

***Nidec***  
All for dreams



*Installation and maintenance*

---

## ***Powerdrive MD2SL***

---

*180T to 1700T  
340TH à 1800TH*

Liquid-cooled freestanding  
variable speed drive

Reference : 5077en- 2017.12 / b

***LEROY-SOMER***<sup>™</sup>

EMERSON reserves the right to modify the characteristics of its products at any time in order to incorporate the latest technological developments. The information contained in this document may therefore be changed without notice.



For the user's own safety, this variable speed drive must be connected to an approved earth  $\perp$  terminal). If accidentally starting the installation is likely to cause a risk to personnel or the machines being driven, it is essential to comply with the power connection diagrams recommended in this manual.

The variable speed drive is fitted with safety devices which, in the event of a problem, control stopping and thus stop the motor. The motor itself can become jammed for mechanical reasons. Voltage fluctuations, and in particular power cuts, may also cause the motor to stop. The removal of the causes of the shutdown can lead to restarting, which may be dangerous for certain machines or installations.

In such cases, it is essential that the user takes appropriate precautions against the motor restarting after an unscheduled stop.

The variable speed drive is designed to be able to supply a motor and the driven machine above its rated speed. If the motor or the machine are not mechanically designed to withstand such speeds, the user may be exposed to serious danger resulting from their mechanical deterioration.

Before programming a high speed, it is important that the user checks that the installation can withstand it.

The variable speed drive which is the subject of this manual is designed to be integrated in an installation or an electrical machine, and can under no circumstances be considered to be a safety device. It is therefore the responsibility of the machine manufacturer, the designer of the installation or the user to take all necessary precautions to ensure that the system complies with current standards, and to provide any devices required to ensure the safety of equipment and personnel.

EMERSON declines all responsibility in the event of the above recommendations not being observed.

.....

**This manual only describes the general features, characteristics and installation of the Powerdrive MD2SL. For commissioning, refer to manual ref. 4617.**

(In accordance with the low voltage directive 2014/35/EU)



Throughout the manual, this symbol warns of consequences which may arise from inappropriate use of the drive, since electrical risks may lead to material or physical damage as well as constituting a fire hazard.

### 1 - General

Depending on their degree of protection, the variable speed drives may contain unprotected live parts, which may be moving or rotating, as well as hot surfaces, during operation.

Unjustified removal of protection devices, incorrect use, faulty installation or inappropriate operation could represent a serious risk to personnel and equipment.

For further information, consult the documentation.

All work relating to transportation, installation, commissioning and maintenance must be performed by experienced, qualified personnel (see IEC 364, CENELEC HD 384 or DIN VDE 0100, as well as national specifications for installation and accident prevention).

In these basic safety instructions, qualified personnel means persons competent to install, mount, commission and operate the product and possessing the relevant qualifications.

### 2 - Use

Variable speed drives are components designed for integration in installations or electrical machines.

When integrated in a machine, commissioning must not take place until it has been verified that the machine conforms with directive 2006/42/EC (Machinery Directive). It is also necessary to comply with standard EN 60204, which stipulates in particular that electrical actuators (which include variable speed drives) cannot be considered as circuit-breaking devices and certainly not as isolating switches.

Commissioning can take place only if the requirements of the Electromagnetic Compatibility Directive (EMC 2014/30/EC) are met.

The variable speed drives meet the requirements of the Low Voltage Directive 2014/35/EU. The harmonised standards of the DIN VDE 0160 series in connection with standard VDE 0660, part 500 and EN 60146/VDE 0558 are also applicable. The technical characteristics and instructions concerning the connection conditions specified on the nameplate and in the documentation provided must be observed without fail.

### 3 - Transportation, storage

All instructions concerning transportation, storage and correct handling must be observed.

The climatic conditions specified in the technical manual must be observed.

### 4 - Installation

The installation and cooling of equipment must comply with the specifications in the documentation supplied with the product.

The variable speed drives must be protected against any excessive stress. In particular, there must be no damage to parts and/or modification of the clearance between components during transportation and handling. Avoid touching the electronic components and contact parts.

The variable speed drives contain parts which are sensitive to electrostatic stresses and may be easily damaged if handled incorrectly. Electrical components must not be exposed to mechanical damage or destruction (risks to health!).

### 5 - Electrical connection

When work is performed on variable speed drives which are powered up, the national accident prevention regulations must be respected.

The electrical installation must comply with the relevant specifications (for example conductor cross-sections, protection via fused circuit-breaker, connection of protective conductor). More detailed information is given in the documentation.

Instructions for an installation which meets the requirements for electromagnetic compatibility, such as screening, earthing, presence of filters and correct insertion of cables and conductors, are given in the documentation supplied with the variable speed drives. These instructions must be followed in all cases, even if the variable speed drive carries the CE mark. Adherence to the limits given in the EMC legislation is the responsibility of the manufacturer of the installation or the machine.

### 6 - Operation

Installations in which variable speed drives are to be integrated must be fitted with additional protection and monitoring devices as laid down in the current relevant safety regulations, such as the law on technical equipment, accident prevention regulations, etc. Modifications to the variable speed drives using control software are permitted.

Active parts of the device and the live power connections must not be touched immediately after the variable speed drive is powered down, as the capacitors may still be charged. In view of this, the warnings fixed to the variable speed drives must be observed.

Permanent magnet motors generate electrical energy while they are rotating, even when the drive is switched off. In this case, the drive continues to be powered by the motor terminals. If the load is capable of turning the motor, a switching device must be provided upstream of the motor to isolate the drive during maintenance operations.

During operation, all doors and protective covers must be kept closed.

### 7 - Servicing and maintenance

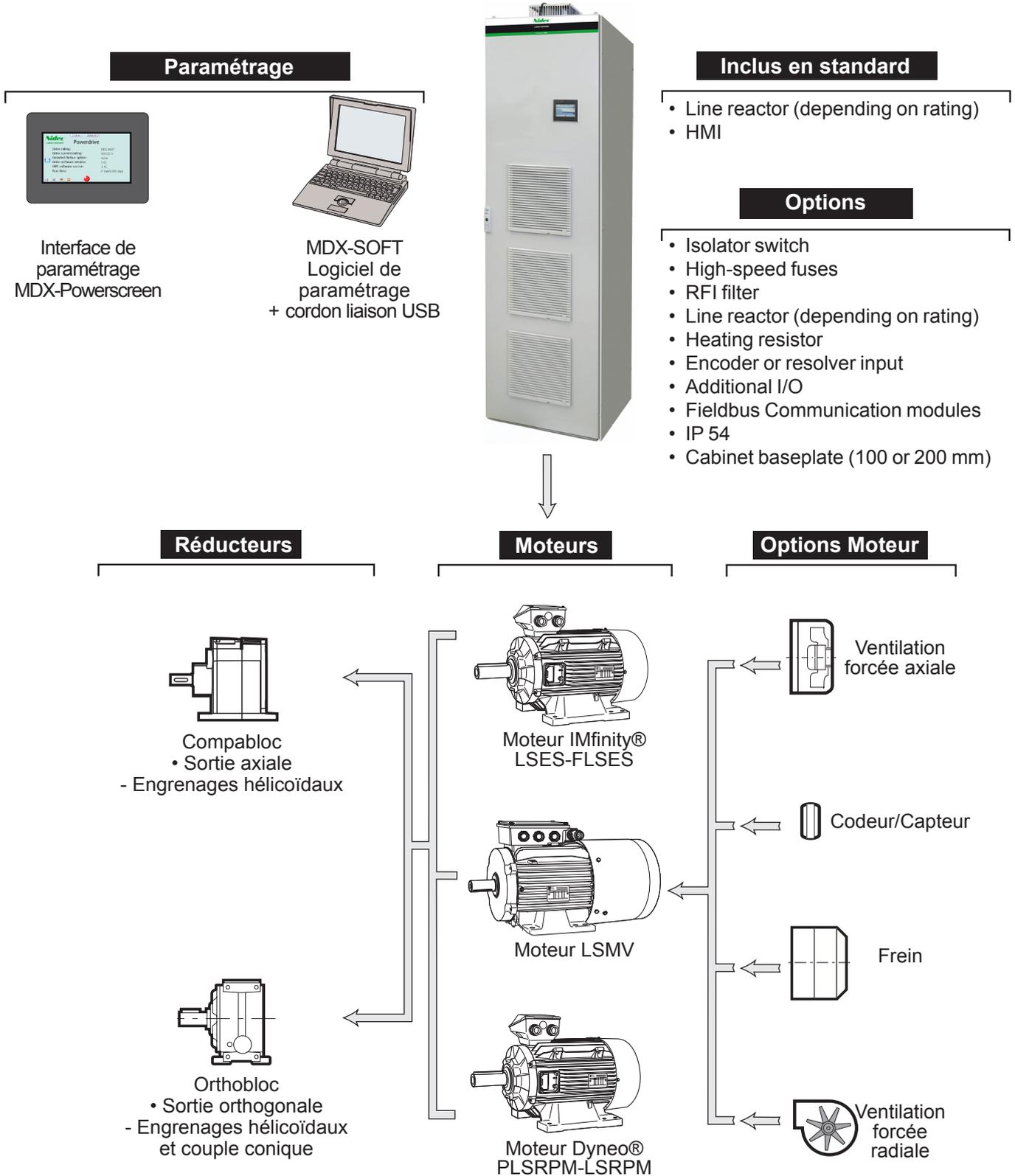
Refer to the manufacturer's documentation.

See the Maintenance section in this document.

**This manual is to be given to the end user.**

This manual describes the installation of **POWERDRIVE MD2SL** variable speed drives. It also gives details of all its options and extensions which the user may choose to suit his requirements.

## Powerdrive MD2SL



<b>1 - GENERAL INFORMATION .....</b>	<b>7</b>
1.1 - General .....	7
1.2 - Environmental characteristics .....	7
1.3 - Electrical characteristics .....	8
1.3.1 - General characteristics .....	8
1.3.2 - Electrical characteristics .....	8
1.3.3 - Derating at low frequency .....	9
1.3.4 - Derating according to the temperature and switching frequency .....	10
<b>2 - MECHANICAL INSTALLATION .....</b>	<b>12</b>
2.1 - Checks upon receipt .....	12
2.2 - Handling .....	12
2.3 - Cooling .....	13
2.3.1 - Drive losses .....	13
2.3.2 - Air cooling .....	13
2.3.3 - Liquid cooling .....	14
2.4 - Dimensions .....	18
2.5 - Weight .....	18
<b>3 - CONNECTIONS .....</b>	<b>19</b>
3.1 - Power Terminals .....	19
3.1.1 - Overview .....	19
3.1.2 - Terminal sizes and torque settings .....	19
3.1.3 - Electronics and forced ventilation power supply .....	19
3.1.4 - Location of power terminal blocks .....	22
3.1.5 - Cables and fuses .....	22
3.2 - Connection of the control .....	24
3.2.1 - Control terminal block location .....	24
3.2.2 - Control terminal block characteristics .....	24
3.2.3 - Factory configuration of control terminal blocks .....	26
3.3 - STO-1/STO-2 inputs: Safe Torque Off function .....	27
3.3.1 - Single channel locking (SIL1 - PLb) .....	27
3.3.2 - Double channel locking (SIL3 - PLe) .....	27
<b>4 - GENERAL EMC - HARMONICS - MAINS INTERFERENCE .....</b>	<b>28</b>
4.1 - Low-frequency harmonics .....	28
4.2 - Radio-frequency interference: Immunity .....	28
4.2.1 - General .....	28
4.2.2 - Standards .....	28
4.2.3 - Recommendations .....	28
4.3 - Radio-frequency interference: Emission .....	28
4.3.1 - General .....	28
4.3.2 - Standards .....	28
4.4 - Mains supply .....	29
4.4.1 - General .....	29
4.4.2 - Mains transient overvoltages .....	29
4.4.3 - Unbalanced power supply .....	29
4.4.4 - Ground connections .....	29
4.5 - Basic precautions for installation .....	30
4.5.1 - Wiring inside the cabinet .....	30
4.5.2 - Wiring outside the cabinet .....	30
4.6 - Electromagnetic compatibility (EMC) .....	31



- 5 - PARAMETER-SETTING INTERFACE AND OPTIONS..... 32**
  - 5.1 - Parameter setting interfaces ..... 32
    - 5.1.1 - Location of the drive connectors / ports ..... 32
    - 5.1.2 - MDX-Powerscreen ..... 32
  - 5.2 - Add-on options..... 34
    - 5.2.1 - Fieldbus modules ..... 34
    - 5.2.2 - Speed feedback options ..... 34
    - 5.2.3 - Additionnal I/O options ..... 34
  - 5.3 - Electrical protections..... 35
    - 5.3.1 - aR semi-conductor fuses ..... 35
    - 5.3.2 - Line switch..... 35
    - 5.3.3 - Emergency stop ..... 35
  - 5.4 - Heater kit ..... 35
  - 5.5 - RFI filters ..... 35
  
- 6 - TRIPS - DIAGNOSTICS ..... 36**
  - 6.1 - Safety notice ..... 36
  - 6.2 - Alarms ..... 36
  - 6.3 - Tripping on a safetrip..... 36
  
- 7 - MAINTENANCE ..... 40**
  - 7.1 - Storage ..... 40
  - 7.2 - Replacing products ..... 40
  - 7.3 - List of spare parts..... 41
    - 7.3.1 - Electronic PCB ..... 41
    - 7.3.2 - Front panel mounted parts..... 41
    - 7.3.3 - Remote control fuses..... 42
    - 7.3.4 - Other parts ..... 42

# 1 - GENERAL INFORMATION

## 1.1 - General

The **POWERDRIVE MD2SL** is a liquid-cooled variable speed drive which combines a diode/thyristor rectifier and an IGBT inverter. The high performances of **POWERDRIVE MD2SL** allow to control:

- Induction motors without speed sensor (open loop mode select **[L]**) for applications that do not need rated torque control above 1/10<sup>th</sup> of the rated speed.

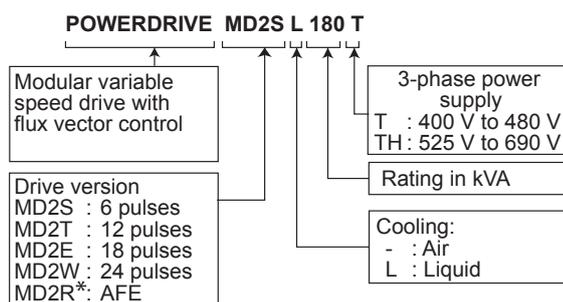
- Asynchronous or synchronous permanent magnet motors with virtual speed feedback (flux vector mode with software sensor function **[S]**) for applications that require rated torque control from 1/20<sup>th</sup> of the rated speed.

Combined with the MDX-ENCODER option, the **POWERDRIVE MD2SL** is a drive that can also be used to control asynchronous or synchronous magnet machines for applications that require very high dynamic performances, torque control from zero speed or high speed accuracy (closed loop vector mode with speed feedback **[S]**).

The performance of the **POWERDRIVE MD2SL** is compatible with use in all 4 quadrants of the torque/speed plane with the braking module option.

With IP54 protection (optional), installation is possible directly in the machine environment.

## Product designation



(\*) See the corresponding installation manual

## Nameplate

<p>MADE IN FRANCE</p>	<b>ENTREE - INPUT</b>			
	Ph	V (V)	Hz (Hz)	I(A)
	3	400-480	50/60	295
	<b>Alim auxiliaire 200VA</b>			
	<b>TYPE : Powerdrive MD2SL 180T</b>			
	S/N :	 0999999999		

I(A) = maximum input current for 400 V mains supply. in normal duty

The nameplate can be found inside the cabinet door at the top (another copy can be found on the outside of the cabinet. at the top on the right-hand side).

## 1.2 - Environmental characteristics

Characteristic	Level
<b>Protection</b>	IP21 (higher degree of protection can be achieved on request)
<b>Ambient temperature</b> - <b>Storage and transport</b> - <b>Operation</b>	-25°C to +60°C (12 months max) -10°C to +40°C. up to 50°C with de-rating (Please contact Emerson Industrial Automation)
<b>Altitude</b>	< 1000m without de-rating > 1000m up to 2000m max : • 1% output current de-rate per 100m (E.g. for 1300 m. de-rate the Ico and Imax currents by 3%) • 0.6°C Operating temperature de-rate per 100 m (E.g. for 1300 m. the electrical characteristics are maintained for an ambient temperature of [40°- (3 x 0.6°)] = 38.2°C.)
<b>Climatic conditions:</b> - <b>Atmospheric pressure :</b> - <b>Humidity :</b>	According to IEC 60721-3-3 Class 3K3 - 700 to 1060 hPa - <90% RH non condensing
<b>Contamination level</b>	In accordance with IEC 60721-3-3 • class 3B1 for biological substances • class 3C2 for chemical gases • class 3S2 for solid particle
<b>Vibrations :</b> - <b>Transportation in the protective packing</b> - <b>Operation</b>	3.5mm (2 - 9Hz) 10m/s <sup>2</sup> (9 - 200Hz)  ± 1 mm 3.5mm (2 - 13.2Hz) 7m/s <sup>2</sup> (13.2 - 200Hz)
<b>Shocks (packaged product)</b>	In accordance with IEC 60068-2-29 : 100m/s <sup>2</sup> . 11ms
<b>Cooling</b>	See §2.3

### Coolant

Characteristics	Level
<b>Temperature cycle</b>	In accordance with IEC 60068-2-14 -10°C to +40°C. 5 cycles
<b>Acceptable liquids</b>	Drinking or demineralised water or a mix of water and glycol up to a 50%-50% ratio.
<b>Liquid temperature</b>	See §2.3.3.3

## 1.3 - Electrical characteristics

 All work relating to installation, commissioning and maintenance must be carried out by experienced, qualified personnel.

### 1.3.1 - General characteristics

Characteristic	Level
Power supply voltage	3-phase mains supply: 400 V -10% to 480 V +10% ("T" ratings) or 525 V -10% to 690 V +10% ("TH" ratings)
Phase voltage imbalance	< 2%
Input frequency	5% around the rated frequency (50 or 60 Hz)
Maximum number of power-ups per hour (power)	20
Output frequency range	0 to 590 Hz
ROHS conformance	Conforming to standard 2002-95-EC

 For operation with a neutral IT point connection, follow the instructions given in section 4.4.3.

### 1.3.2 - Electrical characteristics

**I<sub>co</sub>**: Continuous output current.

**P<sub>out</sub>**: Output power.

**I<sub>max</sub> (60s)**: Maximum output current, available for 60 seconds every 600 seconds.

**Heavy duty**: For heavy-duty constant torque machines (presses, grinders, hoisting, etc) and all applications where significant inertia has to be accelerated quickly (centrifuges, translation of travelling cranes, etc).

**Normal duty**: For normal-duty constant torque or centrifugal torque machines (fans, compressors, etc).

**CAUTION: In its factory setting, the drive operates with a switching frequency of 3 kHz.**

#### 400 V 3-phase mains supply

Switching frequency = 3 kHz - ambient temperature ≤ 40°C - altitude ≤ 1000 m.

Rating	Heavy duty			Normal duty			I <sub>max</sub> (60 s) (A)
	P <sub>out</sub> @400V <sup>(1)</sup> (kW)	P <sub>out</sub> @460V <sup>(1)</sup> (HP)	I <sub>co</sub> (A)	P <sub>out</sub> @400V <sup>(1)</sup> (kW)	P <sub>out</sub> @460V <sup>(1)</sup> (HP)	I <sub>co</sub> (A)	
180T	132	175	260	160	200	315	365
220T	160	200	310	200	300	400	435
270T	200	300	375	250	350	470	530
340T	250	350	470	315	450	580	660
400T	315	450	540	355	500	650	760
470T	355	500	670	450	600	800	940
570T	400	600	750	500	650	880	1050
750T	550	800	990	675	900	1220	1390
900T	675	900	1225	800	1000	1500	1720
1100T	800	1000	1375	900	1250	1650	1930
1400T	900	1250	1850	1200	1500	2250	2590
1700T	1200	1500	2065	1350	1700	2480	2890

(1) Motor winding voltage

**525 V to 690 V 3-phase mains supply**

Switching frequency = 3 kHz - ambient temperature ≤ 40°C - altitude ≤ 1000 m.

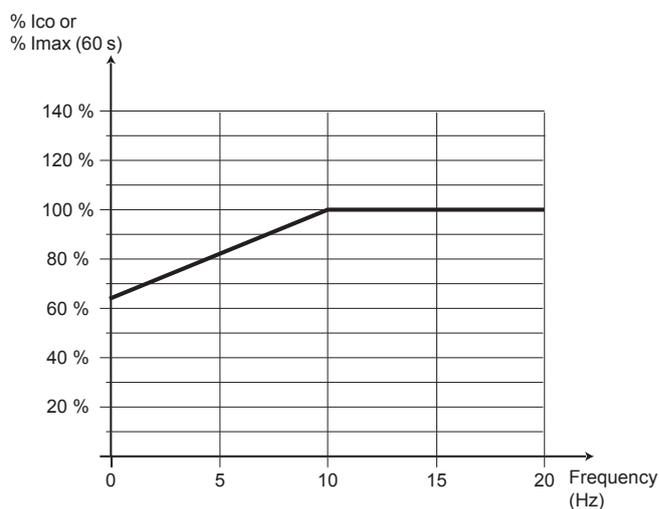
Rating	Heavy duty			Normal duty			I <sub>max</sub> (60 s) (A)
	Pout @690V <sup>(1)</sup> (kW)	Pout @575V <sup>(1)</sup> (HP)	I <sub>co</sub> (A)	Pout @690V <sup>(1)</sup> (kW)	Pout @575V <sup>(1)</sup> (HP)	I <sub>co</sub> (A)	
340TH	250	250	270	315	300	340	380
400TH	315	300	335	400	400	415	470
500TH	400	400	390	450	500	500	550
600TH	450	450	490	550	600	580	690
750TH	550	600	615	700	700	780	860
900TH	700	700	720	850	900	940	1010
1200TH	850	900	900	1100	1000	1090	1260
1500TH	1100	1000	1075	1300	1250	1410	1510
1800TH	1300	1250	1355	1600	1500	1630	1900

(1) Motor winding voltage

**1.3.3 - Derating at low frequency**

Measuring the temperature of the power bridges in conjunction with thermal modelling of the IGBTs protects the **Powerdrive MD2SL** against overheating.

At low motor frequencies, IGBT modules are subject to tough temperature cycling, which may reduce their life time. To prevent this risk, the curve opposite indicates the derating for output currents **I<sub>co</sub>** and **I<sub>max</sub>** when operating at low motor frequency in continuous operation.



### 1.3.4 - Derating according to the temperature and switching frequency

Ambient temperature  $\leq 40^{\circ}\text{C}$  - altitude  $\leq 1000$  m.

Rating	Duty	Ico (A)									
		Flow rate : Minimum (1)					Flow rate : Optimized (1)				
		2kHz	3kHz	4kHz	5kHz	6kHz	2kHz	3kHz	4kHz	5kHz	6kHz
180T	Heavy duty	260	260	260	255	230	260	260	260	260	255
	Normal duty	315	315	305	290	265	315	315	310	305	290
220T	Heavy duty	310	310	310	305	290	310	310	310	310	305
	Normal duty	400	400	380	350	330	400	400	385	380	350
270T	Heavy duty	375	375	375	375	370	375	375	375	375	375
	Normal duty	470	470	470	440	420	470	470	470	470	440
340T	Heavy duty	470	470	470	470	450	470	470	470	470	470
	Normal duty	580	580	580	540	510	580	580	580	580	540
400T	Heavy duty	540	540	540	540	510	540	540	540	540	540
	Normal duty	650	650	630	620	580	650	650	640	630	620
470T	Heavy duty	670	670	645	580	-	670	670	660	615	-
	Normal duty	800	800	735	660	-	800	800	750	700	-
570T	Heavy duty	750	750	660	-	-	750	750	660	-	-
	Normal duty	910	880	750	-	-	940	880	750	-	-
750T	Heavy duty	990	990	990	990	960	990	990	990	990	990
	Normal duty	1220	1220	1180	1160	1090	1220	1220	1200	1180	1160
900T	Heavy duty	1225	1225	1215	1090	-	1225	1225	1225	1155	-
	Normal duty	1500	1500	1380	1240	-	1500	1500	1410	1310	-
1100T	Heavy duty	1375	1375	1240	-	-	1375	1375	1240	-	-
	Normal duty	1710	1650	1410	-	-	1760	1650	1410	-	-
1400T	Heavy duty	1850	1850	1825	1640	-	1850	1850	1850	1735	-
	Normal duty	2250	2250	2070	1860	-	2250	2250	2110	1970	-
1700T	Heavy duty	2065	2065	1860	-	-	2065	2065	1860	-	-
	Normal duty	2560	2480	2110	-	-	2650	2480	2110	-	-

For intermediate switching frequencies (3.5 - 4.5 - 5.5 kHz). the available current value will be the average of the upper frequency and lower frequency currents.

(1) : See § «2.3.3.1 - Flow rate», page 14

Ambient temperature  $\leq 40^{\circ}\text{C}$  - altitude  $\leq 1000$  m.

Rating	Duty	Ico (A)									
		Flow rate : Minimum (1)					Flow rate : Optimized (1)				
		2kHz	3kHz	4kHz	5kHz	6kHz	2kHz	3kHz	4kHz	5kHz	6kHz
340TH	Heavy duty	270	270	270	270	260	270	270	270	270	270
	Normal duty	340	340	340	320	300	340	340	340	340	320
400TH	Heavy duty	335	335	335	325	285	335	335	335	335	325
	Normal duty	415	415	415	375	330	415	415	415	400	375
500TH	Heavy duty	390	390	390	390	380	390	390	390	390	390
	Normal duty	500	500	500	475	440	500	500	500	500	475
600TH	Heavy duty	490	490	485	435	400	490	490	490	470	420
	Normal duty	580	580	560	500	460	580	580	580	540	485
750TH	Heavy duty	615	615	615	610	540	615	615	615	615	610
	Normal duty	780	780	780	700	620	780	780	780	750	700
900TH	Heavy duty	720	720	720	720	710	720	720	720	720	720
	Normal duty	940	940	940	890	820	940	940	940	940	890
1200TH	Heavy duty	900	900	900	815	745	900	900	900	875	790
	Normal duty	1090	1090	1050	940	860	1090	1090	1090	1010	910
1500TH	Heavy duty	1075	1075	1075	1075	1075	1075	1075	1075	1075	1075
	Normal duty	1410	1410	1410	1330	1240	1410	1410	1410	1410	1330
1800TH	Heavy duty	1355	1355	1355	1225	1120	1355	1355	1355	1320	1180
	Normal duty	1630	1630	1570	1410	1290	1630	1630	1630	1520	1360

For intermediate switching frequencies (3.5 - 4.5 - 5.5 kHz). the available current value will be the average of the upper frequency and lower frequency currents.

(1) : See § «2.3.3.1 - Flow rate», page 14

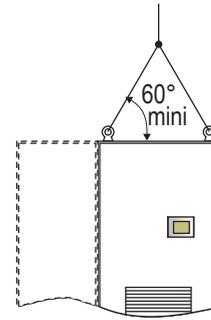
## 2 - MECHANICAL INSTALLATION

**!** • It is the responsibility of the owner or user of the Powerdrive MD2SL to ensure that the installation, operation and maintenance of the drive and its options comply with legislation relating to the safety of personnel and equipment and with the current regulations of the country of use.

• Powerdrive MD2SL drives must be installed in an environment free from conducting dust, corrosive fumes, gases and fluids, dripping water and any source of condensation (class 2 according to IEC 664.1). The drive must not be installed in hazardous areas unless it is in an appropriate enclosure. In this case, the installation must be approved.

• In atmospheres where condensation may form, install a heating system.

• Prevent access by unauthorised personnel.

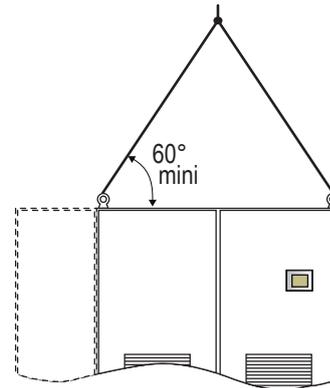


### 2.1 - Checks upon receipt

**!** Make sure that the cabinet has been transported vertically, as otherwise it could be damaged.

Before installing the **Powerdrive MD2SL**, check that:

- The drive has not been damaged during transport
- The information on the nameplate is compatible with the power supply



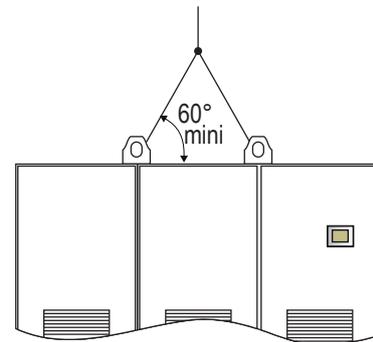
### 2.2 - Handling

**!** • The centre of gravity may be high up and / or off-centre, so beware of the risk of the cabinet tipping over.

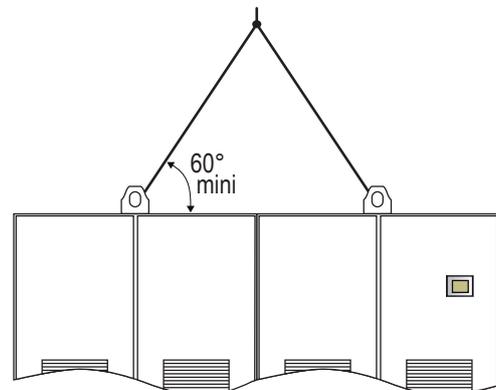
• Check that the handling equipment is suitable for the weight to be handled.

• The lifting accessories provided are limited solely to handling the cabinet. If subsequent handling operations are carried out, always check that these lifting accessories are in good condition.

When handling the cabinet, respect the following instructions, depending on the cubicle width, as indicated below.



Above 2400 mm wide (W), a baseplate 100 mm high is installed as standard to ensure the rigidity of all the cabinets.



## 2.3 - Cooling

~ 85% of the **POWERDRIVE MD2SL** losses is located in the coolant circuit. The remaining 15% losses are linked to thermal radiation, electrolytic capacitors and electronic board losses. These losses need to be removed by air circulation in the cabinet.

### 2.3.1 - Drive losses

Losses @ 40°C

Rating	Duty	Losses (kW)		
		2kHz	3kHz	4kHz
180T	Heavy duty	3.4	3.6	3.8
	Normal duty	4.1	4.4	4.5
220T	Heavy duty	4.1	4.3	4.6
	Normal duty	5.3	5.5	5.6
270T	Heavy duty	4.9	5.2	5.5
	Normal duty	6.2	6.5	6.9
340T	Heavy duty	6.2	6.5	6.9
	Normal duty	7.6	8.0	8.5
400T	Heavy duty	7.1	7.5	7.9
	Normal duty	8.6	9.0	9.3
470T	Heavy duty	8.8	9.3	9.5
	Normal duty	10.5	11.1	10.8
570T	Heavy duty	9.9	10.4	9.7
	Normal duty	12.0	12.2	11.0
750T	Heavy duty	13.0	13.7	14.5
	Normal duty	16.1	16.9	17.3
900T	Heavy duty	16.1	17.0	17.8
	Normal duty	19.7	20.8	20.3
1100T	Heavy duty	18.1	19.1	18.2
	Normal duty	22.5	22.9	20.7
1400T	Heavy duty	24.4	25.6	26.8
	Normal duty	29.6	31.2	30.4
1700T	Heavy duty	27.2	28.6	27.3
	Normal duty	33.7	34.4	31.0
340TH	Heavy duty	6.1	6.5	7.2
	Normal duty	7.7	8.1	9.0
400TH	Heavy duty	7.6	8.0	8.9
	Normal duty	9.4	9.9	11.0
500TH	Heavy duty	8.9	9.3	10.3
	Normal duty	11.4	12.0	13.3
600TH	Heavy duty	11.1	11.7	12.9
	Normal duty	13.2	13.9	14.9

Rating	Duty	Losses (kW)		
		2kHz	3kHz	4kHz
750TH	Heavy duty	14.0	14.7	16.3
	Normal duty	17.7	18.6	20.7
900TH	Heavy duty	16.3	17.2	19.1
	Normal duty	21.3	22.5	24.9
1200TH	Heavy duty	20.4	21.5	23.9
	Normal duty	24.8	26.1	27.9
1500TH	Heavy duty	24.4	25.7	28.5
	Normal duty	32.0	33.7	37.4
1800TH	Heavy duty	30.8	32.4	36.0
	Normal duty	37.0	39.0	41.7

### 2.3.2 - Air cooling

The purpose of the fan located on the cabinet roof is to maintain a constant temperature inside the cabinet and also to cool the passive components and circuit boards.

Never obstruct the drive ventilation. Ensure that hot air is not being recycled via the air inlets by leaving sufficient free space above the **POWERDRIVE MD2SL** or providing a means of evacuating the hot air expelled by the product. If necessary, add a suction duct.

The air inlet filters must be cleaned and changed regularly.

#### Drive ventilation flow rates and noise levels :

Rating	Flow rate (m³/h)	Noise level (dBA)
180T to 570T	250	65
750T to 1100T	500	68
1400T & 1700T	750	71
340TH to 600TH	250	65
750TH to 1200TH	500	68
1500TH & 1800TH	750	71

**▲** After connecting the power, reposition the cable bush plates at the bottom of the cabinet and fill any gaps with expanding foam.



### 2.3.3 - Liquid cooling

#### 2.3.3.1 - Flow rate

MD2SL rating		180T - 570T 340TH - 600TH	750T - 1100T 750TH - 1200TH	1400T-1700T 1500TH-1800TH
Number of heatsinks		4	8	12
Minimum value	Flow rate (l/min)	24	48	72
	Pressure drop (mbars)	330 / 270 (1)		
Optimised value	Flow rate (l/min)	32	64	96
	Pressure drop (mbars)	480 / 420 (1)		

(1) Pressure drop : glycol water / Normal water  
Maximum pressure : 3 bars

#### 2.3.3.2 - Coolant thermal regulation

Max coolant temperature: 40°C

To prevent condensation in the **Powerdrive MD2SL** cabinet :

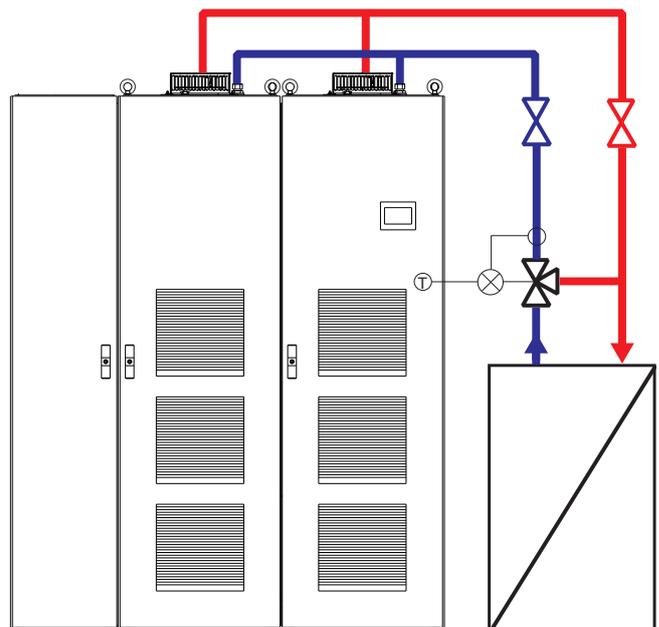
- Respect the coolant temperature indicated in the below table
- Shut down the liquid circulation when the drive is disable during more than 1 minute

Coolant minimum temperature	Internal air temperature of the Powerdrive MD2SL cabinet (°C) @1 bar									
	10°C	15°C	20°C	25°C	30°C	35°C	40°C	45°C	50°C	
Relative Humidity (%)	40%	-2.6	1.5	6.0	10.5	15.0	19.4	23.8	28.2	32.8
	50%	0.1	4.7	9.3	13.9	19.0	23.0	27.6	32.1	36.7
	60%	2.6	7.3	12.0	16.7	21.0	26.0	30.7	35.4	
	70%	4.8	9.6	14.4	19.1	24.0	29.0	33.5	38.2	
	80%	6.7	11.6	16.4	21.3	26.0	31.0	35.9		
	90%	8.4	13.4	18.3	23.2	28.0	33.0	38.0		

**Example:** for an air temperature of 40°C and a relative humidity of 50% inside the **Powerdrive MD2SL** cabinet. the coolant temperature must not drop below to 27.6°C

To ensure the above coolant temperature. a 3-way controlled valve or a variable speed pump can be installed.

A regulated heating system should be installed to maintain a minimum temperature of **5°C** inside the cabinet at drive start (to be turned off when the drive is running).



### 2.3.3.3 - Cooling circuit characteristics

The drive global cooling system is made of aluminium for the heatsinks, stainless steel for the customer connection, and nitrile for the link between these two circuits.

**Breakdown of exchange surface areas according to the material**

Material \ Rating	Exchange surface area (mm <sup>2</sup> )		
	180T - 570T & 340TH - 600TH	750T - 1100T & 750TH - 1200TH	1400T - 1700T & 1500TH - 1800TH
Aluminium	178 206	356 412	534 618
Stainless steel	139 744	279 488	419 232
Nitrile	159 592	319 184	478 776

The recommended fluids are therefore drinking or demineralised water or a mixture of water and glycol up to a 50%-50% ratio. Salt water is prohibited.

We recommend use of an external cooling loop so that the fluid is used in a closed circuit.

#### • Liquid quality

Since the drive most stressed components are totally liquid-cooled, liquid characteristics directly affects the quality of cooling and therefore the drive service life.

To prevent electrochemical corrosion and obstruction due to sediment, ensure that the cooling agent used satisfies the following criteria:

- sulphate content <150 mg/l
- pH between 6 and 9
- electrical conductivity <100 µS/cm
- chlorides <100 mg/l
- iron <0.5 mg/l
- ion chloride concentration < 1000 ppm at 20°C

#### • Liquid temperature rise

In steady state, the maximum temperature rise for the coolant at the drive output with the minimum recommended fluid flow rate is 8°C.

#### • Protection against electrochemical corrosion

When an external coolant loop is being used, it is advisable to add an inhibitor to prevent electrochemical corrosion.

If there is no external loop, such corrosion must be prevented by using materials compatible with the materials used in the drive cooling circuit (see table above with breakdown of exchange surface areas according to the material).

#### • Protection against obstruction due to sediment

A coolant with too many particles in it can speed up obstruction of the heatsinks due to sediment, and it is therefore advisable to install filters upstream of the drive fluid system.

### 2.3.3.4 - Draining and servicing

The frequency of the draining and servicing cycles depends on the quality of the coolant. These cycles must therefore be determined according to the quality of the fluid used and designed to suit the installation.

Temperature rises caused by passive components and circuit boards can create condensation on the heatsinks or the pipework connections, depending on the moisture in the air and the difference in temperature between the inside of the cabinet and the cooling circuit.

It is therefore advisable to have a coolant temperature as close as possible to the cabinet internal temperature depending on how much the drive is used. This can be achieved by reducing the ambient temperature or by increasing the fluid temperature (comply with the maximum temperatures described in section 2.3.3.2).

However, if condensation occurs, it will be directed to a drain pan. This pan should be checked regularly depending on the conditions of use and likely occurrence of condensation.

A biannual draining and servicing cycle for the drain pan circuit is recommended.

#### • Draining the water system

**Powerdrive MD2SL** is equipped with a drainage system for the water circuit. Before performing a draining refer to §7 - Maintenance.

To access the water system drain valve, remove the 3 knurled nuts, then the vertical ramp protective plate. Take the discharge pipe outside the **Powerdrive MD2SL** cabinet and open the valve on the bottom drain pan (see the diagram next page).

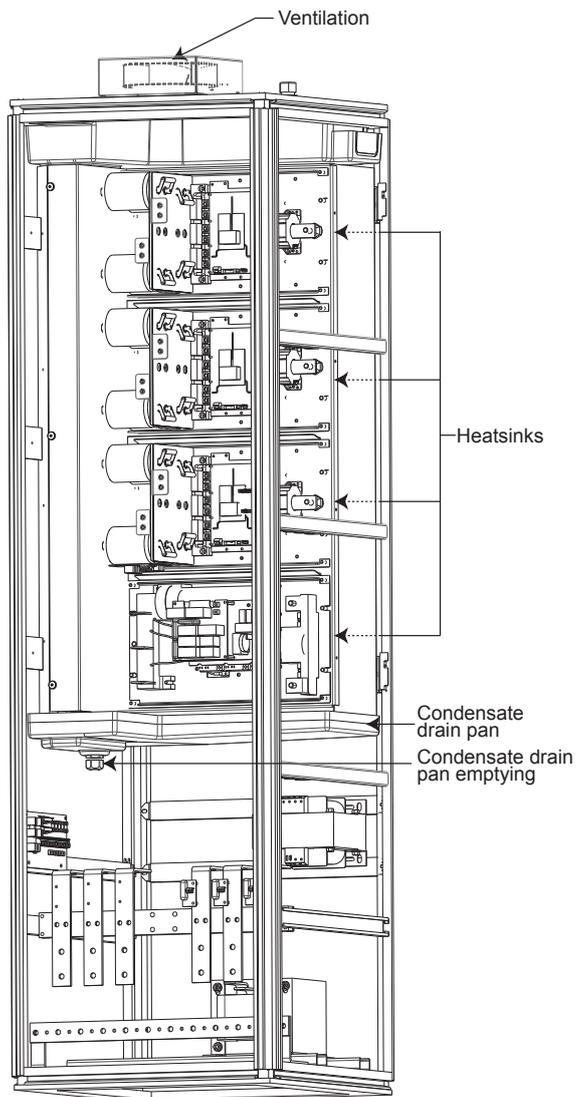
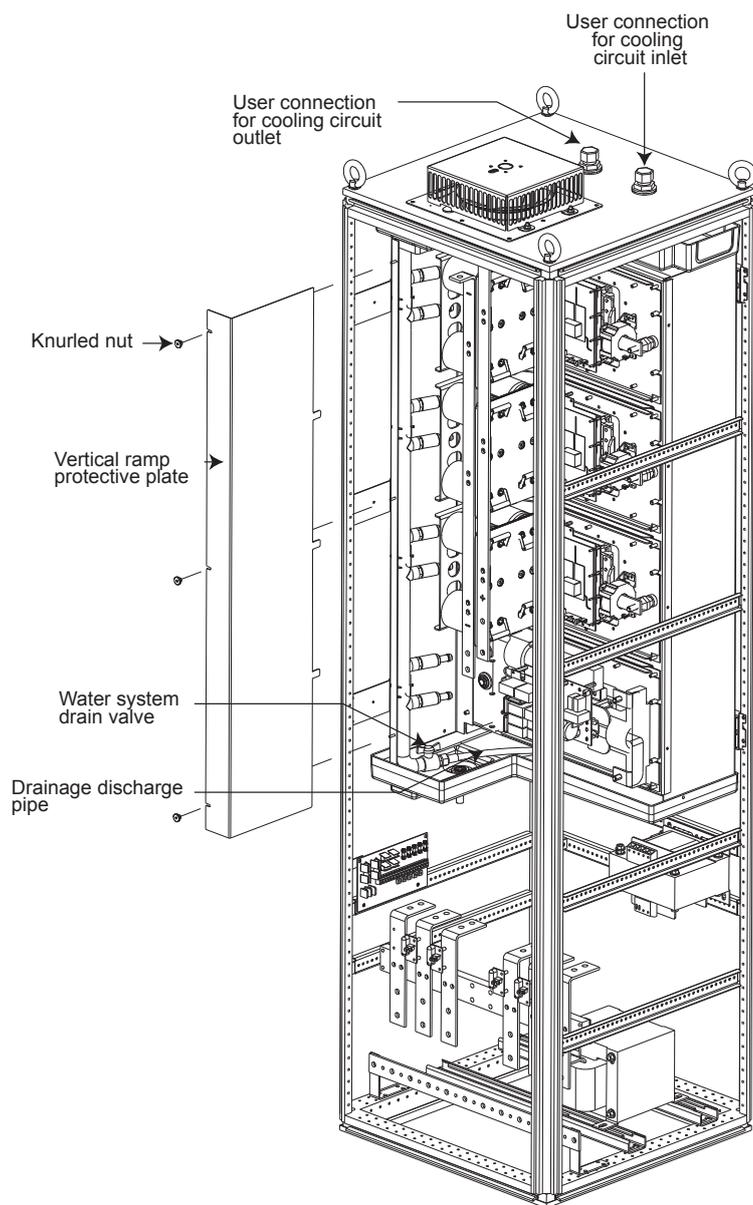
Once servicing is complete, make sure that the valve is closed correctly before reattaching the vertical ramp protective plate.

#### • Condensate drain pan

The **Powerdrive MD2SL** is fitted with a condensate drain pan. If condensation occurs, it will be directed into this pan.

The outlet for this drain pan should be connected to a drainage system, well away from any live parts.

Regularly check that the orifice on this pan is not obstructed so that condensates can be drained outside the **Powerdrive MD2SL** cabinet. See the diagram next page.

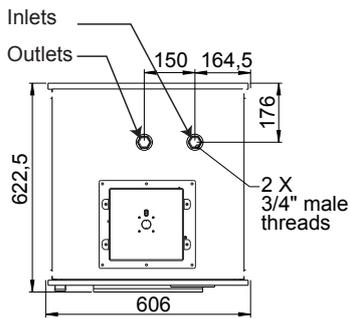


**2.3.3.5 - Recommendations and coolant circuit connections**

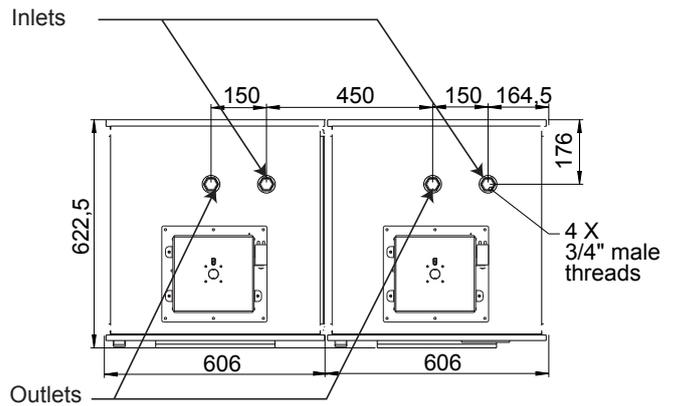
- Each cabinet cooling circuit is independent, and must be connected independently to the coolant unit.
- **Cabinet cooling circuits must not be connected in series.**
- To prevent clogging and loss of coolant effect, it is advisable to install filters on the cooling unit.

- To make it easier to drain the cooling circuit, it is advisable to use a by-pass valve in the main pipe and valves on each cabinet inlet.
- The installation of a sensor for detecting the lack of coolant flow is highly recommended

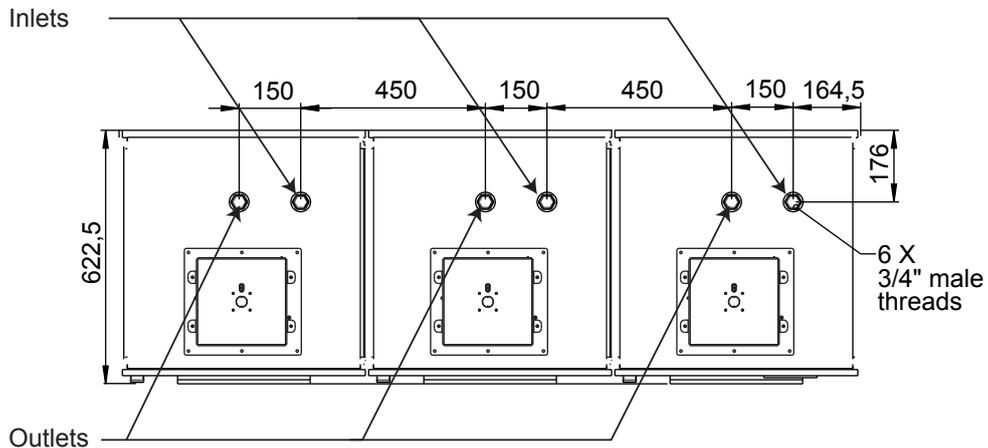
**Powerdrive MD2SL 180T to 570T  
& 340TH to 600TH**



**Powerdrive MD2SL 750T to 1100T  
& 750T to 1200TH**



**Powerdrive MD2SL 1400T, 1700T & 1500TH, 1800TH**



## 2.4 - Dimensions

The cabinet-mounted **POWERDRIVE MD2SL** solution is obtained by assembling cabinet modules of 400 or 600 mm wide and 600 mm deep.

The table below gives the product **width (W** in mm) and **height (H** in mm) depending on the options fitted:

Ratings	Height H (mm)	Options						Width W (mm)
		Switch	High-speed fuses	RFI filter	Mains choke	DC choke	Braking transistor	
180T to 470T	2100		✓			included		606
		✓	✓	✓	✓	included	✓	1006
570T	2300		included		included	-		606
		✓	included	✓	included	-	✓	1006
750 & 900T	2100		✓			included		1206
		✓	✓	✓	✓	included	✓	1806
1100T	2300		included		included	-		1206
		✓	included	✓	included	-	✓	1806
1400T & 1700T	2300 (1)		✓			included		1806
		✓	✓	✓	included	-	✓	2406 (1)
340TH to 600TH	2300		✓			included		606
		✓	✓	✓	included	-	✓	1006
750TH to 1200TH	2300		✓			included		1206
		✓	✓	✓	included	-	✓	1806
1500TH & 1800TH	2300 (1)		✓			included		1806
		✓	✓	✓	included	-	✓	2406 (1)

The following options can be fitted into the **POWERDRIVE MD2SL** without affecting its dimensions:

- MD-AU1 emergency stop
- Communication modules
- Additional I/O modules
- Speed feedback modules



The table below gives the product **height (H)** depending on the options fitted:

Option	Height (mm)
IP21 protection	+ 0
IP54 protection	+ 100
100mm baseplate	+ 100
200mm baseplate	+ 200
baseplate for width ≥ 2400mm (1)	+ 100

(1) For width of 2400mm and above, a 100 mm high baseplate must be installed to ensure the rigidity of the cabinet assembly. Cables cannot run through this baseplate, but a 100mm or 200mm baseplate can be added.

For more details depending on the options chosen, use the Leroy-Somer configurator:

<http://configureurls.leroy-somer.com/>

## 2.5 - Weight

The values indicated in the table below are maximum net weights.

Rating	Weight without option (kg)	Maximum weight (kg)
180T to 270T	335	570
340T to 470T	360	570
570T	380	990
750T and 900T	720	1040
1100T	745	1250
1400T	1265	1550
1700T	1450	2100
340TH	360	570
400TH and 600TH	400	620
750TH and 1200TH	820	1080
1500 TH	1250	1520
1800TH	1450	2100

### 3 - CONNECTIONS

- ⚠ • All connections work must be performed by qualified electricians in accordance with the laws in force in the country in which the drive is installed. This includes earthing to ensure that no directly accessible part of the drive can be at the mains voltage or any other voltage which may be dangerous.
- The drive must be supplied through an approved circuit-breaking device so that it can be powered down safely.
- The optional isolator supplied with the drive does not isolate the drive input busbars. It must without fail be associated with a circuit-breaking device in the switchboard.
- The drive power supply must be protected against overloads and short-circuits.
- Check that the voltage and current of the drive, the motor and the mains supply are compatible.
- The voltages on the connections of the mains supply, the motor, the braking resistor or the filter may cause fatal electric shocks. The protective plates supplied with the drive must always be installed correctly to protect the user against electric shocks.
- Only one permanent magnet motor can be connected to the drive output. It is recommended to install a circuit-breaking device between the permanent magnet motor and the drive output to eliminate the risk of hazardous voltage feedback when performing maintenance work.
- See also the recommendations in section 7.

### 3.1 - Power Terminals

#### 3.1.1 - Overview

Powerdrive MD2SL power connections are detailed for each model in §3.1.4.

#### 3.1.3 - Electronics and forced ventilation power supply

The control electronics and forced ventilation units are supplied through a single-phase transformer which primary is connected to terminals L1-L2 of the power supply. If necessary, this transformer can be supplied with an external power source (PX4 terminal block on fuse board).

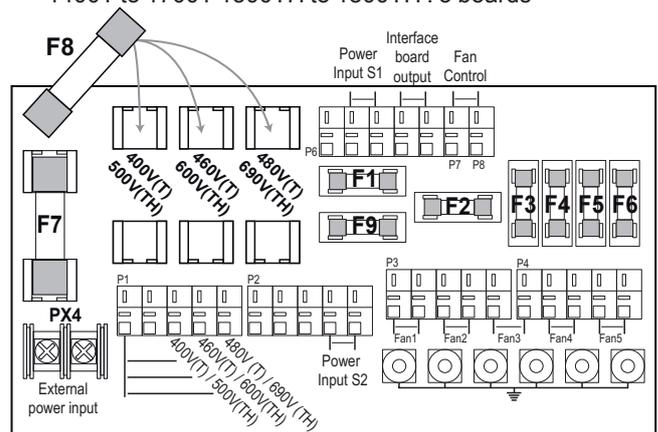
##### 3.1.3.1 - Electrical characteristics:

	Voltage	Maximum power
<b>Secondary 1</b> (Electronics power supply)	230 V isolated	100 VA ⚠ <b>The neutral of the electronics power supply not connected to earth</b>
<b>Secondary 2</b> (Forced ventilation and auxiliaries power supply)	230 V connected to earth	180T to 570T : P = 200 VA 750T to 1100T : P = 400 VA 1400T to 1700T : P = 600 VA 400TH to 600TH : P = 200 VA 750TH to 1200TH : P = 400 VA 1500TH to 1800TH : P = 600 VA

##### 3.1.3.2 - Fuse boards

Depending on the rating, **Powerdrive MD2SL** may include one or more identical fuses board:

- 180T to 570T & 340TH to 600TH : 1 board
- 750T to 1100T & 750TH to 1200TH : 2 boards
- 1400T to 1700T 1500TH to 1800TH : 3 boards



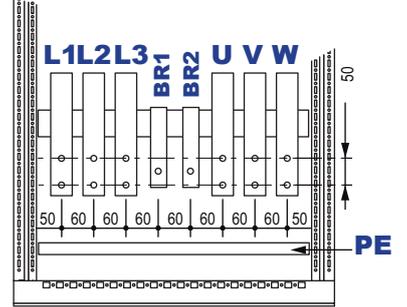
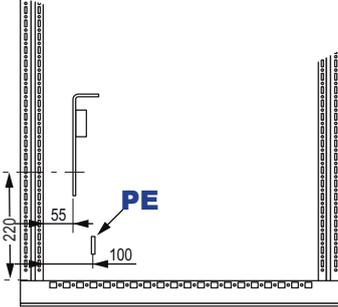
⚠ Position the F8 fuse according to the mains supply voltage

#### 3.1.2 - Terminal sizes and torque settings

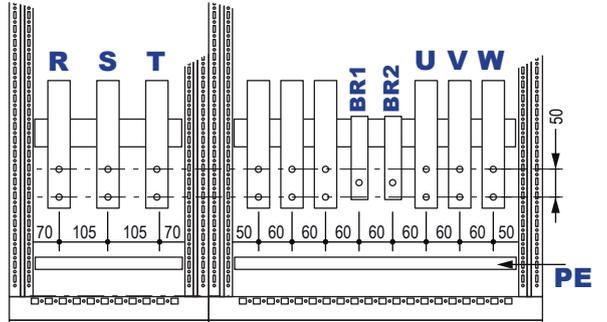
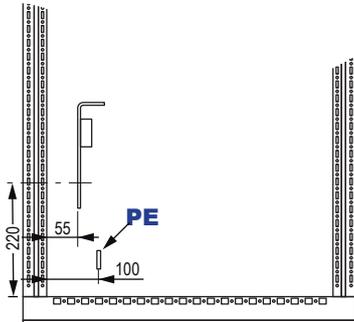
Functions/connections	Refs.	Type of connection and tightening torque	
		180T to 270T	340T to 1700T 340TH to 1800TH
Mains power supply	L1. L2. L3. or R. S. T See §3.1.4	M10 screw bolt - 20 Nm / 15 lb.ft	
Motor outputs	U. V. W See §3.1.4		
Earth	PE See §3.1.4	M10 bolt - 20 Nm / 15 lb.ft	M8 bolts - 12 Nm / 9 lb.ft
Braking resistor (1)	BR1. BR2. PE See §3.1.4	M8 screw bolt - 12 Nm / 9 lb.ft	
EMC commoning link	P4. P5 see §4.4.3	Torx screws Ø20 - 4 Nm / 3 lb.ft	
Optional external emergency stop	X1-1. X1-2		

⚠ Do not exceed the indicated maximum tightening torque.  
(1) If braking transistor is fitted.

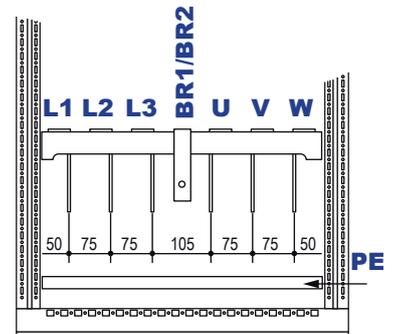
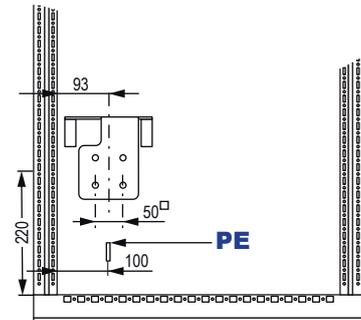
MD2SL 180T / MD2SL 220T / MD2SL 270T  
without option



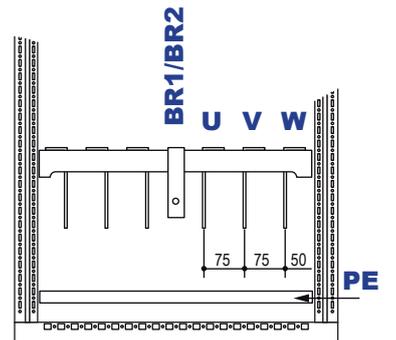
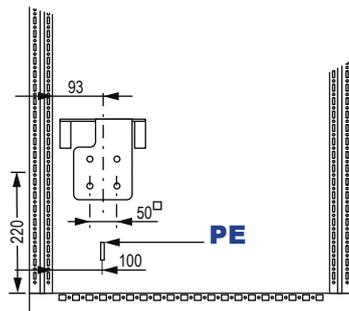
MD2SL 180T / MD2SL 220T / MD2SL 270T  
with options



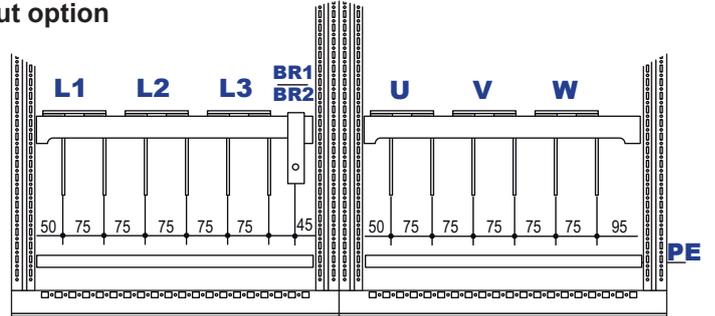
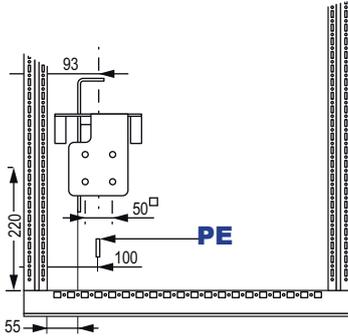
MD2SL 340T / MD2SL 400T / MD2SL 470T / MD2SL 570T  
MD2SL 340TH / MD2SL 400TH / MD2SL 500TH  
without option



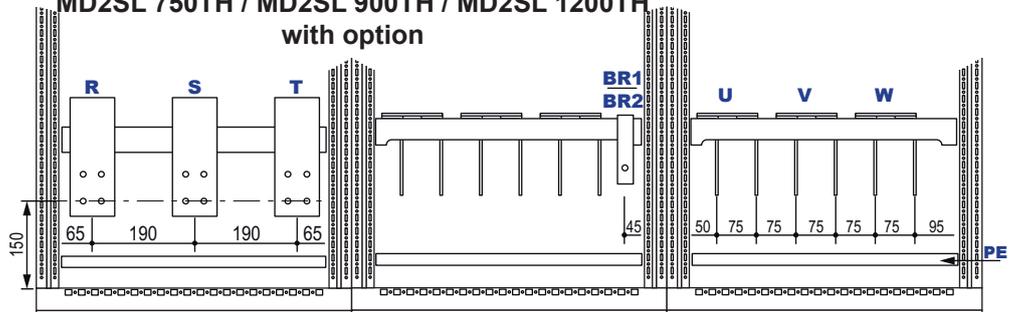
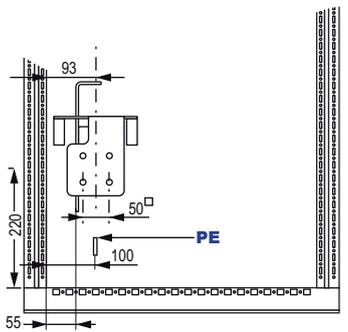
MD2SL 340T / MD2SL 400T / MD2SL 470T / MD2SL 570T  
MD2SL 340TH / MD2SL 400TH / MD2SL 500TH  
with options



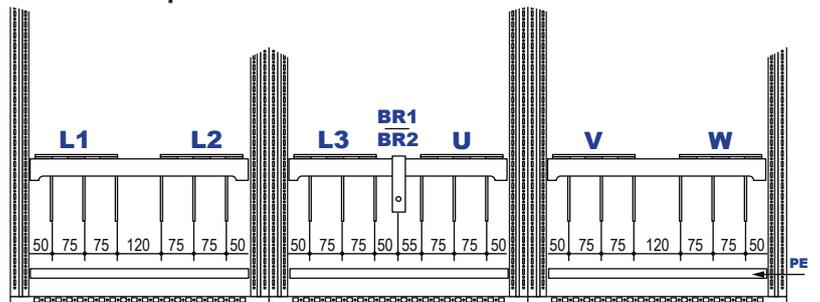
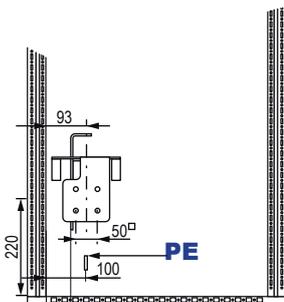
**MD2SL 750T / MD2SL 900T / MD2SL 1100T  
MD2SL 750TH / MD2SL 900TH / MD2SL 1200TH  
without option**



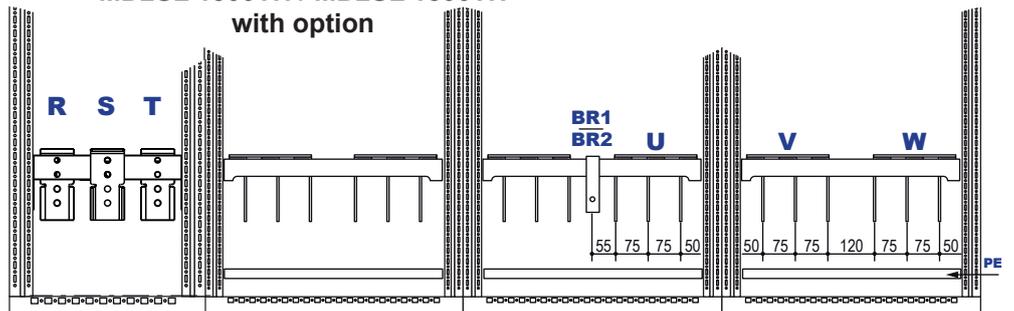
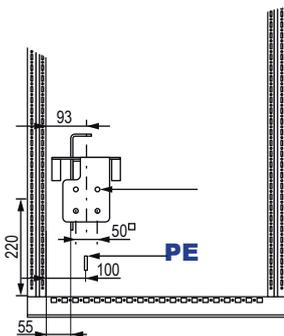
**MD2SL 750T / MD2SL 900T / MD2SL 1100T  
MD2SL 750TH / MD2SL 900TH / MD2SL 1200TH  
with option**



**MD2SL 1500T / MD2SL 1700T  
MD2SL 1500TH / MD2SL 1800TH  
without option**



**MD2SL 1500T / MD2SL 1700T  
MD2SL 1500TH / MD2SL 1800TH  
with option**



### 3.1.4 - Location of power terminal blocks

### 3.1.5 - Cables and fuses

**⚠** • It is the responsibility of the user to connect and provide protection for the Powerdrive MD2SL in accordance with the current legislation and regulations in the country of use. This is particularly important with regard to the size of the cables, the type and rating of fuses, the earth or ground connection, powering down, acknowledging trips, isolation and protection against overcurrents.

• The installation must have a short circuit current ( $I_{sc}$ ) > 20  $I_L$  at the point of drive connection.

• This table is given for information only, and must under no circumstances be used in place of the current standards.

$I_L$ : Maximum line current

$I_{co}$ : Continuous output current

Rating		Mains power supply									Motor	
		400 V - 50 Hz				460/480 V - 60 Hz						
		$I_L$ (A)	Fuses		Cable cross-section (mm <sup>2</sup> ) (3)	$I_L$ (A)	Fuses			Cable cross-section (mm <sup>2</sup> ) (3)	$I_{co}$ (A)	Cable cross-section (mm <sup>2</sup> ) (4)
Gg type (1)	aR type (2)	Gg type (1)	aR type (2)	Class J (UL)								
180T	Heavy	245	315	500	3x120 + PE	215	315	500	400	3x95 + PE	260	3x120 + PE
	Normal	295	315	500	3x150 + PE	245	315	500	400	3x120 + PE	315	3x185 + PE
220T	Heavy	295	315	550	3x150 + PE	245	315	500	400	3x120 + PE	310	3x185 + PE
	Normal	370	400	630	3x240 + PE	365	400	630	500	3x240 + PE	400	3x240 + PE
270T	Heavy	370	400	630	3x240 + PE	365	400	630	600	3x240 + PE	375	3x240 + PE
	Normal	460	500	800	2x[3x150 + PE]	425	500	700	600	2x[3x120 + PE]	470	2x[3x150 + PE]
340T	Heavy	460	500	800	2x[3x150 + PE]	425	500	700	600	2x[3x120 + PE]	470	2x[3x150 + PE]
	Normal	580	630	1000	2x[3x185 + PE]	540	630	800	-	2x[3x185 + PE]	580	2x[3x185 + PE]
400T	Heavy	580	630	1000	2x[3x185 + PE]	540	630	800	-	2x[3x185 + PE]	540	2x[3x185 + PE]
	Normal	650	800	1100	2x[3x240 + PE]	600	630	1000	-	2x[3x185 + PE]	650	2x[3x240 + PE]
470T	Heavy	650	800	1250	2x[3x240 + PE]	600	630	1000	-	2x[3x185 + PE]	670	2x[3x240 + PE]
	Normal	825	1000	1400	4x[3x120 + PE]	715	800	1250	-	4x[3x95 + PE]	800	4x[3x120 + PE]
570T	Heavy	735	1000	1400	4x[3x120 + PE]	715	800	1250	-	4x[3x95 + PE]	750	4x[3x120 + PE]
	Normal	915	1000	1600	4x[3x150 + PE]	775	1000	1400	-	4x[3x150 + PE]	880	4x[3x150 + PE]
750T	Heavy	1010	1250	2x1000	4x[3x185 + PE]	955	1000	2x800	-	4x[3x150 + PE]	990	4x[3x185 + PE]
	Normal	1235	1600	2x1100	4x[3x240 + PE]	1075	1250	2x1000	-	4x[3x185 + PE]	1220	4x[3x240 + PE]
900T	Heavy	1235	1600	2x1250	4x[3x240 + PE]	1075	1250	2x1000	-	4x[3x185 + PE]	1225	4x[3x240 + PE]
	Normal	1460	1800	2x1400	-	1185	1600	2x1250	-	4x[3x240 + PE]	1500	-
1100T	Heavy	1460	1800	2x1400	-	1185	1600	2x1250	-	4x[3x240 + PE]	1375	-
	Normal	1640	2000	2x1600	-	1480	1800	2x1400	-	-	1650	-
1400T	Heavy	1640	2000	3x1250	-	1480	1800	3x1000	-	-	1850	-
	Normal	2190	2500	3x1400	-	1775	2000	3x1250	-	-	2250	-
1700T	Heavy	2190	2500	3x1400	-	1775	2000	3x1250	-	-	2065	-
	Normal	2460	2800	3x1600	-	2015	2500	3x1400	-	-	2480	-

## CONNECTIONS

Rating		Mains power supply					Motor	
		575V / 60Hz - 690 V / 50Hz					I <sub>co</sub> (A)	Cable cross-section (mm <sup>2</sup> ) (4)
		I <sub>L</sub> (A)	Fuses (1)			Cable cross-section (mm <sup>2</sup> ) (3)		
Gg type (1)	aR type (2)		Class J (UL)					
340TH	Heavy	260	315	500	350	3x120 + PE	270	3x150 + PE
	Normal	330	400	550	450	3x185 + PE	340	3x185 + PE
400TH	Heavy	325	400	630	450	3x185 + PE	335	3x185 + PE
	Normal	415	400	700	500	2x[3x120 + PE]	415	2x[3x120 + PE]
500TH	Heavy	415	400	700	500	2x[3x120 + PE]	390	2x[3x120 + PE]
	Normal	470	500	800	600	2x[3x150 + PE]	500	2x[3x150 + PE]
600TH	Heavy	470	500	800	600	2x[3x150 + PE]	490	2x[3x150 + PE]
	Normal	570	630	1000	--	2x[3x185 + PE]	580	2x[3x185 + PE]
750TH	Heavy	570	630	2x500	--	2x[3x185 + PE]	615	2x[3x185 + PE]
	Normal	730	800	2x630	--	4x[3x120 + PE]	780	4x[3x120 + PE]
900TH	Heavy	730	800	2x630	--	4x[3x120 + PE]	720	4x[3x120 + PE]
	Normal	885	1000	2x800	--	4x[3x150 + PE]	940	4x[3x150 + PE]
1200TH	Heavy	885	1000	3x500	--	4x[3x150 + PE]	900	4x[3x150 + PE]
	Normal	1145	1250	3x550	--	4x[3x240 + PE]	1090	4x[3x240 + PE]
1500TH	Heavy	1145	1250	3x550	--	4x[3x240 + PE]	1075	4x[3x240 + PE]
	Normal	1350	1600	3x630	--		1410	
1800TH	Heavy	1350	1250	3x550	--		1355	
	Normal	1665	1600	3x630	--		1630	

Note: The line current value  $I_L$  is a typical value which depends on the source impedance. The higher the impedance, the lower the current.

(1) gG fuse or equivalent solution (fuses connected in parallel, preferably C type circuit-breaker, etc). This protection must always be connected in series with aR semi-conductor fuses.

(2) Semiconductor aR fuses do not ensure the protection of the drive power supply line and must always be associated with a protection device against overload, localized at the head of the line.

(3) The recommended mains cable cross-sections have been determined for single-core cable with a maximum length of 20 m. For longer cables, take line voltage drop into consideration due to high cable length.

(4) The motor cable cross-sections are given for information only for a current corresponding to the value of the  $I_{co}$  current at 3 kHz, a maximum length of 50 m, output frequency less than 100 Hz and an ambient temperature of 40°C. **The recommended motor cables are shielded multicore type.**

The values supplied are typical values.

Example: Cable cross-section of 3 x (3 x 185 + 95) corresponds to 3 cables each consisting of 3 phase conductors (cross-section 185 mm<sup>2</sup>) + earth conductors (cross-section 95 mm<sup>2</sup>).



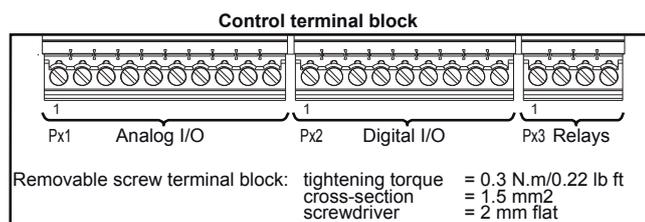
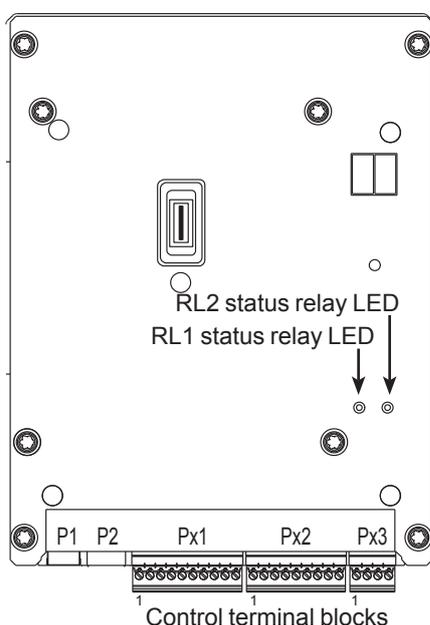
### 3.2 - Connection of the control

**!** • The Powerdrive MD2SL inputs have a positive logic configuration. Using a drive with a control system which has a different control logic may cause unexpected starting of the motor.

• The Powerdrive MD2SL control circuit is isolated from the power circuits by single insulation. Its electronic 0V is connected to the connection terminal on the outer protective conductor (earth terminal). The installer must ensure that the external control circuits are isolated against any human contact.

• If the control circuits need to be connected to circuits complying with SELV safety requirements, additional insulation must be inserted to maintain the SELV classification (see EN 61140).

#### 3.2.1 - Control terminal block location



#### 3.2.2 - Control terminal block characteristics

##### 3.2.2.1 - PX1 terminal block characteristics

<b>1</b>	<b>10V</b>	+10 V internal analog source
Accuracy		± 2%
Maximum output current		10 mA

<b>2</b>	<b>AI1+</b>	Differential analog input 1 (+)
<b>3</b>	<b>AI1-</b>	Differential analog input 1 (-)
Factory setting		0-10V speed reference
Input type		± 10 V differential bipolar analog voltage (for common mode, connect terminal 3 to terminal 6)
Absolute maximum voltage range		± 36 V
Voltage range in common mode		± 24 V/0 V
Input impedance		> 100 kΩ
Resolution		11 bits + sign
Sampling period		2 ms
Input filter bandwidth		~ 200 Hz

<b>4</b>	<b>AI2+</b>	Differential analog input 2 (+)
<b>5</b>	<b>AI2-</b>	Differential analog input 2 (-)
Factory setting		4-20 mA speed reference
Input type		Unipolar current (0 to 20 mA, 4 to 20 mA, 20 to 0 mA, 20 to 4 mA)
Absolute maximum current		30 mA
Voltage range in common mode		± 24 V/0 V
Input impedance		100 Ω
Resolution		12 bits
Sampling period		2 ms
Input filter bandwidth		~ 200 Hz

<b>6</b>	<b>0V</b>	Analog circuit common 0 V
The 0 V on the electronics is connected to the metal ground of the drive		

<b>7</b>	<b>AI3</b>	Analog input 3
Factory setting		No assignment
Input type		± 10 V bipolar analog voltage in common mode or unipolar current (0 to 20 mA, 4 to 20 mA)
Resolution		11 bits + sign
Sampling period		2 ms
Input filter bandwidth		~ 200 Hz
Voltage range in common mode		± 24 V/0 V

##### Voltage mode

Input impedance	> 50 kΩ
Absolute maximum voltage range	± 30 V

##### Current mode

Input impedance	100 Ω
Absolute maximum current	30 mA

<b>8</b>	<b>AO1</b>	Analog output
Factory setting	4-20 mA motor current signal	
Output type	Bipolar analog voltage in common mode or unipolar current in common mode	
Resolution	13 bits	
Sampling period	2 ms	
<b>Voltage mode</b>		
Voltage range	± 10 V	
Load resistance	1 kΩ minimum	
<b>Current mode</b>		
Current range	0 to 20 mA, 4 to 20 mA	
Load resistance	500 Ω maximum	

<b>9</b>	<b>DI1 PTC</b>	Digital input 1 or PTC thermal sensor
Factory setting	No assignment	
Sampling period	2 ms	
<b>Thermal sensor input</b>		
Voltage range	± 10 V	
Trip threshold	> 3.3 kΩ	
Reset threshold	< 1.8 kΩ	
<b>Digital input</b>		
Type	Digital input in positive logic	
Voltage range	0 to + 24 V	
Absolute maximum voltage range	0 V to + 35 V	
Thresholds	0 : < 5 V 1 : > 13 V	

<b>10</b>	<b>0V</b>	Analog circuit common 0 V
The 0 V on the electronics is connected to the metal ground of the drive		

**3.2.2.2 - PX2 terminal block characteristics**

<b>1</b>	<b>+24V ref</b>	+24 VDC user output or +24 VDC external input
<b>9</b>		
<b>+24 VDC user output</b>		
Output current	100 mA	
Accuracy	± 5%	
Protection	Current limiting and setting to trip mode	
<b>+24 VDC external input</b>		
Rated voltage	24 VDC	
Minimum operating voltage	22 V	
Absolute maximum voltage	28 V	
Recommended power	50 W	
Recommended fuse	2.5 A	
An external power supply connected to the +24V Ref terminal is used to maintain the control power supply in the event of mains loss.		

<b>2</b>	<b>DO1</b>	Digital output
Factory setting	Zero speed	
Characteristic	Open collector	
Absolute maximum voltage	+ 30 V/0 V	
Overload current	150 mA	

<b>3</b>	<b>STO-1</b>	Drive enable input 1 (Safe Torque Off function)
<b>6</b>	<b>STO-2</b>	Drive enable input 2 (Safe Torque Off function)
Input type	Positive logic only	
Absolute maximum voltage	+ 30 V	
Thresholds	0 : < 5 V 1 : > 13 V	
Response time	< 20 ms	

<b>4</b>	<b>DI2</b>	Digital input 2
<b>5</b>	<b>DI3</b>	Digital input 3
<b>7</b>	<b>DI4</b>	Digital input 4
<b>8</b>	<b>DI5</b>	Digital input 5
DI2 factory setting	Selection of speed reference	
DI3 factory setting		
DI4 factory setting	Run FWD/Stop input	
DI5 factory setting	Run reverse/Stop input	
Type	Digital inputs in positive logic	
Voltage range	0 to + 24 V	
Absolute maximum voltage range	0 to + 35 V	
Thresholds	0 : < 5 V 1 : > 13 V	

**3.2.2.3 - PX3 terminal block characteristics**

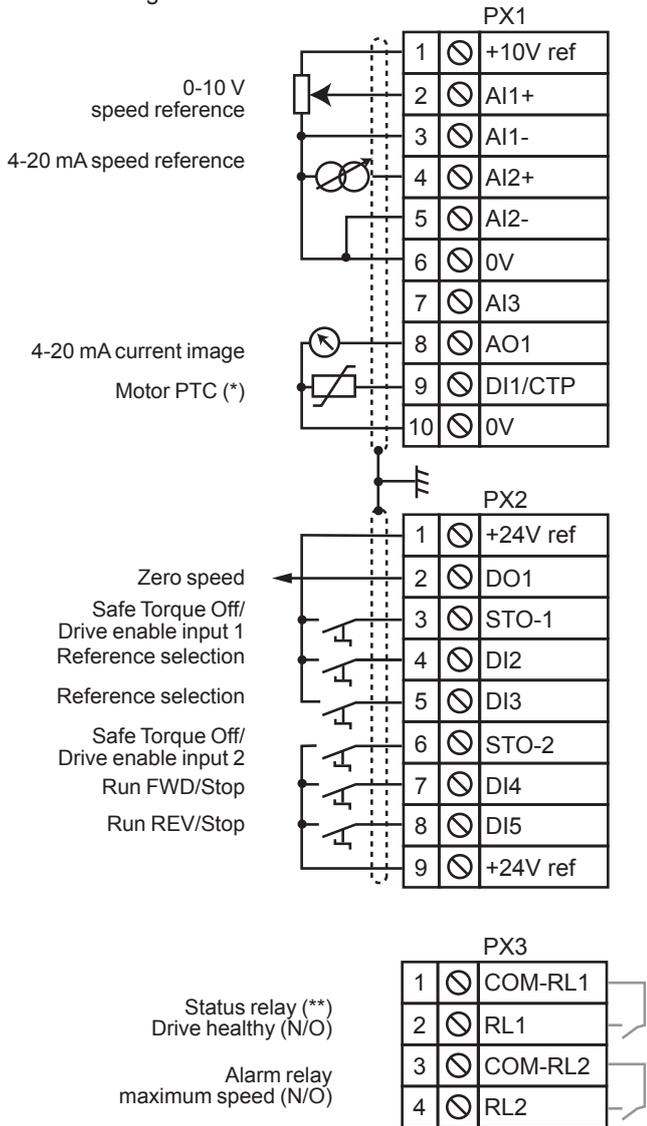
<b>1</b>	<b>COM-RL1</b>	N/O (normally open) relay output
<b>2</b>	<b>RL1</b>	
<b>3</b>	<b>COM-RL2</b>	N/O (normally open) relay output
<b>4</b>	<b>RL2</b>	
Factory setting RL1	Drive status relay	
Factory setting RL2	Maximum speed alarm	
Voltage	250 VAC	
Maximum contact current	2 A - 250 VAC, resistive load	
	1 A - 250 VAC, inductive load	
	2 A - 30 VDC, resistive load	

 **• Provide a fuse or other overcurrent protection in the relay circuit.**

**Note:** When the RL1 or RL2 relay is activated, the corresponding status LED on the control board lights up.

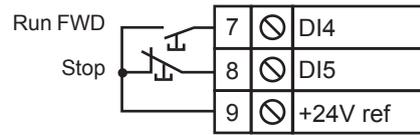
### 3.2.3 - Factory configuration of control terminal blocks

**Nota :** For more details on the parameters, please refer to the commissioning manual ref.4617



• **Modification of the Run/Stop control logic**

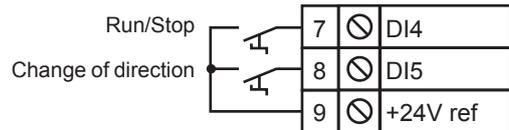
- For "3-wire" control (jog Run/Stop):



List of parameters to set:

- Ctr.06 (06.04)** = Run Latched (1)
- I/O.10 (08.25)** = **06.39** Stop (DI5 terminal)

- For Run/Stop control with change of direction:



List of parameters to set:

- Ctr.06 (06.04)** = Run Fwd/Rev (2)
- I/O.09 (08.24)** = **06.34** Run/Stop (DI4 terminal)
- I/O.10 (08.25)** = **06.33** Fwd/Reverse (DI5 terminal)

• **Selection of the reference via digital inputs:**

DI2	DI3	Selection
0	0	Voltage speed reference (0-10 V) on analog input AI1+, AI1-
0	1	Current speed reference (4-20 mA) on analog input AI2+, AI2-
1	0	Preset reference 2
1	1	<b>Spd.05 (01.22)</b> to be set

**Note:** This configuration has been obtained from a drive with factory settings (default parameter settings). The STO-1 and STO-2 inputs must be closed before giving a run command.

(\*) If the motor thermal sensor needs to be connected to DI1/PTC, set **Mtr.06 (05.70)** = Drive terminal (1).

(\*\*) If the 2 STO inputs are not in the same status, the relay RL1 opens.

### 3.3 - STO-1/STO-2 inputs: Safe Torque Off function

The STO-1 and STO-2 inputs are safety inputs that can be used to disable the drive output so no torque at the motor shaft is generated.

They are independent of one another. They are created by simple hardware not connected to the microcontroller. They act on two different stages of the IGBT output bridge control. To enable the drive, the STO-1 and STO-2 inputs must be connected to the +24V source.

The opening of a minimum of one input locks the output bridge.

These 2 inputs can be used in conjunction to create a "Safe Torque Off" function with a logic combining 2 separate channels.

In this configuration, the "Safe Torque Off" function is guaranteed with a very high level of integrity in conformity with standards:

- EN 61800-5-2
- EN/ISO 13849-1: 2006; PLe
- IEC/EN 62061: 2005; SIL3

(CETIM approval no. CET0047520)

This built-in function enables the drive to act as a contactor that switches off the motor power, allowing a deceleration in a free wheel mode. This corresponds to an uncontrolled stop in accordance with stop category 0 of IEC 60204-1.

The STO-1 and STO-2 inputs are compatible with self-tested logic outputs in controllers such as PLCs, for which the test pulse lasts for 1 ms maximum.

If the data sent by the 2 inputs are not identical, this generates a drive trip. The RL1 relay opens and the drive indicates a "t.r./63" trip on the drive 2-digit display or "STO input inconsistency" trip on the parameter-setting interface.

For correct use, the power and control connection diagrams described in the following paragraphs must be adhered to.

**⚠ • The STO-1/STO-2 inputs are safety components which must be incorporated in the complete system dedicated to machine safety. As for any installation, the complete machine must be subject to a risk analysis. The integrator must determine the safety category which the installation must comply with.**

• The STO-1 and STO-2 inputs, when open, lock the drive, so the dynamic braking function is no longer available. If a braking function is required before the drive secure disable lock is applied, a time-delayed safety relay must be installed to activate the locking automatically after the end of braking.

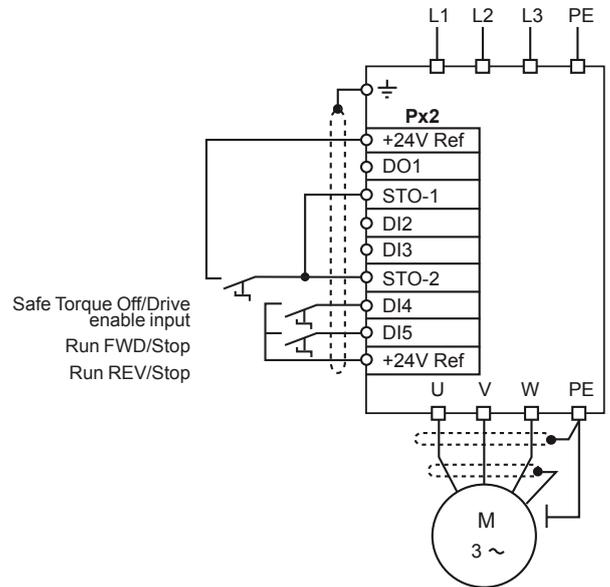
If braking needs to be a machine safety function, it must be provided by an electromechanical solution since the dynamic braking by the drive function is not considered as a secure disable function.

• The STO-1/STO-2 inputs do not provide the electrical isolation function. Prior to any work carried out on the drive / installation, the power supply must therefore be switched off through an approved isolating device (isolator, switch, etc).

• The line switch integrated as an option in the drive does not isolate the drive input busbars. During the installation and maintenance phases, make sure that the power supply line is disrupted.

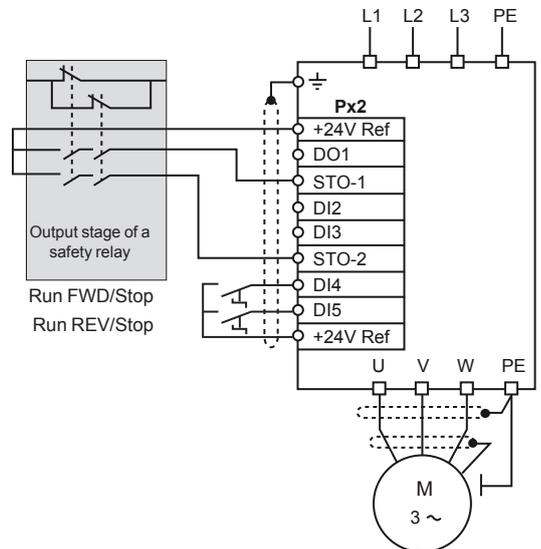
#### 3.3.1 - Single channel locking (SIL1 - PLb)

3-phase AC power supply, in accordance with safety standard IEC/EN 62061: 2005 and EN/ISO 13849-1: 2006 - Single channel locking (SIL1 - PLb).



#### 3.3.2 - Double channel locking (SIL3 - PLe)

3-phase AC power supply, in accordance with safety standard IEC/EN 62061: 2005 and EN/ISO 13849-1: 2006 - Double channel locking (SIL3 - PLe)



## 4 - GENERAL EMC - HARMONICS - MAINS INTERFERENCE

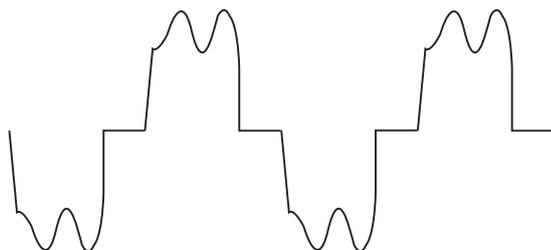
The power structure of frequency inverters leads to the occurrence of two types of phenomenon :

- Low-frequency harmonics fed back to the mains supply
- Emission of radio-frequency signals (RFI)

These are independent phenomena. They have different consequences on the electrical environment.

### 4.1 - Low-frequency harmonics

The rectifier, at the head of the frequency inverter, generates a non-sinusoidal AC line current.



3-phase rectifier line current consumption.

This current carries harmonics with number  $6n \pm 1$ .

**Their amplitudes depend on the impedance of the mains supply upstream the rectifier bridge, and on the structure of the DC bus downstream the rectifier bridge.**

The more inductive the mains supply and the DC bus, the more these harmonics are reduced.

They only affect the quality of the mains supply for loads on frequency inverters of several hundred kVA, if these loads represent more than a quarter of the total load on a site.

In the above conditions:

- These harmonics have virtually no effect on the electrical energy consumption level.
- The associated temperature rises in transformers and motors directly connected to the mains supply are negligible.

**It is very rare for these low-frequency harmonics to cause interference on sensitive equipment.**

## 4.2 - Radio-frequency interference: Immunity

### 4.2.1 - General

The immunity level of a device is defined by its ability to operate in an environment which is contaminated by external elements or by its electrical connections.

### 4.2.2 - Standards

Each device must undergo a series of standard tests (European standards) and meet a minimum requirement in order to be declared as compliant with the variable speed drive standards (EN 61800-3).

### 4.2.3 - Recommendations

An installation consisting exclusively of devices which comply with the standards concerning immunity is very unlikely to be subject to a risk of interference.

## 4.3 - Radio-frequency interference: Emission

### 4.3.1 - General

In order to limit motor losses and obtain a low level of motor noise, frequency inverters use high-speed switches (transistors, semi-conductors) which switch high voltages (> 550 V) at high frequencies (several kHz).

As a result, they generate radio-frequency (R.F.) signals which may disturb operation of other equipments or distort measurements taken by sensors:

- Due to high-frequency leakage currents which escape to earth via the stray capacity of the drive/motor cable and through the motor via the metal structures which support it.
- By conduction or feedback of R.F. signals on the power supply cable: conducted emissions
- By direct radiation near to the mains supply power cable or the drive/motor cable: radiated emissions.

These phenomena are of direct interest to the user.

The frequency range concerned (radio frequency) does not affect the energy distribution company.

### 4.3.2 - Standards

Standard EN 61800-3 defines the maximum emission levels to comply with according to the type of environment the drive is installed in. In some cases, it may be necessary to add an external RFI filter (see section 4.6).

## 4.4 - Mains supply

### 4.4.1 - General

Each industrial power supply has its own intrinsic characteristics (short-circuit capability, voltage value and fluctuation, phase imbalance, etc) and supplies equipment some of which can distort its voltage either permanently or temporarily (notches, voltage dips, overvoltage, etc). The quality of the mains supply has an impact on the performance and reliability of electronic equipments, especially variable speed drives.

The **Powerdrive MD2SL** is designed to operate with mains supplies typical of industrial sites throughout the world. However, for each installation, it is important to know the characteristics of the mains supply in order to carry out corrective measures in the event of abnormal conditions.

### 4.4.2 - Mains transient overvoltages

There are numerous sources of overvoltages on an electrical installation:

- Connection/disconnection of banks of power factor correction capacitors
- High-power thyristor-controlled equipment (oven, DC drive, etc)
- Results of lightning

#### 4.4.2.1 - Connection/disconnection of a bank of power factor correction capacitors

Connecting power factor correction capacitors in parallel on the drive power supply line when the drive is running can generate transient overvoltages that are likely to trip the drive safety devices, or even damage it in extreme cases.

If banks of power factor correction capacitors are used on the power supply line, make sure that:

- The threshold between steps is low enough to avoid causing overvoltage on the line
- The capacitors are not permanently connected

#### 4.4.2.2 - Presence of commutation notches on the line

When high-power thyristor-controlled equipment is connected on the same line as the drive, it is essential to ensure that the harmonics generated by the commutation notches do not excessively distort the mains voltage and do not create voltage peaks with amplitude higher than 2 x mains  $V_{rms}$ . If this is the case, it is essential to take corrective measures by inserting a choke in the line supplying the thyristor-controlled equipment or by moving the drive power supply line to another source.

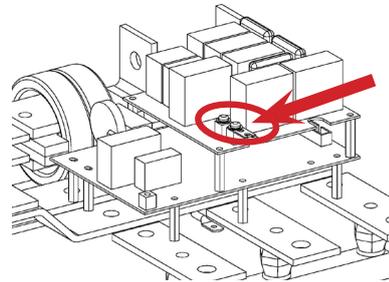
### 4.4.3 - Unbalanced power supply

Similar to what is observed on an electric motor, the line current imbalance of a drive operating on an unbalanced mains supply may be several times the value of the voltage imbalance measured on the power supply. A highly unbalanced mains supply (>2%) associated with a low mains impedance may result in a high level of stress on the components at the input stage of a drive.

Additional mains chokes can be installed upstream of a **Powerdrive MD2SL** supplied by an unbalanced mains in order to reduce the current imbalance factor (see characteristics in section "Line reactors").

#### Neutral IT point connection

For IT power supplies, open the commoning link connecting the EMC capacitors to earth as indicated below.



### 4.4.4 - Ground connections

The equipotential earth bonding of some industrial sites is not always observed. This lack of equipotentiality leads to leakage currents which flow via the earth cables (green/yellow), the machine chassis, the pipework, etc, and also via the electrical equipment. In some extreme cases, these currents can trip the drive.

It is essential that the earth network is designed and implemented by the installation supervisor so that its impedance is as low as possible, so as to distribute the fault currents and high-frequency currents without them passing through electronic equipment.

Metal grounds must be mechanically connected to each other with the largest possible electrical contact area. Under no circumstances can the earth connections designed to protect people, by linking metal grounds to earth via a cable, serve as a substitute for the ground connections (see IEC 61000-5-2). The immunity and radio-frequency emission level are directly linked to the quality of the ground connections.

## 4.5 - Basic precautions for installation

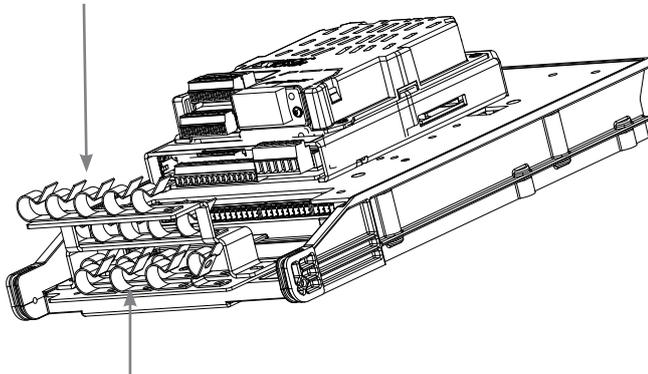
These should be taken into account when wiring the **Powerdrive MD2SL** and the external components. In each paragraph, they are listed in decreasing order of effect on correct operation of the installation.

### 4.5.1 - Wiring inside the cabinet

- Separate as far as possible control cables and power cables (Do not run them in the same cable ducts).
- For control cables, use shielded twisted cables and connect the shield to the grounding bracket.

The bracket for connecting the option shielding is supplied with each option. To attach it, screw the bracket, placing it on top of the control cable shielding clamps (the shielding clamp furthest to the right should be removed).

Grounding bracket  
of the options



Grounding bracket

### 4.5.2 - Wiring outside the cabinet

#### 4.5.2.1 - Control wiring

If the control cable needs to run outside the cabinet, use a shielded cable and connect the shield to the grounding bracket.

#### 4.5.2.2 - Power wiring

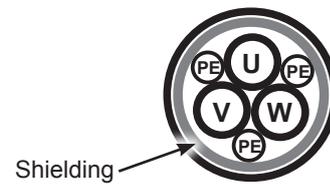
- **Connect the motor earth terminal directly to that of the drive.**



**Never use shielded single-core cables**

**Use shielded 3-core cables with symmetrical conductors for protective earthing as indicated below.**

The shield must be connected at both ends: drive end and motor end (connected round the whole circumference).



A separate PE protective conductor is mandatory if the conductivity of the cable shielding is less than 50% of the conductivity of the phase conductor.

- The shielding must be connected at both ends: drive end and motor end (connected round the whole circumference).
- In the second industrial environment, the shielded motor power supply cable can be replaced by a 3-core + earth cable placed in a fully enclosed metal conduit (metal cable duct for example). This metal conduit must be mechanically connected to the electrical cabinet and the structure supporting the motor.

If the conduit consists of several pieces, these should be interconnected by braids to ensure earth continuity. The cables must be positioned and held in a cloverleaf formation in the conduit.



- There is no need to shield the power supply cables between the mains supply and the drive.
- Isolate the power cables from the control cables. The power cables must intersect the other cables at an angle of 90°.
- Isolate sensitive elements (probes, sensors, etc) from metal structures which may be shared by the motor support.
- The motor cables and network power cables should not be routed side by side in the same channel to reduce proximity couplings.

## 4.6 - Electromagnetic compatibility (EMC)

**CAUTION:**

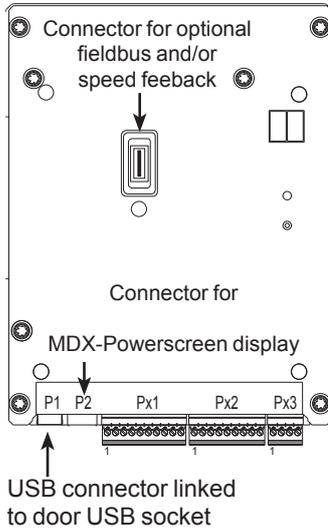
Conformity of the drive is only assured when the mechanical and electrical installation instructions described in this manual are adhered to.

Immunity			
Standard	Description	Application	Conformity
IEC 61000-4-2	Electrostatic discharges	Product casing	Level 3 (industrial)
EN 61000-4-2			
IEC 61000-4-3	Immunity standards for radiated radio-frequency	Product casing	Level 3 (industrial)
EN 61000-4-3			
IEC 61000-4-4	Bursts of fast transients	Control cable	Level 4 (industrially hardened)
EN 61000-4-4		Power cable	Level 3 (industrial)
IEC 61000-4-5	Shock waves	Power cables	Level 4
EN 61000-4-5			
IEC 61000-4-6	Generic immunity standards for conducted radio-frequency	Control and power cables	Level 3 (industrial)
EN 61000-4-6			
EN 50082-2	Generic immunity standards for the industrial environment	-	Conforming
IEC 61000-6-2			
EN 61000-6-2			
EN 61800-3	Variable speed drive standards		Conforming to the first and second environment
IEC 61800-3			
EN 61000-3			

## 5 - PARAMETER-SETTING INTERFACE AND OPTIONS

### 5.1 - Parameter setting interfaces

#### 5.1.1 - Location of the drive connectors / ports



##### ◦ P1 connector

This connector is a slave type B USB connector linked to door USB socket, and is used to communicate via PC using the MDX-SOFT software.

**⚠ In conformity with standard EN 60950, the USB link can only be used via a device that provides isolation of 4 kV (MDX-USB isolator option).**

##### ◦ P2 terminal block

This is a standard RS485/RS422 terminal block which is used to connect a parameter-setting interface (MDX Powerscreen, MDX Keypad) or to communicate via Modbus RTU.

Terminals	Description
1	0V
2	Rx\, Tx\
3	Rx, Tx
4	24V

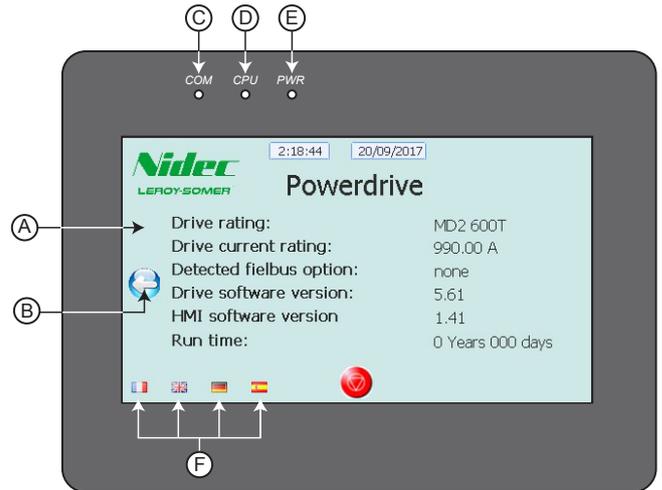
**⚠ Check that control circuits are powered down before disconnecting the programming interface from the P2 connector.**

#### 5.1.2 - MDX-Powerscreen

##### • General

The POWERSCREEN interface is a touch screen which can be used to access various menus to setup and supervise the drive. It is installed as standard on the **POWERDRIVE MD2SL**.

After the loading phase following the power-up of the drive, the parameter-setting interface displays the screen below in french. Select language using the "F" buttons below



Ref.	Function
A	4.3" touch screen
B	Touch-sensitive button to access the main menu
C	"COM" LED, indicates the state of the communication with the drive. Off: no communication Flashing: communicating
D	"CPU" LED, indicates the status of the interface CPU
E	"PWR" LED, indicates the state of the interface power supply
F	Touch-sensitive buttons for language selection (can take a few minutes to load)

## • Architecture

From the welcome screen, press the  button to access the main page of the parameter-setting interface, consisting of 5 touch-sensitive buttons:

- **Information**: Can be used to obtain information very quickly about the drive, the fieldbus option, the parameter-setting interface, and can also be used to select the language.
- **Read mode**: Is used to display the status of the drive when stopped or in operation, as well as its main operating data.
- **Parameter setting**: Used for reading and/or modifying all the drive parameters, as well as setting the date and time on the display.
- **Control via keypad**: Gives direct access to motor control via the touch screen (Run/Stop, direction of rotation, speed reference). These screen parameters can be set using the Parameter setting/Parameter setting via the keypad menu. Control via the keypad is disabled in factory-set configuration.
- **Trip history**: Gives a quick overview of the last 10 drive trips.
-  : This button is accessible on all screens in factory-set configuration and is used to give a stop command (can be disabled).

At any time and regardless of the screen displayed, the  button can be used to return to previous pages, as far as the interface main page.

For further information, see the commissioning manual ref. 4617.

## MDX-SOFT

The MDX-SOFT enables parameter setting or supervision of the **Powerdrive MD2SL** from a PC. Numerous functions are available:

- Fast commissioning
- File saving
- Comparison of 2 files or one file with the factory settings
- Printing of a complete file or differences compared to the factory settings
- Supervision
- Diagnostics

**To connect the PC to the Powerdrive MD2SL, use an "MDX-USB Isolator" isolated USB cable.**

This software can be downloaded from the web at the following address: <http://www.emersonindustrial.com/>

**Powerdrive MD2SL** can be set via the USB connector, even if the drive is not powered.

Attention. In this case, options modules will not be powered and settings will not be saved. To make an option module setting / backup , it is necessary to provide an auxiliary power supply.

## 5.2 - Add-on options

The control board is designed to be plugged with various optional modules. Several options can be combined:

- Fieldbus (see section 5.2.1)
- Speed feedback (see section 5.2.2)
- Additional I/O (see section 5.2.3)

### 5.2.1 - Fieldbus modules

Depending on the configuration of the speed feedback and inputs/outputs optional modules, two types of fieldbus are proposed:



**MDX option:** option to be fitted to the control board



**CM module:** compact module to be integrated in an existing MDX board

Association table :

Main option	Fieldbus	
	MDX version	CM version
None		
MDX-ENCODER		X
MDX-RESOLVER		X
MDX-I/O Lite		X
MDX I/O M2M	X	
MDX-ENCODER + MDX I/O M2M		X
MDX-RESOLVER + MDX I/O M2M		X

Fieldbus modules can be used to communicate with the corresponding networks respective. They can be integrated in and are supplied by the drive.

The following fieldbus are available on **Powerdrive MD2SL** :

- **MDX/CM-MODBUS** : Modbus RTU (RS485/232)
- **MDX/CM-ETHERNET** : Modbus TCP (Ethernet)
- **MDX/CM-ETHERNET-IP** : EtherNet/IP
- **MDX/CM-PROFIBUS** : Profibus DP V1
- **MDX/CM-PROFINET** : ProfiNet

For more details, consult the specific documentations.

### 5.2.2 - Speed feedback options



Two options are available to manage the motor speed feedback. :

- **MDX-ENCODER:** The MDX-ENCODER option is used to It manages incremental encoders with or without commutation channels (up to 500kHz).
- **MDX-RESOLVER:** The MDX-RESOLVER option is used to manage 2 to 8 poles resolvers.

For more details, consult the specific documentations.

### 5.2.3 - Additional I/O options

Two options are available to increase the **Powerdrive MD2SL** number of inputs and outputs :



**MDX-I/O LITE**



**MDX-I/O M2M**

Fonctions	MDX-I/O Lite	MDX-I/O M2M
Analog input (V, mA)	-	1
Differential analog input (V, mA)	1	1
Analog outputs (V, mA)	2	1
Motor thermistor KTY84-130 or PT100	1	1
Digital inputs	2	4
Digital outputs	1	2
Assignable relay	1	2
Drive forced fan's management	✓	✓
Real time clock	-	✓
<b>Ethernet connection :</b>		
• WEB pages: drive configuration and status	-	✓
• 2 Programmable emails		
• Configuration backup & restoration		
<b>Datalogger</b>	-	✓

For more details, consult the specific documentations.

### 5.3 - Electrical protections

In the factory, a switching device can be integrated as an option to the **Powerdrive MD2SL**.

**⚠ The optional power switch integrated to the drive doesn't isolate the input busbars of the drive. During the installation and maintenance operation ensure that the supply line is open.**

References and size of the options below, mounted in a **Powerdrive MD2SL**, are detailed in the Leroy-Somer Configurator : <http://configurateurls.leroy-somer.com>

#### 5.3.1 - aR semi-conductor fuses

The aR semiconductor fuses limit the consequences of an incident related to a short-circuit in the drive. They don't provide protection to the drive power line and must always be associated with a protective device against overload located upstream the line.  
aR semiconductor fuses kits (optional Fu aR) are available for **Powerdrive MD2SL**.

#### 5.3.2 - Line switch

**A 3-pole switch is available for the Powerdrive MD2SL. This option is used to isolate the motor from the AC supply during maintenance operations.**

- Fully visible break with padlockable handle on the front of the drive cabinet (can be turned manually, padlock not supplied)
- Conforming to standard IEC/EN 60947-3

The QS3P switch must **always** be included in aR semi-conductor fuse kits, in accordance with the table in section 3.1.5.

The QS3P switch is necessarily associated with semiconductor aR fuses in compliance with table § 3.1.

#### Characteristics at 40°C in category AC21

$I_{th}$  = thermal current

Powerdrive MD2SL rating	Switch			
	Reference	$I_{th}$ @ 400V (A)	$I_{th}$ @ 690V (A)	Number of operations
180T & 220T	QS3P_400A	400	400	5 000
270TH & 340TH				
270T & 340T	QS3P_630A	630	630	5 000
400TH to 600TH				
400T	QS3P_800A	800	800	3 000
750TH				
470T to 570T	QS3P_1000A	1000	800	3 000
750T	QS3P_1250A	1250	1000	4 000
900TH				
900T	QS3P_1600A	1600	1000	4 000
1100T	QS3P_1800A	1800	1000	4 000
1400T & 1700T	Contact your local technical support.			
1200TH to 1800TH				

### 5.3.3 - Emergency stop

- **MD2-AU1: SIL1/PLb protection device**

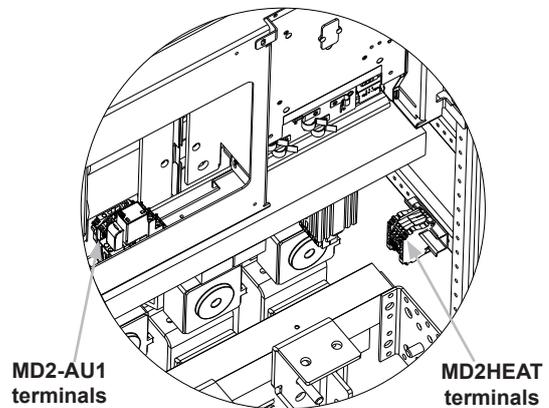
The MD2-AU1 protection device consists of an emergency stop wired on the STO inputs and mounted on the front.

- **SIL3/PLe protection device**

The **Powerdrive MD2SL** can be made compatible with SIL3/PLe by incorporating a safety relay for double channel locking.  
Contact LEROY-SOMER.

### 5.4 - Heater kit

To prevent condensation in the **Powerdrive MD2SL** a self-limited temperature heater is available as an option.  
The intaller must provide ~230V single phase protection (fuse rating indicated below) and ensure its control (the module must be turned off when the drive is in operation).



### 5.5 - RFI filters

The use of RFI filters contributes to a reduction in the emission levels of radio-frequency signals. They allow the compliance of the **Powerdrive MD2SL** components with the variable speed standard EN61800-3.

Depending on the drive and the application, install the RFI filter recommended (available as option) between the mains and the drive input.

**CAUTION:**  
The specific design of these filters makes it possible to connect to IT power supplies. The installer should, however, ensure that insulation supervision systems dedicated to these installations are suitable for monitoring electrical equipment that may contain electronic variable speed drives.

## 6 - TRIPS - DIAGNOSTICS

### 6.1 - Safety notice

 **The user must not attempt to repair the drive himself, nor perform diagnostics other than those listed in this section. If the drive malfunctions, please contact your local technical support.**

### 6.2 - Alarms

Alarms may appear during drive operation.

These alarms are for information only, in order to warn the user: the drive continues to operate but may trigger a safetrip if no corrective action is taken.

The HMI displays a page «active trips» where «ALARM» appears at the top of the screen. All alarms shown on the console or the configuration interface are listed in the following table.

On the drive control board, 2 LED displays indicate alternately "A.L." and a number that can be used to identify the alarm by means of the table below (this number corresponds to the value of parameter **10.97**).

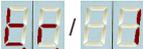
Code	No.	Meaning
A.L.	1 to 4	User alarm 1 ( <b>10.54</b> ) to User alarm 4 ( <b>10.54</b> )
	6	Motor overload ( <b>10.17</b> )
	7	Drive overtemperature ( <b>10.18</b> )
	8	Microcontroller overoccupancy
	9	Rectifier
	10	Emergency operation (see menu 20)

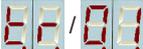
### 6.3 - Tripping on a safetrip

If the drive trips, the drive output bridge is inactive, and the drive no longer controls the motor.

When a trip is active, the LEDs present on the control board display alternately "t.r." and a number that can be used to identify the active trip (see left-hand column in the table below). For trips numbered higher than 100, only the last 2 digits are displayed with a point displayed on both LEDs to indicate the hundred.

Example:

 : indicates trip no. 1

 : indicates trip no. 101

After consulting the table, follow the procedure below:

- Make sure that the drive is disabled (STO-1 and STO-2 terminals open)
- Isolate the drive power supply
- Carry out the necessary checks in order to eliminate the reason for the trip
- Activate the STO-1 and STO-2 inputs to clear the trip

The HMI displays an active trip page, where "TRIP" appears at the top of the screen.

All the trips indicated on the keypad or parameter-setting interface are listed in the table below.

 **Opening and then closing the STO-1/STO-2 drive enable terminals and clear the trip. If the Run FWD or Run reverse terminal is closed at that time, the motor may or may not start immediately, depending on the setting of Ctr.06 (06.04).**

No.	Parameter-setting interface name	Reason for trip	Solution
1	DC UnderVolt	DC bus undervoltage	<ul style="list-style-type: none"> <li>• Check the input fuses.</li> <li>• Check the quality of the power supply (voltage dips).</li> </ul>
2	DC over volt	DC bus overvoltage	<ul style="list-style-type: none"> <li>• Check that the mains voltage is within the permitted tolerance.</li> <li>• Check the quality of the power supply (commutation notches or transient overvoltages).</li> <li>• Check the motor insulation.</li> <li>• Check that the deceleration mode (<b>02.04</b>) is compatible with the application.</li> <li>• If an MD2-TF option is used, check its size, its wiring and the state of the thermal relay.</li> </ul>
3	Over current	Overcurrent at drive output	<ul style="list-style-type: none"> <li>• Check the motor insulation.</li> <li>• Check the motor cables (connections and insulation).</li> <li>• Check the quality of the mains supply.</li> </ul>
<b>This trip cannot be reset for a period of 10 seconds.</b>			

No.	Parameter-setting interface name	Reason for trip	Solution
4	Brak. IGBT	Braking IGBT transistor overcurrent	<ul style="list-style-type: none"> <li>• Check the braking resistor wiring and insulation level.</li> <li>• Make sure that the resistor ohmic value is compatible with the MD-TF option used.</li> </ul>
		<b>This trip cannot be reset for a period of 10 seconds.</b>	
5	I IMBALANCED	Motor current imbalance: vectorial sum of the 3 motor currents is not zero	<ul style="list-style-type: none"> <li>• Check the motor insulation.</li> <li>• Check the cable insulation.</li> </ul>
6	Out Ph. loss of a motor phase	Loss of a motor phase	Check the motor cable and resistance values between motor phases.
7	Overspeed	The speed is greater than $(1.3 \times \mathbf{01.06})$ or $(\mathbf{01.06} + 1000 \text{ rpm})$	<ul style="list-style-type: none"> <li>• Check the drive settings.</li> <li>• When the flying restart function is not being used, check that <b>06.09</b> is at "Disabled".</li> </ul>
8	Drive overload lxt	The drive overload level exceeds the conditions defined in section 1.4.2 of the installation manual	<ul style="list-style-type: none"> <li>• Check the drive is suitable for the motor current cycle.</li> <li>• Check the ambient temperature.</li> </ul>
9	IGBT U	Internal protection of phase U IGBTs	<ul style="list-style-type: none"> <li>• Check the motor and cable insulation.</li> <li>• Run power diagnostics.</li> </ul>
10	Th rectifier	Rectifier heatsink temperature too high	<ul style="list-style-type: none"> <li>• Clean the cabinet dust filters.</li> <li>• Check the drive external and internal fans are working correctly.</li> <li>• Check that the product air inlet temperature is not outside the limits.</li> </ul>
11	Encoder rot	The measured position does not vary (only if a feedback speed option is present)	<ul style="list-style-type: none"> <li>• Check the encoder wiring.</li> <li>• Check that the motor shaft turns.</li> </ul>
13	UVW invert	The encoder U, V, W signals are reversed (only if a feedback speed option is present)	Check the conformity of the encoder wiring.
14	TUNE U Encod	During the autotune phase, one of the encoder U, V or W commutation channels is not present	<ul style="list-style-type: none"> <li>• Check the encoder wiring.</li> <li>• Check the encoder connections.</li> <li>• Change the encoder.</li> </ul>
15	TUNE V Encod		
16	TUNE W Encod		
18	AUTOTUNE	A stop command has been given during the autotune phase.	Repeat the autotune procedure (see <b>05.12</b> )
19	Brak. resist.	Parameter <b>10.39</b> "Braking energy overload accumulator" has reached 100%	<ul style="list-style-type: none"> <li>• Check the settings of <b>10.30</b> and <b>10.31</b>.</li> <li>• Check the resistor is compatible with the application requirements.</li> </ul>
21	IGBT U overheating	Overheating of phase U IGBTs	<ul style="list-style-type: none"> <li>• Clean the cabinet dust filters.</li> <li>• Check the drive ventilation units are working correctly.</li> <li>• Check that the product air inlet temperature is not outside the limits.</li> <li>• If the trip appears at frequencies lower than 10 Hz, check that the current levels depending on the frequency are complied with.</li> <li>• Check that the switching frequency <b>05.18</b> is compatible with the motor current level.</li> </ul>

TRIPS - DIAGNOSTICS

No.	Parameter-setting interface name	Reason for trip	Solution
24	Motor PTC	Opening of the PTC input of the PX1 terminal block or T1 and T2 inputs of the MDX-ENCODER option	<ul style="list-style-type: none"> <li>• Check the ambient temperature around the motor.</li> <li>• Check that the motor current is less than the stated current.</li> <li>• Check the thermal sensor wiring.</li> </ul>
26	Overload + 24V	Overload on the +24 V power supply or digital outputs	Check the I/O wiring.
28	AI2 loss	Loss of the current reference on analog input AI2	Check the input wiring and source.
29	AI3 loss	Loss of the current reference on analog input AI3	
30	COM loss	Loss of communication on the P2 connector serial link	<ul style="list-style-type: none"> <li>• Check the cable connections.</li> <li>• Check that parameter <b>11.63</b> is compatible with the timing of requests from the master.</li> </ul>
31	EEPROM	Number of write cycles to EEPROM exceeded (>1,000,000)	<ul style="list-style-type: none"> <li>• Change the control board.</li> <li>• Check the recurrence of write cycles from the drive controller.</li> </ul>
33	Stator resistance	Trip during measurement of the stator resistance	Check the motor wiring.
34	Fieldbus loss	Disconnection of the fieldbus during operation or timing error	<ul style="list-style-type: none"> <li>• Check the fieldbus connections.</li> <li>• Check that parameter <b>15.07</b> is compatible with the timing of requests from the master.</li> </ul>
35	STO inputs	Simultaneous opening of both STO (Safe Torque Off) inputs during operation	Check the remote control link.
37	Encoder break	One of the encoder feedback data items is missing	<ul style="list-style-type: none"> <li>• Check the encoder wiring.</li> <li>• Check the encoder connections.</li> </ul>
38	Breakdown	Breakdown of synchronous motor in sensorless closed loop mode	Check the menu <b>5</b> parameters are compatible with the values on the motor nameplate
39	Mains synchro	Not used	
41	User 1	User trip 1 triggered by <b>10.61</b> .	• See <b>10.61</b> .
42	User 2	User trip 2 triggered by <b>10.63</b> .	• See <b>10.63</b> .
43	User 3	User trip 3 triggered by <b>10.65</b> .	• See <b>10.65</b> .
44	User 4	User trip 4 triggered by <b>10.67</b> .	• See <b>10.67</b> .
45	User 5	User trip 5 triggered by the serial link <b>10.38</b> = 45	• See <b>10.38</b> .
46	User 6	User trip 6 triggered by the serial link <b>10.38</b> = 46	
47	User 7	User trip 7 triggered by the serial link <b>10.38</b> = 47	
48	User 8	User trip 8 triggered by the serial link <b>10.38</b> = 48	
49	User 9	User trip 9 triggered by the serial link <b>10.38</b> = 49	
50	User 10	User trip 10 triggered by the serial link <b>10.38</b> = 50	
51	DO2 MDX-I/O over Id	The DO2 output load current (MDX-I/O option) is >200 mA	Check that DO2 is not short-circuited.

No.	Parameter-setting interface name	Reason for trip	Solution
52	DO3 MDX-I/O over Id	The DO3 output load current (MDX-I/O option) is >200 mA	Check that DO3 is not short-circuited.
53	MDX-I/O link	Communication problem between the drive and the MDX-I/O option	Check the MDX-I/O option mounting.
54		Not used	
55	Unstable DC bus	The drive DC bus oscillates significantly	<ul style="list-style-type: none"> <li>• Check the balancing of the mains phases.</li> <li>• Check that all 3 mains phases are present.</li> </ul>
56	IGBT V	Internal protection of phase V IGBTs	<ul style="list-style-type: none"> <li>• Check the motor and cable insulation.</li> <li>•</li> </ul>
57	IGBT W	Internal protection of phase W IGBTs	
58	IGBT V overheating	Overheating of phase V IGBTs	<ul style="list-style-type: none"> <li>• Clean the cabinet dust filters.</li> <li>• Check the drive ventilation units are working correctly.</li> <li>• Check that the product air inlet temperature is not outside the limits.</li> <li>• If the trip appears at frequencies lower than 10 Hz, check that the current levels depending on the frequency have been complied with.</li> <li>• Check that the switching frequency <b>05.18</b> is compatible with the motor current level.</li> </ul>
59	IGBT W overheating	Overheating of phase W IGBTs	
60	Diagnostic	Problem detected during the control and interface boards test, the power test or during the self-test	<ul style="list-style-type: none"> <li>• Check that the STO1 and STO2 inputs are closed.</li> <li>• See diagnostic error table.</li> </ul>
63	STO input inconsistency	The STO1 and STO2 inputs have had a different state for more than 100 ms	Check the remote control link for the STO1 and STO2 inputs.
65	10V over Id	Overload on the +10 V power supply	Check the I/O wiring
66	DO1 over Id	The DO1 output load current is >200 mA	Check that DO1 is not short-circuited.
67	Internal ventilation	Not used	
68	Motor overcurrent	The current has exceeded the limit programmed in <b>05.55</b> . The load is too high for the setting.	Check that <b>05.55</b> is consistent with the application.
69	24 V MDX-I/O over Id	The 24 V load current is too high	Check the MDX-I/O option I/O wiring.
70	4 mA loss on MDX-IO AI4	Loss of the current reference on analog input AI4 of the MDX-I/O option	Check the input wiring and source of the MDX-I/O option.
71	4 mA loss on MDX-IO AI5	Loss of the current reference on analog input AI5 of the MDX-I/O option	
101	AC mains loss	Loss of AC supply	<ul style="list-style-type: none"> <li>• Check the input fuses</li> <li>• Check the quality of the power supply (voltage dips)</li> </ul>
102	Rectifier	Not used	

## 7 - MAINTENANCE

- 
 • All work relating to installation, commissioning and maintenance must be carried out by experienced, qualified personnel.
- When a trip detected by the drive causes the motor to stop, fatal residual voltages remain on the terminals and in the drive.
- The drive stop function does not protect against high voltages on the terminal blocks.
- Before carrying out any work on the drive or the motor, disconnect and padlock the isolating switch in the switchboard.
- The line switch integrated as an option in the drive does not isolate the drive input busbars. During the installation and maintenance phases, make sure that the power supply line is disrupted.
- When the drive controls a permanent magnet motor, the isolating switch between the drive and the motor must be open to avoid the risk of motor voltage feedback. If there is no isolating switch, make sure the machine shaft is jammed to prevent it turning while work is carried out.
- After the drive is switched off, the external control circuits can still be active and presents dangerous voltage. Check that these circuits are powered down before working on the control cables.
- Ensure that the DC bus voltage is below 40V before carrying out any work (the control board power-on indicator LED must be off).
- Before any work is carried out, make sure that the water supply to the cooling circuit has been turned off.
- After the drive has been operated, keep away from the heatsink as it may be very hot (70°C).
- After working on the motor, check that the phase order is correct when re-connecting the motor cables.
- All protective covers must remain in place during tests.
- Before performing high voltage tests or voltage withstand tests on the motor, switch off the drive and disconnect the motor.

There are very few maintenance and repair operations to be performed by the user on **Powerdrive MD2SL** drives. Regular servicing operations are described below. See section 2.3.3.4 for liquid cooling circuit maintenance.

### • Servicing

Printed circuits and drive components do not normally require any maintenance. Contact your vendor or the nearest approved repair company in the event of a problem.

#### **CAUTION:**

**Do not dismantle the printed circuits while the drive is still under warranty, as this immediately makes the warranty null and void.**

Do not touch the integrated circuits or the microprocessor with your fingers (ESD risk).

From time to time, with the drive powered down, check that the power connections are correctly tightened. The door filters must be checked and changed regularly depending on their state.

### • Preventive maintenance

Device	Action	Frequency
Door filters (10µm)	Clean (1)	3 months
	Replace	2 years
Power connections	Check tightness	1 year
Internal ventilation and in cabinet roof	Replace	5 years
Surge suppressor board	Replace	5 years

## 7.1 - Storage

The **Powerdrive MD2SL** incorporates aluminium electrolytic capacitors.

If the drive has been stored for more than 12 months, it must therefore be switched on for 5 hrs at the rated operating voltage, and this operation must be repeated every 6 months. If the drive has been stored for more than 36 months, the capacitors must be reformed.

This consists of gradually applying a DC voltage to the banks of capacitors, until voltage values close to the rated voltages are achieved, while ensuring that the dissipated power does not exceed the maximum values authorised by the manufacturer.

An instruction sheet is available - please contact your local technical support.

## 7.2 - Replacing products

#### **CAUTION:**

**Products must be returned in their original packaging or in similar packaging, to prevent them being damaged. Otherwise, replacement under warranty could be refused.**

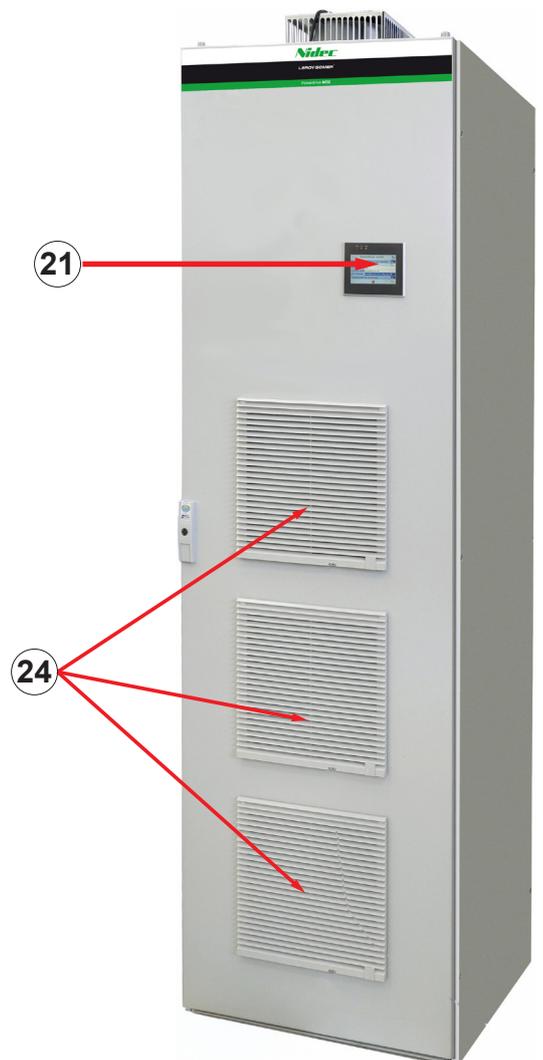
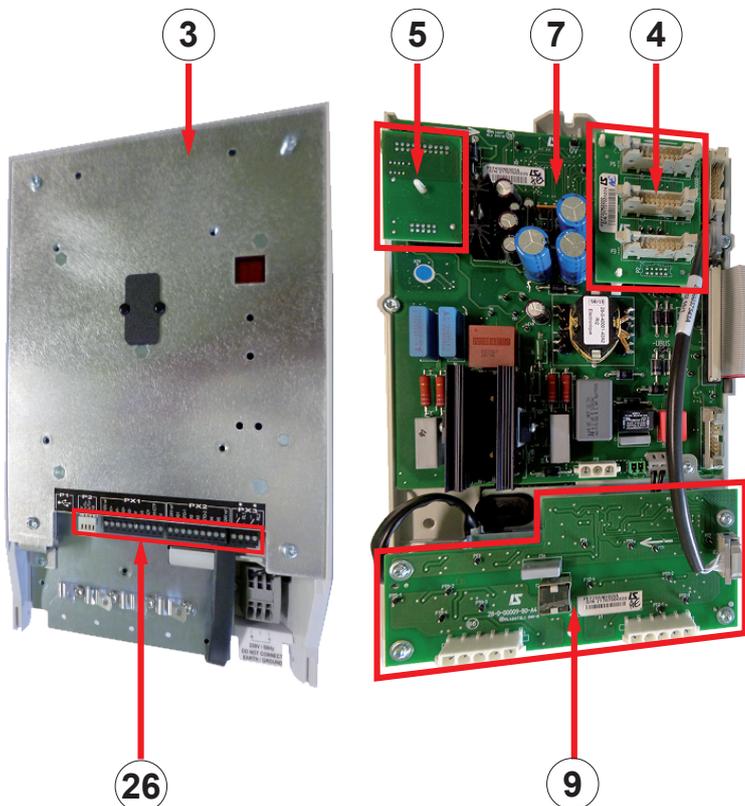
### 7.3 - List of spare parts

#### 7.3.1 - Electronic PCB

Rep.	Description	LS code
3	Control board	PEF400NB000A
4	Distribution board 60T to 150T	PEF190NE000A
	Distribution board ratings 180T to 570T ratings 270TH to 500TH	PEF720NG000
5	Rating identification Board	Consult. LS
7	Interface board 60T to 270T	PEF400NE001A
	Interface board 340T to 570T	PEF400NE003A
	Interface board 270TH to 500TH	PEF280NE100A
9	Voltage sensing Board	PEF280NH000A
26	Control board terminal blocs	KITCTRLTERM

#### 7.3.2 - Front panel mounted parts

Key	Description	LS code
21	HMI : MDX POWERSCREEN	RDKITIHMMDO5PR2
24	Enclosure Outlet filter	VEN323FV000
	Set of 5 filter cartridges	40018862



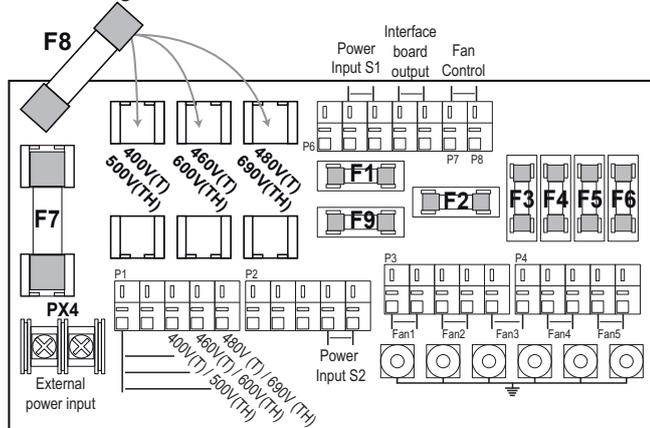
### 7.3.3 - Remote control fuses

#### • Input protection board (Key 10)

Board reference:

«T» rating: PEF28ANE000A

«TH» rating: PEF280NL000A



#### • Fuse kit (Key 25)

All **Powerdrive MD2SL** control fuses can be order in the kit: **EDA016LF006**. It included the following parts :

- 3 fus. 5X20 1,25A
- 3 fus. AM 10X38 4A
- 3 fus. AM 10X38 6A
- 3 fus. T6X32 2A

### 7.3.4 - Other parts

Key	Description	LS code
1	Rectifier module	Consult LS
2	Inverter module	Consult LS
6	DC bus sensing board	PEF720NH000
8	EMC Board	PEF180NA000A
27	Transformer	TRF115MA001
31	Top panel cooling fan	BLOCVFTOIT
40	Line choke (optional)	Consult LS

#### ◦ Protection fuses for the forced ventilation units :

Fuse	Size	Type	Value
F2 to F6	5 x 20	SA	1.25A/250V

#### ◦ Protection fuses for the control electronics (all ratings):

Fuse	Size	Type	Value
F1	5 x 20	SA	1.25A/250V
F9			

Note: F9 is not used on the **Powerdrive MD2SL**

#### ◦ Protection fuses for the transformer primary :

Rating	Fuse	Size	Type	Value
T	F7	10 x 38	aM/ATQ	4A/500V
	F8			
TH	F7	10 x 38	aM	4A/690V
	F8			

#### • Motor output bar fuse

Board reference:

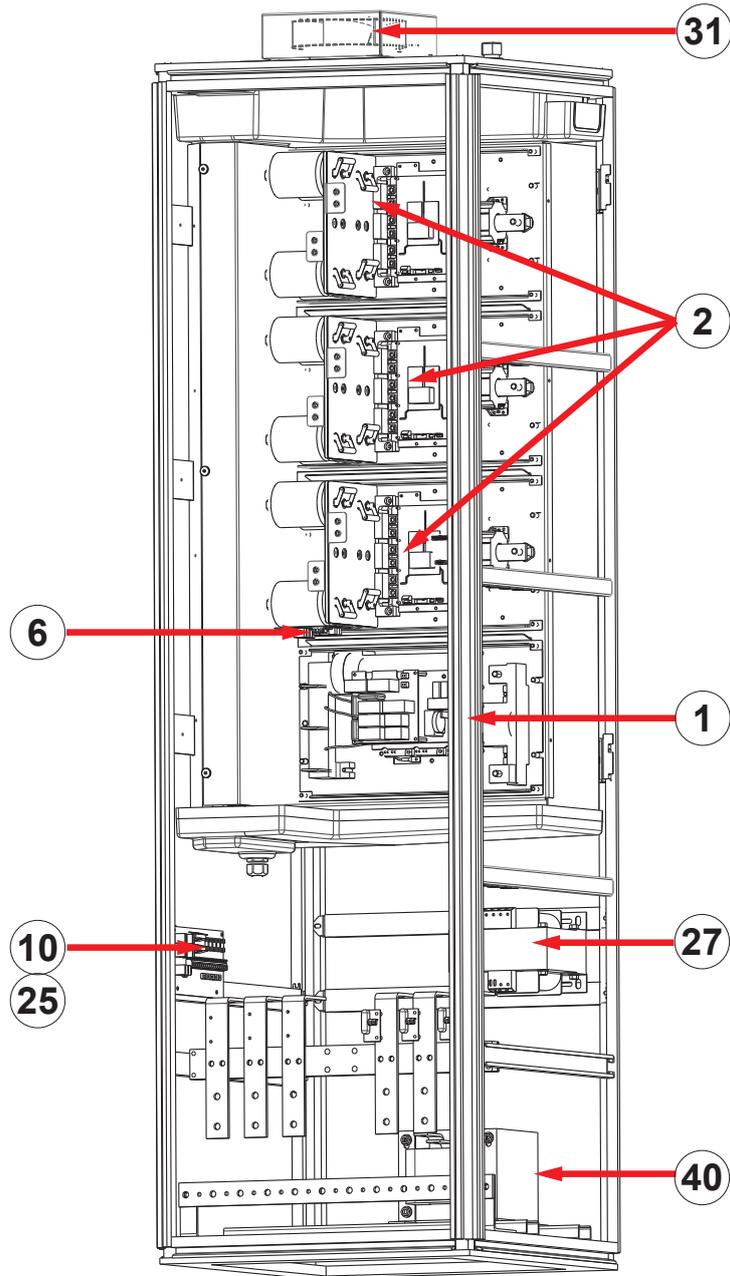
- Ratings 340T to 1400T : PEF240NK000
- Ratings 270T to 1500TH : PEF240NU102A

Rating	Fuse	Size	Type	Value
T	F1 - F2 - F3	6 x 32	U <sub>R</sub>	2A/660 V
TH		6 x 32	U <sub>R</sub>	4A/690V

#### • Fuse on the DC bus sensing board (Key 6)

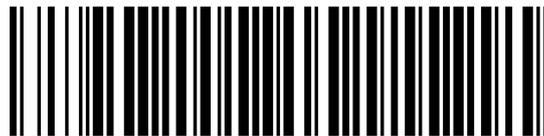
These fuses are under the capacitor blocks of the power bridges, above the control block.

Fuse	Size	Type	Value
F1 - F2	6 x 32	FA	2 A/660 V



***Nidec***  
All for dreams

**LEROY-SOMER<sup>TM</sup>**



IMP297NO 667

Moteurs Leroy-Somer  
Headquarter: Boulevard Marcellin Leroy - CS 10015  
16915 ANGOULÊME Cedex 9

Limited company with capital of 65,800,512 €  
RCS Angoulême 338 567 258

[www.leroy-somer.com](http://www.leroy-somer.com)