• 15P0102B300 •

AC/DC UNIT 465
AC/DC UNIT 1050

- Installation Guide -

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R.01

English

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REVISION INDEX

The following subjects covered in this Installation Guide (revision **R.01**) have been added, changed or suppressed in respect to the previous Installation Guide (revision **R.00**).

Figures 14, 15, 21 and 25 modified.
M1 and M2 connectors renamed as MR1 and MR2.
Changed the description of the connectors coming from the “master” (Signal IN) and to the “slave” (Signal OUT).
Changed from 12PHU and 18PHU to “Do not use” the description of Terminals 1 in Signal IN and Signal OUT connectors.
Changed the description of the sequence in CONTROLLING THE PRECHARGE CIRCUIT.
Sections starting from 4.4 renumbered from 4.3.

USER MANUALS MENTIONED IN THIS INSTALLATION GUIDE

The following User Manuals from Enertronica Santerno S.p.A. are mentioned throughout this Installation Guide:
15P0102B100 SINUS PENTA – Installation Guide
15R0102B200 SINUS PENTA – Programming Guide

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1. OVERVIEW

The AC/DC UNITS of the SINUS PENTA series are three-phase rectifier units capable of power supplying a DC busbar that can be connected to multiple inverters and braking modules. When some of the connected drives are regenerating energy to the DC busbar, other drives absorb that energy for the optimum energy efficiency of the whole system.

This manual covers the technical features of the power supply units and describes how to assemble them. Assembly includes mechanical installation, electrical installation and the connection of the external components required.

NOTE This manual is an addition to the SINUS PENTA's Installation Guide.

CAUTION **THE AC/DC UNITS ARE NOT SUITABLE FOR POWER SUPPLYING LOADS OTHER THAN STATIC CONVERTERS,** such as merely resistive loads. Any application to loads other than drives and braking modules of the SINUS PENTA series must be authorised by Enertronica Santerno S.p.A..

2. TECHNICAL SPECIFICATIONS

The technical specifications of the AC/DC UNITS are given in Table 1.

AC/DC UNIT	Rated supply voltage (Vac)	Rated input current (Aac)	Maximum input current (Aac)	Output voltage (Vdc)	Max. voltage applicable to output terminals (Vdc)	Rated output current (Adc)	Maximum output current (Adc)
465	380-690	395	474	513-931	1200	465	558
1050	380-690	893	935	513-931	1200	1050	1100

Table 1: Technical specifications of the power supply units

CAUTION

The input current ratings relate to a general-purpose installation with loads affected by current harmonics (such as the AC/DC UNIT) and loads featuring sine absorption. The input current ratings also take into account using reactors installed on the supply mains. The current RMS increases where harmonic loads are present.

NOTE

The maximum current is the current delivered for 1 minute every 10 minutes.

CAUTION

Being as the load of the power supply units typically consists of drives, when the load is decelerated or pulled, drives can regenerate energy thus increasing the DC busbar voltage. In any case, the voltage of the DC busbars connected to the power supply units must not exceed 1200 Vdc.

The drives and braking modules have a capacitor bank connected to the DC busbar. In order to avoid that uncontrolled charge current is generated, a resistive precharge circuit is to be installed, which will be bypassed once the precharge is complete. The precharge resistors and bypass elements are inside the power supply units. An external command is required to close the bypass element (see section 5.1).

Because the capacitor charge energy must go through the precharge resistor, there is a maximum allowable limit as per the capacitors that can be connected to the power supply units. That limit is also dependent on the power supply voltage, as given in the table below.

AC/DC UNIT	Maximum capacitor ratings with 380-400 Vac power supply (µF)	Maximum capacitor ratings with 415-480 Vac power supply (µF)	Maximum capacitor ratings with 500-575 Vac power supply (µF)	Maximum capacitor ratings with 660-690 Vac power supply (µF)
465	95000	68000	47000	33000
1050	365000	250000	175000	121000

Table 2: Maximum ratings of the capacitors that can be connected to the outputs of the power supply units

CAUTION

Connecting a load with capacitor ratings exceeding the maximum allowable ratings may damage the AC/DC UNIT.

In order to calculate the total capacitor ratings for the DC busbar, the internal capacitor ratings for each drive is given in the table below. For some sizes, the DC connection of the drive envisages a precharge circuit (internal precharge in the table), so these drives are not to be included in the calculation of the total capacitor ratings.

Size	Model	Capacitor ratings (µF)
S05-S12-S14-S15-S20-S30-S22-S32	All	Internal precharge
S41	0180-0202	20000
S41	0217-0260	25000
S42	0181-0201	13333
S42	0218-0259	16667
S51	All	30000
S52	All	20000
S60	All	60000
S64-4T	0598-0748	44550
S64-4T	0831	59400
S64-5/6T	0457-0524	19800
S64-5/6T	0598-0748-0831	26400
BU200	-------	330
BU600	-------	6600
AC/DC UNIT	465	Not present
AC/DC UNIT	1050	4400

Table 3: Capacitors inside the different drive models and accessories

3. DELIVERY CHECK

Make sure that the equipment is not damaged and that it complies with the equipment you ordered by referring to the nameplates represented below. The inverter nameplate is described below. If the equipment is damaged, contact the supplier or the insurance company concerned. If the equipment does not comply with the one you ordered, please contact the supplier as soon as possible.
If the equipment is stored before being started, make sure that the ambient conditions do not exceed the ratings mentioned in SINUS PENTA's Installation Guide. The product warranty covers any manufacturing defect. The manufacturer has no responsibility for possible damages occurred when shipping or unpacking the product. The manufacturer is not responsible for possible damages or faults caused by improper and irrational uses; wrong installation; improper conditions of temperature, humidity, or the use of corrosive substances. The manufacturer is not responsible for possible faults due to the inverter operation at values exceeding the inverter ratings and is not responsible for consequential and accidental damages.

3.1. Nameplate

The product is identified by a nameplate located on its side.

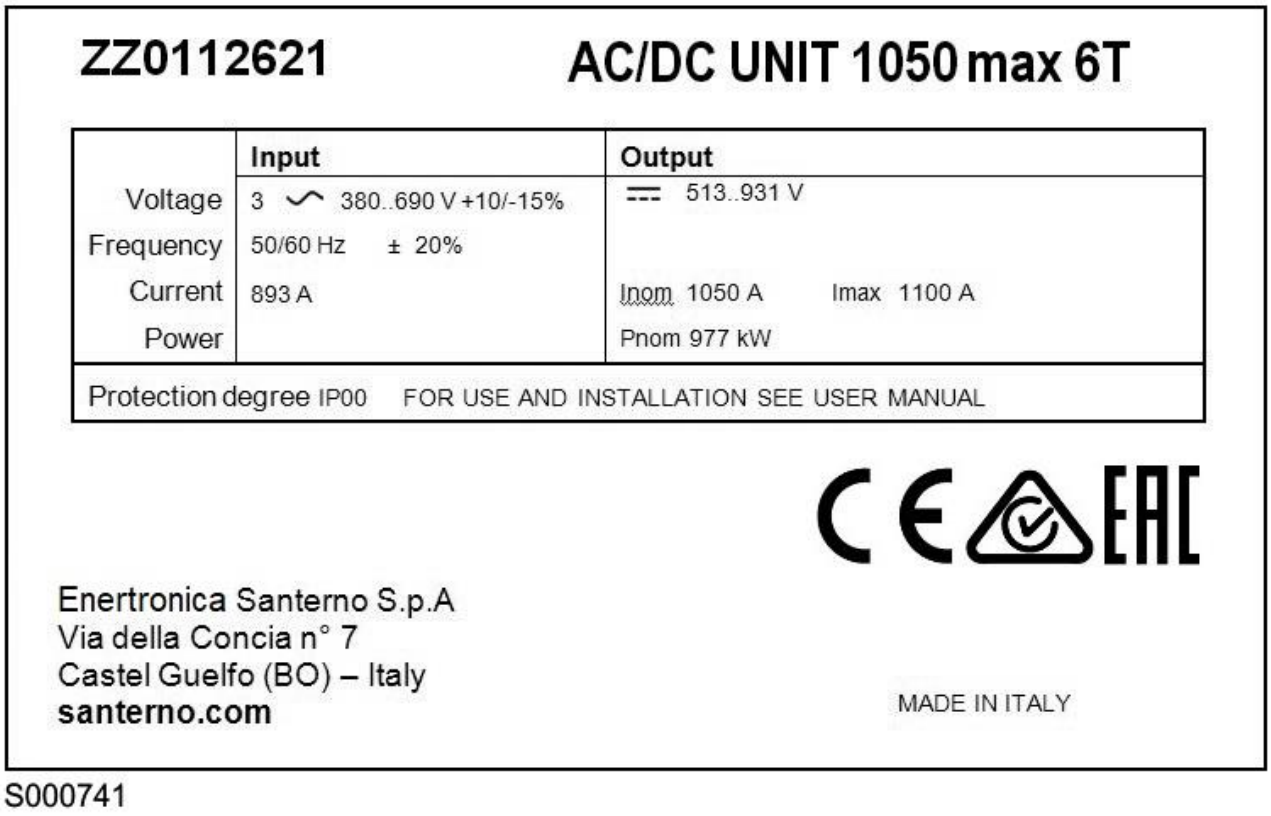


Figure 1: Nameplate of the power supply unit

4. INSTALLATION

4.1. Transport and Handling

The AC/DC UNIT packing ensures easy and safe handling. Handling shall be done using a transpallet or a lift truck with a carrying capacity of at least 100 kg, in order not to damage the product.

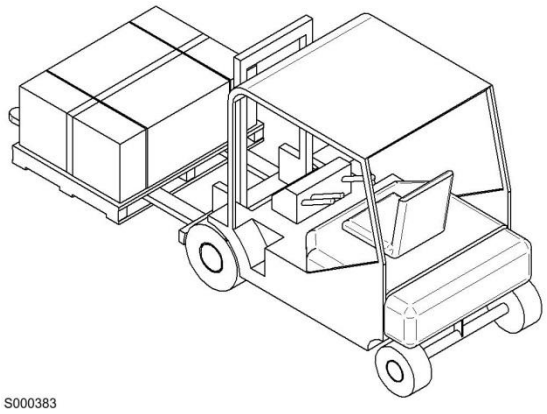


Figure 2: Lifting the packing from underneath

4.2. Unpacking

Get near the installation place, then unpack following the instructions provided below.

CAUTION **The whole original packing is to be kept for the full duration of the warranty period.**

1. Cut with pincers the plastic straps that fix the package of the product to the pallet.
2. Cut with a cutter the adhesive tape closing the box on the side where the package orientation symbol is reproduced (see Figure 4, on one of the two sides of the product packing).

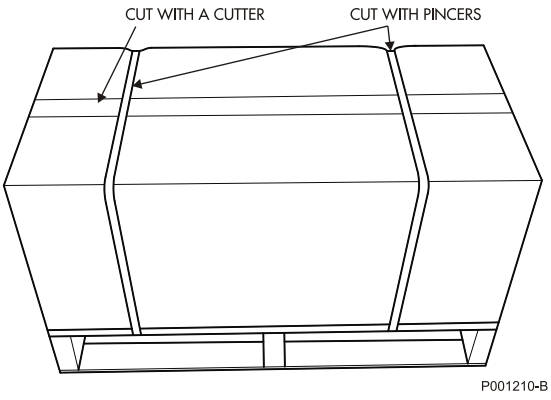


Figure 3: How to open the packing

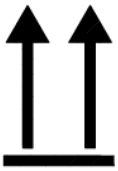


Figure 4: "This side up" pictogram

3. Remove the AC/DC UNIT from its packing by lifting it from its sides. To avoid damaging the packing, lift the product keeping it horizontal to the floor.

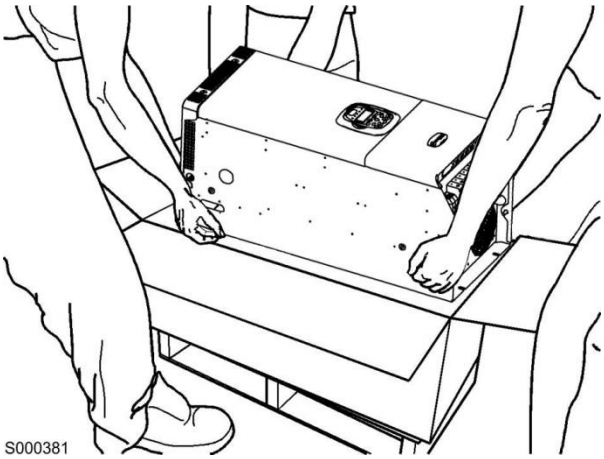


Figure 5: Removing the AC/DC UNIT from its packing

4. Put all the packing elements in the box and store it in a dry environment.

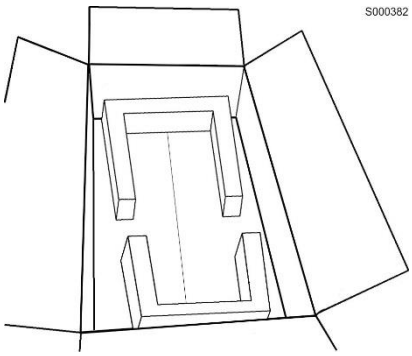


Figure 6: Sinus Penta packing box with the internal protective elements

The AC/DC UNITS are Open Type Equipment – degree of protection IP00 and IP20 – that can be installed inside another enclosure featuring degree of protection IP3X as a minimum requirement.

NOTE The AC/DC UNIT must be installed vertically.

The ambient conditions, the instructions for the mechanical assembly and the electrical connections of the inverter are detailed in the sections below.

CAUTION Do not install the product horizontally or upside-down.

CAUTION Do not mount any heat-sensitive components on top of the product to prevent them from damaging due to hot exhaust air.

CAUTION The product rear panel may reach high temperatures; make sure that the inverter bearing surface is not heat-sensitive.

CAUTION The product shall be mounted on a stiff surface.

4.3. Environmental Requirements for the Equipment Installation, Storage and Transport

Any electronic board installed in the products manufactured by Enertronica Santerno S.p.A. is tropicalized. This enhances electrical insulation between the tracks having different voltage ratings and ensures longer life of the components. It is however recommended that the requirements below be met:

Maximum surrounding air temperature	–10 °C ÷ +55 °C It might be necessary to apply 2% derating of the rated current by every degree beyond 40 °C.
Ambient temperatures for storage and transport	–25 °C ÷ +70 °C
Installation environment	Pollution degree 2 or better (according to EN 61800-5-1). Do not install in direct sunlight and in places exposed to conductive dust, corrosive gases, vibrations, water sprinkling or dripping (except for IP54 models); do not install in salty environments.
Altitude	Max. altitude for installation 2000 m a.s.l. For installation above 2000 m and up to 4000 m, please contact Enertronica Santerno S.p.A.. Above 1000 m, derate the rated current by 1% every 100 m.
Operating ambient humidity	From 5% to 95%, from 1 g/m^3 to 29 g/m^3, non-condensing and non-freezing (class 3k3 according to EN 50178).
Storage ambient humidity	From 5% to 95%, from 1 g/m^3 to 29 g/m^3, non-condensing and non-freezing (class 1k3 according to EN 50178).
Ambient humidity during transport	Max. 95%, up to 60 g/m^3; condensation may appear when the equipment is not operating (class 2k3 according to EN 50178).
Storage and operating atmospheric pressure	From 86 to 106 kPa (classes 3k3 and 1k4 according to EN 50178).
Atmospheric pressure during transport	From 70 to 106 kPa (class 2k3 according to EN 50178).

CAUTION As environmental conditions strongly affect the inverter life, do not install the equipment in places that do not have the above-mentioned ambient conditions.

CAUTION Always transport the equipment within its original package.

4.4. Air Cooling

Make sure to allow adequate clearance around the inverter for the free circulation of air through the equipment. The tables below show the minimum clearance to leave in respect to other devices installed near the inverter. The different sizes of the inverter are considered.

Size	A – Side clearance (mm)	C – Bottom clearance (mm)	D – Top clearance (mm)
465	150	100	100
1050	20	See Figure 7	100

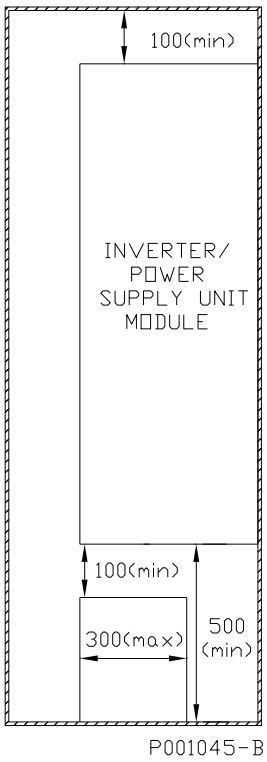


Figure 7: Clearance to allow when installing the AC/DC UNIT 1050

AC/DC UNIT	Dimensions (mm)			Weight (kg)	Dissipated power (W)	Position of the fixing holes (mm)					Noise level (dBA)
	W	H	D			X	Y	D1	D2	Type of screws	
465	257	550	398.5	36.6	1100	170	515	12	24	M8-M10	59
1050	228	1385	478	111	3100	178	1350	11	25	M10	71

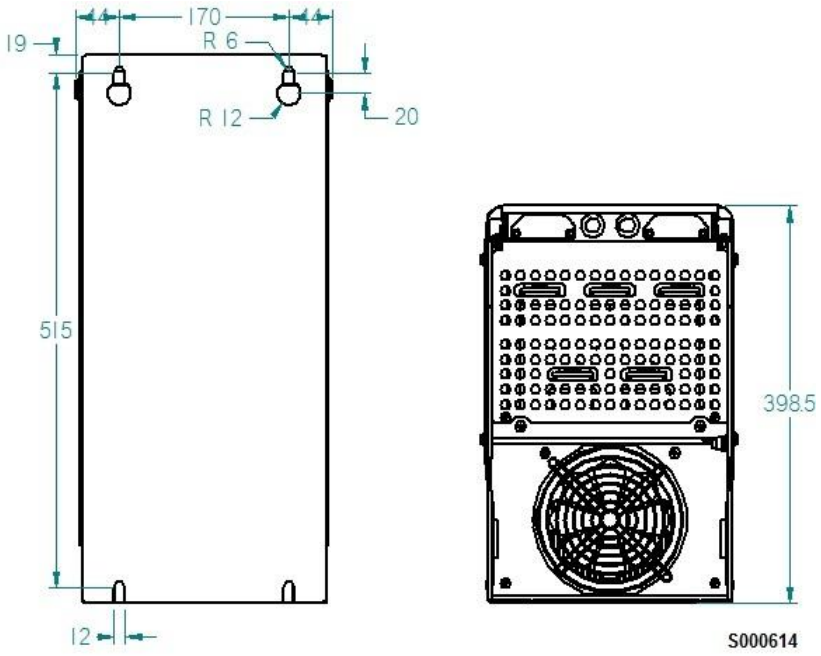


Figure 8: Dimensions and fixing points for the AC/DC UNIT 465

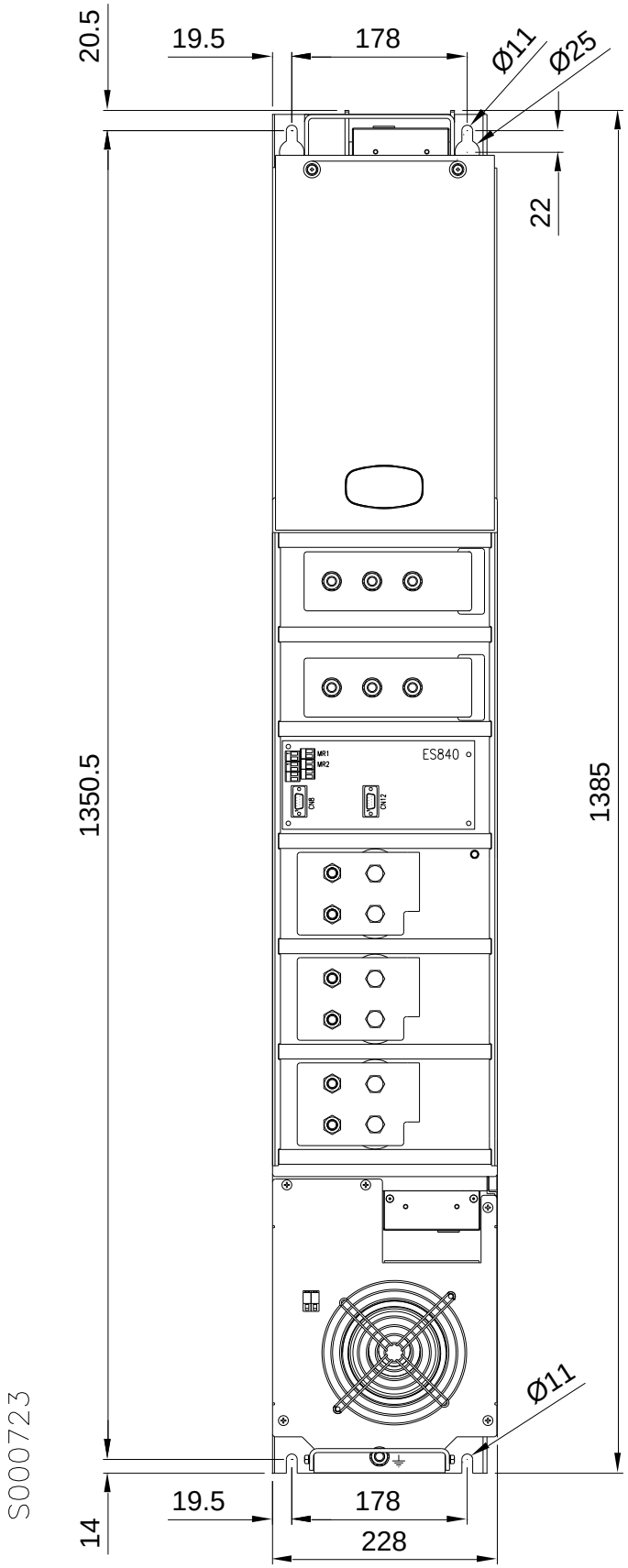


Figure 9: Dimensions and fixing points for the AC/DC UNIT 1050

4.5. IP21 Kit

The AC/DC UNIT 465 may be provided with a special safety kit against top-down water dripping to get IP21 degree of protection. Consequently, the side dimensions become 30mm.

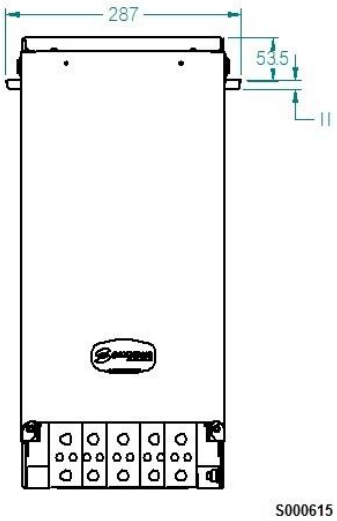


Figure 10: Overall dimensions when mounting IP21 kit

4.6. Kit for AC/DC UNIT 465 Through-panel Assembly

The power supply unit may be provided with the special through-panel kit for the segregation of the air flows.

Dimensions (mm)			Fixing point (mm)				Type of screws	Weight (kg)
W	H	D	X	Y	X1	Y1	M8-M10	2
325	683	398,5	250	650	293	400		

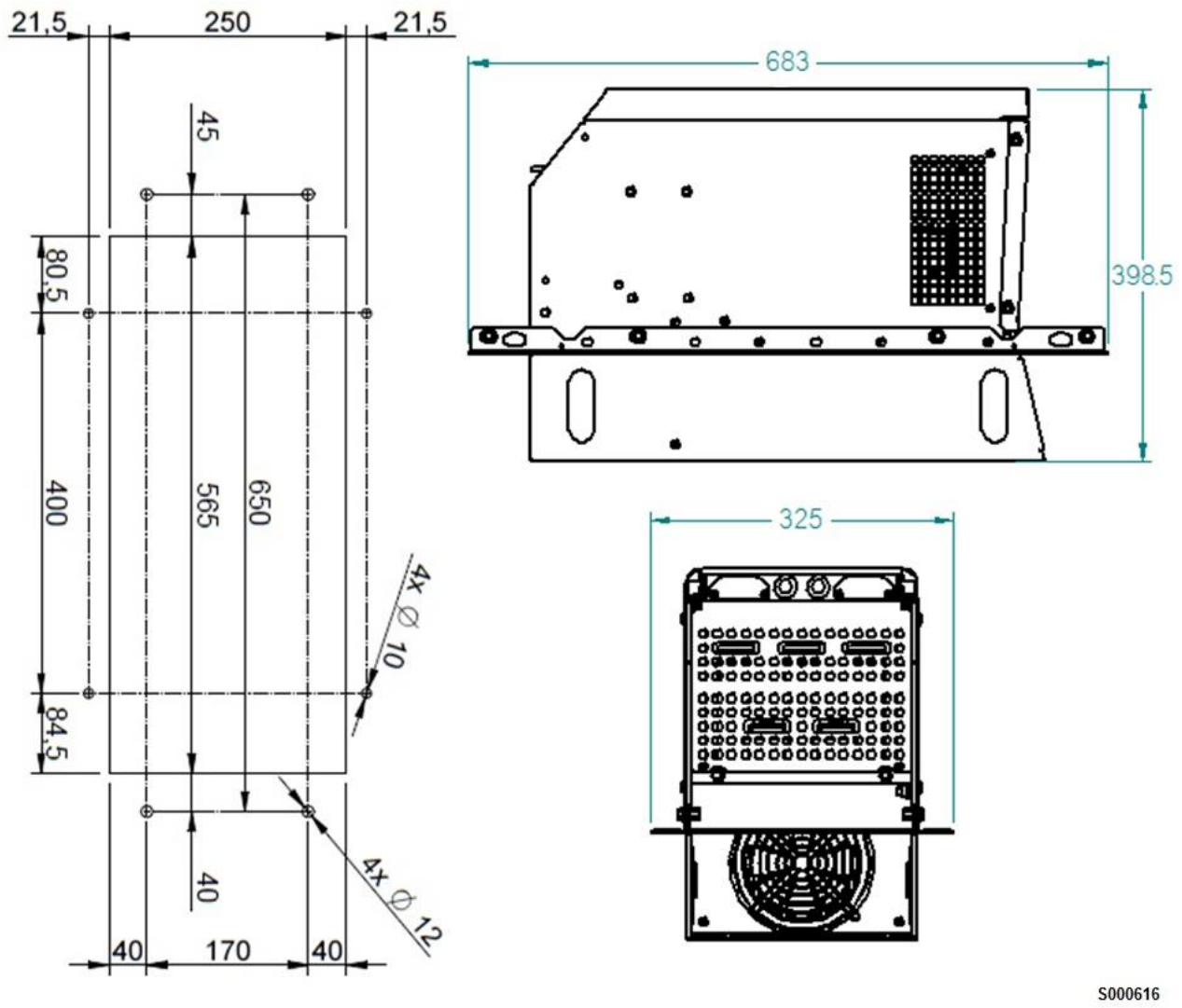


Figure 11: Dimensions and fixing points when using through-panel assembly

4.7. NEMA1 Kit for AC/DC UNIT 465

The AC/DC UNIT 465 may be provided with the special NEMA1 kit against accidental contacts.
This optional kit is to be installed directly on the power supply unit case and provides protection against accidental contacts with the power terminals in the power supply unit.

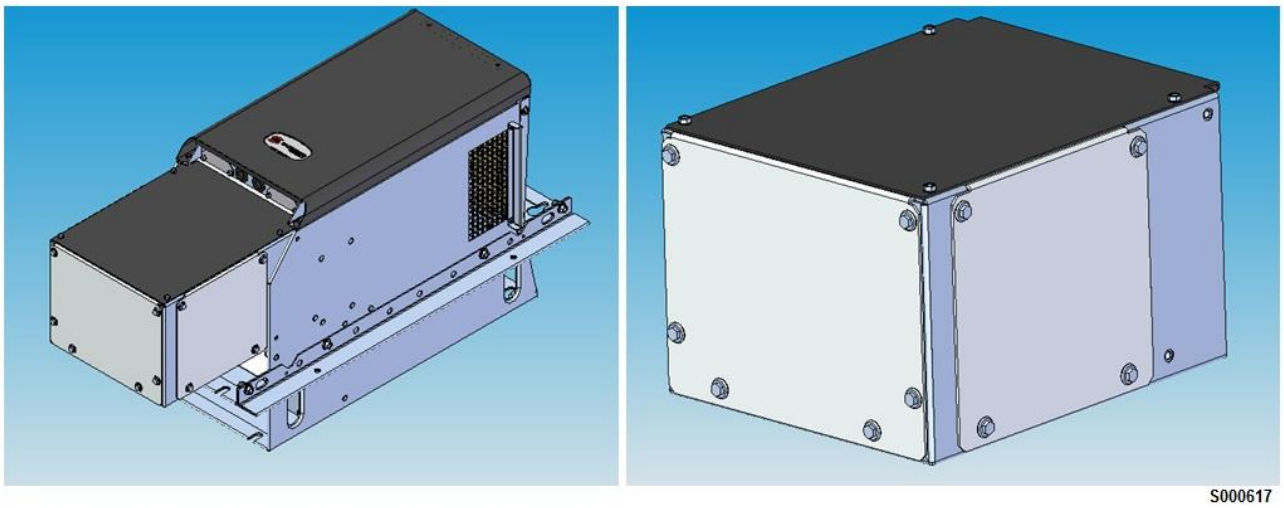


Figure 12: NEMA1 kit and kit installation on the AC/DC UNIT 465

The NEMA1 kit is provided with N.3 removable plates that may be drilled to suit the installer's needs in terms of cable paths to the mains and the unit to be power supplied.

The installer is responsible for the utilization of safe materials able to preserve the equipment's degree of protection. It is recommended that the cables do not enter into contact with sharp metal parts that may jeopardize isolation.

Kit dimensions (mm)			AC/DC UNIT 465 Length + NEMA1 Kit	Type of screws for mounting	Weight (kg)
W	H	D	H	M8	3.4
187	298	248	765		

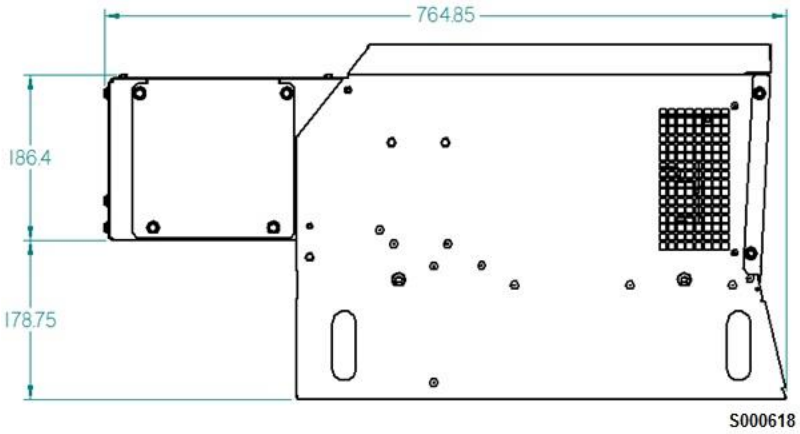


Figure 13: Overall dimensions when installing the NEMA1 kit

4.8. Power Wiring

The wiring diagrams below include the connection to the three-phase low voltage mains.
More than one power supply sources may be connected in parallel to obtain 12-pulse wiring or 18-pulse wiring by using a dedicated transformer and a suitable number of power supply units.

CAUTION

The power supply units need internal precharge circuitry for the power supply of high-input rated loads. The precharge circuit is controlled by an external circuit controlling the bypass of the precharge resistors once the capacitors have been precharged.

A wrong control in the precharge circuitry may damage the equipment (see section 5.1).

CAUTION

Make sure that the load capacitor ratings are lower than the ratings given in Table 2.

Greater capacitor ratings may damage the equipment.

DANGER

Before operating on wiring, remove voltage from the equipment and wait at least 20 minutes to wait for the complete discharge of the internal capacitors.

Use type B RCD circuit breakers only.

In the event of power supply by way of IT network, an isolation loss detector is required.

CAUTION

Connect power supply only to the power supply terminals. Connecting power supply to any other terminal can cause the equipment fault.

Always make sure that the supply voltage ranges between the limits stated in the equipment nameplate.

Always connect the earth terminal to avoid electric shock hazard and to limit disturbance.
The user has the responsibility to provide earth bonding in compliance with the regulations in force.
After connecting the equipment, check the following:

- all wires must be properly connected;
- no link is missing;
- no short-circuit is occurring between the terminals and between the terminals and the earth.

To perform UL compliant installation, the Wire Connectors shall be any Listed (ZMVV) or R/C Wire Connectors and Soldering Lugs (ZMVV2), used with 60 °C/75 °C copper (Cu) conductor only, within electrical ratings and used with its properly evaluated crimping tool.

The Field Wiring Terminals shall be used with the tightening torque values specified in the Table of the corresponding section in this Manual.

The Auxiliary Wiring Terminal Blocks, provided for end-use installation connection with external devices, shall be used within the ratings specified. Refer to section 4.13.

The equipment power supply must always be protected by fast fuses or by a moulded-case circuit breaker.

Do not apply single-phase voltage.
Always mount antidisturbance filters on the contactor coils and the solenoid valve coils.

4.9. Wiring Diagram for the AC/DC UNIT

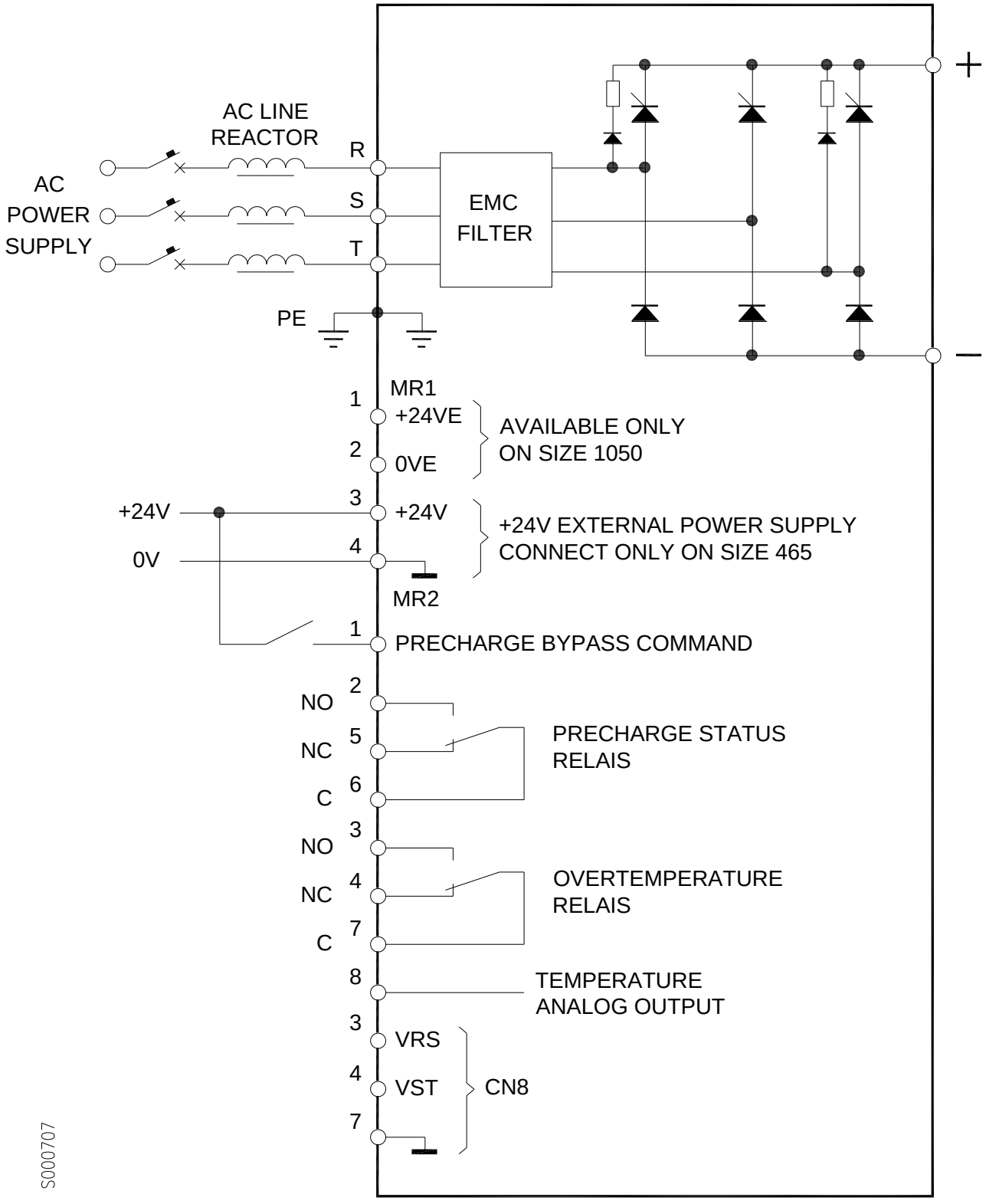
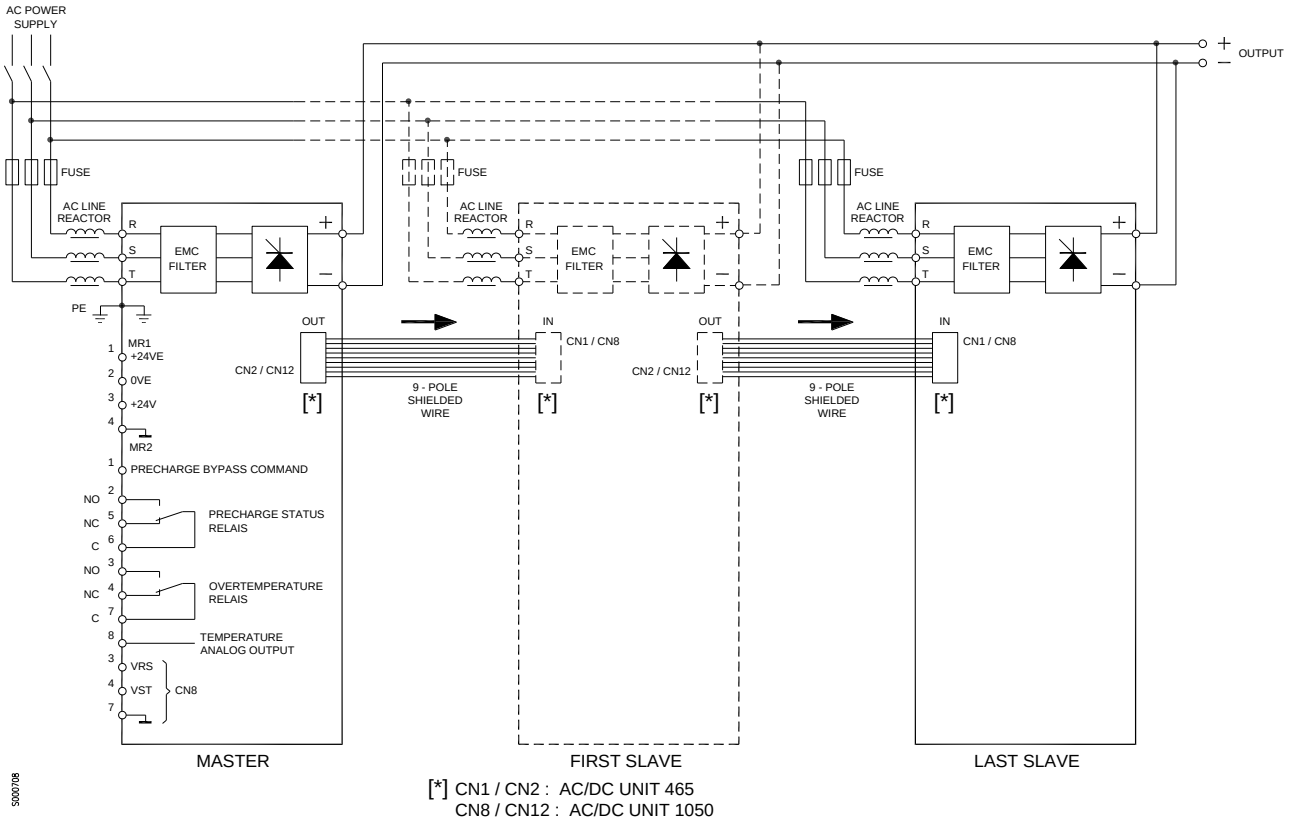


Figure 14: Wiring diagram when installing only one power supply unit



[*] CN1 / CN2 : AC/DC UNIT 465
CN8 / CN12 : AC/DC UNIT 1050

Figure 15: Wiring diagram when installing multiple parallel-connected power supply units

CAUTION

Always install the fuse failure detection device, that disables the inverters connected to the DC busbar, to avoid single-phase operation of the equipment.

4.10. Power Terminals and Signal Terminals Layout

Power Wiring

Figure 16 and Figure 17 show the power terminals layout for the AC/DC UNITS.

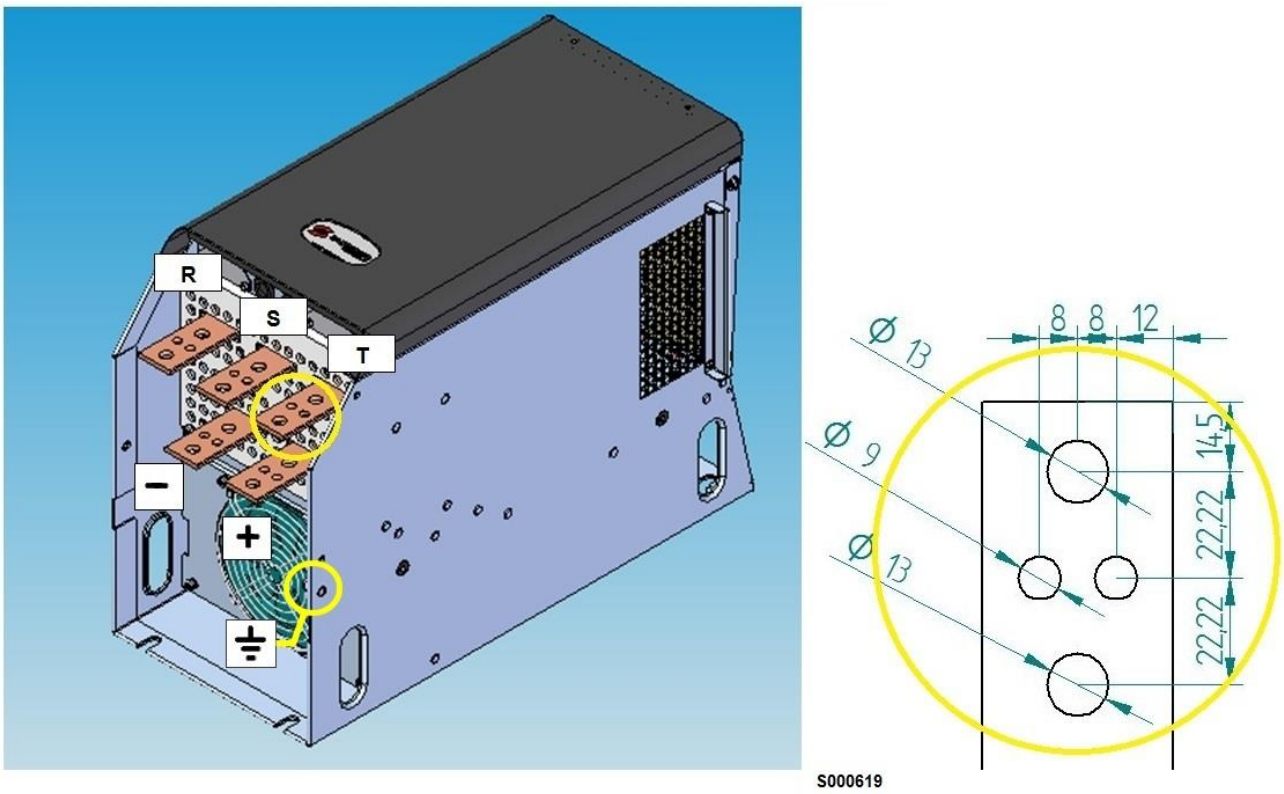


Figure 16: Power terminals for the AC/DC UNIT 465

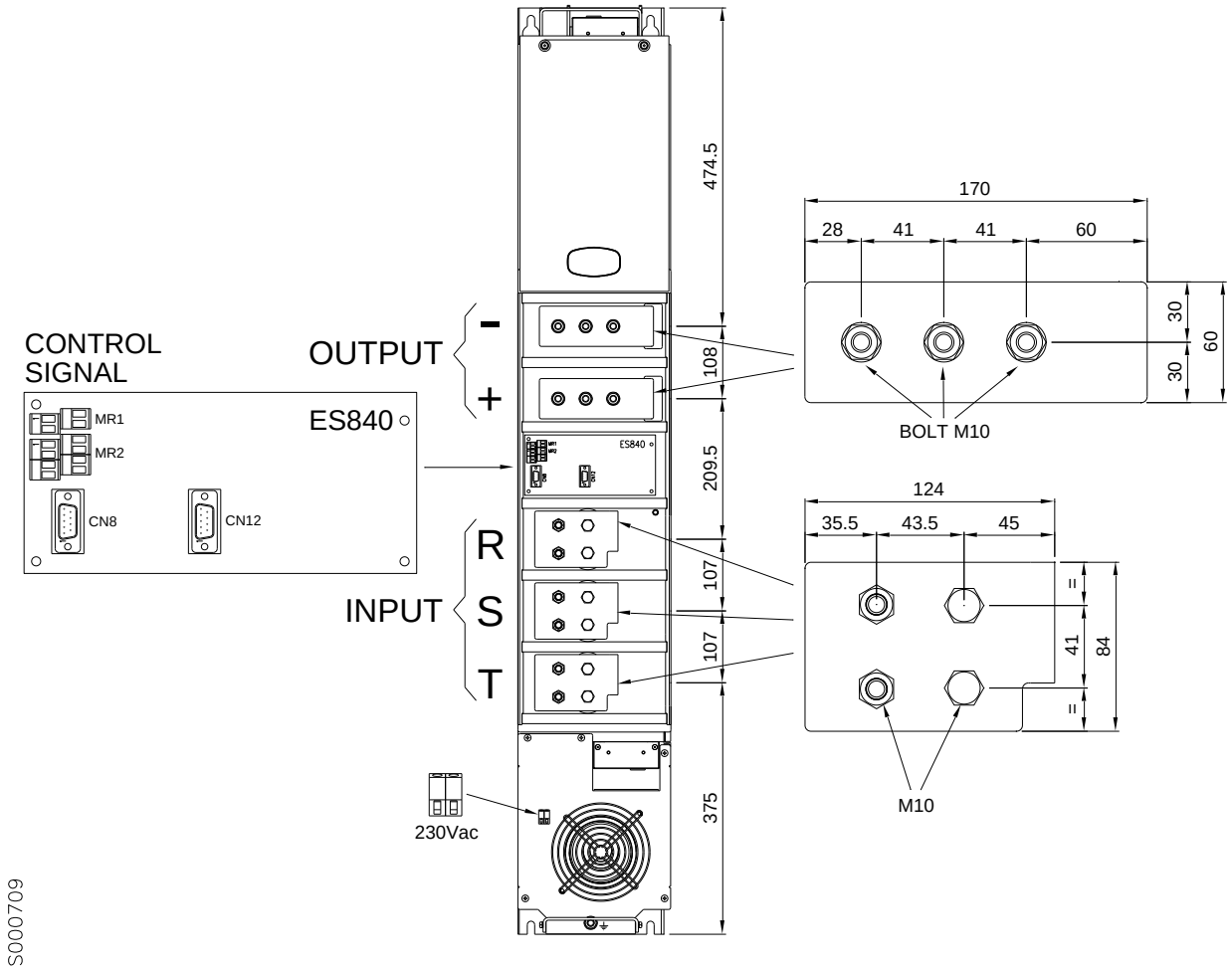


Figure 17: Power terminals for the AC/DC UNIT 1050

4.11. Cross-sections of the Power Cables and Sizes of the Protective Devices

The minimum requirements of the inverter cables and the protective devices needed to protect the system against short-circuits are given in the tables below. It is however recommended that the applicable regulations in force be observed; also check if voltage drops occur for cable links longer than 100 m.
When wiring with multiple conductors is required for the same phase, for example, 2x150 in the column relating to the cable cross-section means that two 150 mm^2 parallel conductors are required for each phase.
Multiple conductors shall have the same length and must run parallel to each other, thus ensuring even current delivery at any frequency value. Paths having the same length but a different shape might deliver uneven current at high frequency.
Also, do not exceed the tightening torque for the terminals to the busbar connections. For connections to busbars, the tightening torque relates to the bolt tightening the cable lug to the copper bar. The cross-section values given in the tables below apply to copper cables.
The links between the motor and the Penta drive must have the same lengths and must follow the same paths. Use 3-phase cables where possible.

Decisive Voltage Class C according to EN 61800-5.1

Terminal	Type of terminal		Tightening torque (Nm)		Cable/bar cross-section (mm^2)				NOTES
					Size 465		Size 1050		
	Size 465	Size 1050	Size 465	Size 1050	Wire	Bar	Wire	Bar	
R	Bar 40x5	Bar 80x6	30	20	240	40x2	3x240	80x4	To be connected to power supply phase R
S	Bar 40x5	Bar 80x6	30	20	240	40x2	3x240	80x4	To be connected to power supply phase S
T	Bar 40x5	Bar 80x6	30	20	240	40x2	3x240	80x4	To be connected to power supply phase T
47	Bar 40x5	Bar 60x5	30	20	2x150	40x3	Not applicable	63x6	Output positive pole
49	Bar 40x5	Bar 60x5	30	20	2x150	40x3	Not applicable	63x6	Output negative pole

Table 4: Type of terminals and cables recommended for AC/DC UNIT wiring

CAUTION

The recommended cable cross-sections relate to copper cables with insulation operating temperature at 90 °C and environmental temperature at 40 °C.

Voltage class	SIZE	Fast fuses (700 V) + Disconnector	MCCB	AC1 Contactor
		A	A	A
4T-5T-6T	465	500	630	500
4T-5T-6T	1050	1000	1000	1000

Table 5: Safety devices to be applied to the power supply line

DANGER

DUAL POWER SUPPLY: If the AC/DC UNIT is used as a 12-pulse rectifier or if multiple power supply sources connected to the same DC busbars are present, the AC/DC UNIT is live both on AC side (input) and on DC side (output).
Disconnect all power supply sources before operating on the equipment. Wait at least 20 minutes to give the capacitors time to discharge, apply a tester to make sure that no dangerous voltage is present both on AC side and on DC side (safe voltage level depends on the standards applicable to the installation place and the environmental requirements), then you can operate on the terminals.

S000625

4.12. Earth Bonding

Use the special earth bolts. The earth cable dimensioning must meet the requirements of the installation place.

4.13. Auxiliary Power Supply Terminals

Auxiliary power supply sources are required for the correct operation of the AC/DC UNITS. Auxiliary power supply sources are based on the size of the power supply unit, as detailed in the tables below.

Decisive Voltage Class A according to EN 61800-5.1

AC/DC UNIT	Terminal	Description	Ratings
465	**MR1/3-4**	Inputs for control board power supply	24 Vdc/0.7 A

Decisive Voltage Class C according to EN 61800-5.1

AC/DC UNIT	Terminal	Description	Ratings
1050	**61–62**	Inputs for fan power supply	230 Vac/2 A

CAUTION

Make sure that the supply frequency stated in the nameplate located beside the terminals for the fan power supply is the same as the mains supply frequency.
Applying different supply frequency to the fan might damage the fan itself.

4.14. Signal Wiring

The AC/DC UNITS require external control to avoid malfunction.

CAUTION

Incorrect application of the control and diagnostic signals may lead to AC/DC UNIT malfunction.

Terminal boards and signal connectors are mounted on the ES840 board.

In order to gain access to the ES840 board when using the AC/DC UNIT 465, remove the fixing screws from the cover of the drive enclosure.

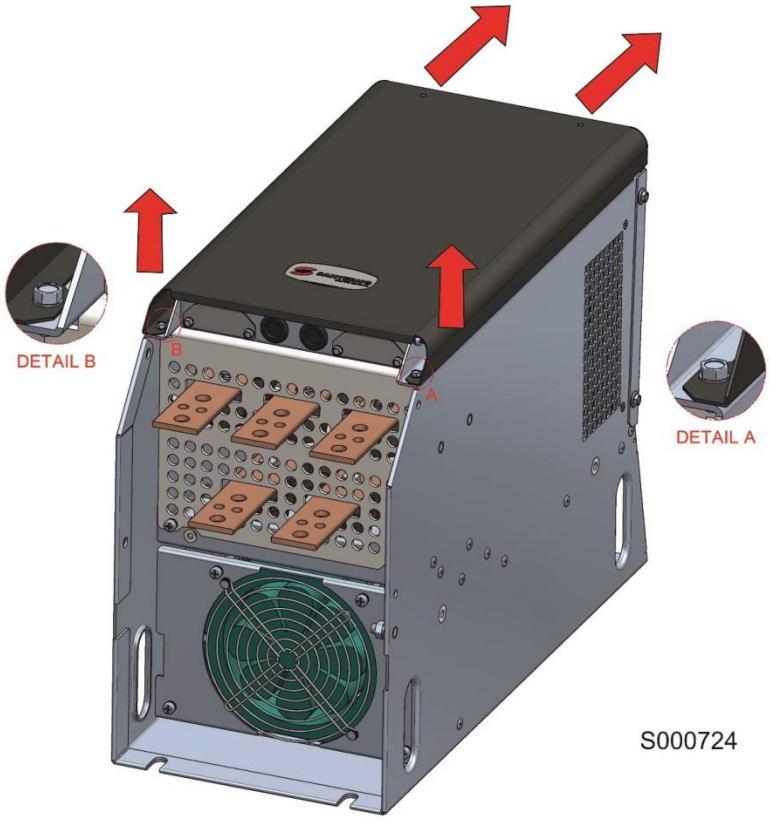


Figure 18: How to access ES840 board in the AC/DC UNIT 465

Remove the polycarbonate panel to access the ES840 board when using the AC/DC UNIT 1050.

Figure 19: Accessing the ES840 board in the AC/DC UNIT 1050

MR1 Terminal board

Type:

Screwable terminal board in two extractable sections suitable for cross-sections 0.2 to 2.5 mm^2 (AWG 24-12)
Tightening torque: 0.5-0.6 Nm
Cable stripping: 7 mm

Decisive voltage class A according to EN 61800-5.1

N.	Name	Description	I/O Features	NOTES FOR SIZE 465	NOTES FOR SIZE 1050
1	+24VE	24 V power supply available to the user	24 V-4 A	Terminals not connected **DO NOT USE**	24 V power supply available to the user
2	0VE	24 VE available to the user	0 V		
3	+24V	24V power supply	24 V	Auxiliary power supply available for control circuits; 24 V+/-10% - 0.7 A	Available for the control of the precharge bypass circuit (VBOK)
4	0V	24 V ground	0 V		Earth of the available measurements

MR2 Terminal board

Type:

Screwable terminal board in two extractable sections suitable for cross-sections 0.2÷2.5 mm^2 (AWG 24-12)
Tightening torque: 0.5-0.6 Nm
Cable stripping: 7 mm

N.	Name	Description	I/O Features	NOTES	Decisive voltage according to EN 61800-5-1
1	VBOK	ON/OFF command for thyristors controlling precharge resistor bypass	0-24 V 4 mA	+24 V for thyristor firing; command to be sent when the precharge stage of the capacitors connected to the DC busbar is complete	A
2	NOPREC	NO contact of the relay indicating the status of the devices controlling the precharge resistor bypass	250 Vac-5 A 30 Vdc-5 A	Energized relay, means bypassing precharge resistors	C
3	NOPT	NO contact of the overtemperature fault relay indicating the status of the thermoswitch located on the heatsink of the AC/DC UNIT	250 Vac-5 A 30 Vdc-5 A	Energized relay, means normal operation (thermoswitch not tripped)	C
4	NCPT	NC contact of the precharge status relay indicating the status of the thermoswitch located on the heatsink of the AC/DC UNIT	250 Vac-5 A 30 Vdc-5 A	Energized relay, means normal operation (thermoswitch not tripped)	C
5	NCPREC	NC contact of the relay indicating the status of the devices controlling the precharge resistor bypass	250 Vac-5 A 30 Vdc-5 A	Energized relay, means bypassing precharge resistors	C

6	**COMPREC**	Common of the relay indicating the status of the devices controlling the precharge resistor bypass	250 Vac-5 A 30 Vdc-5 A	Energized relay, means bypassing precharge resistors	C
7	**COMPT**	NO common of the relay indicating the status of the thermoswitch located on the heatsink of the AC/DC UNIT	250 Vac-5 A 30 Vdc-5 A	Energized relay, means normal operation (thermoswitch not tripped)	C
8	**NTC**	Voltage proportional to the resistor of an NTC located on the AC/DC UNIT heatsink referred to control board 0V (MR1-4)	0-5 V Max 10 mA	Correspondence between terminal voltage and heatsink temperature is given in Table 8.	A

CAUTION Do not exceed the electrical and mechanical features of the terminals to avoid equipment malfunction.

N. 2 DB9 connectors are available, that can be used for accessing additional measurements or parallel-connecting multiple power supply sources.
DB9 Connectors are located:

- on the bottom part of the AC/DC UNIT 465 (see Figure 21), marked as CN1 and CN2
- directly the ES840 board of the AC/DC UNIT 1050 (see Figure 17), marked as CN8 and CN12

Description of the DB9 connectors.

Connector coming from the “master” (Signal IN):

- for the isolated and damped voltage measurements
- for the master-slave connection of multiple power supply units

SIZE	Connector name	Connector type
465	CN1	Male DB9 connector.
1050	CN8	Male DB9 connector.

Decisive voltage class A according to EN 61800-5.1

N.	Name	Description	I/O Features	NOTES
1	**-**			Do not use
2	**PREC_M**	Bypass circuit closure (master)	0-24 V max 1 mA	+24 V: precharge not complete; 0 V: precharge complete Duplication of the precharge status relay function. To be used only for the parallel-connection of multiple power supply units
3	**Vrs**	Vrs supply voltage, isolated and damped by 250	Analog, ±5 V Max. 1 mA	Sine-wave alternating signal
4	**Vst**	Vst supply voltage, isolated and damped by 250	Analog, ±5 V Max. 1 mA	Sine-wave alternating signal
5	**VBOK**	ON/OFF command for thyristors controlling precharge resistor bypass	0-24 V 4 mA	+24 V for thyristor firing. Duplication of the signal on terminal 1 in MR2
6	**+24V**	24 Vdc Power supply	24 V	Duplication of the signal on terminal 3 in MR1; to be used for the parallel-connection of multiple power supply units to supply the slave units
7	**0V**	0 V	Control board zero volt	Duplication of the signal on terminal 4 in MR1; to be used for the parallel-connection of multiple power supply units as the control board zero volt.
8	**PT_M**	Thermoswitch (master)	0-24 V	+24 V open thermoswitch; 0 V: thermoswitch OK. Duplication of the overtemperature alarm relay function. To be used for the parallel-connection of multiple power supply units as the control board zero volt.
9	**NTC_M**	NTC readout (master)	5 V Max	NTC 10k polarized at 5 V with 6k81. To be used for the parallel-connections only to get the measurement of the highest temperature among the power supply units (terminal 8 in MR2).

Connector to the “slave” (Signal OUT)

The connector is to be used for the master-slave connection of multiple power supply units only.

SIZE	Connector name	Connector type
465	CN2	Female DB9 connector.
1050	CN12	Male DB9 connector.

Decisive voltage class A according to EN 61800-5.1

N.	Name	Description	I/O Features	NOTES
1	**-**			Do not use
2	**PREC_S**	Bypass circuit closure (slave)	0-24 V	+24 V: precharge not complete; 0 V: precharge complete Duplication of the precharge status relay function. To be used only for the parallel-connection of multiple power supply units
3	**-**			Not connected
4	**-**			Not connected
5	**VBOK**	ON/OFF command for thyristors controlling precharge resistor bypass	0-24 V	+24 V for thyristor firing. Duplication of the signal on terminal 1 in MR2. To be used only for the parallel-connection of multiple power supply units.
6	**+24V**	24 Vdc power supply	24 V	Duplication of the signal on terminal 3 in MR1; to be used for the parallel-connection of two AC/DC UNITS 465 to supply the slave units.
7	**0V**	0 V	Control board zero volt	Duplication of the signal on terminal 4 in MR1; to be used for the parallel-connection of multiple power supply units as the control board zero volt.
8	**PT_S**	Thermoswitch (master)	0-24 V	+24 V open thermoswitch; 0 V: thermoswitch OK. Duplication of the overtemperature alarm relay function. To be used for the parallel-connection of multiple power supply units as the control board zero volt.
9	**NTC_S**	NTC Readout (master)		NTC 10k polarized at 5 V with 6k81. To be used for the parallel-connections only to get the measurement of the highest temperature among the power supply units (terminal 8 in MR2).

NOTE When multiple AC/DC UNITS 465 are parallel-connected, it is possible to power supply a slave unit through the 9-pin shielded cable. In that case, apply double supply current (1.4 A instead of 0.7 A) to terminal 3 in MR1. If more than 2 AC/DC UNITS 465 are parallel-connected, apply 24 V supply voltage to terminals 3 and 4 every 2 power supply units.

NOTE In order to send signal controls to the ES840 boards, use 9-pin shielded cable, AWG26 as a minimum requirement (see Figure 22).

AC/DC UNIT	Preceding master/slave connector	Power distribution cable	Internal connection	Power distribution cable	Next slave connector
465	CN1-Male	Female DB9	1→1 2→2 3→3 4→4 5→5 6→6 7→7 8→8 9→9 Shield not connected	Male DB9	CN2-Female
1050	CN8-Male	Female DB9		Female DB9	CN12-Male

Table 6: Connections of signal distribution cable

The connection in parallel of more than one supply unit requires configuring the ES840 control board by changing the default settings of special-purpose jumpers. Those settings are given in the table below, based on the position of the supply unit in the device chain (first position, intermediate position, end position).

Jumper	Single configuration	Parallel-connected units		
		AC/DC UNIT in first position	AC/DC UNIT in intermediate position	AC/DC UNIT in end position
J1	ON	ON	ON	ON
J2	ON	ON	ON	ON
J3	ON	OFF	OFF	ON
J4	ON	OFF	OFF	ON
J5	ON	ON	OFF	OFF
J6	ON	ON	OFF	OFF
J7	2-3	2-3	2-3	2-3
J7	2-3	2-3	2-3	2-3

Table 7: Configuration of the ES840 control board for the parallel-connection of multiple AC/DC units

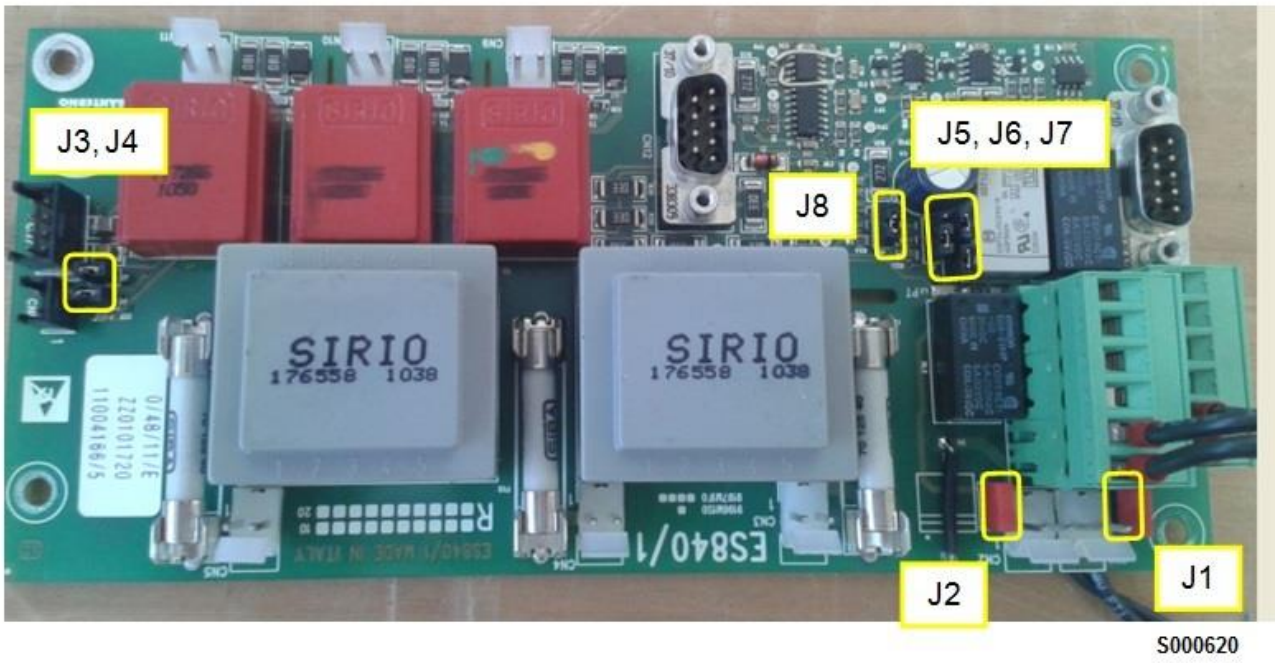


Figure 20: Position of the jumpers in ES840 board

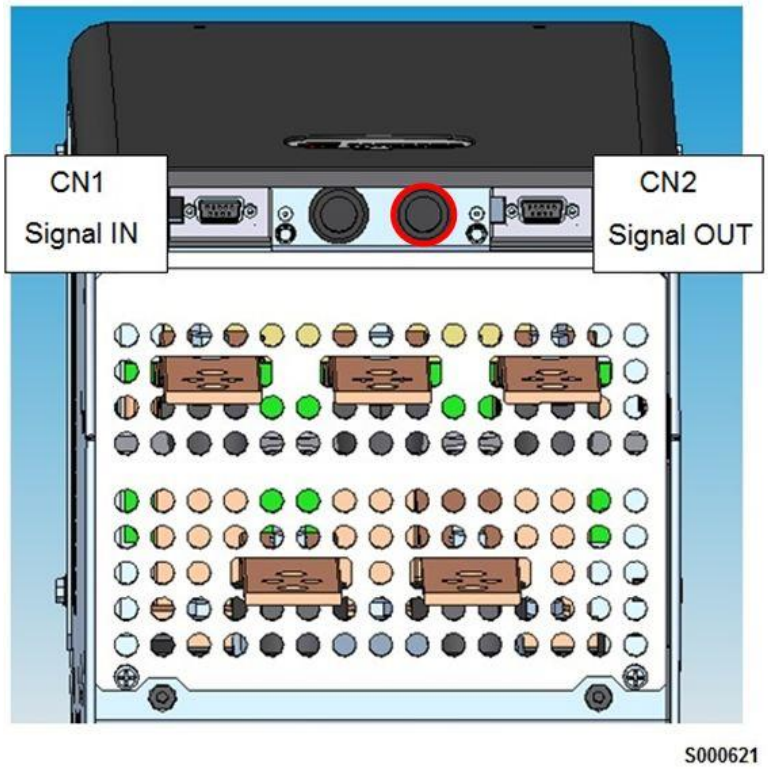


Figure 21: Position of connectors CN1 and CN2 on the AC/DC UNIT 465

Figure 22: Example of a 9-pin shielded cable for signal connection

5. CONTROLLING THE PRECHARGE CIRCUIT

5.1. Controlling and Monitoring the Precharge Circuit

Figure 23 shows a principle diagram of the precharge circuit. The command of the precharge circuit requires the output voltage measurement and the supply voltage measurement.

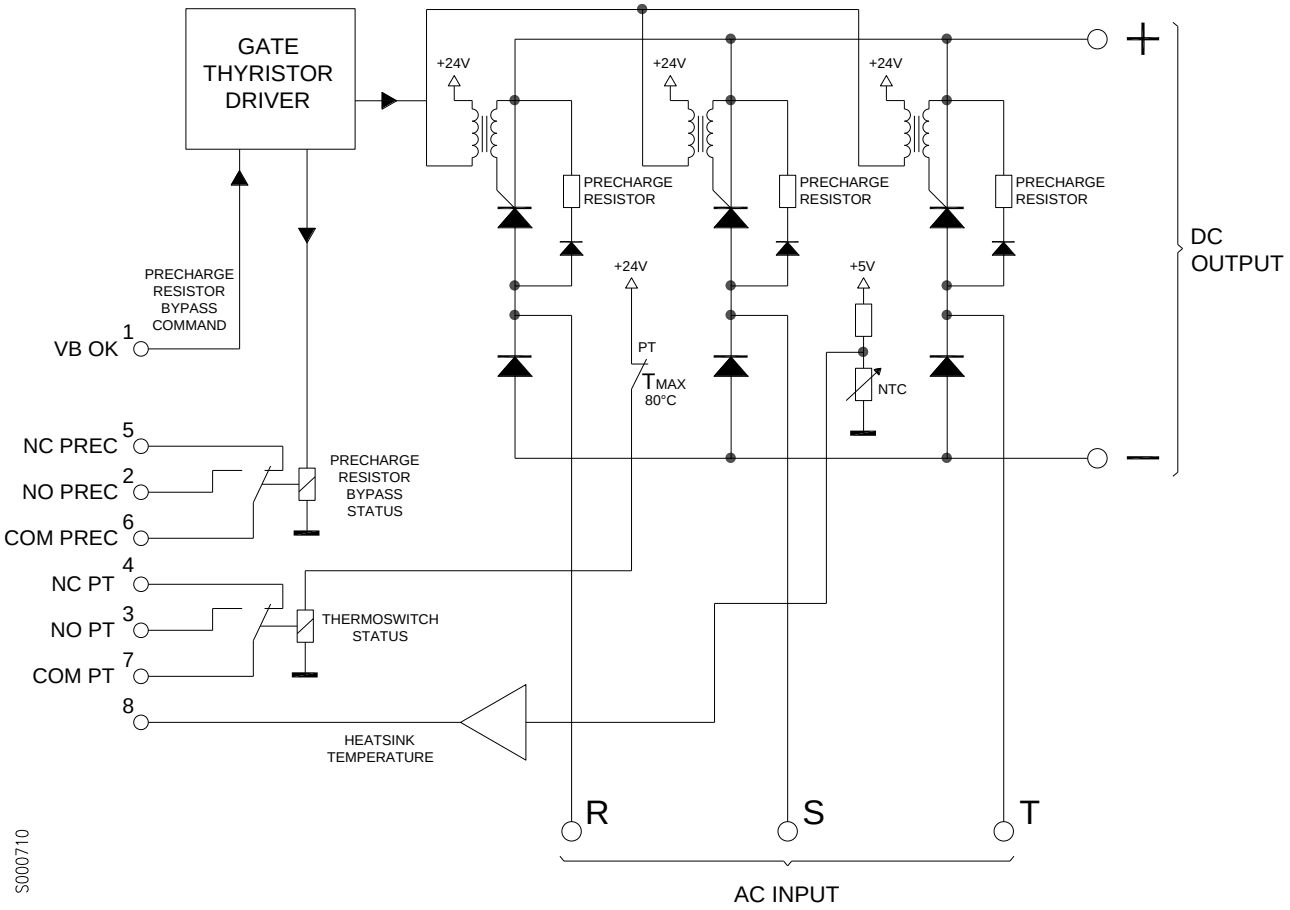


Figure 23: Principle diagram of the precharge circuit

The command sequence is given below:

- apply voltage to the AC/DC UNIT;
- send the VBOK command to complete the circuit controlling the bypass of the precharge resistors using a relay from Sinus Penta configured as Precharge OK (**P298**=10) **[*]**;
- wait for the feedback of the bypass closure (precharge circuit status relay energized);
- it is now possible to enable the drives connected to the DC busbar;
- keep the precharge circuit status signal monitored during the equipment operation. If the relay detects that the bypass circuit opens or is faulty, cut off power supply immediately.

NOTE [*] As an alternative, wait for the DC output voltage to be 95% x AC supply voltage x √2, wait 5s more and then send the VBOK command to complete the circuit controlling the bypass of the precharge resistors.

CAUTION Improper control signals and diagnostic signals may damage the AC/DC UNITS.

5.2. Maximum Heatsink Temperature Fault

The AC/DC UNIT houses a thermoswitch tripping when the heatsink temperature exceeds 80 °C. The status of the thermoswitch is given in MR2 terminal board through the contacts of a relay. The relay is energized when the heatsink temperature is below 80 °C (maximum temperature that the heatsink surface may reach). Keep the thermoswitch status signal monitored during the equipment operation. If the maximum allowable temperature is exceeded, cut off power supply immediately.

CAUTION Failure to cut off power supply when the heatsink temperature exceeds 80 °C will cause the AC/DC UNIT malfunction.

5.3. Temperature Measurement

An analog signal is made available from terminal 8 in terminal board MR2. That analog signal may be used to monitor the heatsink temperature as it is proportional to the resistance of an NTC sensor. That analog signal is strongly non-linear. The correspondence between terminal voltage and heatsink temperature is given in Table 8.

T (°C)	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90
Vntc (V)	4.17	3.97	3.74	3.5	3.24	2.97	2.7	2.44	2.18	1.94	1.71	1.51	1.32	1.16	1.01	0.89	0.77	0.68	0.59

Table 8: Correspondence between terminal voltage and heatsink temperature (terminal 8 in MR2)

6. TYPICAL APPLICATION

A typical application is the connection of multiple devices of the SINUS PENTA series to the DC bus bar obtained by the AC/DC UNITS.
The SINUS PENTA is to be connected to the positive pole of the DC busbar through terminal 47 or 47+, where fitted, and to the negative pole through the DC busbar through terminal 49.

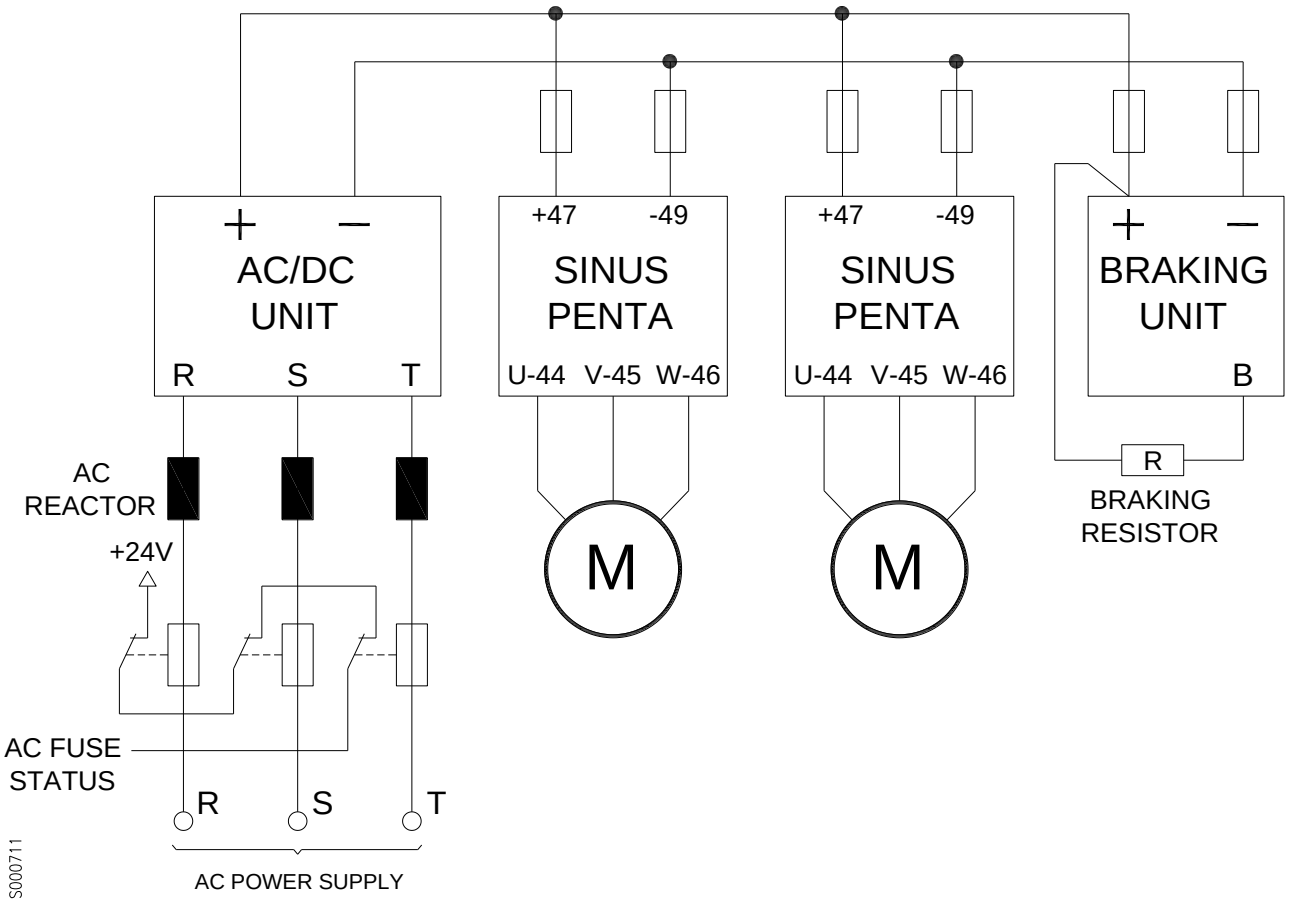


Figure 24: Principle diagram of an application featuring the AC/DC UNIT

Figure 24 shows the power wiring of an application featuring the AC/DC UNIT.

This application includes the following:

- One AC/DC UNIT, 690 Vac power supply
- One SINUS PENTA S52 0401 driving a 630 kW motor and one SINUS PENTA S42 0181 driving a 250 kW motor
- One BU600 braking unit

The power to be delivered to the DC busbar is computed as follows:

$$Pdc = \left(\frac{P_{mot_1}}{\eta_{mot_1}} + P_{loss_1}\right) + \left(\frac{P_{mot_2}}{\eta_{mot_2}} + P_{loss_2}\right) + \cdots \ldots \ldots \ldots \left(\frac{P_{mot_n}}{\eta_{mot_n}} + P_{loss_n}\right)$$

Where:
$\left(\frac{P_{mot_i}}{\eta_{mot_i}} + P_{loss_i}\right)$ is the power absorbed by the DC busbar by every group inverter + motor:
$\frac{P_{mot_i}}{\eta_{mot_i}}$ is the power of each motor divided by the motor's efficiency
P_{loss_i} is the power dissipated by each drive.

N.2 SINUS PENTA drives are adopted in the example. Supposing 95% motor efficiency and considering the drive losses as per the calculations given in the SINUS PENTA's Installation Guide, the following formula is obtained:

$$\left(\frac{630}{0.95}+7.65\right)+\left(\frac{250}{0.95}+3.45\right)=937.4kW$$

The contribution of the braking unit is negligible as it activates only when no power is absorbed by the mains. The current to be delivered by the AC/DC UNIT is equal to the power divided by the mean value of the DC busbar rectified voltage:

$$Idc=\frac{937.4}{690*1.35}=1006A$$

The AC/DC UNIT 1050 is required for this application.

Make sure that the rated value of the capacitor connected to the DC busbar is not greater than the allowable capacitor value for the AC/DC UNIT 1050.

Table 3 allows obtaining the total value for the capacitors connected to the DC busbar, namely:
$Cdc=C_{S52_{0402}}+C_{S42_{0181}}+C_{BU600}$ = 20000+13333+6600 = 39933 µF

The maximum allowable capacitor ratings for the AC/DC UNIT 1050 is given in Table 2 and is 121000 µF, greater than 39933 µF, so that the AC/DC UNIT may be applied.

Should fuses be applied to the DC power supply line to the drives and the BU, consider fuse dimensioning based on the voltage applied to the DC busbar (1000 Vdc rated fuses are required in the example) as well as the current absorbed by each device connected to the DC busbar).

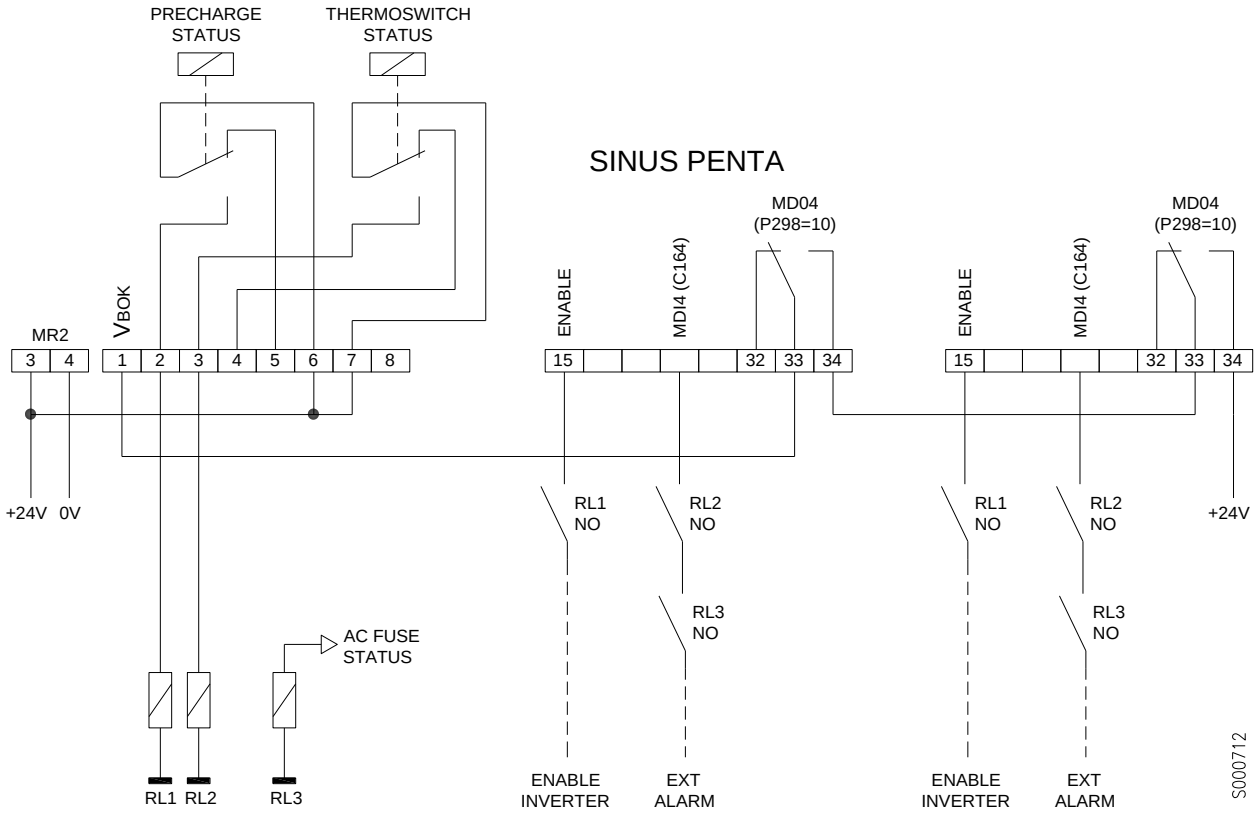


Figure 25: Signal wiring between the AC/DC UNIT and the SINUS PENTA

Figure 25 gives an example of the control signal wiring for the correct precharge control in case of two inverters in parallel.

Terminal N.	Name	Description	Wiring	NOTES
1	**VBOK**	ON/OFF command for thyristors controlling precharge resistor bypass	Contacts in series of the MDO4 relay digital output of the SINUS PENTA drives	When the drive command detects that the capacitor precharge is complete, the relay is energized. By connecting in series the contacts of the two relays, the resistors will be bypassed only when the precharge stage is complete for all the drives. Set the digital output as precharge OK (**P298**=10).
2-6	**NOPREC COMPREC**	NO contact of the relay indicating the status of the devices controlling the precharge resistor bypass	An additional relay is installed to insert a normally open contact in series to the ENABLE input in the drive	Energized relay, means bypassing precharge resistors: this prevents the drive from operating until the precharge resistors are bypassed or the bypass is open.
3-7	**NOPT COMPT**	NO contact of the overtemperature fault relay indicating the status of the thermoswitch located on the heatsink of the AC/DC UNIT	An additional relay is installed to send a signal on the relay status to the MDI4 input in each drive programmed as external fault (input +24V correspond to normal operation)	Energized relay, means normal operation (thermoswitch not tripped): normally, the external fault command is not sent. Set **C164**=4 to allocate MDI4 input to external fault. The signal status of the fuses on the power supply line is connected in series to the external fault signal. In that case, when a fuse blows, a fault trips for all the drives and the current from the AC/DC UNIT is cut off.

NOTE For more details on how to set the SINUS PENTA parameters accordingly, please refer to the SINUS PENTA's Programming Guide .

7. INDUCTORS

7.1. Three-phase Input Inductors for the AC/DC UNITS

7.1.1. 4T Class – AC Line Inductors

AC/DC UNIT SIZE	INPUT THREE-PHASE AC INDUCTOR
0465	IM0126332
1050	IM0126404

INDUCTOR MODEL	APPLICATION	INDUCTOR RATINGS		DIMENSIONS							HOLE	WEIGHT	LOSSES
		mH	A	TYPE	L	H	P	M	E	G	mm	kg	W
IM0126332	Input	0.050	455	C	300	317	217	100	250	128	9x24	54	410
IM0126404	Input	0.023	945	C	300	320	240	100	250	143	9x24	67	752

7.1.2. 5T and 6T Class – AC Line Inductors

AC/DC UNIT SIZE	INPUT THREE-PHASE AC INDUCTOR
0465	IM0127330
1050	IM0127404

INDUCTOR MODEL	APPLICATION	INDUCTOR RATINGS		DIMENSIONS							HOLE	WEIGHT	LOSSES
		mH	A	TYPE	L	H	P	M	E	G	mm	kg	W
IM0127330	Input	0.096	415	C	360	340	250	120	325	166	9x24	60	610
IM0127404	Input	0.040	945	C	360	385	260	120	250	200	12	88	1193

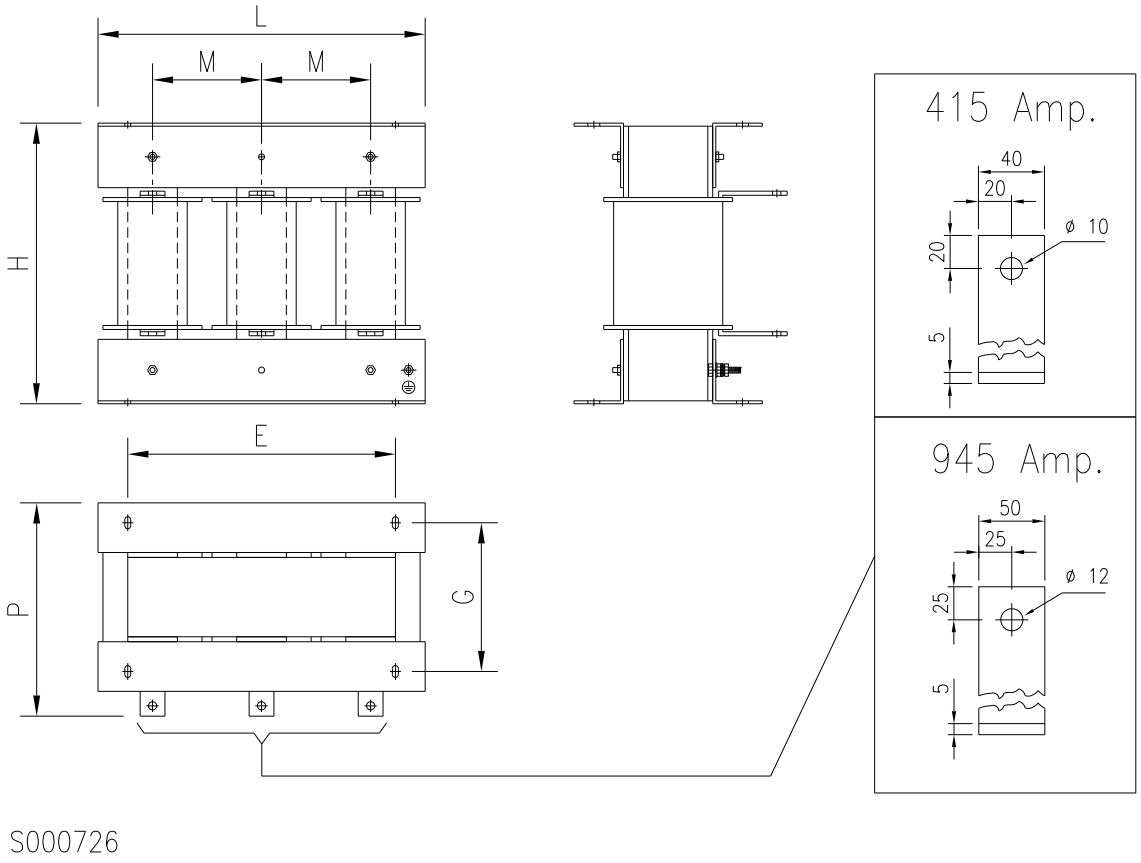


Figure 26: Mechanical features of the three-phase input inductors

8. SCHEDULED MAINTENANCE OF THE AC/DC UNITS

For the scheduled maintenance of the AC/DC UNITS, please refer to the Inverter Scheduled Maintenance section in the SINUS PENTA's Installation Guide with reference to the applicable parts.