

• 15P0102B200 •

SINUS PENTA

ASSEMBLY INSTRUCTIONS FOR SINUS PENTA S41 S42 S51 S52 PARALLEL-CONNECTED MODELS

Issued on 23/02/2022
R.02

English

- This manual is integrant and essential to the product. Carefully read the instructions contained herein as they provide important hints for use and maintenance safety.
- This device is to be used only for the purposes it has been designed to. Other uses should be considered improper and dangerous. The manufacturer is not responsible for possible damages caused by improper, erroneous and irrational uses.
- Enertronica Santerno S.p.A. is responsible for the product in its original setting.
- Any changes to the structure or operating cycle of the product must be performed or authorized by Enertronica Santerno S.p.A..
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Enertronica Santerno S.p.A.
Via della Concia, 7 - 40023 Castel Guelfo (BO) Italia
Tel. +39 0542 489711 - Fax +39 0542 489722
santerno.com info@santerno.com

REVISION INDEX

The following subjects covered in this Assembly Instructions Guide (revision R.02) have been changed in respect to the previous Assembly Instructions Guide (revision R.01).

In the Components, Wiring and Sizes of the Protective Devices section added a note describing the tables below.

In the Power Components: Parallel-connected Drive Supply tables removed the reference to Fast Fuses.

Figure 4: Electrical schematic for qty 3 parallel-connected drives fixed.

OTHER USER MANUAL MENTIONED IN THIS GUIDE

The following other Manual from Enertronica Santerno S.p.A. is mentioned throughout this Guide:

- **15P0102B100** SINUS PENTA – Installation Guide

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1. OVERVIEW

The drives of the SINUS PENTA series, sizes S41, S42, S51 and S52 may be parallel connected to make up a system composed of maximum 3 units. Special additional components are required.

The units making up the parallel connections are called the Master (qty 1 drive) and Slave(s) (qty 1 or 2 drives) throughout this manual.

This manual covers how to assemble parallel connected drives of the SINUS PENTA series, sizes S41, S42, S51 and S52 as well as their additional components (wiring cables, current split inductors).

Assembly consists of wiring the drives and the relevant components to obtain the drive parallel connection.



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

The sizes that can be obtained by parallel-connecting Sinus Penta drives S41, S51, S42, S52 are given in Table 1 and Table 2.

Drive size	Drive model	qty of drives to be parallel connected	Final size	Final model	Applicable motor power with overload up to 120%									Inom	Imax
					380-415 Vac			440-460 Vac			480-500 Vac				
					kW	HP	A	kW	HP	A	kW	HP	A	A	A
S41	0260	2	S43	0523	450	610	765	500	680	731	560	760	751	800	960
S51	0313	2	S53	0599	500	680	841	560	760	817	630	860	864	900	1100
	0367			0749	560	760	939	630	860	939	710	970	960	1000	1300
	0402			0832	710	970	1200	800	1090	1160	900	1230	1184	1200	1440
S51	0313	3	S55	0850	800	1090	1334	900	1230	1287	1000	1360	1317	1340	1600
	0367			0965	900	1230	1480	1000	1360	1431	1100	1500	1480	1480	1780
	0402			1129	1000	1360	1646	1170	1600	1700	1270	1730	1700	1700	2040
Drive supply voltage					380-415 Vac			440-460 Vac			480-500 Vac				

Table 1: Drive sizes that can be obtained when applying 380 V to 500 V supply voltage

Drive size	Drive model	qty of drives to be parallel connected	Final size	Final model	Applicable motor power with overload up to 120%						Inom	Imax
					525-575 Vac			660-690 Vac				
					kW	HP	A	kW	HP	A	A	A
S42	0259	2	S44	0459	630	860	720	710	970	696	720	880
S52	0290	2	S54	0526	710	970	800	800	1090	773	800	960
	0314			0600	800	1090	900	900	1230	858	900	1100
	0368			0750	900	1230	1000	1000	1360	954	1000	1300
	0401			0828	1000	1360	1145	1240	1690	1200	1200	1440
S52	0368	3	S56	0960	1270	1730	1480	1530	2090	1480	1480	1780
	0401			1128	1460	1990	1700	1750	2380	1700	1700	2040
Drive supply voltage					525-575 Vac			660-690 Vac				

Table 2: Drive sizes that can be obtained when applying 500 V to 690 V supply voltage

Key:

Inom = continuous rated current of the drive

Imax = maximum current that can be delivered by the drive for 60 s every 10 min.



CAUTION

The drive size to be obtained involves configuring the drive electronic boards accordingly. Specify the drive configuration to be obtained at the same time as ordering the equipment.



CAUTION

Do not change the layout and wiring covered in this manual when parallel connecting the SINUS PENTA drives. Any configuration other than that covered in this manual is not allowed and may damage the equipment or lead to equipment malfunction.

2. DELIVERY CHECK

The following kits will be delivered based on the drive model you ordered:

Drive		Kit components			
Drive size	Drive model	Master drive	First slave drive	Last slave drive	Number of flat cables for signal connections
S43	0523	0260 Master	Not fitted	0260 Last Slave	1
S53	0599	0313 Master	Not fitted	0313 Last Slave	1
	0749	0367 Master	Not fitted	0367 Last Slave	1
	0832	0402 Master	Not fitted	0402 Last Slave	1
S55	0850	0313 Master	0313 First Slave	0313 Last Slave	2
	0965	0367 Master	0367 First Slave	0367 Last Slave	2
	1129	0402 Master	0402 First Slave	0402 Last Slave	2
S44	0459	0259 Master	Not fitted	0259 Last Slave	1
S54	0526	0290 Master	Not fitted	0290 Last Slave	1
	0600	0314 Master	Not fitted	0314 Last Slave	1
	0750	0368 Master	Not fitted	0368 Last Slave	1
	0828	0401 Master	Not fitted	0401 Last Slave	1
S56	0960	0368 Master	0368 First Slave	0368 Last Slave	2
	1128	0401 Master	0401 First Slave	0401 Last Slave	2

Table 3: Components of the kit to assemble a drive composed of parallel connected elements



NOTE Flat cables are inside the slave drives (see section 4.1.4).

Make sure that the equipment is not damaged and it complies with the equipment you ordered by referring to its nameplate given below. Contact the supplier if the equipment is damaged. 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 acceptable environmental requirements are met (see SINUS PENTA – Installation Guide). The equipment warranty covers any manufacturing defect.

The manufacturer has no responsibility for possible damages due to the equipment transportation or unpacking. 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 equipment operation at values exceeding the equipment ratings and is not responsible for consequential and accidental damages.

**ZZ0124063 74203289 SINUS PENTA 0402 4T XA2K0 S51
(First Slave)**

	INPUT	OUTPUT
Voltage	AC 3PH 380..500 V+10/-15%	AC 3PH 0 .. Vin
Frequency	50/60 Hz \pm 20%	0.. 500 Hz
Current	680 A	Inom 680 A I _{max} 850 A
Power		P _{nom} 588.2 kVA
Protection degree IP00 – UL Open Type / IP21 – UL Type 1 with NEMA 1 Glandkit ZZ0124850		

FOR FURTHER DETAILS
SEE USER MANUAL



Enertronica Santerno S.p.A
Via della Concia n° 7
40023 Castel Guelfo (BO) – Italy
santerno.com

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Figure 2: Nameplate for the First Slave drive

3. MECHANICAL INSTALLATION

The parallel-connected drives may be the Master drive, the First Slave and the Last Slave.

Master drive this is drive housing the control board and it is always installed on the left-hand side of the slave drives.

First Slave drive this is the slave installed in the middle position when there are 3 parallel-connected drives.

Last Slave drive this is the drive installed on the right-hand side in the configuration including qty 2 or qty 3 parallel-connected drives.



CAUTION

Any configuration other than that covered in this manual may damage the equipment or lead to serious malfunction.

The drive layout inside the cabinet must consider the following:

1. Position of the master drive and the slave drive
2. Connection of the DC bus for the control signal

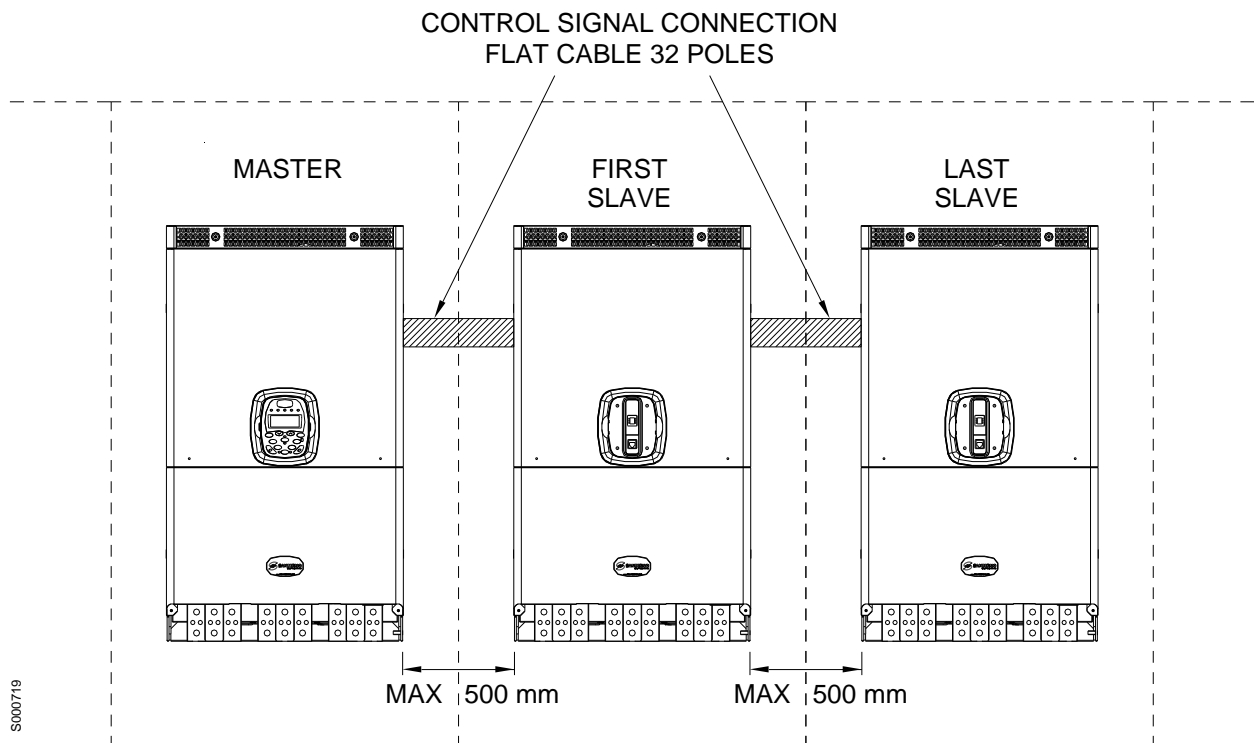


Figure 3: Drives installed inside a cabinet

Figure 3 shows an example of a parallel-connection of qty 3 drives installed inside a cabinet. Do the following:

1. Do not exceed maximum clearance between the drives
2. Make sure that the path of the flat cable for the control signals is clear; in particular, the flat cable must not touch live parts and must not be laid close to dangerously live parts. It must not be close to electromagnetic disturbance or to parts that may mechanically damage it; it must not touch or be close to parts that may reach 60 °C or more. Arrange a clear area of approx. 200 mm next to the path of the flat cable and centred on the flat cable itself.

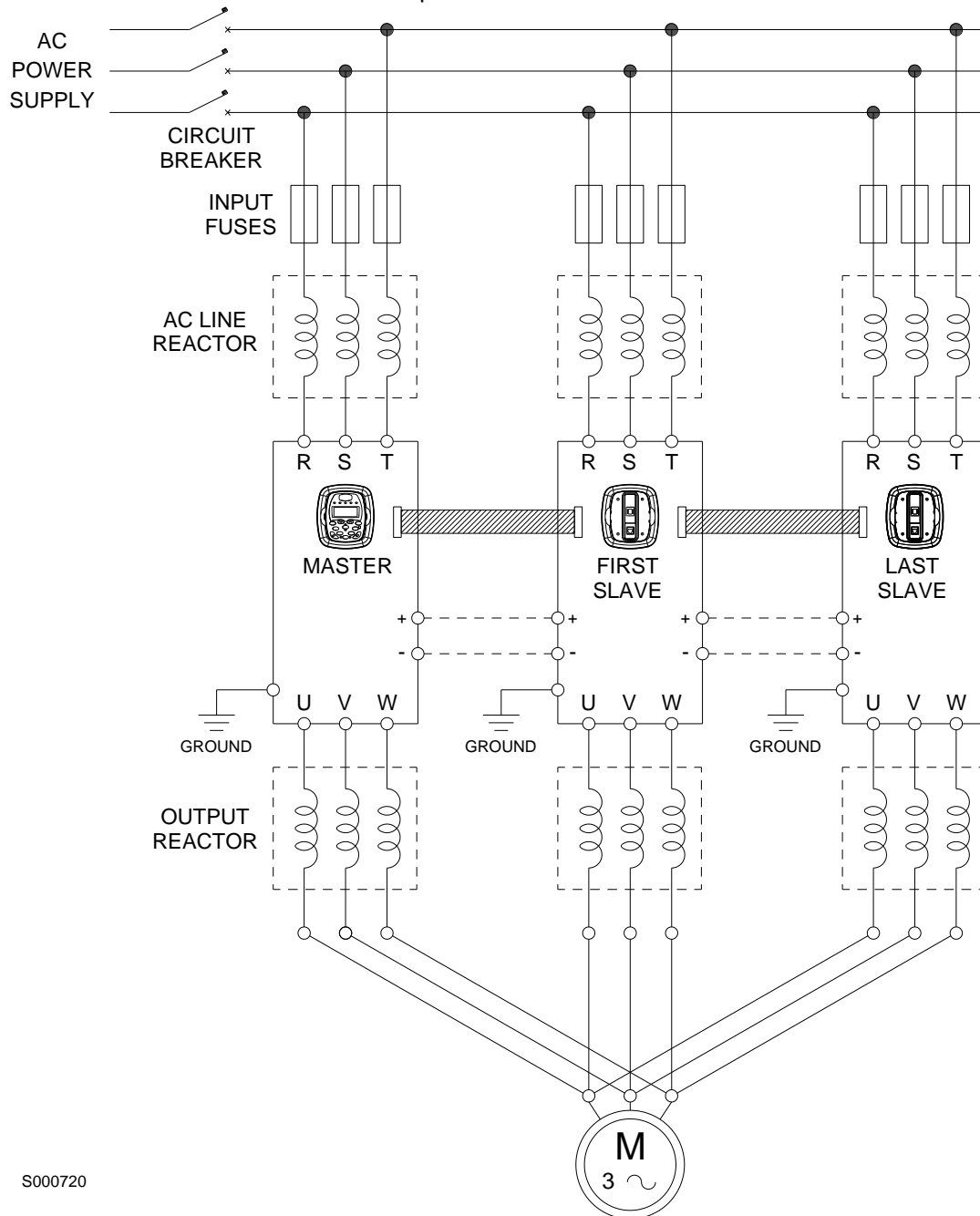


NOTE

Dimensions, weights and fixing points of each drive are given in the SINUS PENTA – Installation Guide.

4. ELECTRICAL SCHEMATIC FOR PARALLEL-CONNECTED DRIVES

Figure 4 shows the electrical schematic for the parallel-connected drives.



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Figure 4: Electrical schematic for qty 3 parallel-connected drives



CAUTION

Always install the fuse failure detection device, that disables the drive, to avoid single-phase operation of the equipment.



NOTE

If the application does not require any device connected to the DC bus (e.g. a braking unit) or 12-pulse power supply, it is not necessary to connect to each other the DC bus terminals of the drive.

4.1. Components, Wiring and Sizes of the Protective Devices

The components required for the parallel connection of the Sinus Penta drives are given in the tables below.

The minimum requirements of the drive cables and the protective devices needed to protect the system against short-circuits are also 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.

For the largest drive sizes, special links with multiple conductors are provided for each phase. For example, 2x150 in the column relating to the cable cross-section means that two 150 mm² 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 deliver uneven current at high frequency.

Also, do not exceed the tightening torque for the terminals to the bar connections. For connections to bars, 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 SINUS PENTA drive must have the same lengths and must follow the same paths. Use 3-phase cables where possible.

Basically, the following components are needed:

- qty 1 safety device on the supply mains to the parallel-connected drives.
- qty 1 safety device on the supply mains to each drive that is parallel-connected to the other drives.
- qty 1 input inductor to the supply mains to each drive that is parallel-connected to the other drives. The inductor is utilized to split the supply current.
- qty 1 output inductor between each parallel-connected drive and the motor. The inductor is utilized to split the output current.

The parallel connection of the motor cables is to be done directly to the motor terminals as shown in Figure 4, in order to get even better current splitting.



NOTE

The notes below are general-purpose guidelines that cannot be applied to any configuration.

The component dimensioning shall meet the environmental requirements as well as the requirements of the place where the equipment is installed.



NOTE

The following tables describe the components to be mounted on:

- Parallel-connected Drive Supply (just upstream and downstream the general protection components)
- Drive Supply (each single branch)
- Drive to Motor

4.1.1. Power Components: Parallel-connected Drive Supply

4.1.1.1. 4T Class

Size	SINUS PENTA Model	Parallel drive line current	Copper bar cross-section	Disconnecter Switch	Magnetic Circuit breaker	AC1 Contactor
		A	mm ²	A	A	A
S43	0523	800	5x50	900	900	800
	0599	900	8x40	1000	1000	1000
S53	0749	1000	10x40	1250	1250	1000
	0832	1200	10x50	1400	1400	1250
S55	0850	1340	10x63	1500	1500	1400
	0965	1480	10x80	1800	1800	1600
	1129	1700	10x100	2000	2000	1800

4.1.1.2. 5T-6T Class

Size	SINUS PENTA Model	Parallel drive line current	Copper bar cross-section	Disconnecter Switch	Magnetic Circuit breaker	AC1 Contactor
		A	mm ²	A	A	A
S44	0459	720	5x50	800	800	800
S54	0526	800	5x50	900	900	800
	0600	900	8x40	1000	1000	1000
	0750	1000	10x40	1250	1250	1000
	0828	1200	10x50	1400	1400	1250
S55	0960	1480	10x80	1800	1800	1600
	1128	1700	10x100	2000	2000	1800

4.1.2. Power Components: Drive Supply

4.1.2.1. 4T Class

Size	SINUS PENTA Model	Drive line current	Copper bar cross-section	Copper cable cross-section	Input inductor	Fast fuses (700 V)
		A	mm ²	mm ² (AWG/kcmils)	mH/A	A
S41	0260	425	3x40	2x120 (2x250kcmils)	0.05 mH 455 Arms	630
S51	0313	480	4x40	2x150 (2x300kcmils)	0.031 mH 720 Arms	700
	0367	550	5x40	2x185 (2x350kcmils)		800
	0402	680	6x40	2x240 (2x500kcmils)		1000

4.1.2.2. 5T-6T Class

Size	SINUS PENTA Model	Drive line current	Copper bar cross-section	Copper cable cross-section	Input inductor	Fast fuses (700 V)
		A	mm ²	mm ² (AWG/kcmils)	mH/A	A
S42	0259	400	3x40	2x120 (2x250kcmils)	0.096 mH 415 Arms	630
S52	0290	450	3x40	2x150 (2x300kcmils)	0.061 mH 650 Arms	630
	0314	500	4x40	2x150 (2x300kcmils)		700
	0368	560	5x40	2x185 (2x350kcmils)		800
	0401	640	5x40	2x240 (2x500kcmils)		900

4.1.2.3. UL-approved Fuses

UL-approved semiconductor fuses, which are recommended for the Sinus Penta drives, are listed in the table below.

In multiple cable installations, install one fuse per phase (NOT one fuse per conductor).

Fuses suitable for the protection of semiconductors produced by other manufacturers may be used, provided that they have the same or better ratings and

- are Nonrenewable UL Listed Cartridge Fuses, or UL Recognized External Semiconductor Fuses;
- are of the type specifically approved also with reference to the Canadian Standard.

Size	SINUS PENTA Model	UL-approved Fuses Manufactured by							
		SIBA Sicherungen-Bau GmbH (200 kA _{RMS} Symmetrical A.I.C.)				Bussmann Div Cooper (UK) Ltd (100/200 kA _{RMS} Symmetrical A.I.C.)			
		Part number	Ratings			Part number	Ratings		
			Current Arms	I ² t (500 V) A ² sec	Vac		Current Arms	I ² t (500 V) A ² sec	Vac
S41	0260	20 622 32 630	630	210000	700	FWP-600A	600	185000	700
	0313					FWP-700A	700	129000	
S51	0367	20 622 32 700	700	287000		FWP-900A	900	228000	
	0402	20 622 32 900	900	665000					
		Part number	Current Arms	I ² t (690 V) A ² sec		Part number	Current Arms	I ² t (690 V) A ² sec	
S42	0259	20 622 32 630	630	309000		FWP-600A	600	250000	
	0290	20 622 32 630	630	309000		FWP-600A	600	250000	
	0314	20 622 32 700	700	422000		FWP-700A	700	300000	
S52	0368	20 622 32 800	800	598000		FWP-800A	800	450000	
	0401	20 622 32 900	900	979000		FWP-900A	900	530000	

4.1.3. Power Components: Drive to Motor

4.1.3.1. 4T Class

Size	SINUS PENTA Model	Drive output current	Cross-section of the motor cable	Output inductor
		A	mm ² (AWG/kcmils)	mH/A
S41	0260	425	2x120 (2x250kcmils)	0.035 mH 440 Arms
S51	0313	480	2x150 (2x300kcmils)	0.025 mH 700 Arms
	0367	550	2x185 (2x350kcmils)	
	0402	680	2x240 (2x500kcmils)	

4.1.3.2. 6T Class

Size	SINUS PENTA Model	Drive output current	Cross-section of the motor cable	Output inductor
		A	mm ² (AWG/kcmils)	mH/A
S42	0259	400	2x120 (2x250kcmils)	0.035 mH 440 Arms
S52	0290	450	2x150 (2x300kcmils)	0.025 mH 700 Arms
	0314	500	2x150 (2x300kcmils)	
	0368	560	2x185 (2x350kcmils)	
	0401	640	2x240 (2x500kcmils)	



CAUTION

The three drives are to be parallel connected to the motor terminals. Cables shall have the same length. Preferably use three-phase cables.



NOTE

The inductor ratings are given in the relevant section.

4.1.4. Signal Connections

The parallel connection of the SINUS PENTA drives requires a control board housed in the master drive. For the connections related to the control board, please refer to the SINUS PENTA – Installation Guide. A special cable supplied with the drives to be parallel connected is required.

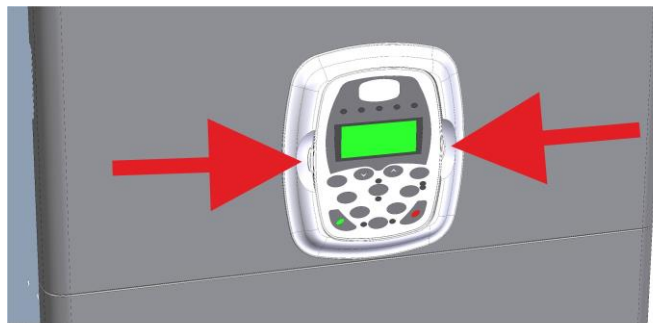
One or two cables will be supplied, based on the number of drives to be parallel connected.

Do the following to install the signal cable:

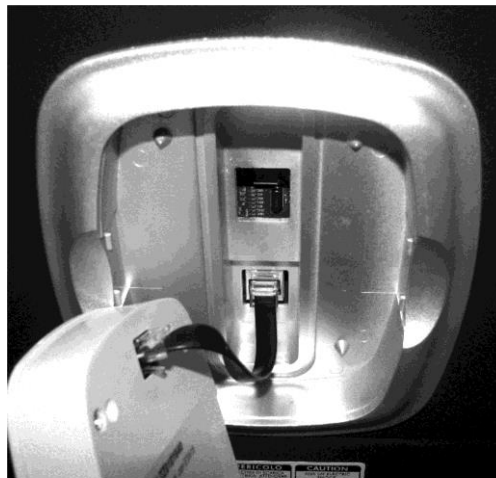
- Remove the main cover from the drives.

Do the following:

- Remove the keypad and its cable (fitted on the master drive only).

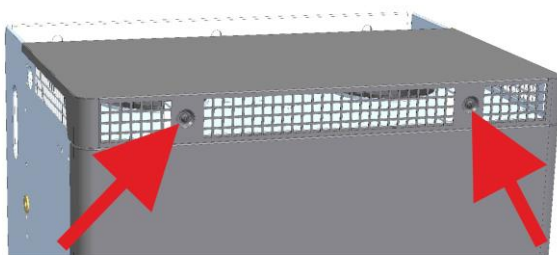


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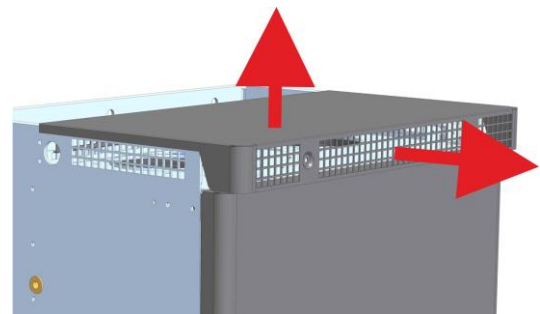


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Remove the top cover:



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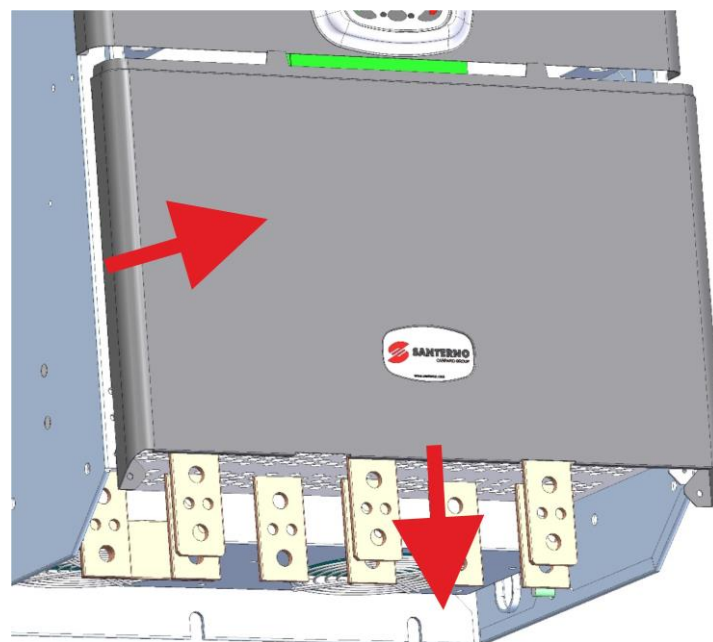


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Remove the terminals cover:

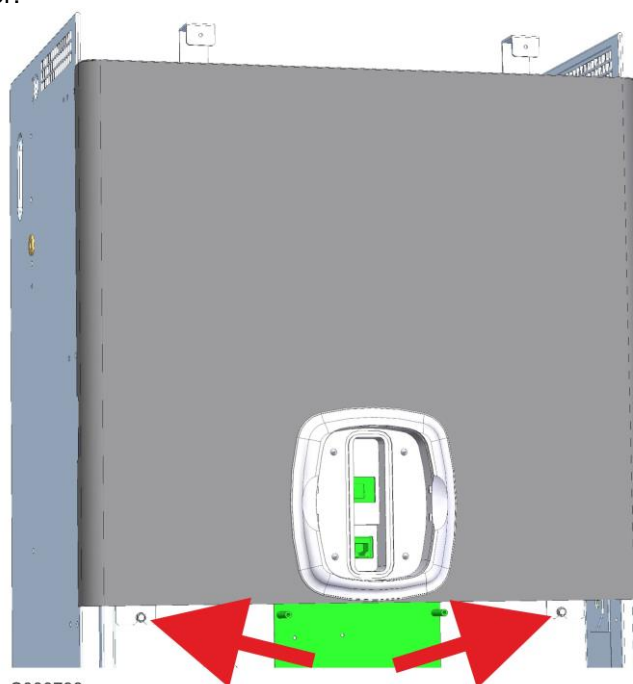


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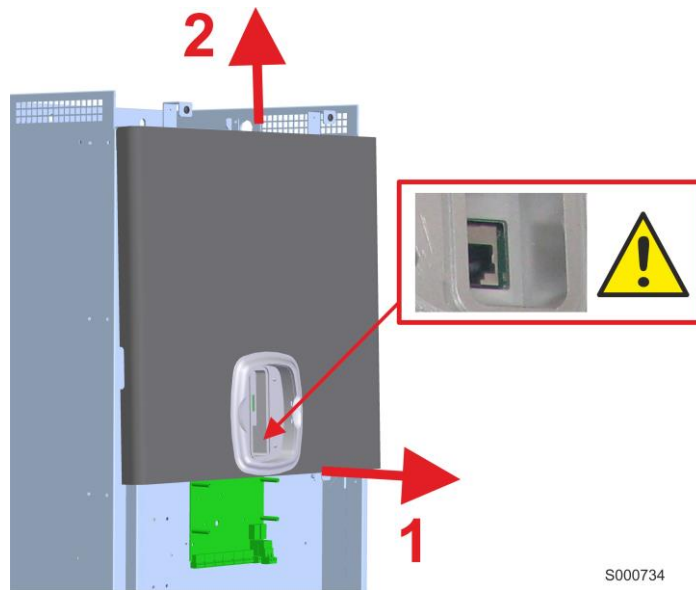


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1. Remove the main cover:



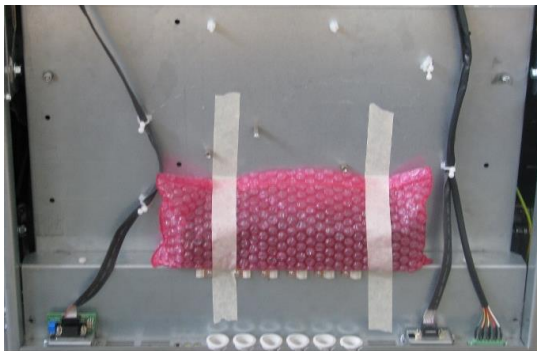
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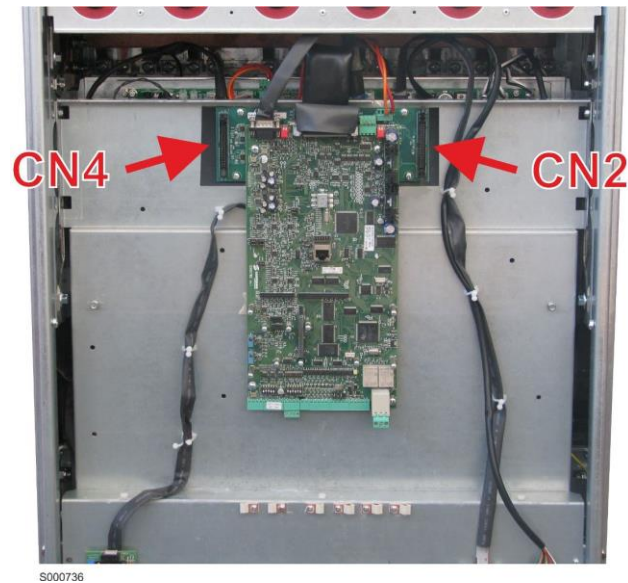
CAUTION

Remove the main cover carefully to avoid damaging the connector of the keypad cable located on the control board. In particular, do not slide the cover downwards, but slightly lift it before removing it.

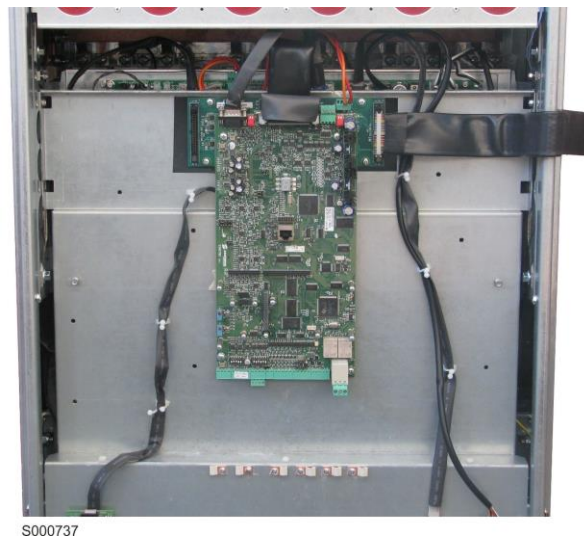
2. Remove the flat cable from the slave drives:



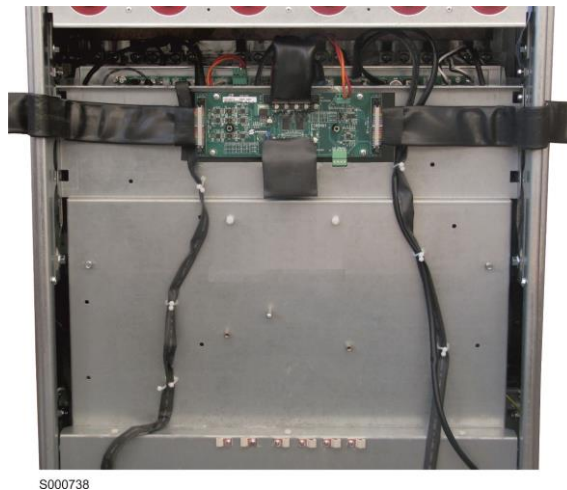
3. Plug the flat cable to connector CN2 on the ES884 control board on the master drive.



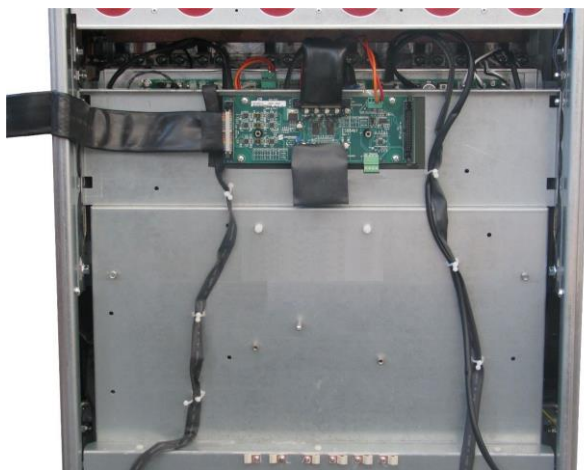
4. Plug the flat cable to connector CN4 on the ES884 control board on the first slave drive, if fitted, otherwise go to step 5.



5. Plug the second cable to connector CN2 on the ES884 control board on the first slave drive.



6. Plug the cable to CN4 on the ES884 control board on the last slave drive.



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7. Reassemble the main cover on the drives. Make sure that the flat cables enter the special openings. Follow the instructions given above in the reverse order.
8. Reassemble the top cover, the terminals cover and the keypad (master drive only).

5. INDUCTORS

5.1. Three-phase Input and Output Inductors, 4T Class

DRIVE SIZE	DRIVE MODEL	INPUT INDUCTOR	OUTPUT INDUCTOR	MAX. OUTPUT FREQUENCY (Hz)
S41	0260	IM0126332 0.05 mH–455 Arms	IM0138250 0.035 mH–440 Arms	120
S51	0313	IM0126372 0.031 mH–720 Arms	IM0138300 0.025 mH–700 Arms	120
	0367			
	0402			

5.2. Three-phase Input and Output Inductors, 6T Class

DRIVE SIZE	DRIVE MODEL	INPUT INDUCTOR	OUTPUT INDUCTOR	MAX. OUTPUT FREQUENCY (Hz)
S42	0259	IM0127330 0.096 mH–415 Arms	IM0138250 0.035 mH–440 Arms	120
S52	0290	IM0127350 0.061 mH–650 Arms	IM0138300 0.025 mH–700 Arms	120
	0314			
	0368			
	0401			

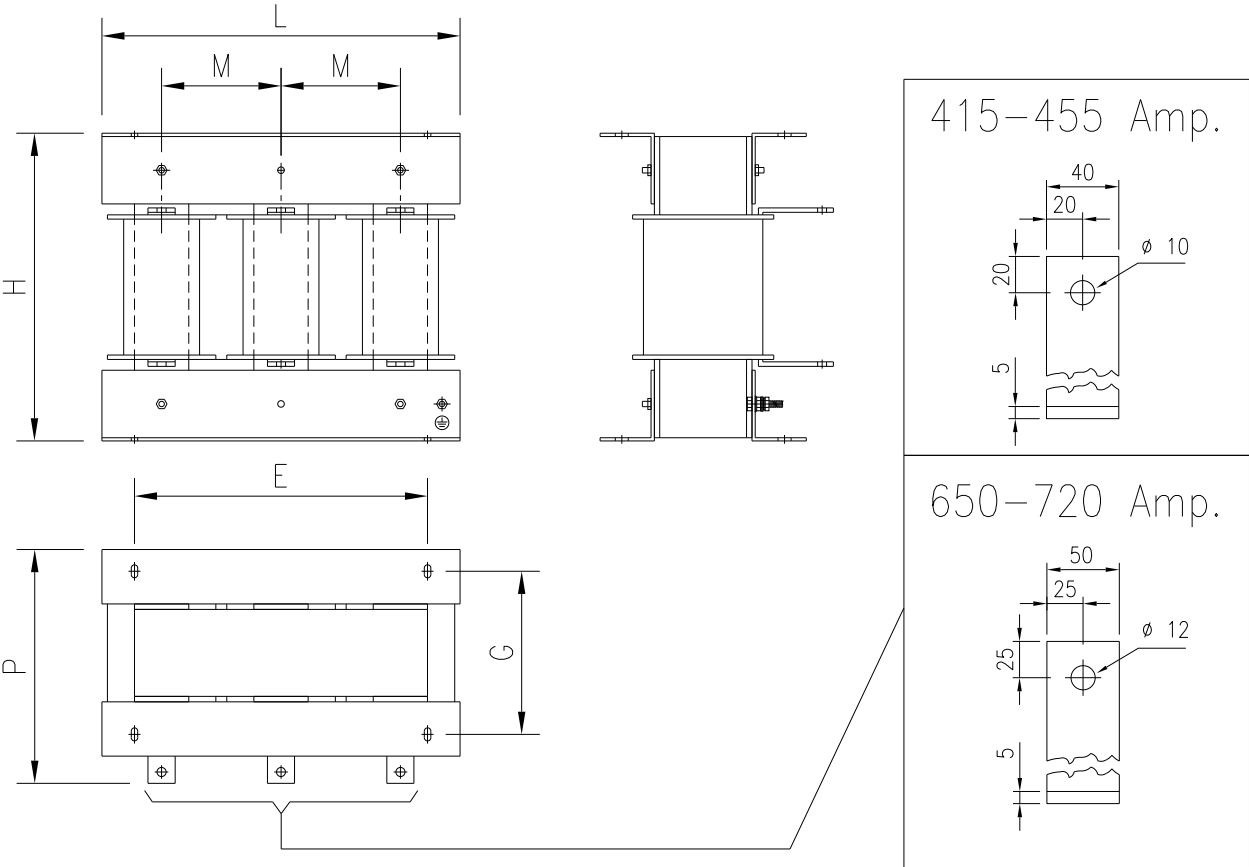
5.2.1. Inductor Ratings

5.2.1.1. 4T Class – AC 3-Phase Inductors

INDUCTOR MODEL	TYPE	INDUCTOR RATINGS		DIMENSIONS							HOLE	WEIGHT	LOSSES
		mH	A	TYPE	L	H	P	M	E	G	mm	kg	W
IM0126332	Input only	0.050	455	C	300	317	217	100	250	128	9x24	54	410
IM0126372	Input only	0.031	720	C	360	342	268	120	325	176	9x24	84	700

5.2.1.2. 5T-6T Class – 3-Phase Inductors

INDUCTOR MODEL	TYPE	INDUCTOR RATINGS		DIMENSIONS							HOLE	WEIGHT	LOSSES
		mH	A	TYPE	L	H	P	M	E	G	mm	kg	W
IM0127330	Input only	0.096	415	C	360	340	250	120	325	166	9x24	80	610
IM0127350	Input only	0.061	650	C	360	411	298	120	240	220	9x24	113	920

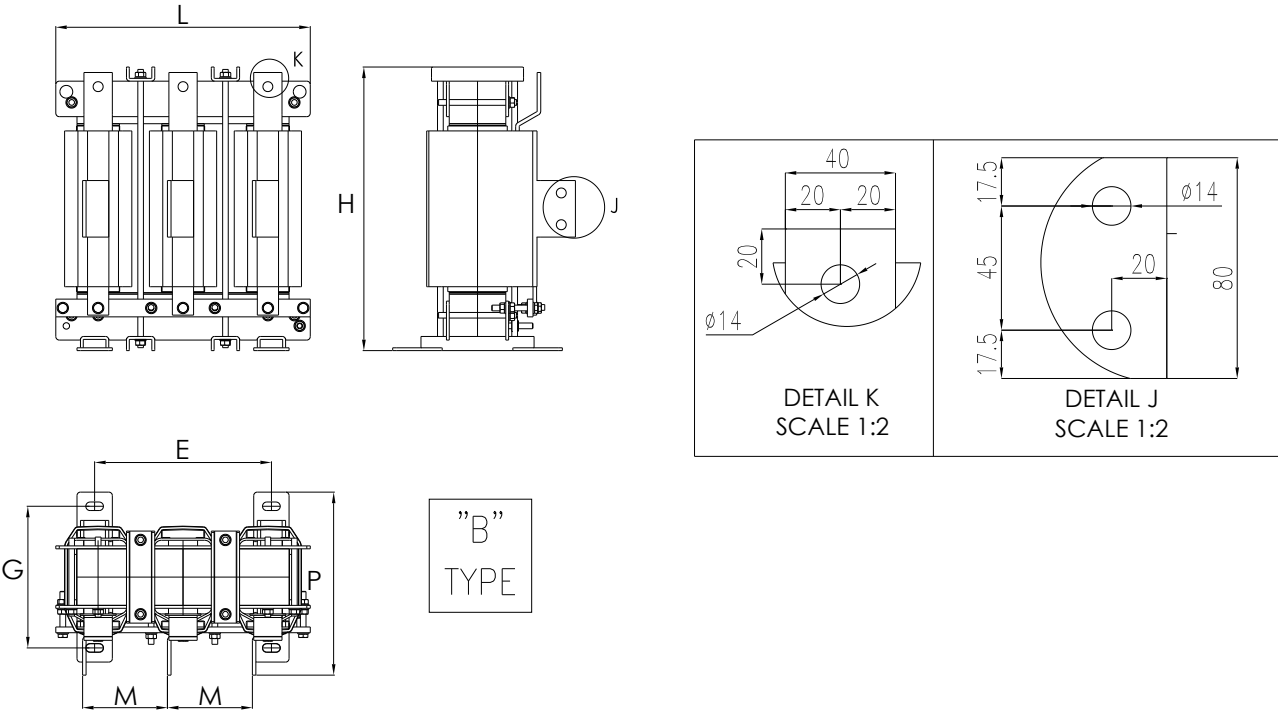


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Figure 5: Mechanical features of a 3-phase input inductor

5.2.1.3. 4T, 5T, 6T Class – 3-Phase Output Inductor

INDUCTOR MODEL	TYPE	INDUCTOR RATINGS		DIMENSIONS							HOLE mm	WEIGHT kg	LOSSES W
		mH	A	TYPE	L	H	P	M	E	G			
IM0138250	Output only	0.035	440	B	360	401	268	120	250	200	12x25	75	710
IM0138300	Output only	0.025	700	B	360	411	279	120	250	200	12x25	93	875



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Figure 6: Mechanical features of a 3-phase output inductor