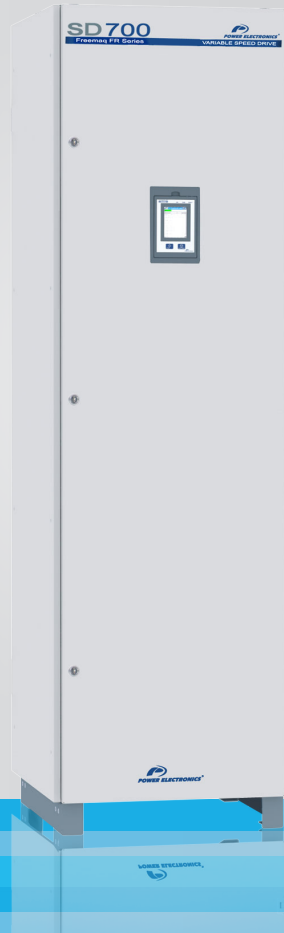


SD700

Freemaq FR Series

VARIABLE SPEED DRIVE



Regenerative Variable Speed Drive
Hardware and Installation Manual

SD700

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VARIABLE SPEED DRIVE

Regenerative Variable Speed Drive
Hardware and Installation Manual

Edition: March 2015

SD7FRMTHW01CI Rev. C

SAFETY SYMBOLS

Always follow safety instructions to prevent accidents and potential hazards from occurring.

**WARNING**

This symbol means improper operation may result in serious personal injury or death.

**CAUTION**

Identifies shock hazards under certain conditions. Particular attention should be given because dangerous voltage may be present. Qualified personnel should do maintenance operation.



Identifies potential hazards under certain conditions. Read the message and follow the instructions carefully.



Identifies shock hazards under certain conditions. Particular attention should be given because dangerous voltage may be present.

Edition of March 2015

This publication could present technical imprecision or misprints. The information here included will be periodically modified and updated, and all those modifications will be incorporated in later editions.

To consult the most updated information of this product you might access through our website www.power-electronics.com where the latest version of this manual can be downloaded.

Revisions

Date	Revision	Description
07 / 01 / 2013	A	First edition
18 / 07 / 2014	B	Clearances, Frames 6 and 9 power connections.
18 / 03 / 2015	C	Ground connection and LVRT.

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SAFETY INSTRUCTIONS

IMPORTANT!

- Read this manual carefully to maximise the performance of this product and to ensure its safe use and installation.
- Power Electronics accepts no responsibility or liability for any damage resulting from inappropriate use of the equipment.
- In this manual, safety messages are classified as follows:



WARNING

Do not remove the metal cover while the power is applied or the unit is in operation.
Otherwise electric shock could occur.

Do not run the drive with the front cover removed.
Otherwise, you may get an electric shock due to the high voltage terminals or exposure of charged capacitors.

The drive does not remove the voltage from the input busbars of the drive. Before working on the drive, isolate the whole drive from the supply.

Do not remove the cover except for periodic inspections or wiring, even if the input power is not applied.
Otherwise, you may access to the charged circuits and may get an electric shock.

Wiring and periodic inspections should be performed at least 10 minutes after disconnecting the input power. To remove the front cover check that the DC Link red LED is off, then remove the terminals metallic cover and check with a multimeter the following measures:

- **Measure between the output power busbars U, V, W and the cabinet and check that the voltage is around 0V.**
- **Measure that the DC bus voltage is below 30VDC.**

Otherwise, you may get an electric shock.

Operate the switches with dry hands.
Otherwise, you may get an electric shock.

Do not use cables with damaged insulation.
Otherwise, you may get an electric shock.

Do not subject the cables to abrasions, excessive stress, heavy loads or pinching.
Otherwise, you may get an electric shock.

Do not make any insulation or voltage withstand tests on the motor with the drive connected.



CAUTION

Install the drive on a non-flammable surface. Do not place flammable material nearby. Otherwise fire could occur.

Disconnect the input power if the drive is damaged. Otherwise, it could result in a secondary accident or fire.

After stopping the drive, it will remain hot for a couple of minutes. Touching hot parts may result in skin burns.

Do not apply power to a damaged drive or to a drive with parts missing even if the installation is complete. Otherwise, you may get an electric shock.

It is not permitted to weld the cabinet; this can damage the electronic sensitive equipment inside.

Do not allow lint, paper, wood chips, dust, metallic chips or other foreign matter into the drive. Otherwise fire or accident could occur.



WARNINGS

RECEPTION

- The SD700FR are carefully tested and perfectly packed before delivering.
 - In the event of transport damage, please ensure that you notify the transport agency and POWER ELECTRONICS: 902 40 20 70 (International +34 96 136 65 57) or your nearest agent, within 24hrs from receipt of the goods.
-

UNPACKING

- Make sure model and serial number of the variable speed drive are the same on the box, delivery note and unit.
 - Each variable speed drive is delivered with Hardware and Software technical manuals.
-

RECYCLING

- Packing of the equipments should be recycled. For this, it is necessary to separate different materials included (plastic, paper, cardboard, wood ...) and deposit them on proper banks.
 - Waste products of electric and electronic devices should be selectively collected for your correct recycling company.
-

ELECTROMAGNETIC COMPATIBILITY EMC

- The drive is intended to be used in industrial environment (Second Environment), it achieve compliance with C3 category defined in IEC/EN 61800-3 standard following the installation recommendation within this manual.
 - Select communication and control system according to the drive EMC environment. Otherwise, systems could suffer from interferences due to a low EMS level.
-

SAFETY

- Before operating the drive, read this manual thoroughly to gain and understanding of the unit. If any doubt exists then please contact POWER ELECTRONICS, (902 40 20 70 / +34 96 136 65 57) or your nearest agent.
 - Wear safety glasses when operating the drive with power applied or the front cover is removed.
 - Handle and transport the drive following the recommendations within this manual.
 - Install the drive according to the instructions within this manual and the local regulations.
 - Do not place heavy objects on the drive.
 - Ensure that the drive is mounted vertically and keeping the minimum clearances distances.
 - Do not drop the drive or subject it to impact.
 - The SD700FR drives contain static sensitive printed circuits boards. Use static safety procedures when handling these boards.
 - Avoid installing the drive in conditions that differ from those described in the *Technical Characteristics* section.
-

CONNECTION PRECAUTIONS

- To ensure correct operation of the drive it is recommended to use a SCREENED CABLE for the control wiring.
 - The motor cable should comply with the requirements within this manual. Due to increased leakage capacitance between conductors, external ground fault protection threshold value should be adjusted ad hoc.
 - Do not disconnect motor cables if input power supply remains connected.
 - The internal circuits of the SD700FR Series will be damaged if the incoming power is connected and applied to output terminals (U, V, W).
 - Do not use power factor correction capacitors banks, surge suppressors, or RFI filters on the output side of the drive. Doing so may damage these components.
 - Always check whether the DC Link red LED is OFF before wiring terminals. The capacitors may hold high-voltage even after the input power is disconnected.
 - Do not connect the drive in grids whose THDv is higher than 8%.
-

TRIAL RUN

- Verify all parameters before operating the drive. Setting of parameters may be required depending on application and load.
 - Always apply voltage and current signals to each terminal that are between levels indicated within this manual.
-

OPERATION PRECAUTIONS

- When the Auto Restart function is enabled, keep clear of driven equipment, as the motor will restart suddenly after the fault reset.
 - The “STOP / RESET” key on the keypad is active only if the appropriate function setting has been made. Pushing this button the drive will NOT perform a safe stop. It is available STO optional board, which installed with an additional EMERGENCY STOP pushbutton, will disconnect the motor’s power and will be unable to generate torque in the motor with high reliability.
 - If a fault is reseted with the reference signal still active, the drive will unexpectedly restart. Verify that it is permissible for this to happen. Otherwise, it could cause a personal injury.
 - Do not modify or alter internal wiring and spare parts without Power Electronics supervision.
 - Before programming or operating the SD700FR Series, initialise all parameters back to factory default values.
-

EARTH CONNECTION

- Ground the drive and adjoining cabinets to ensure a safety operation and to reduce electromagnetic emission.
 - Connect the input PE wire only to the dedicated PE terminal of the drive. Do not use the cabinet or the chassis screw for grounding.
 - Ground the drive chassis through the dedicated and labelled terminals. Use appropriate conductors to comply with the local regulations. The ground conductor should be connected first and removed last.
 - Motor ground cable must be connected to the PE output terminal of the drive and not to the installation's ground. We recommend that the section of the ground conductor (PE) should be equal or greater than the active conductor (U, V, W).
 - If the user decides to use shielded motor cable, ensure a correct 360° shield bonding in both the drive cabinet and the motor terminal box.
-

HOW TO USE THIS MANUAL

Quick Guide

- 1- Make sure model and serial number of the drive are the same on the delivery note and unit. **See Chapter 2.**
- 2- Read carefully the safety instructions before installation, commissioning, operation and maintenance of the drive. **See safety instructions section.**
- 3- For reception, handling and transportation, see **Chapter 4.**
- 4- Before the mechanical installation, check the environmental ratings, drive configuration mounting, clearances, and dimensions. **See chapter 5 and 10.**
- 5- Follow the mechanical installation instructions. **See Chapter 5.**
- 6- Before the electrical installations, check basic configuration, wiring recommendations, **see Chapters 6 and Chapter 7.**
- 7- Follow the instructions in **Chapter 6 and Chapter 7.**
- 8- For hardware Modbus Communication, **see Chapter 8.**
- 9- Follow the commissioning instructions in **Chapter 9.**
- 10- For preventive maintenance instructions, follow the recommendations in **Chapter 11.**

1. INTRODUCTION

SD700 low voltage drives by Power Electronics is the most extensive product family with a power range from 1.5kW to 2000kW. It has been designed focused on maximum motor care, components durability and easy maintenance. SD700 portfolio is divided in 3 products series that comply with specific demands and standards in worldwide installations thanks to its own specific features: SD700, SD700KOMPAKT, SD700FREEMAQ (SD700FR & SD700FL).

SD700FR is based on the active front end technology changing the traditional thyristor-diode rectifier bridge for an IGBT rectifier bridge. This technology enables a bidirectional and fully controlled power flow, which allows the energy regeneration, besides the cosine phi control, a high immunity against voltage drops and a reduced THDi.



Figure 1.1 SD700FR frame 5

SD700 products provide high efficiency, maximum control, functional safety, durability, easy commissioning and easy maintenance for the whole range. Power Electronics delivers flexible integrated solutions, fully tested under the most demanding environmental and electrical conditions.

2. CONFIGURATION TABLE & STANDARD RATINGS

2.1. Configuration table

EXAMPLE

CODE: SD7FR037052T

SD7	FR		0370		5		2		-		T		-	
SD700 Series	Model		Output current ^[1]		Input Voltage		Degree of protection		EMC Filter		Floating Earth ^[2]		Input Frequency	
	FR	SD700 FR Regenerative	0460	460A	5	380-480VAC	2	IP20	-	Second Environment	-	Without floating earth	-	50Hz
			1800	1800A	7	525VAC	5	IP54	F	First Environment ^[2]	T	With floating earth	6	60Hz ^[3]
			2500	2500A	6	690VAC								

GENERAL CONSIDERATIONS:

[1] Verify the rated current of the motor nameplate to guarantee the compatibility with the selected drive.

[2] Floating earth drive not available with first environment filter.

[3] Consult availability.

CODIFICATION EXAMPLES:

- **SD7FR180062F** SD700FR Regenerative, 1800A, 690Vac, Degree of protection IP20, First Environment, Without floating earth, 50Hz.
- **SD7FR180062F** SD700FR Regenerative, 1800A, 690Vac, Degree of protection IP20, First environment, Without floating earth, 50Hz.
- **SD7FR010055T** SD700FR Regenerative, 100A, 400Vac, Degree of protection IP54, Second environment, With floating earth, 50Hz.
- **SD7FR046075** SD700FR Regenerative, 460A, 525Vac, Degree of protection IP54, Second Environment, Without floating earth, 50Hz.

2.2. Standard ratings – 380Vac to 480Vac

STANDARD RATINGS 400 V _{AC}							
FRAME	CODE	Operation Temperature 50°C HEAVY DUTY			Operation Temperature 40°C NORMAL DUTY		
		I(A) Rated	Motor Power (kW) at 400VAC	150% Overload (A)	I(A) Rated	Motor Power (kW) at 400VAC	120% Overload (A)
5	SD7FR0210 5X Y	210	110	315	263	132	315
	SD7FR0250 5X Y	250	132	375	313	160	375
	SD7FR0275 5X Y	275	150	413	344	200	413
6	SD7FR0330 5X Y	330	160	495	413	220	495
	SD7FR0370 5X Y	370	200	555	463	250	555
	SD7FR0460 5X Y	460	250	690	575	315	690
7	SD7FR0580 5X Y	580	315	870	725	400	870
	SD7FR0650 5X Y	650	355	975	813	450	975
	SD7FR0720 5X Y	720	400	1080	900	500	1080
8	SD7FR0840 5X Y	840	450	1260	1050	560	1260
	SD7FR0925 5X Y	925	500	1388	1156	630	1388
	SD7FR0990 5X Y	990	560	1485	1238	710	1485
9	SD7FR1150 5X Y	1150	630	1725	1438	800	1725
	SD7FR1260 5X Y	1260	710	1890	1575	900	1890
	SD7FR1440 5X Y	1440	800	2160	1800	1000	2160
10	SD7FR1580 5X Y	1580	900	2370	1975	1100	2370
	SD7FR1800 5X Y	1800	1000	2700	2250	1200	2700
11	SD7FR2200 5X Y	2200	1200	3300	2750	1500	3300
	SD7FR2500 5X Y	2500	1400	3750	3100	1750	3750

STANDARD RATINGS 440 V _{AC}									
FRAME	CODE	Operation Temperature 50°C HEAVY DUTY				Operation Temperature 40°C NORMAL DUTY			
		I(A) Rated	Motor Power at 440VAC		150% Overload	I(A) Rated	Motor Power at 440VAC		120% Overload
			kW	HP			kW	HP	
5	SD7FR0210 5X Y	191	110	150	286,5	238,7	132	180	286,5
	SD7FR0250 5X Y	227	132	180	340,5	283,7	160	240	340,5
	SD7FR0275 5X Y	250	150	200	375	312,5	200	275	375
6	SD7FR0330 5X Y	300	160	240	450	375	220	300	450
	SD7FR0370 5X Y	336	200	275	504	420	250	340	504
	SD7FR0460 5X Y	418	250	340	627	522,5	315	400	627
7	SD7FR0580 5X Y	527	315	400	790,5	658,7	400	500	790,5
	SD7FR0650 5X Y	591	355	450	886,5	738,7	450	600	886,5
	SD7FR0720 5X Y	654,5	400	500	981,7	818,1	500	650	981,7
8	SD7FR0840 5X Y	764	450	600	1146	955	560	750	1146
	SD7FR0925 5X Y	841	500	650	1261,5	1051,2	630	850	1261,5
	SD7FR0990 5X Y	900	560	750	1350	1125	710	900	1350
9	SD7FR1150 5X Y	1045,5	630	850	1568	1306,8	800	1000	1568
	SD7FR1260 5X Y	1145,5	710	900	1718	1431,8	900	1250	1718
	SD7FR1440 5X Y	1309	800	1000	1963,5	1636,2	1000	1400	1963,5
10	SD7FR1580 5X Y	1436	900	1250	2154	1795	1100	1500	2154
	SD7FR1800 5X Y	1636	1000	1400	2454	2045	1200	1600	2454
11	SD7FR2200 5X Y	2000	1200	1600	3000	2500	1500	1800	3000
	SD7FR2500 5X Y	2300	1400	1900	3450	2800	1750	2350	3450

STANDARD RATINGS 480 V _{AC}							
FRAME	CODE	Operation Temperature 50°C HEAVY DUTY			Operation Temperature 40°C NORMAL DUTY		
		I(A) Rated	Motor Power (kW) at 500VAC	150% Overload (A)	I(A) Rated	Motor Power (kW) at 500VAC	120% Overload (A)
5	SD7FR0210 5X Y	168	110	252	210	132	252
	SD7FR0250 5X Y	200	132	300	250	150	300
	SD7FR0275 5X Y	212	150	318	265	160	318
6	SD7FR0330 5X Y	264	160	396	330	200	396
	SD7FR0370 5X Y	296	200	444	370	250	444
	SD7FR0460 5X Y	368	250	552	460	315	552
7	SD7FR0580 5X Y	464	315	696	580	355	696
	SD7FR0650 5X Y	520	355	780	650	400	780
	SD7FR0720 5X Y	576	400	864	720	450	864
8	SD7FR0840 5X Y	672	450	1008	840	500	1008
	SD7FR0925 5X Y	740	500	1110	925	560	1110
	SD7FR0990 5X Y	767	560	1151	959	630	1151
9	SD7FR1150 5X Y	920	630	1380	1150	710	1380
	SD7FR1260 5X Y	1008	710	1512	1260	800	1512
	SD7FR1440 5X Y	1152	800	1728	1440	900	1728
10	SD7FR1580 5X Y	1264	900	1896	1580	1000	1896
	SD7FR1800 5X Y	1440	1000	2160	1800	1200	2160
11	SD7FR2200 5X Y	1760	1200	2640	2200	1500	2640
	SD7FR2500 5X Y	2000	1400	3000	2500	1750	3000

2.3. Standard ratings – 525Vac

STANDARD RATINGS 525 V _{AC}							
FRAME	CODE	Operation Temperature 50°C HEAVY DUTY			Operation Range 40°C NORMAL DUTY		
		I(A) Rated	Motor Power (kW) at 525VAC	150% Overload	I(A) Rated	Motor Power (kW) at 525VAC	120% Overload
5	SD7FR0180 7X Y	180	132	270	222	150	270
	SD7FR0205 7X Y	205	150	308	254	185	308
6	SD7FR0270 7X Y	270	200	405	334	250	405
	SD7FR0295 7X Y	295	220	443	360	280	443
	SD7FR0340 7X Y	340	250	510	417	315	510
7	SD7FR0425 7X Y	425	315	638	526	400	638
	SD7FR0470 7X Y	470	355	705	586	450	705
	SD7FR0535 7X Y	535	400	803	666	500	803
8	SD7FR0660 7X Y	660	500	990	824	600	990
	SD7FR0750 7X Y	750	560	1125	936	700	1125
9	SD7FR0845 7X Y	845	630	1268	1052	800	1268
	SD7FR0950 7X Y	950	710	1425	1157	900	1425
10	SD7FR1070 7X Y	1070	800	1605	1337	1000	1605
	SD7FR1205 7X Y	1205	900	1808	1504	1100	1808
	SD7FR1340 7X Y	1340	1000	2010	1672	1250	2010
	SD7FR1605 7X Y	1605	1200	2408	2006	1500	2408
11	SD7FR2005 7X Y	2005	1500	3008	2507	1900	3008

2.4. Standard ratings – 690Vac

STANDARD RATINGS 690 V _{AC}							
FRAME	CODE	Operation Temperature 50°C HEAVY DUTY			Operation Temperature 40°C NORMAL DUTY		
		I(A) Rated	Motor Power (kW) at 690VAC	150% Overload	I(A) Rated	Motor Power (kW) at 690VAC	120% Overload
5	SD7FR0130 6X Y	130	110	195	163	132	195
	SD7FR0150 6X Y	150	132	225	188	160	225
	SD7FR0170 6X Y	170	160	255	213	200	255
6	SD7FR0210 6X Y	210	200	315	263	250	315
	SD7FR0260 6X Y	260	250	390	325	315	390
	SD7FR0320 6X Y	320	315	480	400	355	480
7	SD7FR0385 6X Y	385	355	578	481	450	578
	SD7FR0460 6X Y	460	450	690	575	500	690
8	SD7FR0550 6X Y	550	500	825	688	630	825
	SD7FR0660 6X Y	660	630	990	825	800	990
9	SD7FR0750 6X Y	750	710	1125	938	900	1125
	SD7FR0840 6X Y	840	800	1260	1050	1000	1260
	SD7FR0950 6X Y	950	900	1425	1188	1100	1425
10	SD7FR1140 6X Y	1140	1000	1710	1425	1300	1710
	SD7FR1270 6X Y	1270	1200	1905	1588	1600	1905
	SD7FR1420 6X Y	1420	1400	2130	1775	1700	2130
11	SD7FR1500 6X Y	1500	1500	2250	1875	1800	2250
	SD7FR1800 6X Y	1800	1800	2700	2250	2000	2700

3. TECHNICAL CHARACTERISTICS

SD700FR FREEMAQ REGENERATIVE		
INPUT	POWER RANGE ^[1]	110kW – 2000kW
	VOLTAGE RANGE	380-480Vac, 525 Vac, 690Vac, 3 phases (±10%)
	INPUT FREQUENCY	50Hz/60Hz (±6%)
	INPUT RECTIFIER TECHNOLOGY / RECTIFIER CARRIER FREQUENCY	IGBT / 2.8kHz
	DISPLACEMENT POWER FACTOR (DPF = cos Φ)	1 (factory settings) 0.90 leading ... 0.90 lagging (adjustable)
	POWER FACTOR (PF= I _r /I _{ms} · cos Φ)	≥0.98
	MOMENTARY POWER LOSS	> 2sec (depending on the load inertia)
	EMC INPUT FILTER	Second environment (Industrial): (C3 Standard) First environment (Domestic): C2 (Optional). C1 consult with Power Electronics
	HARMONICS FILTER	LCL Filter
	CURRENT THD (%) ^[2]	< 5%
	REGENERATIVE	Yes -4Quadrant operation
	OUTPUT	OUTPUT FREQUENCY ^[3]
OVERLOAD CAPACITY		Constant torque/heavy duty: 150% during 60 sec at 50°C Variable torque/normal duty: 120% during 60 sec at 40°C
EFFICIENCY (At full load)		≥97%
CONTROL METHOD		V/Hz VECTOR CONTROL Open Loop: PWM speed / torque control, AVC: speed / torque control Close Loop (Encoder): PWM speed / torque control, AVC: speed / torque control
INVERTER CARRIER FREQUENCY		4 to 8kHz – PEWave
OUTPUT DV/DT FILTER		500 to 800V/μs
OUTPUT CABLE LENGTH ^[4]		USC 300m, SC 150m
ENVIRONMENTAL RATINGS	AMBIENT TEMPERATURE	Minimum: -20°C Maximum: +50°C
	STORAGE TEMPERATURE	Minimum: -40°C Maximum: +70°C
	ALTITUDE	1000m
	POWER ALTITUDE DERATING	>1000m, 1% P _N (kW) per 100m; 4000m maximum
	AMBIENT HUMIDITY	<95%, non-condensing
	DEGREE OF PROTECTION	IP20, IP54
	VIBRATION	Deflection 0.075mm at 10Hz-57Hz; Acceleration 9.8m/s ² at 57Hz-150Hz
	HEATING RESISTORS	Optional
PROTECTIONS	MOTOR PROTECTIONS	Rotor locked Motor, overload (thermal model), Output current limit, Phase current imbalance, Phase voltage imbalance, Motor over-temperature (PTC signal), Speed limit Torque limit.
	DRIVE PROTECTIONS	Overload, IGBT's overload, Input phase loss, Low input voltage, High input voltage, DC Bus voltage limit, Low DC Bus voltage, High input frequency, Low input frequency, IGBT temperature, Heat-sink over-temperature, Power supply fault, Drive thermal model, Ground fault, Software and Hardware fault, Analogue input signal loss (speed reference loss), Safe stop/Emergency Stop

[1] Other configuration, consult Power Electronics.

[2] Harmonics are below the limits defined in IEEE519 for all I_{sc}/L

[3] For operation frequencies higher than 100Hz consult Power Electronics.

[4] SC: Shielded cable, USC: Unshielded Cable. Follow Power Electronics installation recommendations. For greater cable lengths, consult Power Electronics.

SD700FR FREEMAQ REGENERATIVE

HARDWARE	DIGITAL INPUTS	6 programmable, Active high (24Vdc), Isolated power supply 1 PTC input,
	DIGITAL OUTPUTS	3 programmable changeover relays (250Vac, 8A or 30Vdc, 8A)
	ANALOGUE INPUT	2 programmable and differential inputs. 0 – 20mA, 4 – 20mA, 0 – 10Vdc and ±10Vdc. Optically isolated
	ANALOGUE OUTPUTS	2 isolated programmable outputs: 0 – 20mA, 4 – 20mA, 0 – 10Vdc and ±10Vdc
	ENCODER INPUTS (Optional)	Two differential encoders input. Voltages inputs from 5 to 24Vdc
	USER POWER SUPPLY	+24Vdc user power supply (Max 180mA) regulated and short-circuit protected +10Vdc user power supply (Max 2 potentiometers R= 1 kΩ) regulated and short-circuit protected
	I/O EXTENSION BOARD (Optional)	4 Digital Inputs: Programmable inputs and active high (24Vdc). Optically isolated. 1 Analogue Input: Programmable and differential input. 5 Digital Outputs: programmable multi-function relays. 1 analogue Output: Programmable outputs in voltage / current.
EXTERNAL POWER SUPPLY (Optional)	24 V _{DC} External Power Supply, Fault Relay integrated	
COMMUNICATION	STANDARD HARDWARE	USB port
		RS232 port
		RS485 port
	OPTIONAL HARDWARE	Optical fiber
	STANDARD PROTOCOL	Ethernet
	OPTIONAL PROTOCOL	Modbus-RTU
		Profibus-DP
DeviceNet		
Ethernet (Modbus TCP)		
Ethernet IP		
CAN Open		
N2 Metasys Gateway		
INTERFACE	TYPE	Removable
	LENGTH	3 meters and 5 meters (optional)
	CONNECTION	RJ45
	VISUALIZATION LEDES	LED ON: Control board is energized
		LED RUN: Motor receiving power supply
		LED FAULT: Flashing displays that a fault has occurred
	ALPHANUMERIC DISPLAY	4 lines x 16 characters Keypad with 6 keys to control and configure the drive, start and stop/reset Independent memory
	COLOUR TOUCH SCREEN DISPLAY (Optional)	3,5" Touch Screen (240x320 pixels) with pen 4Gb MicroSD card Faults and events log and notification Quad Band GSM modem integrated to remote start, stop and notification by SMS Ethernet Switch with two RJ45 connections Optional 5V _{DC} external power supply or batteries
	DISPLAY INFORMATION	Average current and 3-phase motor current
		Average voltage and 3-phase motor voltage
		Average input voltage and 3-phase input voltage
		3-phase input and output frequency
		DC Bus Voltage
		Drive Status
		Speed, Torque, Power, Power factor of motor
Register of total and partial drive running time with reset function. (hours)		
Register of total and partial drive energy consumption with reset function (kWh)		
Register of total and partial energy regenerated with reset function (kWh)		
Relay status		
Digital inputs / PTC status		
Output comparator status		
Analogue inputs and sensor values		
Analogue output value		
Motor overload and equipment status		
Drive and rectifier temperature		
Fault history (last 6 faults)		
OTHERS	Real time clock	
	Perpetual calendar	
	Adjustable DC bus voltage	

SD700FR FREEMAQ REGENERATIVE

REGULATIONS	CERTIFICATIONS	CE, cTick ^[5] , UL ^[5] , cUL ^[5] ,
	ELECTROMAGNETIC COMPATIBILITY	EMC Directive (2004/108/CE)
		IEC/EN 61800-3
		IEEE 519
	DESIGN AND CONSTRUCTION	LVD Directive (2006/95/CE)
		IEC/EN 61800-2 General requirements
		IEC/EN 61800-5-1 Safety
IEC/EN 60146-1-1 Semiconductor converters		
IEC60068-2-6 – Vibration		
	IEC/EN 61800-5-2(STO) certified by Tüv Rheiland	

[5] On certification process.

4. RECEPTION, HANDLING AND TRANSPORTATION



CAUTION

Read carefully the following instructions for a correct handling.
Otherwise, the equipment can be damaged and lead to injury to people.

4.1. Reception and Storage

The SD700FR are carefully tested and perfectly packed before delivering. In the event of transport damage, please ensure that you notify the transport agency and Power Electronics: 902 40 20 70 (International +34 96 136 65 57) or your nearest agent, within 24hrs from receipt of the goods.

Make sure model and serial number of the drive are the same on the delivery note and unit.

Drive's storage should be sun and moisture protected and with an ambient temperature between -40°C and +70°C, < 95 RH without condensation. It is recommended not pile more than two units.

4.2. Handling and Transportation

Only the transport methods described in this document are permissible. Any other transport method or system could damage the unit.

SD700FR is delivered horizontally fastened to a wooden pallet. Additionally the drive is covered with a wooden box. Depending on the transport method, the drive is moisture protected with a vacuum plastic bag. Move the complete pallet as close as possible to its final installation place before unpacking, to avoid any damage during transportation.

It is mandatory to transport it with a pallet truck, forklift or crane fork, taking care about the load distribution and the center of gravity. Check the size and weight of VFD components to choose proper lifting equipment with a capacity greater than the drive weight.

Unpack the drive carefully. Do not use edge tool to protect the product from damage. After open the package, please check the goods contained. Verify the item numbers contained within the package with the packing inventory list. Please set aside and reserve, if contained, the case of spare parts shipped with the product. There should be no evident damage caused by vibration, dropping or moisture.



CAUTION

If the maximum tonnage of cranes cannot meet the requirement, it could cause damage to the equipment and lead to injury to people.

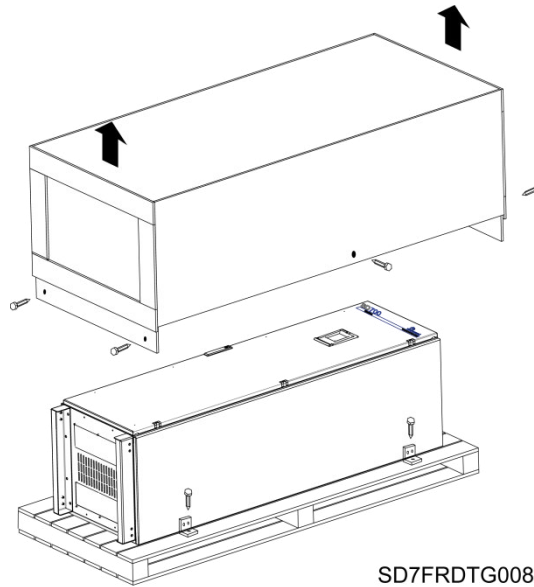


Figure 4.1 Unpacking for frame 5

To unpack, unscrew the bolts that fix the wooden box with the pallet. Then, the drive is fixed to the pallet through the L shapes place in its four corners, unscrew all the fixation screws. Otherwise, if the cabinet is lifted, the pallet could cause damage.

To rise to an upright position use only a crane or forklift equipped with belts or slings. Lift it carefully pulling from the top eyebolts.

Once it is upright positioned, reallocate the belts/slings. The crane lifts the drive pulling from the four top eyebolts. The forklift or pallet truck lifts the drive from its bottom part. Avoid brusque movements and shocks during transportation. At the time of placing the drive on the floor, stop lowering it just before reaching the floor and then slowly lower it on the floor to avoid any shock.

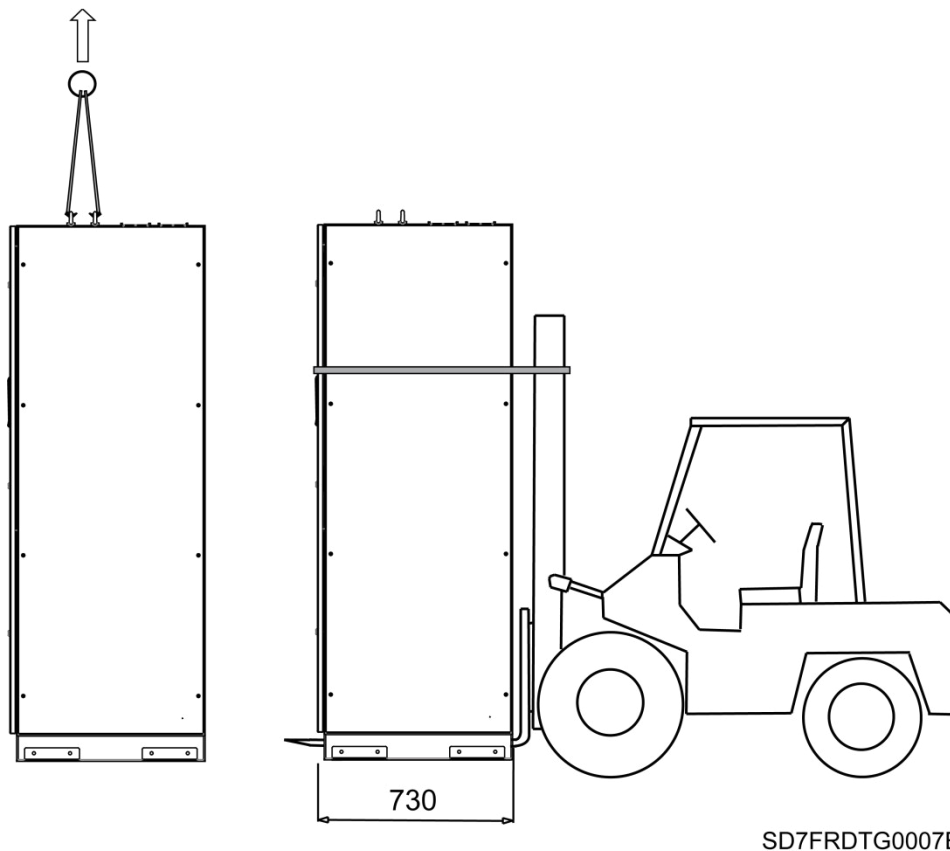


Figure 4.2 Lifting of the equipment

Handling and transportation must be done carefully. The equipment should not be exposed to moisture, overturned, inverted, tilted or impacted. The tilting angle should be no more than 30°.

5. MECHANICAL INSTALLATION



CAUTION

The installation must be done by qualified personal.

Otherwise, the equipment can be damaged and lead to injury to people.

5.1. Environmental ratings

It is recommended to follow the instructions of this manual to ensure the correct operation of the drive. The installer has the responsibility of a properly indoor installation to ensure the ambient conditions of the drive. Additionally, the installer is ultimate responsible of the local regulation fulfilment. The environmental ratings are the following ones:

- Environmental category: Indoor
- Wet locations: No
- Pollution degree: PD3
- Ingress protection rating: Clean zone: Electronics IP54 or IP20
Power connection and Input filters: IP20
- Operation Ambient temperature: -20°C to 50°C
- Storage Ambient temperature: -40°C to 70°C
- Humidity: 10 % to 95 % (non condensing)
- Heating resistors: Optionals
- Maximum altitude and power derating: 1000m 1% PN(kW) per 100m; 4000m maximum
- Vibration (IEC60068-2-6): Amplitude: 0.075mm at 10Hz-57Hz
Acceleration 9.8m/s² at 57Hz-150Hz
- Audible Noise: < 79dB
- Overvoltage category: III
- Protection class: Class 1
- Painting: Standard colour RAL 7047, other under request

5.2. Drive mounting

This section provides guidelines to select the best mounting location to ensure the optimum performance, and cautions that you should follow to avoid injury and/or equipment damage.

SD700FR drives are designed to be placed over a technical floor, vertically. The floor must guarantee a non-flammable, solid, plain and levelled surface to the drive, a minimum clearance around it and a smoothly cable access. The maximum allowed slope is 1cm in every 6 meters. If necessary, the installation site should be levelled, as the cabinet is not equipped with adjustable feet. The walls adjoining the drive must be made of a non-flammable material.

Fix the cabinets to the wall or floor by using the L brackets placed in both sides of the drive. They have an $\varnothing 12$ mm slot in the rear part and an $\varnothing 7$ mm slot in the legs of the drive.

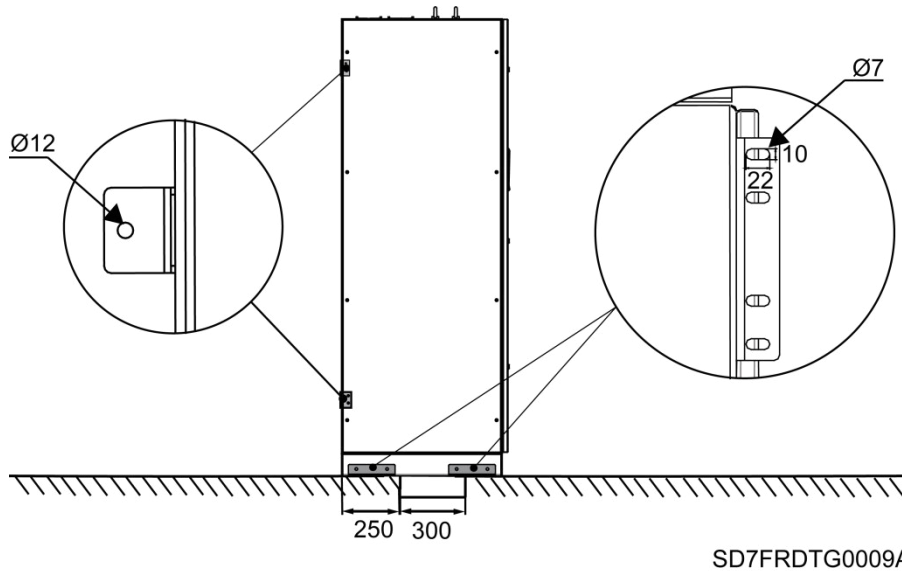


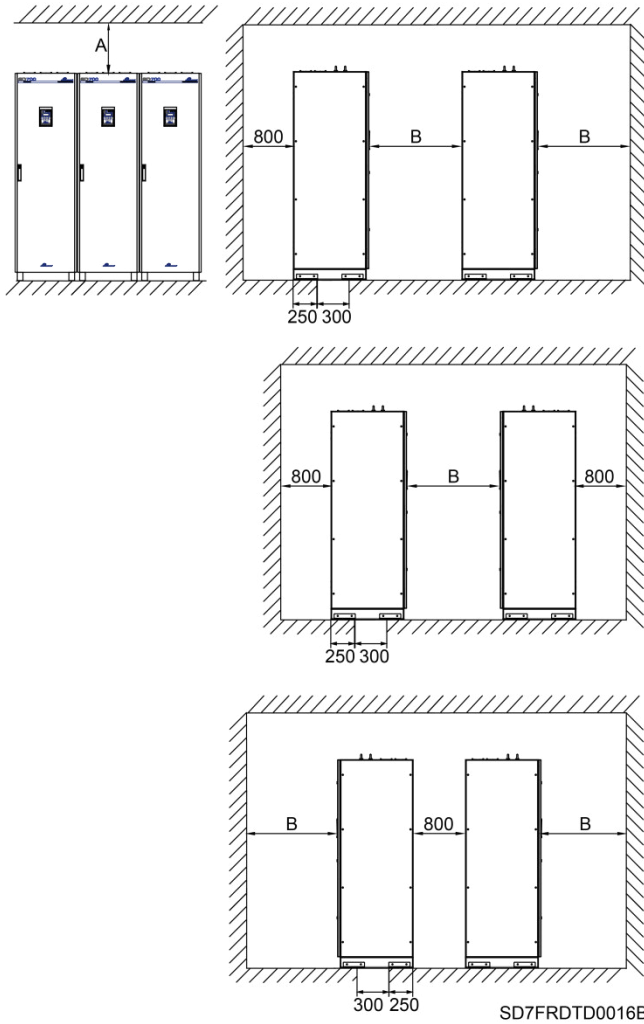
Figure 5.1 Wall or floor fixation [mm]

It is recommended to construct a cable duct below the middle part of the cabinet. The duct width may not exceed 300 mm and the contact surface of the floor must resist the cabinet weight that lies on the legs. The duct begins at 250 mm from the rear part of the drive.

5.3. Clearances

Keep always the minimum passage width between the opened door of the SD700FR and the next fixed obstacle. The minimum passage width must comply with national standards. The recommended minimum passage width is 500 mm.

The cabinets can be installed against a wall or back-to-back with another unit in their rear and side parts. However, Power Electronics recommends keeping a minimum passage distance of 800mm in the rear part of the cabinet. The following figure and table show the clearances for all the SD700FR.



FRAME	MINIMUM CLEARANCE (mm)	
	A	B
5	400	1095
6	400	1095
7	400	1625
8	400	1625
9	400	1095
10	400	1625
11	400	1625

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Figure 5.2 Clearances [mm]

Note: It is recommended to have enough space in the front side of the equipment. The distance must be higher than the minimum distance in order to be able to move the equipment in case of need.

5.4. Cooling

SD700FR drives integrate a variable speed system that varies the cooling flow depending on the IGBT temperature, increasing the fans' lifetime and their efficiency.

The heat sources inside the equipment correspond with the inverter and rectifier bridge (IGBTs), input filter and the output dV/dt filter. SD700 series present an overall efficiency higher than 97% at rated power, so the heat dissipation approximately corresponds to 3% of the input power.

It is mandatory to keep all the inlet and outlet gratings of the drive without any obstacle that could reduce the cooling capacity of the drive.

The bottom metal panels must be mechanized to pass through them the power cables. It is forbidden to mechanize the bottom inlet gratings; otherwise, the drive could have a deficient cooling flow.

The cooling system of the drive depends on the degree of protection, the frame type and the frame size. Basically, the drive is designed with three independent cooling areas.

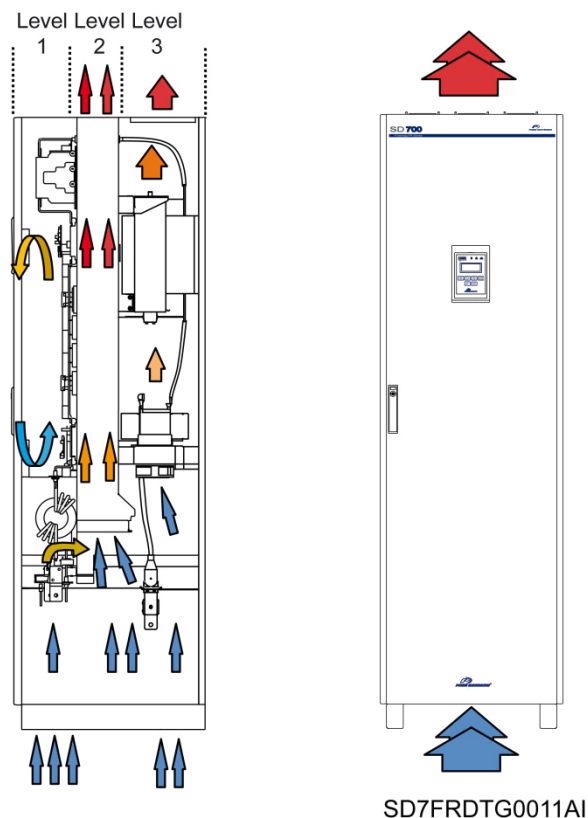


Figure 5.3 Cooling airflow for SD700FR

1st Area/Level - Electronics:

IP20 cabinets are equipped with fans on the top of the cabinet that evacuates the internal heat generated in the area.

IP54 cabinets have a totally sealed electronics. The internal heat generated is evacuated through the metallic doors by an internal forced convection system.

2nd Area/Level – Rectifier bridge, Inverter bridge and DC bus cooling area:

The drive integrates axial fans that intake the air from the bottom part of the drive and evacuates it through the middle top outlet gratings. The fans propel the air through the heat sink evacuating the heat generated by the main components. The fans will increase or decrease the internal air speed depending on the IGBT's temperature.

3rd Area/Level – Filters:

Cabinets integrate in its rear part the input LCL. Both are equipped with exhaust fans on the top of the cabinet that evacuates the internal heat generated within the area. Additionally, internal disperse fans are placed to increase the cooling capacity.

The installer must ensure that the indoor installation area is equipped with a suitable cooling system that is in accordance the ambient conditions of the drive (exhaust air vents, inlet gratings, air conditioning system, etc). The following figure and table provides the data for a correct cooling system dimensioning.

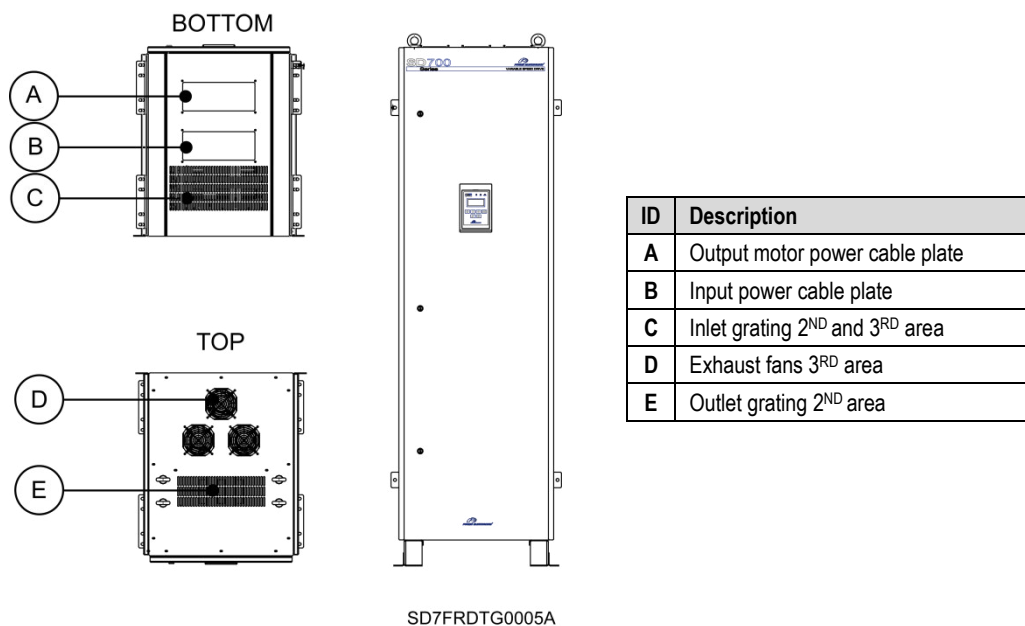


Figure 5.4 Cooling systems for SD700FR

		ID	FRAME 5
GENERAL	INLET GRATING NET SECTION (m ²)	C	0.026028
2 ND AREA	MAXIMUM OPERATION FLOW (m ³ /h)	C-E	1600 m ³ /h
	OUTLET GRATING NET SECTION (m ²)	E	0.017642
3 RD AREA	MAXIMUM FLOW (m ³ /h)	D	480 m ³ /h

SD700FR has a modular design. Frames 6 to 11 drives consist of frame 5 units parallel connection. Therefore, to calculate the cooling data for bigger frames multiply the data from the tables above by the following factors.

FRAME	6	7	8	9	10	11
FACTOR	x2	x3	x4	x6	x9	x12

Heat dissipation

The heat generated by the SD700FR depends on the carrier frequency (Hz), the grid frequency and the load. It could be estimated by the following equation. Rated power condition is the worst case.

$$P_{loss} [W] = 0.03 \cdot P_{motor} [W]$$

In order to avoid dust ingress in the LCL contactor, the drive integrates in its bottom part a special box that contains it. The box's grating is protected with a dust filter that may be cleaned or replaced periodically depending on the ambient conditions. To clean or replace it, access from the rear part and remove the screws that fix the grating.

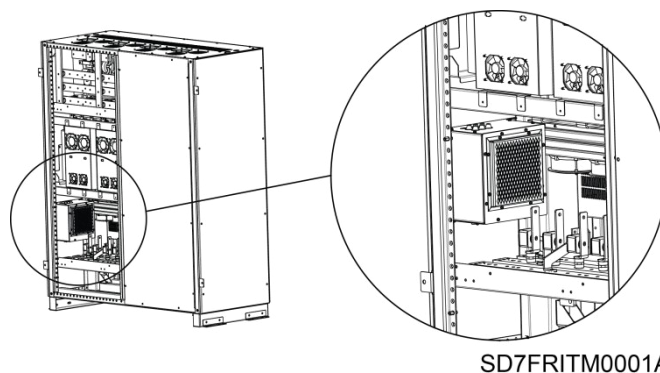


Figure 5.5 LCL contactor box

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6. POWER CONNECTION

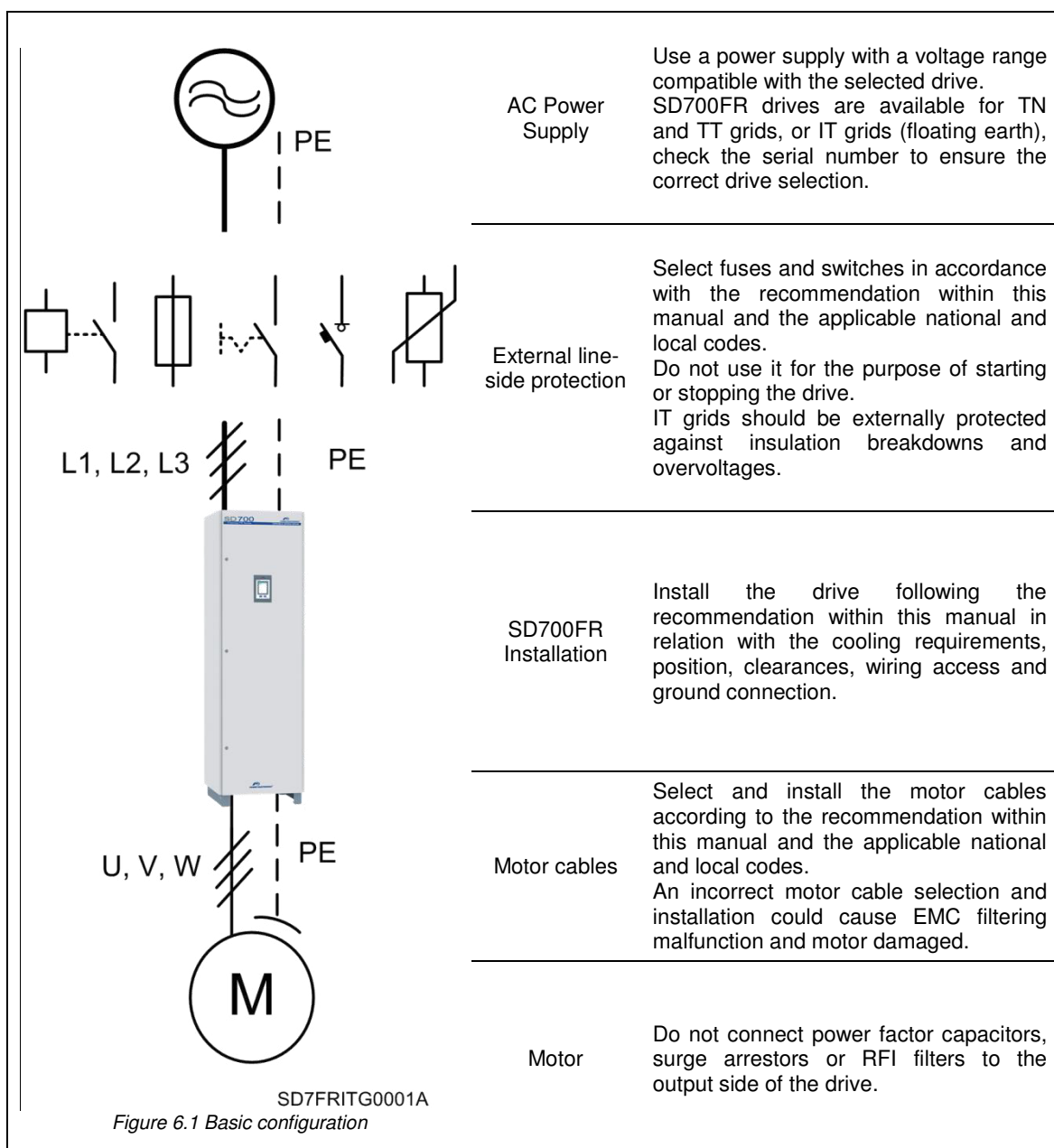


CAUTION

Read carefully the following instructions for a correct electrical installation. Otherwise, it could cause damage to the equipment and lead to injury to people.

6.1. Basic configuration

Proper peripheral devices must be selected and correct connections must be done to ensure proper operation. An incorrectly applied or installed drive can result in system malfunction or reduction in product lifetime as well as component damage. You must read and understand this manual thoroughly before proceeding.



6.2. Topology

The following scheme illustrates the SD700FR frame 5 internal power structure. Frames 6 on are implemented through the parallel connection of unitary frame 5 modules.

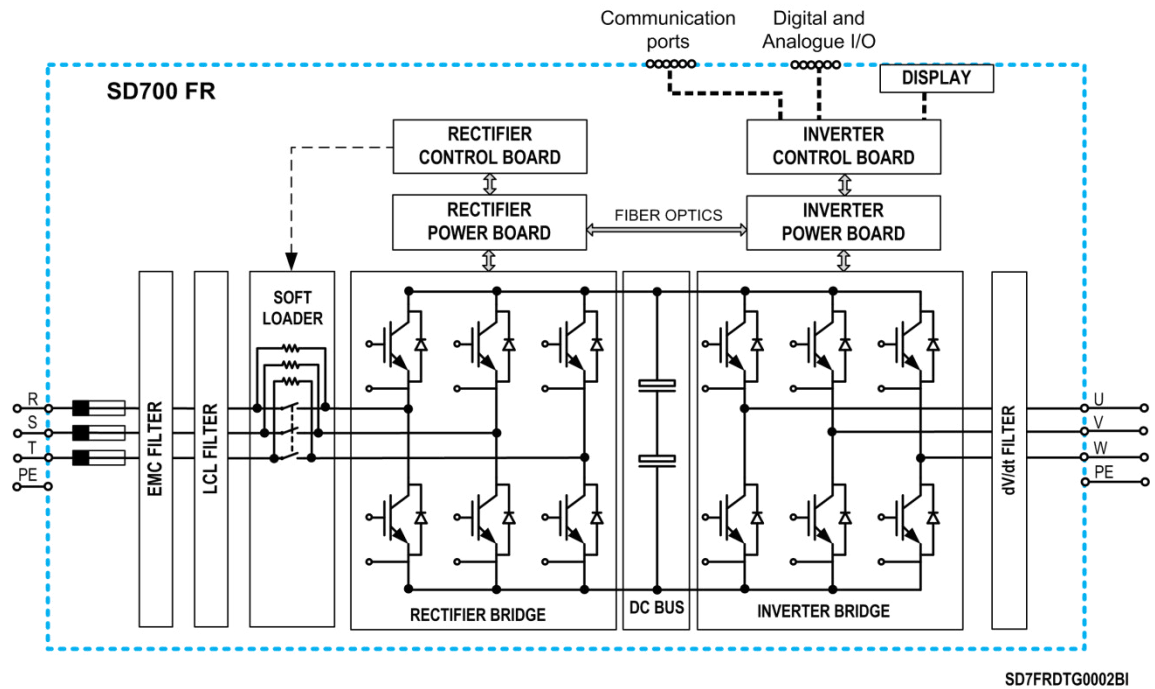


Figure 6.2 SD700FR Topology

SD700FR is based on an active in feed topology that substitutes the thyristor diode rectifier by an IGBT rectifier. The IGBT rectifier bridge enables new features such as the power factor control, the input current harmonic distortion reduction, the DC link's constant voltage and the energy regeneration. The following charts show the input voltage and current waveforms differences between a 6-pulse drive, 18 pulse drive and SD700FR drive. It is show the THDi reduction in the input current waveform for SD700FR drive.

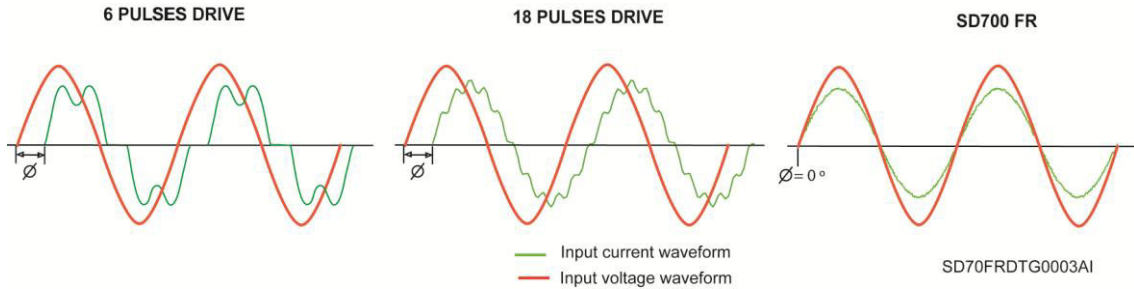


Figure 6.3 Input voltage and current waveforms comparison.

SD700FR frames 5 on integrates as standard ultra fast fuses that protect the drive against downstream overcurrents.

The SD700FR include a power and a control board by each IGBT bridge. These boards controls the rectifier IGBT's bridge shooting, the soft charge, the LCL temperature and the DC bus voltage. Furthermore, the power board communicate and synchronize with the inverter power board (via fiber optic) providing information related to the input power and rectifier bridge. The inverter's control and power board regulate the inverter IGBT's bridge shooting, and the motor performance. In addition, the inverter control board integrate interface terminals such as communications ports, digital and analogue inputs and outputs, alphanumeric display etc.

The input LCL filter reduces the THDi values to achieve compliance with IEEE519 during motor and regenerative operation. It is recommended that the relative short circuit power $RSC = I_{sc}/I_L$ of the supply system has a value greater than 10. Otherwise, the line-side fundamental voltage wave may increase until it reaches values beyond the permissible drive voltage range.

The SD700FR integrates a soft loader block that increases the bus voltage through the inrush current resistor and the freewheeling diode of the IGBTs rectifier bridge. When the V_{bus} is higher than a preconfigured voltage, the line contactor switches ON and the V_{bus} achieves the rated voltage. Then, the rectifier bridge could safely switch ON/OFF their IGBTs in order to get the bus voltage configured. The VFD is able for grids in which the THDv is lower than 8%.

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The output IGBT inverter bridge generates the PWM wave that controls the motor performance (voltage, current, torque, etc.). SD700FR as the SD700 drives family by Power Electronics, integrate as standard dV/dt filters and a CLAMP system that reduces the dV/dt from 4000V/ μ s to 500V/ μ s - 800V/ μ s, therefore, it reduces the motor peak voltages, the common mode currents and the EMC emissions.

This topology allows a bidirectional current flow allowing the energy regeneration during braking periods with a low THDi. This four quadrants operation does not require the installation of external braking resistance.

6.3. Power connection and wiring



CAUTION

The following installation recommendations are suitable for TN and TT grids, for IT grids check the dedicated section. Otherwise, it could cause damage to the equipment and lead to injury to people.

Wiring and periodic inspections should be performed at least 10 minutes after disconnecting the input power. To remove the front cover check that the DC Link red LED is off, then remove the metallic cover and check with a multimeter the following measures:

- Measure between the output power busbars U, V, W and the cabinet and check that the voltage is around 0V.
- Measured DC bus voltage should be less than 30V_{DC}. Otherwise, you may get an electric shock.

The user input and output busbars are labelled according to the following diagram.

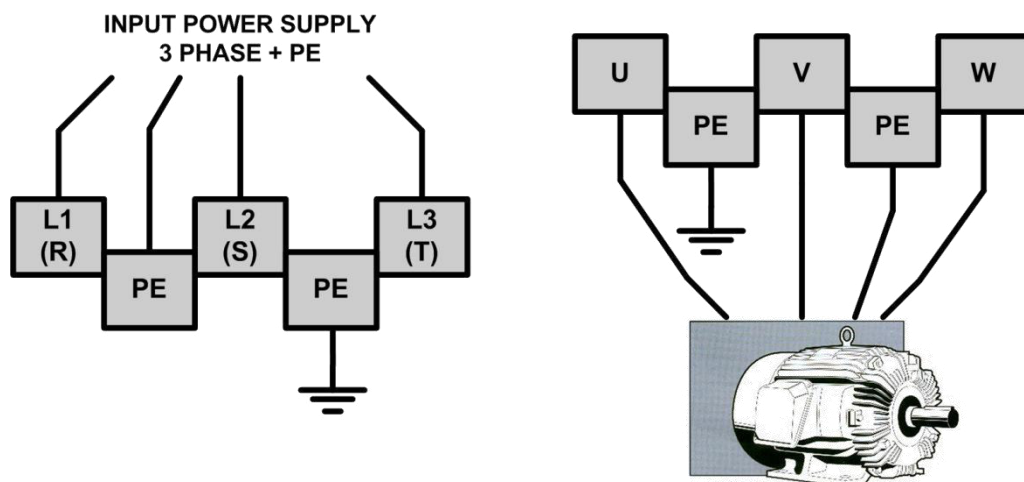


Figure 6.4 Power wiring connection

The input terminals L1, L2, L3 and PE (drive supply), and output terminals U, V, W and PE (motor supply) must be introduced through the metallic panels situated in the bottom part of the cabinet.



CAUTION

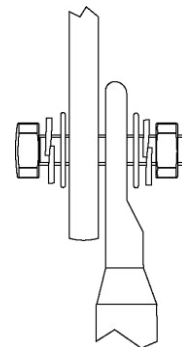
Do not drill or mechanize the gratings. Otherwise, the drive could reduce its cooling capacity.

Check that the power transformer of the 400Vac and 480Vac drives is correctly wired. Otherwise, the drive will not start.

In the bottom, the front metal panel corresponds to the motor cables and the rear metal panel to the input cables; these are not delivered drilled or pre-cut to fulfil worldwide configurations. Each cable must be equipped with its own cable gland or grommet that prevent for dust or moisture penetration.

As standard, the input and output terminals are made of tin plated copper. If they are oxidized prior to its installation, the connections will be poorly executed and will cause overheating. To avoid this effect is recommended to follow the next steps.

- It is recommended to use Ø11 tin plated copper terminal lugs.
- Use M10 zinc bolts and nuts and apply a torque of 40Nm. Check after the first week of operation that the torque applied is maintained.
- The number of available terminals depends on the frame size. Check the power terminal section.
- Before connecting the cables, clean the contact surfaces with a clean cloth and ethanol cleaner.
- Use a spring washer and a fender washer between the nuts or bolts head and the busbar or terminal lug.
- Use copper or aluminium 600Vac conductors for up to 480Vac rated voltage. For 525Vac and 690Vac phase to phase rated equipment use 1kV conductors.



FSITG0038A

Figure 6.5 Terminal lug connection

The recommended cable types and lengths between the drive (at factory settings) and the motor are:

- **Unshielded cable:** 300m. Asymmetrical 4-wire including PE conductor. It is recommended to use a motor ground cable (PE) cross section equal or higher than active motor wires cross section (U, V, W). When single-wire cables are used in three-phase systems, the three phase conductors must be bundled symmetrically.
- **Shielded cable:** 150m. Ideal symmetrical 3-wire cable plus symmetrically arranged PE conductor- with concentric shield. To implement an effective shield bonding it should be used an EMC gland in both motor terminal box and drive cabinet to ensure effective 360° ground connection and a low high frequency impedance path. Check the EMC recommendations section.



CAUTION

The number of three phase cable hose (U,V,W, PE) to the motor should be equal to the number of IGBT's in the drive. Must be one cable hose by each IGBT's Block.

The following figures show the recommended cable type and bundling.

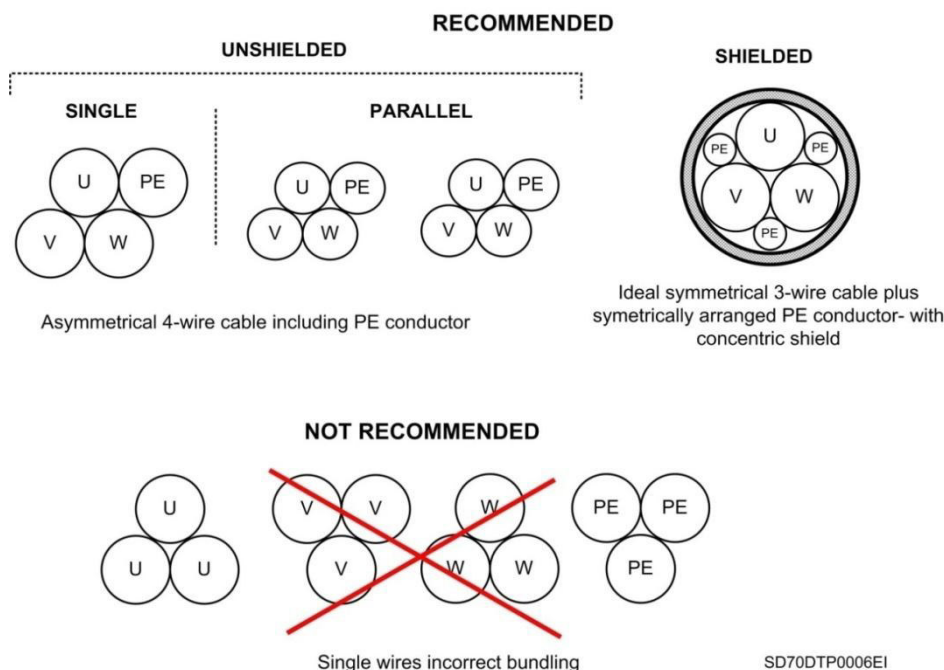


Figure 6.6 Recommended cable type and bundling

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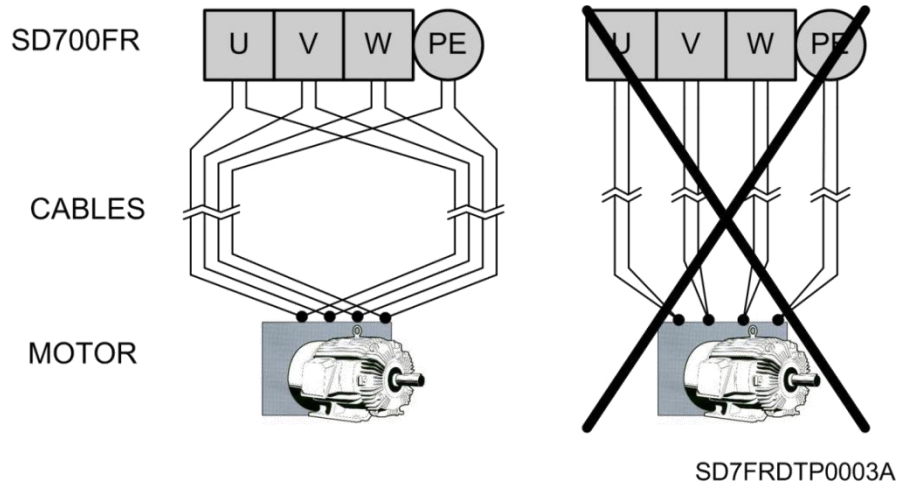


Figure 6.7 Recommended cable bundling scheme



CAUTION

Line voltage (input supply) must never be connected to U, V and W terminals. Otherwise, the drive will be damaged.

It is necessary that installer guarantee the correct observance of the law and the regulations that are in force in those countries or areas where this device is going to be installed.

Do not use capacitors for power factor correction, surge suppressors, or RFI filters on the output side of the drive. Doing so, the component could damage the equipment or even itself.

All power conductors, such as input power cables, output motor cables, DC link cables must be routed separately from the control, signal, PTC, encoder or data cables. The recommended distances between the cables are shown in the following figure.

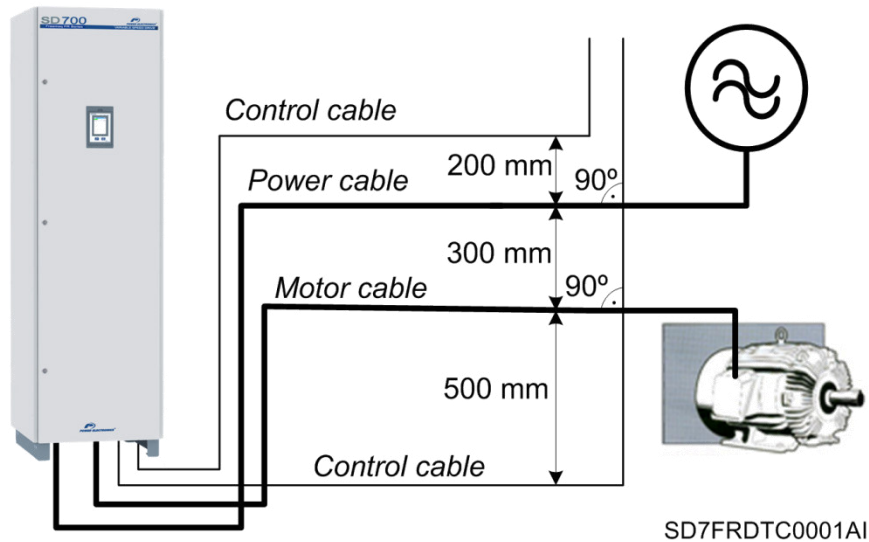


Figure 6.8 Cable routing distances

It is recommended to route in separately cable racks, trays or ducts, the following cable types:

- Single-wire signal or data cables with $V < 60V$.
- Single wire cable with $60V < V < 230V$.
- Input power cables with low level of interferences $230V < V < 1000V$.
- Output motor power cables and Dynamic brake DC cables with high level of interferences $230V < V < 1000V$.
- Medium voltage cables with $V < 1000V$.

The power cables must have sufficient current rating to prevent important wiring overheating and voltage drops. The installer must consider the cable cross-section, cable type, routing method and the environment conditions to select the appropriate cable. It is only allowed the use of cooper or aluminium cables.

6.3.1. Recommended Cable Section for 400VAC

FRAME	CODE	I(A) Rated	Power (kW) at 400VAC	Recommended Cable Section per Phase		Recommended Cable Section for Earth Wire	
				AWG / kcmil	mm ²	AWG / kcmil	mm ²
5	SD7FR0210 5X	210	110	300 – 500	120 – 240	300 – 500	120 – 240
	SD7FR0250 5X	250	132	350 – 500	185 – 240	350 – 500	185 – 240
	SD7FR0275 5X	275	150	2 x 300	2 x 150	2 x 300	2 x 150
6	SD7FR0330 5X	330	160	2 x 350	2 x 185	2 x 350	2 x 185
	SD7FR0370 5X	370	200	2 x 500	2 x 240	2 x 500	2 x 240
	SD7FR0460 5X	460	250	2 x 500	2 x 240	2 x 500	2 x 240
7	SD7FR0580 5X	580	315	3 x 500	2 x 240	3 x 500	2 x 240
	SD7FR0650 5X	650	355	3 x 500	3 x 240	3 x 500	3 x 240
	SD7FR0720 5X	720	400	4 x 500	3 x 240	4 x 500	3 x 240
8	SD7FR0840 5X	840	450	4 x 500	4 x 240	4 x 500	4 x 240
	SD7FR0925 5X	925	500	4 x 500	4 x 240	4 x 500	4 x 240
	SD7FR0990 5X	990	560	6 x 500	6 x 240	6 x 500	6 x 240
9	SD7FR1150 5X	1150	630	6 x 500	6 x 240	6 x 500	6 x 240
	SD7FR1260 5X	1260	710	6 x 500	6 x 240	6 x 500	6 x 240
	SD7FR1440 5X	1440	800	7 x 500	7 x 240	7 x 500	7 x 240
10	SD7FR1580 5X	1580	900	8 x 500	8 x 240	8 x 500	8 x 240
	SD7FR1800 5X	1800	1000	8 x 500	8 x 240	8 x 500	8 x 240
11	SD7FR2200 5X	2200	1200	9 x 500	9 x 240	9 x 500	9 x 240

Note: Cable must be suitable for a permanent $T^a > 75^{\circ}C$. Use 600V cables for up to 480Vac rated voltage. For 525Vac and 690Vac phase to phase rated equipment use 1kV cables. However, this is a recommendation. Local regulations must always be followed.

6.3.2. Recommended Cable Section for 690VAC

FRAME	CODE	I(A) Rated	Power (kW) at 690VAC	Recommended Cable Section per Phase		Recommended Cable Section for Earth Wire	
				AWG / kcmil	mm ²	AWG / kcmil	mm ²
5	SD7FR0130 6X	130	110	3/0 – 300	70 – 120	3/0 – 300	70 – 120
	SD7FR0150 6X	150	132	3/0 – 300	70 – 120	3/0 – 300	70 – 120
	SD7FR0170 6X	170	160	3/0 – 300	95 – 150	3/0 – 300	95 – 150
6	SD7FR0210 6X	210	200	300 – 500	120 – 240	300 – 500	120 – 240
	SD7FR0260 6X	260	250	2 x 300	2 x 150	2 x 300	2 x 150
	SD7FR0320 6X	320	315	2 x 500	2 x 185	2 x 500	2 x 185
7	SD7FR0385 6X	385	355	2 x 500	2 x 240	2 x 500	2 x 240
	SD7FR0460 6X	460	450	2 x 500	2 x 240	2 x 500	2 x 240
8	SD7FR0550 6X	550	500	2 x 500	2 x 240	2 x 500	2 x 240
	SD7FR0660 6X	660	630	3 x 500	3 x 240	3 x 500	3 x 240
9	SD7FR0750 6X	750	710	4 x 500	4 x 240	4 x 500	4 x 240
	SD7FR0840 6X	840	800	4 x 500	4 x 240	4 x 500	4 x 240
	SD7FR0950 6X	950	900	4 x 500	4 x 240	4 x 500	4 x 240
10	SD7FR1140 6X	1140	1000	6 x 500	6 x 240	6 x 500	6 x 240
	SD7FR1270 6X	1270	1200	6 x 500	6 x 240	6 x 500	6 x 240
	SD7FR1420 6X	1420	1400	7 x 500	7 x 240	7 x 500	7 x 240
11	SD7FR1500 6X	1500	1500	8 x 500	8 x 240	8 x 500	8 x 240
	SD7FR1800 6X	1800	1800	8 x 500	8 x 240	8 x 500	8 x 240

Note: Cable must be suitable for a permanent $T^a > 75^{\circ}\text{C}$. Use 600V cables for up to 480Vac rated voltage. For 525Vac and 690Vac phase to phase rated equipment use 1kV cables. However, this is a recommendation. Local regulations must always be followed.

6.4. Ground connection

Before connecting the power conductors, be sure that the chassis of the drive and the adjoining cabinets are connected to ground through the dedicated (PE) terminals. They are situated at both sides of the bottom metallic walls of the drive and they are labelled with the appropriate ground connection. Check section “6.8 Power Terminals”.

Motor’s chassis ground must be connected to the drive. In other words, connect the motor’s ground conductor to the PE terminal of the drive and not to the installation’s ground. We recommend that the cross section of the motor’s ground conductor (PE) should have at least the cross section of the active conductor (U, V, W). Additionally, it should be installed following the recommendations indicated in section “6.3 Power Connection and wiring”.

The line ground must be connected to the drive. In other words, connect the installation’s transformer ground conductor to the PE terminal of the drive and not to the installation’s ground. We recommend that the cross section of the transformer’s ground conductor (PE) complies with the IEC 61800-5-1 standard (10mm² for copper cables and 16mm² for aluminium cables). Additionally, it should be installed following the recommendations indicated in section “6.3 Power Connection and wiring”.

When connecting the earth, ensure that all connected terminal lugs are securely tight and protected from mechanical forces. The tightening torque in case of M10 PE terminals is 40Nm.



CAUTION

For safety reasons it is determinant to measure the grounding resistance of the plant itself. This must be established before the first start up of the plant and with the drive disconnected.

It is responsibility of the installer, to provide the adequate number, type and cross section grounding conductor in accordance with the characteristics of the drive used and the Plant. This should be done to minimize the grounding resistance and comply with the local and national regulation.

6.5. EMC Requirements

6.5.1. Introduction

The European EMC Directive defines electromagnetic compatibility as follows: the capability of an apparatus, an industrial plant, or a system to work satisfactorily in the electromagnetic environment without at the same time causing electromagnetic disturbance, which would be unacceptable to apparatus, industrial plant, or systems present in this environment.

The Electromagnetic compatibility (EMC) depends of two mains characteristics of the equipment: the Electromagnetic Interference (EMI) and Electromagnetic Susceptibility (EMS). The EMC standards aims to ensure that all the electrical equipment that could operate simultaneously in the same environment are compatible. That means the interference immunity of all the devices is greater than the interference emission of all the devices within the same environment.

The EMC requirements for Power Drive System (PDS) are defined in IEC/EN 61800-3 standard that is included in the Declaration of conformity CE enclosed. In European Union, EN61800-3 standard takes precedence over all generic or previously applicable product family EMC standards. The PDS in the context of this standard comprises the drive converter, the motor cables and the motor. Therefore, the installer as the ultimate responsible must follow the installation instructions given within this manual.

Depending on the location of the drive, the standards define four categories distributed in two environments.

- *First Environment:* First Environment includes domestic premises. It also includes establishments directly connected without an intermediate transformer to a low-voltage power supply network, which supplies buildings used for domestic purposes such as shopping malls, cinemas, hospitals...
- *Second environment:* Industrial use. Second Environment includes all establishments other than those directly connected to a low-voltage power supply network, which supplies buildings used for domestic purposes. E.g. factories and those other premises supplied by their own dedicated transformer.

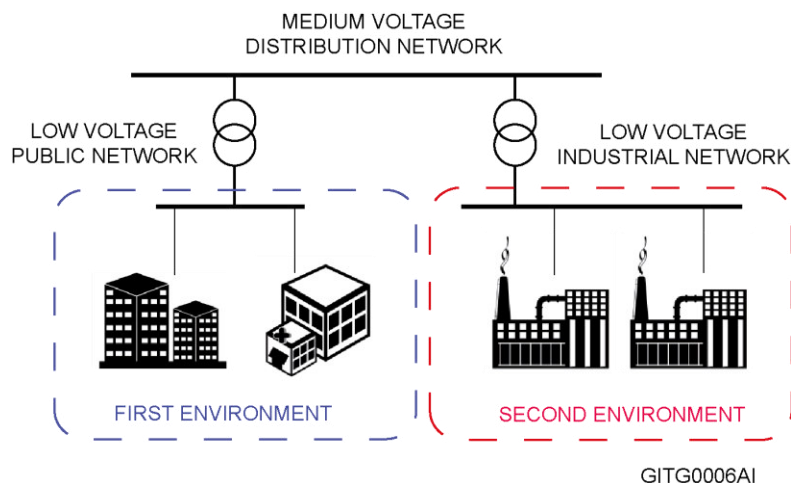


Figure 6.9 Environments definition

The two environments are divided in four categories C1 to C4 that are summarized in the following table.

	FIRST ENVIRONMENT		SECOND ENVIRONMENT	
	C1	C2	C3	C4
Restricted Installation [1]	NO	YES	YES	YES [2]

Notes

[1]. "Restricted Installation" means that the installation and commissioning must be carried out by specialist personnel.

[2]. C4 category applies only for complex systems or when ratings are equal or above to 1,000 V or 400 A. Instead of relying on emissions limits for compliance C4 devices are treated later on as fixed installations that should only be assessed when installed in its intended location. Good engineering practices – as the recommended on the standard - should be applied ad hoc and documented to form an EMC plan by the installation responsables.

6.5.2. SD700FR compliance

SD700FR variable speed drives are designed for industrial (second environment) use. The use of radio frequency interference filters (RFI filters) and dV/dt filters as standard, and the correct installation following the recommendations within this manual, permits to achieve compliance with C3 category defined in IEC/EN 61800-3.

Optionally the SD700FR on-floating earth variable speed drive could be installed in residential areas (first environment) by employing optional RFI filters that permits to achieve compliance with C2 category.

SD700FR is not a retail unit, which is neither a plug in device nor a movable device and it is intended to be installed and commissioned by qualified personnel. Therefore, C1 category will not be required.

SD700FR with floating earth configuration can be installed in Industrial (Second Environment) IT grids. Although they do not integrate normal RFI filters, following the installation recommendation within this manual and its dV/dt filter as standard, permits to achieve compliance with C3 category defined in IEC/EN61800-3.

6.5.3. EMC installation requirements

SD700FR do not require the use of shielded motor cable to achieve compliance with C3 category, when a correct installation is done. Wiring and Installation recommendations are included in sections “6.3 Power Connection and wiring” and “6.4 Ground connection”.

It is recommended to implement a 360° contact that creates an effective shield bonding in both the SD700FR cabinet and the motor terminal box. As an example, it could be installed EMC cable glands as shown in the next figure.

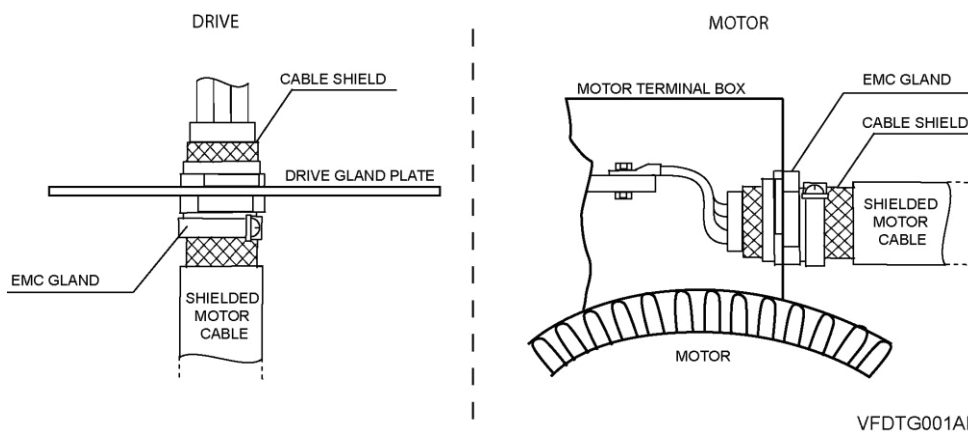


Figure 6.10 Correct output motor cables shield bonding

It is recommended for control signals to use shielded cable and to follow recommendations included in section “7.1 Wiring recommendations”.



CAUTION

Select communication and control system according to the drive EMC environment. Otherwise, systems could suffer from interferences due to a low EMS level.

6.6. Protections

6.6.1. Short circuit

SD700FR includes ultra fast fuses as standard. Frame 5 includes one fuse per phase with a rated current that depends on the drive's nominal current. Frames 6 on are constructed through the parallel connection of frame 5 so the fuses per phase in those frames correspond with the number of parallel drive modules (frame 5) interconnected. The breaking capacity of the fuses and the rated current is described in the following table.

FUSE CHARACTERISTICS						
In (A)	Ic @ Un (A)	I ² t @ 1ms I ² t _p (A ² s)	I ² t @ Un (A ² s)	Un (V)	Manufacturer	Model
200A	200kA	2600	13500	690VAC	WESTCODE	069UR1S0250B
250A	200kA	4700	25000	690VAC	WESTCODE	069UR1S0250B
350A	200kA	10500	55000	690VAC	WESTCODE	069UR1S0350B

Therefore, it is not recommended to install the drive in points where the short-circuit current available is higher than 200kA. If so, install general fuses with a greater breaking capacity and with fastest overcurrent capacity.

FRAME	DRIVE	FUSES PER PHASE (n ^o x In)
380Vac- 480Vac		
5	SD7FR0210 5X Y	1x350A
	SD7FR0250 5X Y	1x350A
	SD7FR0275 5X Y	1x350A
6	SD7FR0330 5X Y	2x350A
	SD7FR0370 5X Y	2x350A
	SD7FR0460 5X Y	2x350A
7	SD7FR0580 5X Y	3x350A
	SD7FR0650 5X Y	3x350A
	SD7FR0720 5X Y	3x350A
8	SD7FR0840 5X Y	4x350A
	SD7FR0925 5X Y	4x350A
	SD7FR0990 5X Y	4x350A
9	SD7FR1150 5X Y	6x350A
	SD7FR1260 5X Y	6x350A
	SD7FR1440 5X Y	6x350A
10	SD7FR1580 5X Y	9x350A
	SD7FR1800 5X Y	9x350A
11	SD7FR2200 5X Y	12x350A
	SD7FR2500 5X Y	12x350A

FRAME	DRIVE	FUSES PER PHASE (n ^o x In)
525Vac		
5	SD7FR0180 7X Y	1x350A
	SD7FR0205 7X Y	1x350A
6	SD7FR0270 7X Y	2x350A
	SD7FR0295 7X Y	2x350A
	SD7FR0340 7X Y	2x350A
7	SD7FR0425 7X Y	3x350A
	SD7FR0470 7X Y	3x350A
	SD7FR0535 7X Y	3x350A
8	SD7FR0660 7X Y	4x350A
	SD7FR0750 7X Y	4x350A
9	SD7FR0845 7X Y	6x350A
	SD7FR0950 7X Y	6x350A
10	SD7FR1070 7X Y	9x350A
	SD7FR1205 7X Y	9x350A
	SD7FR1340 7X Y	9x350A
	SD7FR1605 7X Y	9x350A
11	SD7FR2005 7X Y	12x350A

FRAME	CODE	FUSES PER PHASE (n ^o x In)
690 Vac		
5	SD7FR0130 6X Y	1x250A
	SD7FR0150 6X Y	1x250A
	SD7FR0170 6X Y	1x250A
6	SD7FR0210 6X Y	2x200A
	SD7FR0260 6X Y	2x250A
	SD7FR0320 6X Y	2x250A
7	SD7FR0385 6X Y	3x250A
	SD7FR0460 6X Y	3x250A
8	SD7FR0550 6X Y	4x250A
	SD7FR0660 6X Y	4x250A
9	SD7FR0750 6X Y	6x250A
	SD7FR0840 6X Y	6x250A
	SD7FR0950 6X Y	6x250A
10	SD7FR1140 6X Y	9x250A
	SD7FR1270 6X Y	9x250A
	SD7FR1420 6X Y	9x250A
	SD7FR1500 6X Y	12x250A
11	SD7FR1500 6X Y	12x250A
	SD7FR1800 6X Y	12x250A

6.6.2. Ground fault protection

The drive is equipped with an internal software ground fault protective function to protect the drive against input and output unbalanced currents. The response threshold can be set from 0% to 30% of the rated current (G.11.3). For further information, see Programming and Software Manual.

This function is not intended to work as a personnel safety or fire protection, so an external protection must be provided to ensure that a substantial ground fault current is promptly interrupted. The SD700 FR drives are suitable to operate with RCD components Type B, if it is required. The EMC filters and long motor cables increase the ground leakage currents so the threshold response of the protection should be adjusted according to the relevant plant conditions. For additional information, contact with Power Electronics.

6.6.3. Motor thermal protection

The drive includes a motor thermal protection that based on the motor performance parameters mathematically calculates the thermal reservoir of the motor. When this reservoir is reduced below the limits, the drive automatically stops the motor. The thermal model sensitivity could be configured in parameter G2.7, for further information consult Software and programming manual.

The drive includes as standard a PTC connection that permits to monitor the motor temperature. Once connected and configured the drive could either stop the motor or generate a warning signal.

6.6.4. Low Voltage Ride Through (LVRT)

The Low Voltage Ride Through (LVRT) protection is very useful for applications that control a continuous process and cannot afford to stop because of short voltage outages or dips coming from the grid. The process must continue to run through these outages, typically 2 to 3 cycles.

Voltage dips cause a decrease of the DC Bus voltage in the drive. During very brief dips, it may be possible to supply the energy from the DC Bus capacitors. However, during longer dip periods, the DC Bus voltage will drop to a lower level and if this falls below the DC Bus trip voltage, the drive will trip in the default configuration.

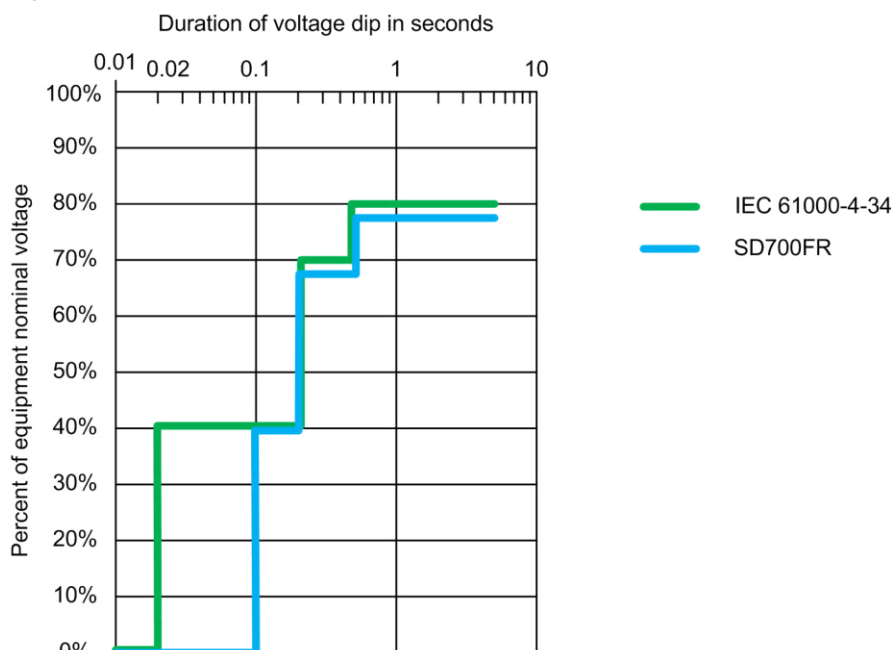
A voltage dip could usually be a risky situation for any kind of equipment and/or circuit protection devices connected to the grid when it is cleared. At this moment, as full AC voltage is connected, some devices, including VFD's, can demand a high current causing high voltages and current transients.

SD700FR drives are by default in compliance with IEC/EN 61800-3 product standard "Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods". Dip test levels are defined in IEC 61000-4-34 "Voltage dips, short interruptions and voltage variations immunity tests for equipment". During a voltage dip, drives are allowed, by criterion C of IEC/EN 61800-3, to trip. A manual restart could even be required. They are neither allowed to be damaged nor misconfigured.

Furthermore, SD700FR drives with software version AFE_R1.4.0 or higher, include a new algorithm that overperforms the requirements of the standard by making them comply with the criterion A or B of the IEC/EN 61800-3, for the tests as defined in IEC 61000-4-34, regardless of the voltage dip depth and duration, and capable to restart them automatically without affecting its operational safety during a voltage dip. Depending on the voltage dip depth and duration, the drive's two possible behaviours are as follows:

- When voltage dips are up to 70%, the drive remains connected, regulating the DC voltage and keeping the motor's performance at any moment.
- When voltage dips are higher than 70%, the drive remains connected using the rectifier bridge in "diodes" mode (no IGBT switching) and the DC Bus voltage varies depending on the input voltage level. In this case, the motor can increase its input current, and vary its torque and speed response depending on its operation conditions. When the input voltage is back to nominal conditions, the rectifier bridge restarts automatically and the intended torque and motor speed levels are recovered immediately.

Test results can demonstrate that SD700FR new LVRT algorithm improves the requirements of the standard, not only on performance criteria achieved, but also in dips severity, as shown in the next figure:



SD7FRDTP0004AI

Figure 6.11 Low Voltage Ride Through

6.6.5. Others

The drive implements additional motor and drive protections such as power-loss ride through, automatic fly restart, high and low input and output voltage, pump overload and underload... For further information, consult Software and Programming manual.

6.6.6. Safety Stop Function

Safe Torque Off (STO) allows the drive output to be disabled so that the drive cannot provide power or generate torque in the motor. The STO safety function has been certified by TÜV Rheinland according to IEC/EN 61800-5-2. For further information, see section 7.3.

6.7. IT grids - floating earth Connection

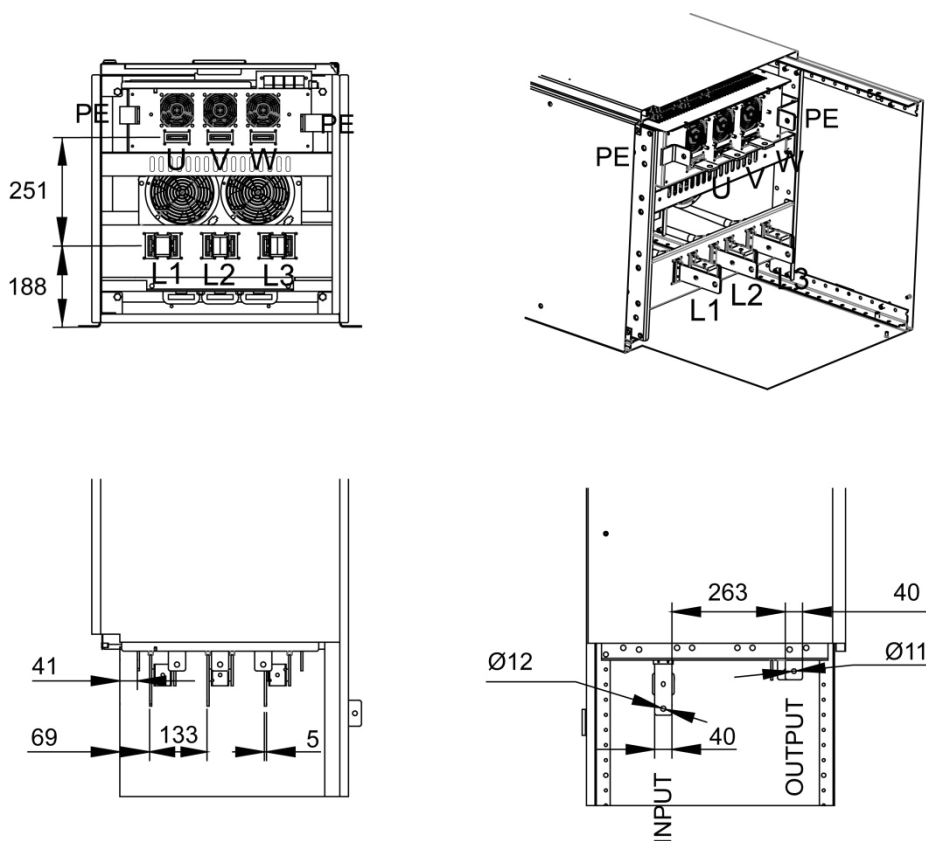
When planning an IT grid electrical installation select the drive for floating earth operation. Check the drive reference to ensure the correct drive selection.

IT grids must be equipped with an insulation monitoring system. To set the parameter settings, consider that the drive has inherent very high impedance, even when a large number of drives are working in parallel on the same IT system.

It is recommended the installation of surge arrester to ground to protect against transient overvoltages. The surge arrester must have rated voltage greater than the drive voltage range to prevent its operation during normal conditions.

6.8. Power terminals

6.8.1. Frame 5

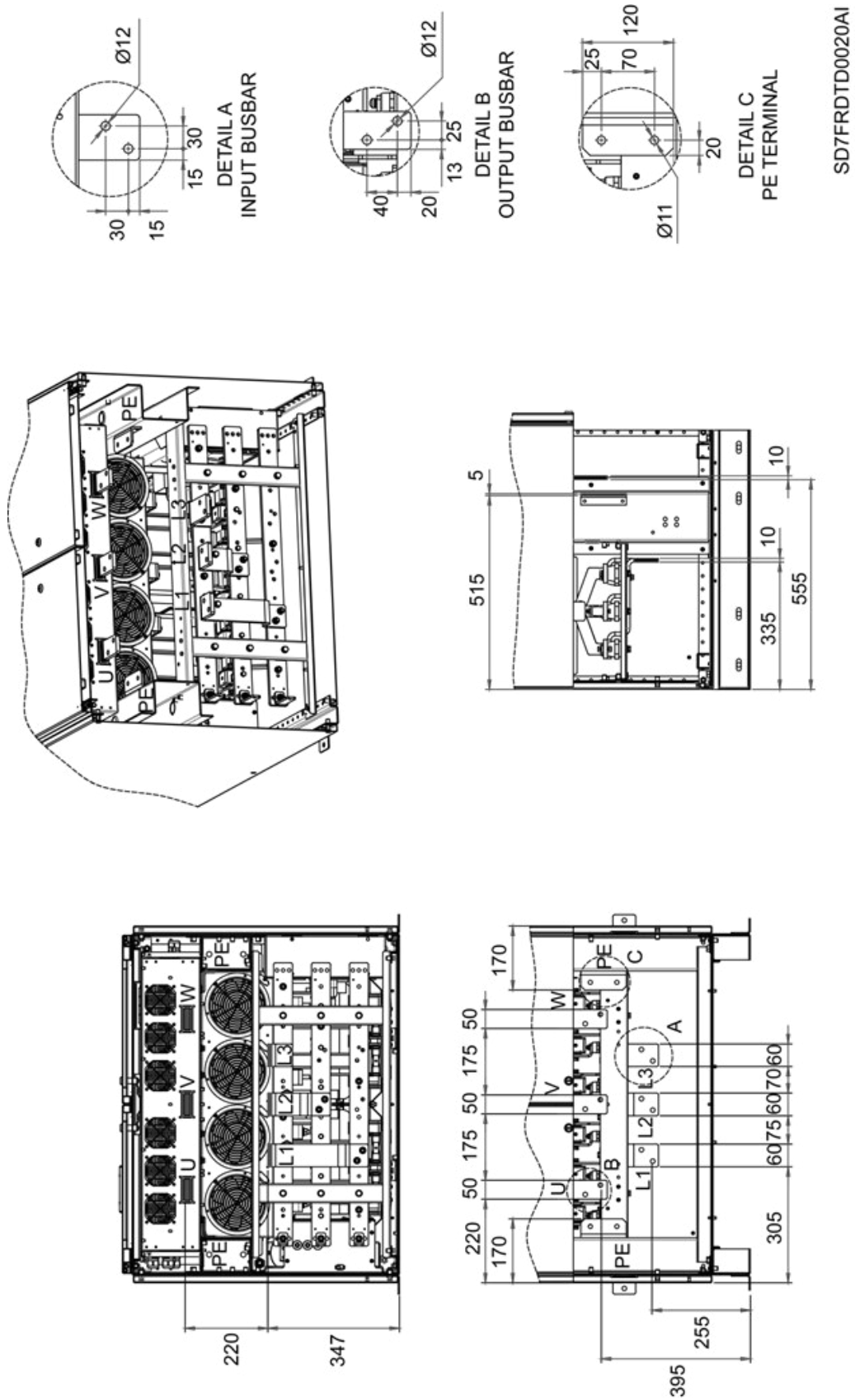


SD7FRDTD0017AI

Figure 6.12 Frame 5 – Power terminals [mm]

E
N
G
L
I
S
H

6.8.2. Frame 6



SD7FRD0020AI

Figure 6.13 Frame 6 – Power terminals [mm]

6.8.3. Frame 7

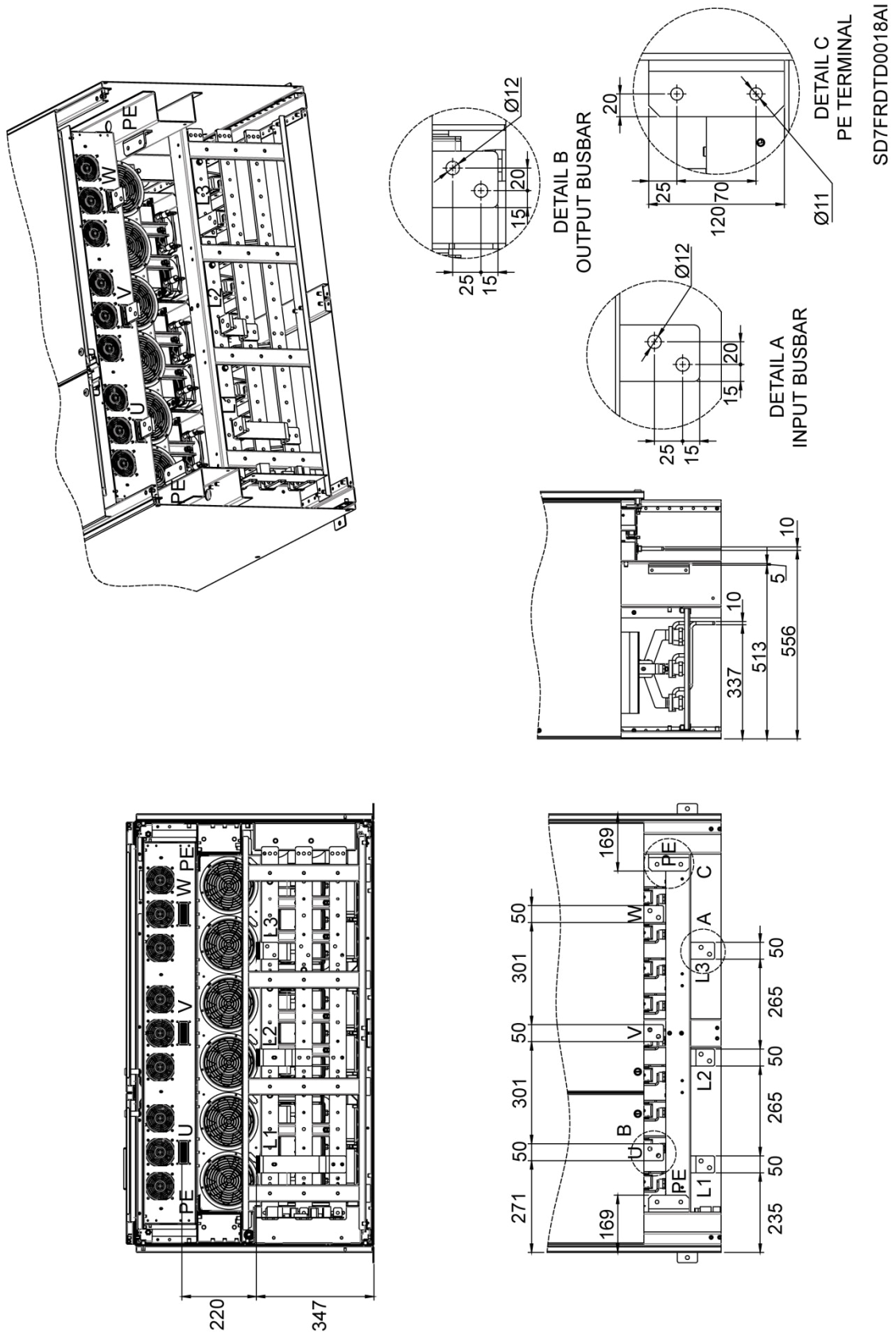


Figure 6.14 Frame 7 – Power terminals [mm]

6.8.4. Frame 8

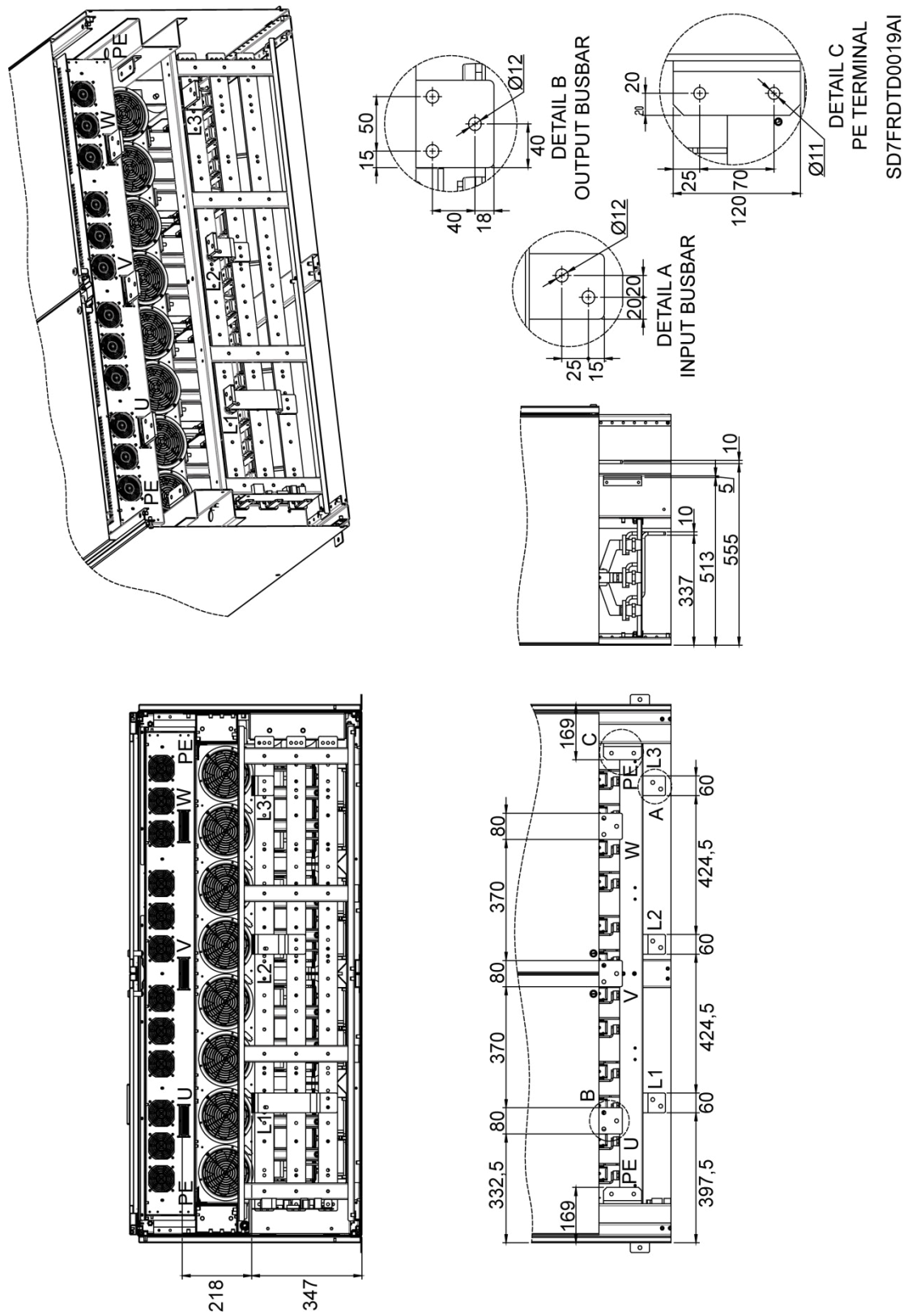
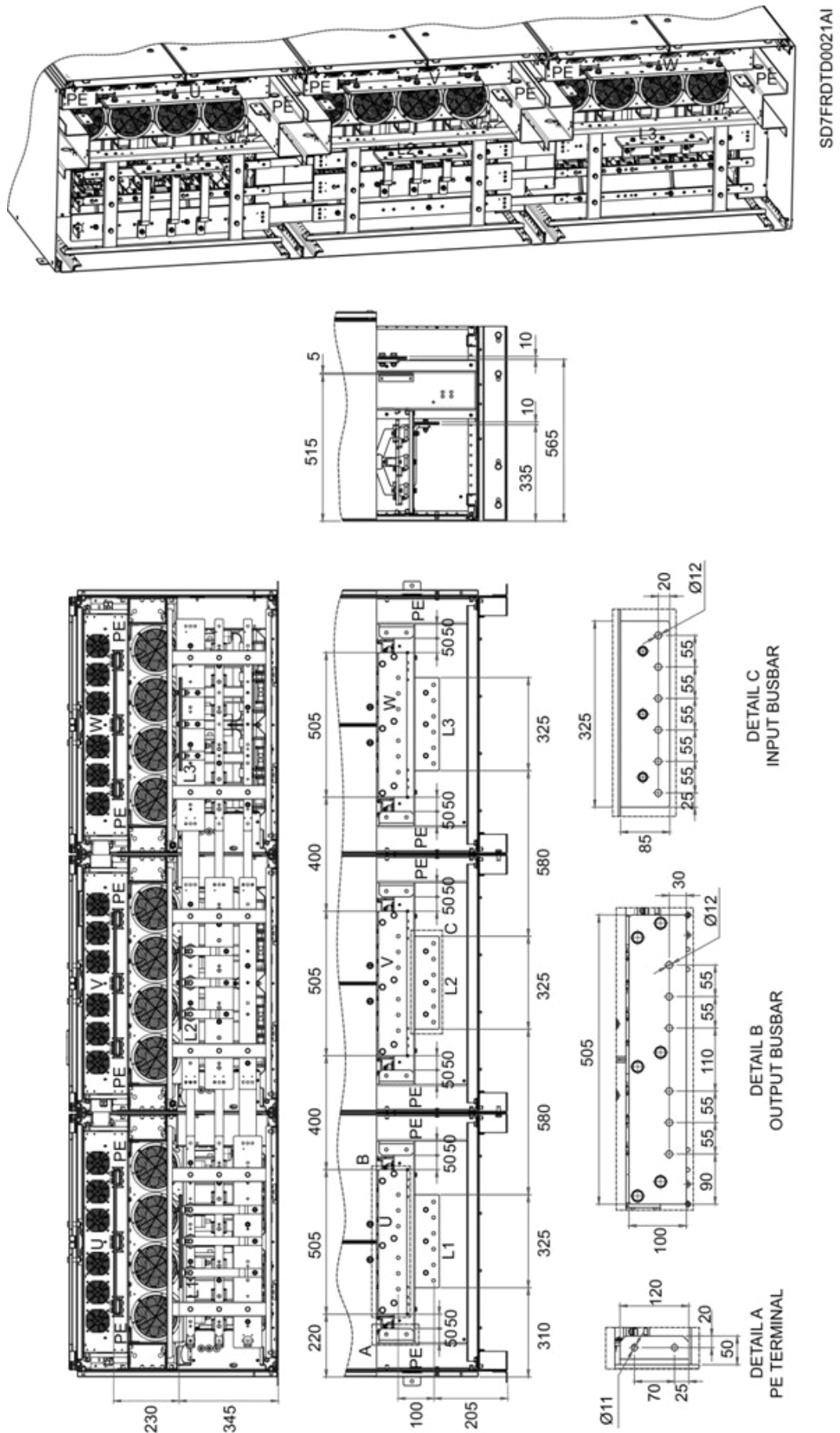


Figure 6.15 Frame 8 – Power terminals [mm]

6.8.5. Frame 9



SD7FRD0021AI

I S - F N E

Figure 6.16 Frame 9 – Power terminals [mm]

7. CONTROL CONNECTION

7.1. Wiring recommendations

Before planning the installation, follow the next recommendations. The parallel cable routing should be minimized and the distance between the control wiring and the power wiring should be maximized. It is recommended to route control cables with different voltages in separately cable racks, trays or ducts.

It is recommended to use shielded twisted cable for all the data, signal or control cables that came out from the variable speed drive, with the properly shield bonding to ground. To ensure an effective shield bonding, it is recommended to include in the SD700FR front metal panel of the control board, EMC shield clamps that ensure a 360° effective shield bonding.

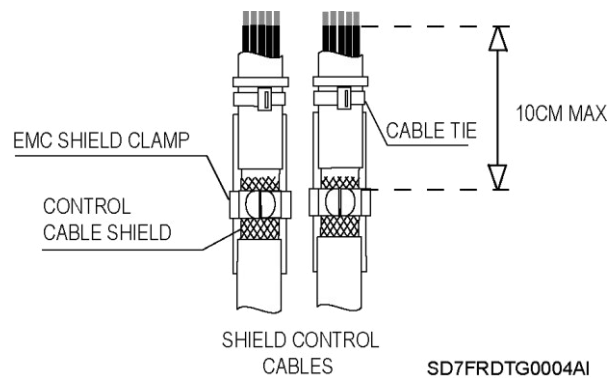


Figure 7.1 Shield bonding

Digital signal cables must be grounded at both ends of the cable. It is recommended to use independent shielded cables for digital and analogue signals. When using multiple analogue signals do not use common return for them. If a low-interference is experienced (hum loops) using analogue signals disconnect the shield grounding from one of the ends. The maximum section for the control cables is 2.5mm² and the recommended tightening torque is 0.4Nm.

Although the control board is insulated galvanically, for safety reasons it is recommended not to modify the wiring while the equipment is connected to the input power supply.



CAUTION

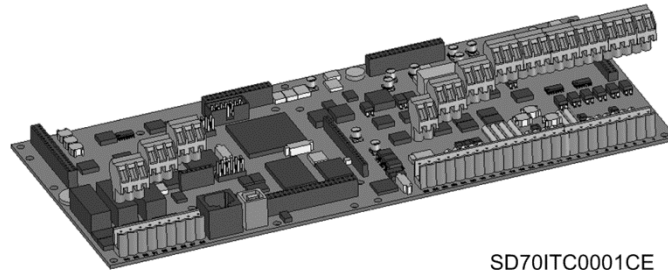
Changes of control wiring or bridges should be performed following the safety instructions indicated before. Otherwise, it could cause damage to the equipment and lead to injury to people.

7.2. Control board terminals description



CAUTION

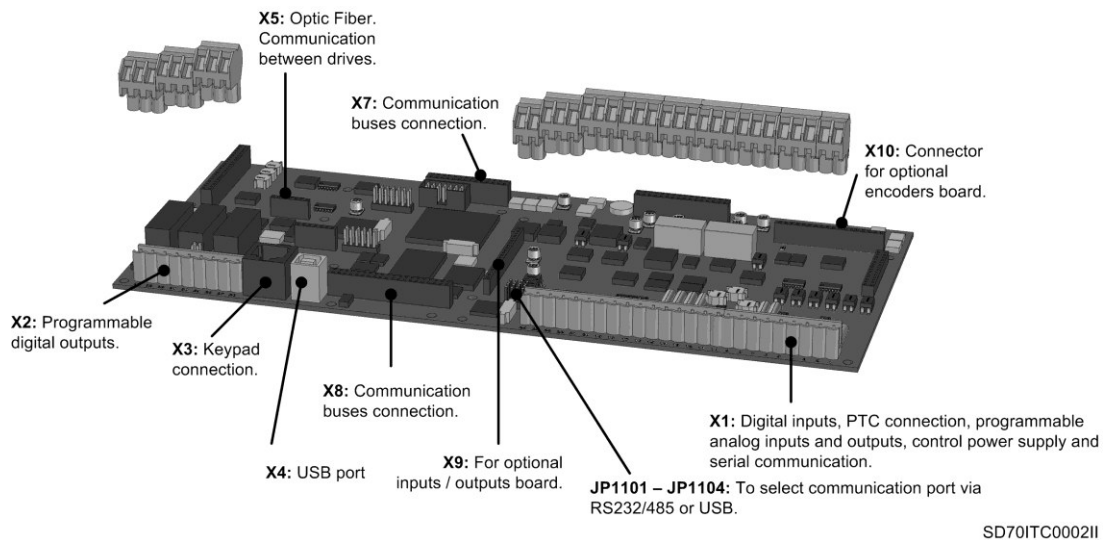
Changes of control wiring or bridges should be performed at least 10 minutes after disconnecting the input power and after checking the DC Link voltage is discharged (below 30VDC). Otherwise, you may get an electric shock.



SD70ITC0001CE

Figure 7.3 Control board of SD700FR

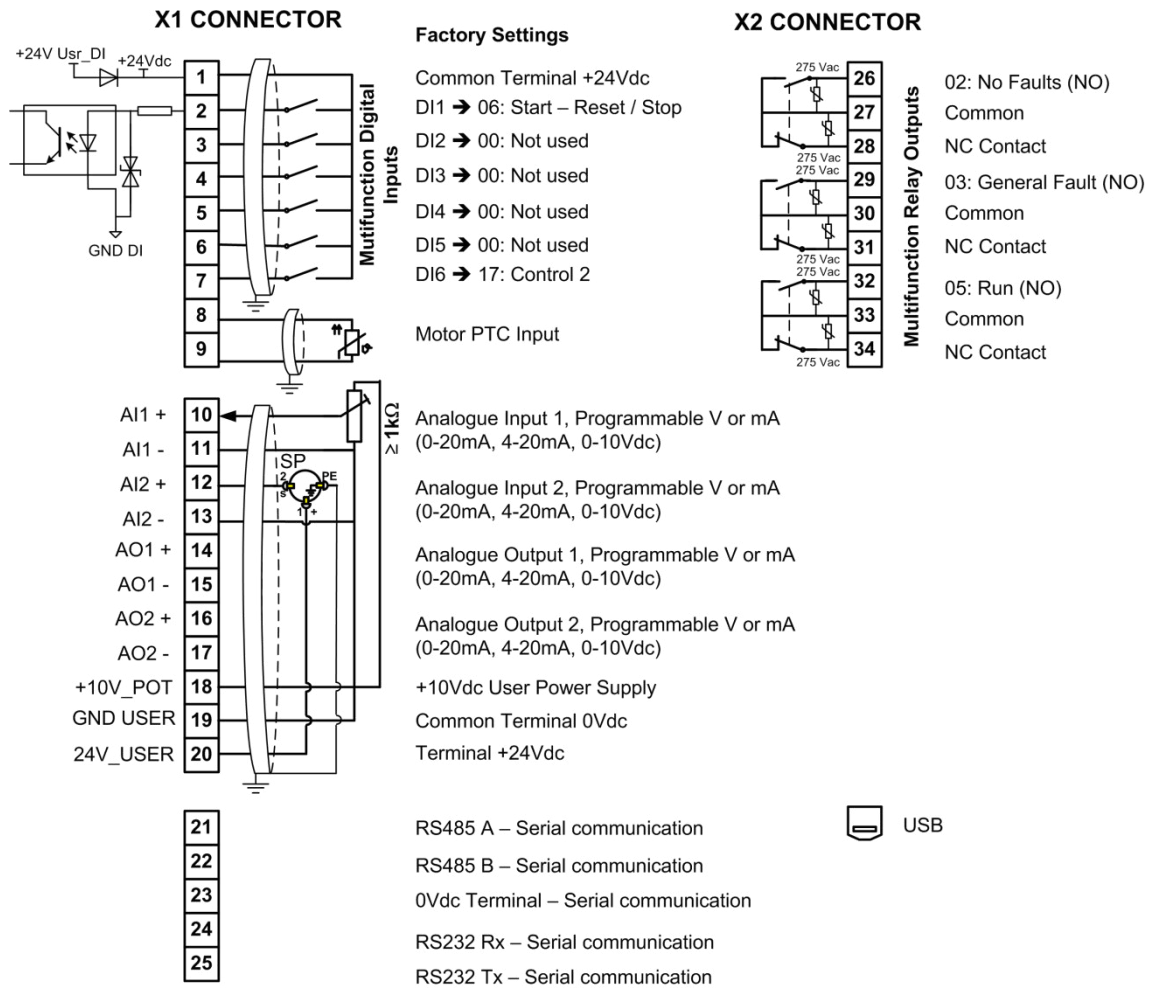
The user will only have access to the inverter control board equipped with the user interface ports and connectors. As mentioned in previous paragraph, the inverter control board integrate as standard PTC connection, analogue and digital inputs/outputs, DC external input power supplies, RS485, RS232, USB port communication and display ports. Moreover, the board is ready for the connection of optional boards such as I/O expansion board, encoder board, communication boards, fiber optic board, etc.



SD70ITC0002II

Figure 7.4 Location and description of user connectors

The following figure provides an overview of the standard wiring for control terminals through the X1 and X2 user connectors.



SD70DTC0001HI

Figure 7.5 Example of control terminals standard wiring

Digital inputs can be configured individually or collectively. Analogue inputs can be configured as comparators. Details on varying standard configurations are available in the Software Manual. The following figure shows typical wiring configuration for a 3-wire start / stop push button system.

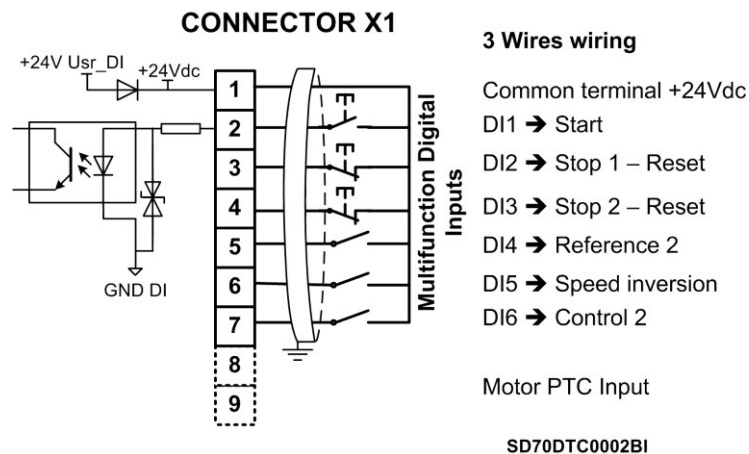


Figure 7.6 Wire control terminals wiring

		PIN	SIGNAL	DESCRIPTION
X1 CONNECTOR	DIGITAL INPUTS	1	+24V_USER	Power supply for digital inputs. Short circuit and overload protected. (Maximum +24VDC, 180mA)
		2	DI1	Programmable Digital Input 1. Digital inputs are configured in the Input group. Their status can be displayed in the visualisation group. It is powered from terminal 1 or an external power 24VDC supply. If an external power supply is used, the common should be connected to the terminal 19 (user GND).
		3	DI2	Programmable Digital Input 2. See DI1 description.
		4	DI3	Programmable Digital Input 3. See DI1 description.
		5	DI4	Programmable Digital Input 4. See DI1 description.
		6	DI5	Programmable Digital Input 5. See DI1 description.
		7	DI6	Programmable Digital Input 6. See DI1 description.
		8	PTC +	Control signal of the motor temperature through the connection of a PTC.
		9	PTC -	
	ANALOGUE INPUTS	10	AI1 +	Voltage or current programmable Analogue Input 1 (V or mA). Configurable for 0-10VDC, ± 10 VDC, 0-20mA or 4-20mA. Input resistance value in voltage mode is $R_i=20k\Omega$. Input resistance value in current mode is $R_i=250\Omega$.
		11	AI1 -	Common for Analogue Input 1.
		12	AI2 +	Voltage or current programmable Analogue Input 2 (V or mA). See AI1 description.
		13	AI2 -	Common for Analogue Input 2.
	ANALOGUE OUTPUTS	14	AO1 +	Voltage or current programmable Analogue Output 1 (V or mA). Configurable for 0-10VDC, ± 10 VDC, 0-20mA or 4-20mA.
		15	AO1 -	Common for Analogue Output 1.
		16	AO2 +	Voltage or current programmable Analogue Output 2 (V or mA). Configurable for 0-10VDC, ± 10 VDC, 0-20mA or 4-20mA.
		17	AO2 -	Common for Analogue Output 2.
	USER POWER SUPPLY	18	+10V_POT	10VDC power supply for analogue inputs. Input power for maximum 2 potentiometers ($R \geq 1k\Omega$).
		19	GND_USER	Common for analogue inputs (0VDC).
		20	+24V_USER	User power supply. It provides a DC supply to an external sensor. (Maximum: +24VDC, 180mA).
	SERIAL COMMUNICATION	21	RS485 A	RS485 serial communication interface for Modbus.
		22	RS485 B	
		23	RS Common	Common for RS485 / RS232 serial communication signals.
		24	RS232 Rx	RS232 serial communication interface for Modbus.
		25	RS232 Tx	
X2 CONNECTOR	DIGITAL OUTPUTS	26	RLY1 NO	Digital Output 1. Programmable change over relay (NO / NC). Potential free (Maximum: 250VAC, 8A; 30VDC, 8A).
		27	RLY1 C	
		28	RLY1 NC	
		29	RLY2 NO	Digital Output 2. Programmable change over relay (NO / NC). Potential free (Maximum: 250VAC, 8A; 30VDC, 8A).
		30	RLY2 C	
		31	RLY2 NC	
		32	RLY3 NO	Digital Output 3. Programmable change over relay (NO / NC). Potential free (Maximum: 250VAC, 8A; 30VDC, 8A).
		33	RLY3 C	
34	RLY3 NC			

7.3. STO - Safe Torque Off

The STO function is defined as follows:

Power, that can cause rotation, is not applied to the motor. The frequency converter will not provide energy to the motor, which can generate torque.

For three-phase asynchronous motor, that means to stop supplying alternating three-phase power to the stator.

This function corresponds with an Emergency Stop Category 0 according to IEC 60204-1. When the drive is running and the STO function is applied, the motor will freely stop by its own inertia.

The SD700FR's STO optional board permits to achieve two Safety Levels, SIL3^[1] or PLe for the STO function. . The safety integrity level SIL3 requires the use of an external SELV/PELV 24V_{DC} source, emergency push button, and safety relay SIL3 certified with feedback. For safety integrity, level SIL1 – equivalent to a Performance Level Plc (ISO 13849-1) - only requires an external push button. Maximum reaction time of STO function is less than 50ms. See section 7.3.1 and 7.3.2 for additional information.

By using this function, cleaning, emergencies or maintenance work on non-electrical parts of the machinery can be performed without switching off the input power supply to the drive.

Based on the study of each application and the risk assessment, the designer should define the safety function required and each safety level.

The STO safety function has been certified by Tüv Rheinland according to IEC/EN 61800-5-2.



CAUTION

The STO safety function does not disconnect the main input power and auxiliary power supply. STO function enables the drive to disconnect the output motor power supply. Therefore, active conductors may be present inside, so DO NOT carry out electric maintenance tasks without isolating the drive. Otherwise, it could cause damage to the equipment and lead to injury and death to people.

Do not use the STO function as a normal drive stop.

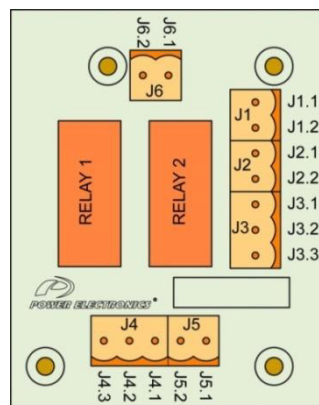


Figure 7.6 Optional STO board terminals

It is recommended to use double-shielded twisted pair cable for external 24V_{dc} and safety channels. Shielded must be connect to ground as it is indicated in the examples.

CON.	Terminal	Description
J1	J1.1 (STO O1)	STO output channel 1
	J1.2 (STO O2)	STO output channel 2
J2	J2.1 (GND)	GND
	J2.2 (STO I1)	STO input channel 1
J3	J3.1 (STO I2)	STO input channel 2
	J3.2 (FB1)	Feedback 1 contact
	J3.3 (FB2)	Feedback 2 contact
J6	J6.1 (+24Vdc)	24V _{DC} power supply. (24 V _{DC} , Max:2W)
	J6.2 (GND)	0 V _{DC} power supply

^[1] This safety integrity level replace the older Category 3 according to EN 954-1.

7.3.1. Safety Integrity Level (SIL3- PLe)

This assembly provide a highly reliable safety function. When the sensor (E-Push Button) is activated, the STO function interrupts providing energy to the motor. Therefore, it will stop the motor by its own inertia or will avoid any possible unexpected start.

The use of an external safety relay permits to monitor all the safety elements and feedbacks signals, therefore in case a relay failure or elements malfunction the motor will safely stop and a restart will be prevented. The external safety relay must be SIL3 or PLe certified, and compatible with the following features: 24Vdc power supply, 2 safety input terminals, at least 2 NO and 1 NC outputs contacts and a reset function (Example: PILZ PNOZ X2.P8). The sensors (emergency push buttons, interlock switches, etc) must be certified as safety elements. The total probability of a dangerous random hardware failure per hour (PFH) value of all elements, which are applied for the realization of the safety function, shall not exceed the limit of the corresponding SIL level. The installation must be performed by trained personal with experience in functional safety.

Example 1: Emergency stop (SIL3, PLe) safety function with automatic restart. The STO's board power terminals will be connected to an external auxiliary SELV/PELV 24Vdc power supply. Both input safety channels will be connected to NO contacts of safety relay, and the monitoring channel (J3.2 and J3.3) will be connected to the terminals of the safety relay restart. To ensure a correct drive response when a fault occurs, J3.1 terminal must be connected to the digital input 5 of the SD700, previously set as external fault (G4.1.9 option 24 EXTERN EMERGE). It is mandatory to use a push button equipped with two normally close contacts that will be connected to the relay's safety inputs.

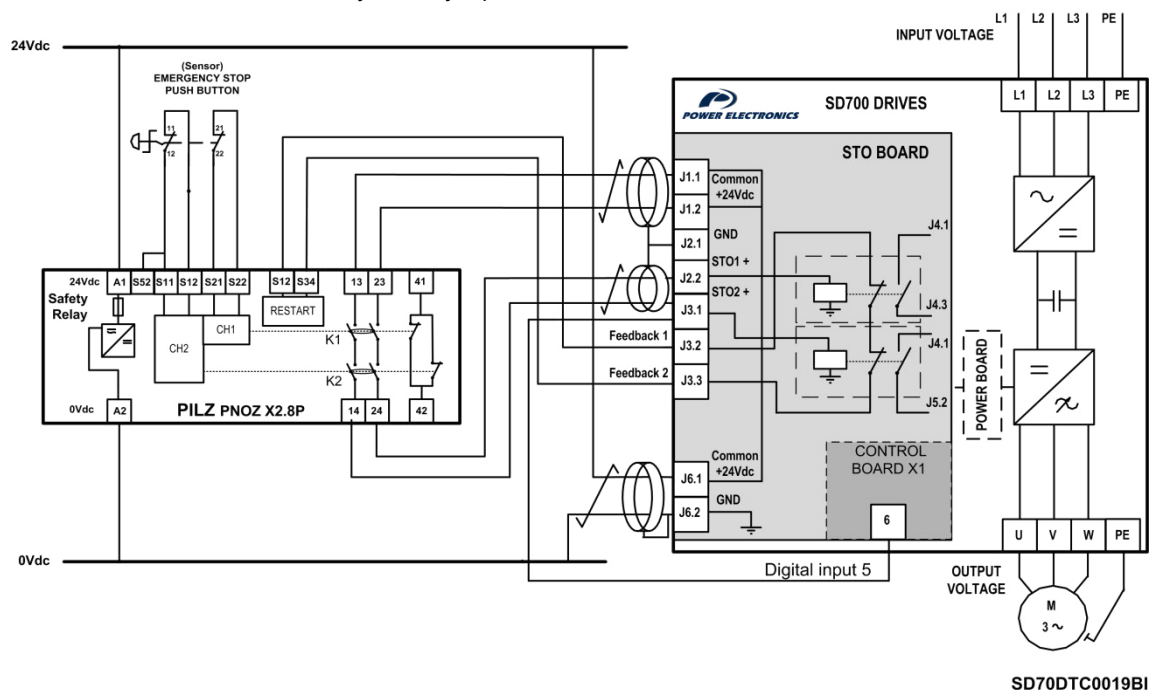


Figure 7.7 Example 1- Emergency stop push button



CAUTION

According to EN 60204-1, an automatic restart is not allowed after an emergency stop. For this reason the machine control must prevent it.

In SIL 3 applications, the safety function has to be tested regularly (approximately once per month) in order to detect certain failures.

To ensure a correct drive response when a fault occurs, J3.1 terminal must be connected to the digital input 5 of the SD700 drive, previously set as external fault (G4.1.9 option 24 EXTERN EMERGE).

Example 2: SIL3 (PLe) Safety door opening stop for maintenance tasks with manual restart. This function is used to prevent an unexpected restart when a maintenance task is being carried out in a risk area. In this case, the relay's safety inputs will be connected to a safety interlock switch placed in the door. Additionally a push button is installed to force a manual restart of the safety relay and a lamp connected to the NC output contact of the external safety relay will indicate the restart. To ensure a correct drive response when a fault occurs, J3.1 terminal must be connected to the digital input 5 of the SD700, previously set as external fault (G4.1.9 option 24 EXTERN EMERGE).

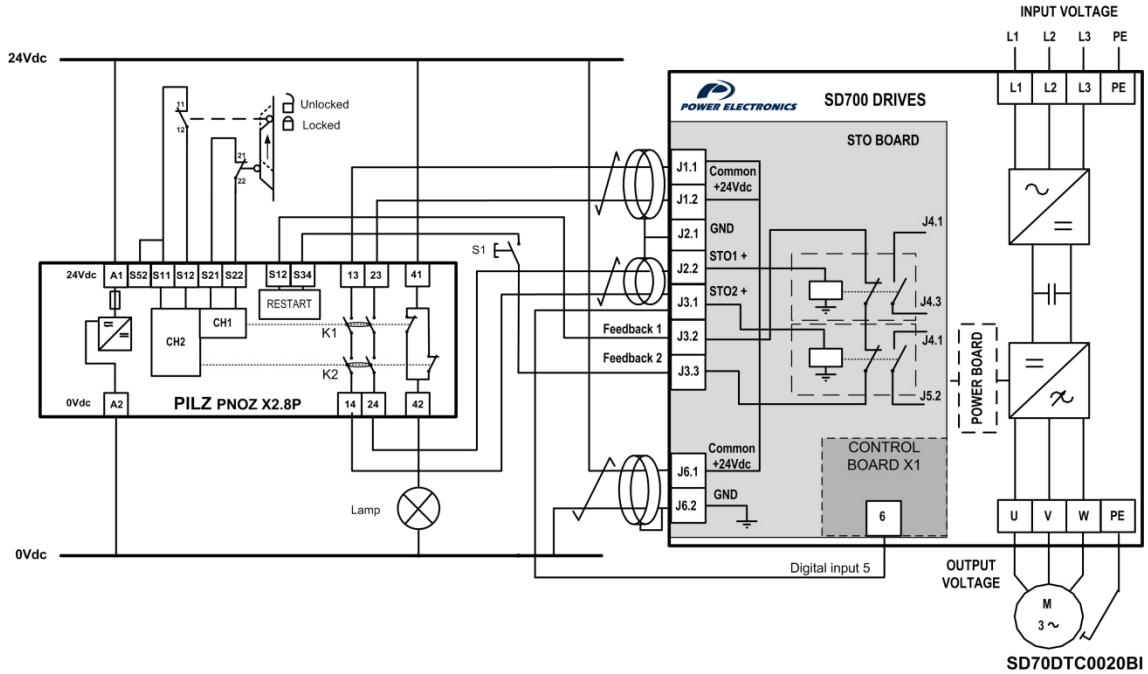


Figure 7.8 Example 2- Safety door opening

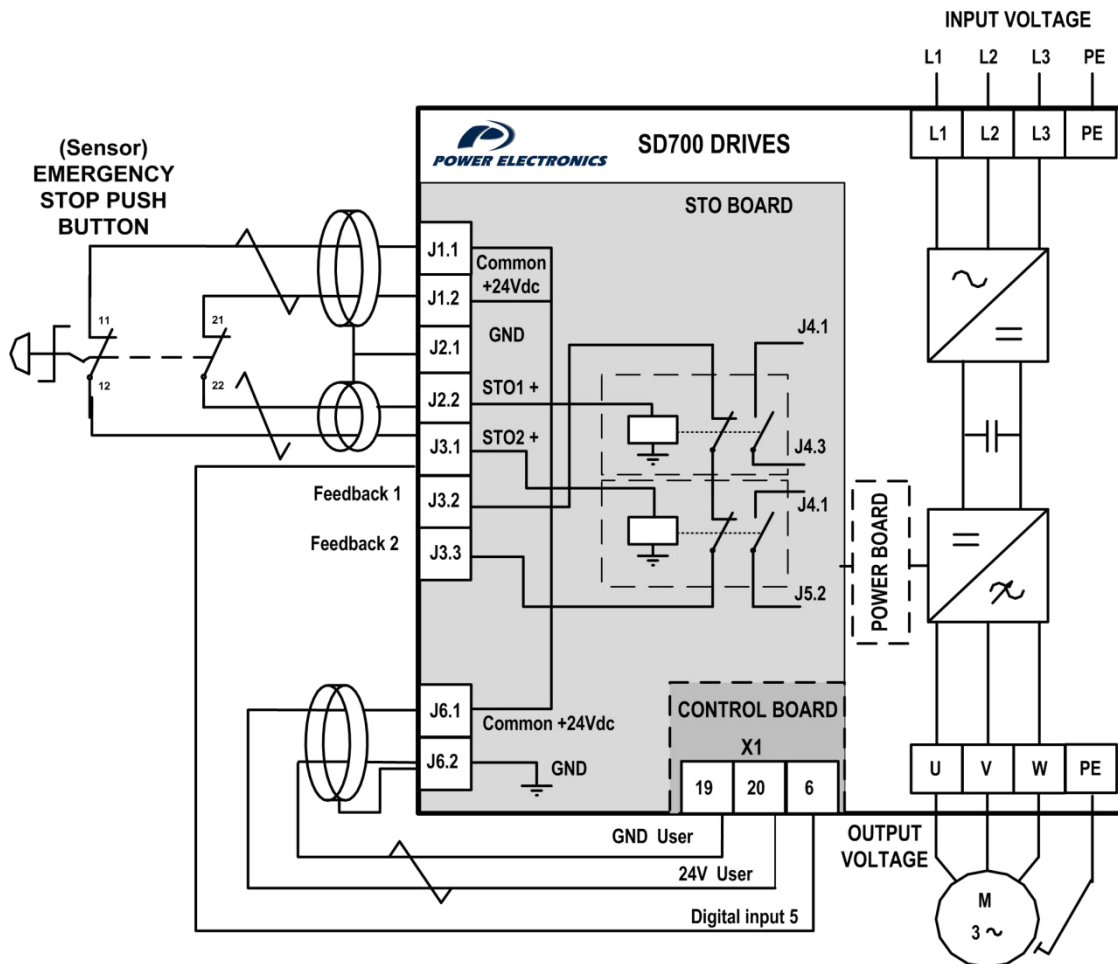
 **CAUTION**

For SIL 3 applications the safety function has to be tested regularly (approximately once per month) in order to detect certain failures.

To ensure a correct drive response when a fault occurs, J3.1 terminal must be connected to the digital input 5 of the SD700 drive, previously set as external fault (G4.1.9 option 24 EXTERN EMERGE).

7.3.2. Safety Integrity Level (SIL1- PLc)

This connection scheme provides an easy and cost effective solution for installations that not require the higher safety level requirements. In this case, the two NC contacts from the external push button are directly connected to the optional STO board. As the previous solutions, the operator pressing sensor will deactivates the IGBT switching of the inverter bridge through two independent paths, disconnecting the motor power supply and avoiding any possible unexpected restart. The monitoring terminals will not be connected. To ensure a correct drive response when a fault occurs, J3.1 terminal must be connected to the digital input 5 of the SD700, previously set as external fault (G4.1.9 option 24 EXTERN EMERGE).



SD70DTC0021BI

Figure 7.9 Emergency Stop Push button connection scheme – SIL 1 -PLc

X1.19 and X1.20 terminals can be used for other purpose depending on the inverter applications (frequency reference performed by an external potentiometer, analogue feedback etc...). In order to avoid the multiple cable connection in a single terminal (X1.19, X1.20), it is recommended to add additional external terminals to distribute the power supply.



CAUTION

According to EN 60204-1 automatic restart is not allowed after an emergency stop. For this reason the machine control must prevent an automatic start after emergency stop.

To ensure a correct drive response when a fault occurs, J3.1 terminal must be connected to the digital input 5 of the SD700 drive, previously set as external fault (G4.1.9 option 24 EXTERN EMERGE).

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7.4. Connection with ATEX motors

ATEX regulations and guidelines are related to the regulations governing the use of machinery, installations or equipment within potentially explosive atmospheres. In the European Union, the use of equipment within these areas becomes a legal requirement described in two complementary directives: Directive 1999/92/EC for the installation environment and workers protection, and Directive 94/9/EC for the ATEX equipment. These guidelines and directives are based on two basic concepts: the classification of potentially explosive areas or zones, and the branding of products that are able to be installed within a zone.

Power Electronics provides a solution for driving ATEX motors such as “Ex nA”, “Ex d” and “Ex p”, under the ATEX zone areas illustrated below. For different ATEX motor and zone combination, consult Power Electronics.

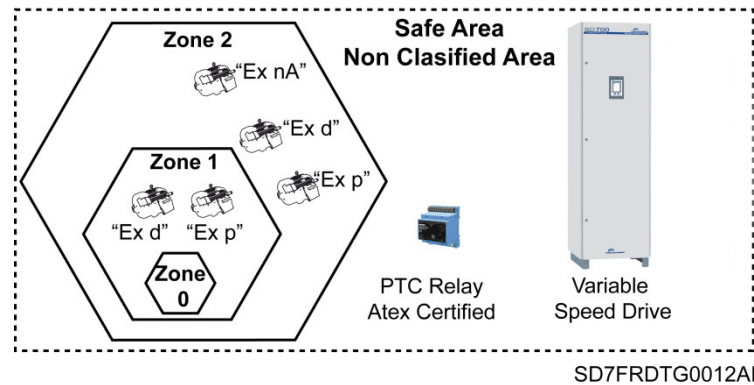


Figure 7.10: ATEX motors and Zones combination

The solution is valid for motors with type of protection “Ex d” or “Ex p” installed in ATEX zone 1 and 2, or motors with type of protection “EX nA” located in zone 2. The external PTC relay must be ATEX certified, and compatible with the following features: 24Vdc power supply, 2 safety input terminals, at least 2 NO and a reset function. As illustrated below, the SD700 drive and ATEX relay must be placed in a safe area, outside the ATEX zone. (Example: ZIEHL -PTC MSR 220 Vi)

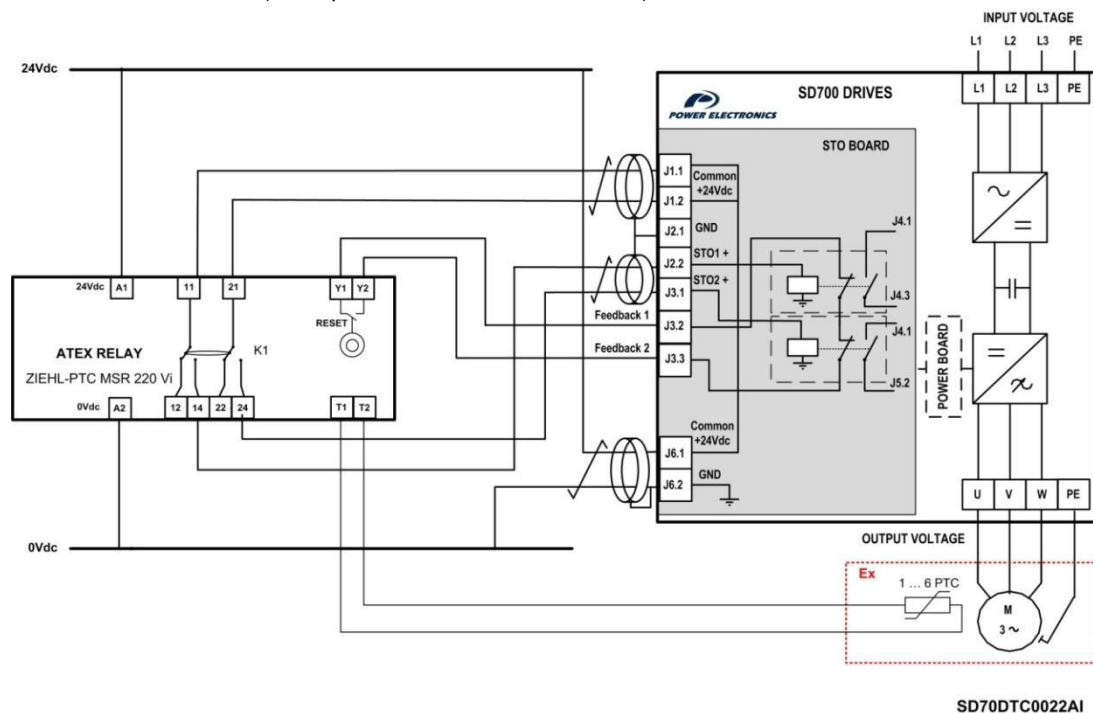


Figure 7.11: Connection scheme (Example with ZIEHL -PTC Thermistor Relay Type MSR 220 Vi)

SD700FR series are built-in as standard with dV/dt filter and a unique CLAMP system that reduce the dV/dt and voltage peaks at the motor windings. Therefore, it reduces the risk of winding sparks, motor overheating and bearing currents.

Additionally, the motor thermal mode protection could be adjusted to increase the protection against motor overheating. In case of self-ventilated motors, it could be required to apply a derating to the drive according to the motor manufacturer derating curves.

8. MODBUS COMMUNICATION

8.1. Introduction

To guarantee a correct operation of the drive, peripheral elements should be selected correctly and should be connected properly. A wrong installation and/or application could cause a wrong operation of the system or a reduction of the long life of the equipment, and its parts may be damaged. This manual should be read carefully and understood before proceeding.

The purpose of the Serial Communication Network of the SD700FR is to integrate the drive itself into a network compatible with the Modbus communications protocol. This is possible using RS232 or RS485 physical communications port or USB port. For this, it is necessary to modify the position of the jumper of the control board JP1101 – JP1104. Communications ports are clearly indicated in that connector. Put the jumper in the desired position according to your needs.

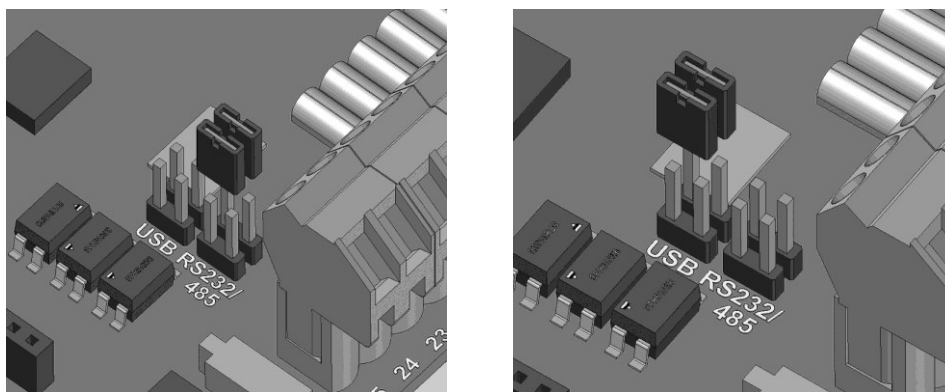


Figure 8.1 Jumper for communications port selection

Modbus communication system allows SD700FR drives to be controlled and/or monitored as a slave by a Modbus master from a remote location.

RS485 network allows connecting up to 240 equipments in the same network. Nevertheless, RS232 network only allows connecting one unit (slave) into the network.

SD700FR drives operate as a peripheral slave when connected to Modbus system. This means that the drive do not start the communication task, master will be the one that starts this task.

Mostly all of the operating modes, parameters and drive characteristics are accessible through serial communications. For example, master can give start and stop order to the drive, control SD700FR status, read the current used by the motor etc., in other words, master mode can access to all the possibilities of the drive.

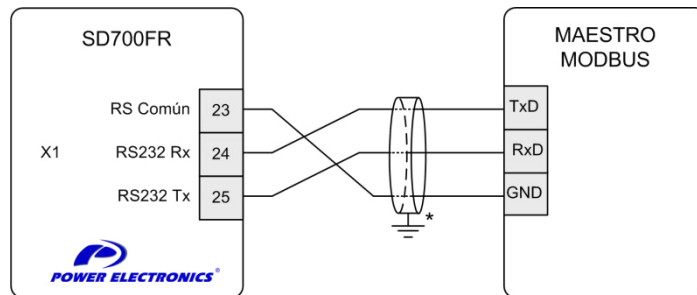
8.2. Hardware technical specifications

RS232	Physical level	3 cables, optically insulated, half duplex, RS232 single ending
	Terminals	23 → RS Common (0VDC)
		24 → RS232 Rx (receiving line)
		25 → RS232 Tx (transmitting line)
	Output signal level	'1' logical ≤ 6.5V regarding to 0V
		'0' logical ≥ 6.5V regarding to 0V
	Input signal level	'1' logical < +0.8V
		'0' logical > +2.4V
	Maximum line impedance	2500pF, 3kΩ
	Insulation	± 50VDC regarding to the earth
Programmable inputs via Modbus	7 digital inputs	
	2 programmable analogue inputs (0 – 10V, ±10V, 0 – 20mA, 4 – 20mA)	
Programmable outputs via Modbus	3 relay outputs	
	2 programmable analogue outputs (0 – 10V, ±10V, 0 – 20mA, 4 – 20mA)	
Max. number of SD700 in network	1	
Maximum cable length	15m	
RS485	Physical level	2 cables, optically insulated, half duplex, RS485 differential mode
	Terminals	21 → RS485 A (negative)
		22 → RS485 B (positive)
		23 → RS Common (0VDC)
	Output signal level	'1' logical = +5V differential
		'0' logical = -5V differential
	Input signal level	'1' logical = +5V differential
		'0' logical = -5V differential
	Insulation	± 50VDC regarding to the earth
	Programmable inputs via Modbus	7 digital inputs
2 programmable analogue inputs (0 – 10V, ±10V, 0 – 20mA, 4 – 20mA)		
Programmable outputs via Modbus	3 relay outputs	
	2 programmable analogue outputs (0 – 10V, ±10V, 0 – 20mA, 4 – 20mA)	
Max. number of SD700 in network	240	
Maximum cable length	1000m	
USB	Connector: USB 1.1 and 2.0 type B. Controller FTDI chip Model FT232BM	For the correct operation of the USB connection, you should install the proper drivers. For this, you only need to access to the information of the proper model in: http://www.ftdichip.com/Drivers/VCP.htm From here, you can download the required files and complete their correct installation.

Note: Installation in the driver Host of the SD700FR USB, USB device of the SD700FR will be detected by operating systems XP and 2000, it is only necessary to indicate the driver at the time of the installation. In case of operating systems before W98 / Me, execute a search of new Hardware in the device administrator, and complete the installation by indicating the drivers when the computer requires them.

8.3. RS232 Connections

The following diagram shows a common wiring for a RS232 connection:



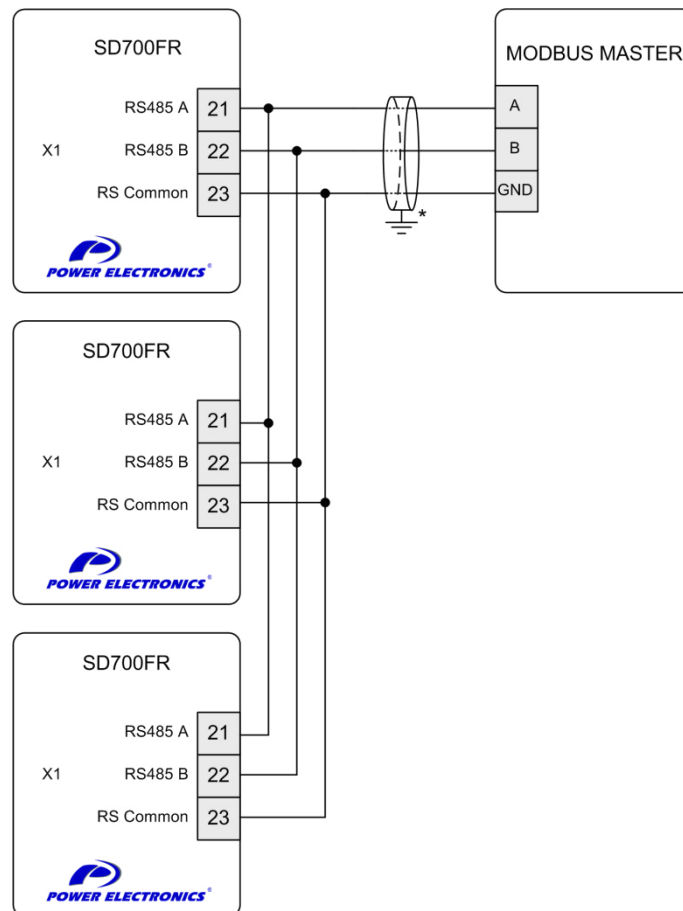
* La conexión de la pantalla se realizará en el lado del maestro de Modbus o en el otro extremo en función de la instalación

SD7FRDTR0005AE

Figure 8.2 RS232 Connection

8.4. RS485 Connections

The following diagram shows a common wiring for a RS232 connection RS485:



* The connection of the shield could be realized on the gateway terminals or on the opposite extreme of the cable, depending on the installation conditions.

SD7FRDTR0006AI

Figure 8.3 RS485 connection

9. COMMISSIONING



CAUTION

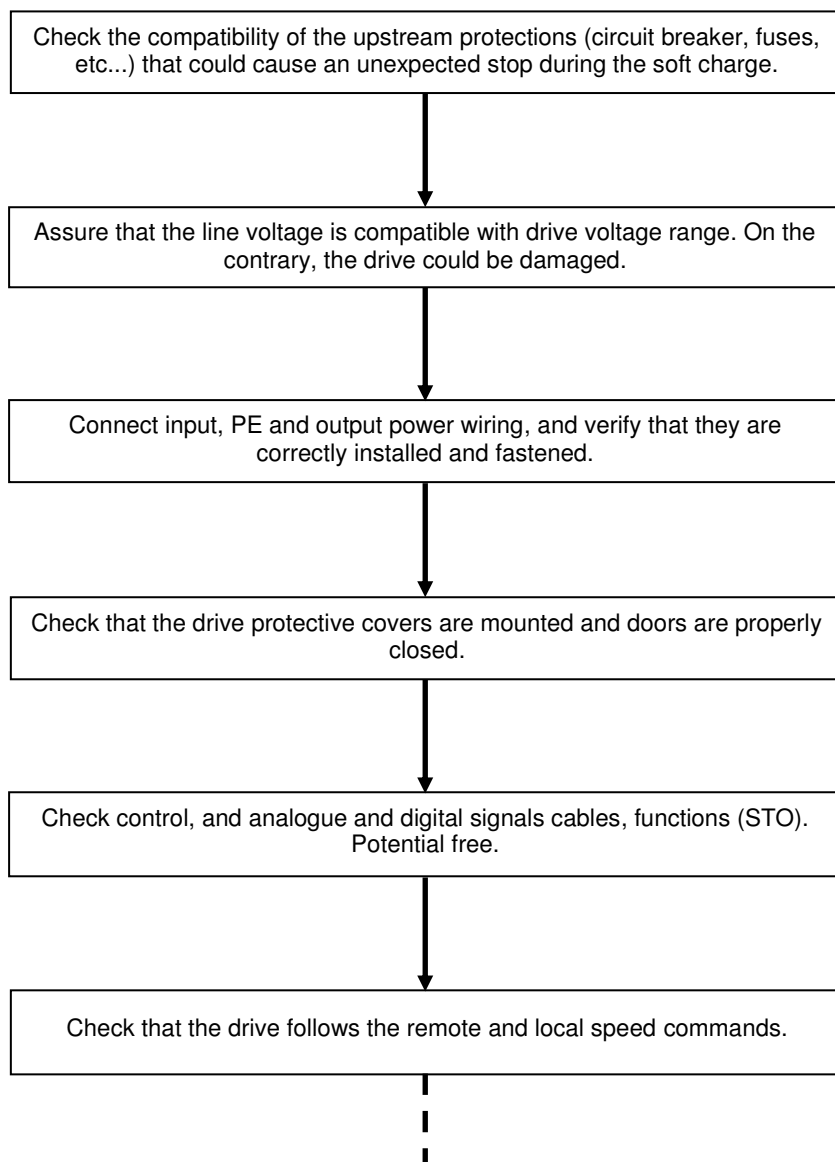
Only qualified personal is allowed to commission the drive. Read and follow the safety instructions on the first pages of this manual.

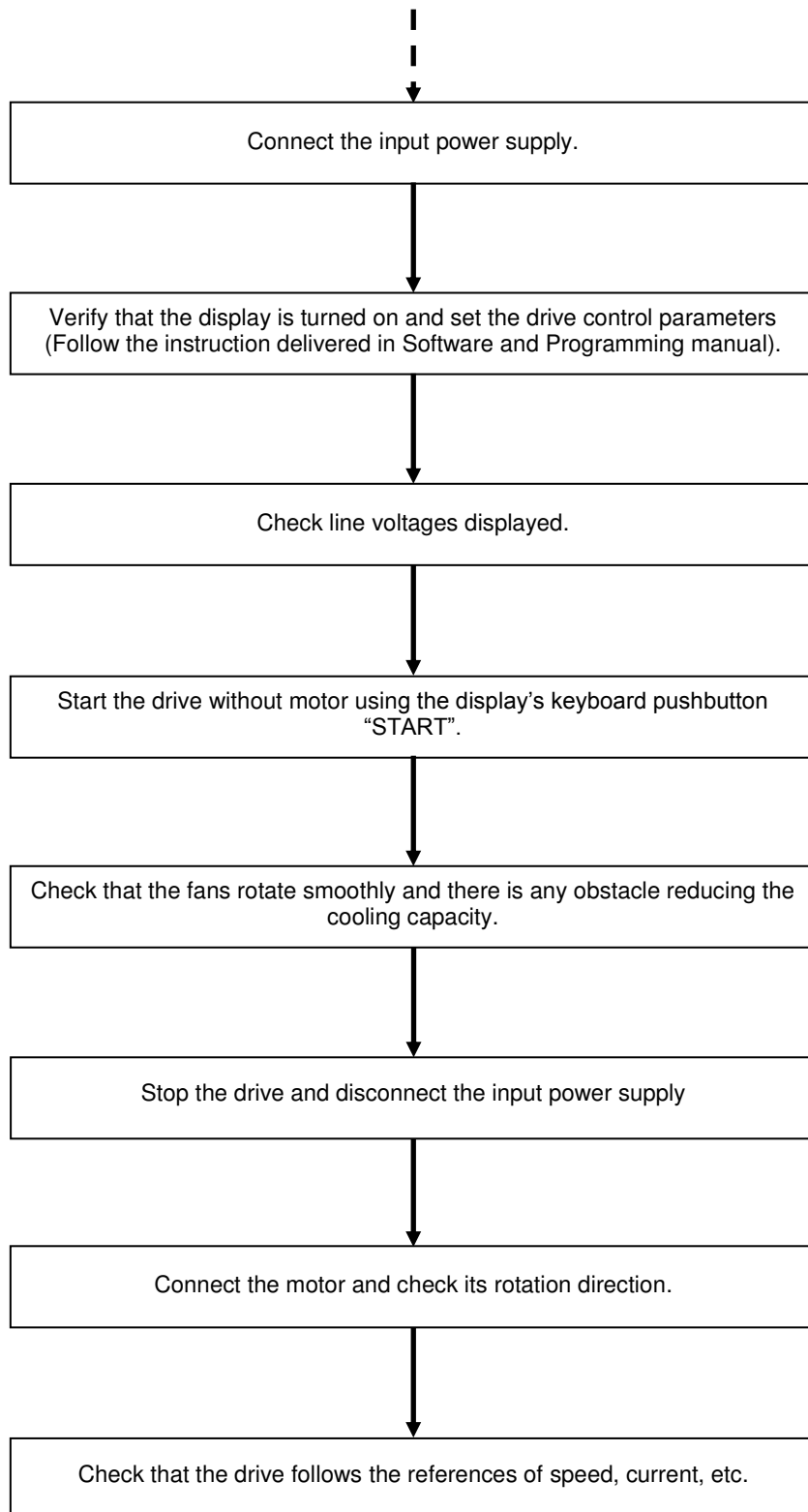
Otherwise, the equipment can be damaged and lead to injury to people.

Ensure that there is no voltage present in the input power terminals and no voltage can be connected to the drive inadvertently.

This chapter do not include all the tasks to be performed during commissioning, follow local and national regulations.

For a suitable commissioning, we recommend to check the following steps:





10.DIMENSIONS

FRAME	INPUT VOLTAGE			WEIGHT (kg)
	380-480VAC	525VAC	690VAC	
5	SD7FR0210 5X Y B SD7FR0250 5X Y B SD7FR0275 5X Y B	SD7FR0180 7X Y B SD7FR0205 7X Y B	SD7FR0130 6X Y B SD7FR0150 6X Y B SD7FR0170 6X Y B	450

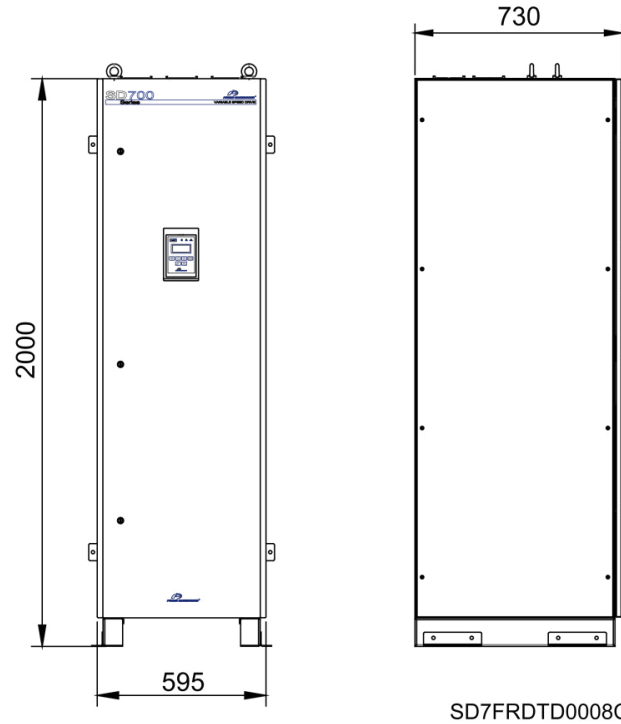


Figure 10.1 Dimensions frame 5 [mm]

FRAME	INPUT VOLTAGE			WEIGHT (kg)
	380-480VAC	525VAC	690VAC	
6	SD7FR0330 5X Y B SD7FR0370 5X Y B SD7FR0460 5X Y B	SD7FR0270 7X Y B SD7FR0295 7X Y B SD7FR0340 7X Y B	SD7FR0210 6X Y B SD7FR0260 6X Y B SD7FR0320 6X Y B	900

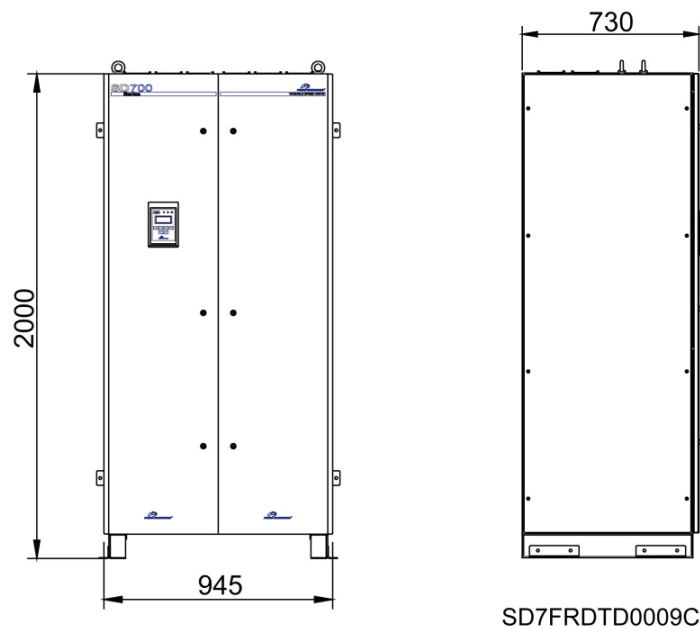


Figure 10.2 Dimensions of frame 6 [mm]

FRAME	INPUT VOLTAGE			WEIGHT (kg)
	380-480VAC	525VAC	690VAC	
7	SD7FR0580 5X Y B SD7FR0650 5X Y B SD7FR0720 5X Y B	SD7FR0425 7X Y B SD7FR0470 7X Y B SD7FR0535 7X Y B	SD7FR0385 6X Y B SD7FR0460 6X Y B	1200

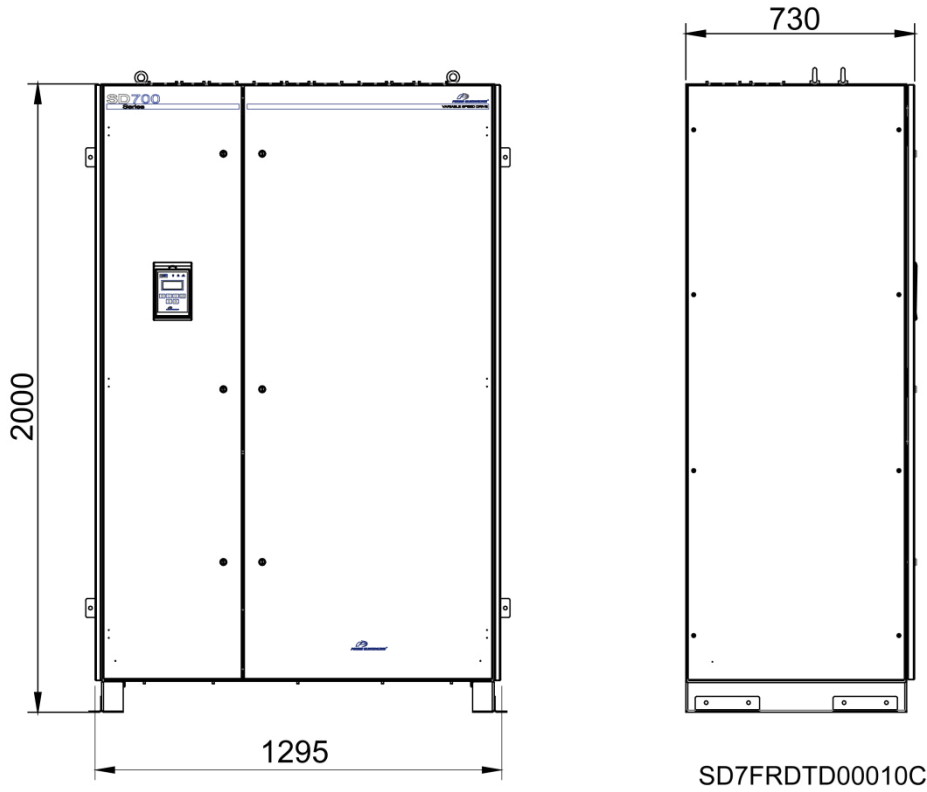


Figure 10.3 Dimensions frame 7 [mm]

FRAME	INPUT VOLTAGE			WEIGHT (kg)
	380-480VAC	525VAC	690VAC	
8	SD7FR0840 5X Y B SD7FR0925 5X Y B SD7FR0990 5X Y B	SD7FR0660 7X Y B SD7FR0750 7X Y B	SD7FR0550 6X Y B SD7FR0660 6X Y B	1500

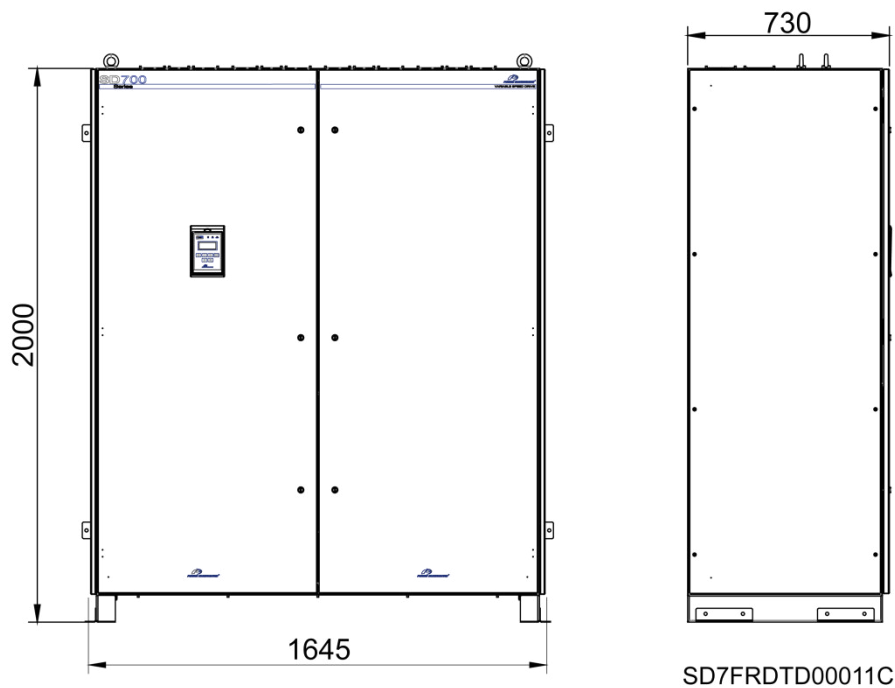
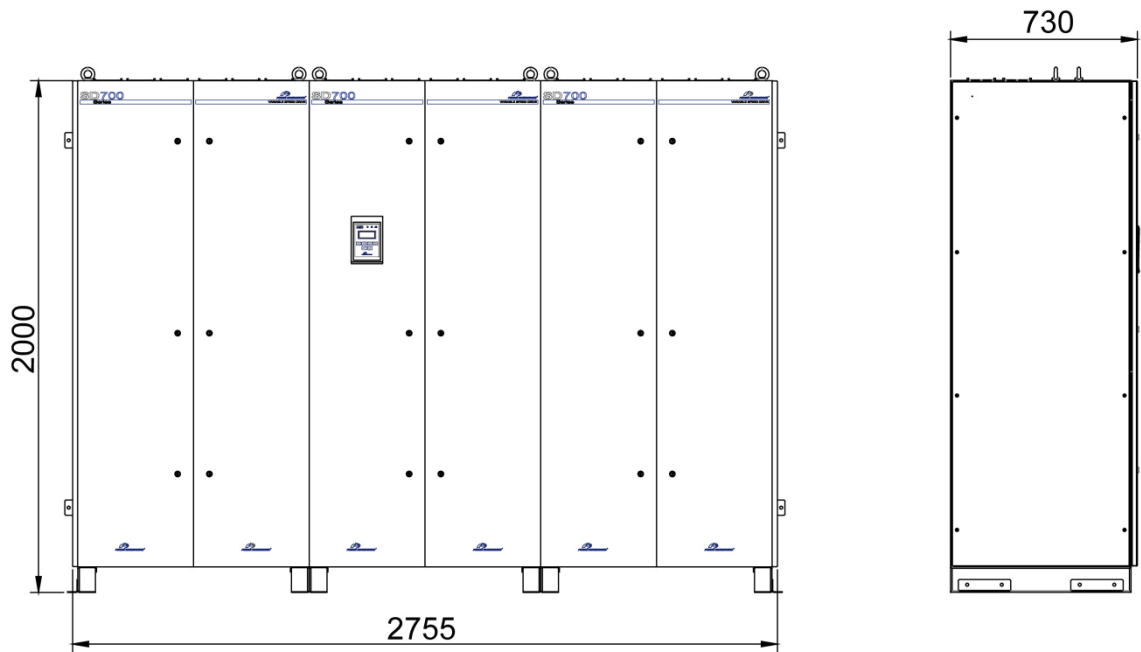


Figure 10.4 Dimensions frame 8 [mm]

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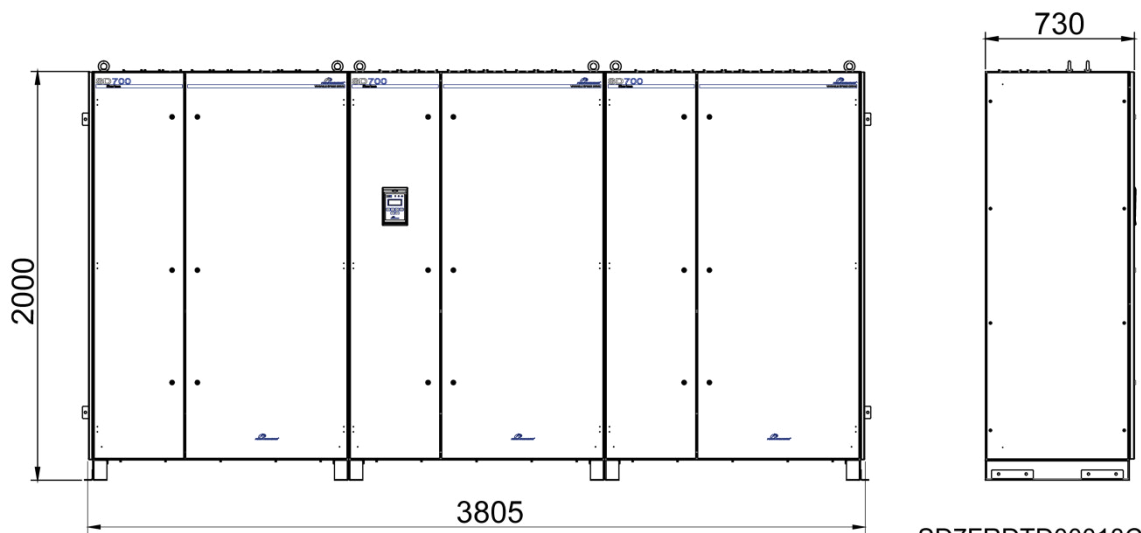
FRAME	INPUT VOLTAGE			WEIGHT (kg)
	380-480VAC	525VAC	690VAC	
9	SD7FR1150 5X Y B SD7FR1260 5X Y B SD7FR1440 5X Y B	SD7FR0845 7X Y B SD7FR0950 7X Y B	SD7FR0750 6X Y B SD7FR0840 6X Y B SD7FR0950 6X YB	2700



SD7FRDTD00012C

Figure 10.5 Dimensions frame 9 [mm]

FRAME	INPUT VOLTAGE			WEIGHT (kg)
	380-480VAC	525VAC	690VAC	
10	SD7FR1580 5X Y B SD7FR1800 5X Y B	SD7FR1070 7X Y B SD7FR1205 7X Y B SD7FR1340 7X Y B SD7FR1605 7X Y B	SD7FR1140 6X Y B SD7FR1270 6X Y B SD7FR1420 6X Y B	3600



SD7FRDTD00013C

Figure 10.6 Dimensions frame 10 [mm]

FRAME	INPUT VOLTAGE			WEIGHT (kg)
	400-480VAC	525VAC	690VAC	
11	SD7FR2200 5X Y B SD7FR2500 5X Y B	SD7FR2005 7X Y B	SD7FR1500 6X Y B SD7FR1800 6X Y B	4500

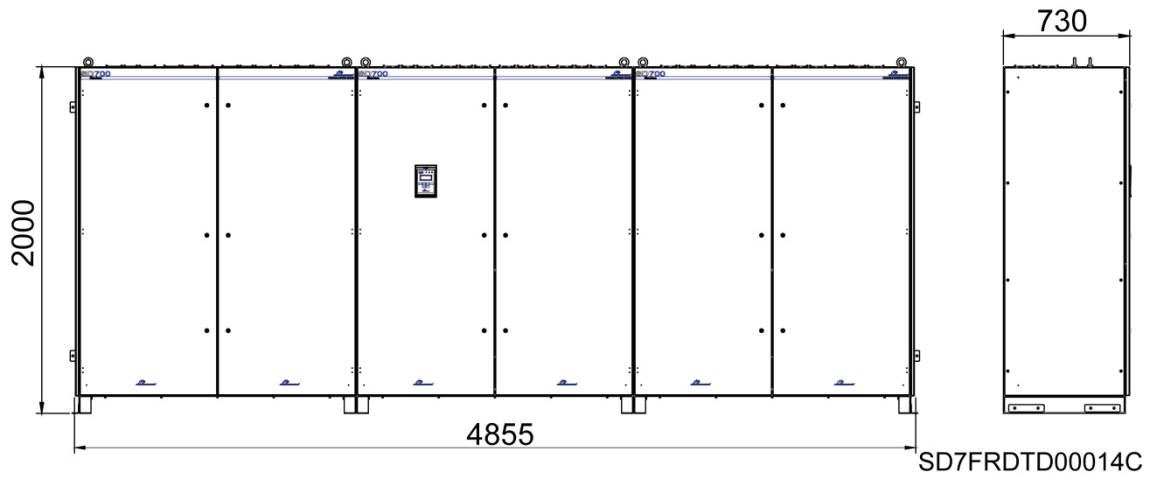


Figure 10.7 Dimensions frame 11 [mm]

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11.MAINTENANCE

SD700FR drives consist of advanced semiconductor devices. Temperature, humidity, vibration and deteriorated components can reduce their efficiency. To avoid any possible irregularity we recommend making periodic inspections.

11.1. Warnings

- Be sure to remove the input power while performing maintenance.
- Be sure to perform maintenance after checking the DC Link capacitor has discharged. Check that the voltage between terminals +HVDC and -HVDC is below DC 30V. The bus capacitors in the drive main circuit can still be charged even after the power is turned off.
- The correct output voltage of the drive can only be measured by using an RMS voltage meter. Others voltage meters, including digital voltage meters, are likely to display incorrect values caused by the high frequency PWM output voltage of the drive.

11.2. Routine Inspection

Be sure to check the following points before handling the drive:

- Installation site conditions.
- Drive cooling system conditions.
- Excessive vibrations or noise in the motor.
- Excessive overheating.
- Normal output current value on the monitor.

Inspection site	Inspection element	Inspection	Period			Inspection method	Criterion	Instrument of Measurement
			Monthly	3 months	2 years			
All	Ambient conditions	Are there dust particles? Are the ambient temperature and the humidity within specification?	o			Visual check	Temperature: -30 to +50 (or 40°C) Humidity: below 95% non-condensing.	Thermometer, Hygrometer, Recorder.
	Module	Are there any abnormal noises or oscillations?	o			Visual and audible.	There are no anomalies.	
	Input power	Is the input power to the main circuit correct?	o			Measure the voltage between terminals L1, L2, L3 and GND.		Digital multimeter. Tester.
	Power connections	Are the Power terminals correctly fastened?		o		Measure the temperature and torque of the power connections	Fasten the bolts again one week after its start-up. Check that the temperature is homogeneous and below 70°C	Infrared thermometer, Torque key
Main circuit	Conductor/ Cable	Is the conductor corroded? Is the sheathing of the cable damaged?		o		Visual check.	No anomaly.	
	Terminal	Is any damage visible?		o		Visual check.	No anomaly.	
	IGBT's module Diodes module and Rectifier	Check the resistance value between each one of the terminals			o	Disconnect the cables of the inverter and measure the resistance value between: L1, L2, L3, ⇔ VDC+, VDC- and U, V, W ⇔ VDC+, VDC- with a tester > 10kΩ		Digital multimeter. Analogue tester.

Inspection site	Inspection element	Inspection	Period			Inspection method	Criterion	Instrument of Measurement
			Monthly	3 months	2 years			
Main circuit	Correct capacitor	Have fluid leakages been observed? Is the capacitor well fastened? Is any dilation or retraction sign observed? Measure the capacitance	o	o		Visual check. Measure the capacitance with a proper instrument.	No anomaly Capacitance higher than 85% of rated capacitance.	Instrument for measuring capacity.
	Input Inductances	Is there any liquid leak? Is there any overheated point?		o		Visual check. Measure the surface and connectors' temperature.	No anomaly. Check that the temperature is homogeneous and below 70°C	Infrared thermometer.
	Contactors	Is there any contactor chatter? Is the contact damaged?		o	o	Audible check. Visual check.	No anomaly.	
Control circuit and Protections	Operating check	Is there any imbalance between output voltage phases?		o		Measure voltage between output terminals U, V and W.	Balanced voltage between phases i.e. lower than 8V difference for 400V models.	Digital multimeter / RMS voltage meter.
Cooling system	Cooling fans	Are there any abnormal noises or oscillations? Is the cooling fan disconnected?	o			Disconnect the power supply (OFF) and rotate the fan manually. Check the connections.	Fan should rotate effortlessly. No anomaly.	
	Dust filters	Are the dust filters obstructed?		o		Visual check	No anomaly	
Display	Measurement	Is the displayed value correct?	o	o		Check the reading instrument with an external measurement.	Check the specified values and the control values.	Voltage meter / Current meter etc.
Motor	All	Is there any noise or abnormal vibrations? Has any unusual smell been perceived?	o			Audible, sensory and visual check. Check if damages have been produced by overheating.	No anomaly.	
	Insulation resistance	Megger check (between terminals of output circuit and ground terminal)			o	Disconnect the cables U, V and W and join them together. Check the resistance between this join and ground.	More than 5MΩ	Megger type 500V

Note: Long life of the main components above indicated are based on a continuous operation for the stipulated load. These conditions can change according to the environment conditions.

12. OPTIONAL EQUIPMENT

12.1. Accessories

CODE	DESCRIPTION
SD7PD	Profibus Communication Board.
SD7ET	Ethernet Communication Board.
SD7DN	DeviceNet Communication Board.
SD7CO	CAN Open Communication Board.
- *	N2 Metasys Communication Gateway.
SD7EC	Encoder Board. It allows connecting up to 2 differential Encoders (one of them for the user and the other one for vector control) working from 5 to 24VDC, according to the requirements.
SD7IO	Inputs / Outputs Expansion Board. It allows increasing the number of inputs and outputs of the drive. It includes: <ul style="list-style-type: none"> • 4 Programmable Digital Inputs optically isolated • 1 Programmable Analogue Input • 5 Digital Outputs (Relays) • 1 Programmable Analogue Output
SD7FO	Fibre Optic Board. It allows to communicate trough fiber optics multiple drive in a master slave configuration.
SD7STO	Safe Torque Off (STO) board. Allows implementing in the drive the safe torque off function according to IEC 61800-5-2 (SIL1 or SIL3).
SD7ES01E	External 24V_{DC} Power Supply. For Frames 1, 2 and 3 of SD700FR. Exterior Assembly.
SD7ES04I	External 24V_{DC} Power Supply. For Frame 4 of SD700FR. Interior Assembly.
SD7ES05I	External 24V_{DC} Power Supply. For Frame 5 of SD700FR. Interior Assembly.
SD7ES06I	External 24V_{DC} Power Supply. For Frames 6, 7, 9 and 10 of SD700FR. Interior Assembly.
SD7ES08I	External 24V_{DC} Power Supply. For Frame 8 and 11 of SD700FR. Interior Assembly.
V11	Kit 3 meters Extender for Display.
V12	Kit 5 meters Extender for Display.

* Consult availability with Power Electronics.

12.2. Communication boards

SD700FR family is compatible with the most commonly used communication protocols (Profibus-DP, DeviceNet, Modbus TCP, Ethernet IP, N2 Metasys, CAN Open..), thanks to its optional boards.



SD70ITR0031A

Figure 12.1 Example of Profibus optional board

13.CE MARKING

The CE Marking is a system to identify equipment that complies with the relevant directives (EMC directive). CE marking guarantees the free movement of the product within the EEA. CE marking shows that the product complies with technical safety, compatibility issues and conformity assessment.

13.1. EMC Directive

The EMC Directive defines the requirements for immunity and emissions of electrical equipment used within the European Union. SD700 Series drives are in accordance with the directive IEC 61800-3:2004 about adjustable speed electrical power drive systems.

13.2. Low Voltage Directive

The low voltage directive defines the security requirements of low voltage electrical equipment in order to circulate freely within the European Economic Area. SD700 Series drives are in accordance with the directive IEC 61800-5-1:2007 about adjustable speed electrical power drive systems.

DECLARATION OF CONFORMITY CE

The Company:

Name: **POWER ELECTRONICS ESPAÑA, S.L.**
Address: C/ Leonardo Da Vinci, 24-26, 46980 Paterna (Valencia)
Telephone: +34 96 136 65 57
Fax: +34 96 131 82 01

Declares under its own responsibility, that the product:

Variable Speed Drive for A.C. motors

Brand: Power Electronics
Model name: SD700FR Series

Is in conformity with the following European Directives:

References	Title
2006/95/CE	Electrical Material intended to be used with certain limits of voltage
2004/108/CE	Electromagnetic Compatibility
*2006/42/CE	Machinery directive

*Models with optional STO card installed

References of the harmonized technical norms applied under the Low Voltage Directive:

References	Title
EN 61800-5-1:2007	Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy (IEC 61800-5-1:2007);

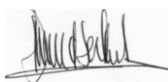
References of the harmonized technical norms applied under the Electromagnetic Compatibility Directive:

References	Title
IEC 61800-3:2004	Adjustable speed electrical power drive systems. Part 3: EMC requirements and specific test methods.

References of the harmonized technical norms applied under the Machinery Directive:

References	Title
IEC 61800-5-2:2007	Adjustable speed electrical power drive systems. Part 5-2: Safety requirements - Functional

Paterna, October 5th 2012



David Salvo
Executive Director





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