Figure 7.2

