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## Installation, use and maintenance manual



**BEFORE PUTTING THE COSMOS 3020 INVERTERS INTO SERVICE, CAREFULLY READ THIS MANUAL AND FOLLOW ALL INSTRUCTIONS, IN ORDER TO ENSURE MAXIMUM SAFETY**

# INVERTER COSMOS 3020



The technical data and drawings shown in this manual may have undergone subsequent modifications; always refer to the latest version available.

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## 1 Preface

This manual provides all necessary information for the installation, use and maintenance of COSMOS 3020 inverters.

The instructions included in this manual are addressed to the following professionals:


<b>User</b>	User is a person, a company or an institution that buys the equipment and uses it for the purposes it was designed for.
<b>User/operator</b>	User or operator is a person authorized by the user to operate on the equipment.
<b>Specialized personnel</b>	It refers to all persons with specific competence, able to recognize and avoid the dangers deriving from the use of the equipment.

The present instructions must be made available to all the above individuals.





## 2 General warnings




These assembly instructions are an integral part of the equipment, and must be kept for future reference until it decommissioned.

The user should be informed that the present instructions reflect the state of the art at the moment when the equipment was sold; they will remain fully acceptable despite subsequent upgrades based on new technical update.

	<p><b>DO NOT USE THE EQUIPMENT, NOR MAKE ANY INTERVENTION BEFORE INTEGRALLY READING AND UNDERSTANDING THIS MANUAL.</b></p>
<p><b>IN PARTICULAR, ADOPT ALL SAFETY PRECAUTIONS AND PRESCRIPTIONS INDICATED IN THIS MANUAL.</b></p>	
<p><b>THE EQUIPMENT MUST BE USED FOR PURPOSES DIFFERENT THAN THE ONES DESCRIBED IN THIS MANUAL; SMITEC S.p.A. SHALL NOT BE HELD RESPONSIBLE FOR ANY DAMAGES, INCONVENIENCES OR ACCIDENTS DUE TO THE NON-COMPLIANCE WITH THESE PRESCRIPTIONS.</b></p>	

In order to make the manual consultation easier, the following symbols have been adopted:

	<p>Indication of "PROHIBITED ACTION".</p>
	<p>The symbol "DANGER" is used when non-compliance with the prescriptions or misuse may cause serious injuries.</p>
	<p>The symbol "DANGER FROM HOT SURFACES" is used when non-compliance with the prescriptions or misuse may cause serious injuries.</p>
	<p>The symbol "DANGER FROM ELECTRICAL SHOCK" is used when non-compliance with the prescriptions or misuse may cause serious injuries.</p>




	<p>The symbol “USE OF INDIVIDUAL PROTECTIONS” means that protective gloves must be worn.</p>
	<p>The symbol “USE OF INDIVIDUAL PROTECTIONS” means that protective glasses must be worn.</p>
	<p>Indication of “INFORMATION OF PARTICULAR RELEVANCE”.</p>

The safety prescriptions aim at establishing a series of behaviors and obligations to be complied with, while performing the activities described later on in this manual.



These prescriptions constitute the prescribed method of operating the device, in a way that is safe for personnel, equipments and environment.

### 3 Safety instructions


#### 3.1 General information

	<p>Do not install or use the equipment before integrally reading and understanding this manual. In case of difficulties of interpretation, contact SMITEC technical service.</p> <p>It is absolutely forbidden to use the equipment for different purposes than the ones described in this manual. The technical data and the drawings in this manual might have been modified later; always refer to the latest version. All upgrades can be requested to SMITEC S.p.A. directly.</p>
	<p>Make sure that the personnel is qualified and adequately informed about the risks he may run and how to avoid them.</p>
	<p>The COSMOS 3020 inverters is authorized can be used only after the classification of the machine operating area and after checking the safety levels, which must correspond to the assembly safety levels.</p>

#### 3.2 Precautions during handling and assembly

	<p>Use adequate tools during the assembly, in order to avoid crushing or abrasions.</p>
	<p>Metal components and sharp surfaces may cause cuts and tears. In case of contact, be very careful and wear the personal protection equipment.</p>

### 3.3 Precautions against risk of Electric Shock

	<p>The high voltage of some accessories and components in the inverter might cause electrocution, if the user came into contact with them. Be careful to the terminal boards and to the motor/dynamic brake connection.</p>
	<p>There are some condensers inside the inverter which maintain a dangerous voltage for at least 6 minutes after switching them off. Before starting any operation, make sure that the inverter has been switched off at least 6 minutes earlier and that the motor is still.</p>
	<p>Avoid any metal components (screws, electrical cables...) fall into the inverter during the installation, because they might cause short-circuits.</p>
	<p>The inverter is an electric generator. The running speed becomes electric potential. High voltage is already generated at 300 rpm.</p>
	<p>During installation and maintenance, disconnect the device from the mains power supply. Risk of Electric Shock.</p>
	<p>Some components (such as the aluminium heat sink) are made of conductive materials. They must be safely connected to the protective conductor (PE/Ground) by using the specific terminal strips, in order to avoid Electric Shock.</p>
	<p>Never use the device if it is partially or totally disassembled. Risk of Electric Shock and/or damages to people and properties.</p>

### 3.4 Precautions against hot components

#### **WARNING**



The parts of the apparatus can reach an extremely high temperature in operating mode or post-operation; take particular care not to touch the parts of the equipment in these cases, or use special protections and precautions during handling: HOT SURFACE, RISK OF BURN.

#### **AVERTISSEMENT**



Les pièces de l'appareil peuvent atteindre une température extrêmement élevée en mode de fonctionnement ou post-opération; veuillez particulièrement à ne pas toucher les pièces de l'équipement dans ces cas, ou utilisez des protections et des précautions spéciales lors de la manipulation: SURFACE CHAUDE, RISQUE DE BRÛLURE.

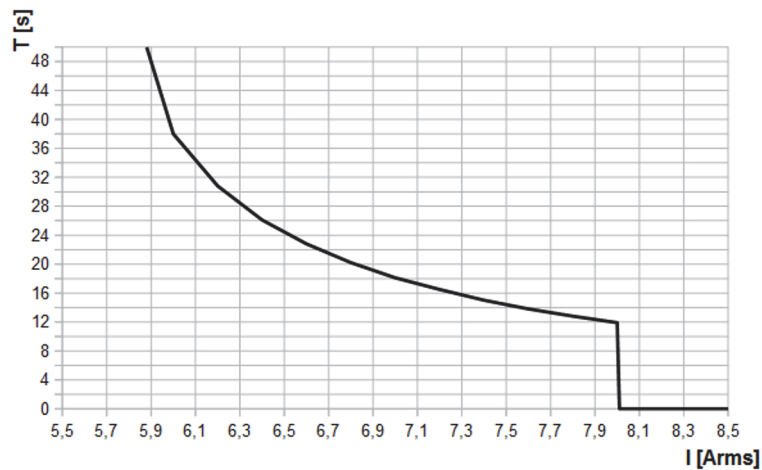


## 4 Data sheet

### 4.1 Description

The COSMOS 3020 inverters are designed for the simultaneous control of two three-phase asynchronous motors; the electronic boards are housed inside a sturdy plastic case, and the dissipation of power is ensured by an aluminium heatsink. To ensure high reliability and quiet operation, they do not have a cooling fan (“fanless”). All power connections are made via screw terminal blocks, while the connectors for the I/O, field bus and encoder are detachable.

These devices implement a V / f scalar type control, with electronic protection on the output current delivered and on the input power input:



#### Limitation of the output current supplied to each individual motor

The power section is made with the latest generation of intelligent IGBT modules, efficient and reliable. Various diagnostic features are available to protect applications and the device itself.

The device is intended for integration into a control system equipped with a proprietary FixIO field bus, which allows a real-time control of the device with cycle times of 1 ms. The electrical connections are made using standard Ethernet cables and connectors (cat.5e).

The inverter is also equipped with four 24V digital inputs for interfacing standard industrial sensors, and an incremental encoder input for position / speed readings.

The COSMOS 3020 inverters have been designed for use in heavy industrial environments (“second environment” as indicated in EN IEC 61800-3).

4.2 Reference documents

Code	Description
DK400211	COSMOS 3020 user and programming manual

4.3 Technical data

4.3.1 Environmental characteristics

<b>Operating temperature</b>	0° ÷ 40°C without derating (full output current)												
	0° ÷ 55°C with derating (reduced output current)												
<b>Maximum surrounding air temperature (UL)</b>	40°C without derating (full output current)												
	55°C with derating (reduced output current)												
<b>Installation environment</b>	Use in Pollution degree 2 Environment												
<b>Overvoltage category</b>	III (3)												
<b>Output current derating as a function of the ambient temperature</b>	<table border="1"> <caption>Output current derating as a function of the ambient temperature</caption> <thead> <tr> <th>T<sub>amb</sub> [°C]</th> <th>I<sub>out</sub> [%]</th> </tr> </thead> <tbody> <tr> <td>40</td> <td>100</td> </tr> <tr> <td>45</td> <td>90</td> </tr> <tr> <td>50</td> <td>80</td> </tr> <tr> <td>55</td> <td>70</td> </tr> </tbody> </table>	T <sub>amb</sub> [°C]	I <sub>out</sub> [%]	40	100	45	90	50	80	55	70		
T <sub>amb</sub> [°C]	I <sub>out</sub> [%]												
40	100												
45	90												
50	80												
55	70												
<b>Derating current output as a function of distance from obstructions</b>	<table border="1"> <caption>Derating current output as a function of distance from obstructions</caption> <thead> <tr> <th>c [mm]</th> <th>I<sub>out</sub> [%]</th> </tr> </thead> <tbody> <tr> <td>100</td> <td>100</td> </tr> <tr> <td>80</td> <td>98</td> </tr> <tr> <td>60</td> <td>95</td> </tr> <tr> <td>40</td> <td>90</td> </tr> <tr> <td>20</td> <td>75</td> </tr> </tbody> </table>	c [mm]	I <sub>out</sub> [%]	100	100	80	98	60	95	40	90	20	75
c [mm]	I <sub>out</sub> [%]												
100	100												
80	98												
60	95												
40	90												
20	75												
<b>Air humidity during operation</b>	5 ÷ 85% non-condensing												
<b>Storage temperature</b>	-25 ÷ +55°C												

<b>Air humidity during storage</b>	5 ÷ 95%												
<b>Air humidity during transport</b>	5 ÷ 95%												
<b>Maximum altitude</b>	1000 m (on the sea level) at nominal output current												
	2000 m (on the sea level) with current derating												
<b>Output current derating as a function of altitude</b>	<table border="1"> <caption>Data points for Output current derating as a function of altitude</caption> <thead> <tr> <th>Altitude h [m]</th> <th>Output current I<sub>out</sub> [%]</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>100</td> </tr> <tr> <td>1000</td> <td>100</td> </tr> <tr> <td>2000</td> <td>90</td> </tr> <tr> <td>3000</td> <td>80</td> </tr> <tr> <td>4000</td> <td>70</td> </tr> </tbody> </table>	Altitude h [m]	Output current I <sub>out</sub> [%]	0	100	1000	100	2000	90	3000	80	4000	70
Altitude h [m]	Output current I <sub>out</sub> [%]												
0	100												
1000	100												
2000	90												
3000	80												
4000	70												

**4.3.2 Power supplies**

<b>Main power supply voltage</b>	Single phase 230 Vac ± 15% 50/60 Hz
<b>Distribution systems allowed</b>	TT, TN
<b>Maximum short-circuit current</b>	5 kA at the point of installation
<b>Current max. main power supply</b>	10 A RMS
<b>24VDC auxiliary power supply voltage</b>	24 VDC -15 ÷ +20%; ripple max 5% of the nominal value
<b>Current max. auxiliary power supply</b>	0.2 A (without connected I / O)
<b>Output voltage Vs</b>	24VDC (not regulated)
<b>Current max. output Vs</b>	1A (protected with self-resetting fuse)
<b>Reverse polarity protection 24VDC</b>	Present
<b>24VDC overvoltage protection</b>	Bidirectional Zener (Vz>30V)

**4.3.3 Motor outputs**

The inverter is characterized by two outputs motor:

<b>Output voltage</b>	Three phase 0 ÷ 230 V
<b>Output frequency</b>	0÷128 Hz
<b>Switching frequency</b>	4/8/10/12/16kHz
<b>Maximum output current</b>	2.4 A RMS

<b>Size maximum asynchronous motor</b>	0.37kW / 1/2 HP (power to the crankshaft)
<b>Active power deliverable</b>	1 kW max.
<b>Peak output current</b>	12 A
<b>Protections</b>	Phase-to-phase short circuit, overload, inverter over temperature

**4.3.4 Digital inputs**

<b>Number of inputs</b>	4
<b>Type</b>	24V digital inputs compatible with type 1 and type 3 according to IEC 61131-2
<b>Max frequency input signal</b>	1 kHz

### 4.4 Configurations / order codes

Up to date, we defined some standard configurations of inverters, with their order code and type number (4 figures, indicating the series, the maximum current and the release). These data are indicated on the inverter label.

<b>TYPE</b>	*	**	*	*	*
<u>Series</u>					
<b>3</b> = 3000					
<u>Peak current</u>					
<b>01</b> = 14Apk – 0,75kW					
<b>02</b> = 2 x 12Apk – 0,37kW					
<b>15</b> = 15Apk – 2.2kW					
<b>25</b> = 25Apk – 5.5kW					
<b>50</b> = 50Apk – 7.5kW					
<u>HW Version</u>					
<i>Sequential number, depending on the other figures</i>					
<u>Communication</u>					
<b>C</b> = EtherCAT					
<b>D</b> = Sercos II					
<b>E</b> = Ethernet					
<b>F</b> = FxIO					
<b>N</b> = None					
<b>R</b> = RS485					
<b>S</b> = Sercos III					
<b>T</b> = Flextron					
<u>Type of motor controlled</u>					
<b>A</b> = Asynchronous					
<b>B</b> = Brushless					
<b>U</b> = Brushless + Asynchronous					

Order code	Model	Description
KZ010525	COSMOS 3020-FA	2X12Apk FxIO ASYNC

### 4.5 Model code

The specific features of a COSMOS 3020 inverter are defined by an alpha-numeric code printed on the device label, near the MODEL code. Here is the code table:

MODEL	*	*	*	*	*	*	*	*	*	*	*	*	*	*
<u>Auxiliary power</u>														
<b>1</b> = 24Vdc														
<u>Main power</u>														
<b>1</b> = 230÷480Vac 3PH														
<u>Maximum output current – Asynchronous motor power</u>														
<b>1</b> = 15A <sub>pk</sub> – 2.2kW														
<b>2</b> = 25A <sub>pk</sub> – 5.5kW														
<b>3</b> = 50A <sub>pk</sub> – 7.5kW														
<u>Safe Torque Off (STO) system</u>														
<b>0</b> = Absent														
<b>1</b> = Present														
<u>Dynamic brake</u>														
<b>0</b> = Absent														
<b>1</b> = Present														
<u>Brake resistor</u>														
<b>0</b> = Absent														
<b>1</b> = 2,5kJ														
<b>2</b> = 5,0kJ														
<b>3</b> = 4,0kJ														
<b>4</b> = 0,8kJ														
<u>Encoder</u>														
<b>0</b> = Absent														
<b>1</b> = Incremental 5V diff. phases and HALL TTL + Hiperface														
<b>2</b> = Hiperface														
<b>3</b> = Incremental 5V diff. phases and HALL TTL														
<b>4</b> = Incremental HTL 24V														
<b>5</b> = Incremental 5V diff. phases and HALL TTL + Out														
<b>6</b> = Incremental 5V diff. phases and HALL TTL/diff.														
<u>Forced ventilation</u>														
<b>0</b> = Absent														
<b>1</b> = 1x31,5CFM														
<b>2</b> = 2x31,5CFM														
<b>3</b> = 2x10.8CFM														
<u>Field bus physical layer</u>														
<b>0</b> = Absent														
<b>1</b> = EIA-RS485														
<b>2</b> = Ethernet														
<b>3</b> = POF – Sercos II														
<u>VISIO 3000 support</u>														
<b>*</b> = Absent per Type 3150														
<b>*</b> = Present per Type 3250/3500														
<b>0</b> = Absent														
<b>1</b> = Present														
<u>I/O Configuration</u>														
<b>*</b> = Absent														
<b>0</b> = Absent														
<b>1</b> = Type 1														
<b>2</b> = Type 2														
<u>Reserved</u>														
<u>Reserved</u>														
<u>Reserved</u>														

**4.6 Accessories**



The COSMOS 3020 inverters are supplied with the complete set of detachable connectors for power and I / O connections (where provided). The same connectors can be ordered separately as well as other accessories not included in the inverter. Below is the list of order codes:

Order code	Article
KF101068	24VDC and I / O power connector (8x1)

**4.7 Electromagnetic compatibility (EMC)**

The inverters comply with EN IEC 61800-3 requirements; they must be installed in the second environment, category C3, on the following conditions:

- The connection between the inverter and the motor is made by means of an adequately sized shielded cable.
- The shielded cable must be connected to earth on both sides, with low RF impedance connection
- The motor type and size are suitable for the inverter
- The start-up is performed by technical engineers, according to the instructions of this manual.

	These inverters are not designed for domestic environment ( <i>first-environment</i> , according to EN IEC 61800-3 standards). In this case, it will be necessary to install an additional mains filter.
	The integrated filter ensures compliance with the EN IEC 61800-3, only if a single inverter is operating. The simultaneous operation of more than one inverter might increase the noise level and might exceed the emission levels fixed by the standards. In this case, an additional filter may be necessary.

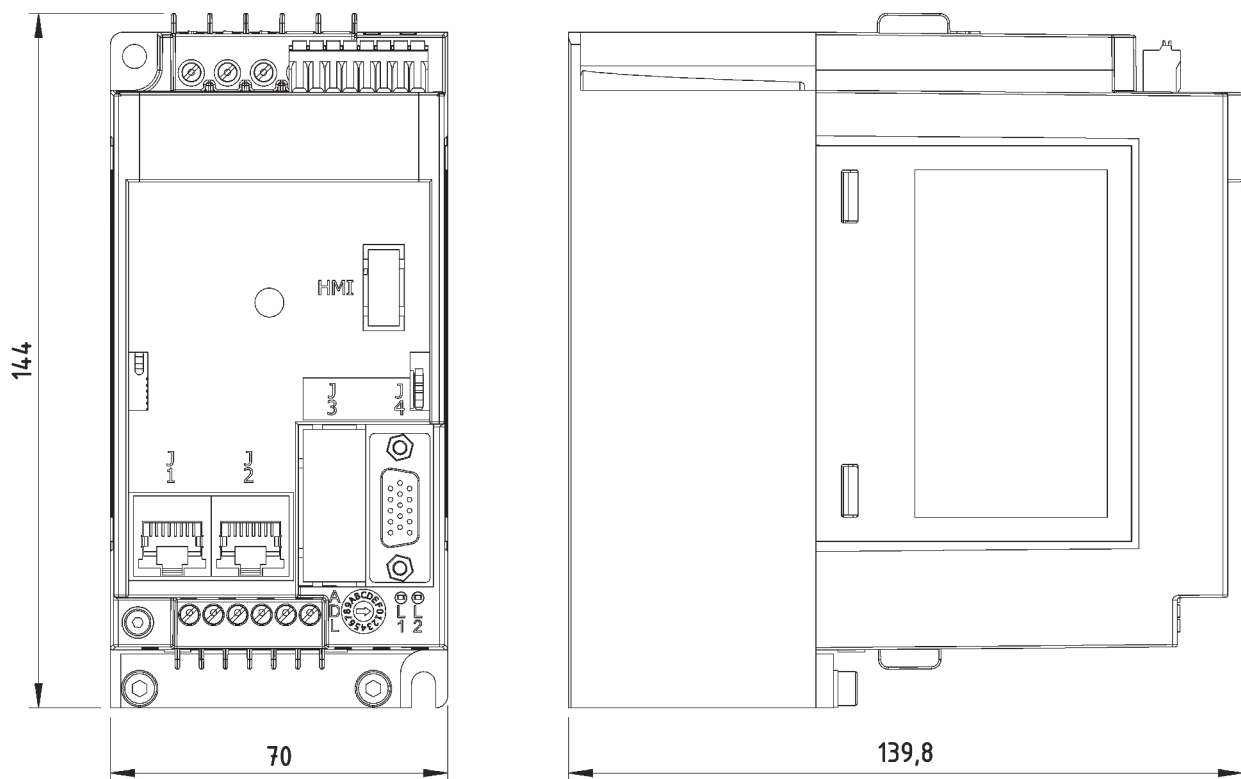
## 4.8 Mechanical specifications

### 4.8.1 Weight

The following table shows the weight:

Type	Weight (kg)
KZ010525	1.0 kg

### 4.8.2 Model size





## 5 Installation and start-up

### 5.1 Preliminary operations

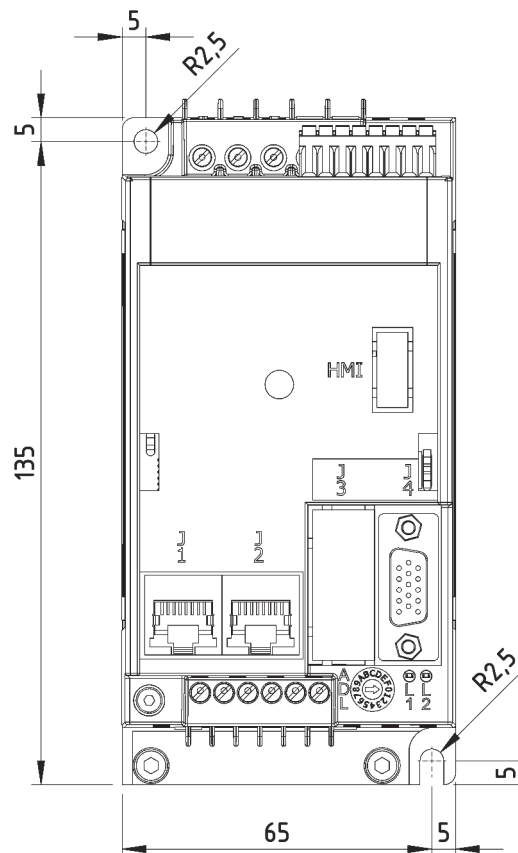
- Verify the perfect integrity of the equipment and its components.
- Make sure the installation manual is present.

### 5.2 Positioning and installation



The inverters COSMOS 3020 are designed for operating in *closed electrical operating areas* (as defined in the EN 61800-5-1 standard); installation outside an electrical panel is not allowed.

The device must be duly tightened to the metal wall of the electrical panel, by means of two screws M5 x 0.8 mm; if the operation generates vibrations, use retention washers (Grover or Belleville) or a thread-lock compound. The following picture shows the front view and the recommended hole pattern.



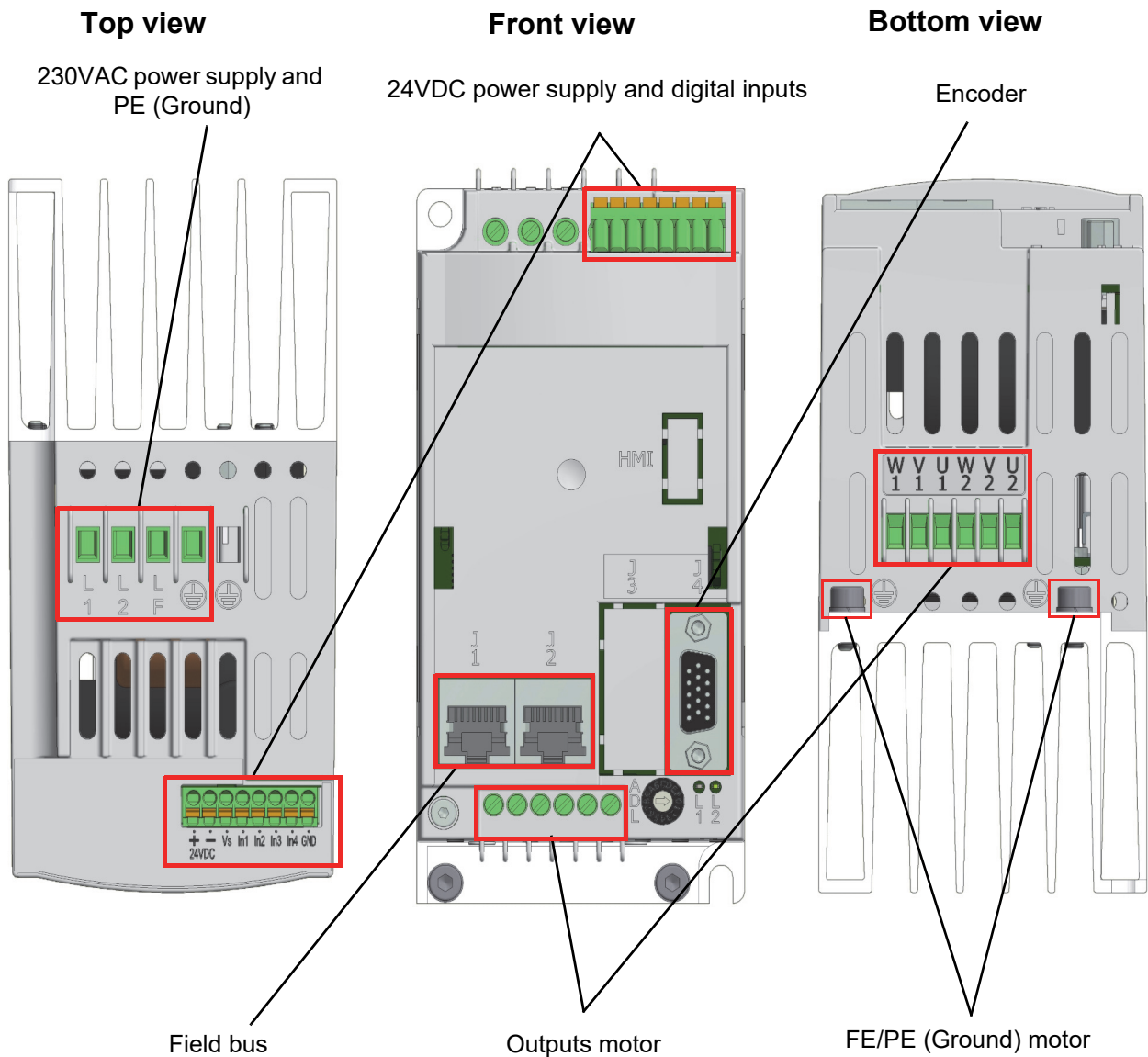
The inverters COSMOS 3020 generate a certain quantity of heat during operation; the electrical panel must be able to dissipate it, in order to avoid an excessive temperature increase. A common solution consists in installing cooling fans or a conditioner. In order to avoid dust ingress, which might degrade the dissipater performance, it is recommended to use filters. The conditioning system must be adequately sized by taking into consideration the total dissipation.

In order to ensure the performance characteristics, the inverters COSMOS 3020 must be installed exclusively in vertical position (as indicated in the previous picture), leaving at least 100mm of obstacle-free space above and below the inverter. If such conditions could not be fulfilled, apply a derating of the available current.

### 5.3 Electrical connections

The device described in this manual is equipped with screw terminal blocks for high voltage electrical connections (mains power supply, motor outputs, PE (Ground) protective conductor), while the extra low voltage connections (24V power supply, 24V digital inputs) are made via detachable connectors.


The following image shows the arrangement of connectors and terminal blocks:




5.3.1 Mains power

These are the connections of 230VAC supply.

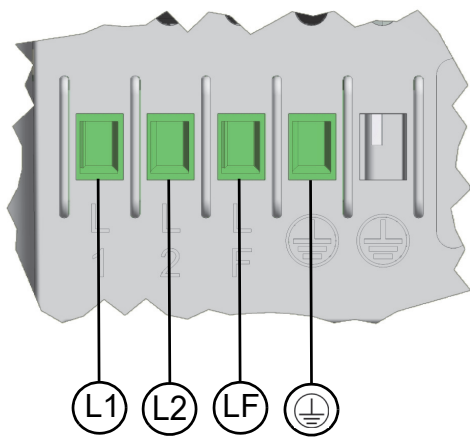
**WARNING**


	<p>Risk of Electric Shock; wait at least No. 360 seconds (6 minutes) after disconnecting power.</p>
---	---

**AVERTISSEMENT**

	<p>Risque de choc électrique; attendez au moins 360 secondes (6 minutes) après la mise hors tension.</p>
---	--


The power wiring must be made by means of the 5-pole terminal board situated on the container top (see picture); it is the same for all releases.




230VAC mains power	
Label	Signal
L1	230VAC mains – phase 1
L2	230VAC mains – phase 2
LF	NC
	PE (Ground)

These devices are designed to operate with TT or TN distribution networks, while with IT distribution networks the device cannot be used, since the EMI filter present internally cannot be disconnected in any way.


**WARNING**

	<p>For safety reasons, the device must always operate with PE (Ground) connected; risk of electric shock! PE (Ground) connection must be made by means of the specific terminal and not merely with screws.</p>
---	---

**AVERTISSEMENT**

	<p>Pour des raisons de sécurité, l'appareil doit toujours fonctionner avec la connexion PE (Ground) connectée. risque d'électrocution! Le raccordement de PE (Ground) doit être effectué à l'aide de la borne appropriée, en évitant de compter uniquement sur les vis de fixation mécaniques.</p>
---	--

The device integrates a EMI filter reducing conducted emissions; it complies with EN IEC 61800-3 standard (second environment, C3 category). If it is installed according to the manual instructions, it is adequate for its protective purposes.

	<p>The EMI filter causes a considerable current waste to earth; do not supply power to the inverter without PE (Ground) connection, in order to avoid electrocution when touching the metal components (such as the heatsink).</p>
---	--

The installation of a battery for several devices causes an increase in the noise level which may exceed the emissions level provided by the standards. In this case, an additional external filter may be necessary. Due to the extremely variable operating conditions (number of inverters, cable length, total current values, required insertion loss), the choice of the filter is up to the user.

**5.3.1.1 Cables and protective devices**


Here are the specifications of the cables to be used for wiring:

Minimum cross-section of solid conductor * **	1.5 mm <sup>2</sup>	24 AWG
Maximum cross-section of solid conductor * **	4.0 mm <sup>2</sup>	12 AWG
Minimum cross-section of flexible conductor * **	1.5 mm <sup>2</sup>	24 AWG
Maximum cross-section of flexible conductor * **	2.5 mm <sup>2</sup>	12 AWG
*= Use 60/75 °C wires only (UL)		
**= Use Copper Conductors only (UL)		

The terminal board contacts must be tightened by means of a flat-blade screwdriver (blade width: 3.5 mm); the recommended tightening torque is equal to 0.55 Nm  $\pm$ 10%.

In order to protect the device and the power cables, install a protective device against overload and short-circuit. Since the input current is strongly distorted by the rectifier, its efficient value may be far higher than the output current, therefore it is necessary to carefully choose the protective devices.

In case of failure, the input current might include a significant direct component; if no fuse is used for protection, install a type-B protective device.

	<p>An inadequate overload protection device might not trip, with consequent danger for people and equipment. Spurious tripping of the protective device might also occur.</p>
	<p>Make sure the maximum short-circuit current of the power supply terminal boards is lower than 5 kA; otherwise, use adequate limiting devices (such as fuses).</p>

**Protection for use exclusively in compliance with EN 61800-5-1**

If the inverter protection is ensured by fuses, their size must guarantee the protection of both the device and the conductors. If you use 10x38mm class gG cartridge-type fuses, their minimum size for ensuring the inverter full-power operation is 12 A. If you install higher rated current fuses, do not exceed 20 A: in case of failure, the maximum short-circuit current that the inverter can handle might be exceeded.

If protection against short-circuits is provided by partial-range fuses (such as aR type), the overload protection must be provided in other ways (for example with circuit breakers).

If the inverter must be used for building a machine, please refer to EN 60204-1 standard for further details about the sizing criteria.

**CAUTION**

The protective fuses must be sized in such a way as to ensure protection against short-circuit and overload. Their cut-off rating must not be lower than the maximum specified short-circuit current.


**ATTENTION**

Les fusibles utilisés pour la protection doivent être dimensionnés de manière à garantir la protection en cas de court-circuit et de surcharge. Son pouvoir de coupure ne doit pas être inférieur au courant de court-circuit maximal prévu.



**Protection for UL applications according to UL 61800-5-1 and CSA C22.2 No.274**

The characteristics of the recommended fuses are summarized in the following tables:

<b>COSMOS 3020</b>	
Marking	Mersen
Model	FR10GR69V16
Class	gR (IEC 60269-4)
Dimension	10x38 mm
Rated current	16 A
Working voltage	700V AC

	<p>Suitable For Use On A Circuit Capable Of Delivering Not More Than 5000 Arms Symmetrical Amperes, 230 Vac Maximum when protected by semiconductor fuses model FR10GR69V16 by Mersen.</p>
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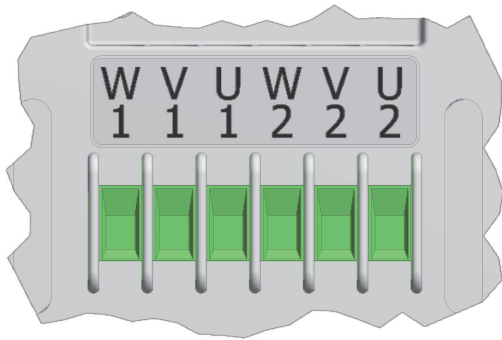
**5.3.1.2 Installation criteria for UL certification**

	<p>Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the Manufacturer Instructions, National Electrical Code and any additional local codes.</p>
	<p>The inverter does not provide Motor Overload protection. External or remote Motor Overload protection shall be provided in the end-use applications.</p>



5.3.2 Motor

The power wiring must be made by means of a 6-pole terminal board; the following picture shows the pin configuration.



Motor wiring	
Label	Signal
W1	Phase output W - motor 1
V1	Phase output V - motor 1
U1	Phase output U - motor 1
W2	Phase output W - motor 2
V2	Phase output V - motor 2
U2	Phase output U - motor 2

Here are the specifications of the cables to be used for wiring:

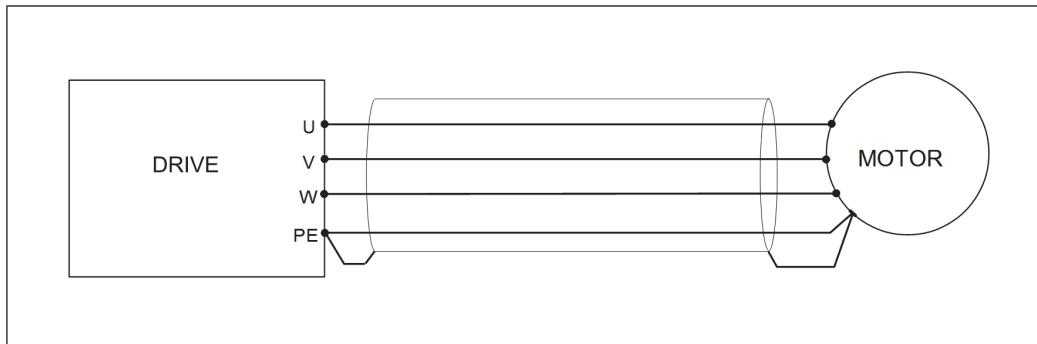
Minimum cross-section of solid conductor * **	0.75 mm <sup>2</sup>	24 AWG
Maximum cross-section of solid conductor * **	2.5 mm <sup>2</sup>	14 AWG
Minimum cross-section of flexible conductor * **	0.75 mm <sup>2</sup>	24 AWG
Maximum cross-section of flexible conductor * **	2.5 mm <sup>2</sup>	14 AWG
*= Use 60/75 °C wires only (UL)		
**= Use Copper Conductors only (UL)		

The terminal board contacts must be tightened by means of a flat-blade screwdriver (blade width: 3.5 mm) or by means of a cross-head screw-driver (PH 0); the recommended tightening torque is 0.55 Nm ±10%.

The conductor section size depends on the maximum current; in case of installation in the electrical panel of a machine, please consider that the EN 60204-1 standard does not allow the use of cables with a cross-section smaller than 0.75 mm<sup>2</sup> inside the housings and 1.0 mm<sup>2</sup> outside (0.75 mm<sup>2</sup> for multi core cables). To connect the motor, a shielded multi-core cable with a cross-section of 0.75 mm<sup>2</sup> may be an excellent choice in most applications.


Therefore it is recommended to use a multi polar cable with a suitable section with shielding >=85% with low parasitic capacitance specific for servomotors, with a length <=20m.

The motor must be connected as shown in the following picture:




Due to the high noise levels generated by PWM modulation on the motor outputs, it is obligatory to use a shielded cable for connecting motors. The shield must be connected to earth on both sides with a low-impedance connection (such as a metal cam); using an unshielded cable or a shielded cable whose shield is not connected to earth may generate EMC problems and interference with nearby devices.

**CAUTION**

	<p>As a safety measure, the motor must be connected to a PE (Ground) using a cable. Do not rely solely on the electrical conductivity of the machinery frame.</p>
--	---

**ATTENTION**

	<p>Par mesure de sécurité, le moteur doit être connecté à PE (Ground) en toute sécurité via un câble. Ne vous fiez pas uniquement à la conductivité électrique du châssis de la machine.</p>
---	--

The motor direction of rotation depends on the order in which the phases (U, V and W) are connected. To reverse the rotation of an asynchronous motor, simply invert two phases; in case of a brushless motor, an incorrect connection of the phases can cause unpredictable operation and possible injury to persons/property.

The motor cables are significant sources of noise; keep them as far away as possible from the signal cables, in order to avoid deterioration of the signals.

**5.3.3 Auxiliary power supply and 24V digital inputs**

The inverter is equipped with a connector for connecting the 24V auxiliary power supply and the digital inputs. The pinout of the connector provided for this purpose is shown in the following paragraphs.

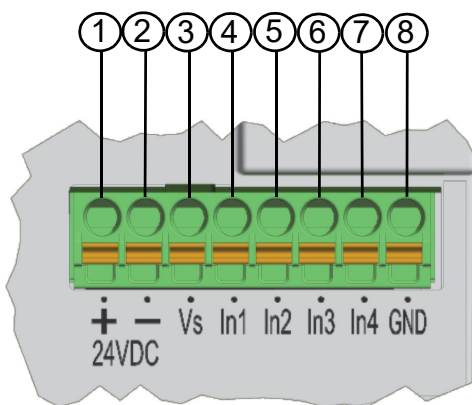
The inverter uses a detachable connector with spring connection, the acceptable sections of the cables to be used for wiring are the following:

Minimum cross-section of solid conductor * **	0.20 mm <sup>2</sup>	24 AWG
Maximum cross-section of solid conductor * **	1.5 mm <sup>2</sup>	16 AWG
Minimum cross-section of flexible conductor * **	0.20 mm <sup>2</sup>	24 AWG
Maximum cross-section of flexible conductor * **	1.5 mm <sup>2</sup>	16 AWG
Minimum cross-section of flexible conductor with terminal * **	0.25 mm <sup>2</sup>	24 AWG
Maximum cross-section of flexible conductor with terminal * **	0.75 mm <sup>2</sup>	16 AWG

\*= Use 60/75 °C wires only (UL)  
 \*\*= Use Copper Conductors only (UL)

Use a flat-head screwdriver to wire the connector; insert the edge of the head into the orange cavity and press to open the contact. At the same time, insert the cable. It is recommended to use a screwdriver with a 2.5 mm flat head.

The connector pinout is shown below:




Auxiliary power supply and 24V digital inputs		
Pin	Marking	Signal
1	24VDC+	24VDC power supply - positive
2	24VDC-	24VDC power supply - negative
3	Vs	24VDC sensor power supply
4	In1	Digital input 1
5	In2	Digital input 2
6	In3	Digital input 3
7	In4	Digital input 4
8	GND	Ground

5.3.3.1 24V auxiliary power supply


A 24VDC auxiliary voltage is required for operation of the control logic and other peripherals such as the encoder. In the absence of this power supply, the inverter will not work even if the 230VAC main power supply is present.

On the connector there is an unregulated 24VDC output to power any sensors connected to the unit inputs, having ground (GND) in common with the auxiliary power supply of the inverter.



**CAUTION**

	<p>For safety reasons, the auxiliary power must be supplied by a PELV power supply with its earth terminal connected to earth (preferably only at one point, to prevent earth loops).</p>
---	---

**ATTENTION**

	<p>Pour des raisons de sécurité, cette alimentation doit être fournie par une alimentation de type PELV, la borne de terre étant reliée à la terre (de préférence uniquement en un point pour éviter les boucles de terre).</p>
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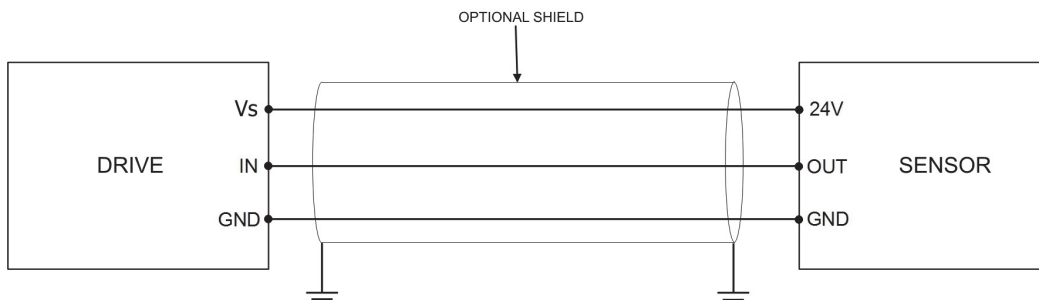
The auxiliary voltage must be stable and within the limits of the inverter (see specific paragraph). If this voltage is outside the prescribed limits, the inverter may be damaged.

	<p>Check the polarity of the auxiliary power before connecting the inverter; otherwise it may be damaged.</p>
	<p>If the protection fuse intervenes due to a short-circuit or overload of the power supply Vs, the inverter will switch off and the connected motors will stop in an uncontrolled manner.</p>

5.3.3.2 24V digital inputs

The inverter is equipped with 4 general purpose 24V digital inputs. These inputs are typically used to acquire data from sensors with digital output, which are very common in industry (such as photocells, limit switches, etc.).

The following picture shows an example of how a sensor is connected; in most applications, the wiring can be made by means of an ordinary unshielded cable.



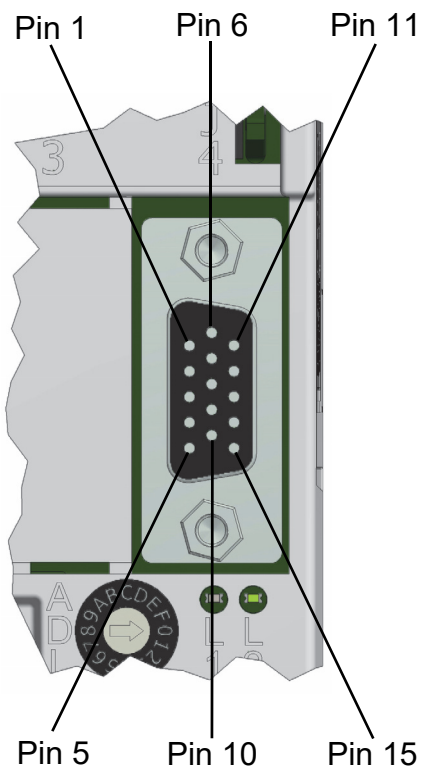
However, if the operating environment is affected by significant electrical noise or the distances to be crossed are significant, the use of a shielded cable may be necessary. In this case, the shield must be connected to earth on both sides, preferably with low-impedance connection, such as a metal cam; the shield is totally ineffective if it is left floating.

Signal quality may be further improved by keeping the cables as far as possible from noise sources, such as power cables, inverters, power supplies, relays, etc.

	<p>Check the sensor polarity before connection; inverted polarity may damage the sensor and/or inverter.</p>
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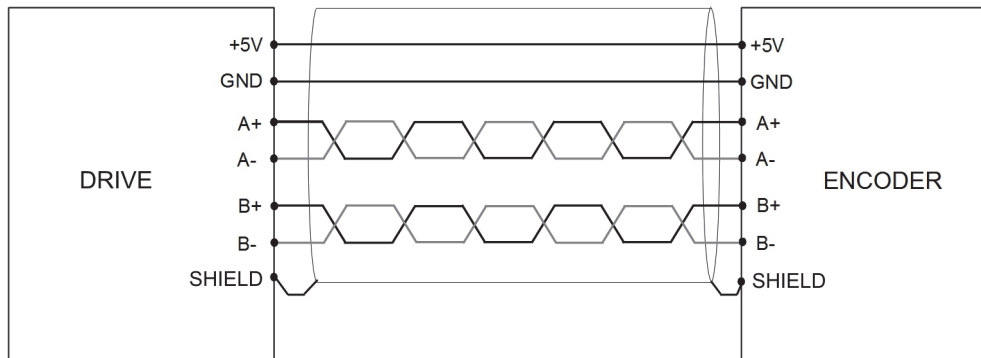
5.3.4 Incremental encoder

An encoder is used as a feedback device for reading and controlling the motor position and speed. Inverters COSMOS 3020 are equipped with a peripheral device that can acquire data from incremental digital encoders, which are powered by 5 VDC and have differential output signals. Differential outputs offer greater noise rejection than common single-ended outputs. When brushless motors are used, it is necessary to know also the rotor initial position; therefore, the encoder must also be equipped with three Hall-effect sensors. The connector used on the encoder is removable; the following picture shows the pin configuration:




Incremental encoder	
Pin	Signal
1	NC
2	NC
3	+5VDC
4	GND
5	Earth
6	A+ channel
7	B+ channel
8	NC
9	NC
10	NC
11	A- channel
12	B- channel
13	NC
14	NC
15	NC

The following picture shows an example of connection; in case of asynchronous motor, the Hall sensors are not included.

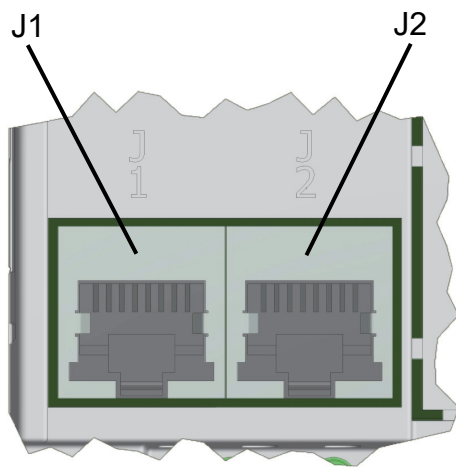


The wiring must be made by a shielded cable; the shield on the cable end on the inverter side must be soldered directly to the connector shell. Connect the other end of the shield to the encoder housing, when possible. Since differential signals are involved, each pair of signals (such as U+ and U-) must be carried with a twisted pair. As to the power conductors, they must be properly sized, in order to prevent excessive voltage drops; conductors with a larger cross-section may be necessary when the wiring extends over great distances. Consult the technical documentation supplied by the manufacturer of the encoder for further details.

5.3.5 Field bus FlxIO

	<p>Refer to the FlxIO bus integration and FlxMod system DK400076 manual for the correct definition of the connection topology of the FlxIO bus.</p>
---	---

The inverter is equipped with an interface for FlxIO field bus. This bus, based on a RS485 electrical non-insulated interface, performs a reliable, real-time control of complex applications. The connections are made by means of RJ45 connectors, situated on the front panel; the following picture indicates the pin configuration.



FlxIO field bus			
Connector J1		Connector J2	
Pin	Signal	Pin	Signal
1	DATA+	1	DATA+
2	DATA-	2	DATA-
3	GND	3	GND
4	NC	4	NC
5	NC	5	NC
6	ADDR_IN	6	ADDR_OUT
7	Internal use	7	Internal use
8	Internal use	8	Internal use

The FlxIO bus allows up to 15 devices to be connected in cascade. The inverter must receive the connection from the FlxIO master device or from the device that precedes it in the chain to the J1 connector (input), while the next device must be connected to the J2 connector (output). This field bus requires standard cables, Ethernet CAT 5E type, with RJ45 connectors; in order to avoid dangerous reflections, a termination resistor is necessary at the end of the chain. To this purpose, a solution for automatic termination has been implemented: the last device in the chain (J2 port is not used on the last slave) detects the lack of cable on the J2 port and automatically activates the termination. By contrast, if further devices are installed downstream, the termination is automatically disconnected by the inverter. In this way, only the last device terminates the cable; the other end is terminated by the master device.



**5.3.5.1 Manual addressing**

Each slave in a FlixIO bus must have its address, which can be modified in a very easy way. To this purpose, the inverter is equipped with a rotary switch (on the front panel), with 16 different positions (from 0 to F, in hexadecimal notation). The address can be set by means of a flat-head screwdriver. The following table shows the correspondence between decimal and hexadecimal values:

<b>Decimal</b>	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<b>Hexadecimal</b>	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F



Rotary microswitch

Addresses 0 and F can not be used; on the same bus each device must have a different address. The COSMOS 3020, being a double inverter, uses two addresses simultaneously: the one set via the rotary switch and the next one. For example, by setting the rotary switch to 1, both address 1 and 2 will be used in the bus; by setting the rotary switch to E, the address E and F will be used, and so on.

The presence of two devices with overlapping addresses causes communication problems and could lead to uncontrolled system behavior.

It is important to specify that the physical address does not correspond to the logical address.

Since the address is read only when the device is switched on, the address must be set before powering the system, otherwise it will not be possible to see the modifications until the system re-starts.

**CAUTION**



Make sure the address is correct before powering up the devices; otherwise the system may behave uncontrollably; risk of danger to persons and/or property.

**ATTENTION**



Vérifiez l'exactitude de l'adresse avant de mettre les périphériques sous tension, sinon le système pourrait avoir un comportement imprévisible. danger de dommages aux personnes et / ou aux choses.

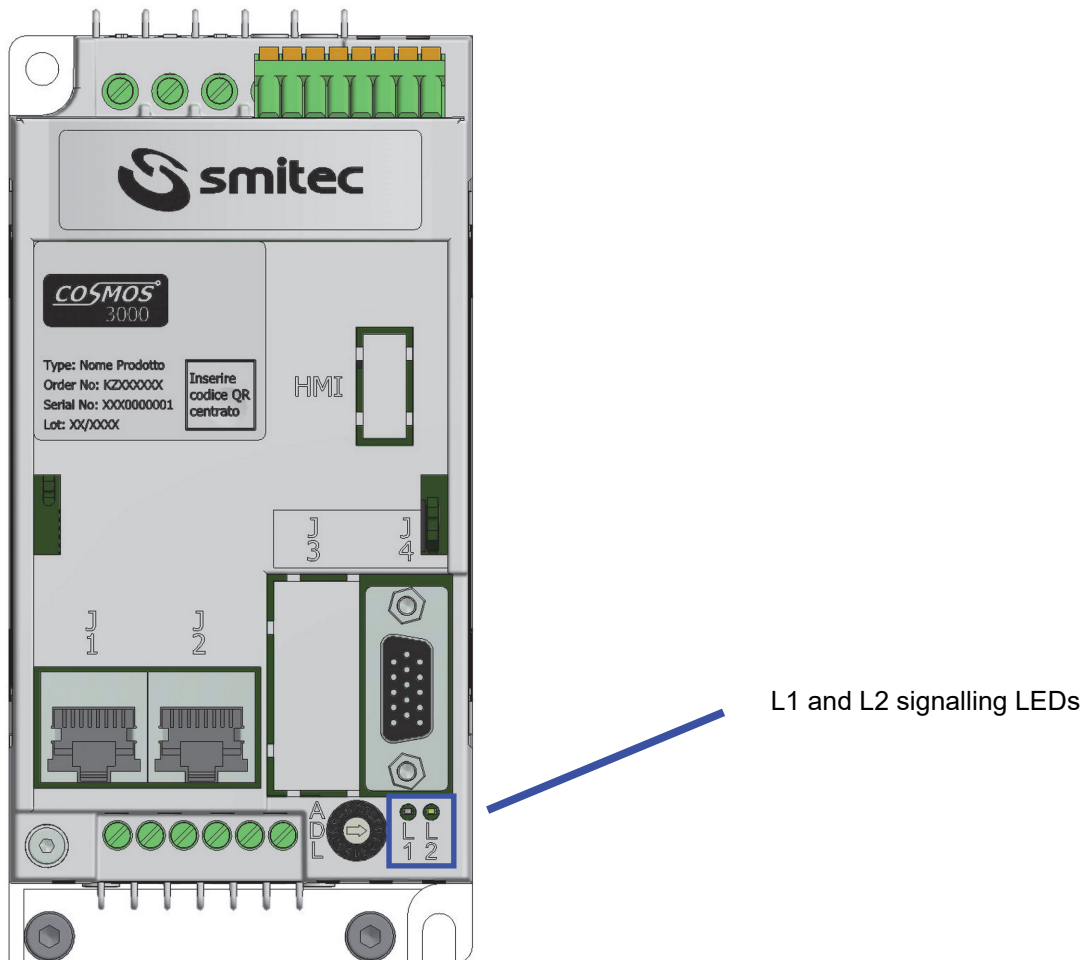
**5.3.5.2 Automatic addressing**

Currently, automatic addressing is not active.

## 6 Diagnostics

### 6.1 Signalling LEDs

On the front panel of the device there are two LED indicators identified with the letters L1 and L2. They indicate the status of the FlxIO field bus of the device.



Front view of LEDs position

The following tables summarize the behavior of the LEDs with FlxIO field bus:

Marking	Function
L1	Field bus status (red LED)
L2	Field bus status (green LED)

They have the following meaning according to the FlxIO standard, based on their switching on and off and the frequency with which they flash:

L1 (red)	L2 (green)	Function
ON	Flash 1Hz	Firmware update of the controller dedicated to FlxIO communication
ON	ON or OFF	Hardware fault of the controller dedicated to FlxIO communication
OFF	Flash 1Hz	Initialization of FlxIO communication in progress
OFF	Flash 4Hz	FlxIO communication in error
OFF	ON	Indicates whether the communication of the FlxIO master device is active or not (bootloader phase)

In caso di errore, la diagnostica viene restituita tramite il bus FlxIO; quindi se si ha l'esigenza di conoscere il tipo di errore verificatosi, sarà necessario interrogare il sistema tramite il bus FlxIO.

## 7 Firmware update

Following improvements or functionality additions, the inverters COSMOS 3020 can be upgraded with a newer firmware version.

This operation can be implemented directly via the FxIO field bus (teleprogramming); if the master device detects that the inverter is programmed with a FW version different from the one loaded in memory, it automatically reprograms it. The procedure takes place when the devices are turned on. A device can not be updated directly.

To update the inverters it is necessary to update the FW of the master device, which then updates the slaves.

## **8 Storage**

The equipment can be stored in its original package for the necessary period; it must be kept in a covered area even if it is packed. Protect the equipment from dust and weather.

Do not stack more than 10 inverters, in order to avoid the package and/or the device being subject to excessive stress.

The equipment can be stored at temperatures from -25°C to +55°C.

## **9 Maintenance**

SMITEC S.p.A. does not require any ordinary maintenance to be performed on inverters COSMOS 3020; remember that no component may be removed from the device, since such removal may compromise the safety level.

Any required repair must be performed exclusively by SMITEC S.p.A.

## 10 Disposal and demolition

The equipment must be disposed of in compliance with the legislation in force in the country where it is installed. In case of partial disposal of the equipment (frame, dissipater, electronic boards), the different materials must be separated (aluminium, plastic, etc.). Also these components must be disposed of in compliance with the legislation in force in the Country where it is installed.



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