Altivar Process

ATV990 MultiDrive Systems

Handbook

English

02/2018

NHA37145.00

www.schneider-electric.com

Schneider Electric

Altivar Process
MultiDrive Systems

The customized solution for your drive

MultiDrive systems are suitable for your applications which require a common DC bus. It is advantageous when the load of several motors leads to the simultaneous operation of both motor and generator.

Compact dimensions

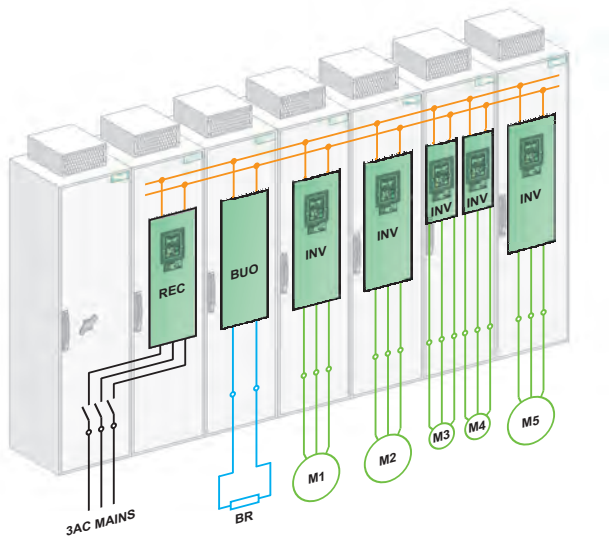
+ Low space required in the control room
+ Generous connecting area for the power cables
+ Easy accessibility of all components
+ Control panel for numerous options

Sophisticated motor control system

+ High overload capability
+ Especially good motor efficiency
+ Impressive robustness against load impacts
+ Excellent performance for all common motor types
+ Significant speed and torque accuracy with and without encoder feedback

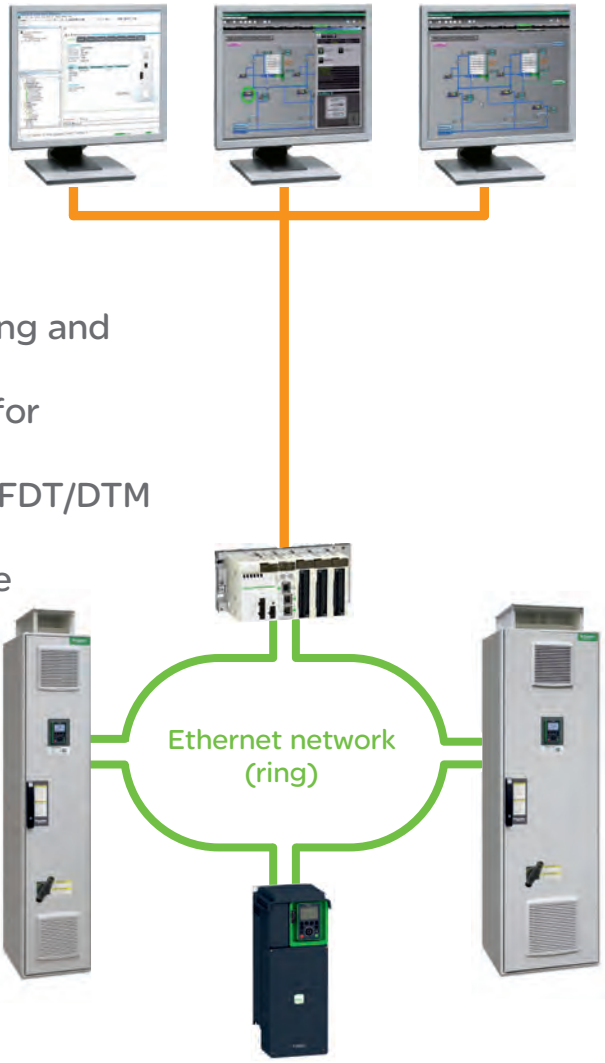
> Asynchronous motors
> PM motors
> Torque motors
> Reluctance motors
> Special motors like submersible pumps, sliding rotor motors,...

DC-Bus Architecture



+ Simple common DC-Bus architecture with modular design
+ Efficient multi-motor applications with load sharing

Extended connectivity



+ Embedded Dual Ethernet for simple wiring and increased availability
+ Dynamic drive-to-drive communication for multi-motor operation
+ Easy integration thanks to standardized FDT/DTM and ODVA technology
+ Easy access via PC, tablet or smartphone

Available on the App Store

Get it on Google play

Sophisticated service concept with QR code

+ Modular design allows easy logistics of spare parts
+ Optimized costs of maintenance due to dynamic maintenance schedule with integrated monitoring of the individual components
+ Simple exchange of power modules and fans
+ Quick assistance with dynamic QR codes and Customer Care App

The information provided in this documentation contains general descriptions and/or technical characteristics of the performance of the products contained herein. This documentation is not intended as a substitute for and is not to be used for determining suitability or reliability of these products for specific user applications. It is the duty of any such user or integrator to perform the appropriate and complete risk analysis, evaluation and testing of the products with respect to the relevant specific application or use thereof. Neither Schneider Electric nor any of its affiliates or subsidiaries shall be responsible or liable for misuse of the information contained herein. If you have any suggestions for improvements or amendments or have found errors in this publication, please notify us.

All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed.

Failure to use Schneider Electric software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

Table of Contents

Safety Information

Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a "Danger" or "Warning" safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

DANGER indicates a hazardous situation which, if not avoided, **will result in** death or serious injury.

⚠ WARNING

WARNING indicates a hazardous situation which, if not avoided, **could result in** death or serious injury.

⚠ CAUTION

CAUTION indicates a hazardous situation which, if not avoided, **could result** in minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury.

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed to Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

Qualification Of Personnel

Only appropriately trained persons who are familiar with and understand the contents of this manual and all other pertinent product documentation are authorized to work on and with this product. In addition, these persons must have received safety training to recognize and avoid hazards involved. These persons must have sufficient technical training, knowledge and experience and be able to foresee and detect potential hazards that may be caused by using the product, by changing the settings and by the mechanical, electrical and electronic equipment of the entire system in which the product is used. All persons working on and with the product must be fully familiar with all applicable standards, directives, and accident prevention regulations when performing such work.

About the Book

At a Glance

Document Scope

This document gives you an overview of the available Altivar Process Drive Systems. Furthermore, you can select from the options described in detail in order to adapt the Altivar Process Drive System to the actual requirements of your system.

Validity Note

Original instructions and information given in this manual have been written in English (before optional translation).

This documentation is valid for the Altivar Process Drive Systems.

The technical characteristics of the devices described in this document also appear online. To access this information online:

Step	Action
1	o to the Schneider Electric home page *www.schneider-electric.com*.
2	In the **Search** box type the reference of a product or the name of a product range. ● Do not include blank spaces in the reference or product range. ● To get information on grouping similar modules, use asterisks (*).
3	If you entered a reference, go to the **Product Datasheets** search results and click on the reference that interests you. If you entered the name of a product range, go to the **Product Ranges** search results and click on the product range that interests you.
4	If more than one reference appears in the **Products** search results, click on the reference that interests you.
5	Depending on the size of your screen, you may need to scroll down to see the data sheet.
6	To save or print a data sheet as a .pdf file, click **Download XXX product datasheet**.

The characteristics that are presented in this manual should be the same as those characteristics that appear online. In line with our policy of constant improvement, we may revise content over time to improve clarity and accuracy. If you see a difference between the manual and online information, use the online information as your reference.

Related Documents

Use your tablet or your PC to quickly access detailed and comprehensive information on all our products on *www.schneider-electric.com*.

The internet site provides the information you need for products and solutions:

- The whole catalog for detailed characteristics and selection guides
- The CAD files to help design your installation, available in over 20 different file formats
- Software and firmware to maintain your drive up to date
- A large quantity of White Papers, Environment documents, Application solutions, Specifications... to gain a better understanding of our electrical systems and equipment or automation
- And finally the User Guides related to your drive, listed below:

Title of Documentation	Reference number
ATV990 Handbook	*NHA37143* (German), *NHA37145* (English)
Drive Systems – Installation manual	*NHA37118* (German), *NHA37119* (English), *NHA37121* (French), *NHA37122* (Spanish), *NHA37123* (Italian), *NHA37124* (Dutch), *NHA37126* (Polish), *NHA37127* (Portuguese), *NHA37129* (Turkish), *NHA37130* (Chinese)
ATV9●● Programming manual	*NHA80757* (English), *NHA80758* (French), *NHA80759* (German), *NHA80760* (Spanish), *NHA80761* (Italian), *NHA80762* (Chinese)
ATV991, ATV992 Programming manual	*QGH33275* (English)
ATV9●● Modbus serial link manual (embedded)	*NHA80939* (English)
ATV9●● Ethernet manual (embedded)	*NHA80940* (English)
ATV9●● PROFIBUS DP manual (VW3A3607)	*NHA80941* (English)
ATV9●● DeviceNet manual (VW3A3609)	*NHA80942* (English)
ATV9●● PROFINET manual (VW3A3627)	*NHA80943* (English)
ATV9●● CANopen serial link manual (VW3A3608, 618, 628)	*NHA80945* (English)
ATV9●● EtherCAT manual (VW3A3601)	*NHA80946* (English)
ATV9●● Communication parameters	*NHA80944* (English)
ATV9●● Safety function manual	*NHA80947* (English)
ATV6●● & ATV9●● ATEX manual	*NVE42416* (English)
SoMove: FDT	*SoMove_FDT* (English, French, German, Spanish, Italian, Chinese)
Altivar Process ATV9●● DTM	*ATV9xx_DTM_Library_EN* (English), *ATV9xx_DTM_Library_FR* (French), *ATV9xx_DTM_Library_DE* (German), *ATV9xx_DTM_Library_SP* (Spanish), *ATV9xx_DTM_Library_IT* (Italian), *ATV9xx_DTM_Library_CN* (Chinese),

You can download these technical publications and other technical information from our website at *www.schneider-electric.com*.

Terminology

The technical terms, terminology and the corresponding descriptions in this manual are inspired by the terms or definitions in the relevant standards.

In the area of drive systems this includes, but is not limited to, terms such as **error, error message, failure, fault, fault reset, protection, safe state, safety function, warning, warning message** and so on.

Among others, these standards include:

- IEC 61800 series: Adjustable speed electrical power drive systems
- EN 61439 series: Low-voltage switchgear and controlgear assemblies
- IEC 61508, Ed. 2 series: Functional safety of electrical/electronic/programmable electronic safety-related
- EN 954-1 Safety of machinery – Safety related parts of control systems
- EN ISO 13849-1 and 2 Safety of machinery – Safety related parts of control systems
- IEC 61158 series: Industrial communication networks – Fieldbus specifications
- IEC 61784 series: Industrial communication networks – Profiles
- IEC 60204-1: Safety of machinery – Electrical equipment of machines – Part 1: General requirements

In addition, the term **zone of operation** is used in conjunction with the description of specific hazards, and is defined as it is for a **hazard zone** or **danger zone** in the EC Machinery Directive (2006/42/EC) and in ISO 12100-1.

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Chapter 1
Drive Systems

What Is in This Chapter?

This chapter contains the following topics:

Overview

Market segment	**Water and waste water** **Oil & gas** **Mining, minerals & metals** **Food & beverage**

Drive Systems	MultiDrive consisting of several frequency inverter coupled via the DC link for energy-efficient speed control of several asynchronous synchronous motors.
Brief description	MultiDrive enclosure unit, alternatively in the standard design, with predefined customizations or as individual customer solution
Special features	One or several frequency inverters, alternatively with rectifier supply unit or AFE supply unit.
Protection degree	IP23 standard design of the enclosure IP54 optional design of the enclosure
Power range	DC bus: 175...2100 kW Motor outputs: 0.75...1000 kW
Voltage ranges	• 3 AC 380 V -10 % ... 415 V +6 % • 3 AC 400 V -10 % ... 415 V +10 % • 3 AC 440 V ±10 % • 3 AC 480 V ±10 %
Mains frequency	50/60 Hz +/- 5 %
Output frequency	0.1…599 Hz
Control method	Asynchronous motor: Constant load torque (open/closed loop), variable load torque (open/closed loop), energy saving Synchronous motor: PM (permanent magnet) motor (open/closed loop)
Interfaces	Operating panels in the enclosure door, control terminals inside the enclosure, control terminals can be extended, fieldbus connection via Ethernet or Modbus, saving the parameters via USB interface at the keypad
References	**ATV990●●●●●X1**
Further reading	You will find detailed information in this document.

ATV990 - MultiDrive Systems

MultiDrive with several frequency inverters as enclosure unit for energy-efficient speed control of several asynchronous and synchronous motors.

Concept

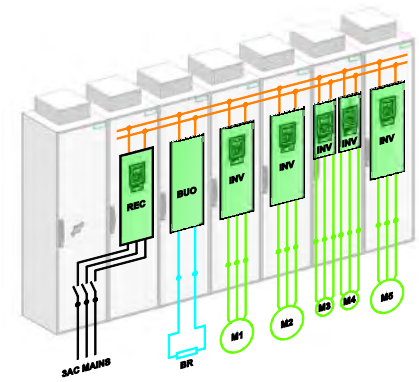
The ATV990 MultiDrive Systems are the optimal solution for drive units where several motors balance their loads. This can be, for example, a simple test bench for testing the life cycle of a belt. Another example is a group of drives for a metal coating line with re- and unwinder, conveyor rollers, grinding wheels and much more.

Basic equipment

The basic equipment consists of a supply unit and one or several inverter units. The energy is distributed via a DC bus. Additionally, a braking unit can be connected. The design is based on the standard enclosure system Spacial SF with graphical operating panels integrated into the enclosure door.

The control is located on spacious control panels. They provide compact dimensions, nevertheless it is enough space for additional extensions and accessibility in case of maintenance.

Device features



REC	Rectifier unit or Active Front End unit
BUO	Braking unit
INV	Inverter units

Enclosure system

The enclosure system Spacial SF with additional internal reinforcement elements and clearly specified cooling air channel provides optimal cooling of the built-in frequency inverter modules and maximum compactness at the same time.

DC bus

Efficient balance of energy via the DC bus especially for applications with several motors.

Connection

The power cables are connected on the mains side and motor side to spaciously dimensioned bars. The strain relief of the cables is realized via an own bar with solid metal clamps. Each device is equipped with an EMC screen bar for correct shield connection. At the standard design, the cables are to be connected at the bottom.

Enclosure Design 400 V

ATV99● - General technical data	
Mains voltage	● 3 AC 380 V -10 % ... 415 V +6 % ● 3 AC 400 V -10 % ... 415 V +10 % ● 3 AC 440 V ±10 % ● 3 AC 480 V ±10 % 50/60 Hz ±5 % for TT, TN-C or TN-S Other voltages and mains topologies on request.
Maximum current	Normal duty (ND): 120 % for 60 s per 10 minutes Heavy duty (HD): 150 % for 60 s per 10 minutes
Ambient temperature	-10...+50 °C (below 0 °C with additional enclosure heating, above +40 °C with derating) You will find further information at chapter "Maximum Ambient Temperature", page 37.
Standard equipment	Enclosure system Spacial SF in RAL 7035, protection degree IP23, graphical operating panels in the enclosure door, rectifier supply unit or AFE supply unit including main switch coupled via the DC bus with one or several frequency inverters, mains and motor terminals, cable entry from bottom
Interfaces	Pluggable control terminals, fieldbus connection via Ethernet or Modbus
Possible customizations	● Increased protection degree IP54 ● Enclosure plinth for basic device ● Connection enclosure cable from top/bottom ● Enclosure lighting ● Enclosure heating ● Key switch "local/remote" ● Ethernet port on front door ● Digital and analog I/O card ● Relay output card ● Communication cards for various fieldbus systems ● Encoder interface modules ● STO - SIL 3 Stop category 0 or 1 ● Front display module (FDM) ● Modified wiring colors ● Remote monitoring ● Differing mains voltages ● Multipulse supply (12-pulse) ● Design without main switch ● Increased short-circuit strength (100 kA) ● Indicator lamps on front door ● Motor temperature monitoring ● Bearing temperature monitoring ● Motor heating ● Circuit breaker ● Undervoltage coil for circuit breaker 230 V ● Motor for circuit breaker 230 V ● Safety labels in local language ● Air intake from back ● Differing enclosure colors ● Customized documentation ● Customized labeling ● Design for IT mains ● Motor contactor ● ...
Standards	CE, ATEX, IEEE 519 (THDi < 5%) (ATV992), RFI filter for second "industrial environment" C3 integrated

Supply unit ATV991 - Rectifier

Type	Size	Nom. DC power	P_{MAX}	Dimensions		
				Width (1)	Depth (2)	Height
ATV991C16●4	1mr (3)	175 kW	210 kW	800 mm	600 mm	2150 mm
ATV991C31●4	2mr	350 kW	420 kW	800 mm	600 mm	2150 mm
ATV991C63●4	4mr	700 kW	840 kW	1400 mm	600 mm	2150 mm
ATV991M10●4	6mr	1050 kW	1260 kW	1800 mm	600 mm	2150 mm
12-pulse-supply and power extension up to 2100 kW DC on request						

(1) Width including supply field (1mr, 2mr: 400 mm, 3mr, 4mr: 600mm)
(2) Total depth including door handle and switch handle: 664 mm
(3) Size 1mr is not available in 12-pulse design

Supply unit ATV992 – AFE unit

Type	Size	Nom. DC power	P_{MAX}	Dimensions		
				Width (1)	Depth (2)	Height
ATV992C11●4	1ma	120 kW	144 kW	600 mm	600 mm	2150 mm
ATV992C13●4		145 kW	174 kW	600 mm	600 mm	2150 mm
ATV992C16●4		175 kW	210 kW	600 mm	600 mm	2150 mm
ATV992C20●4	2ma	240 kW	288 kW	1000 mm	600 mm	2150 mm
ATV992C25●4		290 kW	348 kW	1000 mm	600 mm	2150 mm
ATV992C31●4		350 kW	420 kW	1000 mm	600 mm	2150 mm
ATV992C40●4	3ma	435 kW	522 kW	1600 mm	600 mm	2150 mm
ATV992C50●4		525 kW	630 kW	1600 mm	600 mm	2150 mm
ATV992C63●4	4ma	700 kW	840 kW	2000 mm	600 mm	2150 mm
ATV992C80●4	5ma	875 kW	1050 kW	2600 mm	600 mm	2150 mm
ATV992M10●4	6ma	1020 kW	1260 kW	3000 mm	600 mm	2150 mm
Power extension up to 1750 kW DC on request						

(1) Maybe additional supply field required
(2) Total depth including door handle and switch handle: 664 mm

BUO Braking unit option

Type	Size	Power (1)	Braking power (2)	Dimensions		
				Width	Depth (3)	Height
ModBuoC16●4	1mc	120 kW	170 kW	400 mm	600 mm	2150 mm
ModBuoC31●4		240 kW	340 kW	400 mm	600 mm	2150 mm
ModBuoC50●4		360 kW	510 kW	400 mm	600 mm	2150 mm
ModBuoC63●4	2mc	480 kW	680 kW	800 mm	600 mm	2150 mm
ModBuoC80●4		600 kW	850 kW	800 mm	600 mm	2150 mm
ModBuoM10●4		720 kW	1020 kW	800 mm	600 mm	2150 mm

(1) Power at 50 % duty cycle
(2) Braking power at maximum 5 % duty cycle
(3) Total depth including door handle and switch handle: 664 mm

Inverter unit ATV930

Type	Size	Motor rating (ND / HD)	Output current (ND / HD)
ATV930U07N4	1	0.75 kW / 0.37 kW	2.6 A / 2.2 A
ATV930U15N4		1.5 kW / 0.75 kW	4.8 A / 4 A
ATV930U22N4		2.2 kW / 1.5 kW	6.7 A / 5.6 A
ATV930U30N4		3.0 kW / 2.2 kW	8.6 A / 7.2 A
ATV930U40N4		4.0 kW / 3.0 kW	11.2 A / 9.3 A
ATV930U55N4		5.5 kW / 4.0 kW	15.2 A / 12.7 A
ATV930U75N4	2	7.5 kW / 5.5 kW	19.8 A / 16.5 A
ATV930D11N4		11 kW / 7.5 kW	28.2 A / 23.5 A
ATV930D15N4	3	15 kW / 11 kW	38.0 A / 31.7 A
ATV930D18N4		18.5 kW / 15 kW	47.0 A / 39.2 A
ATV930D22N4		22 kW / 18 kW	55.6 A / 46.3 A
ATV930D30N4	4	30 kW / 22 kW	73.8 A / 61.5 A
ATV930D37N4		37 kW / 30 kW	89.4 A / 74.5 A
ATV930D45N4		45 kW / 37 kW	105.6 A / 88 A
ATV930D55N4	5	55 kW / 45 kW	127.2 A / 106 A
ATV930D75N4		75 kW / 55 kW	174.0 A / 145 A
ATV930D90N4		90 kW / 75 kW	207.6 A / 173 A

NOTE: The real dimensions of the enclosure with built-in ATV930 inverter units are available on request.

Inverter unit ATV993

Type	Size	Motor rating (ND / HD)	Output current (ND / HD)	Dimensions		
				Width	Depth (1)	Height
ATV993C11●4	1mp	110 kW / 90 kW	211 A / 173 A	400 mm	600 mm	2150 mm
ATV993C13●4		132 kW / 110 kW	250 A / 211 A	400 mm	600 mm	2150 mm
ATV993C16●4		160 kW / 132 kW	302 A / 250 A	400 mm	600 mm	2150 mm
ATV993C20●4	2mp	200 kW / 160 kW	370 A / 302 A	600 mm	600 mm	2150 mm
ATV993C25●4		250 kW / 200 kW	477 A / 370 A	600 mm	600 mm	2150 mm
ATV993C31●4		315 kW / 250 kW	590 A / 477 A	600 mm	600 mm	2150 mm
ATV993C35●4	3mp	355 kW / 280 kW	660 A / 520 A	800 mm	600 mm	2150 mm
ATV993C40●4		400 kW / 315 kW	730 A / 590 A	800 mm	600 mm	2150 mm
ATV993C45●4		450 kW / 355 kW	830 A / 660 A	800 mm	600 mm	2150 mm
ATV993C50●4		500 kW / 400 kW	900 A / 730 A	800 mm	600 mm	2150 mm
ATV993C56●4	4mp	560 kW / 450 kW	1020 A / 830 A	1200 mm	600 mm	2150 mm
ATV993C63●4		630 kW / 500 kW	1140 A / 900 A	1200 mm	600 mm	2150 mm
ATV993C71●4	5mp	710 kW / 560 kW	1260 A / 1020 A	1400 mm	600 mm	2150 mm
ATV993C80●4		800 kW / 630 kW	1420 A / 1140 A	1400 mm	600 mm	2150 mm
Power extension up to 1000/800 kW motor rating on request						
(1) Total depth including door handle and switch handle: 664 mm						

Expandability

The new Altivar Process Drive Systems are the result of our many years of experience in the field of electronic drives. Moreover we provide especially designed expansion options for a various range of applications. Our worldwide, certified manufacturing sites and the local engineering teams allow a global offer.

Predefined Customizations

Due to the predefined customizations the Altivar Process Drive System can be adapted easily and quick to the customer requirements. Besides, this allows minimal delivery time for an individually adapted enclosure ready to connect.

Certainly the Altivar Process Drive Systems can be ordered also in the basic design, which is already extensive equipped, without any customization.

Predefined customizations are:

- Braking unit BUO
- Increased protection degree IP54
- Enclosure plinth for basic device
- Connection enclosure cable from top/bottom
- Enclosure lighting
- Enclosure heating
- Key switch "local/remote"
- Ethernet port on front door
- Digital and analog I/O card
- Relay output card
- Communication cards for various fieldbus systems
- Encoder interface modules
- STO - SIL 3 Stop category 0 or 1
- Front display module (FDM)
- Indicator lamps on front door
- Motor temperature monitoring
- Bearing temperature monitoring
- dv/dt filter choke
- Motor heating
- Circuit breaker
- Undervoltage coil for circuit breaker
- Motor for circuit breaker 230 V
- Safety labels in local language
- Modified wiring colors
- Remote monitoring
- Differing mains voltages
- Design without main switch
- Increased short-circuit strength (100 kA)
- Air intake from back
- Differing enclosure colors
- Customized documentation
- Customized labeling
- Design for IT mains
- Motor contactor
- Integrated control functions
- ...

Individual Customizations

Due to our substantial know-how and the high flexibility in performing projects, it is possible to realize unique system solutions. They are individually adapted to the customers demands.

Typical customizations:

- Multi drives (several frequency inverters in an enclosure composition)
- Differing cooling system
- Different enclosure system
- Differing dimensions
- ...

Type designation

Each subunit (ATV991, ATV992, ATV993 or ATV930 enclosure installation) gets an own rating plate to indicate the specific nominal values and serial numbers.

The type designation of the Altivar Process MultiDrive systems consists of several points of signs (characters and figures). The meaning of each point is illustrated in the following example.

		ATV	990	C11	Q4	X1
Product	**Description**					
ATV	Altivar					
Segments						
990	MultiDrive systems complete unit					
991	MultiDrive – Rectifier unit					
992	MultiDrive – AFE unit					
993	MultiDrive – Inverter unit					
930	MultiDrive – Inverter unit					
Drive power						
U07…D90	0.75 / 0.37 kW … 90 / 75 kW					
C11…C80	110 / 90 kW … 1000 / 800 kW					
Mains voltage						
Q4	3 AC 380 V -10 %...415 V +6 % (+10 %)					
R4	3 AC 440 V ±10 %					
T4	3 AC 480 V ±10 %					
N4	3 AC 380...448 V ±10 %					
Design variant						
X1	Europe CE					

Examples:

- MultiDrive system complete unit: ATV990C22Q4X1 (C22: 220 kW total motor power)
- MultiDrive – Rectifier unit: ATV991C31Q4X1 (C31: 340 kW available DC power)
- MultiDrive – AFE unit: ATV992C31Q4X1 (C31: 350 kW available DC power)
- MultiDrive – inverter unit: ATV993C11Q4X1 (C11: 110 kW motor power)

Chapter 2
General Specification

What Is in This Chapter?

This chapter contains the following topics:

Quality

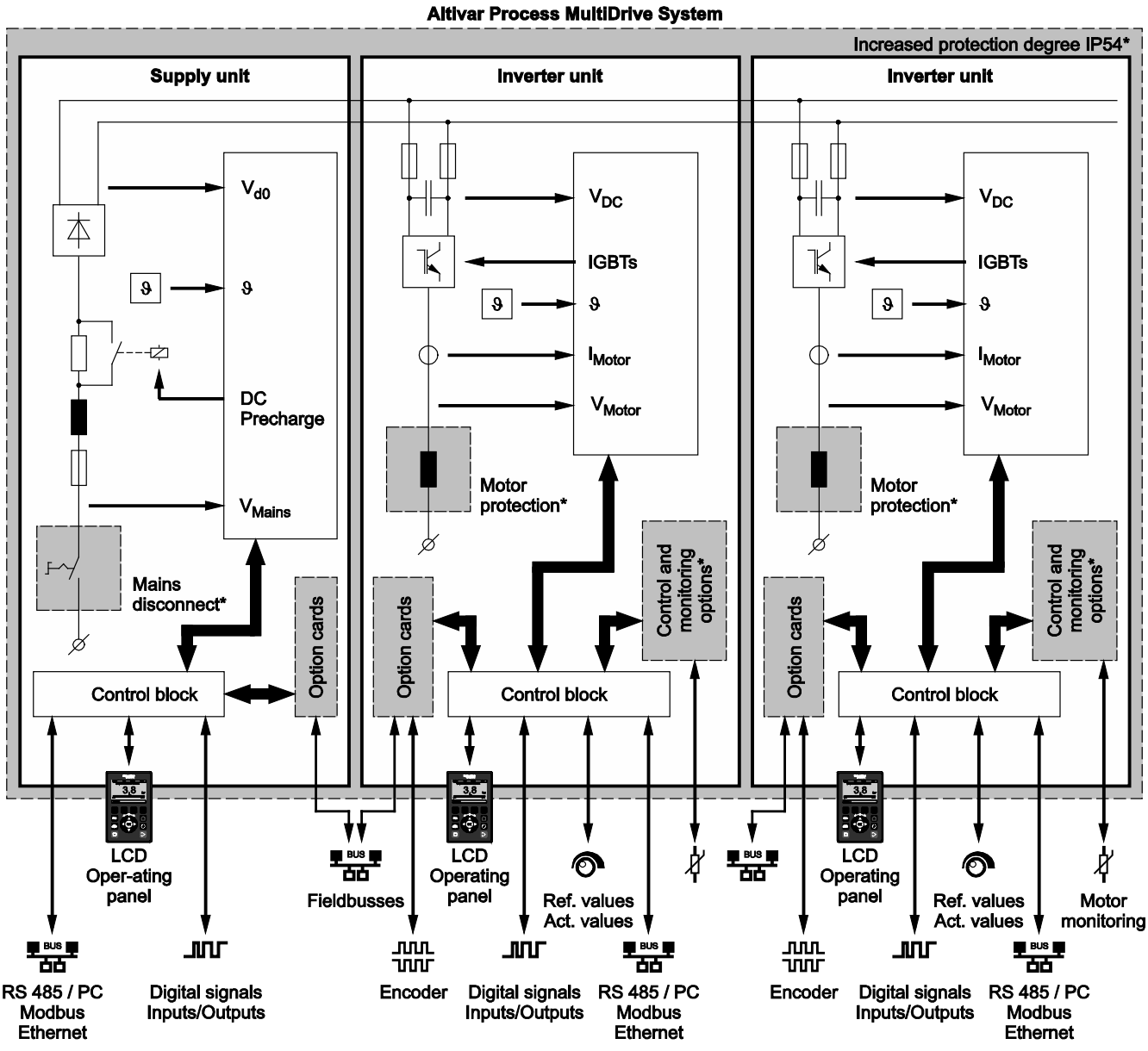
Altivar frequency inverters use modern components and solutions for the control of asynchronous three-phase motors and synchronous three-phase motors. This enables an extremely compact design and user-friendly device features.

Our high degree of quality awareness ranges from the basic requests in the product specification over the development of the cooling system, of the mechanical design, of the electrical circuit diagram and the individual functions up to the production of the device. This process quality level is also long-term guaranteed by means of the corresponding quality assurance systems in the individual business processes and is certified every year by independent authorities according to DIN EN ISO 9001.

The Altivar Process Drive Systems fulfil the relevant international standards and regulations.

System concept ATV99●

The ATV990 MultiDrive Systems are the optimal solution for drive units where several motors balance their loads. The delivered unit includes a supply unit and several inverter units, whereby all units are connected with each other at the DC bus for energy supply and load sharing. Additionally, a braking unit can be integrated.



Available supply units:

- ATV991 MultiDrive – Rectifier unit or
- ATV992 MultiDrive − AFE unit

Available inverter units:

- ATV993 MultiDrive − Inverter unit ≥ 110 kW and/or
- ATV930 Frequency inverter products < 110 kW

Additional units:

- Option BUO MultiDrive − Braking unit
- Connection enclosure cable from top
- Connection enclosure cable from bottom

Depending on the requests on the individual units the basic design can be supplemented by options. Options for the power path, options for control and operation as well as mechanical options are available. They are all integrated into the enclosure unit but they may cause a change of dimensions.

CE Marking

The frequency inverters have a CE marking on the rating plate. However, to achieve the corresponding limits it is necessary to observe the installation regulations, superior and regional standards and directives as well as the directives listed below.

All devices and drives of the electric drive engineering may cause electromagnetic interferences and otherwise they may be influenced by such interferences. Therefore, they are subject to the **EMC directive 2004/108/EC**.

The frequency inverters have an operating voltage which is clearly in the range of 50...1000 V AC or 75...1500 V DC. Therefore, they are also subject to the **Low Voltage Directive 2006/95/EC**.

Because of the EMC filters which are built into the frequency inverters they are in conformity with **EN 61800-3** and **EN 61800-5-1**.

Frequency inverters are not considered as stand-alone machines according to the Machinery Directive 2006/42/EC. They have to be accounted as component of the closed functional safety system.

This product meets the EMC requirements according to the standard IEC 61800-3 if the measures described in this manual are implemented during installation.

If the selected composition (product itself, mains filter, other accessories and measures) does not meet the requirements of category C1, the following information applies as it appears in IEC 61800-3:

⚠ WARNING

RADIO INTERFERENCE

In a domestic environment this product may cause radio interference in which case supplementary mitigation measures may be required.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Installation Regulations

- The frequency inverters have a RFI filter for grounded mains built-in.
- Take care of good HF connection between motor cable screen and filter.
- Use of shielded motor cables, proper connection of the motor cables on both ends or proper laying in a metallic, closed and interconnected cable conduit
- In case of high motor cable lengths a corresponding dv/dt filter choke is required.
- Use shielded control cables and connect them correctly.
- Ground the frequency inverter for human protection.
- Consider the protective separation (PELV) when preparing signal wires and coupling relays.
- Lay the motor cables separate from other cables, especially from the signal wires.

NOTE: Further information is given in the installation manual.

Safety of Machinery

For the functional safety and stop categories the function "Safe Torque Off (STO)" has been integrated. So an optimal adaptation of the drive to the required safety category for the machine is possible.

NOTE: You will find further information about this function in .

For all selectable safety options the implementation of external safety-relevant contacts is provided. So the Altivar Process does not act as a closed functional safety system in terms of the Machine directive and safety standards EN/IEC 61508, ISO 13849-1 and NF EN 62061. It has to be accounted as component in any case.

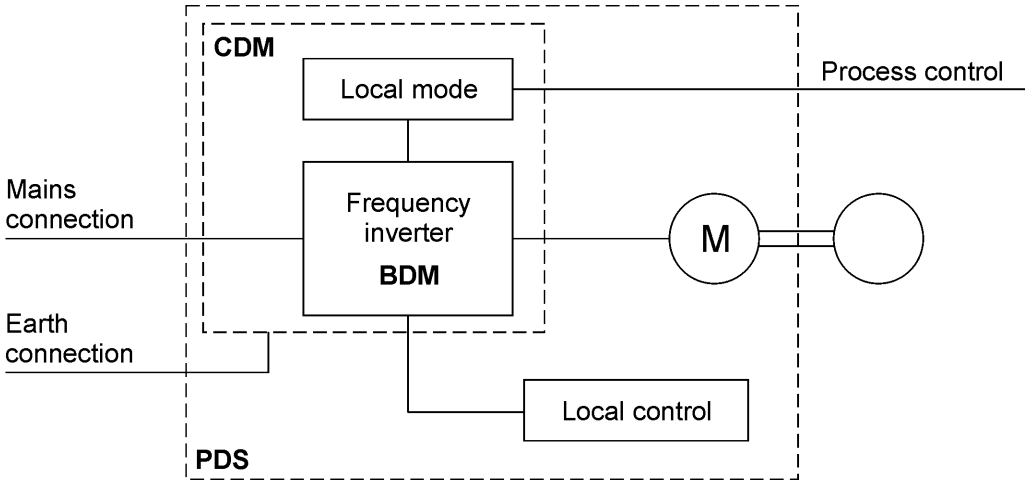
EMC Product Standard for PDS (Power Drive Systems) EN 61800-3

For frequency inverter drives the product standard EN/IEC 61800-3 edition 1 and 2 appeared. It has first priority over the existing general standards (generic standards). If a drive is installed into another device for which a separate EMC product standard exists, then this standard applies.

The aim of the **EMC directive 2004/108/EEC** is the ability of electric and electronic installations to operate satisfactorily in their electromagnetic environment without influencing the environment or other loads therein.

Therefore, the PDS product standard contains both limits for admissible interferences and requirements for the necessary interference resistance.

The power drive standard EN 61800-3 covers the complete drive from the mains supply to the motor shaft.



BDM:	Base-Drive-Module	Basic drive consisting of the power part and the control electronics (e.g. frequency inverter - built-in unit)
CDM:	Complete-Drive-Module	Drive modules consisting of BDM (basic drive) and extensions, if existing (e.g. enclosure including main switch, circuit breaker, line contactor, filter components, power terminals, ...)
PDS:	Power-Drive-System	Drive system consisting of CDM (drive module) and motor, motor cable, local control, power transformer, ... (e.g. the complete electric drive of a machine)

The differentiation in respect of the sales method and the range of use is essential for the handling of frequency inverters.

Use In Industrial Environment

The standard refers to these application areas as "second environment". These are areas which are separated from the public mains by means of an own transformer.

The user has to take care that the suppression components recommended by the manufacturer are used and that the introductions of the manufacturer are observed. Moreover, the user has to take care that strong interferences do not couple into neighboring low-voltage mains.

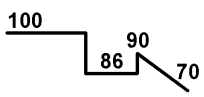
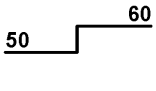
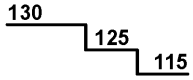
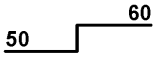
If the neighboring mains is a public mains with residential areas, the limits 66-56/56/60 dB(µV) quasi-peak apply. In case of industrial mains the higher limits 79/73/73 dB(µV) quasi-peak can be used.

Furthermore, it is necessary to enhance the suppression of interferences if other devices are influenced. The operator of the plant is responsible for this improvement.

The limits for immunity are much stricter because they are based on a generally higher level of interferences.

Category C3

Use in industrial environments

Limits for interferences	Line-conducted interferences	Radiation
For drives with a size ≤ 100 A the admissible limits for interferences are 100/86/90-70 dB(µV) quasi-peak and 50/60 dB(µV/m) at a distance of 10 m (class A group 2).	dBµV (QP) 	dBµV/m (QP) 
For drives with a size > 100 A the admissible limits for interferences are 130/125/115 dB(µV) quasi-peak and 50/60 dB(µV/m) at a distance of 10 m (class A group 2).	dBµV (QP) 	dBµV/m (QP) 

Category C4

Use in industrial environments for drives > 1000 V or > 400 A

For these drives are no limits defined. An EMC concept has to be compiled within project planning.

IT mains

In case of non-grounded mains it is usually not possible to keep the limits. Filter capacitors make detection of insulation faults difficult and thus they interfere with the concept of a floating power supply. However, filters that are developed especially for IT mains can be used because they also cause a high reduction of the conducted interferences in non-grounded mains.

NOTE: The basic requirements for compliance with the relevant limits are the observance and compliance of the installation requirements and a correct customization of the Drive System.

Mains Conditions

Mains Voltage

The Altivar Process Drive Systems are designed for standard industrial mains TT and TN with following mains voltage:

- 3 AC 380 V -10 % ... 415 V +6 %
- 3 AC 400 V -10 % ... 415 V +10 %
- 3 AC 440 V ±10 %
- 3 AC 480 V ±10 %

NOTE: Other voltages and the use in IT mains or "Corner grounded networks" are available on request.

The mains voltage must comply with the requirements according to IEC 60038 and EN 50160:

- Unbalance between phases: < 2 %
- Total harmonic factor THD(v): < 10 %
- Maximum single harmonic: < 5 %

NOTICE
DESTRUCTION DUE TO INCORRECT MAINS VOLTAGE Before switching on and configuring the product, verify that it is approved for the mains voltage. **Failure to follow these instructions can result in equipment damage.**

Undervoltage behavior

In case of short-time mains voltage drops outside the specified tolerance, operation is still possible.

If the mains voltage does not return within the specified time, an undervoltage shut-down occurs.

Mains undervoltage	Restriction
-10 % of nominal voltage	Starting the drive and continuous operation possible (1)
-15 % of nominal voltage	Starting the drive and operation (1) for 10 s per 100 s possible
-20 % of nominal voltage	Operation (1) for less than 1 s possible
-30 % of nominal voltage	Operation (1) for less than 0.5 s possible
(1) With nominal current	

Non-grounded Mains

The Altivar Process Drive Systems can be prepared for the use in non-grounded mains (IT mains or "Corner grounded networks").

Radio Interferences

The Altivar Process Drive Systems include a radio frequency interference filter as standard. This filter fulfils the requirements for category "C3 – industrial environments" according to EN/IEC 61800-3 (in the past: EN 55011 class A group 2).

This product meets the EMC requirements according to the standard IEC 61800-3 if the measures described in this manual are implemented during installation.

If the selected composition (product itself, mains filter, other accessories and measures) does not meet the requirements of category C1, the following information applies as it appears in IEC 61800-3:

⚠ WARNING

RADIO INTERFERENCE

In a domestic environment this product may cause radio interference in which case supplementary mitigation measures may be required.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Mains Impedance / Short-circuit Current

The Altivar Process Drive Systems are designed considering a maximal and minimal permitted mains short-circuit current of the supply (values see "Technical data" of the respective frequency inverter).

These frequency inverters can be designed for higher mains short-circuit currents on request. You will find information about the short-circuit protection at chapter "Mains Connection ", page 51.

Reactive Current Compensation Systems

Frequency inverters cause harmonics in the supplying mains (see chapter "Mains Current Harmonics / Mains Voltage Distortion", page 52). If a reactive current compensation system is used upstream of the drive, the harmonics can cause overload of the capacitors of the reactive current compensation system.

Switched reactive current compensation systems can cause overvoltage in the mains supply. Such overvoltages can adversely affect the frequency inverter.

NOTICE

MAINS OVERVOLTAGE AND OVERLOAD OF THE REACTIVE CURRENT COMPENSATION SYSTEM

Install properly rated chokes upstream of the reactive current compensation system.

Failure to follow these instructions can result in equipment damage.

12-/24-pulse Supply

All Altivar Process Drive Systems can be designed with 12-pulse supply. For some types also the design with 24-pulse supply is possible.

NOTE: You will find information about the design variations from page 161.

Switching Rate

Altivar Process Drive Systems are equipped with a main switch for disconnecting the applied mains voltage.

In case of frequent start/stop requests it is recommended to realize them by means of the digital control inputs (or via a serial bus) directly to the electronics of the inverter.

Optionally the mains separation can be realized by a circuit breaker with motor.

NOTE: By means of the certificated control inputs $\overline{\text{STOA}}$ and $\overline{\text{STOB}}$ a "Safe Torque Off" of the drive is considering the safety category according to ISO 13849-1 (and IEC/EN 61800-5-2). Disconnecting the mains supply or the motor is therefore not required.

Rectifier control	Switching rate ATV991
Mains voltage switched external	Max. 60 switching operations per hour
Mains voltage switched internal: ● Main switch (standard) ● Circuit breaker (option) ● Circuit breaker with motor (option)	Max. 10 switching operations per hour Max. 10,000 switching operations total
Start / Stop requests via digital inputs	Max. 60 switching operations per hour

AFE control	Switching rate ATV992
Mains voltage switched external	Max. 60 switching operations per hour
Mains voltage switched internal: ● Main switch (standard) ● Circuit breaker (option)	Max. 10 switching operations per hour Max. 10,000 switching operations total
Start / Stop requests via digital inputs	Max. 60 switching operations per hour

NOTE: The device fans are automatically controlled depending on the start/stop request.

If the power stage is disabled unintentionally, for example, as a result of power outage, errors or functions, there is a possibility that the motor is no longer decelerated in a controlled way.

⚠ WARNING

UNANTICIPATED EQUIPMENT OPERATION

Verify that movements without braking effect does not result in unsafe conditions.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Protection of the Plant

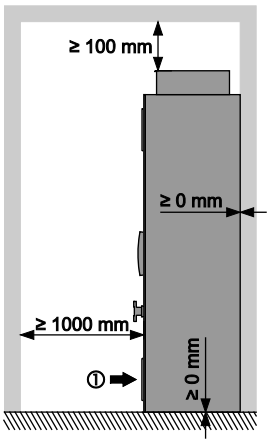
Responsibility

All stated connection recommendations and planning remarks are to be taken merely as suggestions which must be adapted to the local conditions and regulations concerning installation and usage.

This applies especially to the functional safety regulations for machines, the EMC regulations and the general regulations for human protection.

Installation Site

Altivar Process Drive Systems are qualified for vertical installation in electrical operating rooms as well as in the area of production facilities.



- Observe the specified minimum distances. Mounting the Drive Systems side by side or back to back is allowed.
- Install the Altivar Process Drive System vertically on a non-combustible, solid and vibration-free ground.
- Take care of compliance with the ambient conditions.
- Take care that the air exchange is sufficient for dissipation of the lost heat during operation.

① Air inflow temperature: -10...+50 °C (14...122 °F)
(below 0 °C (32 °F) with additional enclosure heating,
above +40 °C (104 °F) with derating)

NOTE: At enclosure design IP54 the ATV99● frequency inverter is qualified for pollution degree 3 according to EN 61800-5-1.

NOTE: Further information is given in the installation manual.

This equipment has been designed to operate outside of any hazardous location. Only install this equipment in zones known to be free of hazardous atmosphere.

⚠ DANGER

POTENTIAL FOR EXPLOSION

Install and use this equipment in non-hazardous locations only.

Failure to follow these instructions will result in death or serious injury.

Increased Motor Speed

With the Altivar Process Drive Systems it is possible to control the rotational speed of motors from 0.1...599 Hz.

Overvoltage Protective Circuit

The AC and DC control circuits must be protected against overvoltage.

Use flyback diodes for DC control circuits.

For AC control circuits, RC circuits are advisable because they can reduce the peak overvoltage and the rise time while varistors only reduce the peak voltage.

NOTICE
INOPERATIVE CONTROL CIRCUITS
Verify that all inductances such as relays, contactors, external brakes, etc. are equipped with appropriate overvoltage protection circuits.
Failure to follow these instructions can result in equipment damage.

Residual Current Circuit Breaker

Frequency inverters, especially those with additional EMC filters and shielded motor cables, lead an increased leakage current against ground.

The leakage current depends on:

- The length of the motor cable
- The type of laying and whether the motor cable is shielded or not
- The set pulse frequency
- The use of an additional radio frequency interference filter
- The grounding of the motor at its installation place (grounded or non-grounded)

Depending on the conditions, the leakage current of plants with high cable lengths can be absolutely higher than 100 mA !

The built-in residual current detection has no current-limiting effect. It only helps to protect the drive and is no human protection.

Particularly because of the capacitors of the radio frequency interference filter, an unintentional triggering of a residual current circuit breaker may occur at the moment of switching on. As well, the ground capacitances may cause an incorrect triggering during operation. On the other hand, it is possible that the triggering is blocked by means of DC components which are caused by the mains rectification at the input of the inverter.

Direct current can be introduced in the protective ground conductor of this drive. If a residual current device (RCD / GFCI) or a residual current monitor (RCM) is used for additional protection against direct or indirect contact, the following specific types must be used:

⚠ **WARNING**
DIRECT CURRENT CAN BE INTRODUCED INTO THE PROTECTIVE GROUND CONDUCTOR
Use a Type B Residual Current Device (RCD / GFCI) or a Residual Current Monitor (RCM) that has approval for use with frequency inverters and is sensitive to all types of current.
Failure to follow these instructions can result in death, serious injury, or equipment damage.

Further conditions for use of a residual current device:

- The drive has an increased leakage current at the moment power is applied. Use a residual current device (RCD / GFCI) or a residual current monitor (RCM) with a response delay.
- High-frequency currents must be filtered.

NOTE: Protect the other loads by means of a separate residual current circuit breaker.

Automatic Restarting

This function increases the availability, especially for drives that are not integrated into the plant control via a fieldbus system. Depending on the parameterization, the frequency inverter can automatically start-up again after each mains switch-on or mains recurrence.

Locking of the Frequency Inverter

Altivar Process Drive Systems include the standard protective function "Safe Torque Off (STO)", which helps to prevent any unintended start-up of the motor. This function fulfills, when correctly wired, the machine standard ISO 13849-1 Performance level PL e, the IEC/EN 61508 Safety integrity level SIL 3 standard for functional safety and the power drive system standard IEC/EN 61800-5-2.

NOTE: You will find further information in the Safety Function Manual (*NHA80947*).

The safety function STO (Safe Torque Off) does not remove power from the DC bus. The safety function STO only removes power to the motor. The DC bus voltage and the mains voltage to the drive are still present.

DANGER

HAZARD OF ELECTRIC SHOCK

- Do not use the safety function STO for any other purposes than its intended function.
- Use an appropriate switch, that is not part of the circuit of the safety function STO, to disconnect the drive from the mains power.

Failure to follow these instructions will result in death or serious injury.

When the safety function STO is triggered, the power stage is immediately disabled. In the case of vertical applications or external forces acting on the motor shaft, you may have to take additional measures to bring the motor to a standstill and to keep it at a standstill when the safety function STO is used, for example, by using a service brake.

WARNING

INSUFFICIENT DECELERATION OR UNINTENDED EQUIPMENT OPERATION

- Verify that using the safety function STO does not result in unsafe conditions.
- If standstill is required in your application, ensure that the motor comes to a secure standstill when the safety function STO is used.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Stop and Go Function

All Altivar Process Drive Systems include the energy saving function "Stop and Go". When the frequency inverter gets a stop or lock request, the own consumption is clearly decreased by reducing the DC link voltage. With the next start request the DC link is charged and the motor can start-up again.

NOTE: For applications where a start delay of 1...2 s is undesired, this energy saving function can be also deactivated.

Connecting and Disconnecting the Motor

Alternatively to the use of the control terminal STO "Safe Torque Off" a safety switch or a motor contactor can be installed to connect and disconnect the motor – Design on request.

After connection the motor restarts by means of the function "Catch on the fly".

Multi-motor Operation

With Altivar Process Drive Systems it is possible to operate several motors at one output.

For multi-motor applications (e.g. roller conveyors), however, observe the following:

- The sum of the nominal currents has to be less than the nominal current of the inverter.
- A different speed control is not possible.
- The total motor cable length has to be taken into consideration.
- No high starting torque is available.
- The inverter does not provide individual motor overload protection.
- Autotuning is not possible (but also not necessary).
- Activation of individual motors is only permitted when the starting current remains less than the maximum inverter current.

Operation of ATEX Motors

If you want to operate an explosion-protected motor (ATEX) with this drive system, you must use the option "Motor monitoring PTC with ATEX certificate".

NOTE: You will find further information about the operation of ATEX motors in the ATEX manual (*NVE42416*).

This equipment has been designed to operate outside of any hazardous location. Only install this equipment in zones known to be free of hazardous atmosphere.

⚠ DANGER

POTENTIAL FOR EXPLOSION

Install and use this equipment in non-hazardous locations only.

Failure to follow these instructions will result in death or serious injury.

Chapter 3
MultiDrive Systems ATV99● – 400 V

What Is in This Chapter?

This chapter contains the following topics:

Description

ATV990 – MultiDrive Systems

The ATV990 MultiDrive Systems are the optimal solution for drive units where several motors balance their loads. This can be, for example, a simple test bench for testing the life cycle of a belt. Another example is a group of drives for a metal coating line with re- and unwinder, conveyor rollers, grinding wheels and much more.

The ATV990 MultiDrive System consists of a supply unit and one or several inverter units. The energy is distributed via a DC bus. Additionally, a braking unit can be connected.

Available supply units:

- ATV991 MultiDrive – Rectifier unit
- ATV992 MultiDrive – AFE unit

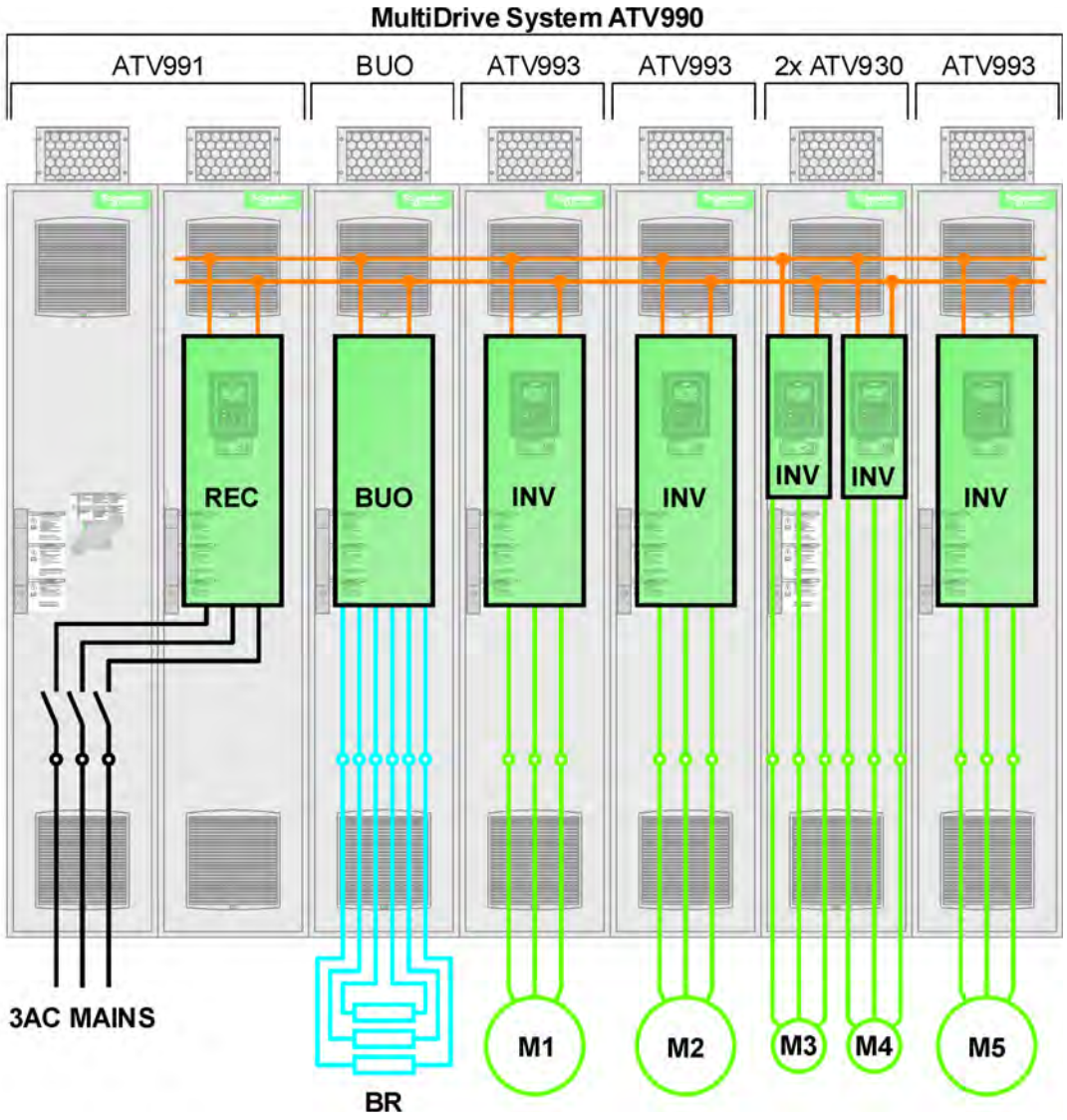
Available inverter units:

- ATV993 MultiDrive – Inverter unit ≥ 110 kW
- ATV930 Frequency inverter products < 110 kW

Additional units:

- Option BUO MultiDrive – Braking unit
- Connection enclosure cable from top
- Connection enclosure cable from bottom

Typical Combination of a MultiDrive System



The picture shows a typical combination, where the required power is supplied by a rectifier unit to the common DC link. The individual motors operate often or sporadically in generator operation and so they feed energy back to the DC bar which is required from other motors at the same time.

If the condition is reached that more energy is returned than energy can be consumed at the moment, the generator power is transferred through the installed braking unit to the braking resistors.

Alternatively to the rectifier unit and the braking unit, supply can also realized by an AFE unit. It controls the DC voltage independent of the energy direction.

Overview of the Available Units

One supply unit (or two in parallel) supplies a common DC bar on which several inverter units are connected. This concept is very advantageous if there is an energy distribution between the motors and motor operation and generator operation can occur at the same time.

Based on the required powers and the desired dynamic at the motor shafts you can select the proper inverter units. The total power of motor power and generator power appearing at the same time defines the selection of the proper supply unit – either a pure rectifier supply, maybe with additional braking unit or an AFE supply unit with full 4Q capability.

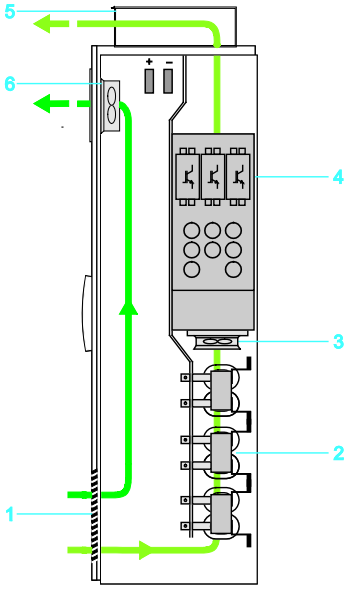
General Technical Data

Input	
Rated voltage U_n	for TT, TN-C or TN-S: ● 3 AC 380 V -10 % ... 415 V +6 % ● 3 AC 400 V -10 % ... 415 V +10 %, ● 3 AC 440 V ±10 % ● 3 AC 480 V ±10 % Other voltages and mains topologies on request.
Rated frequency f_n	50 / 60 Hz ±5 %
Total harmonic distortion	at nominal load and sinusoidal mains voltage; depending on the supply unit: ● With ATV991 rectifier unit: ≤ 38 % ● With ATV992 AFE unit: ≤ 5 %
Power factor	Depending on the supply unit: ● With ATV991 rectifier unit: Fundamental mode cos φ: > 0.98 Total (λ) at full load: 0.93...0.95 Total (λ) at no-load operation: approx. 0.7 ● With ATV992 AFE unit: Fundamental mode cos φ: > 0.99 (at 30...120 % load and power regeneration)
Overvoltage category	Category III according to EN 50178
DC link	
DC voltage	● With ATV991 rectifier unit: Motor operation: 1.35...1.40 U_n Generator operation: max. 800 V at braking operation in case of 400...480 V mains ● At Q4 (315...400 VAC): 540 VDC -10 %...640 VDC +0 % ● At R4 (440 VAC): 595 VDC -10 %...680 VDC +0 % ● At T4 (480 VAC): 650 VDC -10 %...740 VDC +0 % ● With ATV992 AFE unit: In motor and generator operation ● At Q4 (315...400 VAC): 570 VDC -10 %...670 VDC +0 % ● At R4 (440 VAC): 640 VDC -10 %...710 VDC +0 % ● At T4 (480 VAC): 700 VDC -10 %...770 VDC +0 % ● ATV993 input: ● At Q4 (315...400 VAC): 540 VDC -10 %...670 VDC +0 % (800 VDC at braking operation) ● At R4 (440 VAC): 595 VDC -10 %...720 VDC +0 % (800 VDC at braking operation) ● At T4 (480 VAC): 650 VDC -10 %...790 VDC +0 % (800 VDC at braking operation)
Output of the inverter units	
Control method	Asynchronous motor: Constant load torque (open/closed loop), variable load torque (open/closed loop), energy saving Synchronous motor: PM (permanent magnet) motor (open/closed loop)
Voltage	3 AC 0...100 % mains voltage
Overload	Normal Duty (ND): 120 % for 60 s per 10 minutes Heavy Duty (HD): 150 % for 60 s per 10 minutes
Pulse frequency	2.5 kHz, adjustable from 2...8 kHz
Frequency	0.1...599 Hz
Short-circuit protection	Short-circuits and ground faults are handled by overcurrent function and switch-off the output.
Speed accuracy	V/f mode: slip frequency VC without feedback: 0.3 x slip frequency

Mechanical strength	
Mechanical vibrations	According to IEC/EN 60068-2-6 1.5 mm at 3...10 Hz, 0.6 g at 10...200 Hz (3M3 according to IEC/EN 60721-3-3)
Mechanical shock	According to IEC/EN 60068-2-27 4 g for 11 ms (3M2 according to IEC/EN 60721-3-3)
Ambient conditions	
Ambient temperature	-10...+50 °C (below 0 °C with additional enclosure heating, above +40 °C with derating) 3K3 according to IEC/EN 60721-3-3
Storage / Transport temperature	-25...+70 °C
Protection degree	Door closed: IP23 (optionally enclosure design IP54) Door open: IP2x
Environmental class / Humidity	Class 3K3 in accordance with IEC/EN 60721-3-3 / no condensation inside the enclosure, max. 95 % relative humidity
Altitude	Up to 1000 m no derating necessary 1000...2000 m derating of 1 % / 100 m (for all types of mains) 2000...3800 m derating of 1 % / 100 m (only TT/TN, IT) 3800...4800 m derating of 1 % / 100 m (only TT/TN)
Allowed pollution	Pollution degree IP23: 2 according to EN 61800-5-1 Pollution degree IP54 (optional): 3 according to EN 61800-5-1 Chemical / mechanical classification: 3C3 and 3S3 according to EN 60721-3-3
Protection class	Class 1 according to EN 61800-5-1
Functional safety	
Functional safety of the drive	The function "Safe Torque Off" (STO) allows a controlled shut-down and switch-off of the power supply to the motor. It also helps to prevent any unintended start of the motor according to ISO 13849-1, performance level PL e, according to IEC/EN 61508 safety integrity level SIL 3 and IEC/EN 61800-5-2.
Response time	≤ 100 ms at STO (Safe Torque Off)
Standards	
Basic standard	The devices are designed, built and tested on the basis of EN 61800-2, EN 61800-3, EN 61800-5-1 and EN 60204-1.
EMC immunity	According to EN 61800-3, second environment (EN 61000-4-2; EN 61000-4-3; EN 61000-4-4; EN 61000-4-5; EN 61000-4-6)
EMC emission	In accordance with product standard EN 61800-3, second environment, category C3
Insulation	Galvanic insulation of the control circuit in accordance with EN 61800-5-1 PELV (Protective Extra Low Voltage)
Standards	CE, ATEX, IEEE 519 (THDi < 5%) (ATV992), RFI filter for second "industrial environment" C3 integrated

Protection Degree

The standard design of the Altivar Process Drive Systems complies with protection degree IP23. It provides optimal cooling of the built-in frequency inverter modules and all power components as well as maximum compactness at the same time.

Standard enclosure design IP23	
	For optimized cooling of the MultiDrive System, all power part components are arranged in the main cooling air channel. The input of the cooling air takes place by a grid in the lower area of the enclosure door. The internal fan, which is in a separated air channel, provides the cooling of the power part. The air outlet takes place through the top of the enclosure. The heat losses of the control part are exhausted by a fan in the enclosure door. **1** Air inflow grid (without filter mat) for control part and power part **2...4** Power components (different for supply units and inverter units) **5** Air outlet through metal grid with splash water protection **6** Air outlet (without filter mat) with fans for control part Air inflow temperature: -10...+50 °C (below 0 °C with additional enclosure heating, above +40 °C with derating)

Cooling concept

Control/monitoring of fans

The power part fans as well as the fans in the enclosure door are controlled energy optimized depending on the operation. Switching the fans on and off is derived from the start/stop request.

The fans in the power part are equipped with speed monitoring and the fans in the enclosure doors include a temperature monitoring and that helps to protect the Altivar Process Drive Systems. If one of these monitoring units triggers, a warning message is generated.

Furthermore, the operating hours of all fans can be monitored and a warning message can be triggered when the set limit is exceeded.

Overtemperature protection

The temperature of the power part is monitored all the time. In case of overtemperature the pulse frequency or the power is automatically reduced.
The temperature of the control part is monitored with a thermostat. When the set temperature is exceeded, a warning message is generated. Only in case of insufficient cooling the drive is necessarily shut down.

Maximum Ambient Temperature

Supply units

Depending on the ambient temperature a derating is necessary.

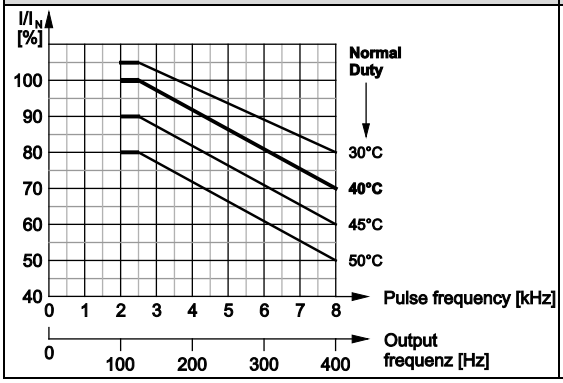
Ambient temperature	Power adaptation
30...39°C	Increase of power by 0.5 % per °C possible
40°C	No reduction of power required
41...50°C	Reduction of power by 1.5 % per °C required

Inverter units

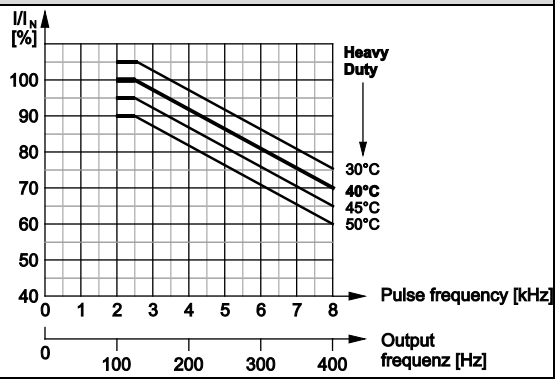
Depending on the chosen pulse frequency, the maximum ambient temperature and the desired output frequency a derating is necessary. This can be determined by means of the following diagrams.

Power reduction depending on the ambient temperature, the pulse frequency and the output frequency

Normal Duty ND



Heavy Duty HD



Observe the following guidelines:

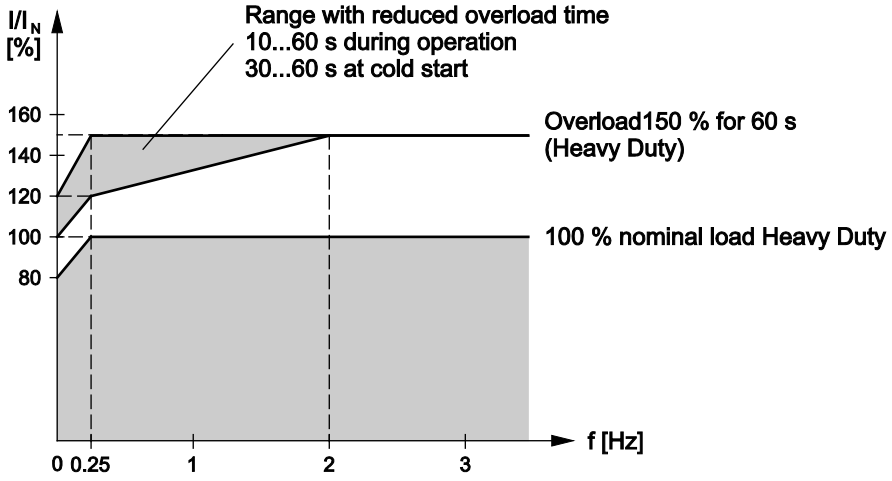
- In case of output frequencies higher than 125 Hz the pulse frequency is increased automatically. So the pulse frequency is increased to 4 kHz at 200 Hz output frequency, for example. Consequently, a derating of 8 % at max. 40°C has to be considered.
- Due to the reduction of the output current also the overload capability of the Altivar Process Drive System is reduced.
- At higher pulse frequencies the allowed motor cable length is reduced (see page 115).
- For full shaft power the motor size should not be more than one power rating bigger than the drive.

NOTE: If the ambient temperature is too high, the pulse frequency is automatically reduced which helps to prevent an overload of the inverter (except in case of operation with sinus-motor-filter).

Continuous Current and Overload at < 2 Hz

Inverter units

In order to avoid thermal overload of the power semiconductors (IGBTs), the pulse frequency will be reduced automatically near 0 Hz operation. If the overload takes too long the drive will change to trip condition.



NOTE: If the frequency inverter is operated with output frequencies < 2 Hz the overload time at high overload up to 150 % is lower than 60 s. This restriction needs to be observed only for drives which continuously operate around 0 Hz and require overloads up to 150 %.

There are practically no effects on the start of a drive because even big motors have a nominal slip greater than 0.25 Hz.

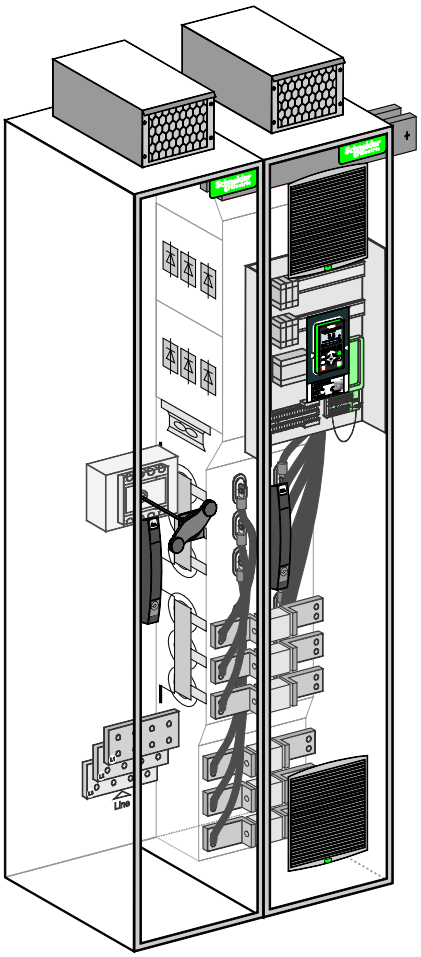
Chapter 4
ATV991●●●●4X1

What Is in This Chapter?

This chapter contains the following topics:

Description

ATV991 – MultiDrive Rectifier Unit



Power components:

- Mains connection terminals
- Main switch or circuit breaker
- Semiconductor fuses
- EMC filter
- Line reactor(s)
- Rectifier module(s)
- Energy distribution via DC bus

Design:

- Floor-standing enclosure
- Integrated control panel
- Protection degree IP23
- Forced cooling
- -10...+50 °C
  (below 0 °C with option enclosure heating,
  above +40 °C with derating)
- Graphical operating panel in the enclosure door

Specification

Technical Data ATV991C16●4X1

Type		ATV991C16●4X1
Nominal data		
DC output power P_{nDC}	U_n = 400 V	175 kW
	U_n = 440 V	190 kW
	U_n = 480 V	200 kW
DC output current I_{nDC}		325 A
Maximum current I_{MAX}	for 60 s per 10 minutes	390 A
Input		
Rated input current I_{in}	U_n = 400 V	280 A
(at I_{scc} = 35 kA)	U_n = 440 V	270 A
	U_n = 480 V	275 A
Rated apparent power S_n	U_n = 400 V	190 kVA
	U_n = 440 V	205 kVA
	U_n = 480 V	230 kVA
Current harmonic THDi (1)		< 38 % at I_{scc} = 35 kA
Protection for upstream cables		
Pre-fuse		315 A gG
Circuit breaker I_{therm} / I_{magn}		315 A / 3 kA
Internal short-circuit protection		
Fuse		400 A aR
Characteristics		
Efficiency at I_n		0.99
Heat losses at I_n	Total losses	1300 W
	Control part only	300 W
Weight	Net	400 kg
	Gross	440 kg
Ambient conditions		
Air flow	Power part	580 m^3/h
	Control part	280 m^3/h
Sound pressure level		70 dB(A)
Rated short-circuit current I_{cc}	Minimum (2)	4 kA
	Maximum (3)	50 kA (100 ms)
Cable cross section		
Mains connection (4)	Typical cable	1x (3x 185 mm²) or 2x (3x 95 mm²)
	Max. cable cross section	2x (3x 185 mm²)

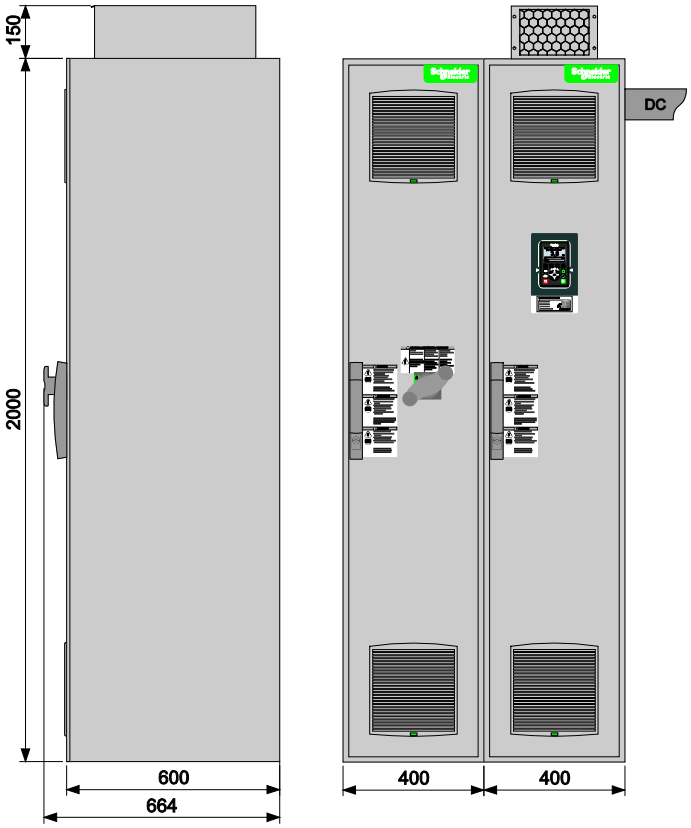
(1) For details see table under chapter "Mains Current Harmonics / Mains Voltage Distortion", page 52.

(2) Minimum mains short-circuit current

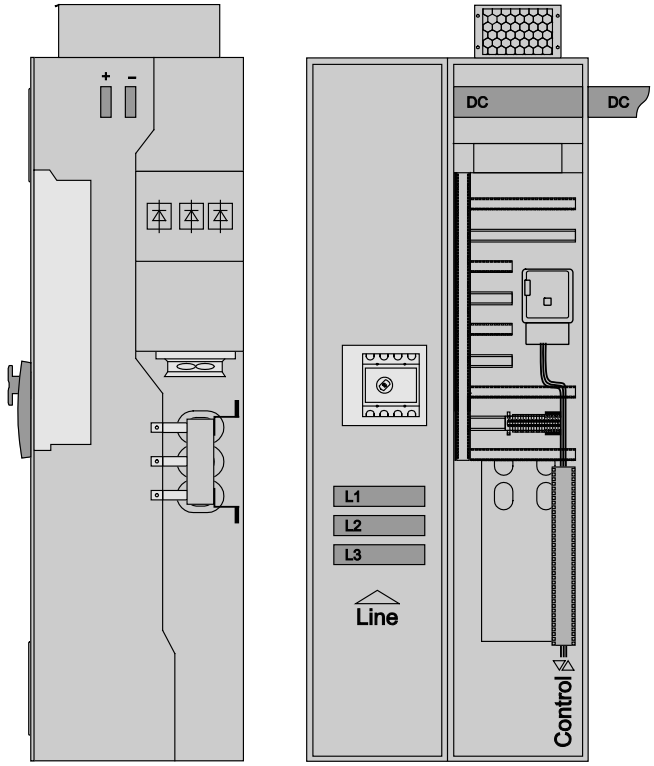
(3) Permitted short-circuit current when the specified pre-fuse or circuit breaker is installed

(4) You will find further information at chapter "Mains Connection ", page 51.

Dimensions IP23 for Size 1mr



Interior View IP23 for Size 1mr



Technical Data ATV991C31●4X1

Type		ATV991C31●4X1
Nominal data		
DC output power P_{nDC}	U_n = 400 V	350 kW
	U_n = 440 V	375 kW
	U_n = 480 V	400 kW
DC output current I_{nDC}		650 A
Maximum current I_{MAX}	for 60 s per 10 minutes	780 A
Input		
Rated input current I_{in}	U_n = 400 V	550 A
(at I_{scc} = 50 kA)	U_n = 440 V	532 A
	U_n = 480 V	540 A
Rated apparent power S_n	U_n = 400 V	375 kVA
	U_n = 440 V	405 kVA
	U_n = 480 V	450 kVA
Current harmonic THDi (1)		< 38 % at I_{scc} = 50 kA
Protection for upstream cables		
Pre-fuse		630 A gG
Circuit breaker I_{therm} / I_{magn}		630 A / 6 kA
Internal short-circuit protection		
Fuse		2x 400 A aR
Characteristics		
Efficiency at I_n		0.99
Heat losses at I_n	Total losses	2500 W
	Control part only	500 W
Weight	Net	430 kg
	Gross	470 kg
Ambient conditions		
Air flow	Power part	580 m^3/h
	Control part	280 m^3/h
Sound pressure level		70 dB(A)
Rated short-circuit current I_{scc}	Minimum (2)	8 kA
	Maximum (3)	50 kA (100 ms)
Cable cross section		
Mains connection (4)	Typical cable	2x (3x 185 mm²) or 3x (3x 120 mm²) or 4x (3x 95 mm²)
	Max. cable cross section	4x (3x 240 mm²)

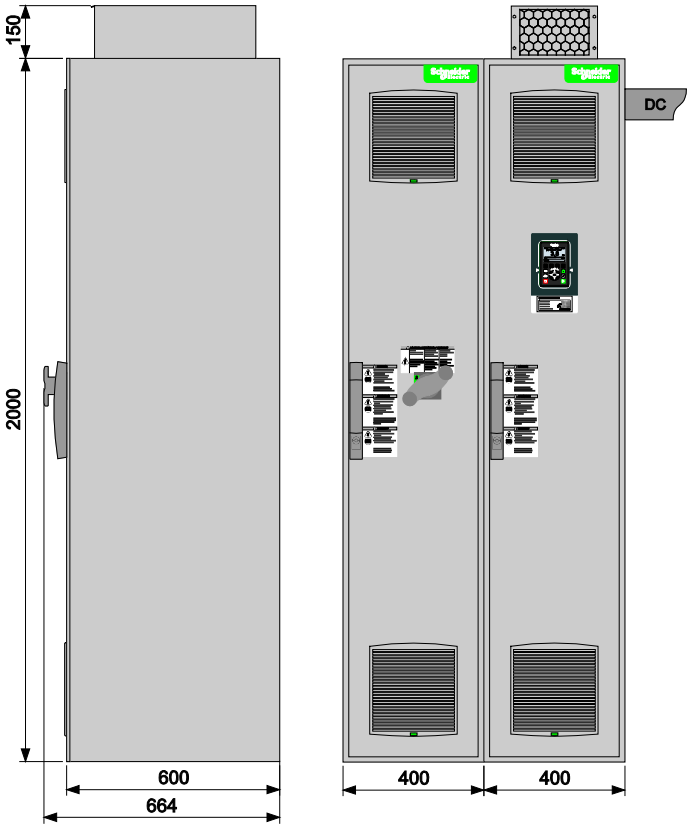
(1) For details see table under chapter "Mains Current Harmonics / Mains Voltage Distortion", page 52.

(2) Minimum mains short-circuit current

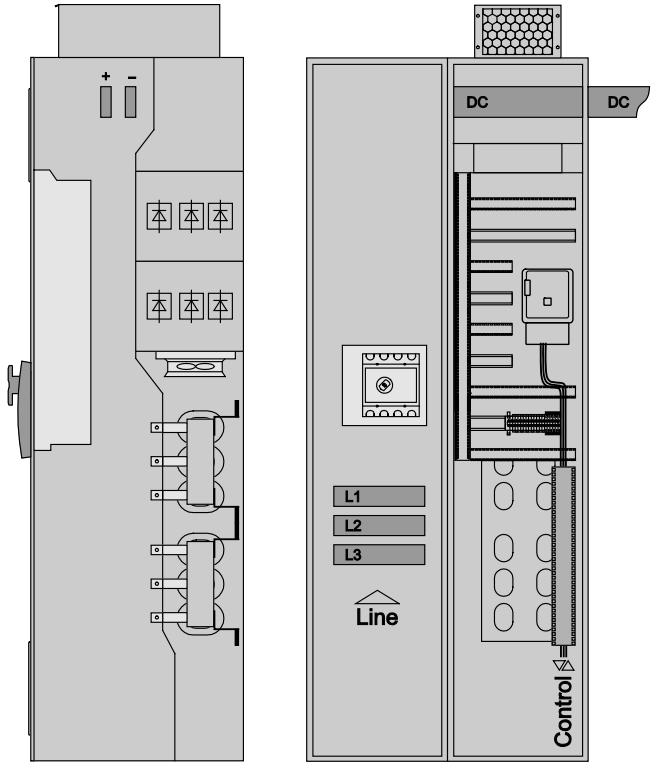
(3) Permitted short-circuit current when the specified pre-fuse or circuit breaker is installed

(4) You will find further information at chapter "Mains Connection ", page 51.

Dimensions IP23 for Size 2mr



Interior View IP23 for Size 2mr



Technical Data ATV991C63●4X1

Type		ATV991C63●4X1
Nominal data		
DC output power P_{nDC}	U_n = 400 V	700 kW
	U_n = 440 V	750 kW
	U_n = 480 V	800 kW
DC output current I_{nDC}		1300 A
Maximum current I_{MAX}	for 60 s per 10 minutes	1560 A
Input		
Rated input current I_{in}	U_n = 400 V	1090 A
(at I_{scc} = 50 kA)	U_n = 440 V	1064 A
	U_n = 480 V	1060 A
Rated apparent power S_n	U_n = 400 V	740 kVA
	U_n = 440 V	810 kVA
	U_n = 480 V	885 kVA
Current harmonic THDi (1)		< 38 % at I_{scc} = 50 kA
Protection for upstream cables		
Pre-fuse		1250 A gG
Circuit breaker I_{therm} / I_{magn}		1250 A / 12 kA
Internal short-circuit protection		
Fuse		4x 400 A aR
Characteristics		
Efficiency at I_n		0.99
Heat losses at I_n	Total losses	4900 W
	Control part only	800 W
Weight	Net	700 kg
	Gross	750 kg
Ambient conditions		
Air flow	Power part	1160 m^3/h
	Control part	420 m^3/h
Sound pressure level		73 dB(A)
Rated short-circuit current I_{scc}	Minimum (2)	17 kA
	Maximum (3)	50 kA (100 ms)
Cable cross section		
Mains connection (4)	Typical cable	4x (3x 240 mm²) or 5x (3x 185 mm²) or 6x (3x 150 mm²)
	Max. cable cross section	6x (3x 240 mm²)

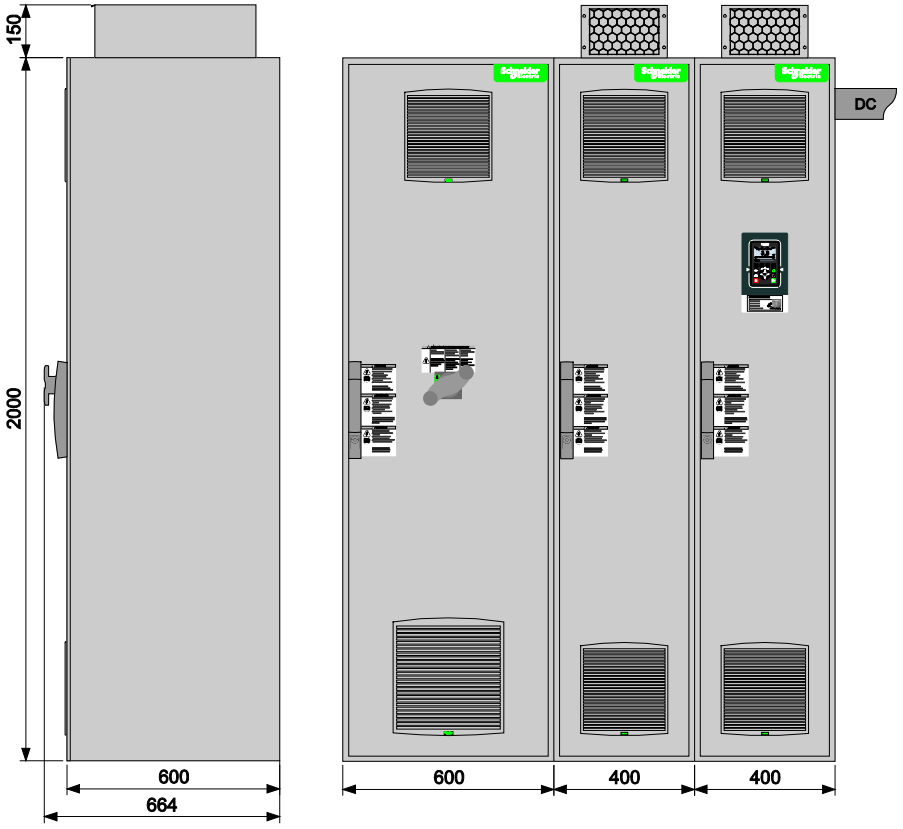
(1) For details see table under chapter "Mains Current Harmonics / Mains Voltage Distortion", page 52.

(2) Minimum mains short-circuit current

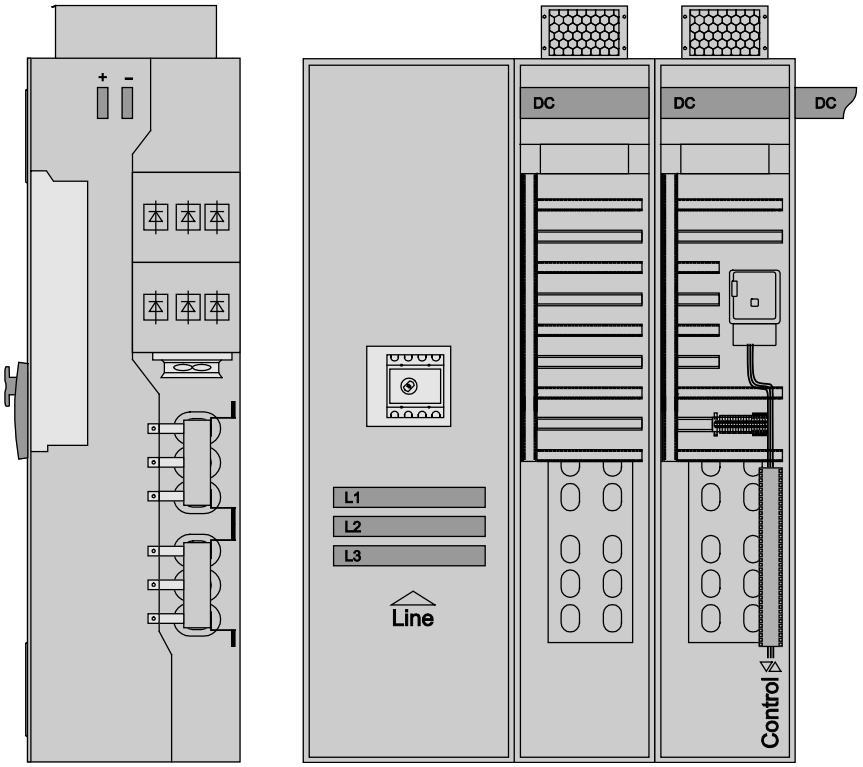
(3) Permitted short-circuit current when the specified pre-fuse or circuit breaker is installed

(4) You will find further information at chapter "Mains Connection ", page 51.

Dimensions IP23 for Size 4mr



Interior View IP23 for Size 4mr



Technical Data ATV991M10●4X1

Type		ATV991M10●4X1
Nominal data		
DC output power P_{nDC}	U_n = 400 V	1050 kW
	U_n = 440 V	1125 kW
	U_n = 480 V	1200 kW
DC output current I_{nDC}		1950 A
Maximum current I_{MAX}	for 60 s per 10 minutes	2340 A
Input		
Rated input current I_{in}	U_n = 400 V	1640 A
(at I_{scc} = 50 kA)	U_n = 440 V	1596 A
	U_n = 480 V	1590 A
Rated apparent power S_n	U_n = 400 V	1110 kVA
	U_n = 440 V	1215 kVA
	U_n = 480 V	1320 kVA
Current harmonic THDi (1)		< 38 % at I_{scc} = 50 kA
Protection for upstream cables		
Pre-fuse		2000 A gG
Circuit breaker I_{therm} / I_{magn}		2000 A / 20 kA
Internal short-circuit protection		
Fuse		6x 400 A aR
Characteristics		
Efficiency at I_n		0.99
Heat losses at I_n	Total losses	7400 W
	Control part only	1100 W
Weight	Net	950 kg
	Gross	1050 kg
Ambient conditions		
Air flow	Power part	1740 m^3/h
	Control part	560 m^3/h
Sound pressure level		73 dB(A)
Rated short-circuit current I_{scc}	Minimum (2)	25 kA
	Maximum (3)	50 kA (100 ms)
Cable cross section		
Mains connection (4)	Typical cable	6x (3x 240 mm²) or 8x (3x 185 mm²)
	Max. cable cross section	8x (3x 240 mm²)

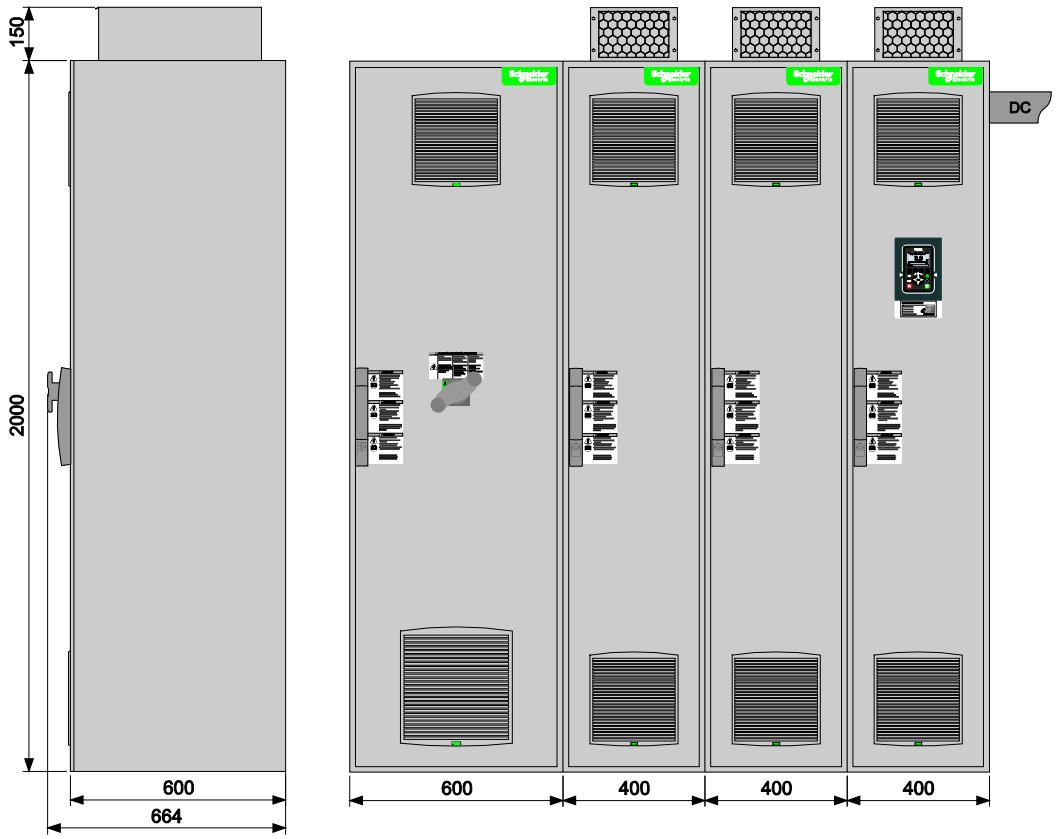
(1) For details see table under chapter "Mains Current Harmonics / Mains Voltage Distortion", page 52.

(2) Minimum mains short-circuit current

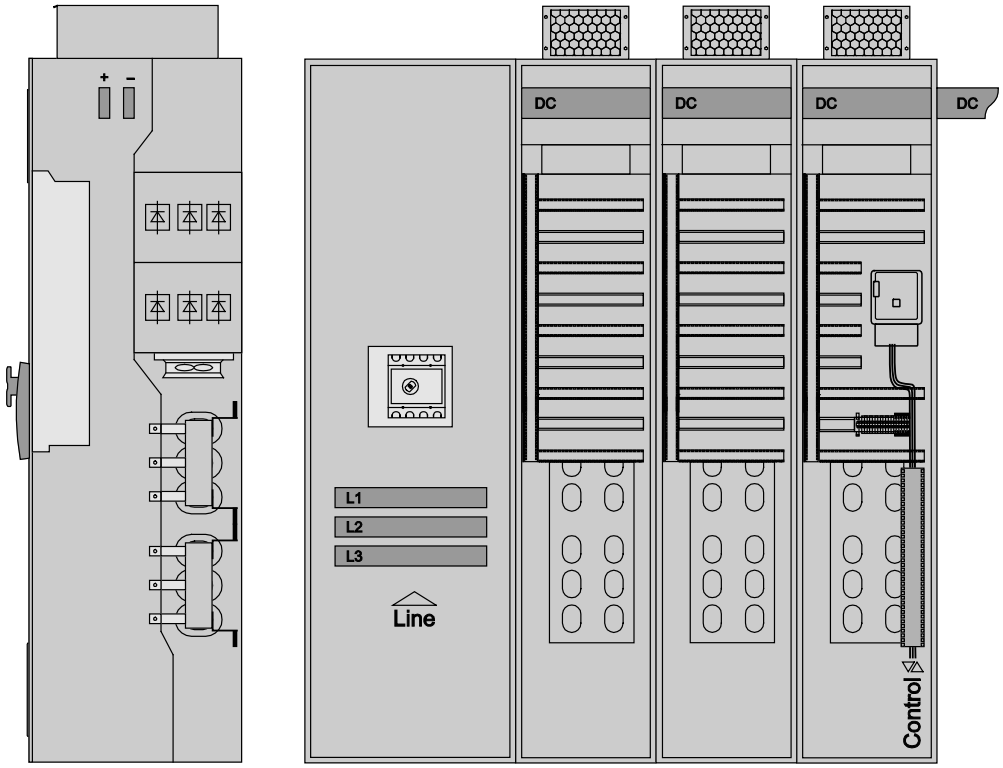
(3) Permitted short-circuit current when the specified pre-fuse or circuit breaker is installed

(4) You will find further information at chapter "Mains Connection ", page 51.

Dimensions IP23 for Size 6mr

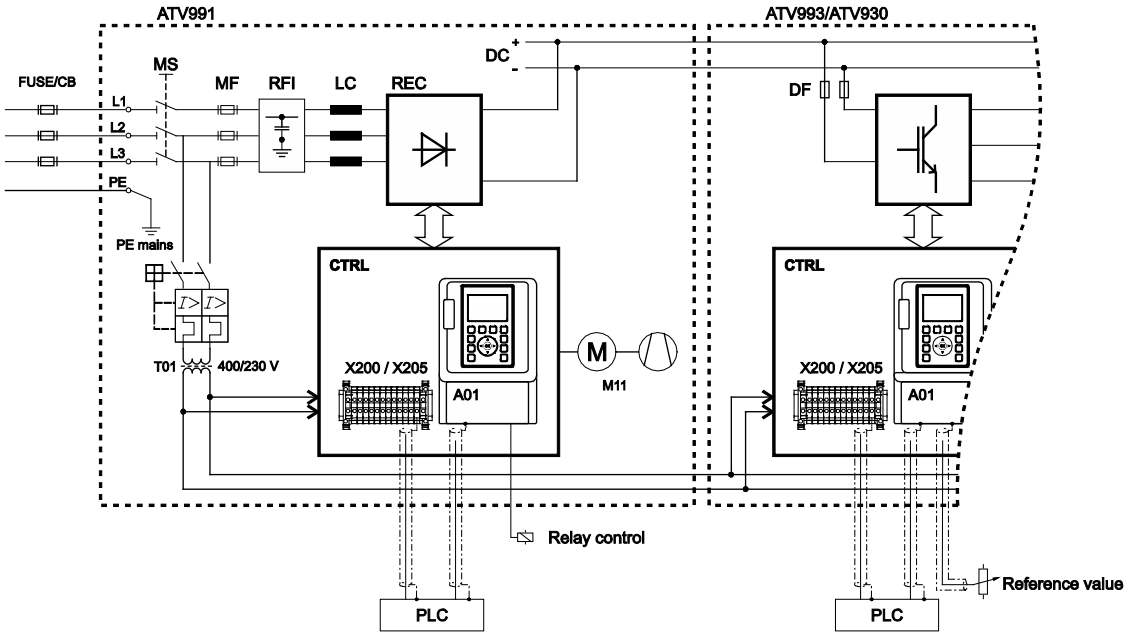


Interior View IP23 for Size 6mr



Circuit Diagram

The following presentation shows a typical wiring of a MultiDrive system starting with the supply unit.



ATV991	Altivar Process MultiDrive Systems – Rectifier unit
FUSE/CB	External pre-fuse or circuit breaker to protect the mains cable
MS	Built-in main switch, lockable in open position
T01	Control transformer 400 / 230 V AC for supplying the whole system
MF	aR fuses for short-circuit shut-down if the electronic protective devices do not work properly
DF	DC fuses for short-circuit shut-down if the electronic protective devices do not work properly
RFI	Radio frequency interference filter
LC	Line reactor to reduce the current harmonics on the mains caused by the DC link.
REC	Rectifier module(s)
DC	Common DC link
ATV993/ATV930	Inverter unit(s)
CTRL	Control panel with control block and further control components
A01	Control terminals at the control block
X200 / X205	Control terminals at the control panel
M11	Fan in enclosure door

Mains Connection

Dimensioning of the Power Cables

The Altivar Process MultiDrive Systems include semiconductor fuses as standard. These fuses are for the case that the electronic protective mechanisms of the system do not work. So they are a secondary protection of the system.

The Altivar Process Drive Systems help to protect themselves as well as the mains cables and the motor cables against thermal overload. The specified pre-fuses or circuit breakers (with magnetic release) must be installed upstream to protect the mains cables against short-circuit.

The recommended values for dimensioning the cable cross sections given in chapter "Technical data" are reference values for multi-core copper power cables layed in air at a maximum ambient temperature of 40°C. Observe different ambient conditions and local regulations.

Recommended types of mains cables	
	Three-phase cable with sector-shaped conductors and reduced protective conductor **NOTE:** Check whether the protective conductor complies with the requirements of IEC 61439-1.
	Three-phase cable with round conductors and reduced protective conductor. **NOTE:** Check whether the protective conductor complies with the requirements of IEC 61439-1.

NOTE: The recommended cable cross sections are given at the technical data of the respective supply unit.

⚠ WARNING

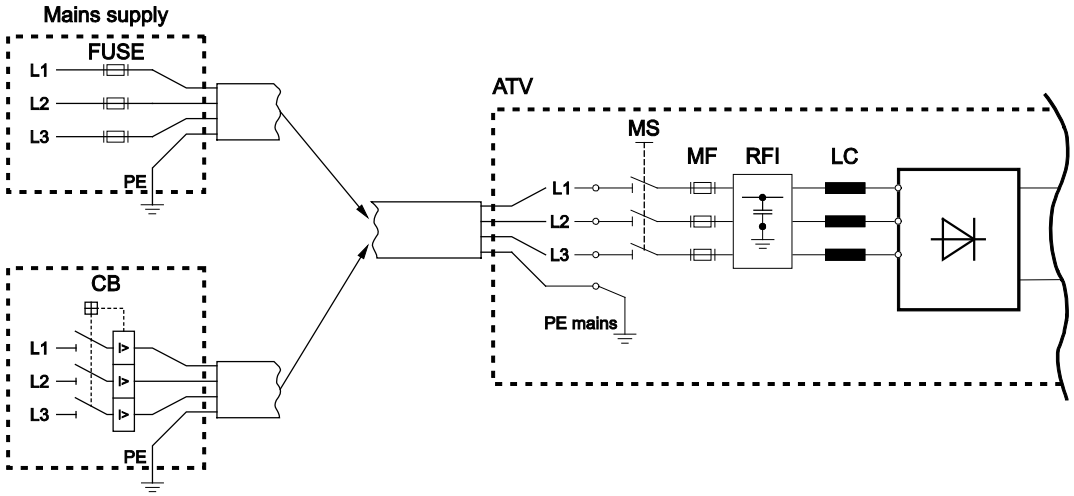
OVERLOAD DUE TO INCORRECT RATING OF MAINS SUPPLY

- Install properly rated upstream mains fuses or circuit breakers.
- When rating the upstream mains fuses and the cross sections as well as the length of the mains cables, take into account the available specified short circuit current.
- If the required short circuit is not available, increase the power of the transformer.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Overcurrent- and Short-circuit Protection

The following picture illustrates the overcurrent protection and short-circuit protection at the input side.



ATV	Altivar Process MultiDrive System ATV991 – Rectifier unit
FUSE	External pre-fuse to protect the mains cable
CB	External circuit breaker to protect the mains cable (alternatively to FUSE)
MS	Built-in main switch, lockable in open position
MF	aR mains fuses for short-circuit shut-down if the electronic protective devices do not work properly
RFI	Built-in radio frequency interference filter
LC	Line reactor to reduce the current harmonics on the mains caused by the DC link.
REC	Rectifier module(s)

The Die Altivar Process supply unit includes semiconductor fuses as standard. These fuses are for the case that the electronic protective mechanisms of the system do not work. So they are a secondary protection of the inverter.

NOTE: If the mains fuses blow, the system already has a primary damage. Therefore, exchanging the blown fuses and switching the system on again without any check is not effective.

NOTE: The overcurrent protection is given at the technical data of the respective supply unit.

Mains Current Harmonics / Mains Voltage Distortion

Because of using a diode rectifier on the input of a conventional inverter, harmonics occur in the mains current which lead to a voltage distortion of the supplying mains.

All ATV991 MultiDrive rectifier units are equipped with line reactors to reduce the current harmonics. They are dimensioned in such a way that a THD(i) < 38 % is kept. Details see table below.

Power [kW]	I_{scc} [kA]	I_n [A]	H1 [A]	Harmonics at nominal load [%]															
				H5	H7	H11	H13	H17	H19	H23	H25	H29	H31	H35	H37	H41	H43	H47	H49	THDi
170	35	280	261	33.1	10.9	6.30	3.07	2.55	1.79	1.22	1.12	0.68	0.68	0.48	0.43	0.38	0.32	0.30	0.26	38.4
340	50	550	515	32.6	10.4	6.23	3.07	2.49	1.79	1.17	1.09	0.66	0.65	0.48	0.42	0.38	0.32	0.29	0.26	37.6
680	50	1090	1032	30.0	8.56	5.78	3.10	2.11	1.73	0.96	0.95	0.63	0.54	0.48	0.39	0.34	0.31	0.24	0.24	33.9
1020	50	1640	1536	28.7	7.95	5.50	3.13	1.91	1.67	0.90	0.86	0.64	0.51	0.46	0.39	0.31	0.30	0.23	0.22	32.3

NOTE: The actual values for the respective mains situation can be calculated on request.

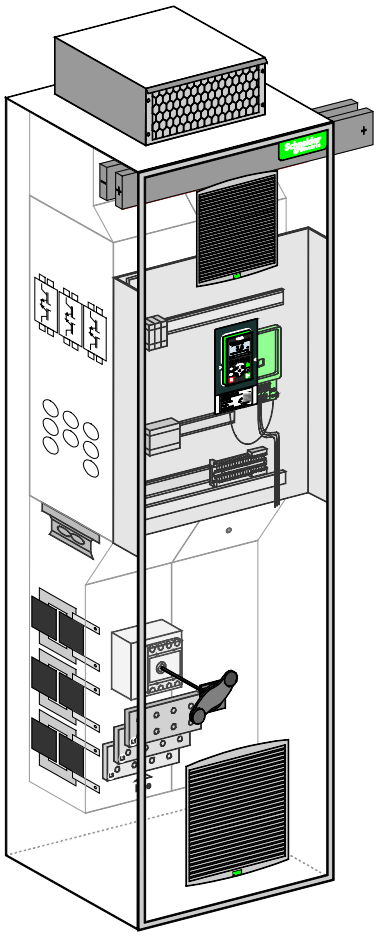
Chapter 5
ATV992●●●●4X1

What Is in This Chapter?

This chapter contains the following topics:

Description

ATV992 – MultiDrive Active Front End Unit



Power components:

- Mains connection terminals
- Main switch
- Semiconductor fuses
- Clean power filter with EMC filter
- Active Front End module(s)
- DC fuses
- Energy distribution via DC bus

Design:

- Floor-standing enclosure
- Integrated control panel
- Protection degree IP23
- Forced cooling
- -10...+50 °C
  (below 0 °C with additional enclosure heating,
  above +40 °C with derating)
- Graphical operating panel in the enclosure door

Specification

Technical Data ATV992C11●4X1

Type		ATV992C11●4X1
Nominal data		
DC output power P_{nDC}	U_n = 400 V	120 kW
	U_n = 440 V	125 kW
	U_n = 480 V	135 kW
DC output current I_{nDC}	U_n = 400 V	205 A
	U_n = 440 V	195 A
	U_n = 480 V	195 A
Maximum current I_{MAX}	U_n = 400 V	246 A
for 60 s per 10 minutes	U_n = 440 V	234 A
	U_n = 480 V	234 A
Input		
Rated input current I_{in}	U_n = 400 V	180 A
	U_n = 440 V	170 A
	U_n = 480 V	169 A
Rated apparent power S_n	U_n = 400 V	124 kVA
	U_n = 440 V	129 kVA
	U_n = 480 V	139 kVA
Current harmonic THDi (1)		< 5 %
Protection for upstream cables		
Pre-fuse		250 A gG
Circuit breaker I_{therm} / I_{magn}		230 A / 2 kA
Internal short-circuit protection		
Fuse		250 A aR
DC fuse		400 A
Characteristics		
Efficiency at I_n		0.98
Heat losses at I_n	Total losses	2700 W
	Control part only	400 W
Weight	Net	350 kg
	Gross	400 kg
Ambient conditions		
Air flow	Power part	1160 m^3/h
	Control part	140 m^3/h
Sound pressure level		70 dB(A)
Rated short-circuit current I_{cc}	Minimum (2)	3 kA
	Maximum (3)	50 kA (100 ms)
Cable cross section		
Mains connection (4)	Typical cable	1x (3x 120 mm²) or 2x (3x 50 mm²)
	Max. cable cross section	2x (3x 185 mm²)

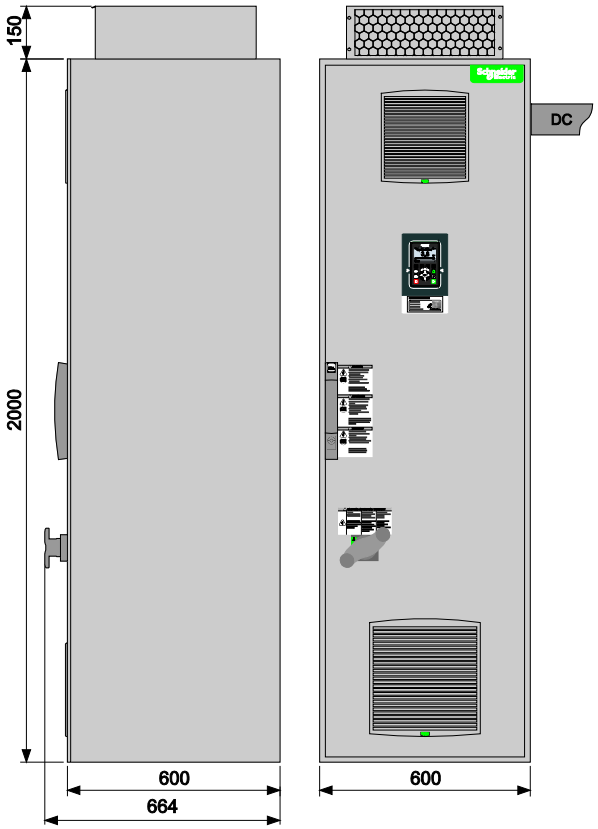
(1) For details see table under chapter "Mains Current Harmonics / Mains Voltage Distortion", page 80.

(2) Minimum mains short-circuit current

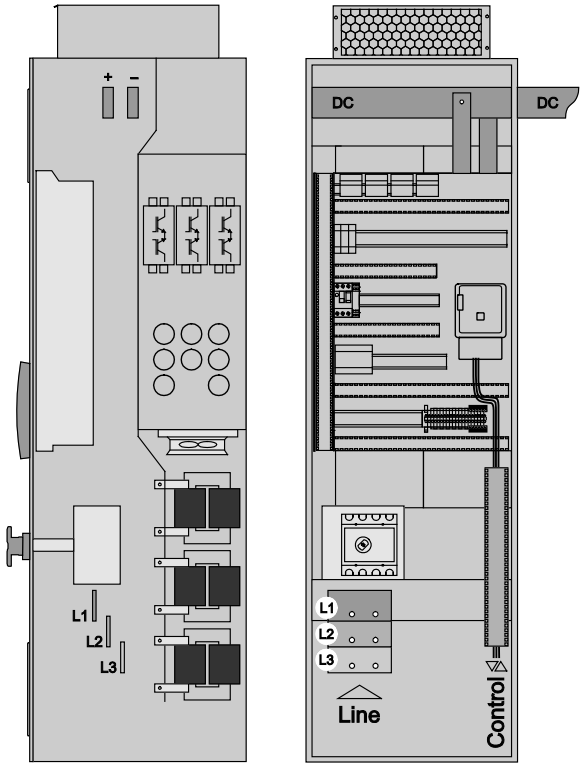
(3) Permitted short-circuit current when the specified pre-fuse or circuit breaker is installed

(4) You will find further information at chapter "Mains Connection ", page 79.

Dimensions IP23 for Size 1ma



Interior View IP23 for Size 1ma



Technical Data ATV992C13●4X1

Type		ATV992C13●4X1
Nominal data		
DC output power P_{nDC}	U_n = 400 V	145 kW
	U_n = 440 V	155 kW
	U_n = 480 V	165 kW
DC output current I_{nDC}	U_n = 400 V	245 A
	U_n = 440 V	235 A
	U_n = 480 V	235 A
Maximum current I_{MAX}	U_n = 400 V	294 A
for 60 s per 10 minutes	U_n = 440 V	282 A
	U_n = 480 V	282 A
Input		
Rated input current I_{in}	U_n = 400 V	217 A
	U_n = 440 V	211 A
	U_n = 480 V	206 A
Rated apparent power S_n	U_n = 400 V	150 kVA
	U_n = 440 V	160 kVA
	U_n = 480 V	170 kVA
Current harmonic THDi (1)		< 5 %
Protection for upstream cables		
Pre-fuse		300 A gG
Circuit breaker I_{therm} / I_{magn}		280 A / 3 kA
Internal short-circuit protection		
Fuse		315 A aR
DC fuse		400 A
Characteristics		
Efficiency at I_n		0.98
Heat losses at I_n	Total losses	3300 W
	Control part only	500 W
Weight	Net	350 kg
	Gross	400 kg
Ambient conditions		
Air flow	Power part	1160 m^3/h
	Control part	140 m^3/h
Sound pressure level		70 dB(A)
Rated short-circuit current I_{cc}	Minimum (2)	3.5 kA
	Maximum (3)	50 kA (100 ms)
Cable cross section		
Mains connection (4)	Typical cable	1x (3x 150 mm²) or 2x (3x 70 mm²)
	Max. cable cross section	2x (3x 185 mm²)

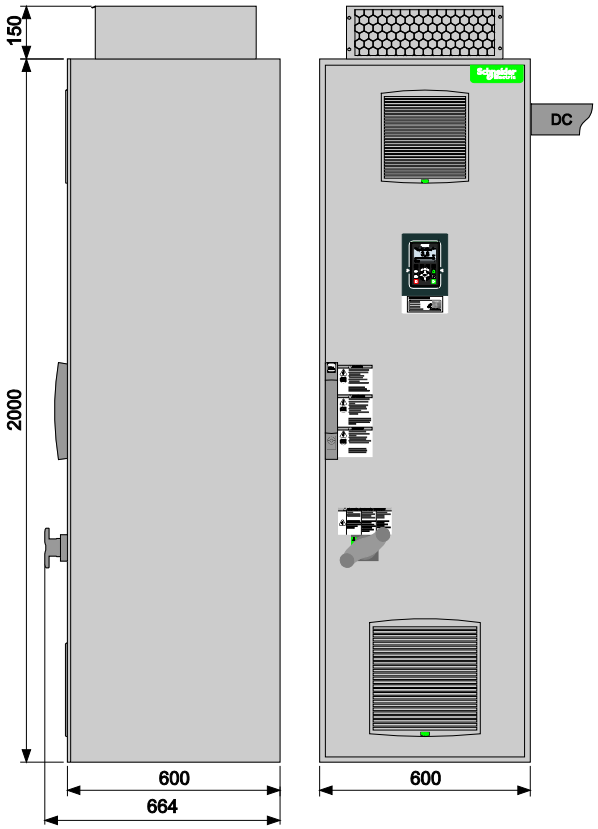
(1) For details see table under chapter "Mains Current Harmonics / Mains Voltage Distortion", page 80.

(2) Minimum mains short-circuit current

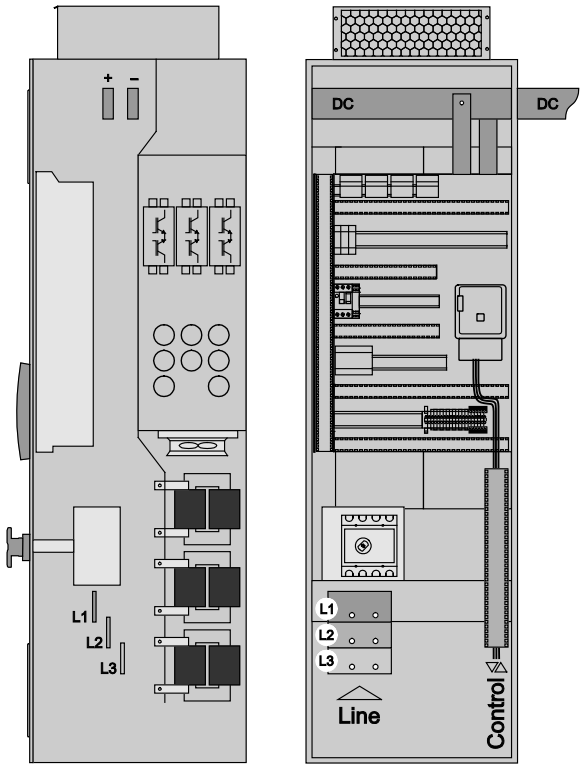
(3) Permitted short-circuit current when the specified pre-fuse or circuit breaker is installed

(4) You will find further information at chapter "Mains Connection ", page 79.

Dimensions IP23 for Size 1ma



Interior View IP23 for Size 1ma



Technical Data ATV992C16●4X1

Type		ATV992C16●4X1
Nominal data		
DC output power P_{nDC}	U_n = 400 V	175 kW
	U_n = 440 V	185 kW
	U_n = 480 V	200 kW
DC output current I_{nDC}	U_n = 400 V	295 A
	U_n = 440 V	285 A
	U_n = 480 V	285 A
Maximum current I_{MAX}	U_n = 400 V	354 A
for 60 s per 10 minutes	U_n = 440 V	342 A
	U_n = 480 V	342 A
Input		
Rated input current I_{in}	U_n = 400 V	262 A
	U_n = 440 V	252 A
	U_n = 480 V	250 A
Rated apparent power S_n	U_n = 400 V	181 kVA
	U_n = 440 V	191 kVA
	U_n = 480 V	206 kVA
Current harmonic THDi (1)		< 5 %
Protection for upstream cables		
Pre-fuse		315 A gG
Circuit breaker I_{therm} / I_{magn}		315 A / 3 kA
Internal short-circuit protection		
Fuse		400 A aR
DC fuse		400 A
Characteristics		
Efficiency at I_n		0.98
Heat losses at I_n	Total losses	3900 W
	Control part only	600 W
Weight	Net	350 kg
	Gross	400 kg
Ambient conditions		
Air flow	Power part	1160 m^3/h
	Control part	140 m^3/h
Sound pressure level		70 dB(A)
Rated short-circuit current I_{cc}	Minimum (2)	4 kA
	Maximum (3)	50 kA (100 ms)
Cable cross section		
Mains connection (4)	Typical cable	1x (3x 185 mm²) or 2x (3x 95 mm²)
	Max. cable cross section	2x (3x 185 mm²)

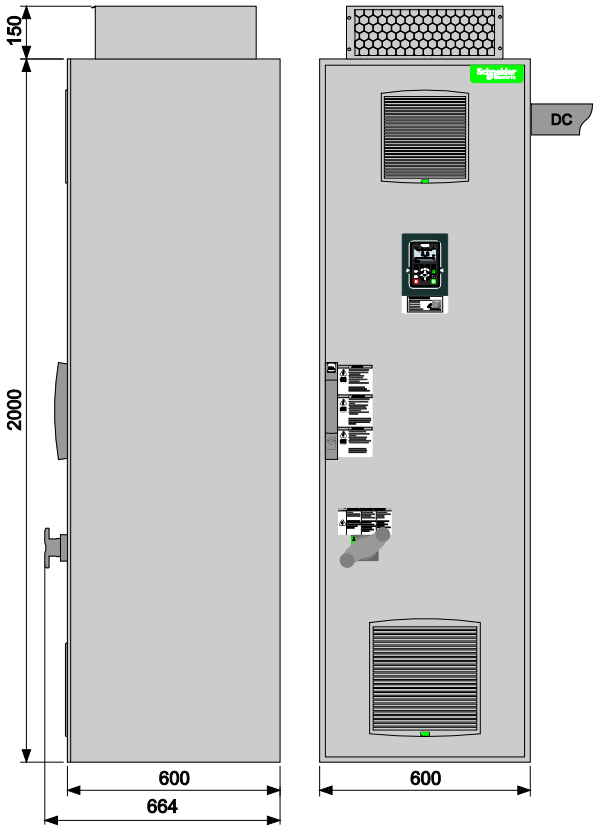
(1) For details see table under chapter "Mains Current Harmonics / Mains Voltage Distortion", page 80.

(2) Minimum mains short-circuit current

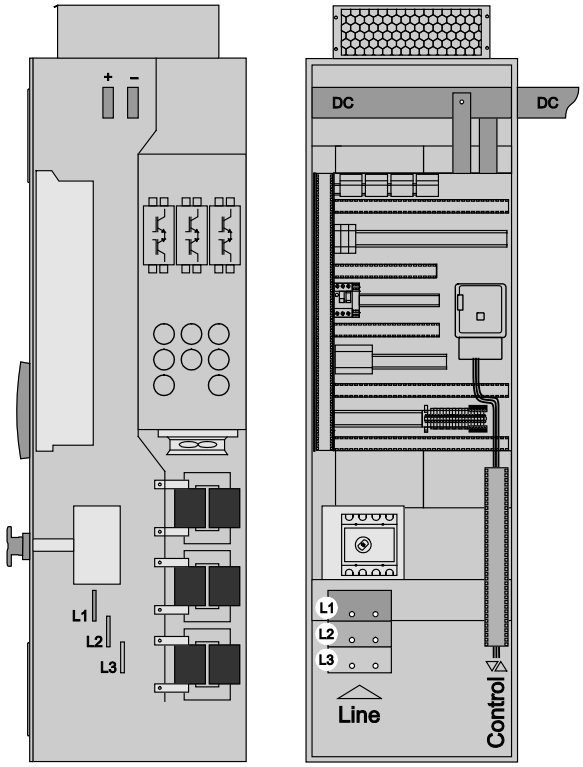
(3) Permitted short-circuit current when the specified pre-fuse or circuit breaker is installed

(4) You will find further information at chapter "Mains Connection ", page 79.

Dimensions IP23 for Size 1ma



Interior View IP23 for Size 1ma



Technical Data ATV992C20●4X1

Type		ATV992C20●4X1
Nominal data		
DC output power P_{nDC}	U_n = 400 V	240 kW
	U_n = 440 V	250 kW
	U_n = 480 V	270 kW
DC output current I_{nDC}	U_n = 400 V	410 A
	U_n = 440 V	390 A
	U_n = 480 V	390 A
Maximum current I_{MAX}	U_n = 400 V	492 A
for 60 s per 10 minutes	U_n = 440 V	468 A
	U_n = 480 V	468 A
Input		
Rated input current I_{in}	U_n = 400 V	359 A
	U_n = 440 V	340 A
	U_n = 480 V	337 A
Rated apparent power S_n	U_n = 400 V	248 kVA
	U_n = 440 V	258 kVA
	U_n = 480 V	278 kVA
Current harmonic THDi (1)		< 5 %
Protection for upstream cables		
Pre-fuse		400 A gG
Circuit breaker I_{therm} / I_{magn}		400 A / 4 kA
Internal short-circuit protection		
Fuse		2x 250 A aR
DC fuse		2x 400 A
Characteristics		
Efficiency at I_n		0.98
Heat losses at I_n	Total losses	5400 W
	Control part only	800 W
Weight	Net	580 kg
	Gross	630 kg
Ambient conditions		
Air flow	Power part	2320 m^3/h
	Control part	280 m^3/h
Sound pressure level		73 dB(A)
Rated short-circuit current I_{cc}	Minimum (2)	5.5 kA
	Maximum (3)	50 kA (100 ms)
Cable cross section		
Mains connection (4)	Typical cable	2x (3x 120 mm²) or 3x (3x 70 mm²)
	Max. cable cross section	3x (3x 185 mm²)

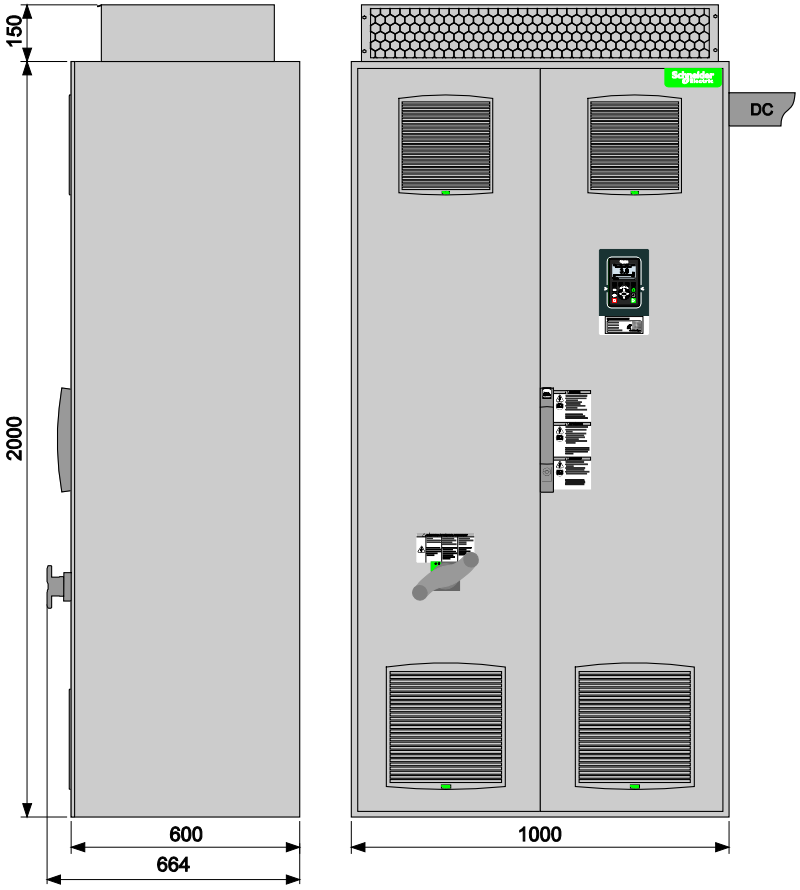
(1) For details see table under chapter "Mains Current Harmonics / Mains Voltage Distortion", page 80.

(2) Minimum mains short-circuit current

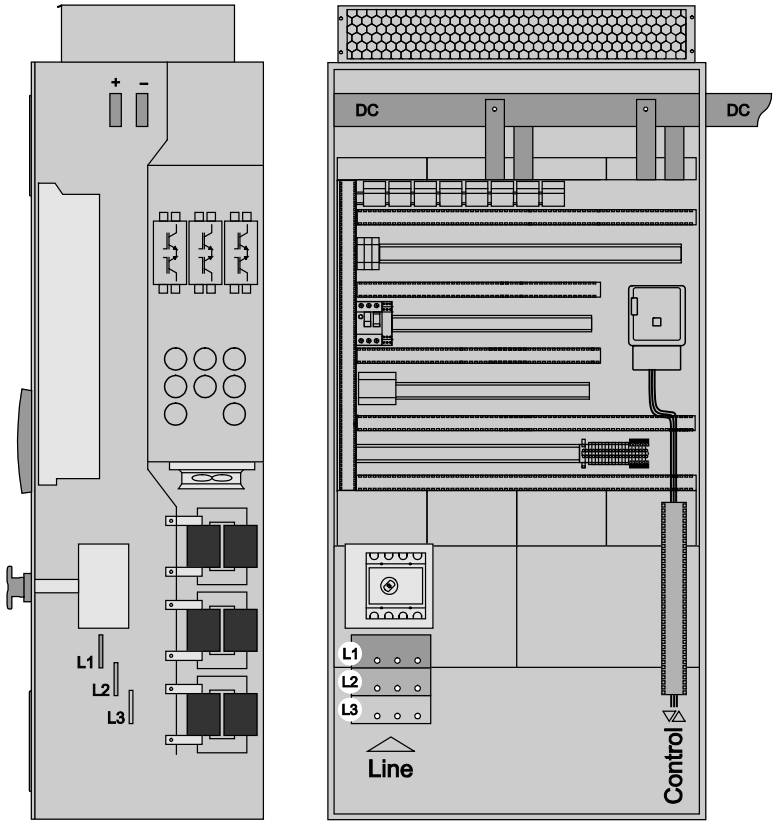
(3) Permitted short-circuit current when the specified pre-fuse or circuit breaker is installed

(4) You will find further information at chapter "Mains Connection ", page 79.

Dimensions IP23 for Size 2ma



Interior View IP23 for Size 2ma



Technical Data ATV992C25●4X1

Type		ATV992C25●4X1
Nominal data		
DC output power P_{nDC}	U_n = 400 V	290 kW
	U_n = 440 V	310 kW
	U_n = 480 V	330 kW
DC output current I_{nDC}	U_n = 400 V	490 A
	U_n = 440 V	470 A
	U_n = 480 V	470 A
Maximum current I_{MAX}	U_n = 400 V	588 A
for 60 s per 10 minutes	U_n = 440 V	564 A
	U_n = 480 V	564 A
Input		
Rated input current I_{in}	U_n = 400 V	434 A
	U_n = 440 V	422 A
	U_n = 480 V	412 A
Rated apparent power S_n	U_n = 400 V	299 kVA
	U_n = 440 V	320 kVA
	U_n = 480 V	340 kVA
Current harmonic THDi (1)		< 5 %
Protection for upstream cables		
Pre-fuse		500 A gG
Circuit breaker I_{therm} / I_{magn}		500 A / 5 kA
Internal short-circuit protection		
Fuse		2x 315 A aR
DC fuse		2x 400 A
Characteristics		
Efficiency at I_n		0.98
Heat losses at I_n	Total losses	6500 W
	Control part only	1000 W
Weight	Net	580 kg
	Gross	630 kg
Ambient conditions		
Air flow	Power part	2320 m^3/h
	Control part	280 m^3/h
Sound pressure level		73 dB(A)
Rated short-circuit current I_{cc}	Minimum (2)	7 kA
	Maximum (3)	50 kA (100 ms)
Cable cross section		
Mains connection (4)	Typical cable	2x (3x 150 mm²) or 3x (3x 95 mm²)
	Max. cable cross section	3x (3x 185 mm²)

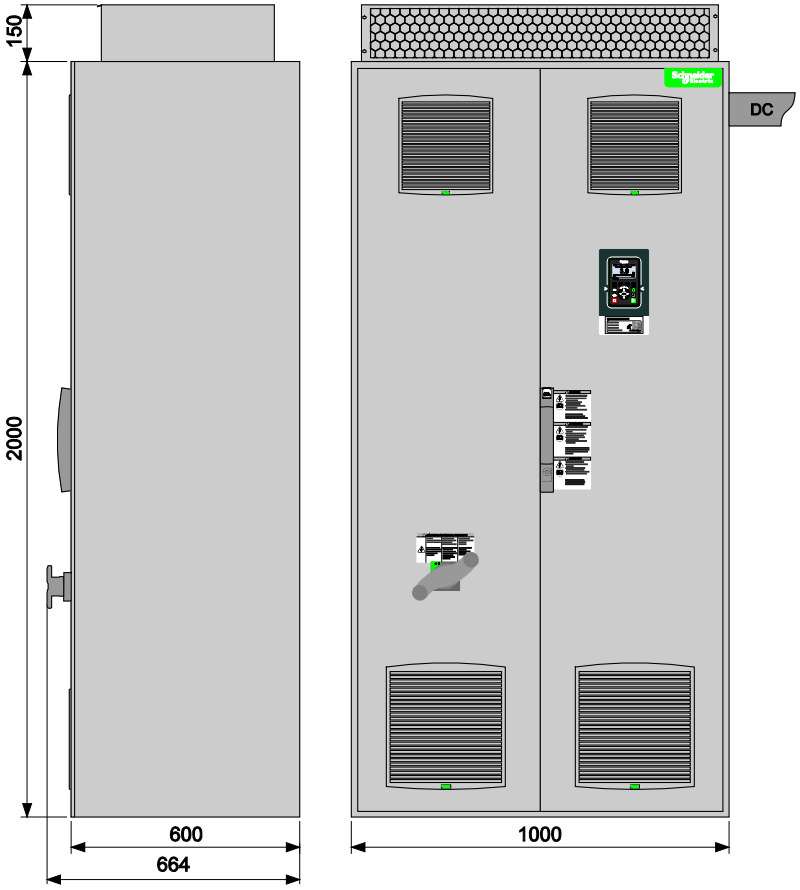
(1) For details see table under chapter "Mains Current Harmonics / Mains Voltage Distortion", page 80.

(2) Minimum mains short-circuit current

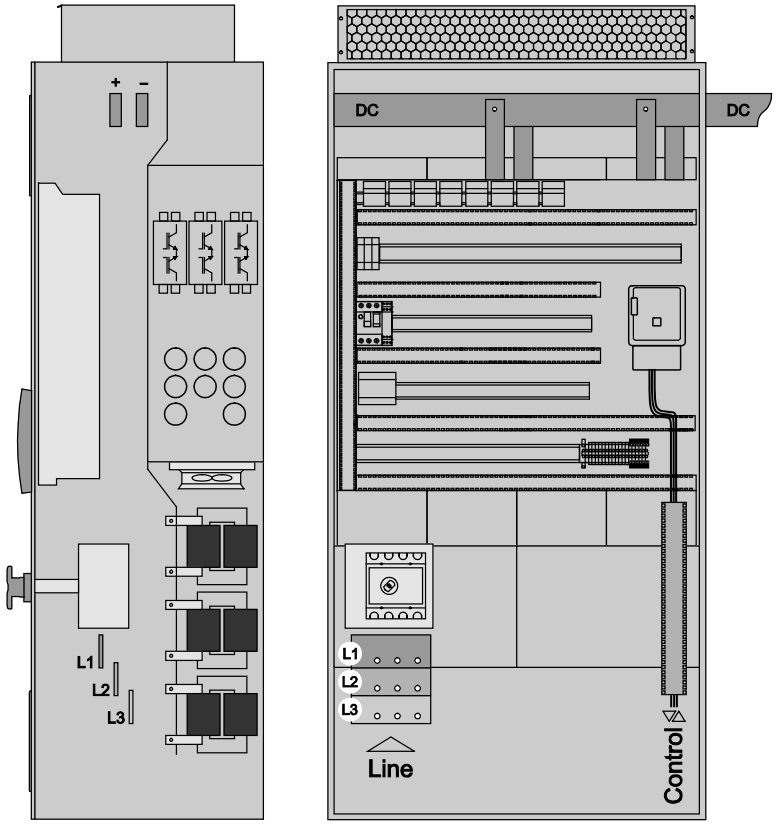
(3) Permitted short-circuit current when the specified pre-fuse or circuit breaker is installed

(4) You will find further information at chapter "Mains Connection ", page 79.

Dimensions IP23 for Size 2ma



Interior View IP23 for Size 2ma



Technical Data ATV992C31●4X1

Type		ATV992C31●4X1
Nominal data		
DC output power P_{nDC}	U_n = 400 V	350 kW
	U_n = 440 V	370 kW
	U_n = 480 V	400 kW
DC output current I_{nDC}	U_n = 400 V	590 A
	U_n = 440 V	570 A
	U_n = 480 V	570 A
Maximum current I_{MAX}	U_n = 400 V	708 A
for 60 s per 10 minutes	U_n = 440 V	684 A
	U_n = 480 V	684 A
Input		
Rated input current I_{in}	U_n = 400 V	524 A
	U_n = 440 V	503 A
	U_n = 480 V	499 A
Rated apparent power S_n	U_n = 400 V	361 kVA
	U_n = 440 V	382 kVA
	U_n = 480 V	412 kVA
Current harmonic THDi (1)		< 5 %
Protection for upstream cables		
Pre-fuse		630 A gG
Circuit breaker I_{therm} / I_{magn}		630 A / 6 kA
Internal short-circuit protection		
Fuse		2x 400 A aR
DC fuse		2x 400 A
Characteristics		
Efficiency at I_n		0.98
Heat losses at I_n	Total losses	7900 W
	Control part only	1200 W
Weight	Net	580 kg
	Gross	630 kg
Ambient conditions		
Air flow	Power part	2320 m^3/h
	Control part	280 m^3/h
Sound pressure level		73 dB(A)
Rated short-circuit current I_{cc}	Minimum (2)	8 kA
	Maximum (3)	50 kA (100 ms)
Cable cross section		
Mains connection (4)	Typical cable	2x (3x 185 mm²) or 3x (3x 120 mm²)
	Max. cable cross section	3x (3x 185 mm²)

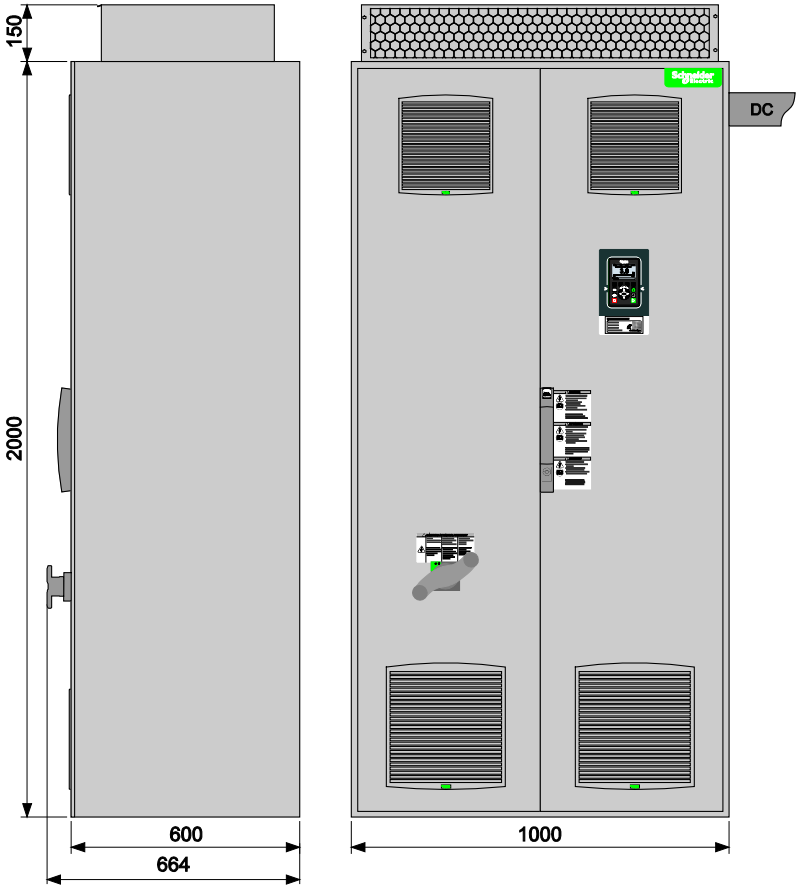
(1) For details see table under chapter "Mains Current Harmonics / Mains Voltage Distortion", page 80.

(2) Minimum mains short-circuit current

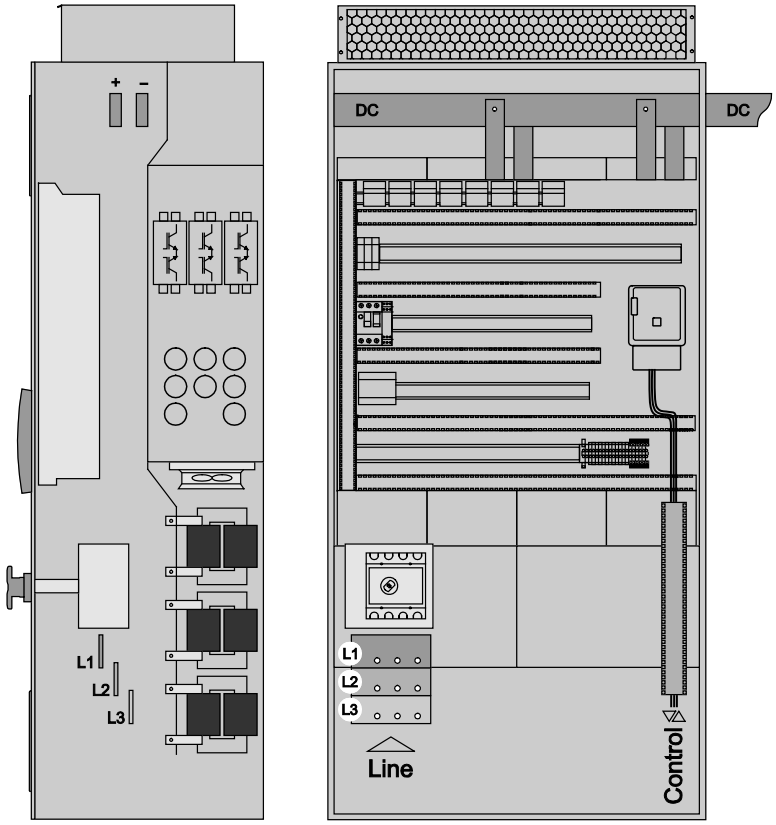
(3) Permitted short-circuit current when the specified pre-fuse or circuit breaker is installed

(4) You will find further information at chapter "Mains Connection ", page 79.

Dimensions IP23 for Size 2ma



Interior View IP23 for Size 2ma



Technical Data ATV992C40●4X1

Type		ATV992C40●4X1
Nominal data		
DC output power P_{nDC}	U_n = 400 V	435 kW
	U_n = 440 V	465 kW
	U_n = 480 V	495 kW
DC output current I_{nDC}	U_n = 400 V	735 A
	U_n = 440 V	705 A
	U_n = 480 V	705 A
Maximum current I_{MAX} for 60 s per 10 minutes	U_n = 400 V	882 A
	U_n = 440 V	846 A
	U_n = 480 V	846 A
Input		
Rated input current I_{in}	U_n = 400 V	651 A
	U_n = 440 V	633 A
	U_n = 480 V	618 A
Rated apparent power S_n	U_n = 400 V	449 kVA
	U_n = 440 V	480 kVA
	U_n = 480 V	510 kVA
Current harmonic THDi (1)		< 5 %
Protection for upstream cables		
Pre-fuse		800 A gG
Circuit breaker I_{therm} / I_{magn}		780 A / 8 kA
Internal short-circuit protection		
Fuse		3x 315 A aR
DC fuse		3x 400 A
Characteristics		
Efficiency at I_n		0.98
Heat losses at I_n	Total losses	9800 W
	Control part only	1450 W
Weight	Net	1000 kg
	Gross	1050 kg
Ambient conditions		
Air flow	Power part	3480 m^3/h
	Control part	420 m^3/h
Sound pressure level		75 dB(A)
Rated short-circuit current I_{cc}	Minimum (2)	11 kA
	Maximum (3)	50 kA (100 ms)
Cable cross section		
Mains connection (4)	Typical cable	3x (3x 185 mm²) or 4x (3x 120 mm²)
	Max. cable cross section	5x (3x 185 mm²)

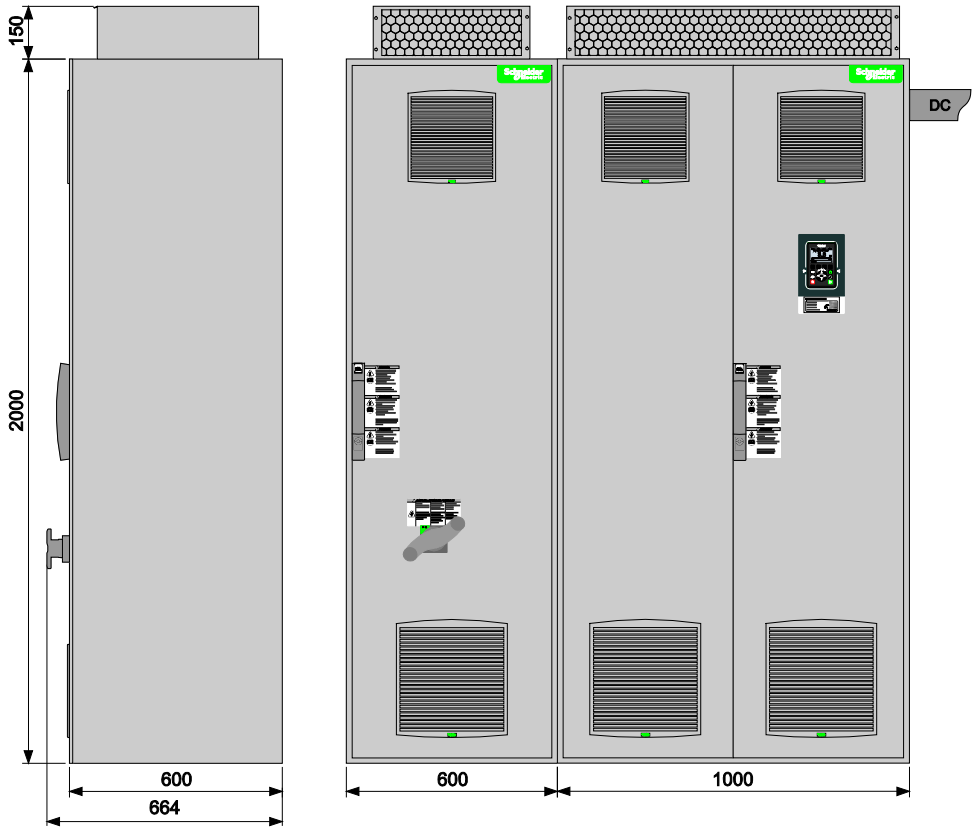
(1) For details see table under chapter "Mains Current Harmonics / Mains Voltage Distortion", page 80.

(2) Minimum mains short-circuit current

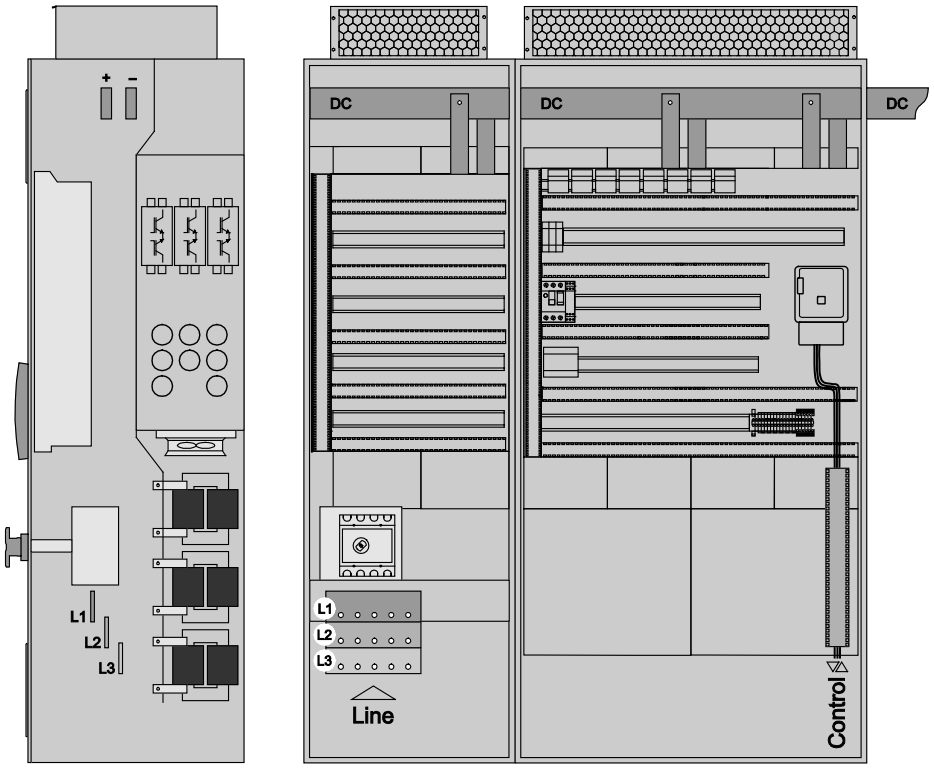
(3) Permitted short-circuit current when the specified pre-fuse or circuit breaker is installed

(4) You will find further information at chapter "Mains Connection ", page 79.

Dimensions IP23 for Size 3ma



Interior View IP23 for Size 3ma



Technical Data ATV992C50●4X1

Type		ATV992C50●4X1
Nominal data		
DC output power P_{nDC}	U_n = 400 V	525 kW
	U_n = 440 V	555 kW
	U_n = 480 V	600 kW
DC output current I_{nDC}	U_n = 400 V	885 A
	U_n = 440 V	855 A
	U_n = 480 V	855 A
Maximum current I_{MAX}	U_n = 400 V	1062 A
for 60 s per 10 minutes	U_n = 440 V	1026 A
	U_n = 480 V	1026 A
Input		
Rated input current I_{in}	U_n = 400 V	786 A
	U_n = 440 V	755 A
	U_n = 480 V	749 A
Rated apparent power S_n	U_n = 400 V	542 kVA
	U_n = 440 V	573 kVA
	U_n = 480 V	618 kVA
Current harmonic THDi (1)		< 5 %
Protection for upstream cables		
Pre-fuse		1000 A gG
Circuit breaker I_{therm} / I_{magn}		1000 A / 10 kA
Internal short-circuit protection		
Fuse		3x 400 A aR
DC fuse		3x 400 A
Characteristics		
Efficiency at I_n		0.98
Heat losses at I_n	Total losses	11800 W
	Control part only	1750 W
Weight	Net	1000 kg
	Gross	1050 kg
Ambient conditions		
Air flow	Power part	3480 m^3/h
	Control part	420 m^3/h
Sound pressure level		75 dB(A)
Rated short-circuit current I_{cc}	Minimum (2)	13 kA
	Maximum (3)	50 kA (100 ms)
Cable cross section		
Mains connection (4)	Typical cable	4x (3x 185 mm²) or 5x (3x 120 mm²)
	Max. cable cross section	5x (3x 185 mm²)

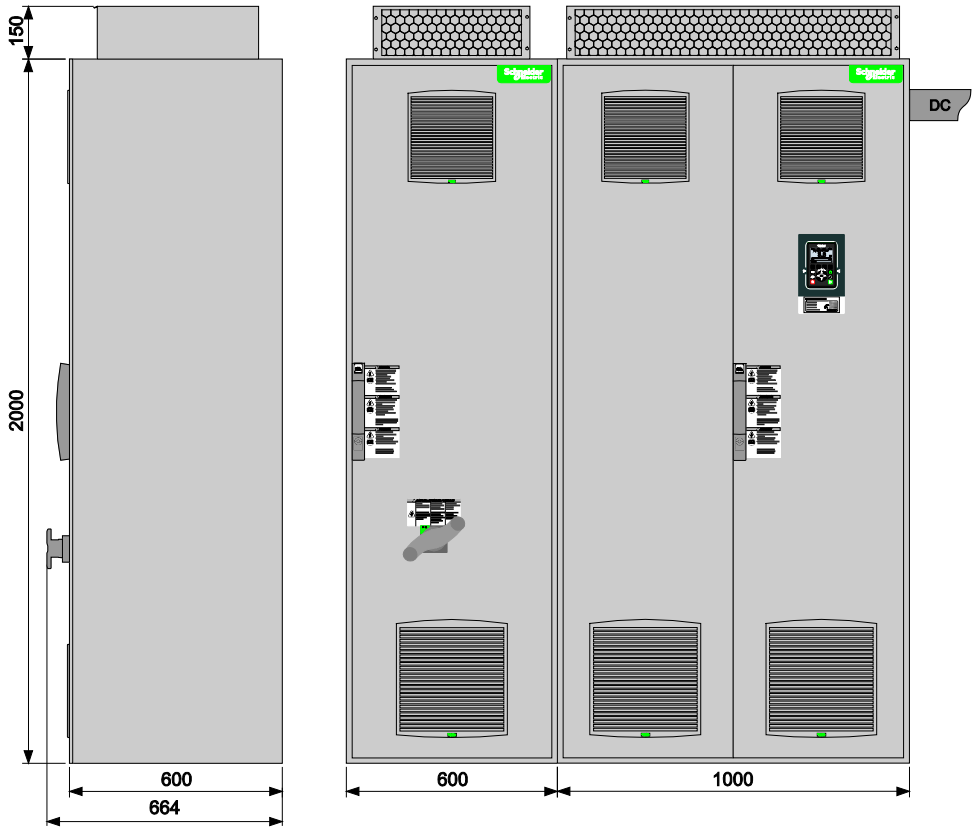
(1) For details see table under chapter "Mains Current Harmonics / Mains Voltage Distortion", page 80.

(2) Minimum mains short-circuit current

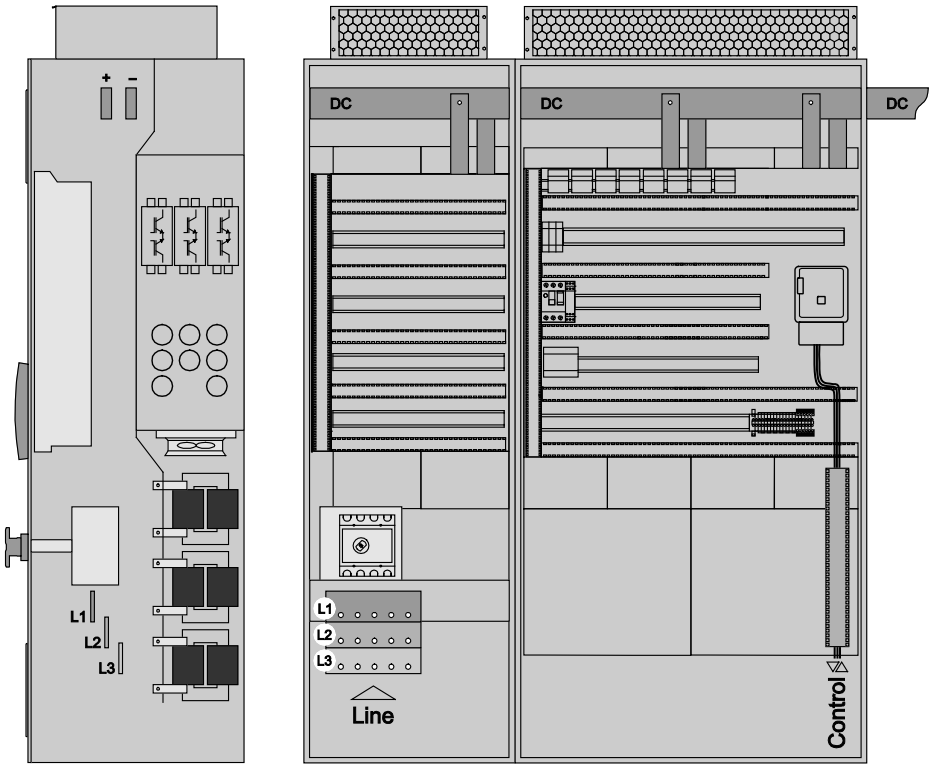
(3) Permitted short-circuit current when the specified pre-fuse or circuit breaker is installed

(4) You will find further information at chapter "Mains Connection ", page 79.

Dimensions IP23 for Size 3ma



Interior View IP23 for Size 3ma



Technical Data ATV992C63●4X1

Type		ATV992C63●4X1
Nominal data		
DC output power P_{nDC}	U_n = 400 V	700 kW
	U_n = 440 V	740 kW
	U_n = 480 V	800 kW
DC output current I_{nDC}	U_n = 400 V	1180 A
	U_n = 440 V	1140 A
	U_n = 480 V	1140 A
Maximum current I_{MAX}	U_n = 400 V	1416 A
for 60 s per 10 minutes	U_n = 440 V	1368 A
	U_n = 480 V	1368 A
Input		
Rated input current I_{in}	U_n = 400 V	1048 A
	U_n = 440 V	1007 A
	U_n = 480 V	1000 A
Rated apparent power S_n	U_n = 400 V	723 kVA
	U_n = 440 V	764 kVA
	U_n = 480 V	824 kVA
Current harmonic THDi (1)		< 5 %
Protection for upstream cables		
Pre-fuse		1250 A gG
Circuit breaker I_{therm} / I_{magn}		1250 A / 12 kA
Internal short-circuit protection		
Fuse		4x 400 A aR
DC fuse		4x 400 A
Characteristics		
Efficiency at I_n		0.98
Heat losses at I_n	Total losses	15700 W
	Control part only	2400 W
Weight	Net	1200 kg
	Gross	1280 kg
Ambient conditions		
Air flow	Power part	4640 m^3/h
	Control part	560 m^3/h
Sound pressure level		77 dB(A)
Rated short-circuit current I_{cc}	Minimum (2)	17 kA
	Maximum (3)	50 kA (100 ms)
Cable cross section		
Mains connection (4)	Typical cable	4x (3x 240 mm²) or 5x (3x 185 mm²)
	Max. cable cross section	5x (3x 240 mm²)

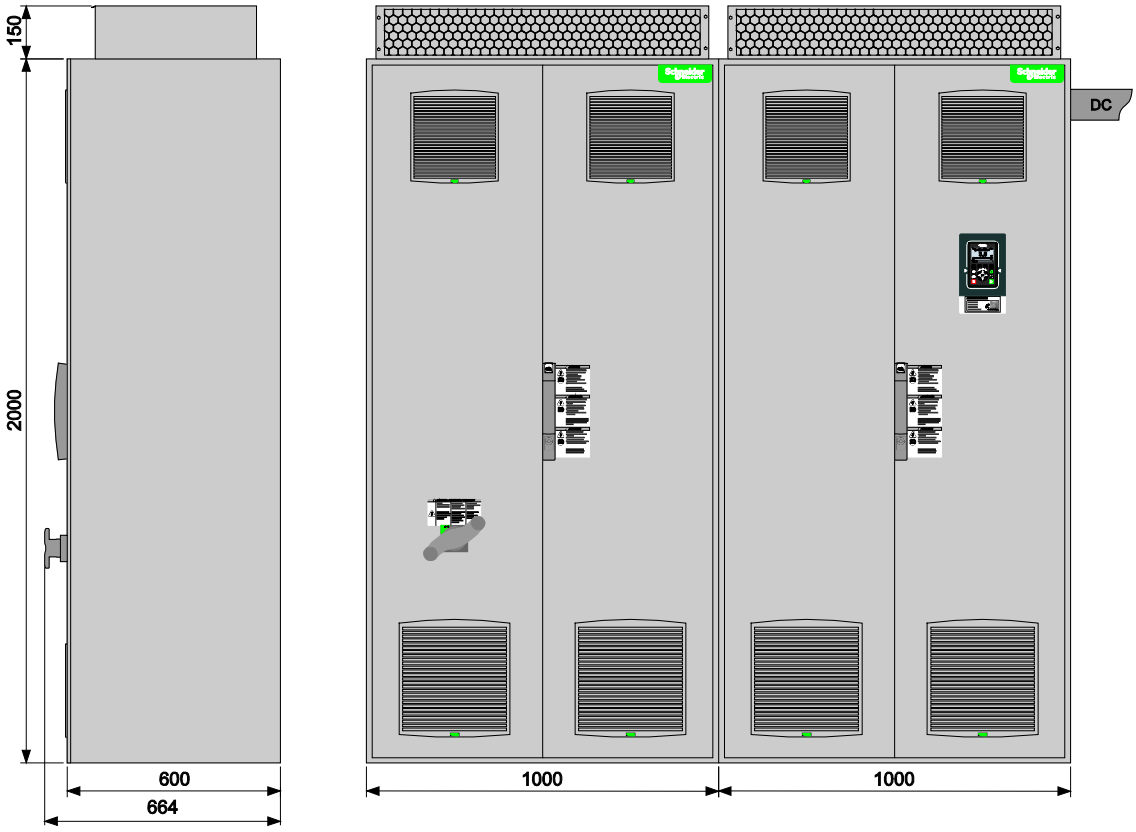
(1) For details see table under chapter "Mains Current Harmonics / Mains Voltage Distortion", page 80.

(2) Minimum mains short-circuit current

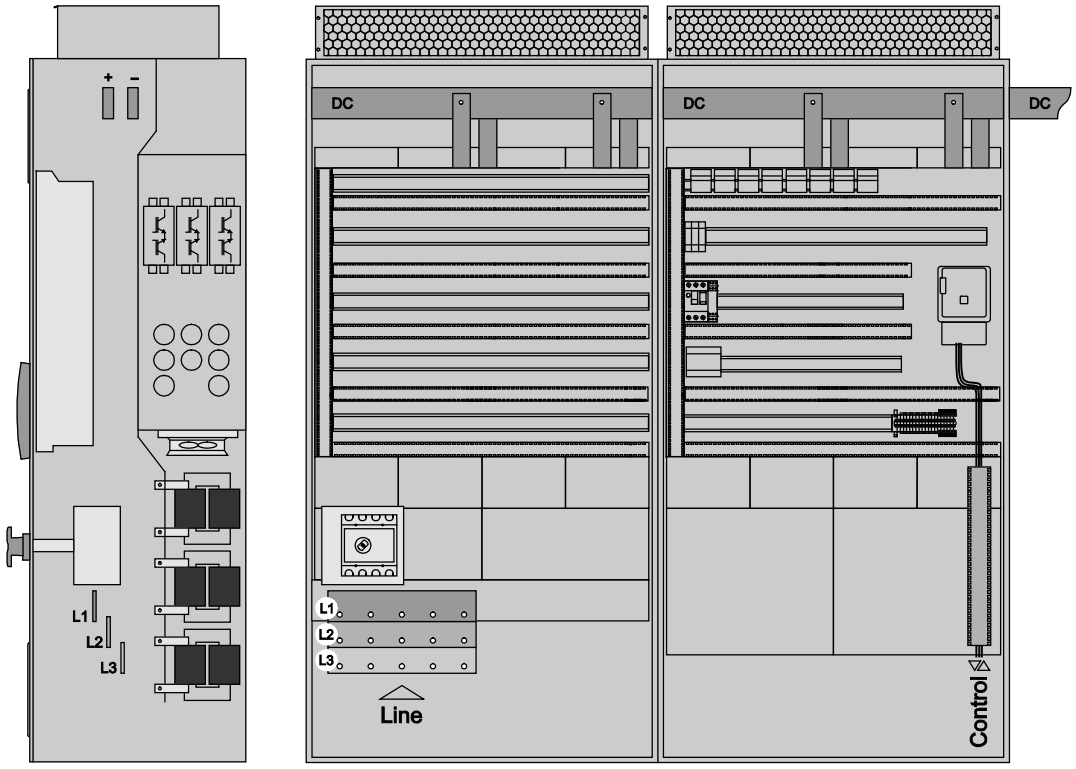
(3) Permitted short-circuit current when the specified pre-fuse or circuit breaker is installed

(4) You will find further information at chapter "Mains Connection ", page 79.

Dimensions IP23 for Size 4ma



Interior View IP23 for Size 4ma



Technical Data ATV992C80●4X1

Type		ATV992C80●4X1
Nominal data		
DC output power P_{nDC}	U_n = 400 V	875 kW
	U_n = 440 V	925 kW
	U_n = 480 V	1000 kW
DC output current I_{nDC}	U_n = 400 V	1475 A
	U_n = 440 V	1425 A
	U_n = 480 V	1425 A
Maximum current I_{MAX}	U_n = 400 V	1770 A
for 60 s per 10 minutes	U_n = 440 V	1710 A
	U_n = 480 V	1710 A
Input		
Rated input current I_{in}	U_n = 400 V	1310 A
	U_n = 440 V	1259 A
	U_n = 480 V	1248 A
Rated apparent power S_n	U_n = 400 V	904 kVA
	U_n = 440 V	955 kVA
	U_n = 480 V	1031 kVA
Current harmonic THDi (1)		< 5 %
Protection for upstream cables		
Pre-fuse		1600 A gG
Circuit breaker I_{therm} / I_{magn}		1600 A / 16 kA
Internal short-circuit protection		
Fuse		5x 400 A aR
DC fuse		5x 400 A
Characteristics		
Efficiency at I_n		0.98
Heat losses at I_n	Total losses	19700 W
	Control part only	3000 W
Weight	Net	1650 kg
	Gross	1750 kg
Ambient conditions		
Air flow	Power part	5800 m^3/h
	Control part	700 m^3/h
Sound pressure level		78 dB(A)
Rated short-circuit current I_{cc}	Minimum (2)	20 kA
	Maximum (3)	50 kA (100 ms)
Cable cross section		
Mains connection (4)	Typical cable	5x (3x 240 mm²) or 6x (3x 185 mm²)
	Max. cable cross section	6x (3x 240 mm²)

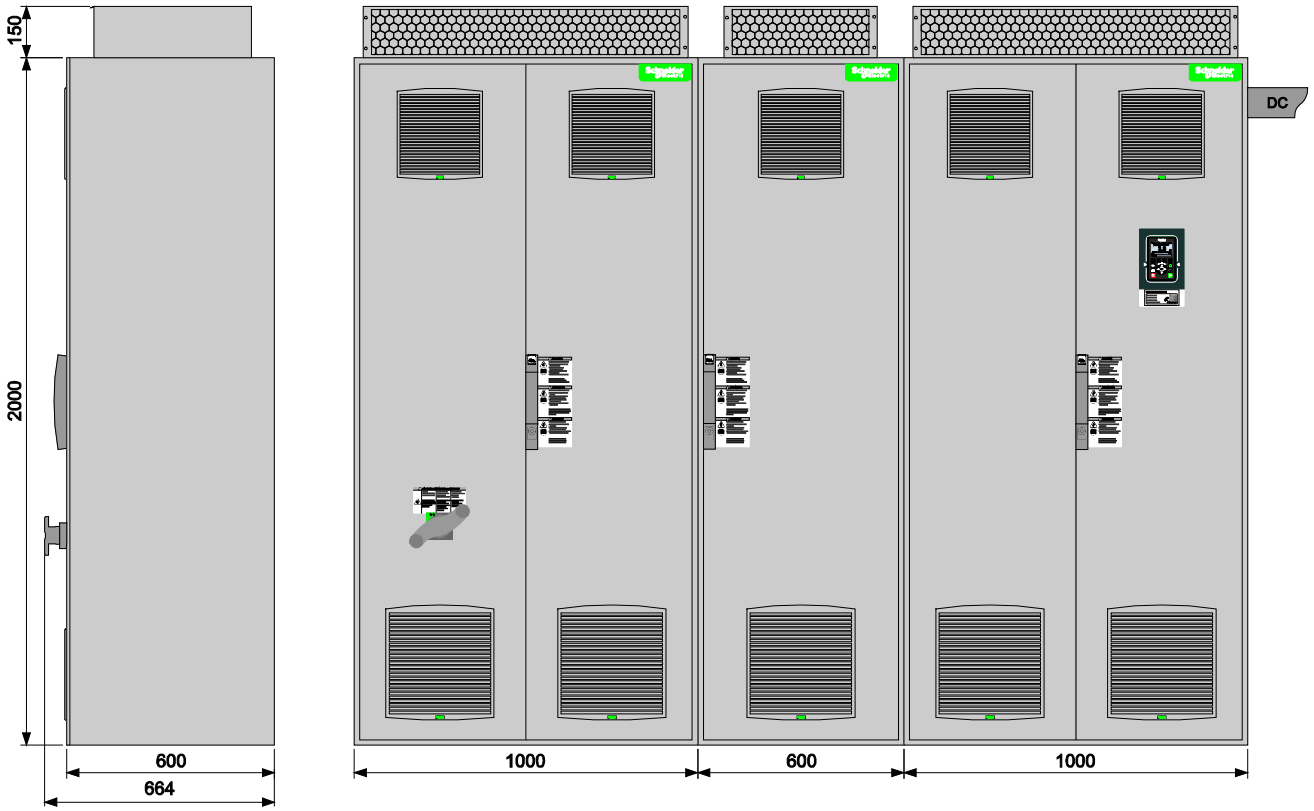
(1) For details see table under chapter "Mains Current Harmonics / Mains Voltage Distortion", page 80.

(2) Minimum mains short-circuit current

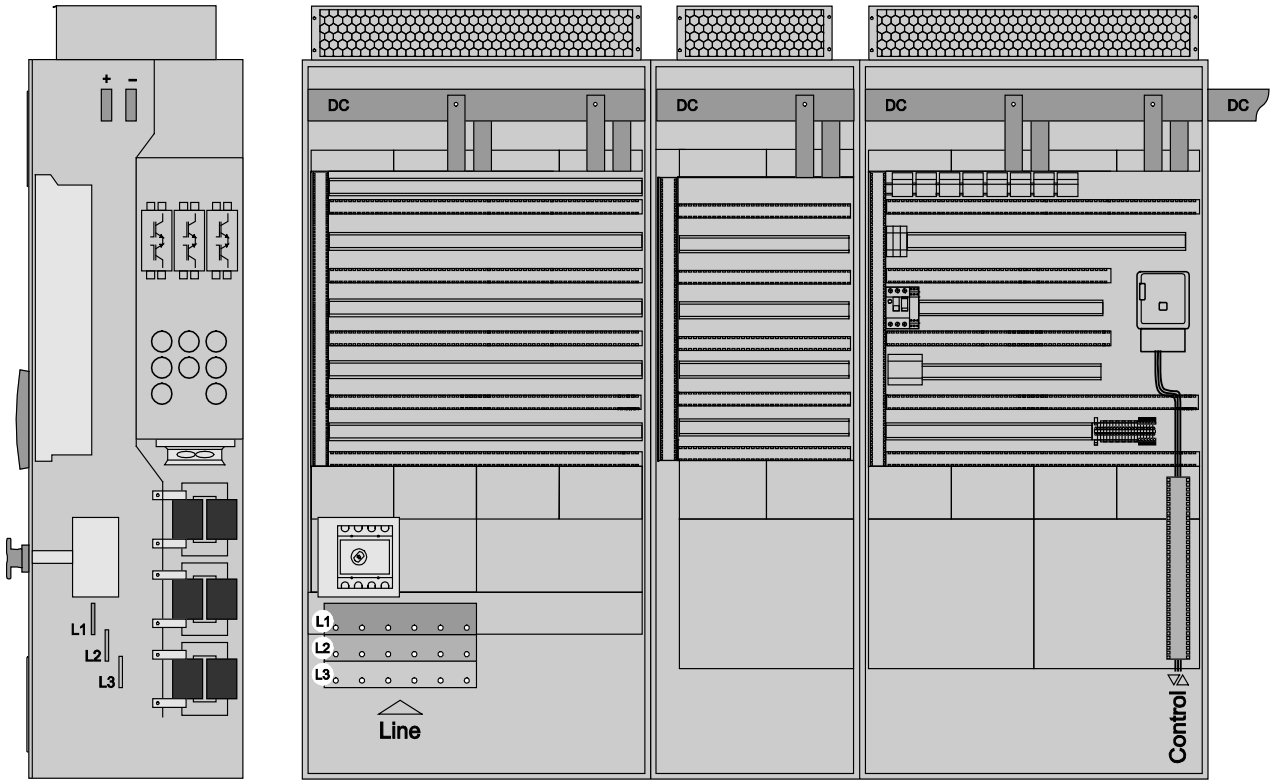
(3) Permitted short-circuit current when the specified pre-fuse or circuit breaker is installed

(4) You will find further information at chapter "Mains Connection ", page 79.

Dimensions IP23 for Size 5ma



Interior View IP23 for Size 5ma



Technical Data ATV992M10●4X1

Type		ATV992M10●4X1
Nominal data		
DC output power P_{nDC}	U_n = 400 V	1050 kW
	U_n = 440 V	1110 kW
	U_n = 480 V	1200 kW
DC output current I_{nDC}	U_n = 400 V	1770 A
	U_n = 440 V	1710 A
	U_n = 480 V	1710 A
Maximum current I_{MAX}	U_n = 400 V	2124 A
for 60 s per 10 minutes	U_n = 440 V	2052 A
	U_n = 480 V	2052 A
Input		
Rated input current I_{in}	Un = 400 V	1572 A
	Un = 440 V	1510 A
	Un = 480 V	1498 A
Rated apparent power S_n	Un = 400 V	1084 kVA
	Un = 440 V	1146 kVA
	Un = 480 V	1237 kVA
Current harmonic THDi (1)		< 5 %
Protection for upstream cables		
Pre-fuse		2000 A gG
Circuit breaker I_{therm} / I_{magn}		2000 A / 20 kA
Internal short-circuit protection		
Fuse		6x 400 A aR
DC fuse		6x 400 A
Characteristics		
Efficiency at I_n		0.98
Heat losses at I_n	Total losses	23600 W
	Control part only	3500 W
Weight	Net	1850 kg
	Gross	1950 kg
Ambient conditions		
Air flow	Power part	6960 m^3/h
	Control part	840 m^3/h
Sound pressure level		78 dB(A)
Rated short-circuit current I_{scc}	Minimum (2)	25 kA
	Maximum (3)	50 kA (100 ms)
Cable cross section		
Mains connection (4)	Typical cable	6x (3x 240 mm²) or 8x (3x 185 mm²)
	Max. cable cross section	8x (3x 240 mm²)

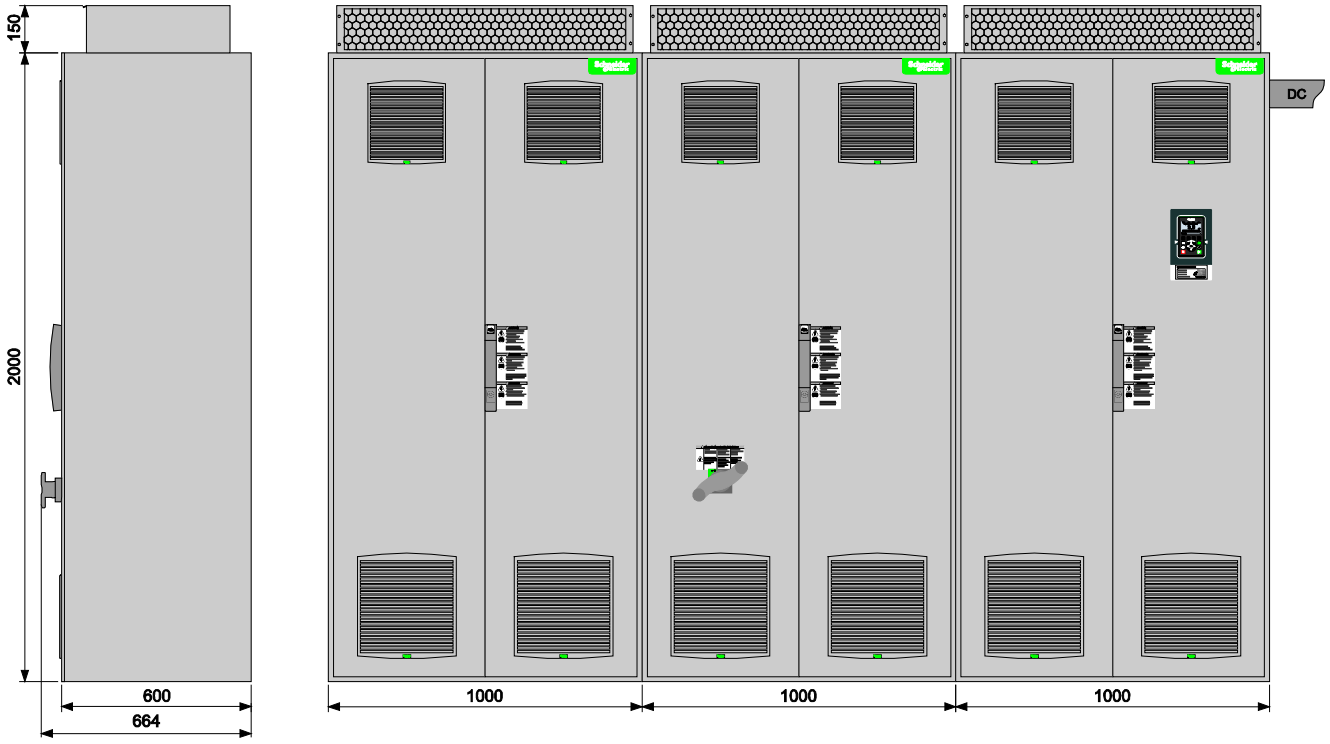
(1) For details see table under chapter "Mains Current Harmonics / Mains Voltage Distortion", page 80.

(2) Minimum mains short-circuit current

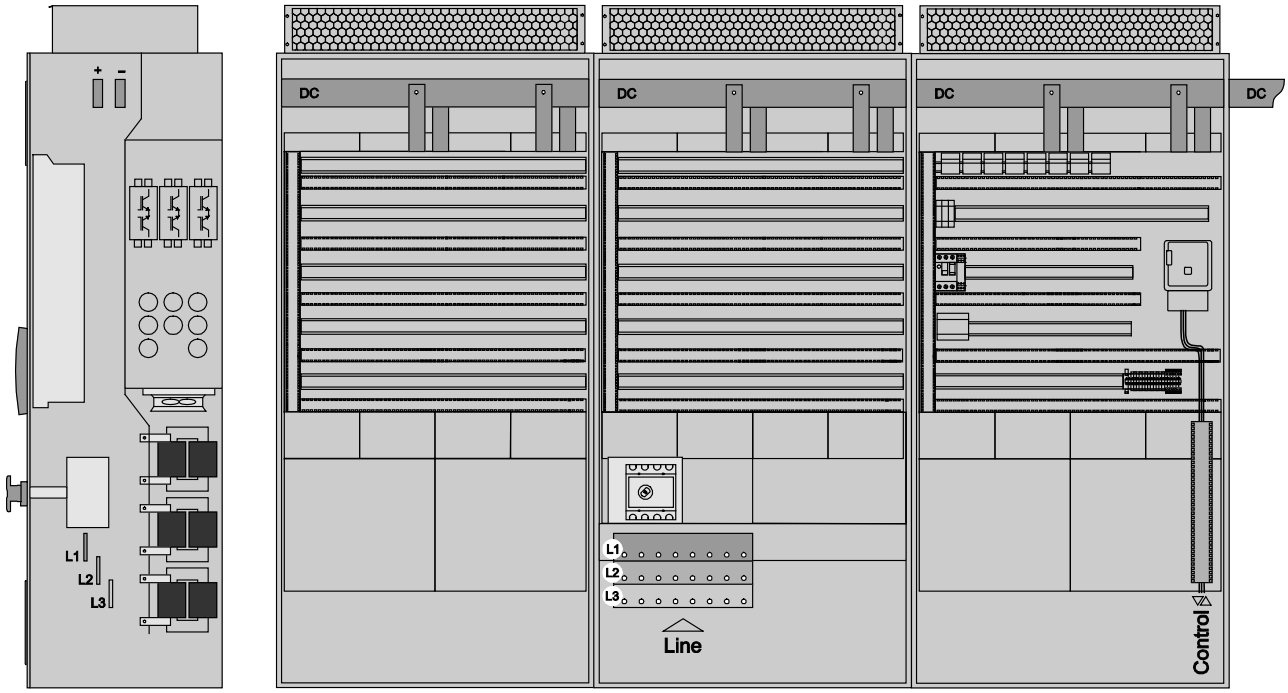
(3) Permitted short-circuit current when the specified pre-fuse or circuit breaker is installed

(4) You will find further information at chapter "Mains Connection ", page 79.

Dimensions IP23 for Size 6ma

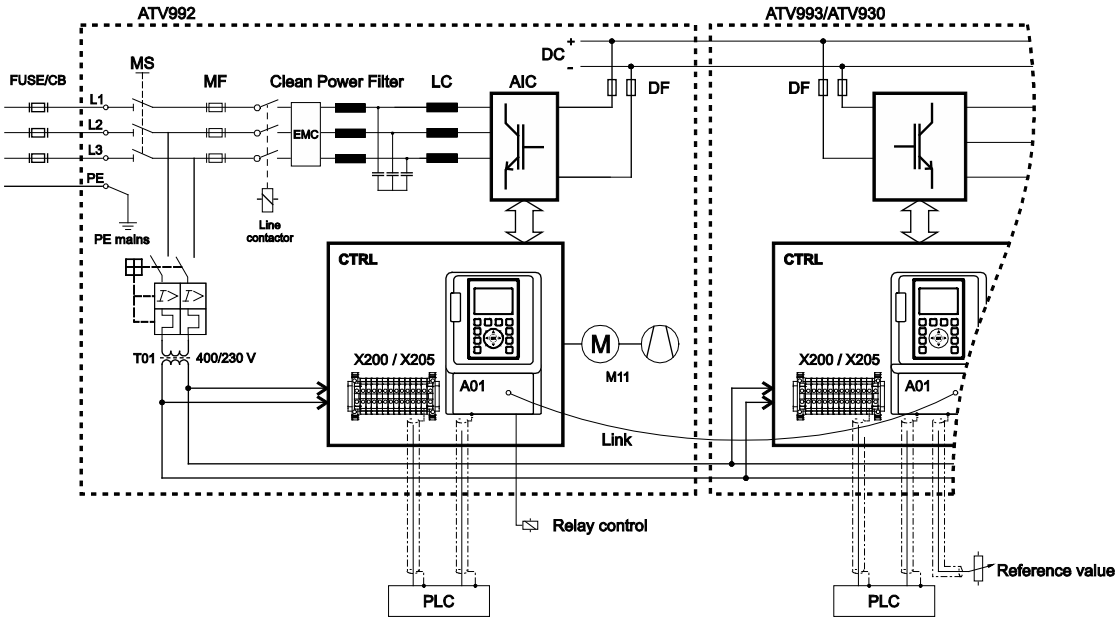


Interior View IP23 for Size 6ma



Circuit Diagram

The following presentation shows a typical wiring of a MultiDrive system starting with the supply unit.



ATV992	Altivar Process MultiDrive Systems – AFE unit
FUSE/CB	External pre-fuse or circuit breaker to protect the mains cable
MS	Built-in main switch, lockable in open position
T01	Control transformer 400 / 230 V AC for supplying the whole system
MF	aR fuses for short-circuit shut-down if the electronic protective devices do not work properly
DF	DC fuses for short-circuit shut-down if the electronic protective devices do not work properly
Clean Power Filter	Clean Power Filter with integrated EMC filter
LC	Filter choke
AIC	Active Infeed Converter module(s)
DC	Common DC link
ATV993/ATV930	Inverter unit(s)
CTRL	Control panel with control block and further control components
A01	Control terminals at the control block
Link	Signal wire PTI/PTO or Modbus for transmitting the DC voltage value
X200 / X205	Control terminals at the control panel
M11	Fan in enclosure door

Mains Connection

Dimensioning of the Power Cables

The Altivar Process MultiDrive Systems include semiconductor fuses as standard. These fuses are for the case that the electronic protective mechanisms of the system do not work. So they are a secondary protection of the system.

The Altivar Process Drive Systems help to protect themselves as well as the mains cables and the motor cables against thermal overload. The specified pre-fuses or circuit breakers (with magnetic release) must be installed upstream to protect the mains cables against short-circuit.

The recommended values for dimensioning the cable cross sections given in chapter "Technical data" are reference values for multi-core copper power cables layed in air at a maximum ambient temperature of 40°C. Observe different ambient conditions and local regulations.

Recommended types of mains cables	
	Three-phase cable with sector-shaped conductors and reduced protective conductor **NOTE:** Check whether the protective conductor complies with the requirements of IEC 61439-1.
	Three-phase cable with round conductors and reduced protective conductor. **NOTE:** Check whether the protective conductor complies with the requirements of IEC 61439-1.

NOTE: The recommended cable cross sections are given at the technical data of the respective supply unit.

⚠ WARNING

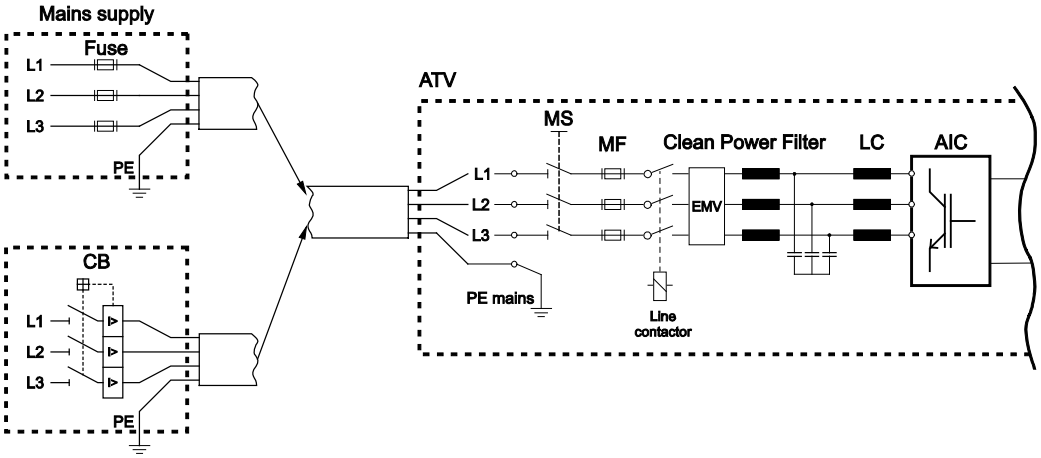
OVERLOAD DUE TO INCORRECT RATING OF MAINS SUPPLY

- Install properly rated upstream mains fuses or circuit breakers.
- When rating the upstream mains fuses and the cross sections as well as the length of the mains cables, take into account the available specified short circuit current.
- If the required short circuit is not available, increase the power of the transformer.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Overcurrent- and Short-circuit Protection

The following picture illustrates the overcurrent protection and short-circuit protection at the input side.



ATV	Altivar Process MultiDrive Systems – AFE unit
FUSE	External pre-fuse to protect the mains cable
CB	External circuit breaker to protect the mains cable (alternatively to FUSE)
MS	Built-in main switch, lockable in open position
MF	aR mains fuses for short-circuit shut-down if the electronic protective devices do not work properly
Clean Power Filter	Clean Power Filter with integrated EMC filter
LC	Filter choke
AIC	Active Infeed Converter module(s)

The Die Altivar Process supply unit includes semiconductor fuses as standard. These fuses are for the case that the electronic protective mechanisms of the system do not work. So they are a secondary protection of the inverter.

NOTE: If the mains fuses blow, the system already has a primary damage. Therefore, exchanging the blown fuses and switching the system on again without any check is not effective.

NOTE: The overcurrent protection is given at the technical data of the respective supply unit.

Mains Current Harmonics / Mains Voltage Distortion

The ATV992 AFE units of the MultiDrive Systems are equipped with an active mains supply module. So the typical harmonic currents of diode rectifiers do not occur anymore.

The new 3-level technology inside the ATV992 MultiDrive System reaches a total harmonic distortion THD(i) of around 2 % and thus fulfills the requirements according to IEEE 519 of THD(i) < 5 % also in case of distorted mains. This low total harmonic distortion THD(i) is reached during mains supply operation as well as during regenerating operation.

Cos Phi ≈ 1 is reached in each load situation (from 30 % P_n) and additionally helps to reduce the load of the mains.

This table represents typical values of the individual current harmonics at operation with the ATV992 MultiDrive System.

Operating mode	Current harmonics in % (1)																	
	H1	H5	H7	H11	H13	H17	H19	H23	H25	H29	H31	H35	H37	H41	H43	H47	H49	THD
Motor	**100**	1.29	1.05	0.38	0.21	0.20	0.19	0.34	0.19	0.11	0.09	0.15	0.12	0.19	0.18	0.07	0.04	**2.2**
Generator	**100**	1.26	0.78	0.39	0.33	0.69	0.60	0.28	0.40	0.22	0.22	0.16	0.20	0.18	0.09	0.04	0.04	**2.1**
(1) Values are valid for operation at nominal load and sinusoidal mains voltage.																		

NOTE: The actual values for the respective mains situation can be calculated on request.

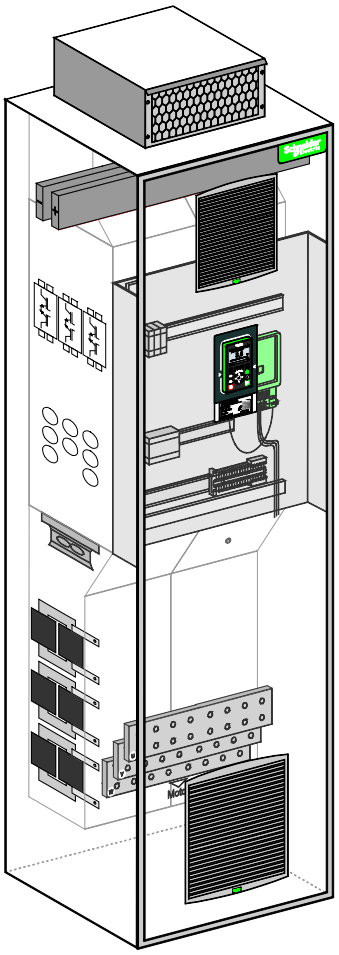
Chapter 6
ATV993●●●●4X1

What Is in This Chapter?

This chapter contains the following topics:

Description

ATV993 – MultiDrive Inverter Unit



Power components:

- Mains connection via DC bus
- DC fuses
- Inverter module(s)
- dv/dt filter choke(s)
- Terminals for motor connection

Design:

- Floor-standing enclosure
- Integrated control panel
- Protection degree IP23
- Forced cooling
- -10...+50 °C
  (below 0 °C with additional enclosure heating,
  above +40 °C with derating)
- Graphical operating panel in the enclosure door

Specification

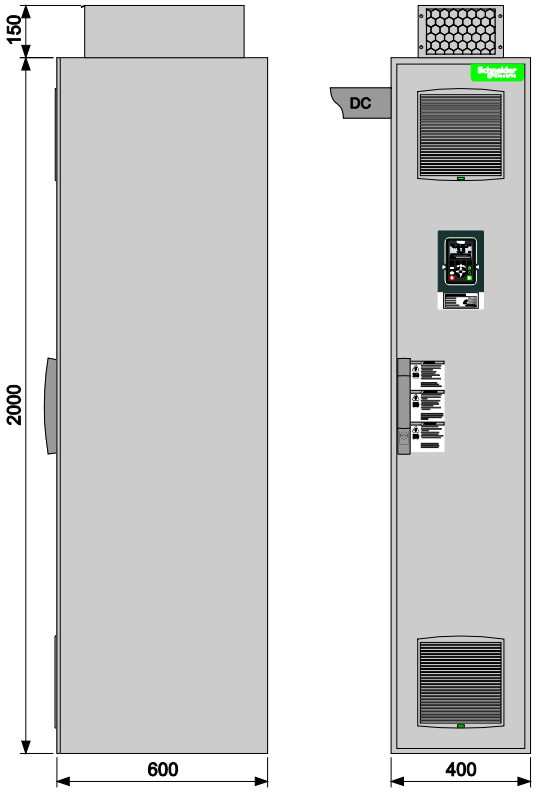
Technical Data ATV993C11●4X1

Type		ATV993C11●4X1	
Nominal data		**Normal Duty ND**	**Heavy Duty HD (1)**
Typical motor rating P_n	U_n = 400 V	110 kW	90 kW
	U_n = 440 V	110 kW	90 kW
	U_n = 480 V	150 hp	125 hp
Rated output current I_n		211 A	173 A
Maximum current I_{MAX}	for 60 s per 10 minutes	253 A	260 A
Input DC			
Rated input current DC	U_n = 400 V	201 A / 242 A	167 A / 250 A
I_{in} / I_{in_MAX}	U_n = 440 V	183 A / 220 A	151 A / 227 A
	U_n = 480 V	171 A / 205 A	144 A / 216 A
Rated input power DC	U_n = 400 V	120 kW / 144 kW	99 kW / 148 kW
P_n / P_{n_MAX}	U_n = 440 V	120 kW / 144 kW	99 kW / 148 kW
	U_n = 480 V	122 kW / 146 kW	102 kW / 154 kW
Internal short-circuit protection			
DC fuse		400 A	
Characteristics			
Efficiency at I_n		0.985	
Heat losses at I_n	Total losses	2000 W	1700 W
	Control part only	300 W	270 W
Weight	Net	250 kg	
	Gross	280 kg	
Ambient conditions			
Air flow	Power part	580 m^3/h	
	Control part	140 m^3/h	
Sound pressure level		69 dB(A)	
Cable cross section			
Motor connection (2)	Typical cable	1x (3x 120 mm^2) or 2x (3x 50 mm^2)	1x (3x 95 mm^2)
	Max. cable cross section	2x (3x 185 mm^2)	2x (3x 185 mm^2)

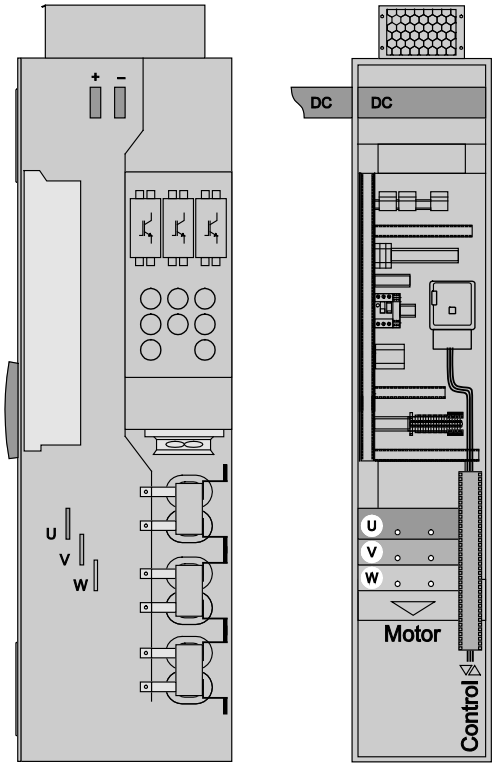
(1) For Heavy Duty HD operation parameter [Dual Rating] drt has to be set to [High rating] HiGH (see programming manual *NHA80757*).

(2) You will find further information at chapter "Motor Connection", page 113.

Dimensions IP23 for Size 1mp



Interior View IP23 for Size 1mp



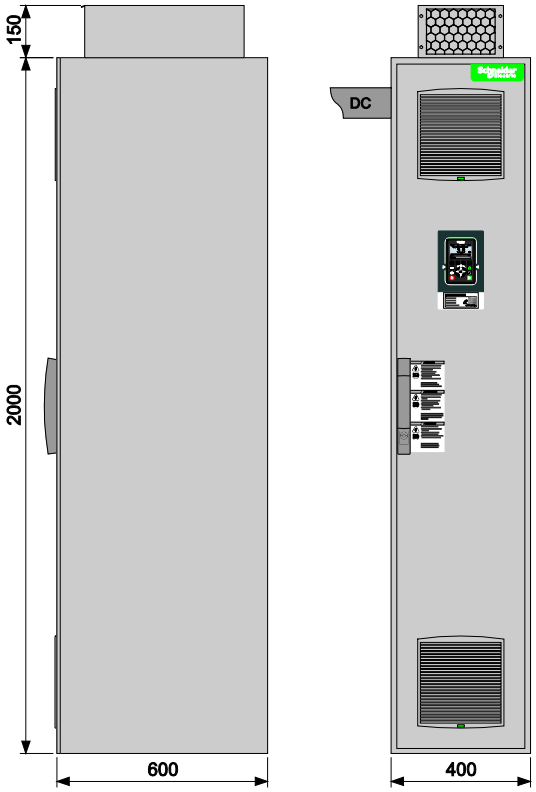
Technical Data ATV993C13●4X1

Type		ATV993C13●4X1	
Nominal data		**Normal Duty ND**	**Heavy Duty HD (1)**
Typical motor rating P_n	U_n = 400 V	132 kW	110 kW
	U_n = 440 V	132 kW	110 kW
	U_n = 480 V	200 hp	150 hp
Rated output current I_n		250 A	211 A
Maximum current I_{MAX}	for 60 s per 10 minutes	300 A	317 A
Input DC			
Rated input current DC	U_n = 400 V	240 A / 289 A	201 A / 302 A
I_{in} / I_{in_MAX}	U_n = 440 V	218 A / 262 A	183 A / 274 A
	U_n = 480 V	226 A / 272 A	171 A / 256 A
Rated input power DC	U_n = 400 V	143 kW / 171 kW	120 kW / 180 kW
P_n / P_{n_MAX}	U_n = 440 V	143 kW / 171 kW	120 kW / 180 kW
	U_n = 480 V	161 kW / 193 kW	122 kW / 182 kW
Internal short-circuit protection			
DC fuse		400 A	
Characteristics			
Efficiency at I_n		0.985	
Heat losses at I_n	Total losses	2400 W	2000 W
	Control part only	350 W	300 W
Weight	Net	250 kg	
	Gross	280 kg	
Ambient conditions			
Air flow	Power part	580 m^3/h	
	Control part	140 m^3/h	
Sound pressure level		69 dB(A)	
Cable cross section			
Motor connection (2)	Typical cable	1x (3x 150 mm²) or 2x (3x 70 mm²)	1x (3x 120 mm²) or 2x (3x 50 mm²)
	Max. cable cross section	2x (3x 185 mm²)	2x (3x 185 mm²)

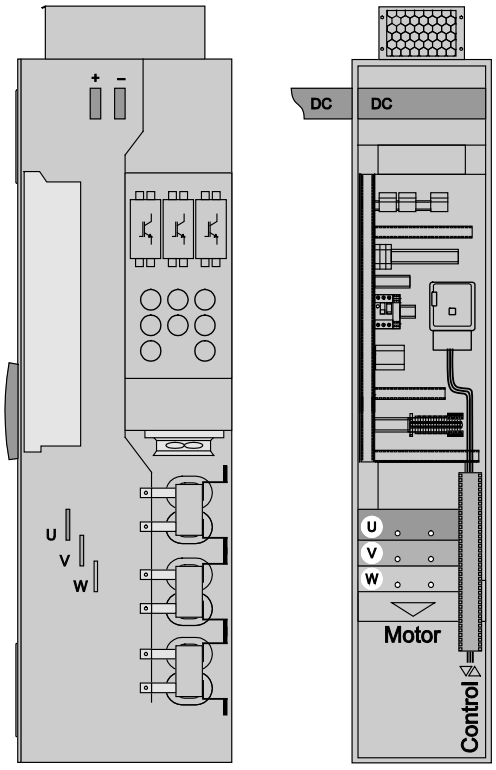
(1) For Heavy Duty HD operation parameter [Dual Rating] drt has to be set to [High rating] HiGH (see programming manual *NHA80757*).

(2) You will find further information at chapter "Motor Connection", page 113.

Dimensions IP23 for Size 1mp



Interior View IP23 for Size 1mp



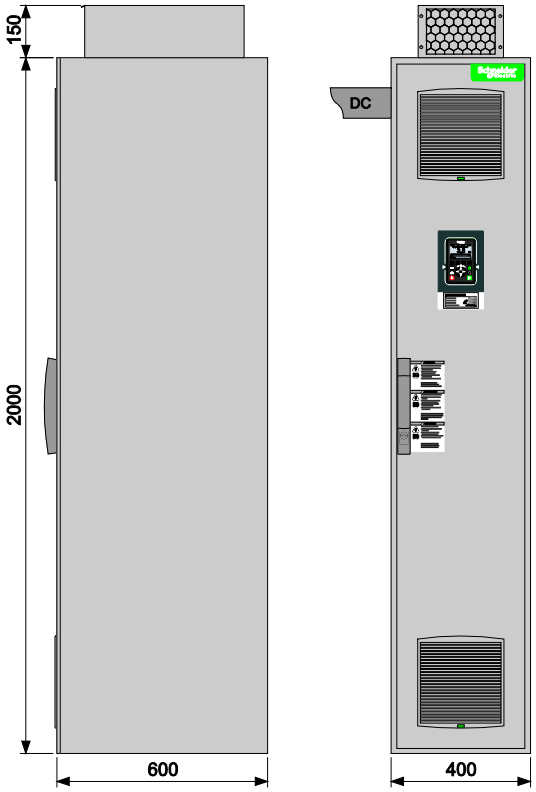
Technical Data ATV993C16●4X1

Type		ATV993C16●4X1	
Nominal data		**Normal Duty ND**	**Heavy Duty HD (1)**
Typical motor rating P_n	U_n = 400 V	160 kW	132 kW
	U_n = 440 V	160 kW	132 kW
	U_n = 480 V	250 hp	200 hp
Rated output current I_n		302 A	250 A
Maximum current I_{MAX}	for 60 s per 10 minutes	362 A	375 A
Input DC			
Rated input current DC	U_n = 400 V	290 A / 348 A	240 A / 361 A
I_{in} / I_{in_MAX}	U_n = 440 V	263 A / 316 A	218 A / 328 A
	U_n = 480 V	281 A / 338 A	226 A / 339 A
Rated input power DC	U_n = 400 V	172 kW / 207 kW	143 kW / 214 kW
P_n / P_{n_MAX}	U_n = 440 V	172 kW / 207 kW	143 kW / 214 kW
	U_n = 480 V	200 kW / 240 kW	161 kW / 242 kW
Internal short-circuit protection			
DC fuse		400 A	
Characteristics			
Efficiency at I_n		0.985	
Heat losses at I_n	Total losses	2900 W	2400 W
	Control part only	400 W	350 W
Weight	Net	250 kg	
	Gross	280 kg	
Ambient conditions			
Air flow	Power part	580 m^3/h	
	Control part	140 m^3/h	
Sound pressure level		69 dB(A)	
Cable cross section			
Motor connection (2)	Typical cable	1x (3x 185 mm²) or 2x (3x 95 mm²)	1x (3x 150 mm²) or 2x (3x 70 mm²)
	Max. cable cross section	2x (3x 185 mm²)	2x (3x 185 mm²)

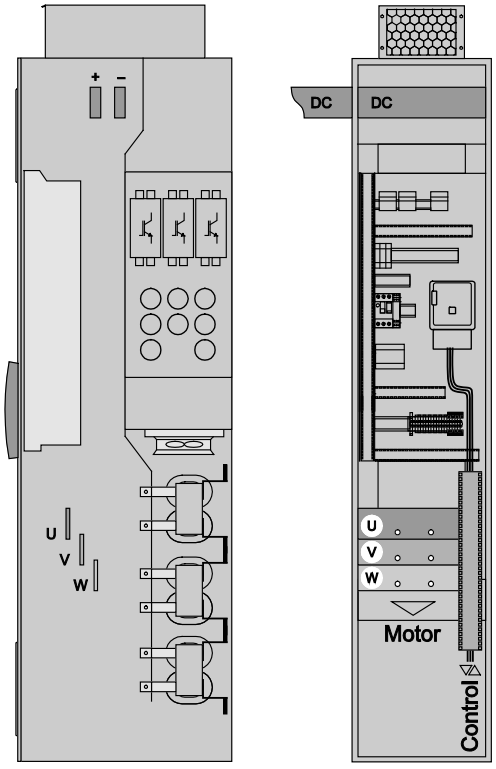
(1) For Heavy Duty HD operation parameter [Dual Rating] drt has to be set to [High rating] HiGH (see programming manual *NHA80757*).

(2) You will find further information at chapter "Motor Connection", page 113.

Dimensions IP23 for Size 1mp



Interior View IP23 for Size 1mp



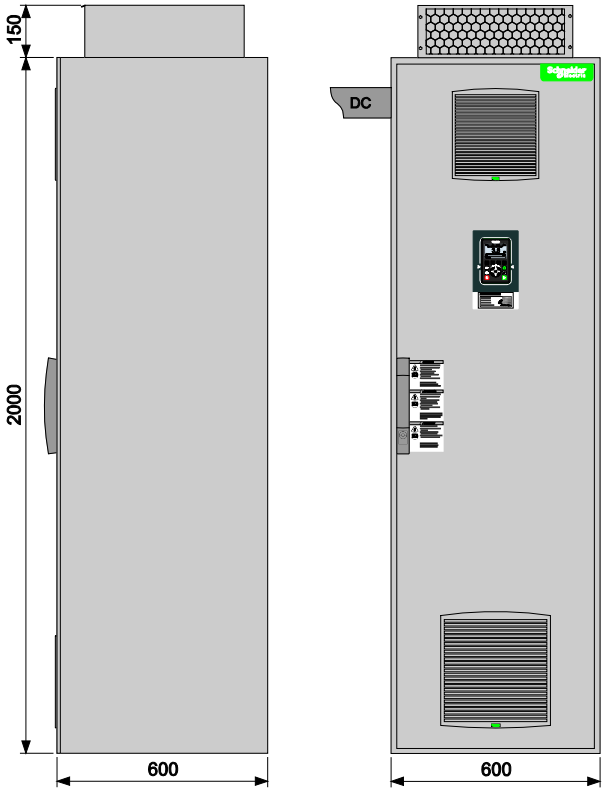
Technical Data ATV993C20●4X1

Type		ATV993C20●4X1	
Nominal data		**Normal Duty ND**	**Heavy Duty HD (1)**
Typical motor rating P_n	U_n = 400 V	200 kW	160 kW
	U_n = 440 V	200 kW	160 kW
	U_n = 480 V	300 hp	250 hp
Rated output current I_n		370 A	302 A
Maximum current I_{MAX}	for 60 s per 10 minutes	444 A	453 A
Input DC			
Rated input current DC	U_n = 400 V	361 A / 433 A	290 A / 435 A
I_{in} / I_{in_MAX}	U_n = 440 V	327 A / 393 A	263 A / 395 A
	U_n = 480 V	336 A / 403 A	281 A / 422 A
Rated input power DC	U_n = 400 V	214 kW / 257 kW	172 kW / 258 kW
P_n / P_{n_MAX}	U_n = 440 V	214 kW / 257 kW	172 kW / 258 kW
	U_n = 480 V	239 kW / 287 kW	200 kW / 301 kW
Internal short-circuit protection			
DC fuse		2x 400 A	
Characteristics			
Efficiency at I_n		0.985	
Heat losses at I_n	Total losses	3600 W	2900 W
	Control part only	500 W	400 W
Weight	Net	300 kg	
	Gross	345 kg	
Ambient conditions			
Air flow	Power part	1160 m^3/h	
	Control part	140 m^3/h	
Sound pressure level		70 dB(A)	
Cable cross section			
Motor connection (2)	Typical cable	2x (3x 120 mm²) or 3x (3x 70 mm²)	1x (3x 185 mm²) or 2x (3x 95 mm²)
	Max. cable cross section	4x (3x 185 mm²)	4x (3x 185 mm²)

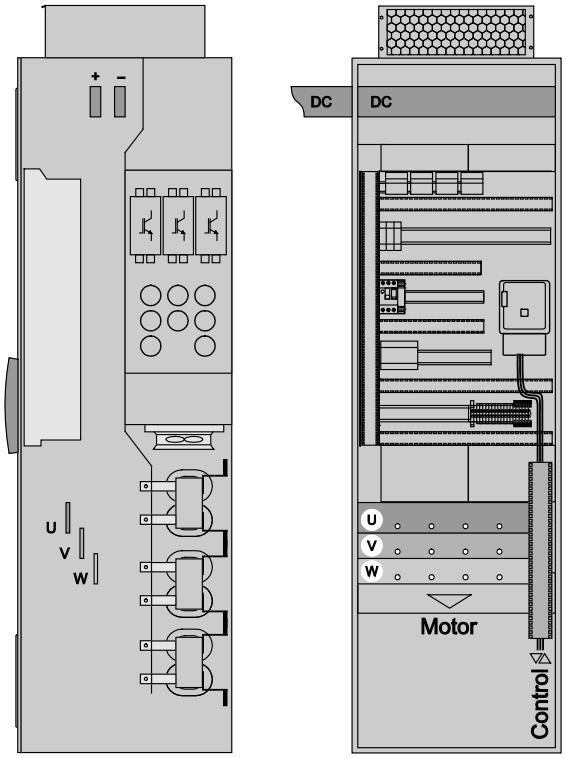
(1) For Heavy Duty HD operation parameter [Dual Rating] drt has to be set to [High rating] HiGH (see programming manual *NHA80757*).

(2) You will find further information at chapter "Motor Connection", page 113.

Dimensions IP23 for Size 2mp



Interior View IP23 for Size 2mp



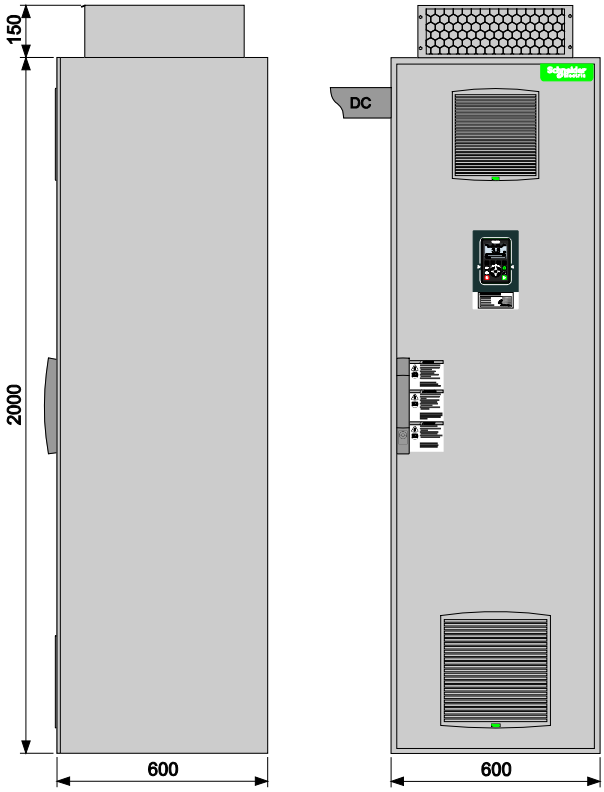
Technical Data ATV993C25●4X1

Type		ATV993C25●4X1	
Nominal data		**Normal Duty ND**	**Heavy Duty HD (1)**
Typical motor rating P_n	U_n = 400 V	250 kW	200 kW
	U_n = 440 V	250 kW	200 kW
	U_n = 480 V	400 hp	300 hp
Rated output current I_n		477 A	370 A
Maximum current I_{MAX}	for 60 s per 10 minutes	572 A	555 A
Input DC			
Rated input current DC	U_n = 400 V	448 A / 538 A	361 A / 541 A
I_{in} / I_{in_MAX}	U_n = 440 V	407 A / 489 A	327 A / 491 A
	U_n = 480 V	446 A / 535 A	336 A / 504 A
Rated input power DC	U_n = 400 V	266 kW / 320 kW	214 kW / 321 kW
P_n / P_{n_MAX}	U_n = 440 V	266 kW / 320 kW	214 kW / 321 kW
	U_n = 480 V	317 kW / 381 kW	239 kW / 359 kW
Internal short-circuit protection			
DC fuse		2x 400 A	
Characteristics			
Efficiency at I_n		0.985	
Heat losses at I_n	Total losses	4500 W	3600 W
	Control part only	600 W	450 W
Weight	Net	300 kg	
	Gross	345 kg	
Ambient conditions			
Air flow	Power part	1160 m^3/h	
	Control part	140 m^3/h	
Sound pressure level		70 dB(A)	
Cable cross section			
Motor connection (2)	Typical cable	2x (3x 150 mm²) or 3x (3x 95 mm²)	2x (3x 120 mm²) or 3x (3x 70 mm²)
	Max. cable cross section	4x (3x 185 mm²)	4x (3x 185 mm²)

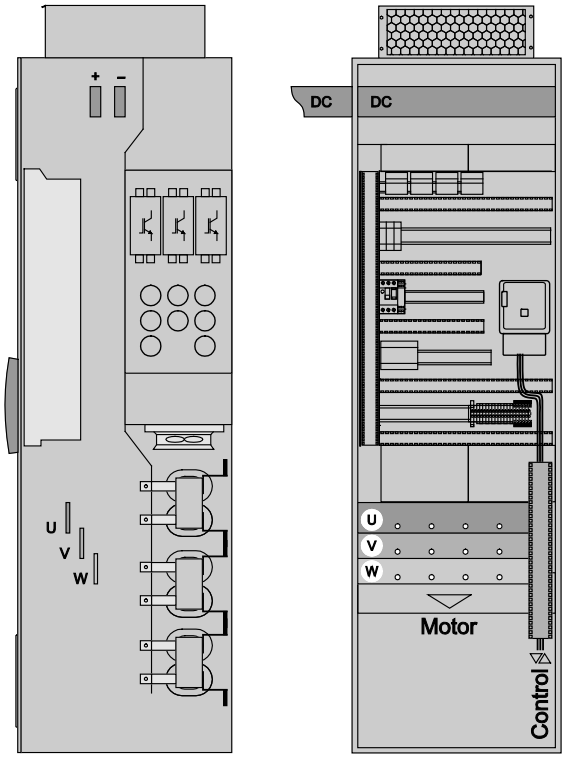
(1) For Heavy Duty HD operation parameter [Dual Rating] drt has to be set to [High rating] HiGH (see programming manual *NHA80757*).

(2) You will find further information at chapter "Motor Connection", page 113.

Dimensions IP23 for Size 2mp



Interior View IP23 for Size 2mp



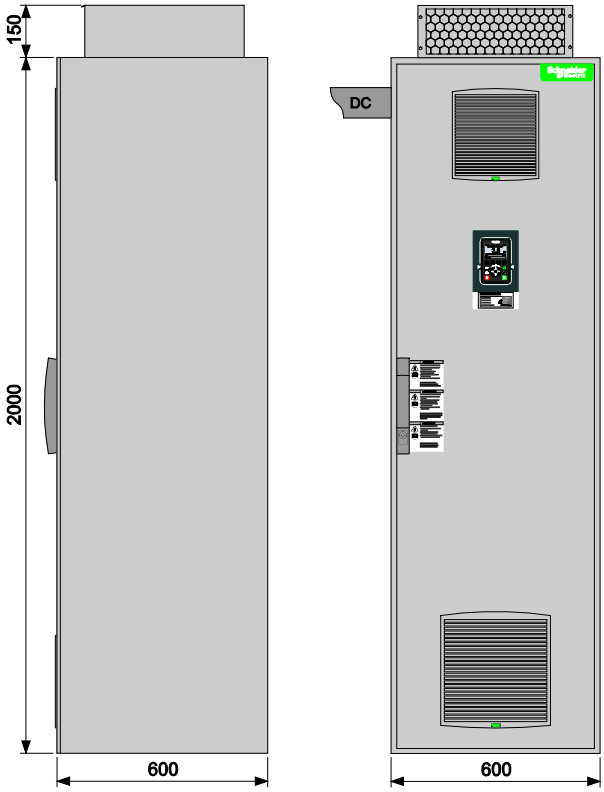
Technical Data ATV993C31●4X1

Type		ATV993C31●4X1	
Nominal data		**Normal Duty ND**	**Heavy Duty HD (1)**
Typical motor rating P_n	U_n = 400 V	315 kW	250 kW
	U_n = 440 V	315 kW	250 kW
	U_n = 480 V	500 hp	400 hp
Rated output current I_n		590 A	477 A
Maximum current I_{MAX}	for 60 s per 10 minutes	708 A	716 A
Input DC			
Rated input current DC	U_n = 400 V	565 A / 678 A	448 A / 672 A
I_{in} / I_{in_MAX}	U_n = 440 V	513 A / 616 A	407 A / 611 A
	U_n = 480 V	557 A / 668 A	446 A / 668 A
Rated input power DC	U_n = 400 V	336 kW / 403 kW	266 kW / 399 kW
P_n / P_{n_MAX}	U_n = 440 V	336 kW / 403 kW	266 kW / 399 kW
	U_n = 480 V	397 kW / 476 kW	317 kW / 476 kW
Internal short-circuit protection			
DC fuse		2x 400 A	
Characteristics			
Efficiency at I_n		0.985	
Heat losses at I_n	Total losses	5700 W	4500 W
	Control part only	700 W	550 W
Weight	Net	300 kg	
	Gross	345 kg	
Ambient conditions			
Air flow	Power part	1160 m^3/h	
	Control part	140 m^3/h	
Sound pressure level		70 dB(A)	
Cable cross section			
Motor connection (2)	Typical cable	2x (3x 185 mm^2) or 3x (3x 120 mm^2)	2x (3x 150 mm^2) or 3x (3x 120 mm^2)
	Max. cable cross section	4x (3x 185 mm^2)	4x (3x 185 mm^2)

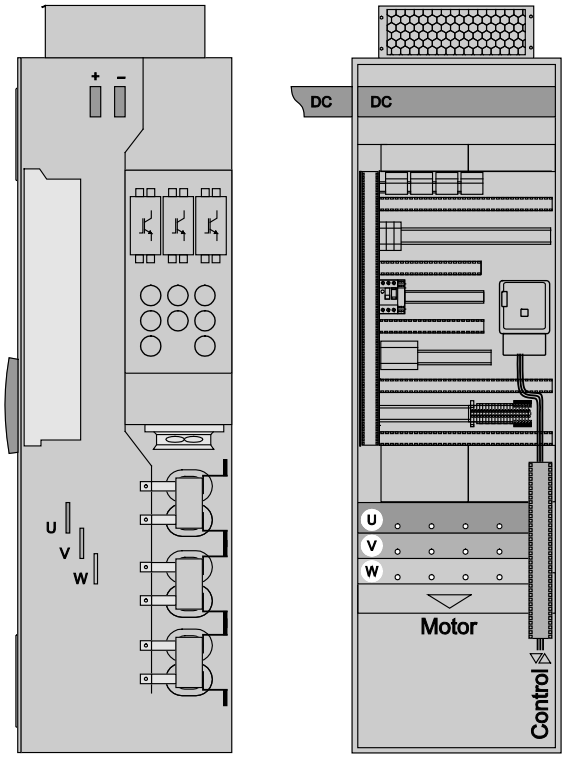
(1) For Heavy Duty HD operation parameter [Dual Rating] drt has to be set to [High rating] HiGH (see programming manual *NHA80757*).

(2) You will find further information at chapter "Motor Connection", page 113.

Dimensions IP23 for Size 2mp



Interior View IP23 for Size 2mp



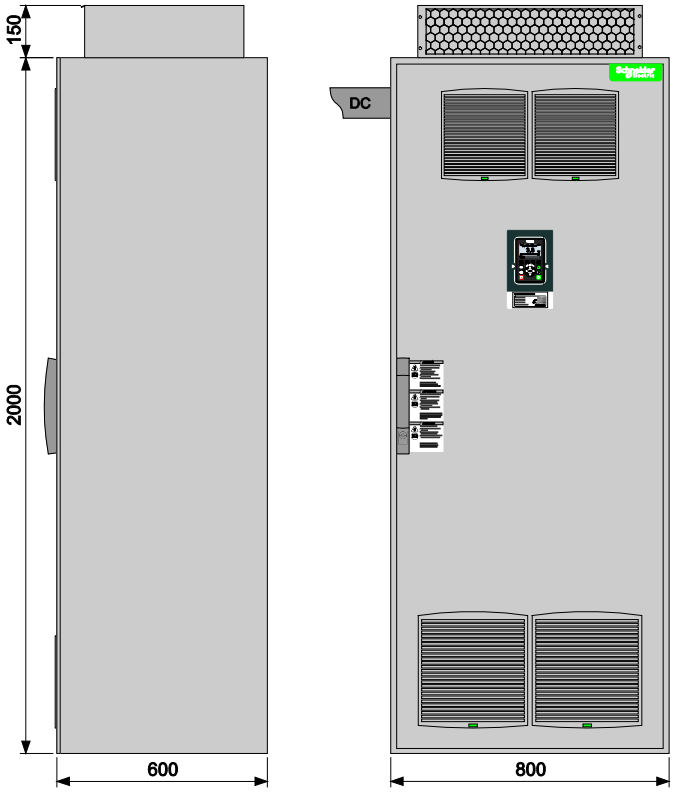
Technical Data ATV993C35●4X1

Type		ATV993C35●4X1	
Nominal data		**Normal Duty ND**	**Heavy Duty HD (1)**
Typical motor rating P_n	U_n = 400 V	355 kW	280 kW
	U_n = 440 V	355 kW	280 kW
	U_n = 480 V	550 hp	450 hp
Rated output current I_n		660 A	520 A
Maximum current I_{MAX}	for 60 s per 10 minutes	792 A	780 A
Input DC			
Rated input current DC	U_n = 400 V	637 A / 764 A	502 A / 753 A
I_{in} / I_{in_MAX}	U_n = 440 V	578 A / 694 A	456 A / 684 A
	U_n = 480 V	613 A / 735 A	501 A / 752 A
Rated input power DC	U_n = 400 V	378 kW / 454 kW	298 kW / 447 kW
P_n / P_{n_MAX}	U_n = 440 V	378 kW / 454 kW	298 kW / 447 kW
	U_n = 480 V	436 kW / 523 kW	357 kW / 535 kW
Internal short-circuit protection			
DC fuse		3x 400 A	
Characteristics			
Efficiency at I_n		0.985	
Heat losses at I_n	Total losses	6400 W	5100 W
	Control part only	850 W	600 W
Weight	Net	500 kg	
	Gross	550 kg	
Ambient conditions			
Air flow	Power part	1740 m^3/h	
	Control part	280 m^3/h	
Sound pressure level		71 dB(A)	
Cable cross section			
Motor connection (2)	Typical cable	3x (3x 150 mm^2) or 4x (3x 95 mm^2)	2x (3x 185 mm^2) or 3x (3x 120 mm^2)
	Max. cable cross section	5x (3x 185 mm^2)	5x (3x 185 mm^2)

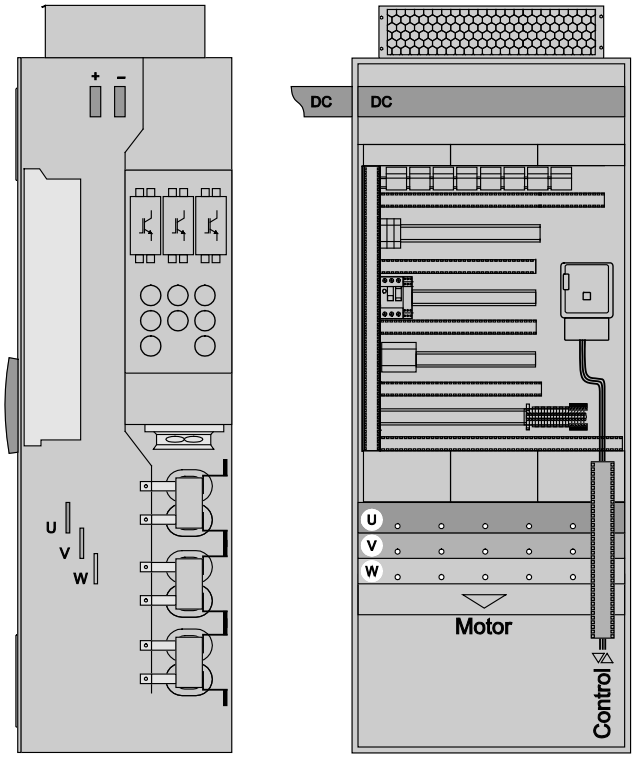
(1) For Heavy Duty HD operation parameter [Dual Rating] drt has to be set to [High rating] HiGH (see programming manual *NHA80757*).

(2) You will find further information at chapter "Motor Connection", page 113.

Dimensions IP23 for Size 3mp



Interior View IP23 for Size 3mp



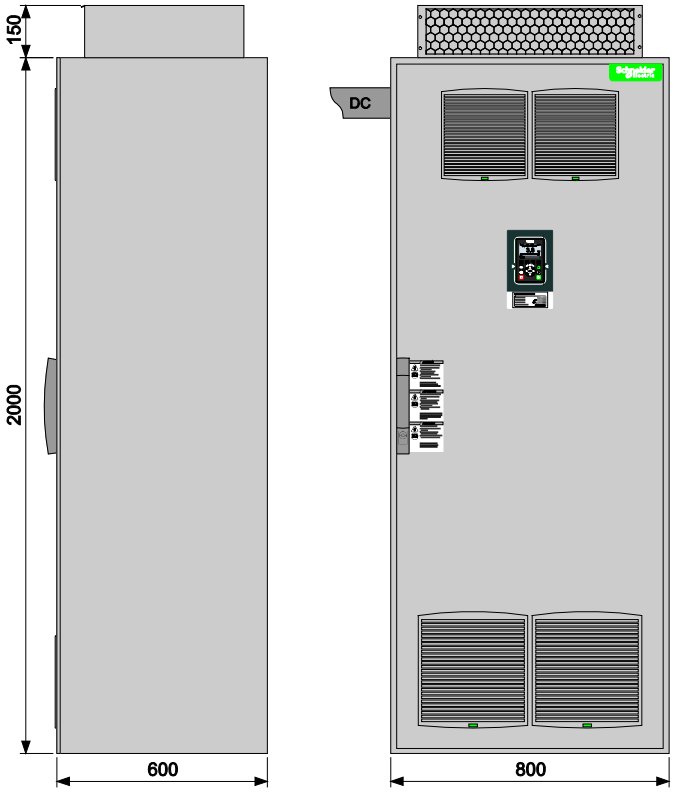
Technical Data ATV993C40●4X1

Type		ATV993C40●4X1	
Nominal data		**Normal Duty ND**	**Heavy Duty HD (1)**
Typical motor rating P_n	U_n = 400 V	400 kW	315 kW
	U_n = 440 V	400 kW	315 kW
	U_n = 480 V	600 hp	500 hp
Rated output current I_n		730 A	590 A
Maximum current I_{MAX}	for 60 s per 10 minutes	876 A	885 A
Input DC			
Rated input current DC	U_n = 400 V	714 A / 856 A	565 A / 847 A
I_{in} / I_{in_MAX}	U_n = 440 V	648 A / 778 A	513 A / 770 A
	U_n = 480 V	665 A / 798 A	557 A / 835 A
Rated input power DC	U_n = 400 V	424 kW / 509 kW	336 kW / 503 kW
P_n / P_{n_MAX}	U_n = 440 V	424 kW / 509 kW	336 kW / 503 kW
	U_n = 480 V	473 kW / 568 kW	397 kW / 595 kW
Internal short-circuit protection			
DC fuse		3x 400 A	
Characteristics			
Efficiency at I_n		0.985	
Heat losses at I_n	Total losses	7200 W	5700 W
	Control part only	1000 W	700 W
Weight	Net	500 kg	
	Gross	550 kg	
Ambient conditions			
Air flow	Power part	1740 m^3/h	
	Control part	280 m^3/h	
Sound pressure level		71 dB(A)	
Cable cross section			
Motor connection (2)	Typical cable	3x (3x 185 mm²) or 4x (3x 120 mm²)	3x (3x 120 mm²) or 4x (3x 95 mm²)
	Max. cable cross section	5x (3x 185 mm²)	5x (3x 185 mm²)

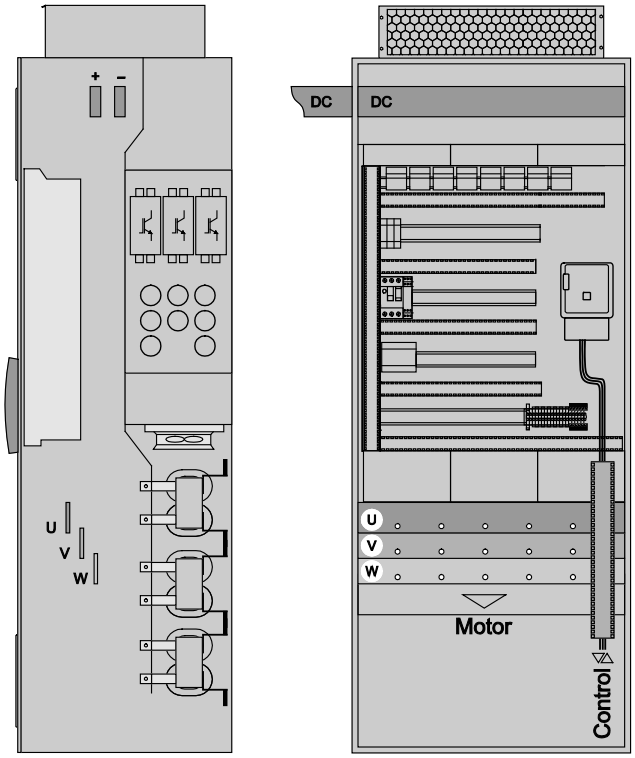
(1) For Heavy Duty HD operation parameter [Dual Rating] drt has to be set to [High rating] HiGH (see programming manual *NHA80757*).

(2) You will find further information at chapter "Motor Connection", page 113.

Dimensions IP23 for Size 3mp



Interior View IP23 for Size 3mp



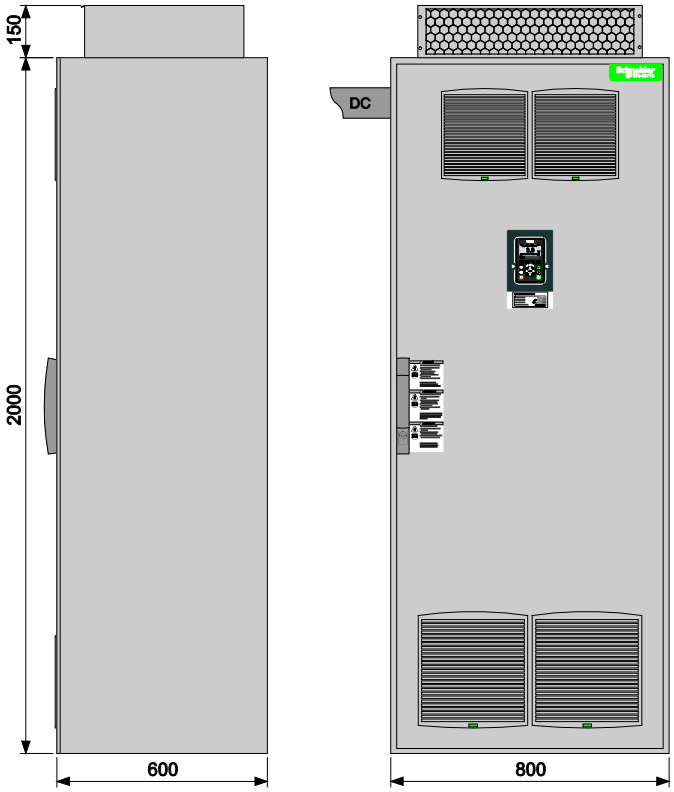
Technical Data ATV993C45●4X1

Type		ATV993C45●4X1	
Nominal data		**Normal Duty ND**	**Heavy Duty HD (1)**
Typical motor rating P_n	U_n = 400 V	450 kW	355 kW
	U_n = 440 V	450 kW	355 kW
	U_n = 480 V	650 hp	550 hp
Rated output current I_n		830 A	660 A
Maximum current I_{MAX}	for 60 s per 10 minutes	996 A	990 A
Input DC			
Rated input current DC	U_n = 400 V	803 A / 963 A	637 A / 955 A
I_{in} / I_{in_MAX}	U_n = 440 V	729 A / 875 A	578 A / 867 A
	U_n = 480 V	720 A / 864 A	613 A / 919 A
Rated input power DC	U_n = 400 V	477 kW / 572 kW	378 kW / 567 kW
P_n / P_{n_MAX}	U_n = 440 V	477 kW / 572 kW	378 kW / 567 kW
	U_n = 480 V	513 kW / 615 kW	436 kW / 654 kW
Internal short-circuit protection			
DC fuse		3x 400 A	
Characteristics			
Efficiency at I_n		0.985	
Heat losses at I_n	Total losses	8100 W	6400 W
	Control part only	1100 W	800 W
Weight	Net	500 kg	
	Gross	550 kg	
Ambient conditions			
Air flow	Power part	1740 m^3/h	
	Control part	280 m^3/h	
Sound pressure level		71 dB(A)	
Cable cross section			
Motor connection (2)	Typical cable	4x (3x 150 mm²) or 5x (3x 120 mm²)	3x (3x 150 mm²) or 4x (3x 95 mm²)
	Max. cable cross section	5x (3x 185 mm²)	5x (3x 185 mm²)

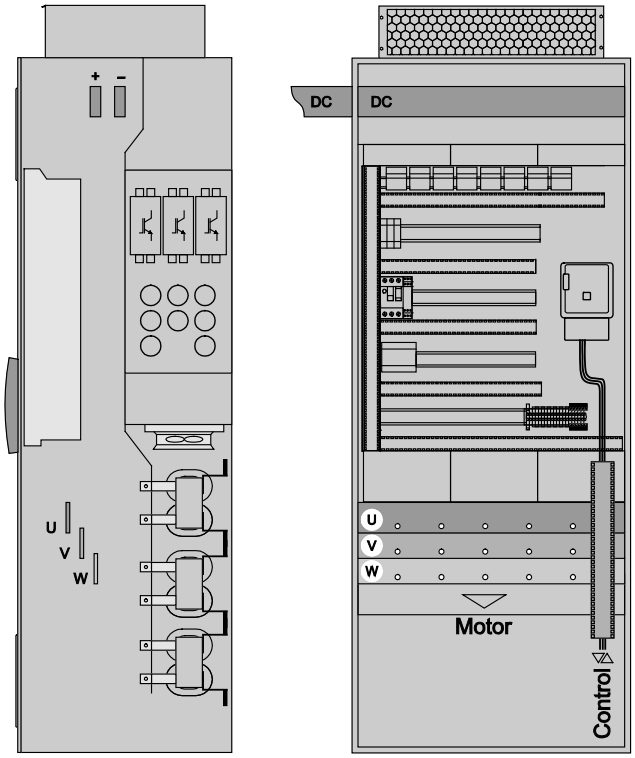
(1) For Heavy Duty HD operation parameter [Dual Rating] drt has to be set to [High rating] HiGH (see programming manual *NHA80757*).

(2) You will find further information at chapter "Motor Connection", page 113.

Dimensions IP23 for Size 3mp



Interior View IP23 for Size 3mp



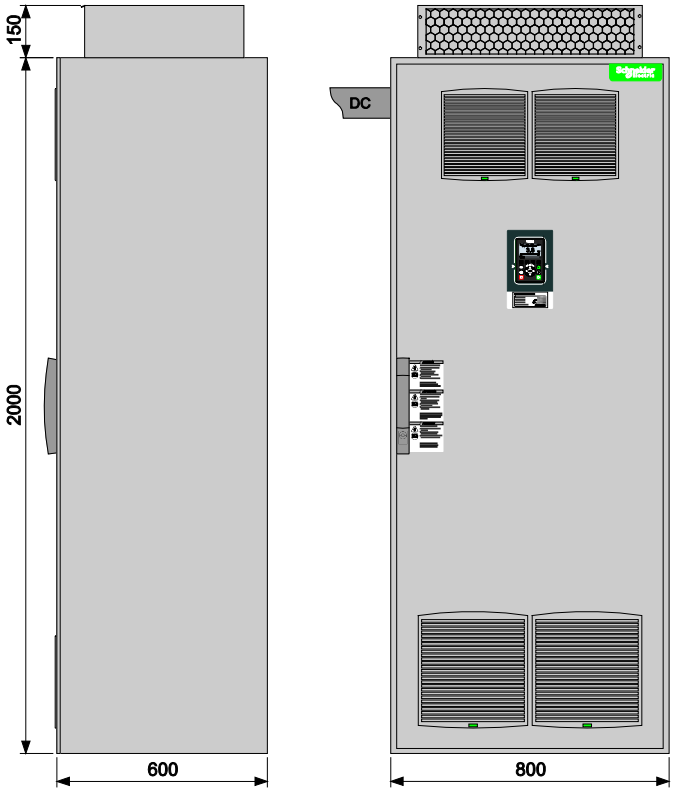
Technical Data ATV993C50●4X1

Type		ATV993C50●4X1	
Nominal data		**Normal Duty ND**	**Heavy Duty HD (1)**
Typical motor rating P_n	U_n = 400 V	500 kW	400 kW
	U_n = 440 V	500 kW	400 kW
	U_n = 480 V	700 hp	600 hp
Rated output current I_n		900 A	730 A
Maximum current I_{MAX}	for 60 s per 10 minutes	1080 A	1095 A
Input DC			
Rated input current DC	U_n = 400 V	892 A / 1070 A	714 A / 1070 A
I_{in} / I_{in_MAX}	U_n = 440 V	810 A / 972 A	648 A / 972 A
	U_n = 480 V	776 A / 931 A	665 A / 997 A
Rated input power DC	U_n = 400 V	530 kW / 636 kW	424 kW / 636 kW
P_n / P_{n_MAX}	U_n = 440 V	530 kW / 636 kW	424 kW / 636 kW
	U_n = 480 V	552 kW / 663 kW	473 kW / 710 kW
Internal short-circuit protection			
DC fuse		3x 400 A	
Characteristics			
Efficiency at I_n		0.985	
Heat losses at I_n	Total losses	9000 W	7200 W
	Control part only	1200 W	1000 W
Weight	Net	500 kg	
	Gross	550 kg	
Ambient conditions			
Air flow	Power part	1740 m^3/h	
	Control part	280 m^3/h	
Sound pressure level		71 dB(A)	
Cable cross section			
Motor connection (2)	Typical cable	4x (3x 185 mm^2) or 5x (3x 120 mm^2)	3x (3x 185 mm^2) or 4x (3x 120 mm^2)
	Max. cable cross section	5x (3x 185 mm^2)	5x (3x 185 mm^2)

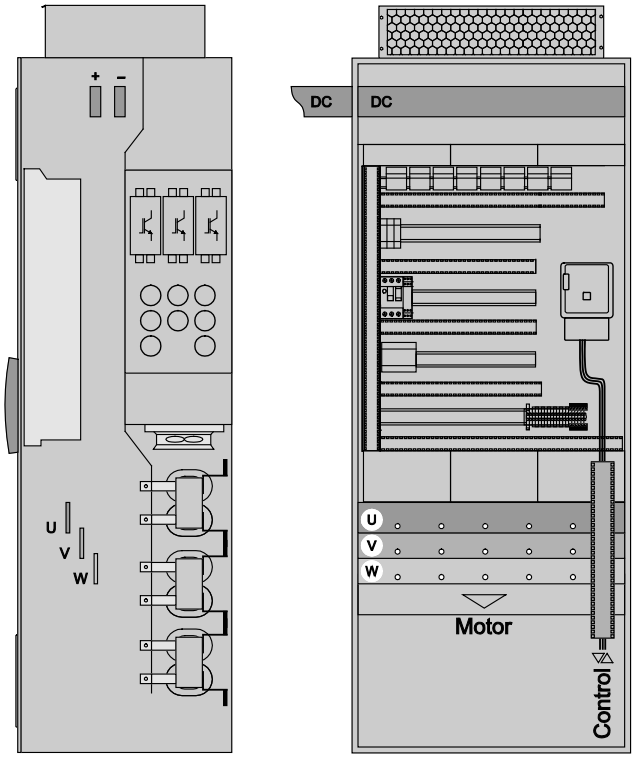
(1) For Heavy Duty HD operation parameter [Dual Rating] drt has to be set to [High rating] HiGH (see programming manual *NHA80757*).

(2) You will find further information at chapter "Motor Connection", page 113.

Dimensions IP23 for Size 3mp



Interior View IP23 for Size 3mp



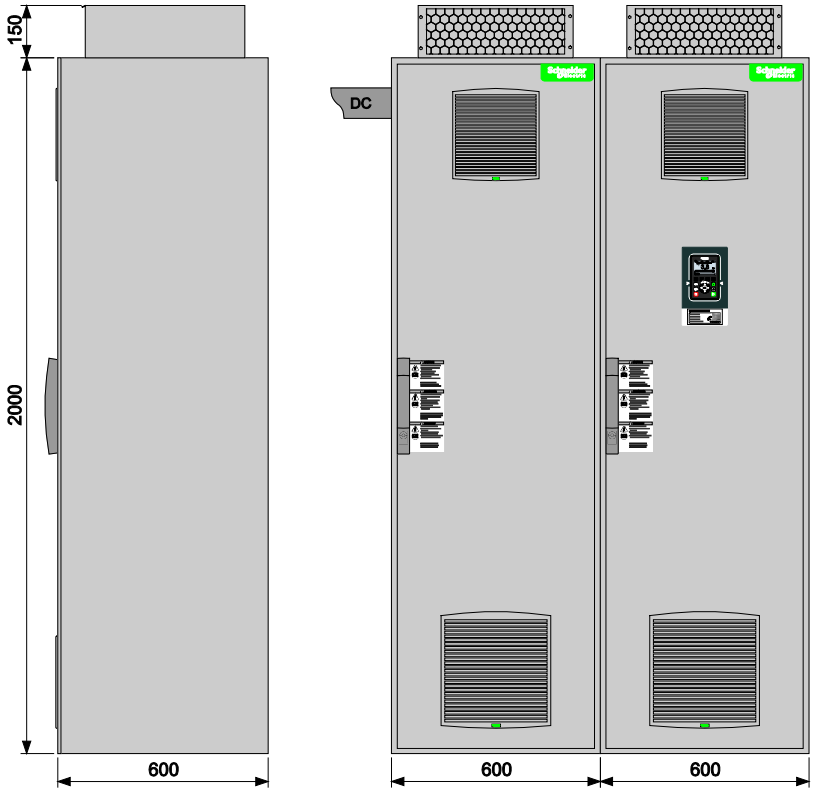
Technical Data ATV993C56●4X1

Type		ATV993C56●4X1	
Nominal data		**Normal Duty ND**	**Heavy Duty HD (1)**
Typical motor rating P_n	U_n = 400 V	560 kW	450 kW
	U_n = 440 V	560 kW	450 kW
	U_n = 480 V	800 hp	650 hp
Rated output current I_n		1020 A	830 A
Maximum current I_{MAX}	for 60 s per 10 minutes	1224 A	1245 A
Input DC			
Rated input current DC	U_n = 400 V	999 A / 1199 A	803 A / 1204 A
I_{in} / I_{in_MAX}	U_n = 440 V	907 A / 1089 A	729 A / 1094 A
	U_n = 480 V	886 A / 1064 A	720 A / 1080 A
Rated input power DC	U_n = 400 V	593 kW / 712 kW	477 kW / 715 kW
P_n / P_{n_MAX}	U_n = 440 V	593 kW / 712 kW	477 kW / 715 kW
	U_n = 480 V	631 kW / 757 kW	513 kW / 769 kW
Internal short-circuit protection			
DC fuse		4x 400 A	
Characteristics			
Efficiency at I_n		0.985	
Heat losses at I_n	Total losses	10100 W	8100 W
	Control part only	1300 W	1000 W
Weight	Net	650 kg	
	Gross	710 kg	
Ambient conditions			
Air flow	Power part	2320 m^3/h	
	Control part	280 m^3/h	
Sound pressure level		73 dB(A)	
Cable cross section			
Motor connection (2)	Typical cable	4x (3x 185 mm^2) or 5x (3x 150 mm^2)	4x (3x 150 mm^2) or 5x (3x 120 mm^2)
	Max. cable cross section	5x (3x 240 mm^2) or 6x (3x 185 mm^2)	5x (3x 240 mm^2) or 6x (3x 185 mm^2)

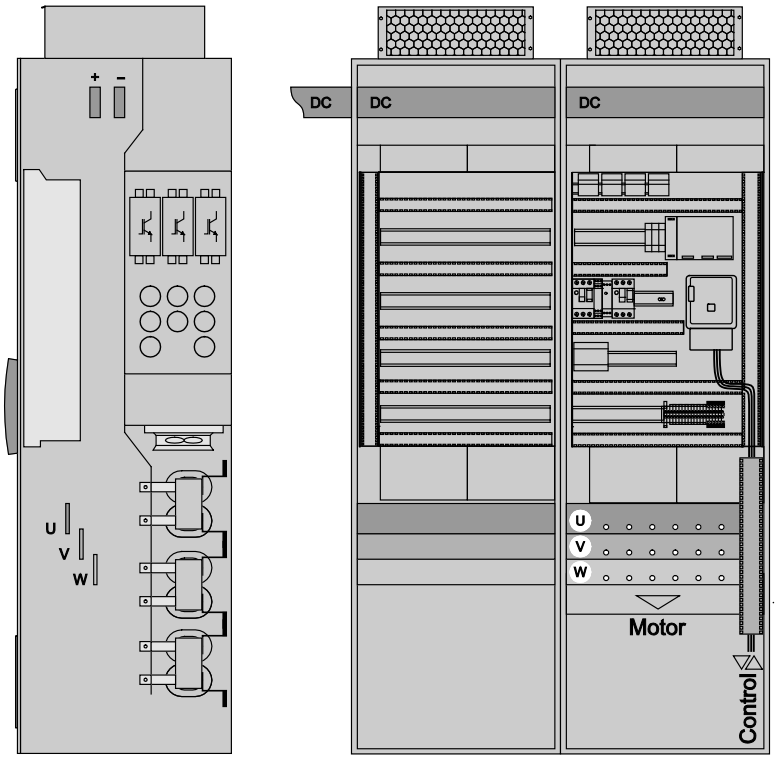
(1) For Heavy Duty HD operation parameter [Dual Rating] drt has to be set to [High rating] HiGH (see programming manual *NHA80757*).

(2) You will find further information at chapter "Motor Connection", page 113.

Dimensions IP23 for Size 4mp



Interior View IP23 for Size 4mp



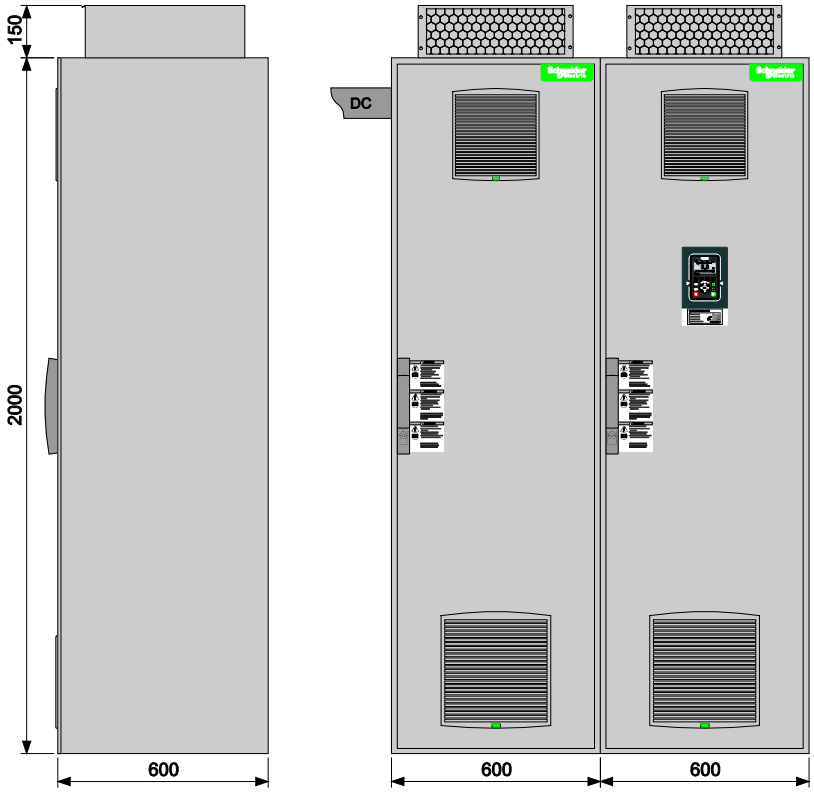
Technical Data ATV993C63●4X1

Type		ATV993C63●4X1	
Nominal data		**Normal Duty ND**	**Heavy Duty HD (1)**
Typical motor rating P_n	U_n = 400 V	630 kW	500 kW
	U_n = 440 V	630 kW	500 kW
	U_n = 480 V	900 hp	700 hp
Rated output current I_n		1140 A	900 A
Maximum current I_{MAX}	for 60 s per 10 minutes	1368 A	1350 A
Input DC			
Rated input current DC	U_n = 400 V	1118 A / 1342 A	892 A / 1338 A
I_{in} / I_{in_MAX}	U_n = 440 V	1016 A / 1219 A	810 A / 1215 A
	U_n = 480 V	992 A / 1190 A	776 A / 1163 A
Rated input power DC	U_n = 400 V	664 kW / 797 kW	530 kW / 795 kW
P_n / P_{n_MAX}	U_n = 440 V	664 kW / 797 kW	530 kW / 795 kW
	U_n = 480 V	706 kW / 848 kW	552 kW / 828 kW
Internal short-circuit protection			
DC fuse		4x 400 A	
Characteristics			
Efficiency at I_n		0.985	
Heat losses at I_n	Total losses	11300 W	9000 W
	Control part only	1500 W	1200 W
Weight	Net	650 kg	
	Gross	710 kg	
Ambient conditions			
Air flow	Power part	2320 m^3/h	
	Control part	280 m^3/h	
Sound pressure level		73 dB(A)	
Cable cross section			
Motor connection (2)	Typical cable	4x (3x 240 mm²) or 5x (3x 185 mm²)	4x (3x 185 mm²) or 5x (3x 120 mm²)
	Max. cable cross section	5x (3x 240 mm²) or 6x (3x 185 mm²)	5x (3x 240 mm²) or 6x (3x 185 mm²)

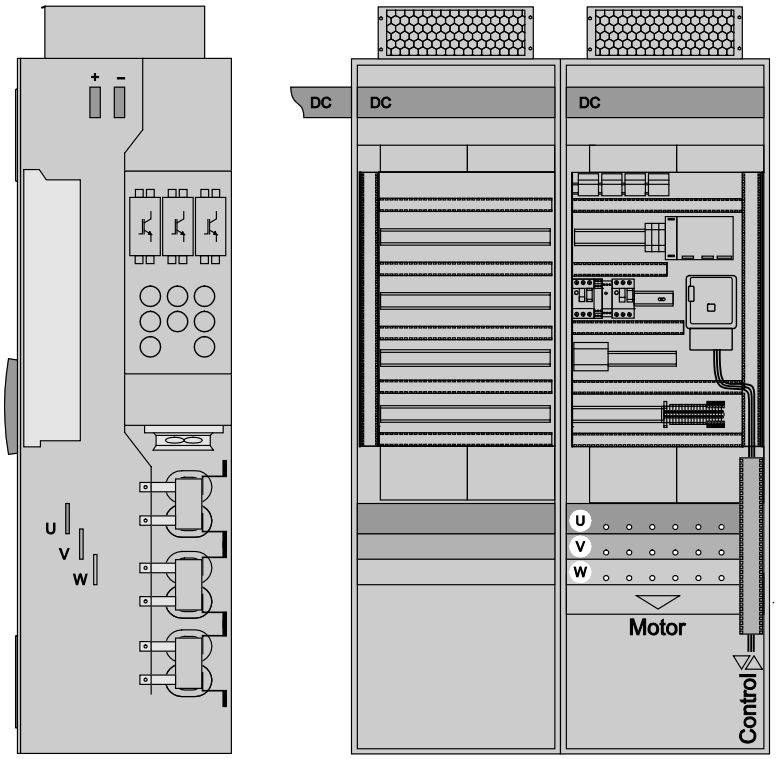
(1) For Heavy Duty HD operation parameter [Dual Rating] drt has to be set to [High rating] HiGH (see programming manual *NHA80757*).

(2) You will find further information at chapter "Motor Connection", page 113.

Dimensions IP23 for Size 4mp



Interior View IP23 for Size 4mp



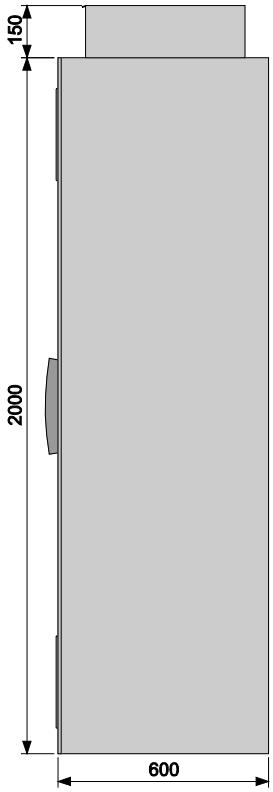
Technical Data ATV993C71●4X1

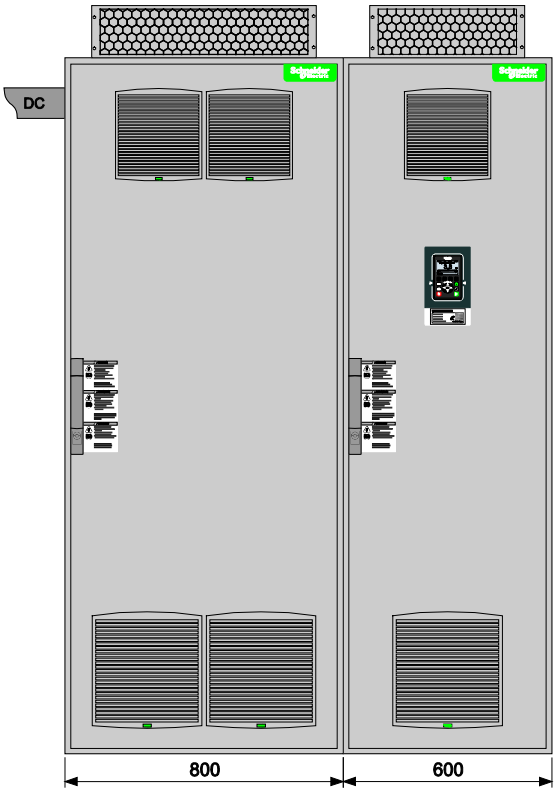
Type		ATV993C71●4X1	
Nominal data		**Normal Duty ND**	**Heavy Duty HD (1)**
Typical motor rating P_n	U_n = 400 V	710 kW	560 kW
	U_n = 440 V	710 kW	560 kW
	U_n = 480 V	1000 hp	800 hp
Rated output current I_n		1260 A	1020 A
Maximum current I_{MAX}	for 60 s per 10 minutes	1512 A	1530 A
Input DC			
Rated input current DC	U_n = 400 V	1260 A / 1512 A	999 A / 1499 A
I_{in} / I_{in_MAX}	U_n = 440 V	1144 A / 1373 A	907 A / 1361 A
	U_n = 480 V	1102 A / 1328 A	886 A / 1330 A
Rated input power DC	U_n = 400 V	748 kW / 898 kW	593 kW / 890 kW
P_n / P_{n_MAX}	U_n = 440 V	748 kW / 898 kW	593 kW / 890 kW
	U_n = 480 V	785 kW / 942 kW	631 kW / 947 kW
Internal short-circuit protection			
DC fuse		5x 400 A	
Characteristics			
Efficiency at I_n		0.985	
Heat losses at I_n	Total losses	12700 W	10100 W
	Control part only	1850 W	1200 W
Weight	Net	900 kg	
	Gross	965 kg	
Ambient conditions			
Air flow	Power part	2900 m^3/h	
	Control part	420 m^3/h	
Sound pressure level		74 dB(A)	
Cable cross section			
Motor connection (2)	Typical cable	5x (3x 185 mm²) or 6x (3x 150 mm²)	4x (3x 185 mm²) or 5x (3x 150 mm²)
	Max. cable cross section	6x (3x 240 mm²)	6x (3x 240 mm²)

(1) For Heavy Duty HD operation parameter [Dual Rating] drt has to be set to [High rating] HiGH (see programming manual *NHA80757*).

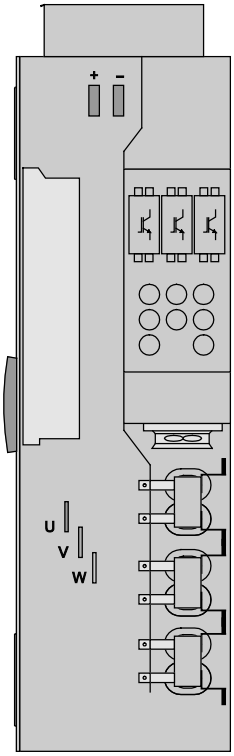
(2) You will find further information at chapter "Motor Connection", page 113.

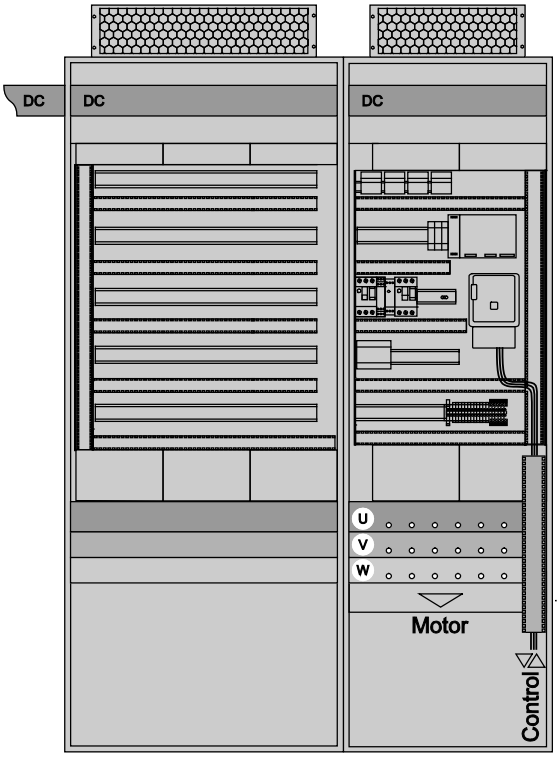
Dimensions IP23 for Size 5mp





Interior View IP23 for Size 5mp





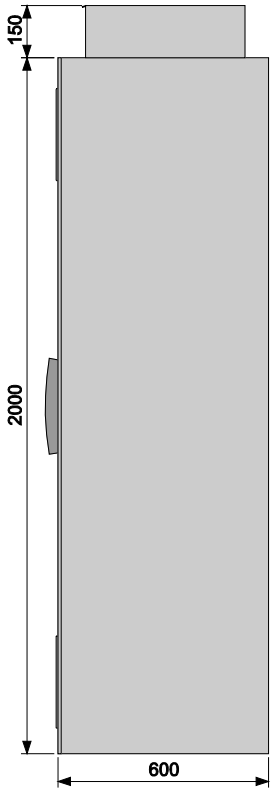
Technical Data ATV993C80●4X1

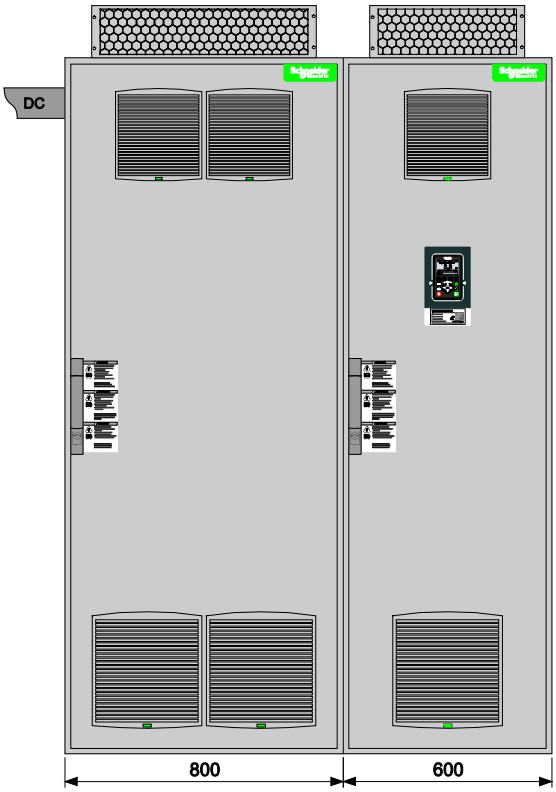
Type		ATV993C80●4X1	
Nominal data		**Normal Duty ND**	**Heavy Duty HD (1)**
Typical motor rating P_n	U_n = 400 V	800 kW	630 kW
	U_n = 440 V	800 kW	630 kW
	U_n = 480 V	1100 hp	900 hp
Rated output current I_n		1420 A	1140 A
Maximum current I_{MAX}	for 60 s per 10 minutes	1704 A	1710 A
Input DC			
Rated input current DC	U_n = 400 V	1412 A / 1695 A	1118 A / 1677 A
I_{in} / I_{in_MAX}	U_n = 440 V	1283 A / 1540 A	1016 A / 1523 A
	U_n = 480 V	1206 A / 1448 A	992 A / 1488 A
Rated input power DC	U_n = 400 V	839 kW / 1007 kW	664 kW / 996 kW
P_n / P_{n_MAX}	U_n = 440 V	839 kW / 1007 kW	664 kW / 996 kW
	U_n = 480 V	859 kW / 1031 kW	706 kW / 1060 kW
Internal short-circuit protection			
DC fuse		5x 400 A	
Characteristics			
Efficiency at I_n		0.985	
Heat losses at I_n	Total losses	14300 W	11300 W
	Control part only	2000 W	1500 W
Weight	Net	900 kg	
	Gross	965 kg	
Ambient conditions			
Air flow	Power part	2900 m^3/h	
	Control part	420 m^3/h	
Sound pressure level		74 dB(A)	
Cable cross section			
Motor connection (2)	Typical cable	5x (3x 240 mm²) or 6x (3x 185 mm²)	4x (3x 240 mm²) or 5x (3x 185 mm²) or 6x (3x 120 mm²)
	Max. cable cross section	6x (3x 240 mm²)	6x (3x 240 mm²)

(1) For Heavy Duty HD operation parameter [Dual Rating] drt has to be set to [High rating] HiGH (see programming manual *NHA80757*).

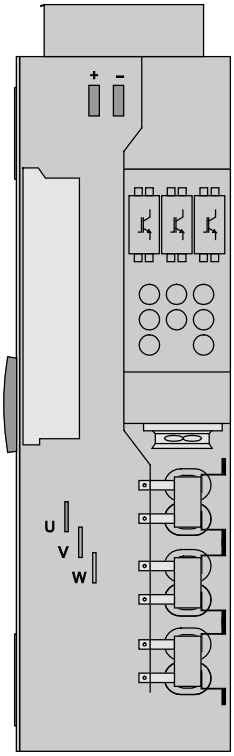
(2) You will find further information at chapter "Motor Connection", page 113.

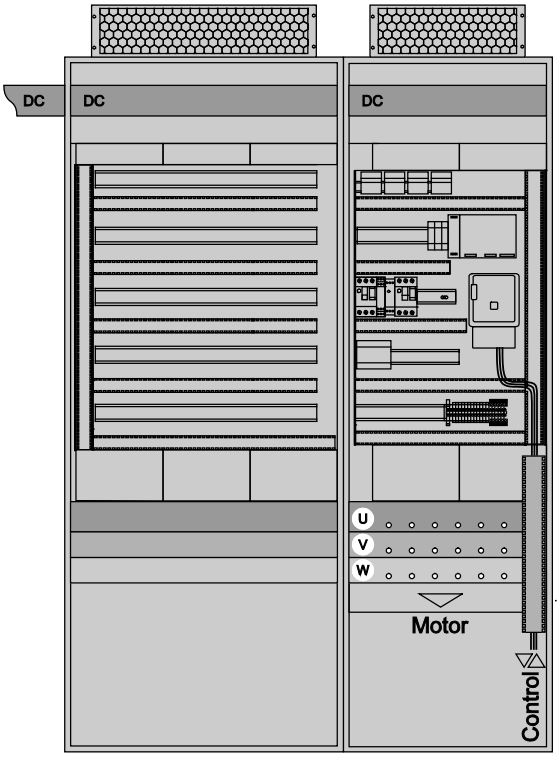
Dimensions IP23 for Size 5mp





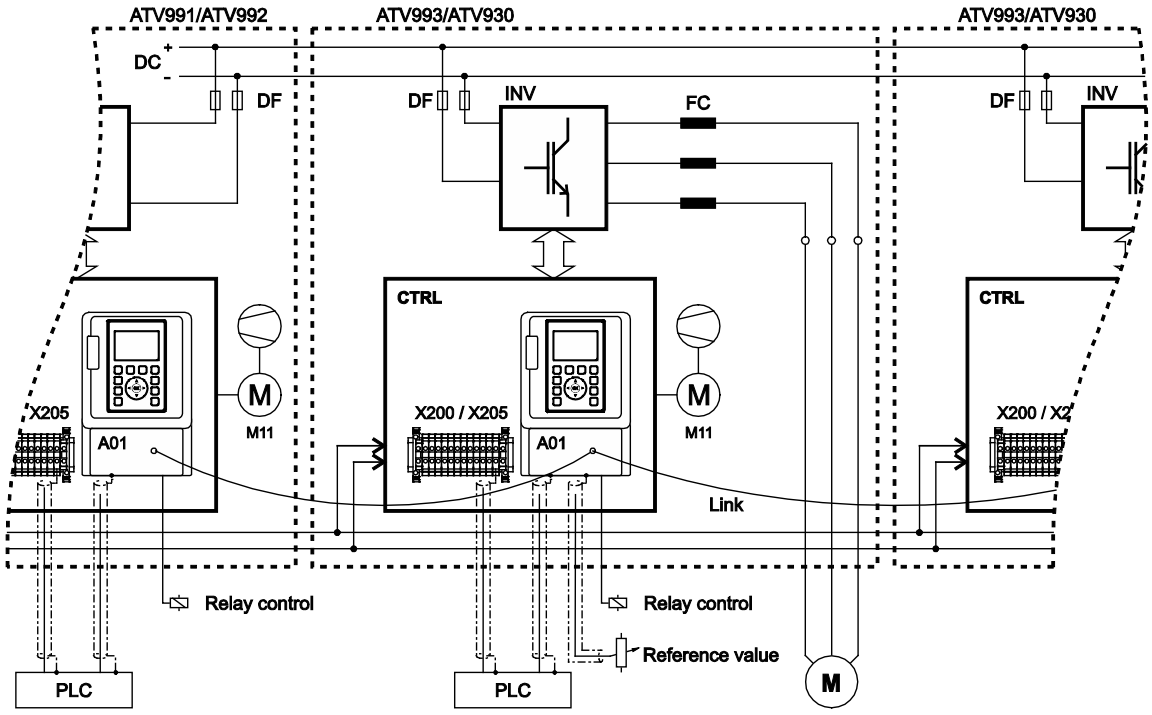
Interior View IP23 for Size 5mp





Circuit Diagram

The following presentation shows a typical wiring of a MultiDrive system inverter unit.



ATV991/ATV992	Altivar Process MultiDrive Systems – Supply unit
ATV993	Altivar Process MultiDrive Systems – Inverter unit
DF	DC fuses for short-circuit shut-down if the electronic protective devices do not work properly
INV	Inverter module(s)
FC	dv/dt filter choke to reduce the voltage load of the motor
DC	Common DC link
CTRL	Control panel with control block and further control components
A01	Control terminals at the control block
Link	Signal wire PTI/PTO or Modbus for transmitting the DC voltage value
X200 / X205	Control terminals at the control panel
M11	Fan in enclosure door

Motor Connection

Assignment of the Motor

All Altivar Process Drive Systems include the function "Dual rating". It enables the use for drives with low overload "Normal duty" (typically pumps and fans) and, on the other hand, also the use with increased requirements regarding overload capability, starting torque, load impacts and control performance "Heavy duty" (e.g. compressors, mixers, rotary blowers,...).

You can select the desired power/overload capability with parameter [Dual rating] drt. When changing this parameter all relevant parameters are adapted to the selected property. For example, the parameters for motor power and motor current are modified accordingly.

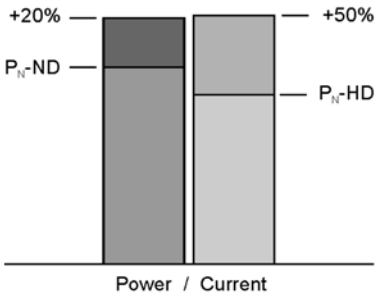
In case of setting HD – Heavy Duty [High rating] HIGH the overload capability and the maximum overload current are increased. But at the same time the nominal motor power and the continuous output current of the frequency inverter are reduced. So you have to select a higher device type for the same motor power.

Example for ATV99●**C13Q4X1:**

Normal Duty ND:

132 kW with 250 A continuous current and 300 A overload current for 60 s

- Nominal power
- Overload 20 %
- Factory setting: [Normal rating] nOrMAL



Heavy Duty HD:

110 kW with 211 A continuous current and 317 A overload current for 60 s

- Lower nominal power
- Overload 50 %
- Selectable via parameter: [High rating] HIGH

The factory setting of the parameter [Dual Rating] drt is "Normal Duty". When the product is reset to the factory settings, this parameter is also reset to "Normal Duty".

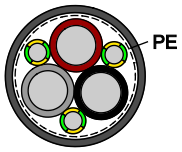
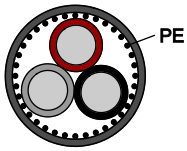
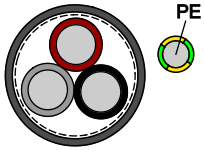
Dimensioning of the Motor Cables

The recommended values for dimensioning the cable cross sections given in chapter "Technical data" are reference values for multi-core copper power cables layed in air at a maximum ambient temperature of 40°C. Observe different ambient conditions and local regulations.

NOTE: The recommended cable cross sections are given at the technical data of the respective Altivar Process Drive System (from page 84).

The motor cables are dimensioned for the maximum continuous current. They apply to 0...100 Hz (up to 300 Hz the cable losses increase about 25 % because of the Skin-effect).

The IGBT modules cause high-frequent interferences which drain off more and more stronger to the ground potential with increasing motor cable length. As a result the line-conducted interferences to the mains increase. In case of too long motor cables the attenuation of the mains filters is not longer sufficient and the permitted interference limits are exceeded.

Recommended types of motor cables	
	Symmetrically shielded cable with three phase conductors, symmetrically arranged PE conductor and a shield. **NOTE:** Check that the PE conductor complies with the requirements according to IEC 61439-1. **Example:** 2YSLCY-JB
	Symmetrically shielded cable with three phase conductors and a concentrical PE conductor as shield. **NOTE:** Check that the shield (PE conductor) complies with the requirements according to IEC 61439-1. **Example:** NYCY / NYCWY
	Symmetrically shielded cable with three phase conductors. **NOTE:** A separate PE conductor is required if the shield does not fulfill the requirements according to IEC 61439-1.

NOTE: Shielded single-conductor cables are not recommended due to increased currents in the shield.

⚠⚠ DANGER

ELECTRIC SHOCK DUE TO OVERLOAD ON MOTOR CABLES

- Verify that the protective conductor complies with the requirements of the standard IEC 61439-1.
- Observe the recommendations for motor power cables described in the standard IEC 60034-25.

Failure to follow these instructions will result in death or serious injury.

Length of Motor Cables

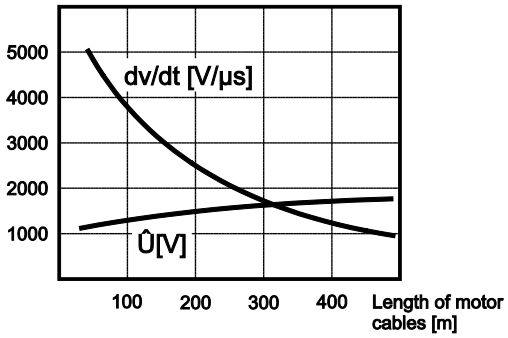
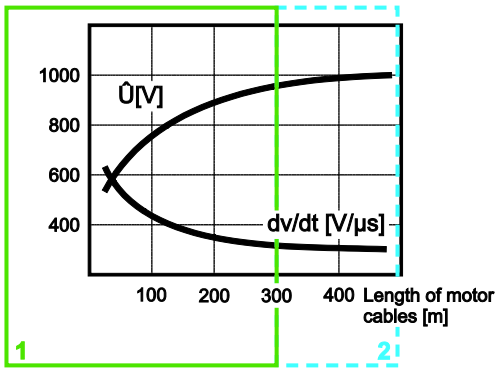
Because of the permitted mains disturbances, the allowed overvoltages at the motor, the occurring bearing currents and the permitted heat losses the distance between inverter and motor(s) is limited. The maximum distance heavily depends on the used motors (insulation material), the type of motor cable used (shielded/unshielded), the cable laying (cable channel, underground installation, ...) as well as from the used options.

Dynamic voltage load of the motor

Overvoltages at the motor terminals result from reflection in the motor cable. Basically the motors are stressed with measurable higher voltage peaks from a motor cable length of 10 m. With the length of the motor cable also the value of overvoltage increases.

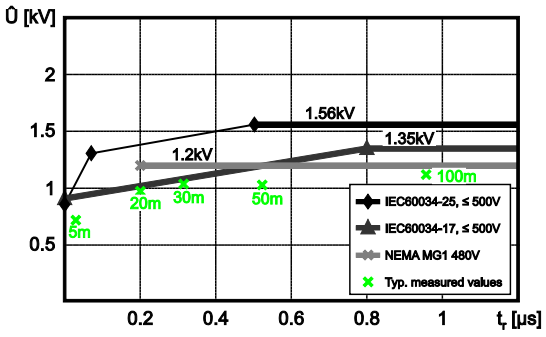
The steep edges of the switching impulses at the output side of the frequency inverter lead to a further load of the motors. The slew rate of the voltage is typically over 5 kV/µs but it decreases with the length of the motor cable.

The ATV993 inverter units are equipped with a dv/dt filter choke, which significantly reduces the load of the motors and so it is in accordance with the allowed limits.

Typical load of the motor (1)	Description
	Load of the motor with overvoltage and slew rate when using conventional frequency inverters without integrated dv/dt filter chokes.
	Reduced load of the motor by using Altivar Process Drive Systems with integrated dv/dt filter chokes 300 m. 1 When using a shielded motor cable 2 When using an unshielded motor cable
(1) The given values are related to the voltage load phase-to-phase. The voltage values phase to ground are approximately 300 V lower, du/dt is approximately 150 V/µs lower.	

The motor standards for IEC and NEMA specify limits for the permitted load regarding slew rate and voltage peaks.

- IEC 60034-17 – Permitted values for standard power supply driven motors at the frequency inverter, up to 500 V
- IEC 60034-25 – Permitted values for "inverter motors" up to 500 V
- NEMA MG1 – Permitted values for "inverter motors"

Typical measured values	Description
	The typical measured values as shown in the diagram correspond with the ATV993 frequency inverter variant with built-in dv/dt filter choke.

Motors according IEC 60034-25 as well as motors according NEMA MG1 are dimensioned for operation with frequency inverters and thus they are well qualified for drives with ATV99● frequency inverters.

Motors according IEC 60034-17 are dimensioned for operation with pure sinusoidal voltage, but they can also be operated at ATV99● when observing the permitted cable lengths and correct customization.

Basically for all motors from frame size 315 (approximately 110 kW) an insulated bearing on the non-drive end is recommended. It helps to prevent internal current flow inside the motor which can result from unbalances. The insulated bearing is to be understood as supplement to the dv/dt filter choke inside the frequency inverter.

NOTICE

OVERVOLTAGE AT THE MOTOR

Do not exceed the maximum length of the motor cables as specified in this document.

Failure to follow these instructions can result in equipment damage.

EMC interferences

The IGBT modules cause high-frequent interferences which drain off more and more stronger to the ground potential with increasing motor cable length. As a result the line-conducted interferences to the mains increase. In case of too long motor cables the attenuation of the mains filters is not longer sufficient and the permitted interference limits are exceeded.

The IGBT modules cause high-frequency interference which increases with increasing motor cable lenght. If the motor cable length exceeds the maximum cable length, the internal mains filters are no longer sufficient.

⚠ WARNING

UNEXPECTED EQUIPMENT OPERATION DUE TO HIGH-FREQUENCY INTERFERENCE

Do not exceed the maximum length of the motor cables as specified in this document.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

This product meets the EMC requirements according to the standard IEC 61800-3 if the measures described in this manual are implemented during installation.

If the selected composition (product itself, mains filter, other accessories and measures) does not meet the requirements of category C1, the following information applies as it appears in IEC 61800-3:

⚠ WARNING

RADIO INTERFERENCE

In a domestic environment this product may cause radio interference in which case supplementary mitigation measures may be required.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Bearing currents

The dv/dt filter choke inside the ATV99● frequency inverter effects a significant reduction of the common mode bearing currents.

Especially in case of big motors with middle up to high motor cable lengths the filter chokes are considerable to increase the availability of the motor.

Multiplication factors

In case of conditions differing from the table the recommended cable lengths have to be converted by means of the following factors.

If several factors apply, please multiply them.

		Correction of the max. cable lengths
The pulse frequency does not correspond to factory setting:	at 4 kHz	multiply all values by 0.70
	at 8 kHz	multiply all values by 0.40
Output frequencies higher than 100 Hz.	up to 200 Hz	multiply all values by 0.80
	up to 300 Hz	multiply all values by 0.50
In case of 6-pole motor cabling (e.g. for star/delta starting circuit)		multiply all values by 0.75
In case of parallel motors with a dedicated cable to each motor the inverter values have to be converted in compliance with the number of motors. When a motor choke is used for each motor, the following values in brackets apply.	at 2 motors	multiply all values by 0.40 (0.80)
	at 3 motors	multiply all values by 0.25 (0.60)
	at 4 motors	multiply all values by 0.15 (0.40)
	at 5 motors	multiply all values by 0.10 (0.25)
In case of parallel motors with a common cable to all motors the inverter values have to be converted in compliance with the number of motors:	at 2 motors	multiply all values by 0.80
	at 3 motors	multiply all values by 0.60
	at 4 motors	multiply all values by 0.40
	at 5 motors	multiply all values by 0.25

Recommended maximum lengths of motor cables in second environment (industrial environment)

EMC category (EN 61800-3)	ATV99●	dv/dt filter choke	Type of cable	Max. cable length
C3	C11●4X1…C80●4X1	Built-in as standard	Shielded	150 m
C4	C11●4X1…C80●4X1	Built-in as standard	Shielded	300 m
	C11●4X1…C80●4X1	Built-in as standard	Unshielded	500 m

NOTE: The specified lengths of motor cables are recommended limits based on typical motor cables, laying in cable channels, default pulse frequency and maximal output frequency of 100 Hz. Longer cable lengths are possible on request.

Thermal Motor Monitoring

In the Altivar Process Drive System several possibilities for thermal motor monitoring are available:

- Standard sensor inputs AI2, AI3 at the control block
  Suitable temperature sensors: PTC, Pt100, Pt1000, KTY84
- Sensor inputs AI4, AI5 at expansion card "Logic and analog I/O card"
  Suitable temperature sensors: PTC, Pt100, Pt1000, KTY84

⚠⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Verify that the temperature sensors in the motor meet the PELV requirements.
- Verify that the motor encoder meets the PELV requirements.
- Verify that any other equipment connected via signal cables meets the PELV requirements.

Failure to follow these instructions will result in death or serious injury.

- On customer request the motor monitoring PTC, a PTC thermistor relay (alternatively with ATEX certificate), is installed and the sensor inputs are wired with the option terminals. The evaluation is performed via the diagnostics system in the Altivar Process Drive System.

- On customer request the motor/bearing monitoring Pt100/Pt1000/KTY is installed, which includes evaluation relays and the wiring of the sensor inputs to the option terminals. The evaluation is performed via the diagnostics system in the Altivar Process Drive System.

NOTE: When protective separation of the thermistor sensors in the motor cannot be guaranteed or in case of long motor cables, this option is highly recommended.

Chapter 7
Wiring of the Control Terminals

What Is in This Chapter?

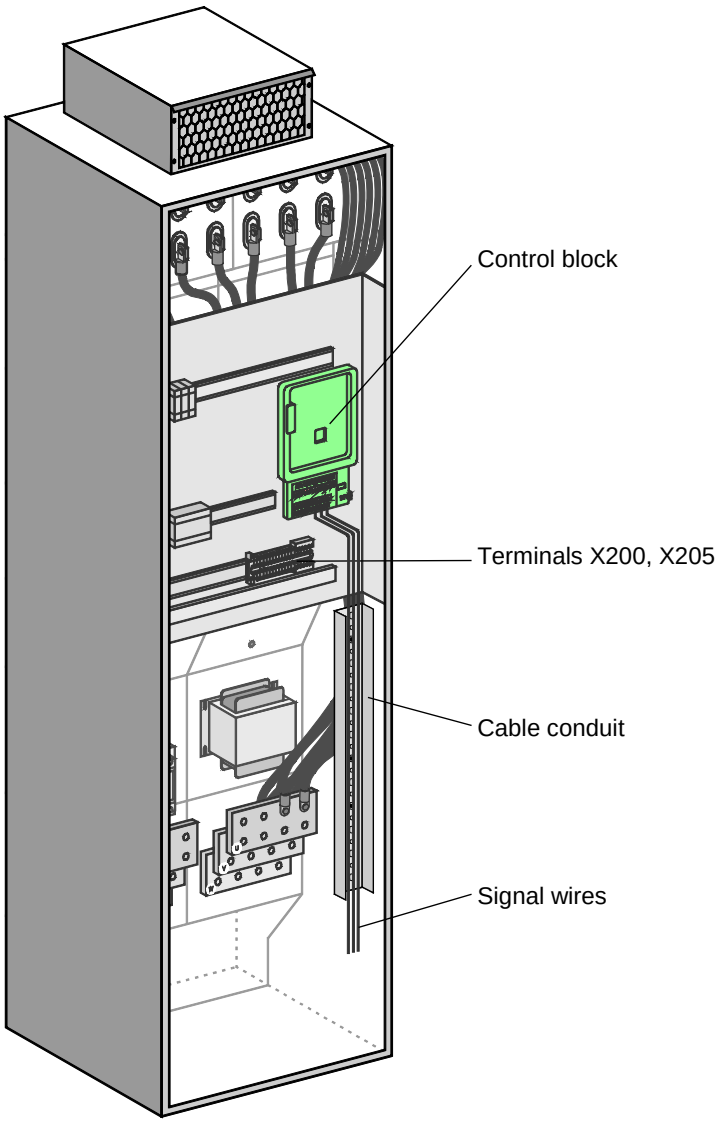
This chapter contains the following topics:

Design/Position of the Individual Terminals

The Altivar Process Drive Systems are already equipped with extensive terminals on the control block as standard. The use and the function of all inputs and outputs can be parameterized.

In addition, there are the terminals X200 and X205, which are wired internally appropriate to the customizations.

For expansion the option cards Logic and analog I/O card and the relay output card are available. Both expansion cards can be installed, but the same card cannot be plugged twice.



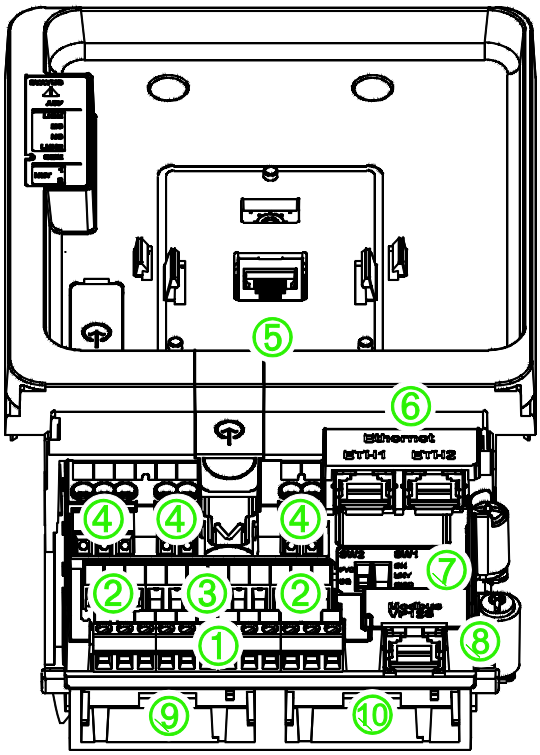
Voltage Supply and Auxiliary Voltage

All Drive Systems are equipped with a control transformer matching with the mains voltage and the required power. It provides a 230 V AC control voltage for supplying the fans in the enclosure doors and the DC supply units.
The DC supply units generate 48 V DC for the internal power part fans and a 24 V DC auxiliary voltage. All control components are supplied by the internally provided voltages.

NOTE: For buffering the control block and with that keeping communication alive (e.g. fieldbus), the control block can be supplied via the terminals P24 and 0V externally with 24 V DC.

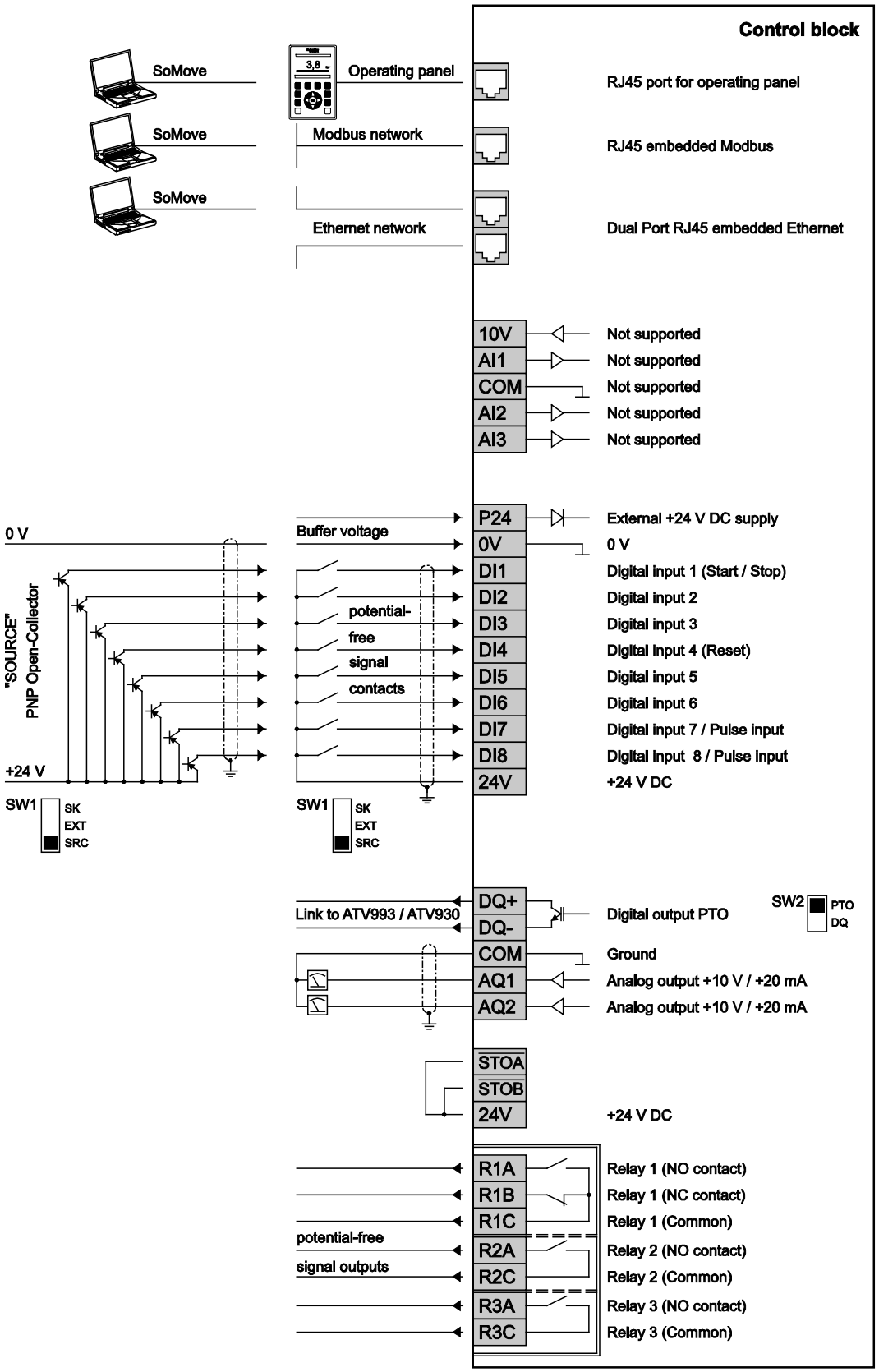
Control block ATV991 & ATV992

Structure of the Control Block

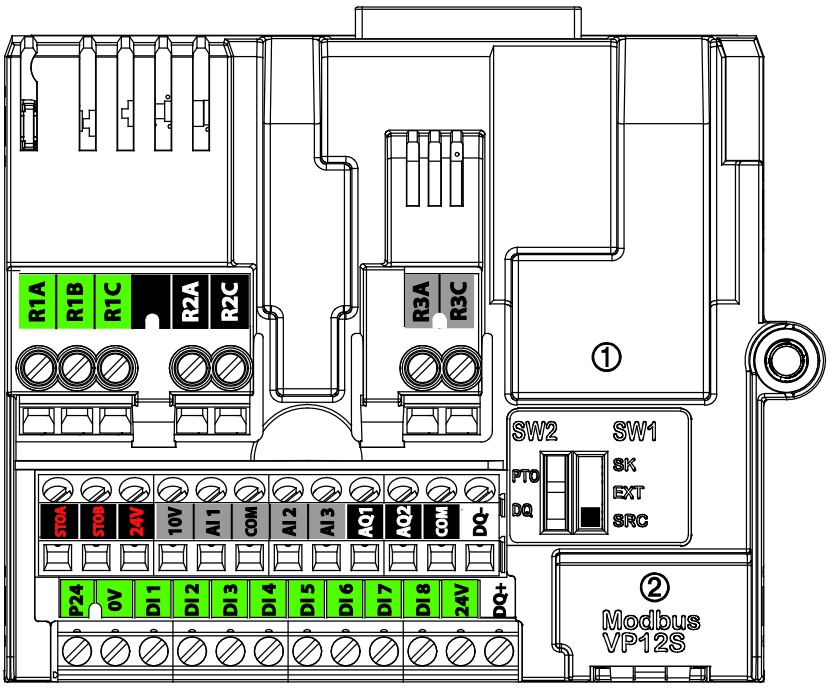


1 Control terminals of digital inputs
2 Control terminals STO (not supported) and analog outputs
3 Control terminals of analog inputs (not supported)
4 Control terminals of relay outputs
5 RJ45 port for the graphical keypad
6 Dual port RJ45 for Ethernet IP or Modbus TCP
7 Sink-Ext-Source selector switch and PTO/DQ selector switch
8 RJ45 port for serial Modbus
9 Slot B for I/O expansion card
10 Slot A for communication card or I/O expansion card

Control Terminals at the Control Block



Specification of the Control Terminals



Screw terminals

Maximum cable cross section for all terminals: 1.5 mm² (AWG 16), 0.25 Nm

Minimum cable cross section:

- For relay terminals 0.75 mm²(AWG 18)
- For all other terminals 0.5 mm²(AWG 20)

Strip length: 10 mm

Maximum cable length:

- AI●, AQ●, DI●, DQ●: 50 m shielded
- $\overline{\text{STOA}}$, $\overline{\text{STOB}}$: 30 m

Terminal	Description	Specification
R1A R1B R1C	Relay output 1 (R1A NO contact, R1B NC contact)	● Minimum switching capacity: 5 mA for 24 V DC ● Maximum switching capacity on resistive load (cos φ = 1): 3 A for 250 V AC and 30 V DC ● Maximum switching capacity on inductive load (cos φ = 0.4 and L/R = 7 ms): 2 A for 250 V AC and 30 V DC ● Response time: 5 ms ± 0.5 ms ● Life cycle: 100,000 switching cycles at max. switching capacity
R2A R2C	Relay output 2 (NO contact)	● Minimum switching capacity: 5 mA for 24 V DC ● Maximum switching capacity on resistive load (cos φ = 1): 3 A for 250 V AC and 30 V DC ● Maximum switching capacity on inductive load (cos φ = 0.4 and L/R = 7 ms): 2 A for 250 V AC and 30 V DC ● Response time: 5 ms ± 0.5 ms ● Life cycle: 100,000 switching cycles at max. switching capacity
R3A R3C	Relay output 3 (NO contact)	● Minimum switching capacity: 5 mA for 24 V DC ● Maximum switching capacity on resistive load (cos φ = 1): 3 A for 250 V AC and 30 V DC ● Maximum switching capacity on inductive load (cos φ = 0.4 and L/R = 7 ms): 2 A for 250 V AC and 30 V DC ● Response time: 5 ms ± 0.5 ms ● Life cycle: 100,000 switching cycles at max. switching capacity

Terminal	Description	Specification
$\overline{\text{STOA}}$, $\overline{\text{STOB}}$	STO inputs	Not supported
24V	Sampling voltage for STO inputs	Not supported
COM	Ground for analog I/O	0 V reference potential for analog outputs
AQ1	Analog output AQ1	Analog output configurable for voltage or current by software ● Analog voltage output 0…10 V DC, min. load impedance 470 Ω ● Analog current output freely programmable from 0…20 mA, max. load impedance 500 Ω ● Max. sampling period: 10 ms ± 1 ms ● Resolution 10 bits ● Accuracy: ± 1 % for a temperature variation of 60°C ● Linearity ± 0.2 %
AQ2	Analog output AQ2	
DQ+	Digital output for transmission of the DC voltage level	Pulse train output by switch PTO/DQ in position PTO ● Open collector not insulated ● Maximum voltage: 30 V DC ● Maximum current: 20 mA ● Frequency range: 0…30 kHz
P24	External input supply	External input supply +24 V DC ● Tolerance: min. 19 V DC, max. 30 V DC ● Current: max. 0.8 A
0V	Weight	0 V for external supply P24
DI1…DI8	Digital inputs	8 programmable digital inputs 24 V DC, comply with IEC/EN 61131-2 logic type 1 ● Positive logic (Source): state 0 when ≤ 5 V DC or digital input not wired, state 1 when ≥ 11 V DC ● Negative logic (Sink): state 0 when ≥ 16 V DC or digital input not wired, state 1 when ≤ 10 V DC ● Impedance 3.5 kΩ ● Maximum voltage: 30 V DC ● Max. sampling period: 2 ms ± 0.5 ms Multiple assignment makes it possible to configure several functions on one input (example: DI1 assigned to forward and preset speed 2, DI3 assigned to reverse and preset speed 3).
24V	Sampling voltage for digital inputs	● +24 V DC ● Tolerance: min. 20.4 V DC, max. 27 V DC ● Current: max. 200 mA for both 24 V terminals ● Terminal protected against overload and short-circuit ● When the selector switch is in position "Ext", this supply is powered by an external PLC.
10V	Sampling voltage for analog inputs	Not supported
AI1, AI3	Analog inputs and sensor inputs	Not supported
COM	Ground for analog I/O	Not supported
AI2	Analog input	Not supported

Signal interference can cause unexpected responses of the drive and of other equipment in the vicinity of the drive.

⚠ WARNING

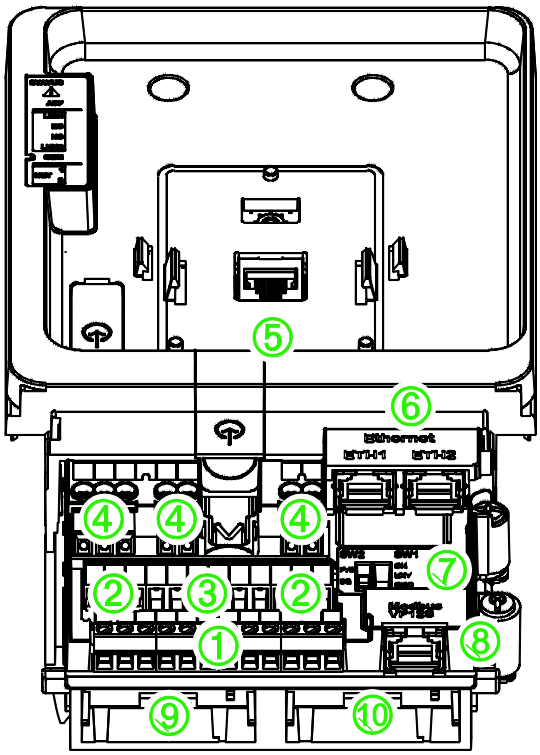
SIGNAL AND EQUIPMENT INTERFERENCE

- Install the wiring in accordance with the EMC requirements described in this document.
- Verify compliance with the EMC requirements described in this document.
- Verify compliance with all EMC regulations and requirements applicable in the country in which the product is to be operated and with all EMC regulations and requirements applicable at the installation site.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

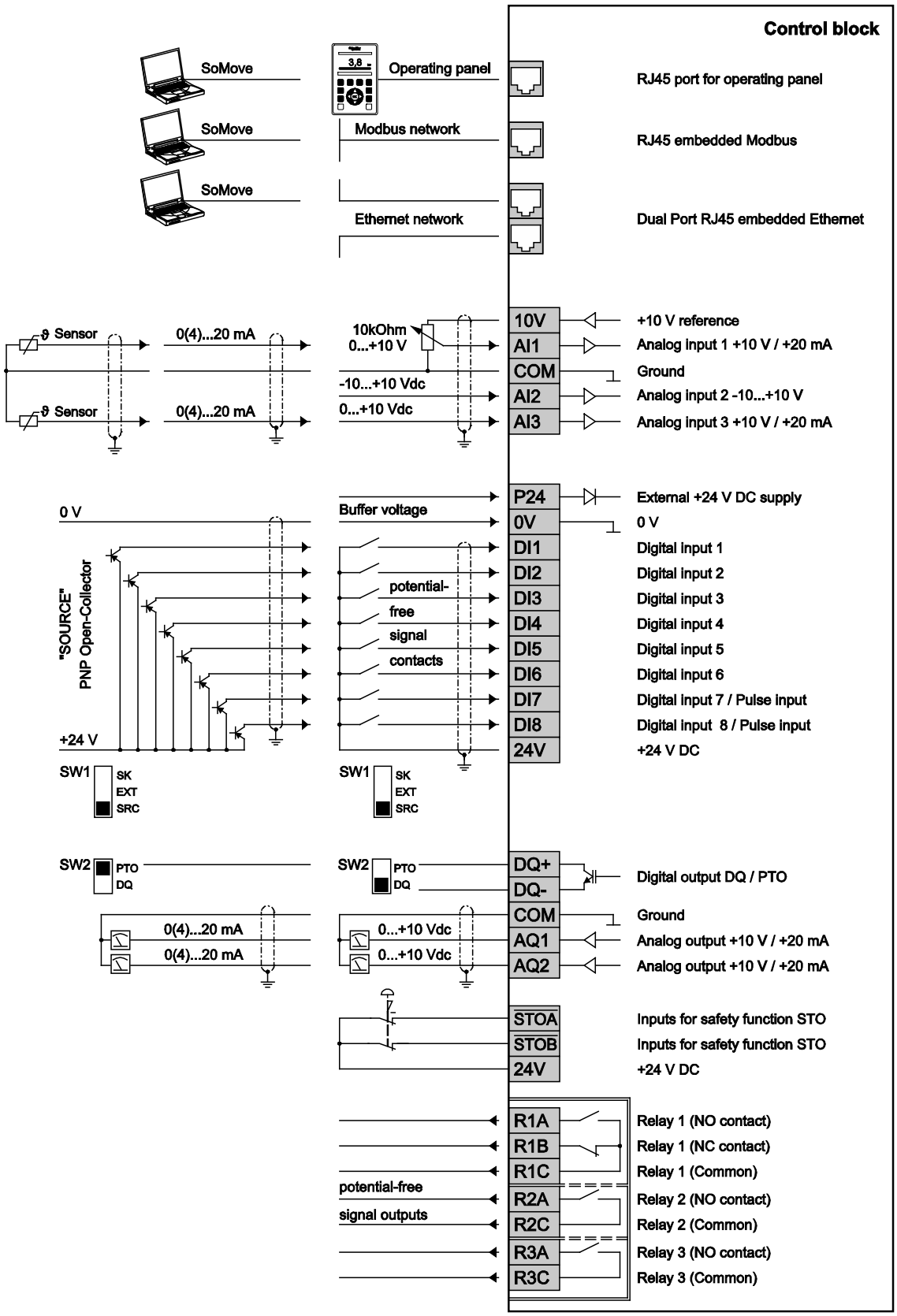
Control block ATV993

Structure of the Control Block

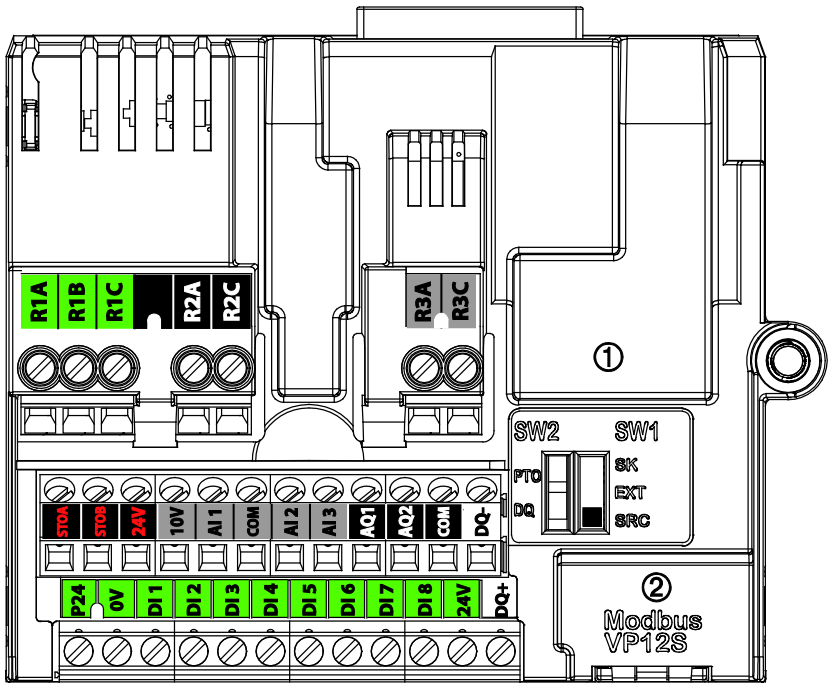


1 Control terminals of digital inputs
2 Control terminals STO (Safe Torque Off) and analog outputs
3 Control terminals of analog inputs
4 Control terminals of relay outputs
5 RJ45 port for the graphical keypad
6 Dual port RJ45 for Ethernet IP or Modbus TCP
7 Sink-Ext-Source selector switch and PTO/DQ selector switch
8 RJ45 port for serial Modbus
9 Slot B for I/O expansion card or encoder interface module
10 Slot A for communication card or I/O expansion card

Control Terminals at the Control Block



Specification of the Control Terminals



Screw terminals

Maximum cable cross section for all terminals: 1.5 mm² (AWG 16), 0.25 Nm

Minimum cable cross section:

- For relay terminals 0.75 mm²(AWG 18)
- For all other terminals 0.5 mm²(AWG 20)

Strip length: 10 mm

Maximum cable length:

- AI●, AQ●, DI●, DQ●: 50 m shielded
- $\overline{\text{STOA}}$, $\overline{\text{STOB}}$: 30 m

Terminal	Description	Specification
R1A R1B R1C	Relay output 1 (R1A NO contact, R1B NC contact)	● Minimum switching capacity: 5 mA for 24 V DC ● Maximum switching capacity on resistive load (cos φ = 1): 3 A for 250 V AC and 30 V DC ● Maximum switching capacity on inductive load (cos φ = 0.4 and L/R = 7 ms): 2 A for 250 V AC and 30 V DC ● Response time: 5 ms ± 0.5 ms ● Life cycle: 100,000 switching cycles at max. switching capacity
R2A R2C	Relay output 2 (NO contact)	● Minimum switching capacity: 5 mA for 24 V DC ● Maximum switching capacity on resistive load (cos φ = 1): 3 A for 250 V AC and 30 V DC ● Maximum switching capacity on inductive load (cos φ = 0.4 and L/R = 7 ms): 2 A for 250 V AC and 30 V DC ● Response time: 5 ms ± 0.5 ms ● Life cycle: 100,000 switching cycles at max. switching capacity
R3A R3C	Relay output 3 (NO contact)	● Minimum switching capacity: 5 mA for 24 V DC ● Maximum switching capacity on resistive load (cos φ = 1): 3 A for 250 V AC and 30 V DC ● Maximum switching capacity on inductive load (cos φ = 0.4 and L/R = 7 ms): 2 A for 250 V AC and 30 V DC ● Response time: 5 ms ± 0.5 ms ● Life cycle: 100,000 switching cycles at max. switching capacity

Terminal	Description	Specification
$\overline{\text{STOA}}$, $\overline{\text{STOB}}$	STO inputs	Inputs of the safety function STO See "Safety Function Manual (NHA80947)" available on *www.schneider-electric.com*.
24V	Sampling voltage for STO inputs	+24 V DC for STO inputs $\overline{\text{STOA}}$ and $\overline{\text{STOB}}$
COM	Ground for analog I/O	0 V reference potential for analog outputs
AQ1	Analog output AQ1	Analog output configurable for voltage or current by software ● Analog voltage output 0…10 V DC, min. load impedance 470 Ω ● Analog current output freely programmable from 0…20 mA, max. load impedance 500 Ω ● Max. sampling period: 10 ms ± 1 ms ● Resolution 10 bits ● Accuracy: ± 1 % for a temperature variation of 60°C ● Linearity ± 0.2 %
AQ2	Analog output AQ2	
DQ+ DQ-	Digital output	Digital output configurable by switch PTO/DQ in position DQ ● Insulated ● Maximum voltage: 30 V DC ● Maximum current: 100 mA ● Frequency range: 0…1 kHz ● Max. sampling period: 2 ms ± 0.5 ms ● Positive/negative logic is realized by wiring
DQ+	Digital output	Pulse train output configurable by switch PTO/DQ in position PTO ● Open collector not insulated ● Maximum voltage: 30 V DC ● Maximum current: 20 mA ● Frequency range: 0…30 kHz
P24	External input supply	External input supply +24 V DC ● Tolerance: min. 19 V DC, max. 30 V DC ● Current: max. 0.8 A
0V	Weight	0 V for external supply P24
DI1…DI8	Digital inputs	8 programmable digital inputs 24 V DC, comply with IEC/EN 61131-2 logic type 1 ● Positive logic (Source): state 0 when ≤ 5 V DC or digital input not wired, state 1 when ≥ 11 V DC ● Negative logic (Sink): state 0 when ≥ 16 V DC or digital input not wired, state 1 when ≤ 10 V DC ● Impedance 3.5 kΩ ● Maximum voltage: 30 V DC ● Max. sampling period: 2 ms ± 0.5 ms Multiple assignment makes it possible to configure several functions on one input (example: DI1 assigned to forward and preset speed 2, DI3 assigned to reverse and preset speed 3).

Terminal	Description	Specification
DI7…DI8	Pulse inputs	Programmable pulse inputs ● Comply with level 1 PLC standard IEC 65A-68 ● State 0 when ≤ 0.6 V DC, state 1 when ≥ 2.5 V DC ● Pulse counter 0…30 kHz ● Frequency range: 0…30 kHz ● Duty cycle: 50 % ± 10 % ● Maximum input voltage: 30 V DC, < 10 mA ● Max. sampling period: 5 ms ± 1 ms
24V	Sampling voltage for digital inputs	● +24 V DC ● Tolerance: min. 20.4 V DC, max. 27 V DC ● Current: max. 200 mA for both 24 V terminals ● Terminal protected against overload and short-circuit ● When the selector switch is in position "Ext", this supply is powered by an external PLC.
10V	Sampling voltage for analog inputs	Internal supply for reference potentiometer (1…10 kΩ) ● 10.5 V DC ● Tolerance: ± 5 % ● Current: max. 10 mA ● Short-circuit protected

AI1, AI3	Analog inputs and sensor inputs	Three analog input configurable for voltage or current by parameter
		● Analog voltage input 0…10 V DC, impedance 31.5 kΩ
		● Analog current input freely programmable from 0…20 mA, impedance 250 Ω
		● Max. sampling period: 1 ms ± 1 ms
		● Resolution 12 bits
		● Accuracy: ± 0.6 % for a temperature variation of 60°C
		● Linearity ± 0.15 % of maximum value
		
		Pt100, Pt1000, KTY84 or PTC sensor configurable by software
		● **Pt100**
		  ● 1 or 3 temperature sensors per analog input (configurable by software)
		  ● Sensor current: 5 mA
		  ● Range -20…200°C
		  ● Accuracy: ± 4 C for a temperature variation of 60°C
		● **Pt1000, KTY84**
		  ● 1 (Pt1000, KTY84) or 3 (Pt1000) temperature sensors in series per analog input (configurable by software)
		  ● Temperature sensor current: 1 mA
		  ● Range -20…200°C
		  ● Accuracy: ± 4 C for a temperature variation of 60°C
		● **PTC**
		  ● 1 to 6 sensors in series
		  ● Sensor current: 1 mA
		  ● Nominal value: < 1.5 kΩ
		  ● Overheat trigger threshold: 2.9 kΩ ±0.2 kΩ
		  ● Overheat reset threshold: 1.575 kΩ ±0.75 kΩ
		  ● Threshold for low impedance detection: 50 kΩ - 10 Ω/+20 Ω
		  ● Short-circuit detection threshold: < 1 kΩ

COM	Ground for analog I/O	0 V reference potential for analog outputs

Terminal	Description	Specification
AI2	Analog input	Bipolar voltage input -10...+10 V DC, impedance: 31.5 kΩ ● Max. sampling period: 1 ms ± 1 ms ● Resolution 12 bits ● Accuracy: ± 0.6 % for a temperature variation of 60°C ● Linearity ± 0.15 % of maximum value

⚠⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Verify that the temperature sensors in the motor meet the PELV requirements.
- Verify that the motor encoder meets the PELV requirements.
- Verify that any other equipment connected via signal cables meets the PELV requirements.

Failure to follow these instructions will result in death or serious injury.

Signal interference can cause unexpected responses of the drive and of other equipment in the vicinity of the drive.

⚠ WARNING

SIGNAL AND EQUIPMENT INTERFERENCE

- Install the wiring in accordance with the EMC requirements described in this document.
- Verify compliance with the EMC requirements described in this document.
- Verify compliance with all EMC regulations and requirements applicable in the country in which the product is to be operated and with all EMC regulations and requirements applicable at the installation site.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Configuration of the Sink / Source Selector Switch

⚠ WARNING

UNANTICIPATED EQUIPMENT OPERATION

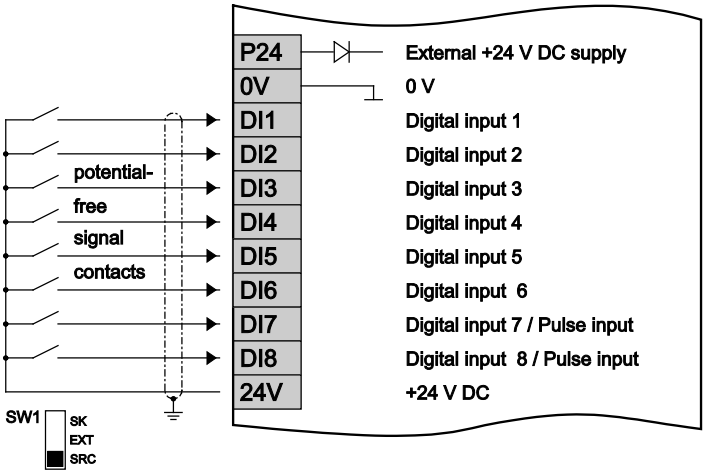
- If the drive is set to "Sink Int" or "Sink Ext", do not connect the "0 V" terminal to ground or to protective ground.
- Verify that accidental grounding of digital inputs configured for sink logic, caused, for example, by damage to the signal cables, cannot occur.
- Follow all applicable standards and directives such as NFPA 79 and EN 60204 for proper control circuit grounding practices.

Failure to follow these instructions can result in death, serious injury or equipment damage.

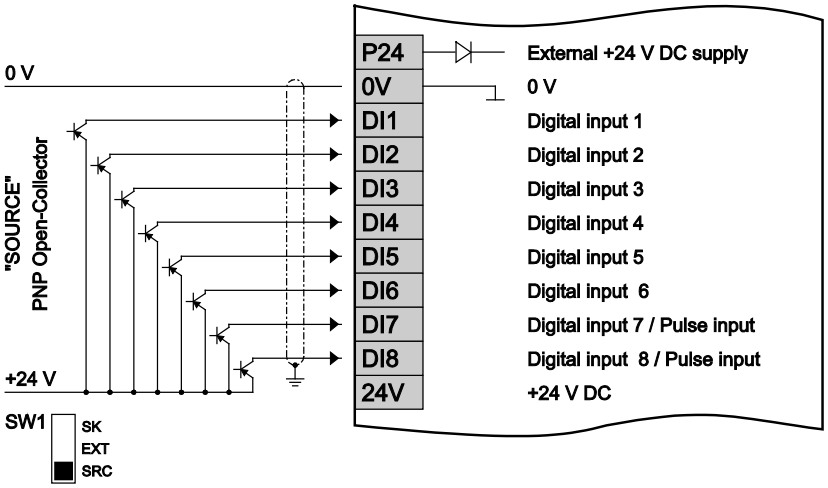
The switch is used to adapt the operation of the digital inputs to the technology of the signal control. The switch is located below the control terminals (see picture at page 123).

- Set the selector switch to SRC (Source) when using PLC outputs with PNP transistors (factory setting).
- Set the switch to Ext (external) when using PLC outputs with NPN transistors.

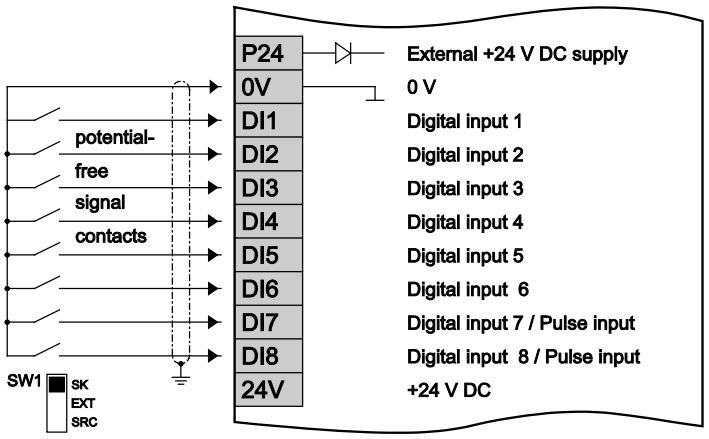
Selector Switch in Position SRC (Source) and Internal Voltage Supply of the Digital Inputs



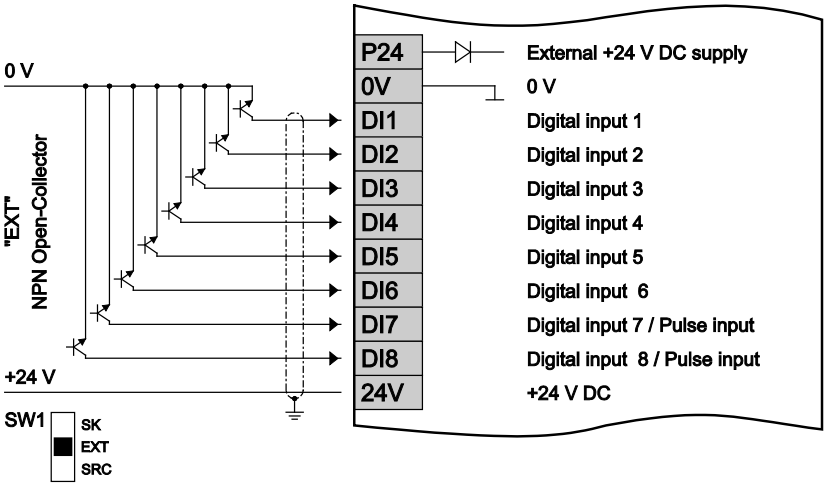
Selector Switch in Position SRC (Source) and External Voltage Supply of the Digital Inputs



Selector Switch in Position SK (Sink) and Internal Voltage Supply of the Digital Inputs



Selector Switch in Position EXT (external) and External Voltage Supply of the Digital Inputs



Configuration of the Selector Switch for Pulse Train Outputs / Digital Outputs

⚠ WARNING

UNANTICIPATED EQUIPMENT OPERATION

- If the drive is set to "Sink Int" or "Sink Ext", do not connect the "0 V" terminal to ground or to protective ground.
- Verify that accidental grounding of digital inputs configured for sink logic, caused, for example, by damage to the signal cables, cannot occur.
- Follow all applicable standards and directives such as NFPA 79 and EN 60204 for proper control circuit grounding practices.

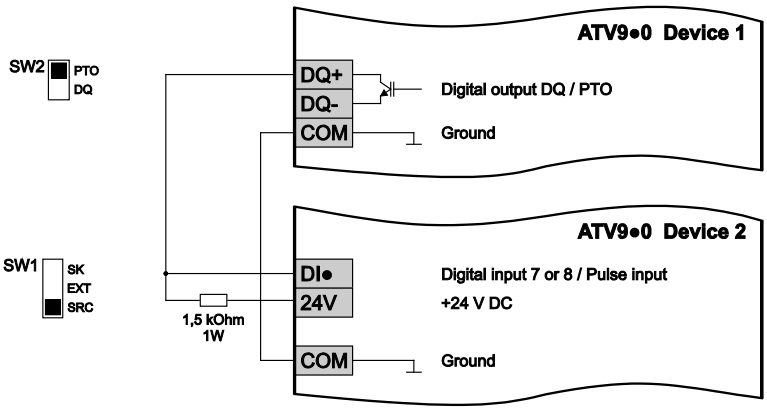
Failure to follow these instructions can result in death, serious injury or equipment damage.

The PTO/DQ switch is used to configure the digital outputs DQ+ and DQ-.

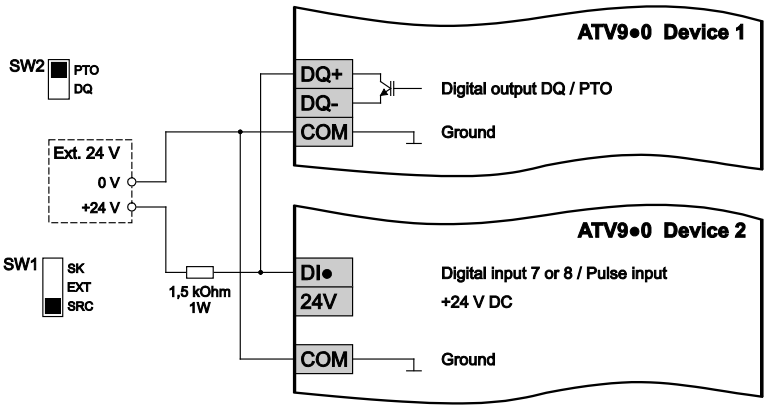
- Set the selector switch to PTO (Pulse Train Output) to configure the outputs DQ+ and DQ- as pulse train outputs. This may be used to chain pulse train inputs of another drive, using its pulse inputs DI7 or DI8.
- Set the selector switch to DQ (Digital Output) to configure the outputs DQ+ and DQ- as assignable logic outputs.

The switch is located below the control terminals (see picture at page 123).

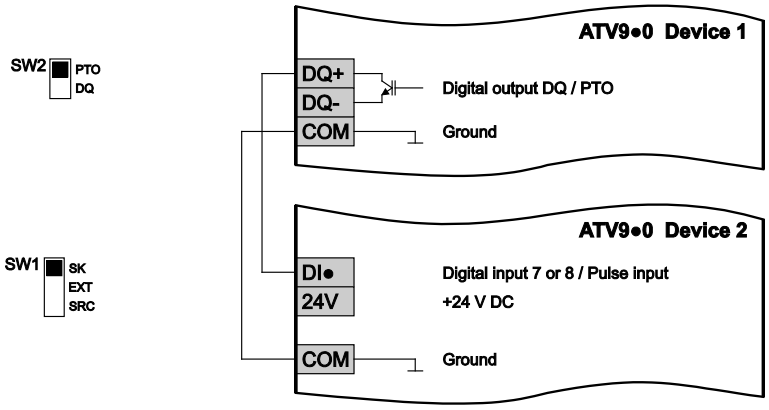
Selector Switch in Position SRC (Source) and Internal Voltage Supply of the Digital Inputs



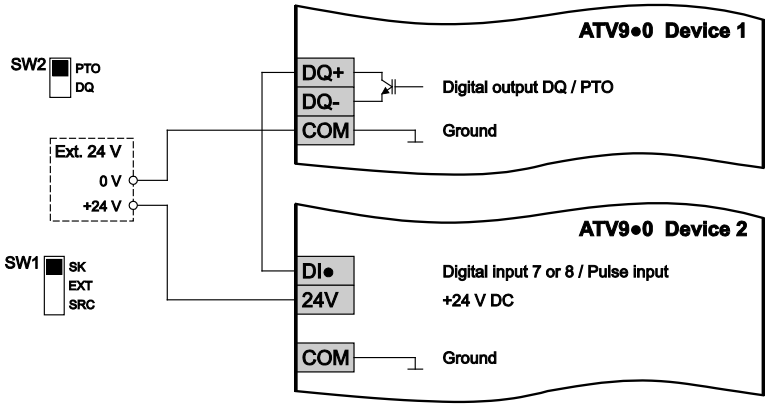
Selector Switch in Position SRC (Source) and External Voltage Supply of the Digital Inputs



Selector Switch in Position SK (Sink) and Internal Voltage Supply of the Digital Inputs



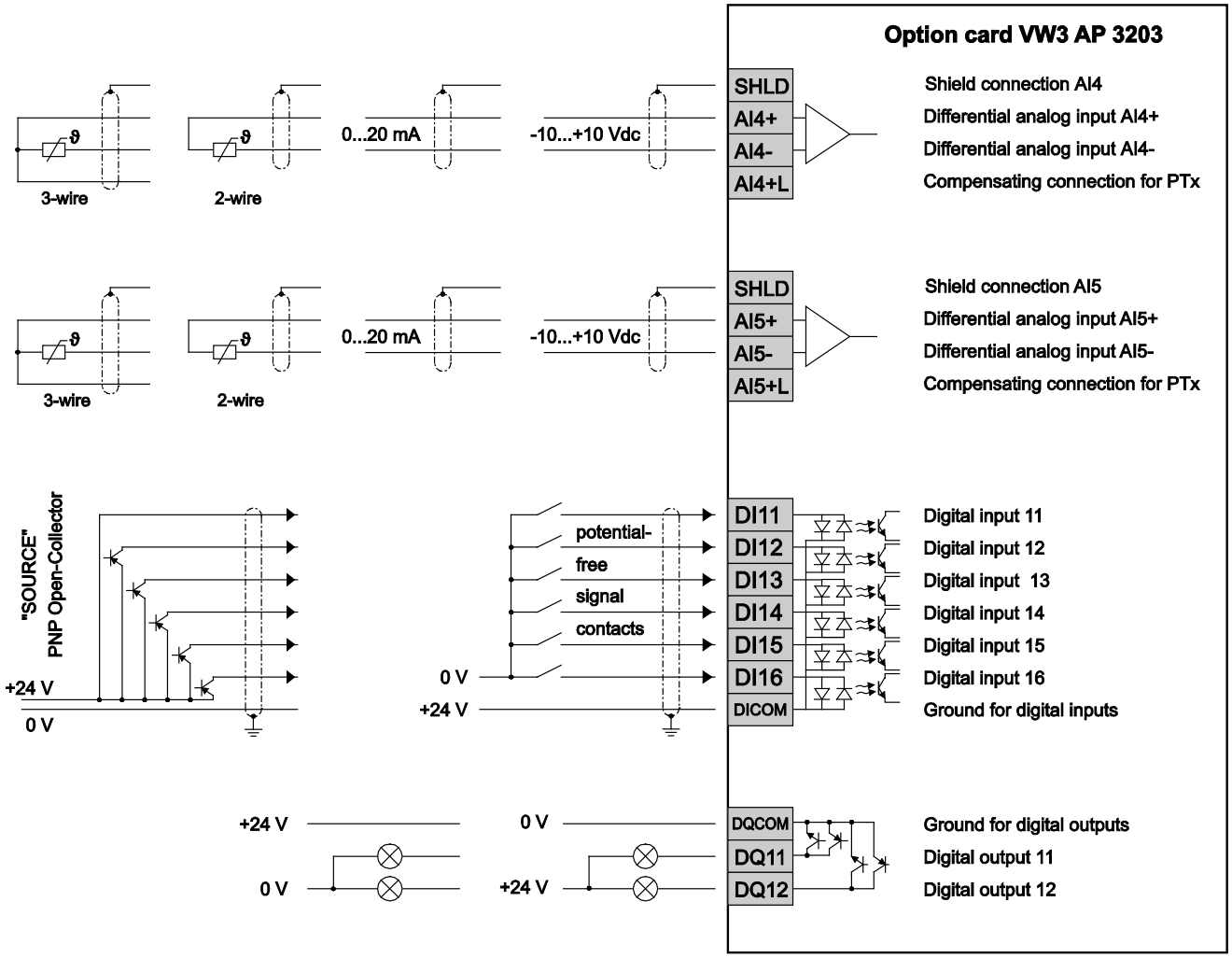
Selector Switch in Position EXT (external) and External Voltage Supply of the Digital Inputs



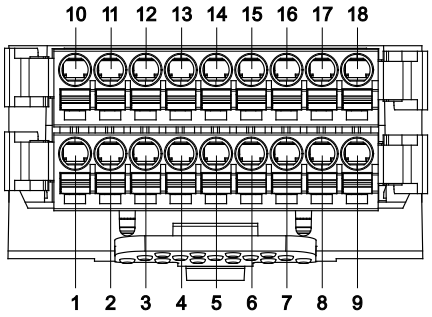
Option "Logic and Analog I/O Card"

Control terminals at the expansion card

Option to expand the control inputs and control outputs of the control block. The expansion card contains two analog inputs, six digital inputs and two digital outputs.



Specification of the Control Terminals



Spring terminals

Max. cable cross section: 1 mm² (AWG 16)
Strip length: 10 mm
Max. cable length AI●, AQ●, DI●, DQ●: 50 m shielded

Pin	Terminal	Description	Specification

1	SHLD	Shield connection for AI4	You can select between voltage, current, Pt100, Pt1000, KTY84 and PTC measurement by software configuration.
			Differential voltage at the input circuit:
			● Range: -10 V DC…+10 V DC
			● Impedance: 20 kΩ
			● Resolution: 11 bits + 1 sign bit
			● Accuracy: ± 0.6 % for a temperature variation of 60 °C
			● Linearity ± 0.15 % of maximum value
			Current measurements:
			● Range: freely programmable from 0…20 mA
			● Impedance: 250 Ω
			● Resolution: 12 bits
			● Accuracy: ± 0.6 % for a temperature variation of 60 °C
			● Linearity ± 0.15 % of maximum value
			● Sampling period: 1 ms
			PTx measurement:
			Pt100, Pt1000, PTC or KTY84 configurable by software
			● **Pt100**
			  ● 1 or 3 temperature sensors in series per analog input (configurable by software)
			  ● Temperature sensor current: max. 7.5 mA
			  ● Range -20…200 °C
			  ● Accuracy: ± 3°C for a temperature variation of 60 °C
			● **Pt1000, KTY84**
			  ● 1 (Pt1000, KTY84) or 3 (Pt1000) temperature sensors in series per analog input (configurable by software)
			  ● Temperature sensor current: max. 1 mA
			  ● Range -20…200 °C
			  ● Accuracy: ± 3 C for a temperature variation of 60 °C
			● **PTC**
			  ● 3 or 6 temperature sensors in series
			  ● Temperature sensor current: max. 1 mA
			  ● Nominal value: < 1.5 kΩ
			  ● Overheat trigger threshold: 2.9 kΩ
			  ● Overheat reset threshold: 1.575 kΩ
			  ● Short-circuit detection threshold: < 1 kΩ
			  ● Wire break detection: > 100 kΩ

2	AI4+	**Differential analog input 4** Depending on software configuration: ● Measurement of differential voltage ● PTx measurement ● 0…20 mA measurement ● Reference potential AI4- for AI4+	
3	AI4-		
4	AI4+L	Compensating connection for one temperature sensor Pt100, Pt1000 or KTY84 in 3-wire-design	
5	SHLD	Shield connection for AI5	
6	AI5+	**Differential analog input 5** Depending on software configuration: ● Measurement of differential voltage ● PTx measurement ● 0…20 mA measurement ● Reference potential AI5- for AI5+	
7	AI5-		
8	AI5+L	Compensating connection for one temperature sensor Pt100, Pt1000 or KTY84 in 3-wire-design	

Pin	Terminal	Description	Specification
9	DQ12	Digital output 12	The 24 V DC digital outputs DQ comply with the standard IEC/EN 61131-2. ● Logic type selected by DQCOM wiring ● Output voltage: ≤ 30 V DC ● Switching capability: ≤ 100 mA ● Voltage drop at 100 mA load: ≤ 3 V DC ● Response time: 1 ms
10	DICOM	Reference potential for the digital inputs	The 24 V DC digital inputs DI are galvanically isolated via optocoupler and comply with the standard IEC/EN 61131-2. ● Logic type selected by DICOM wiring ● Positive logic (Source): state 0 when ≤ 5 V DC, state 1 when ≥ 11 V DC ● Negative logic (Sink): state 0 when ≥ 16 V DC, state 1 when ≤ 10 V DC ● Maximum voltage: ≤ 30 V DC ● Input current (typically): 2.5 mA ● Sampling period: 1 ms
11	DI11	Digital input 11	
12	DI12	Digital input 12	
13	DI13	Digital input 13	
14	DI14	Digital input 14	
15	DI15	Digital input 15	
16	DI16	Digital input 16	
17	DQCOM	Reference potential for the digital outputs	The 24 V DC digital outputs DQ comply with the standard IEC/EN 61131-2. ● Logic type selected by DQCOM wiring ● Output voltage: ≤ 30 V DC ● Switching capability: ≤ 100 mA ● Voltage drop at 100 mA load: ≤ 3 V DC ● Response time: 1 ms
18	DQ11	Digital output 11	

⚠⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Verify that the temperature sensors in the motor meet the PELV requirements.
- Verify that the motor encoder meets the PELV requirements.
- Verify that any other equipment connected via signal cables meets the PELV requirements.

Failure to follow these instructions will result in death or serious injury.

Signal interference can cause unexpected responses of the drive and of other equipment in the vicinity of the drive.

⚠ WARNING

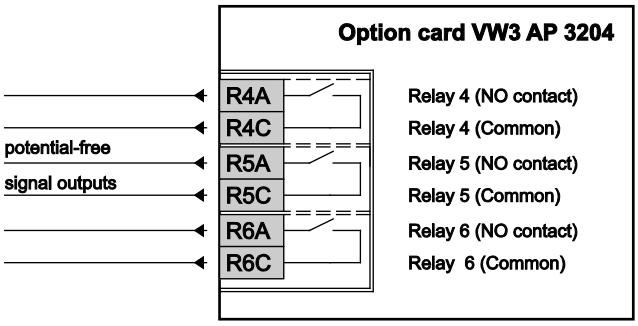
SIGNAL AND EQUIPMENT INTERFERENCE

- Install the wiring in accordance with the EMC requirements described in this document.
- Verify compliance with the EMC requirements described in this document.
- Verify compliance with all EMC regulations and requirements applicable in the country in which the product is to be operated and with all EMC regulations and requirements applicable at the installation site.

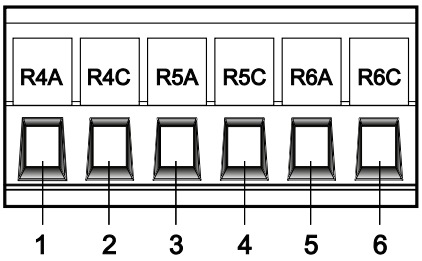
Failure to follow these instructions can result in death, serious injury, or equipment damage.

Option "Relay Output Card"

Control terminals at the expansion card



Specification of the Control Terminals



Screw terminals

Maximum cable cross section: 1.5 mm² (AWG 16)
Maximum tightening torque: 0.5 Nm (4.4 lb.in)
Minimum cable cross section: 0.75 mm² (AWG 18)
Strip length: 10 mm

Pin	Terminal	Description	Specification
1	R4A	Relay output 4 (NO contact)	**Programmable relay output 4:** ● Minimum switching capacity: 5 mA for 24 V DC ● Maximum switching capability on resistive load (cos φ = 1): 3 A for 250 V AC and 30 V DC ● Maximum switching capability on inductive load (cos φ = 0.4 and L/R = 7 ms): 2 A for 250 V AC and 30 V DC ● Response time: 5 ms ± 0.5 ms ● Life cycle: 100,000 switching cycles at max. switching capacity
2	R4C		
3	R5A	Relay output 5 (NO contact)	**Programmable relay output 5:** ● Minimum switching capacity: 5 mA for 24 V DC ● Maximum switching capability on resistive load (cos φ = 1): 3 A for 250 V AC and 30 V DC ● Maximum switching capability on inductive load (cos φ = 0.4 and L/R = 7 ms): 2 A for 250 V AC and 30 V DC ● Response time: 5 ms ± 0.5 ms ● Life cycle: 100,000 switching cycles at max. switching capacity
4	R5C		
5	R6A	Relay output 6 (NO contact)	**Programmable relay output 6:** ● Minimum switching capacity: 5 mA for 24 V DC ● Maximum switching capability on resistive load (cos φ = 1): 3 A for 250 V AC and 30 V DC ● Maximum switching capability on inductive load (cos φ = 0.4 and L/R = 7 ms): 2 A for 250 V AC and 30 V DC ● Response time: 5 ms ± 0.5 ms ● Life cycle: 100,000 switching cycles at max. switching capacity
6	R6C		

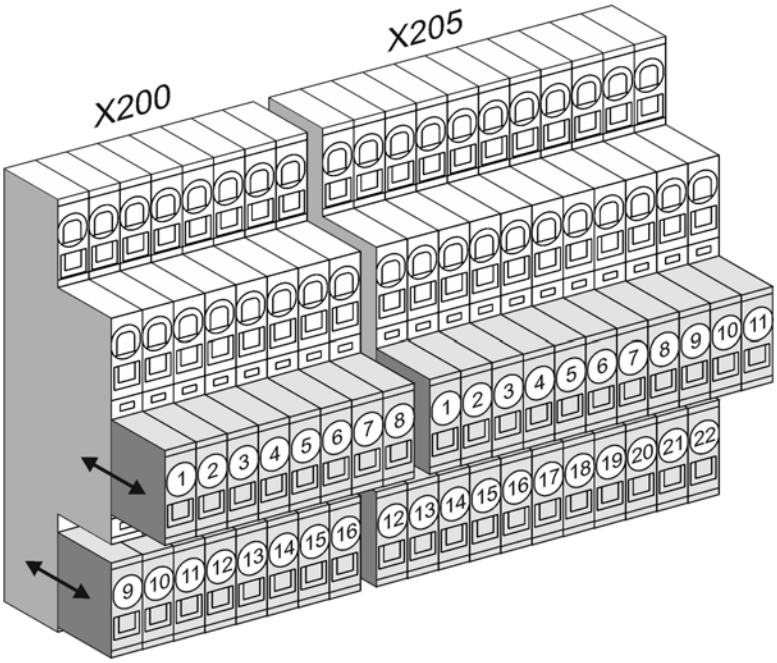
Option Terminals

Control Terminals at the Option Terminals

The option terminals X200 and X205 are built-in at each Altivar Process Drive System as standard. They are designed as pluggable terminals.

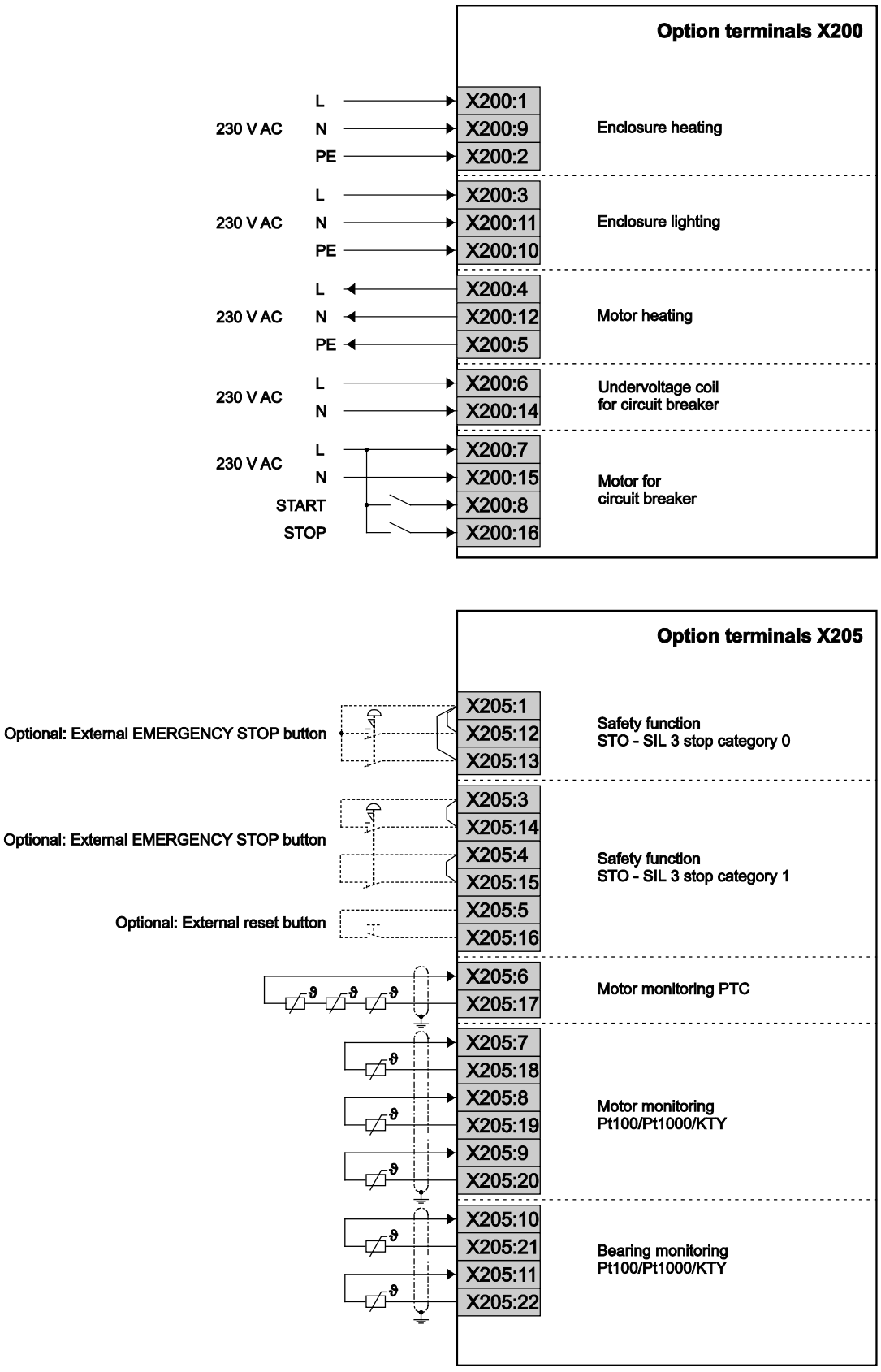
Spring terminals pluggable

Max. cable cross section: 2.5 mm² [AWG 12]
Min. cable cross section: 0.25 mm² [AWG 26]
Strip length: 10 mm



Specification of the Control Terminals

As shown in the following illustration, there are following connections available for the customer depending on the chosen options.



Chapter 8
Customizations

What Is in This Chapter?

This chapter contains the following topics:

Enclosure Options

During manufacturing of the Altivar Process Drive Systems already all customizations are considered. In addition, parameter adjustments are carried out and permanently stored as factory setting, if required.

This chapter contains customizations, which we have already predefined as a result of our many years of experience in order to cover the essential requirements of our customers. But in many cases a unique system solution is necessary due to the variety of applications and requirements.

Your Drive Systems Tendering Team is looking forward to your specific request.

Increased Protection Degree IP54

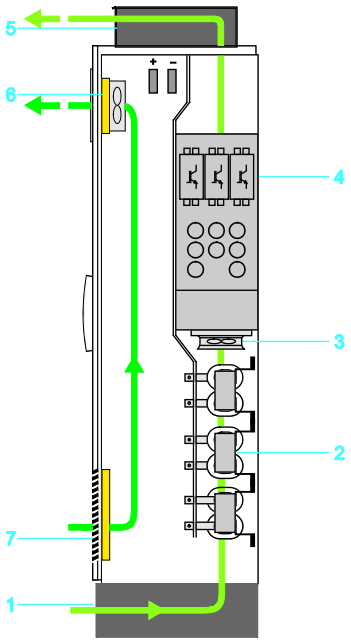
For operation with rough ambient conditions the enclosure can be designed in protection degree IP54. So when the doors are closed the Altivar Process Drive System is protected against:

- Touching live electrical parts
- Harmful dust accumulation inside
- Penetration of spray water from all directions

Typically, IP54 enclosure units are installed production halls and manufacturing sites, where heavy dirt accumulation is expected.

Our solution contains a clearly specified and tested cooling system with a separate cooling air channel which provides highest reliability.

Via this separated cooling air channel about 90 % of the heat losses are exhausted. The interior of the enclosure is cooled via fans in the enclosure door.



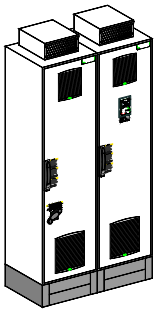
In case of increased protection degree IP54 with separate air channel the cooling air inflow for the power part takes place through the floor and the air outlet through the enclosure roof. The control part is cooled by filter fans in the enclosure door.

1	Cooling air for power part (via enclosure plinth)
2...4	Power components (different for supply units and inverter units)
5	Air outlet through metal grid with splash water protection
6	Air outlet (with filter mat) with fans for control part
7	Air inflow grid (with filter mat) for control part

Air inflow temperature: -10...+50 °C
(below 0 °C with additional enclosure heating,
above +40 °C with derating)

NOTE: The additional enclosure plinth increases the enclosure by 200 mm to a total height of 2350 mm.

Enclosure Plinth for Basic Device

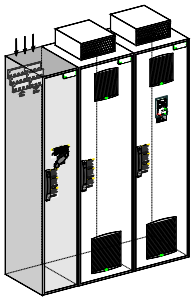


For adapting to the local conditions or for better protection of the enclosure against wet soil, the enclosure can be raised with a plinth (color: RAL 7022) by 200 mm.

So the enclosure height is increased to a total height of 2350 mm.

NOTE: At the customization "Increased protection degree IP54" the enclosure is already equipped with an enclosure plinth as standard.

Connection Enclosure Cable from Top



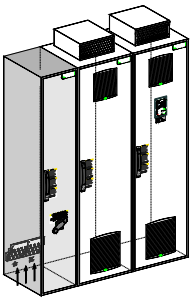
This separate connection enclosure makes it possible to insert and connect the mains cables and motor cables from the top of the enclosure.

The separated connecting enclosure contains all power terminals and the mains disconnection (e.g. main switch), which makes a voltage disconnection of the basic device during maintenance possible.

Furthermore, the connecting enclosure provides enough space for additional customizations.

NOTE: The additional connecting enclosure increases the total width of the enclosure.

Connection Enclosure Cable from Bottom



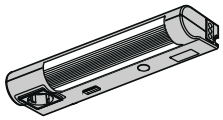
This separate connection enclosure makes it possible to insert and connect the mains cables and motor cables from the bottom of the enclosure.

The separated connecting enclosure contains all power terminals and the mains disconnection (e.g. main switch), which makes a voltage disconnection of the basic device during maintenance possible.

Furthermore, the connecting enclosure provides enough space for additional customizations.

NOTE: The additional connecting enclosure increases the total width of the enclosure.

Enclosure Lighting



In order to make maintenance easier, the enclosure can be equipped with a lighting, which is switched on when opening the enclosure door.

The lighting is externally supplied and so it is also available at switched off mains supply. Furthermore, a power socket according to VDE standard (230 V / 50 Hz, 2 A) is located on the lighting to operate smaller consumers on-site.

NOTE: The additional power supply at terminals X200 has to be provided by the user.

Rated voltage:	230 V
Rated frequency:	50/60 Hz
Rated power:	500 VA

This option requires an additional external 230 V power supply with overvoltage category 1 or 2 (according to IEC/UL 61800-5-1) connected to terminals X200.

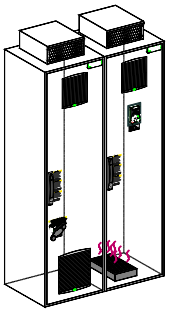
⚠⚠ DANGER

HAZARD OF ELECTRIC SHOCK

Verify that the external power supply complies with all national and local electrical code requirements.

Failure to follow these instructions will result in death or serious injury.

Enclosure Heating



This customization is used to heat the enclosure in order to avoid frost and condensation at an ambient temperature up to -10°C. The enclosure heating is externally supplied, so the enclosure can be also heated when mains supply is switched off.

NOTE: The additional power supply at terminals X200 has to be provided by the user.

Rated voltage:	230 V
Rated frequency:	50/60 Hz
Rated power:	400...800 VA

This option requires an additional external 230 V power supply with overvoltage category 1 or 2 (according to IEC/UL 61800-5-1) connected to terminals X200.

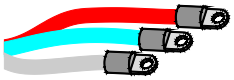
⚠⚠ DANGER

HAZARD OF ELECTRIC SHOCK

Verify that the external power supply complies with all national and local electrical code requirements.

Failure to follow these instructions will result in death or serious injury.

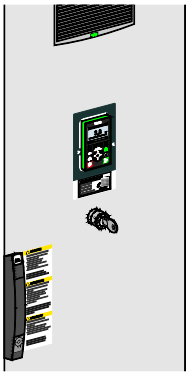
Modified Wiring Colors



This option contains modified wiring colors as well as red, white and blue heat shrink tubes at the power cables.

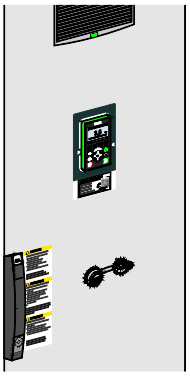
Control Options

Key Switch "local / remote"



The key switch "local / remote" allows to switch between local operation (via the graphical operating panel) or remote control (terminals or bus). The switch can be only operated with a key and so it can be only switched by authorized personnel.

Ethernet Port on Front Door



The Ethernet port in the enclosure door allows access to the frequency inverter without opening the enclosure door. The plug can be closed with a dust protection cap.

I/O Expansion Cards

You will find detailed information in the respective documentation. See listing under chapter "Related Documents", page 7.

Expansion Card With Additional Inputs / Outputs

Expansion card for additional analog and digital inputs and outputs (6 digital inputs, 2 digital outputs, 2 analog inputs)

You will find further information at chapter "Option "Logic and Analog I/O Card"", page 138.

Expansion Card With Relay Outputs

Expansion card with three additional relay outputs

You will find further information at chapter "Option "Relay Output Card"", page 141.

Communication Cards

You will find detailed information in the respective documentation. See listing under chapter "Related Documents", page 7.

Communication Card Modbus TCP or EtherNet IP

Dual port option card for control of the inverter via Modbus TCP or EtherNet/IP

Communication Card CANopen Daisy Chain

Option card for control of the inverter via CANopen Daisy Chain

Communication Card CANopen SUB-D9

Option card for control of the inverter via CANopen with SUB-D port.

Communication Card CANopen With Screw Terminals

Option card for control of the inverter via CANopen with screw terminals

Communication Card DeviceNet

Option card for control of the inverter via DeviceNet

Communication Card Profibus DP

Option card for control of the inverter via Profibus DP V1

Communication Card PROFINET

Option card for control of the inverter via PROFINET

Communication Card EtherCAT Daisy Chain

Option card for control of the inverter via EtherCAT Daisy Chain

Encoder Interface Modules

You will find detailed information in the respective documentation. See listing under chapter "Related Documents", page 7.

Digital Encoder Interface Module 5/12 V

Interface module for connecting a digital encoder

Analog Encoder Interface Module

Interface module for connecting an analog encoder

Resolver Interface Module

Interface module for connecting a resolver

HTL Encoder Interface Module

Interface module for connecting an encoder with push-pull (HTL) output driver

Functional Safety

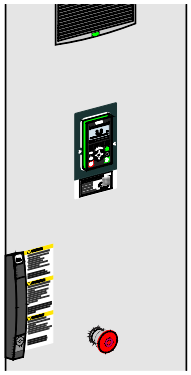
Safe Torque Off (STO)

The Altivar Process is equipped with the safety function "Safe Torque Off STO" according to ISO 13849-1, IEC/EN 61508, IEC/EN 60204-1, which helps to prevent any unintended start-up of the motor.

- Inputs $\overline{\text{STOA}}$ and $\overline{\text{STOB}}$ directly at the control terminals of the control block.
  This function fulfills, when correctly wired, the machine standard ISO 13849-1, Performance level PL e, the IEC/EN 61508 Safety integrity level SIL 3 standard for functional safety and the power drive system standard IEC/EN 61800-5-2.
- Customization SIL3, stop category 0 / PL e
  The triggering of the safety function leads to a coast down of the drive and helps to prevent an unintended restart.
- Customization SIL3, stop category 1 / PL e
  The triggering of this function starts a controlled deceleration, shuts down the drive after the set time and helps to prevent an unintended restart.

NOTE: You will find further information in the Safety Function Manual (*NHA80947*).

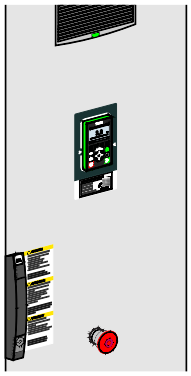
Safe Torque Off STO – SIL 3 Stop Category 0 / Performance Level PL e



Via an EMERGENCY STOP button in the enclosure door or further implemented, external monitoring equipment, the torque at the motor can be switched off according SIL 3 stop category 0 / performance level PL e.

The triggering of the safety function leads to a coast down of the drive and helps to prevent an unintended restart.

Safe Torque Off STO – SIL 3 Stop Category 1 / Performance Level PL e

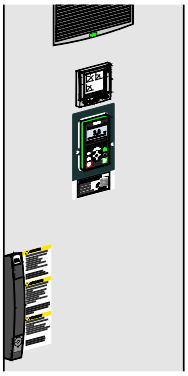


Via an EMERGENCY STOP button in the enclosure door or further implemented, external monitoring equipment, the torque at the motor can be switched off according SIL 3 stop category 1 / performance level PL e.

The triggering of this function starts a controlled deceleration, shuts down the drive after the set time and helps to prevent an unintended restart.

Display Options

Front Display Module (FDM)

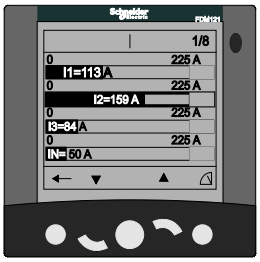


A display element mounted in the enclosure door enables clear indication of real-time values like:

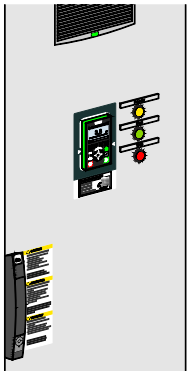
- Indication of mains currents (3x)
- Mains voltages (3x phase voltages, 3x phase-to-phase voltages)
- Mains power

These values can be indicated graphically or digital.

The display element is provided with backlight for increased readability.



Indicator Lamps on Front Door



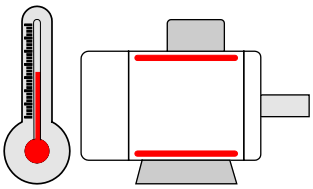
For quick, optical diagnostics of the actual operating state from a greater distance, the enclosure can be equipped with indicator lamps.

The lamps show following operating states:

Operating state	Indicator lamp	Labeling
Ready	Yellow	READY
Operation	Green	RUN
Detected fault	Red	TRIP

Motor Options

Motor Monitoring PTC

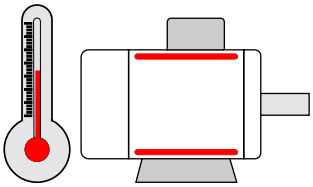


If the motor is equipped with integrated thermistor sensors to help to protect against thermal overload, they can be directly connected to a thermistor relay inside the Altivar Process Drive System.

If the frequency inverter detects an overtemperature at the motor, the drive stops the motor and generates an error message at the display. This operating state is also forwarded to the status relays and to the fieldbus.

NOTE: When protective separation of the thermistor sensors in the motor cannot be guaranteed or in case of long motor cables, this option is highly recommended.

Motor Monitoring PTC with ATEX Certificate



The motor monitoring PTC with ATEX certificate is used to monitor the thermistor sensors of motors which are installed in hazardous area (explosive atmosphere).

If the frequency inverter detects the overtemperature at the motor, the drive stops the motor and generates an error message at the display. This operating state is also forwarded to the status relays and to the fieldbus. The monitoring relay additionally triggers a safe shut-down of the drive.

This equipment has been designed to operate outside of any hazardous location. Only install this equipment in zones known to be free of hazardous atmosphere.

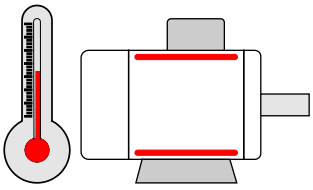
⚠ DANGER

POTENTIAL FOR EXPLOSION

Install and use this equipment in non-hazardous locations only.

Failure to follow these instructions will result in death or serious injury.

Motor monitoring Pt100/Pt1000/KTY

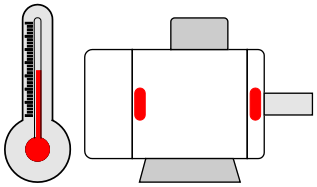


If the motor is equipped with integrated temperature sensors (Pt100, Pt1000, KTY 83/84) in the winding to help to protect against thermal overload, they can be directly connected to the relay inside the Altivar Process Drive System.

If the set temperature at the motor is exceeded, a warning message is generated. When the temperature is further rising over a set value, the drive is stopped and an error message is generated. The operating states are also forwarded to the status relays and to the fieldbus.

NOTE: When protective separation of the thermistor sensors in the motor cannot be guaranteed or in case of long motor cables, this option is highly recommended.

Bearing Monitoring Pt100/Pt1000/KTY

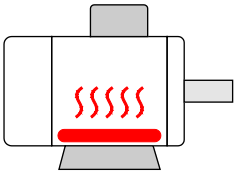


If the motor is equipped with integrated temperature sensors (Pt100, Pt1000, KTY 83/84) in the bearings to help to protect against thermal overload, they can be directly connected to the relay inside the Altivar Process Drive System.

If the set temperature at the motor is exceeded, a warning message is generated. When the temperature is further rising over a set value, the drive is stopped and an error message is generated. The operating states are also forwarded to the status relays and to the fieldbus.

NOTE: When protective separation of the thermistor sensors in the motor cannot be guaranteed or in case of long motor cables, this option is highly recommended.

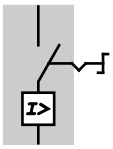
Motor Heating



The motor standstill heating is used to avoid condensate and frost damages at standstill of the motors in cold environment. It is activated when the motor is shut down.

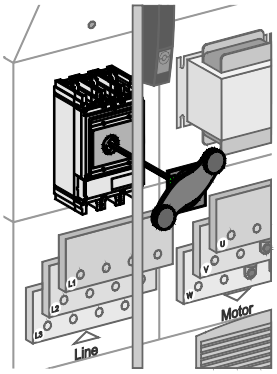
Mains Supply

Circuit Breaker

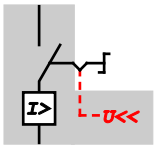


The circuit breaker is used for mains disconnection instead of the main switch. It is operated by a handle in the enclosure door.

The circuit breaker can be optionally equipped with an undervoltage coil and motor.



Undervoltage Coil for Circuit Breaker 230 V



When there is no voltage at the undervoltage coil, the circuit breaker switches off. The undervoltage coil is built into the circuit breaker and is wired to the option terminals.

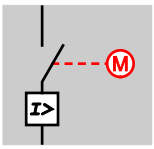
Specification of the control terminals

X200: 6/14	External control voltage
	220…240 V AC 50/60 Hz

NOTE:

- Only when control voltage is applied, the circuit breaker can be switched on manually.
- You will find further information about the topic wiring under chapter "Option Terminals", page 142.

Motor for Circuit Breaker 230 V



Remote control of the circuit breaker via control commands is possible by means of this motor drive. The motor drive is built into the circuit breaker and is wired to the option terminals.

Specification of the control terminals

X200: 7/15	External control voltage 220…240 V AC 50/60 Hz
X200: 8	Start request
X200: 16	Stop request

Specification of the motor drive:

External control circuit voltage:

- 230 V AC ± 5% 50/60 Hz

Reaction time:

- < 80 ms when closing
- < 600 ms when opening

Power input:

- ≤ 500 VA when closing
- ≤ 500 VA when opening

NOTE:

- At this customization no handle for the circuit breaker is possible.
- You will find further information about the topic wiring under chapter "Option Terminals", page 142.
- You will find further information about the topic switching rate under chapter "Switching Rate", page 25.

12-pulse Supply

The ATV990 frequency inverters can be equipped with parallel input rectifiers for 12-pulse rectification on request.

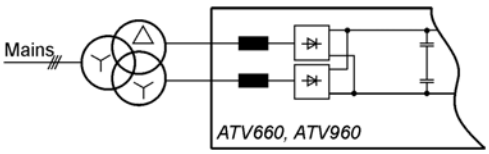
The supply results from a separate transformer with two out-of-phase secondary windings (e.g. superimposing transformer Yy6 Yd5).

Due to the lower tolerances of superimposing transformer in zig-zag-connection you can assume that the output current is approximately 7 % lower.
Example: For 90 kW instead of 2 x 90 A at 400 V only 2 x 84 A.

If the existing mains distortion is mainly caused by frequency inverters with normal 6-pulse-circuit, we highly recommend a superimposing transformer in zig-zag-connection (± 15° phase shift at each secondary windings e.g. Yy1130 Yy0030).

On the main side of the transformer the 5th and 7th current harmonics are practically non-existent as they have been cancelled by the shifted transformer windings.

Due to the internal circuit structure it is possible to operate a single frequency inverter as well as several frequency inverters in parallel at one transformer.



The following specifications must be kept:

Transformer:

- Converter transformer for 12-pulse supply with half-controlled rectifier bridges in a common voltage DC link.
- Recommended design: Superimposing
- Nominal voltage at the primary side: According to the application
- Voltage adaptation at the primary side: +5 % / +2.5 % / 0 / -2.5 % / -5 %
- Nominal output current: See the following table
- Current harmonics at the secondary side: See the following table
- Nominal output voltage (= no-load voltage): See the following table
- Tolerance of the secondary voltages to each other: < 0.3 % (< 0.1 %) of U_{NOM}
- Short-circuit voltage: See the following table
- Tolerance of the relative short-circuit voltage: ±10 % of $u_{SC\text{-}NOM}$
- Tolerance of the relative short-circuit voltage between both secondary windings < 5 % (< 2 %) of $u_{SC\text{-}NOM}$
- Further specifications: According to the application
- Tolerance for unbalance of phase-shift (±0.5°)

Mains:

- Allowed mains distortion: THD(u) < 8 %
- Max. single harmonic (5.): < 5 %

( ) Values in brackets for transformer in zig-zag-connection (±15° phase shift at both secondary windings e.g. Yy1130 Yy0030)

Recommended values for dimensioning a "12-pulse transformer"

Inverter power [kW]	Transformer			Inverter power [hp]	Transformer				
	Output current				Output current		Short-circuit voltage	Harmonics	
	400 V	500 V	690 V		480 V	600 V		Secondary (THDi LV)	Primary (THDi HV)
90	2x 90 A	2x 70 A	2x 60 A	**125**	2x 80 A	2x 65 A	4 %	< 40 %	≤12 %
110	2x 110 A	2x 80 A	2x 65 A	**150**	2x 95 A	2x 75 A	4 %	< 42 %	≤12 %
132	2x 130 A	2x 95 A	2x 75 A	**200**	2x 125 A	2x 115 A	4 %	< 42 %	≤12 %
160	2x 155 A	2x 120 A	2x 90 A	**250**	2x 155 A	2x 140 A	4 %	< 42 %	≤12 %
200	2x 190 A	2x 145 A	2x 120 A	**300**	2x 185 A	2x 160 A	4 %	< 42 %	≤12 %
250	2x 240 A	2x 180 A	2x 145 A	**400**	2x 245 A	2x 200 A	4 %	< 42 %	≤12 %
315	2x 300 A	2x 230 A	2x 180 A	**500**	2x 305 A	2x 250 A	4 %	< 42 %	≤12 %
355	2x 340 A	2x 250 A	2x 210 A	**550**	2x 330 A	2x 275 A	4 %	< 42 %	≤12 %
400	2x 380 A	2x 285 A	2x 230 A	**600**	2x 365 A	2x 290 A	4 %	< 40 %	≤12 %
450	2x 440 A	2x 340 A	2x 260 A	**650**	2x 400 A	2x 320 A	4 %	< 40 %	≤12 %
500	2x 490 A	2x 385 A	2x 285 A	**700**	2x 420 A	2x 340 A	6 %	< 33 %	≤10 %
560	2x 550 A	2x 440 A	2x 320 A	**800**	2x 480 A	2x 395 A	6 %	< 33 %	≤10 %
630	2x 610 A	2x 490 A	2x 365 A	**900**	2x 540 A	2x 430 A	6 %	< 33 %	≤10 %
710	2x 680 A	2x 540 A	2x 420 A	**1000**	2x 600 A	2x 480 A	6 %	< 33 %	≤10 %
800	2x 770 A	2x 610 A	2x 465 A	**1100**	–	2x 540 A	6 %	< 33 %	≤10 %
900	2x 860 A	2x 685 A	2x 525 A	**1250**	–	2x 590 A	6 %	< 33 %	≤10 %
1000	2x 940 A	2x 770 A	2x 570 A	**1400**	–	2x 660 A	6 %	< 33 %	≤10 %
1100	2x 1040 A	2x 840 A	2x 620 A	**1600**	–	2x 755 A	6 %	< 33 %	≤10 %
1200	2x 1110 A	2x 900 A	2x 665 A	**1700**	–	2x 790 A	6 %	< 33 %	≤10 %
1300	2x 1200 A	2x 980 A	2x 725 A	**1900**	–	2x 885 A	6 %	< 33 %	≤10 %
1400	2x 1300 A	2x 1050 A	2x 780 A	**2000**	–	2x 930 A	6 %	< 33 %	≤10 %
1500	–	2x 1120 A	2x 840 A	**2100**	–	2x 980 A	6 %	< 33 %	≤10 %
1800	–	2x 1330 A	2x 1000 A	**2200**	–	2x 1020 A	6 %	< 33 %	≤10 %
2000	–	–	2x 1100 A	**2500**	–	2x 1150 A	6 %	< 33 %	≤10 %
2100	–	–	2x 1150 A	–	–	–	6 %	< 33 %	≤10 %
2400	–	–	2x 1300 A	–	–	–	6 %	< 33 %	≤10 %

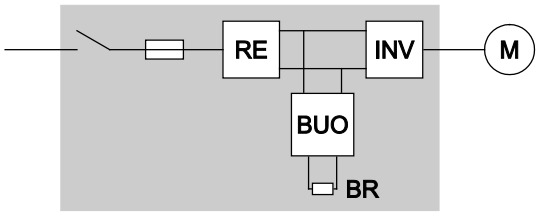
Recommended output voltage for the transformer

The nominal output voltage of a transformer is specified at no load operation. Therefore this value should be 3...5 % higher than the rated voltage of the drive.

Inverter	Transformer output voltage phase / phase (no load)						
	Nominal voltage						
	380 V	400 V	440 V	480 V	500 V	600 V	690 V
400 V range	400 V	425 V	460 V	500 V	–	–	–
690 V range	–	–	–	–	525 V	630 V	715 V

Braking Option

Braking Unit Option BUO



The use of a braking unit is required, if:

- More power is returned to the DC link during the braking procedure than the losses in the motor and the inverter amount to or
- The application requires very short braking times.

The braking unit option BUO is placed in an own enclosure and is equipped with a voltage regulation to control the braking transistors.

If the DC link voltage exceeds an adjustable value, the external braking resistor is switched into the DC link as a consumer. The braking resistor converts the power incurred during generator operation into heat. This helps to avoid a further rising of the DC link voltage and thus a shut-down with overvoltage.

The key benefits of the braking unit option BUO are:

- Significant reduction of capacitor load due to three-phase design
- Monitoring of the braking resistors for overload and interruption
- Shielded braking unit lines allow the compliance with the EMC limits
- Integrated protection against short-circuits and ground faults for the braking resistor and the wiring

The braking unit option BUO has following features and characteristics:

- The ModBuo●●● braking option is 3-phase designed and so it requires three braking resistors (possibly in a housing with six terminals).
- The braking option ModBuo●●● controls itself. But for monitoring the function there is an additional internal bus connection to the frequency inverter. So all settings and displays can take place at the interface of the inverter.
- The braking resistor is monitored for short-circuit and interruption; provided that the nominal power of the resistor is correctly set. The protection against ground faults is realized via the integrated circuit breaker.
- For monitoring and diagnostics all braking resistors are subsumed to one group.
- For simple applications it is possible to assign a braking unit and braking resistors with less power.
- If the installed peak braking power is not sufficient, the inverter automatically extends the deceleration ramp in order to prevent a shut-down. However, if short braking times must be kept, select a braking resistor according to the maximum braking power.

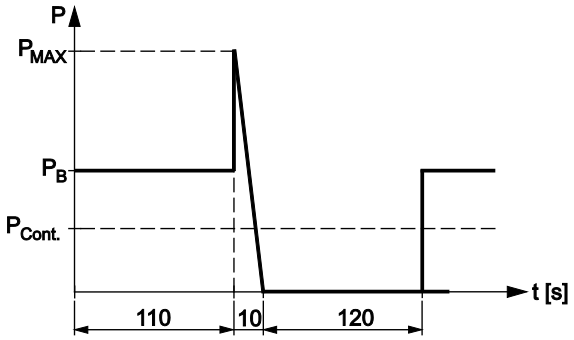
Technical Data Braking Unit

Braking unit ModBuo	C16●4	C31●4	C50●4	C63●4	C80●4	M10●4
Nominal data						
Size Single Drive System	1c			2c		
MultiDrive System	1mc			2mc		
Braking voltage max.	780 V dc	780 V dc	780 V dc	780 V dc	780 V dc	780 V dc
Braking power						
At 780 V dc 12s / 240s (= 5%)	200 kW	400 kW	600 kW	800 kW	1000 kW	1200 kW
At 755 V dc 12s / 240s (= 5%)	180 kW	360 kW	540 kW	720 kW	900 kW	1080 kW
At 720 V dc 12s / 240s (=5%)	170 kW	340 kW	510 kW	680 kW	850 kW	1020 kW
36s / 240s (= 15%)	150 kW	300 kW	450 kW	600 kW	750 kW	900 kW
120s / 240s (= 50%)	120 kW	240 kW	360 kW	480 kW	600 kW	720 kW
Continuous operation (= 100%)	100 kW	200 kW	300 kW	400 kW	500 kW	600 kW
Braking resistor						
Braking resistor Min. (1)	3x 4.0 Ω	3x 3.0 Ω	3x 2.2 Ω	6x 3.0 Ω	6x 2.7 Ω	6x 2.2 Ω
Max. (2)	3x 8.0 Ω	3x 4.0 Ω	3x 2.7 Ω	6x 4.0 Ω	6x 3.4 Ω	6x 2.7 Ω
Characteristics						
Maximum current I_{max}	85	170	255	340	425	510
Heat losses at cont. operation						
Total losses	1050 W	1600 W	2200 W	3300 W	3600 W	3900 W
Control part only	280 W	310 W	350 W	460 W	510 W	540 W
Auxiliary voltage 230V, 50/60Hz	250 W	250 W	250 W	500 W	500 W	500 W
Enclosure width	400 mm			800 mm		
Weight Net	260 kg			510 kg		
Gross	270 kg			530 kg		
Arrangement						
Single Drive System	Right			Right		
MultiDrive System	Centered or right			Centered or right		
Ambient conditions						
Air flow Power part	580 m³/h			1160 m³/h		
Control part	140 m³/h			280 m³/h		
Cable cross section						
Number of terminals	6			12		
Cable cross section Per terminal	2x M12			2x M12		
Max. Cross section	4x 120 mm²			4x 120 mm²		

(1) Nominal value of the braking resistance which may not fall short due to help to protect the braking transistor (-10 % tolerance)

(2) Nominal resistance value at which a peak braking power of 125...150 % of the nominal inverter power HD (Heavy Duty) can still be reached (+25 % tolerance including temperature rise)

Maximum possible load cycle of the braking unit for crane drives



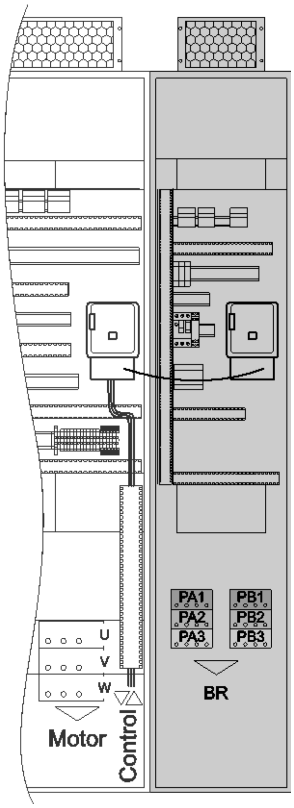
Max. cycle time: 240 s

Legend:

P_{MAX}	Peak braking power	P_{Cont}	Continuous braking power
P_B	Braking power when lowering the load		

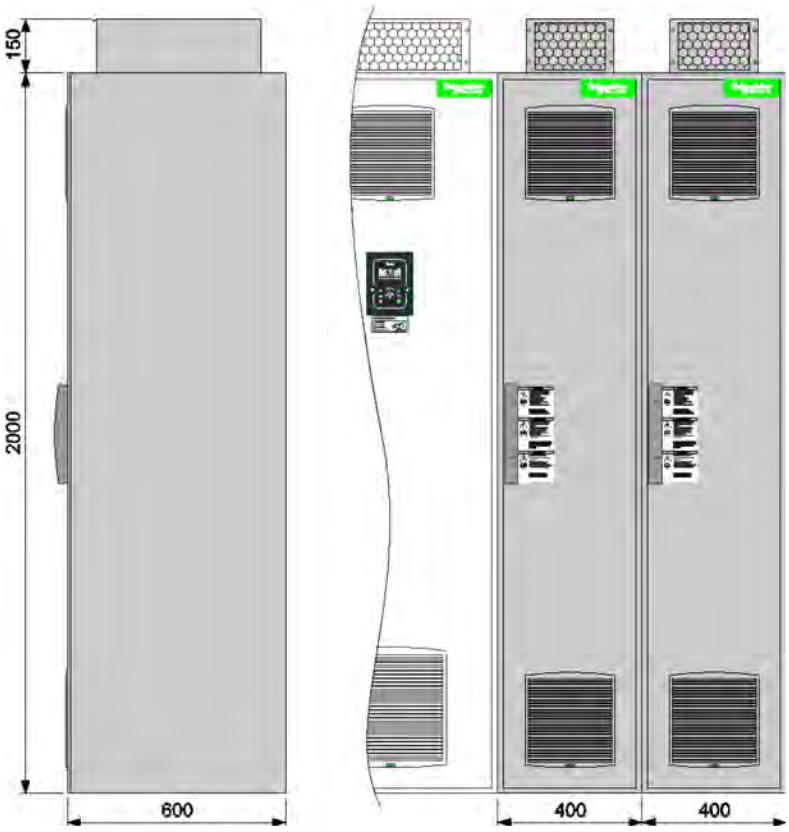
Dimensions Braking Unit Option IP23 Size 1c / 1mc

Interior View Braking Unit Option IP23 for Size 1c / 1mc

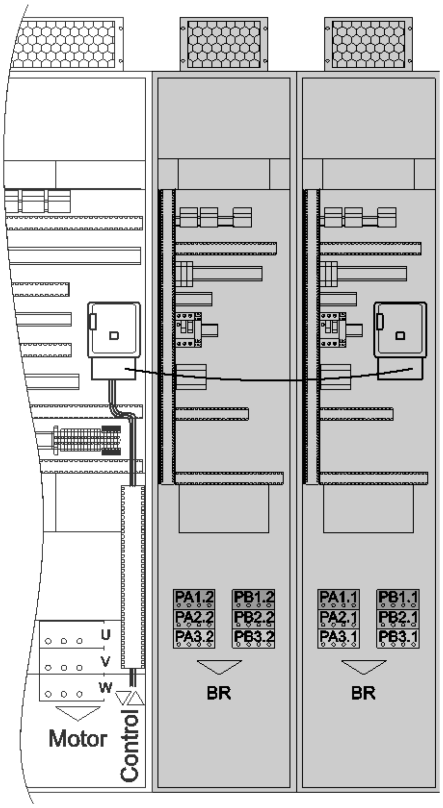


NOTE: At protection degree IP54 the enclosure height is increased by 200 mm.

Dimensions Braking Unit Option IP23 Size 2c / 2mc



Interior View Braking Unit Option IP23 for Size 2c / 2mc



NOTE: At protection degree IP54 the enclosure height is increased by 200 mm.

Braking Resistors BR

The braking resistor converts the power accumulating during generator operation into heat and thus helps to prevent a further rising of the DC link voltage.

Braking resistors can be only connected to Drive Systems which are equipped with an braking unit option BUO.

When allocating the braking resistors to the frequency inverters, observe the following points:

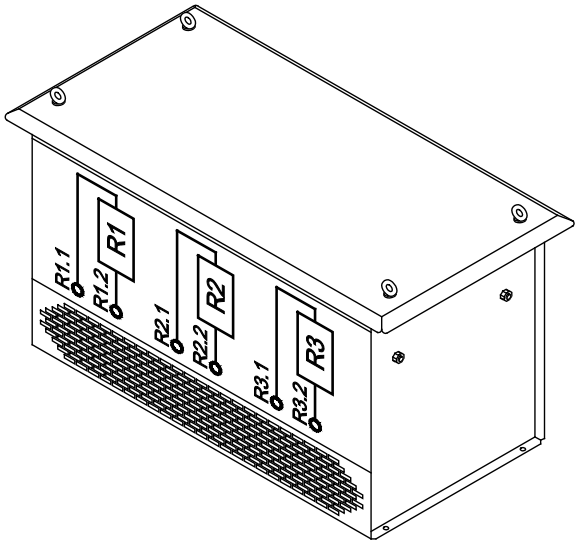
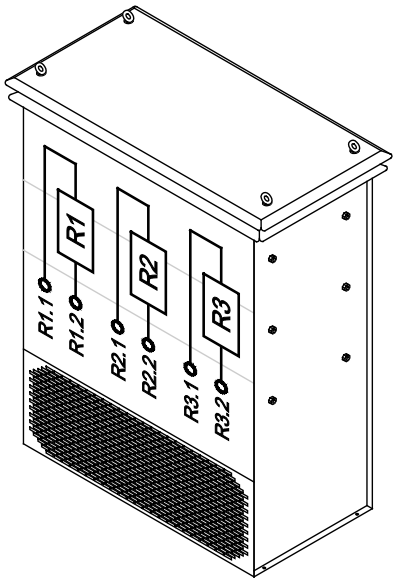
- Minimum braking resistance per inverter power
- Required peak braking power and cycle time
- Necessary continuous power depending on the application requirements
- Recommended assignment of braking resistors

Choose a suitable place for installing the braking resistors where the energy can dissipate unhindered via the ambient air.

Thereby the surface of the resistor may reach up to 250°C. So the braking resistor must be mounted on non-combustible material.

The unhindered air flow may not be impaired by other devices or casing parts!

Schema of the braking resistors BR

BR 6,7-3 / 20	BR 6,7-3 / 60
	

⚠ WARNING

HOT SURFACES

- Ensure that it is not possible to make any contact with a hot braking resistor.
- Do not allow flammable or heat-sensitive parts in the immediate vicinity of the braking resistor.
- Verify that the heat dissipation is sufficient by performing a test run under maximum load conditions.

Failure to follow these instructions can result in death, serious injury or equipment damage.

Technical Data Braking Resistor

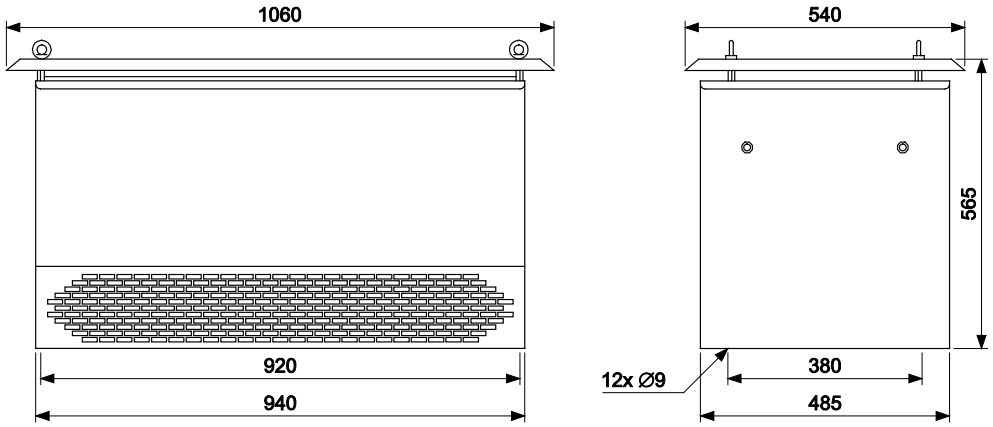
General technical data	
Nominal tolerance at 20°C	±10 %; additionally +15 % resulting from the temperature rise during operation
Thermal protection	Software function in the Drive System (or by a thermal relay / motor protection relay)
Ambient conditions	
Ambient temperature	-25...+40 °C; above +40 °C with derating of 4 % per 10 K
Storage / Transport temperature	-25...+70 °C
Cooling	Natural convection
Thermal time constant	140 s (1)
Protection degree	IP23
Altitude	Up to 1000 m, above with derating of 1 % per 100 m
Standards	
Standards	CE (2)

(1) Set this value via parameter [Braking Resist T Constant] brtC.

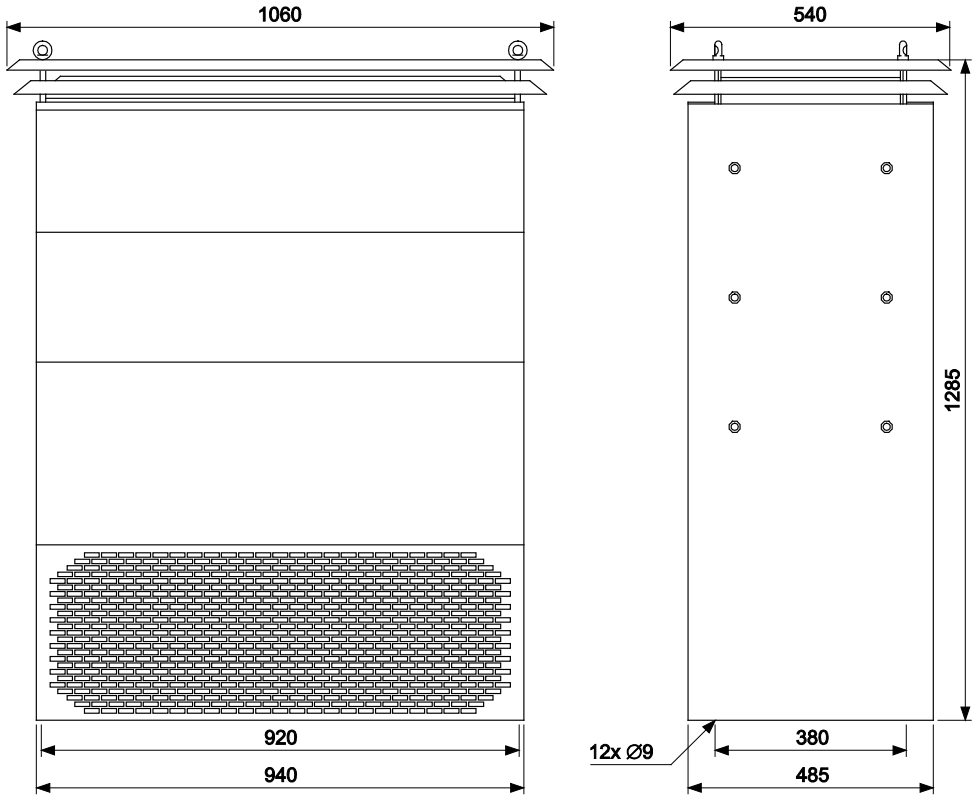
(2) For applications, which require a UL certification, you can choose resistors from the Schneider Electric standard program (e.g. 3x VW3 A7 755 instead of 1x VW3 A7 791).

Braking resistor	**BR 6,7-3 / 20**	**BR 6,7-3 / 60**
Reference number	VW3 A7 790	VW3 A7 791
Nominal data		
Resistance	3x 6.7 Ω	3x 6.7 Ω
Continuous power total	20 kW	60 kW
Parameter brP (x number of resistors connected in parallel)	20	60
Peak braking power at 120 s cycle repetitive		
At 680 V dc	150 kW (max. 7 % duty cycle)	150 kW (max. 24 % duty cycle)
At 780 V dc	200 kW (max. 5 % duty cycle)	200 kW (max. 18 % duty cycle)
At 975 V dc	300 kW (max. 3 % duty cycle)	300 kW (max. 11 % duty cycle)
At 1075 V dc	380 kW (max. 2 % duty cycle)	380 kW (max. 8 % duty cycle)
Duty cycle ED and cycle time		
At 115 kW braking power	12 % duty cycle at 120 s cycle (t_{ON} = 15 s, t_{OFF} = 105 s; repetitive)	50 % duty cycle at 120 s cycle (t_{ON} = 60 s, t_{OFF} = 60 s; max. 3 cycles, then at least 20 min. pause)
		40 % duty cycle at 120 s cycle (t_{ON} = 48 s, t_{OFF} = 72 s; repetitive)
		30 % duty cycle at 200 s cycle (t_{ON} = 60 s, t_{OFF} = 140 s; repetitive)
Characteristics		
Setting value thermal relay	35 A per phase	55 A per phase
Weight Net	50 kg	120 kg
Gross	70 kg	150 kg
Connection		
Connection	6x M10 2x M10 for PE	6x M10 2x M10 for PE

Dimensions BR 6,7-3 / 20

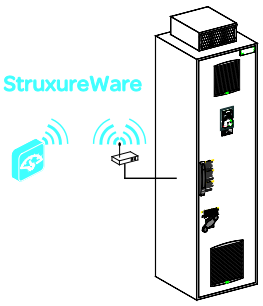


Dimensions BR 6,7-3 / 60



Monitoring Options

Remote Monitoring



With remote monitoring the Altivar Process Drive System can be monitored via Ethernet or Modbus using a PC, tablet or smart phone.

The delivered gateway records the data of the Drive System in regular intervals. The collected data are transmitted using an integrated GPRS modem via the mobile phone network to the Schneider Electric StruxureWare Energy Operation network.

You can easily access the provided date of your Altivar Process System using PC, tablet or smart phone in order to analyze them and to be up-to-date:

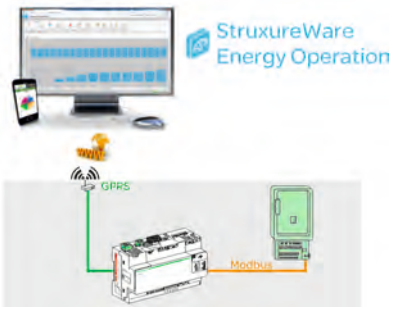
- Notification per email or SMS when reaching warning or error states
- Preset reminders per email for maintenance purpose, inspection,…
- Cyclical sending of status reports

Via the predefined data model the following values are monitored 24/7 and logged:

Registered data	
• Mains voltage	• Energy consumption
• Mains frequency	• Energy saving by frequency inverter operation
• DC link voltage	• Saving of CO_2 emission
• Input / output voltage	• Thermal state of motor and Drive System
• Motor current and voltage	• Operating state of Drive System
• Motor speed	• Event memory with detailed information
• Motor torque	• Application data (input / output pressure, flow,...)

The module contains additional inputs in order to record further measures:

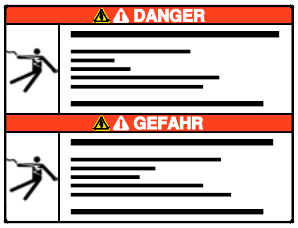
- 2 temperature sensors (Pt100 or Pt1000)
- 6 digital inputs
- 2 analog inputs



NOTE: For this option a service contract is necessary which will imply additional costs.

Documentation / Packaging

Safety Labels in Local Language



All Altivar Process Drive Systems are delivered with safety labels in English and French.

Optionally the devices can be also ordered with labels in the local language.

ATV990_Handbook_EN_NHA37145_00

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02/2018