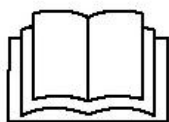


Smitec S.p.A., via Carlo Ceresa 10, 24015 San Giovanni Bianco (BG), Italy, www.smitec.it



Installation, use and maintenance manual



BEFORE STARTING UP THE SERVODRIVE/INVERTER SERIES COSMOS 301X, CAREFULLY READ THIS MANUAL AND FOLLOW ALL INSTRUCTIONS, IN ORDER TO ENSURE MAXIMUM SAFETY

SERVODRIVE/INVERTER SECOND SERIES COSMOS 301X



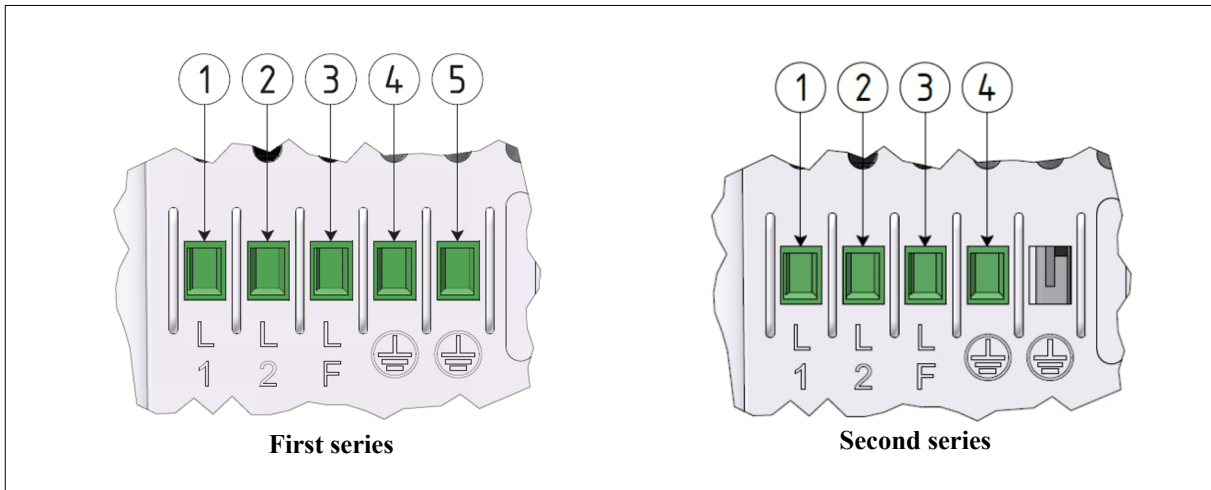
The technical data and the drawings in this manual might have been modified later; always refer to the latest version.

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1 Preface

This manual aims to provide the information necessary for the installation, use and maintenance of the COSMOS 301X second series servo drive/inverter; the second series can be easily distinguished from the first as the 230VAC input terminal block does not have the 5th terminal (PE):



Please note that this manual deals only with the second series of COSMOS 301X servo drives/inverters.

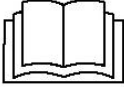
The instructions included in this manual are addressed to the following professionals:

User	User is a person, a company or an institution that buys the equipment and uses it for the purposes it was designed for.
User / operator	User or operator is a person authorized by the user to work on the equipment.
Qualified personnel	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 above persons.

2 General instructions

The assembly instructions are an integral part of the equipment and must be kept for future reference, until it is dismantled. 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 experience.

	DO NOT USE THE EQUIPMENT, NOR MAKE ANY INTERVENTION BEFORE INTEGRALLY READING AND UNDERSTANDING THIS MANUAL.
IN PARTICULAR, ADOPT ALL SAFETY PRECAUTIONS AND PRESCRIPTIONS INDICATED IN THIS MANUAL.	
THE EQUIPMENT CAN NOT BE USED FOR DIFFERENT PURPOSES 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 THE PRESCRIPTIONS.	

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



	The indication of "FORBIDDEN BEHAVIOR".
	The symbol "DANGER" is used when the non-compliance with the prescriptions or misuse may cause serious injuries.
	The symbol "DANGER OF HOT SURFACES" is used when the non-compliance with the prescriptions may cause serious injuries.
	The symbol "DANGER OF ELECTRICAL SHOCK" is used when the non-compliance with the prescriptions may cause serious injuries.
	The symbol "USE OF INDIVIDUAL PROTECTIONS" means that protective gloves must be worn.
	The symbol "USE OF INDIVIDUAL PROTECTIONS" means that protective glasses must be worn.
	The indication of "PARTICULAR RELEVANT INFORMATION".

The safety prescriptions aim at establishing a series of behaviours 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 machine, in a way that is safe for personnel, tools/equipment and environment.

3 Safety instructions


3.1 General information

	Do not install or use the equipment before integrally reading and understanding this manual. In case of difficulties of interpretation, contact SMITEC technical service.
	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.
	Make sure that the personnel is qualified and adequately informed about the risks he may run and how to avoid them.
	The servodrive/inverter 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.

Precautions during handling and assembly

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

3.2 Precautions against risk of Electric Shock

	<p>The high voltage of some accessories and components in the servodrive/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 servodrive/inverter which maintain a dangerous voltage for at least 6 minutes after switching them off. Before starting any operation, make sure that the servodrive/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 servodrive/inverter during the installation, because they might cause short-circuits.</p>
	<p>The servodrive/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>

3.3 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 Technical features

4.1 Description

The servodrive/inverter series COSMOS 301X have been designed for three-phase asynchronous electrical motors and for brushless AC motors (BLAC). The core of the power section is an intelligent IGBT module (IPM), featuring the necessary protections that guarantee an extreme reliability and efficiency, besides reducing the need for external components. The servodrive/inverter for asynchronous and brushless motors is constituted by an aluminium dissipater and by electronic boards included in a special “plastic case”.

In particular, the servodrive/inverter for asynchronous and/or brushless AC motors can control start/stop functions, motor speed and position and motor torque and can perform diagnostic activity, etc. They are also used to manage abnormal conditions, by providing real-time diagnostic information (diagnostics are included in the machine into which the servodrive/inverter is incorporated) and by using a “master” device (on versions equipped with a field bus).

Inverters for asynchronous and brushless motors are mainly intended for the so-called “*second environment*”, i.e. heavy industry.

The control logic is implemented by 32-bit micro-controllers, equipped with a set of instructions optimized for speed and specialized in controlling precision motors. Thanks to their design features, the servodrives/inverters can be considered as of digital type, because they are completely controlled by the micro-controller. As a consequence, the servodrive/inverter is a very flexible appliance which can be reset through a software and is open to all improvements offered by the new technologies in the future.

The equipment is designed for asynchronous motors and brushless AC motors. It operates on 230VAC single-phase power and on 24VDC auxiliary power (on certain versions only). Auxiliary power, when applicable, is used to feed the control section of the device.

Versions equipped with field bus interface feature a “master” device sending commands to the equipment (such as start, stop, motor speed/position, parameters for the motor and/or servodrive/inverter, etc.), besides having a diagnostic function.

The equipment operation is controlled by micro-controllers, which can be updated by uploading new firmware versions. They communicate through field bus, they can control analogue/digital I/O and the motor.

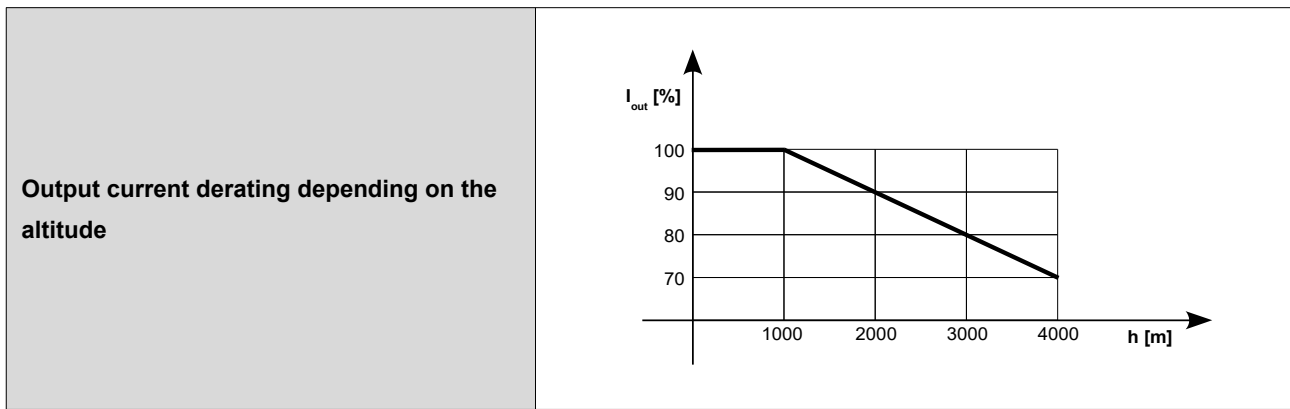
The servodrive/inverter comply with EN IEC 61800-3 standards (EMC Requirements); they can be installed in the second environment (“*Second Environment*”, category C3), provided they comply with the conditions indicated in this *Installation, Use and Maintenance Manual*.

No ordinary/extraordinary maintenance is allowed for servodrive/inverter; in case of bad operation and/or break, it is necessary to replace the equipment integrally. Any repairs must be performed exclusively by SMITEC S.p.A. Technical specifications

4.2 Technical data

4.2.1 Environmental features

Operational temperature	0° ÷ 40°C without derating (full output current)										
	0° ÷ 55°C with derating (reduced output current)										
Maximum surrounding air temperature (UL)	40°C without derating (full output current)										
	55°C with derating (reduced output current)										
Installation environment	Use in Pollution degree 2 Environment										
Overvoltage category	III (3)										
Output current derating depending on the ambient temperature	<table border="1"> <caption>Output current derating vs ambient temperature</caption> <thead> <tr> <th>T_{amb} [°C]</th> <th>I_{out} [%]</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 _{amb} [°C]	I _{out} [%]	40	100	45	90	50	80	55	70
T _{amb} [°C]	I _{out} [%]										
40	100										
45	90										
50	80										
55	70										
Output current derating depending on the distance from obstructions	<table border="1"> <caption>Output current derating vs distance from obstructions</caption> <thead> <tr> <th>c [mm]</th> <th>I_{out} [%]</th> </tr> </thead> <tbody> <tr><td>100</td><td>100</td></tr> <tr><td>60</td><td>100</td></tr> <tr><td>40</td><td>90</td></tr> <tr><td>20</td><td>70</td></tr> </tbody> </table>	c [mm]	I _{out} [%]	100	100	60	100	40	90	20	70
c [mm]	I _{out} [%]										
100	100										
60	100										
40	90										
20	70										
Air humidity during operation	5 ÷ 85% non condensing										
Storage temperature	-25 ÷ +55°C										
Air humidity during storage	5 ÷ 95%										
Transportation temperature	-25 ÷ +70°C										
Air humidity during transportation	5 ÷ 95%										
Maximum altitude	1000 m above sea level at rated output current										
	2000 m above sea level with current derating										



4.2.2 Ratings

Mains voltage	single-phase 230 VAC \pm 15% 50/60 Hz
Distribution systems allowed	TT, TN
Maximum short-circuit current	5 kA at the installation point
Maximum mains input current	10 A RMS
Auxiliary mains voltage	24 VDC -15 \div +20%; max ripple 5% of the rated value
Maximum auxiliary current	Depending on the various models: KZ010375, KZ010376: 0.2 A KZ010385: 0.4 A

4.2.3 Motor output

Output voltage	Three-phase 0 \div 230 V
Output frequency	Depending on the various models: KZ010375: 0 \div 500 Hz KZ010376, KZ010385: 0 \div 128 Hz
Switching frequency	Depending on the various models: KZ010375, KZ010376: 4/8/10/12/16 kHz KZ010385: 5/10/15 kHz

Maximum output current@40°C	4.2 A DC																												
	4.2 A RMS with $f_{sw} = 4$ kHz																												
	Output current derating depending on the switching frequency, according to the following diagram:																												
	<table border="1"> <caption>Approximate data from the derating graph</caption> <thead> <tr> <th>f_PWM [kHz]</th> <th>I_out [A_RMS]</th> </tr> </thead> <tbody> <tr><td>4</td><td>4.2</td></tr> <tr><td>5</td><td>4.1</td></tr> <tr><td>6</td><td>4.0</td></tr> <tr><td>7</td><td>3.9</td></tr> <tr><td>8</td><td>3.8</td></tr> <tr><td>9</td><td>3.75</td></tr> <tr><td>10</td><td>3.7</td></tr> <tr><td>11</td><td>3.65</td></tr> <tr><td>12</td><td>3.6</td></tr> <tr><td>13</td><td>3.55</td></tr> <tr><td>14</td><td>3.5</td></tr> <tr><td>15</td><td>3.45</td></tr> <tr><td>16</td><td>3.3</td></tr> </tbody> </table>	f_PWM [kHz]	I_out [A_RMS]	4	4.2	5	4.1	6	4.0	7	3.9	8	3.8	9	3.75	10	3.7	11	3.65	12	3.6	13	3.55	14	3.5	15	3.45	16	3.3
f_PWM [kHz]	I_out [A_RMS]																												
4	4.2																												
5	4.1																												
6	4.0																												
7	3.9																												
8	3.8																												
9	3.75																												
10	3.7																												
11	3.65																												
12	3.6																												
13	3.55																												
14	3.5																												
15	3.45																												
16	3.3																												
Maximum output current@55°C	2.94 A DC																												
	2.94 A RMS with $f_{sw} = 4$ kHz																												
Asynchronous motor maximum size	0.75 kW (shaft rating)																												
Available active power	1 kW max. (1.34 HP)																												
Peak output current	15 A																												
Protections	Against phase-to-phase short-circuit, overload, inverter overheating, motor overheating																												

4.2.4 Dynamic brake output

Type	Control circuit of the brake resistor with IGBT
Protections	Against brake resistor short-circuit
Brake resistor resistance	30 ÷ 150 Ω
Average available power	150 W max.

4.2.5 Encoder input

Type	Input for readout of incremental encoder with 5 V differential signals
Maximum input frequency	200 kHz
Power supply	5 V, max 200 mA

4.2.6 Digital inputs

Type (KZ010375 and KZ010376)	24 V digital inputs, compatible with type 1 and type 3, according to IEC 61131-2
Type (other versions)	24 V digital inputs
Max. frequency of input signal	1 kHz

4.2.7 Digital outputs

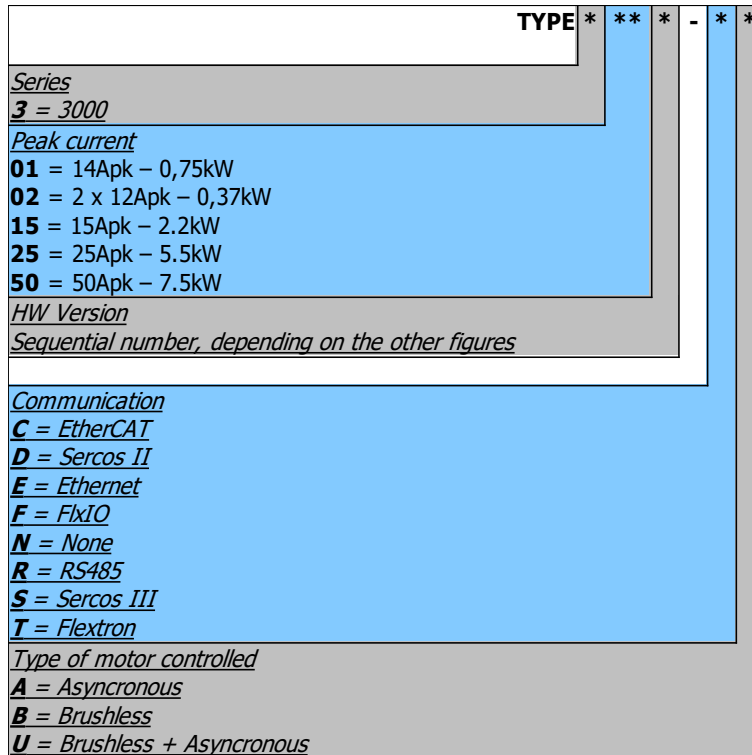
Type	24 V pnp (current-sourcing) digital outputs
Maximum available current	30 mA
Protections	Against short-circuit, overload and overheating

4.2.8 Thermocouple input

Sensor type	Insulated thermocouples – J type
Input voltage range	-6.3 ÷ +27.5 mV
Input temperature range	<p>The diagram shows the temperature range depending on the cold joint temperature:</p>
Resolution	12 bit
Cold junction compensation	internal
Sensor interruption detection	yes (by internal pull-up and full-scale voltage readout)

4.3 Configurations / order codes

Up to date, we defined some standard configurations of servodrives/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 servodrive/inverter label.



Order code	Type	Field bus	Motor type	Encoder type	I/O	Dynamic brake
KZ010375	3010FU	FLxIO	Brushless motors + Three-phase, asynchronous motors	Incremental encoder with differential line-driver outputs – 5V ch. ABUVW	2 x InD	X
KZ010376	3010FA	FLxIO	Three-phase, asynchronous motors	Incremental encoder with differential line-driver outputs – 5V ch. AB	2 x InD	-
KZ010385	3012RA	RS485	Three-phase, asynchronous motors	-	4 x InD 6 x OutD 1 x InTC	-

4.4 Accessories

The servodrives/inverters series COSMOS 301X are supplied with a series of removable connectors for power connection and I/O (where relevant). These connectors can be ordered separately, as well as other accessories not included in the servodrive/inverter.

Here is a list of the order codes.

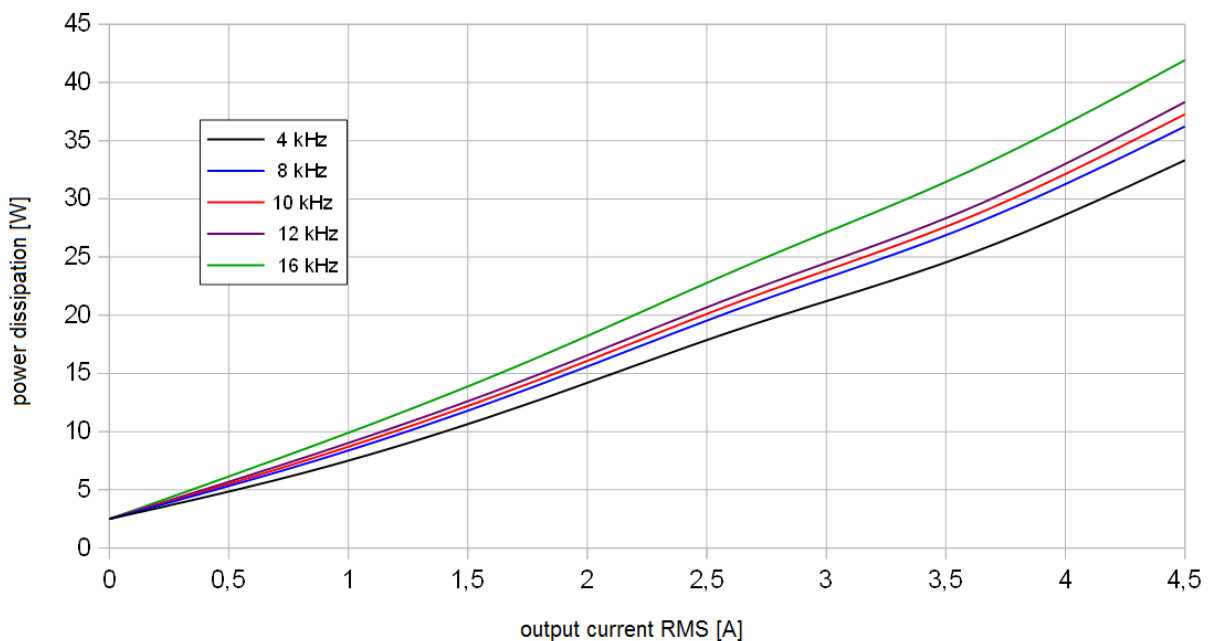
Item	Order code
Connector 24VDC for code KZ010375/76	KF101067
Connector 24VDC and I/O (8x1) for code KZ010385	KF101068
Connector I/O (9x1) for code KZ010385	KF101069
Adapter cable RS485 for programming	KF131284
Converter USB-RS485	KZ020087
Software WinMicro for programming	KW050111

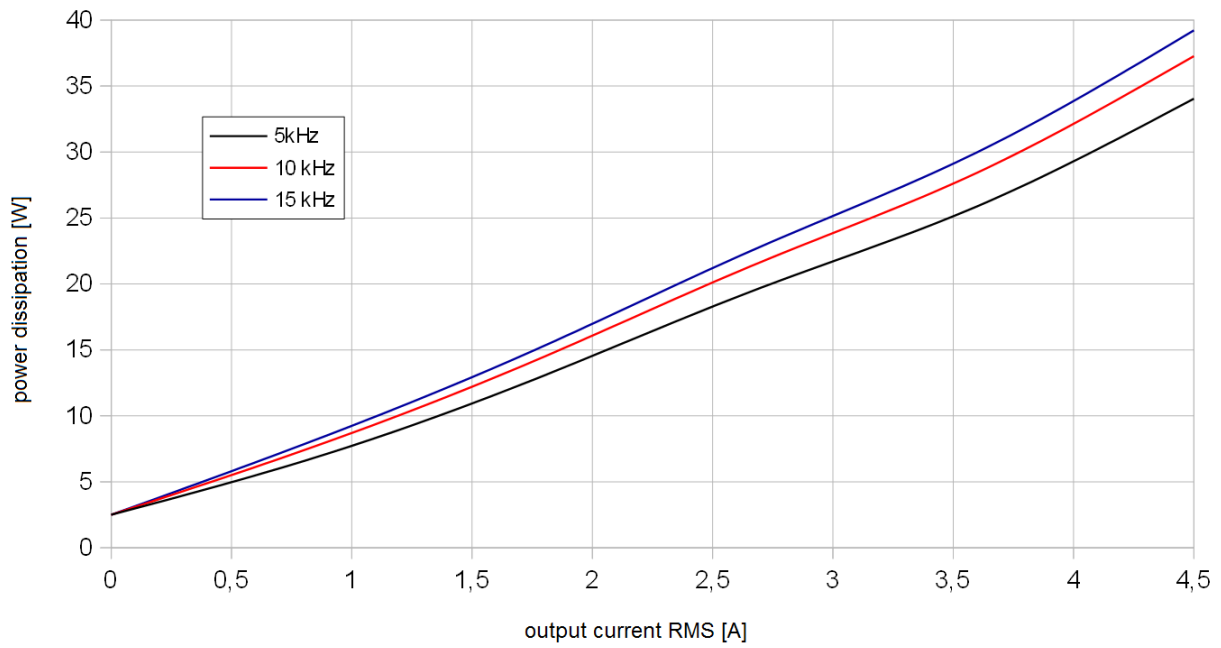
4.5 Heat dissipation

During operation, a servodrive/inverter dissipates a certain quantity of electric power, due to the imperfect nature of electronic components. As a consequence, the components temperature increases, especially for the power section components. This increase must be taken into consideration in order to correctly determine the capacity of the electrical panel cooling system.

The amount of dissipated power depends on the supplied output current and on the switching frequency of the PWM signals. The below diagram, valid for all releases, shows the total thermal dissipation, depending on the rated output current; the four curves represent different switching frequencies. Please consider that:

- In case of variable output current, the average dissipated power must not be calculated from the average current only, but also by including instantaneous power dissipation.
- Power dissipation mostly depends on the servodrive/inverter switching frequency.
- The dissipated power from the braking resistors must be calculated separately.
- Power dissipation scarcely depends on the power factor of the load, but mostly on the absolute value of the output current; this is to say that the dissipated power is not strictly linked to the active power supplied to the load.






The current that a servodrive/inverter can supply depends on the ambient temperature; in order to avoid a reduction in the actual deliverable current, install a cooling system, if necessary.

4.6 Electromagnetic compatibility (EMC)

The servodrives/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 servodrive/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 servodrive/inverter
- The start-up is performed by technical engineers, according to the instructions of this manual.

	<p>The integrated filter ensures compliance with the EN IEC 61800-3, only if a single servodrive/inverter is operating. The simultaneous operation of more than one servodrive/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.</p>
	<p>These servodrives/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.</p>
	<p>If the ground leakage currents generated by the servo drive/inverter cannot be tolerated, it will generally be necessary to install an external low loss mains filter.</p>

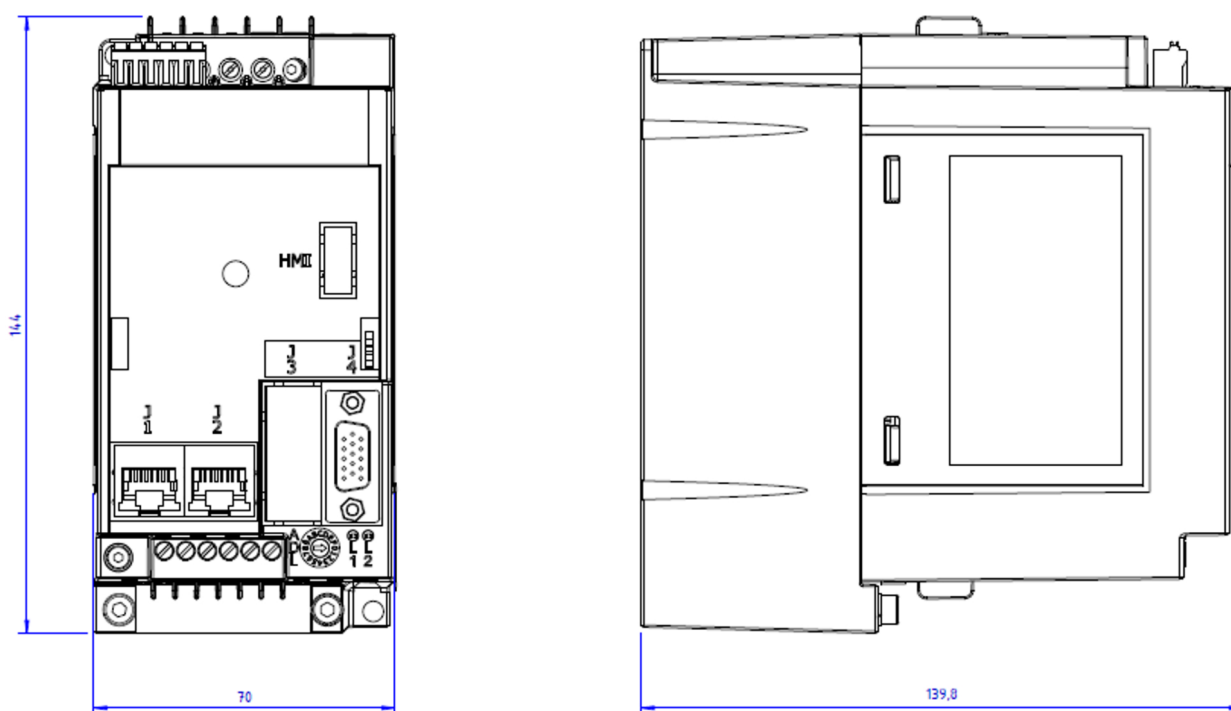
4.7 Mechanical specifications

4.7.1 Weight

The following table indicates the weight of the different models, with all removable connectors:

Type	Weight (kg)
KZ010375	1.0
KZ010376	1.0
KZ010385	1.0

4.7.2 External dimensions



5 Installation and start-up

5.1 Preliminary operations

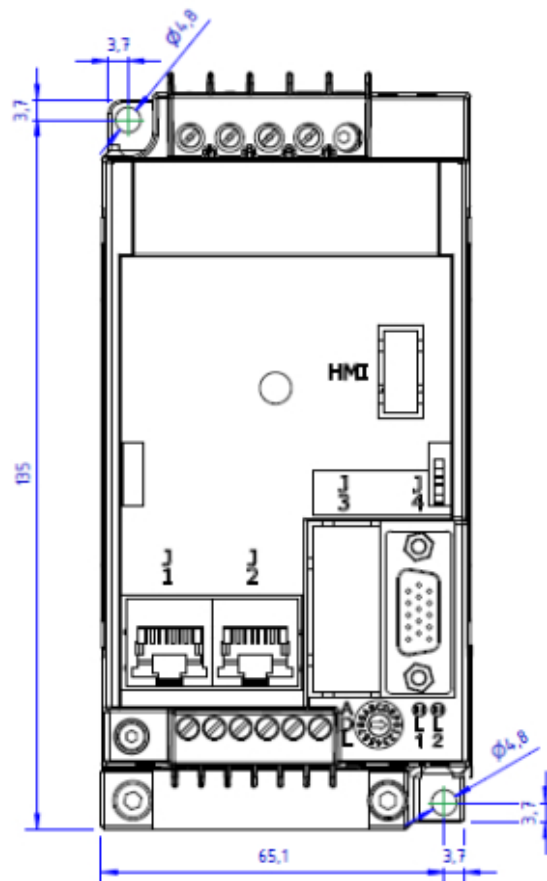
- Verify the perfect integrity of the equipment and its components.
- Make sure the installation manual is present.

5.2 Positioning and installation



The servodrives/inverters 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 servodrives/inverters 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 cooling system must be adequately sized by taking into consideration the total dissipation.

In order to ensure the performance characteristics, the servodrives/inverters 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 servodrive/inverter. If such conditions could not be fulfilled, apply a derating of the available current.

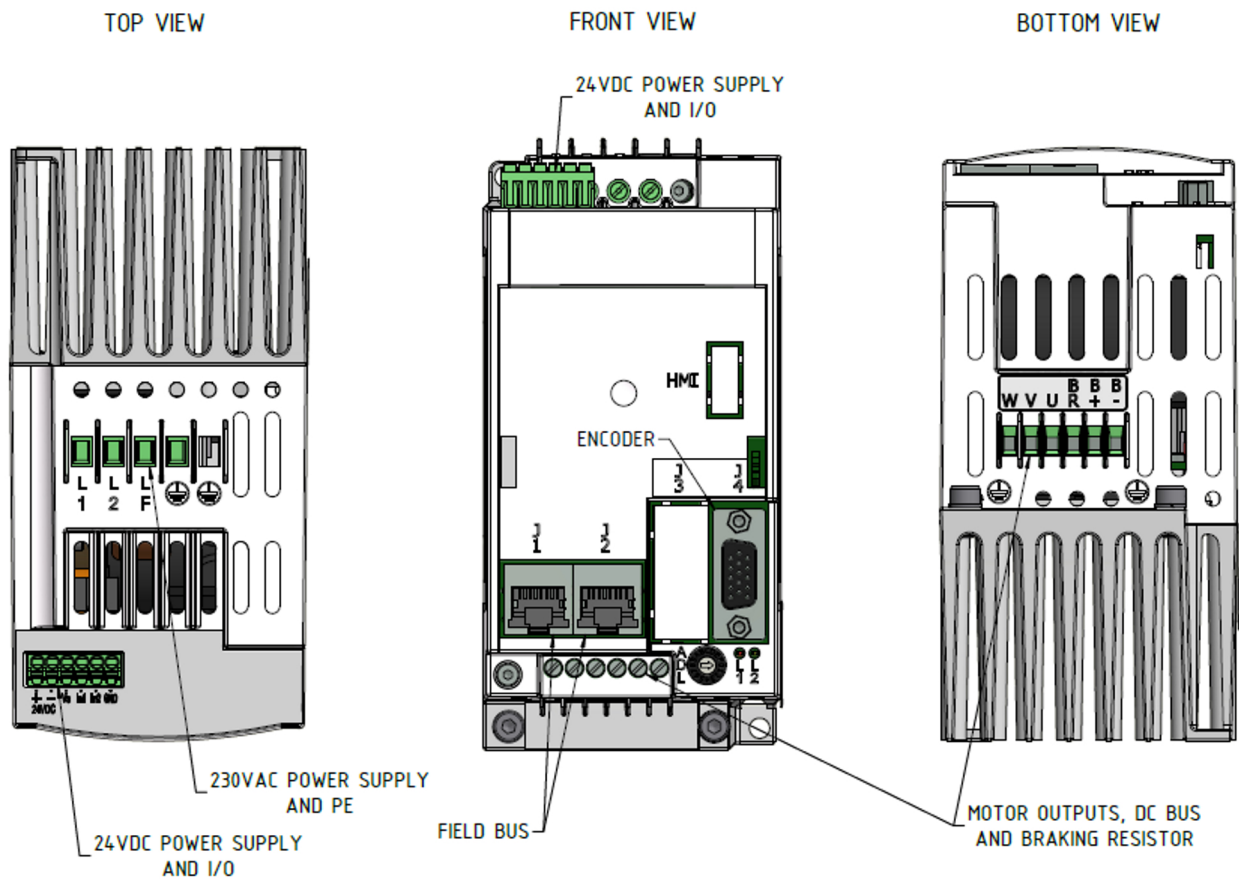
5.3 Electrical connections

The devices described in this manual are equipped with a screw-type terminal board for high-voltage connections [mains power, motor outputs, bus voltage, brake resistor, protective conductor PE (Ground)]; low-voltage connection (24V power supply, I/Os) is possible through removable connectors.

The following sub-sections show the location of the connectors and terminal boards for the different models.

5.3.1 Connections (KZ010375 and KZ010376)

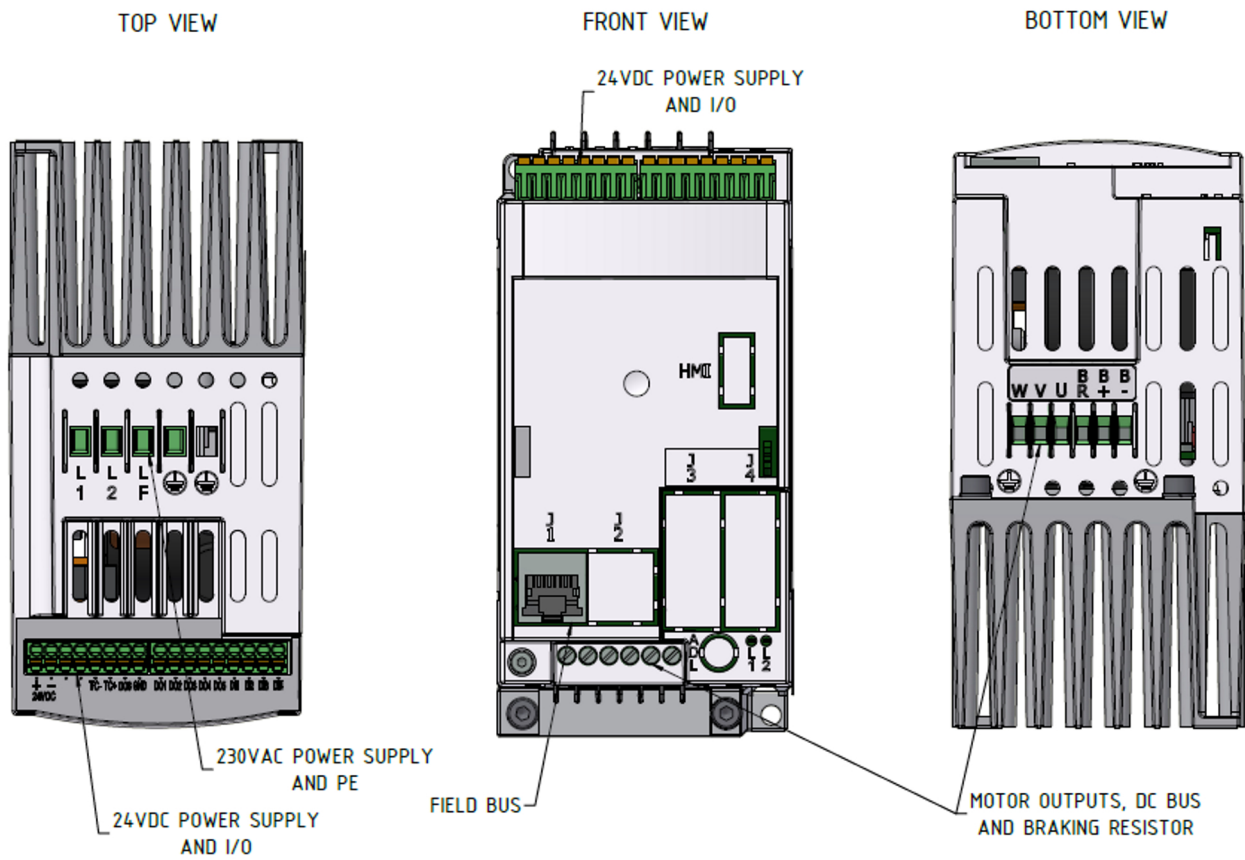
The following picture shows the arrangement of the connectors and terminal boards:



The release code KZ010375 is also equipped with a stage for piloting the brake resistor.

5.3.2 Connections (KZ010385)


The following picture shows the arrangement of the connectors and terminal boards:




5.3.2.1. Mains power

These are the connections of 230VAC supply.

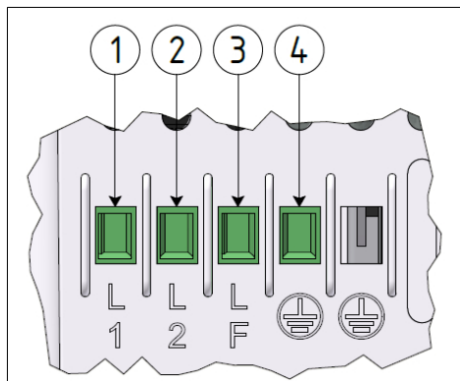
CAUTION


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

ATTENTION

	<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 4-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 the device cannot be used with IT distribution networks, since the EMI filter present internally cannot be deactivated in any way.

CAUTION

	<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>
---	---

ATTENTION

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.

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.



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

If different emission levels are required (e.g. due to different regulations, different installation category, etc.), it is generally necessary to insert an external EMI filter; the responsibility regarding the choice of filter falls entirely on the user.

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 servodrives/inverters, cable length, total current values, required insertion loss), the choice of the filter is up to the user.

5.3.2.1.1. Cables and protection devices


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

Minimum cross-section of solid conductor * **	1.5 mm ²	24 AWG
Maximum cross-section of solid conductor * **	4.0 mm ²	12 AWG
Minimum cross-section of flexible conductor * **	1.5 mm ²	24 AWG
Maximum cross-section of flexible conductor * **	2.5 mm ²	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 ±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.

	An inadequate overload protection device might not trip, with consequent danger for people and equipment. Spurious tripping of the protective device might also occur.
	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).

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

If the servodrive/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 servodrive/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 servodrive/inverter can handle might be exceeded.

If bus voltage and/or voltage on the dynamic brake resistor is/are connected, a down-stream short-circuit might damage the rectifier bridge; in order to provide protection, use fuses with a I^2t value lower than 90 A²s. Also the gG-type 10x38mm cartridge fuses with 12A rated current will protect the servodrive/inverter.

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 servodrive/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.




5.3.2.1.3. 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:

COSMOS 301X	
Marking	Mersen
Model	FR10GR69V16
Class	gR (IEC 60269-4)
Dimension	10x38 mm
Rated current	16 A
Working voltage	700V AC

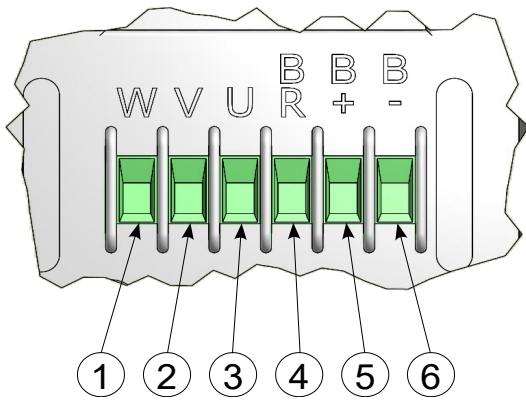
	<p>Suitable For Use On A Circuit Capable Of Delivering Not More Than 5000 Arms Symmetrical Amperes, 230 Vac Maximum when protected by semiconductor fuses model FR10GR69V16 by Mersen.</p>
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5.3.2.1.4. Installation criteria for UL certification

	<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 servodrive/inverter does not provide Motor Overload protection. External or remote Motor Overload protection shall be provided in the end-use applications.</p>
	<p>The servodrive/inverter is intended to be used with motors that must have integral thermal protection.</p> <p>The integral thermal protection signal shall be connected on the equipment, on terminal "J4", pins 1-2 for models 301X-FU e 301X-FA.</p> <p>Signal was rated maximum 5Vdc, 5mA.</p>

5.3.2.2. Motor, brake resistor and DC bus wiring

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



Motor, brake resistor and DC bus	
label	signal
W	Motor output – phase W
V	Motor output – phase V
U	Motor output – phase U
BR	Brake resistor output
B+	Bus voltage - positive
B-	Bus voltage - negative

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

Minimum cross-section of solid conductor * **	0.75 mm ²	24 AWG
Maximum cross-section of solid conductor * **	2.5 mm ²	14 AWG
Minimum cross-section of flexible conductor * **	0.75 mm ²	24 AWG
Maximum cross-section of flexible conductor * **	2.5 mm ²	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%.

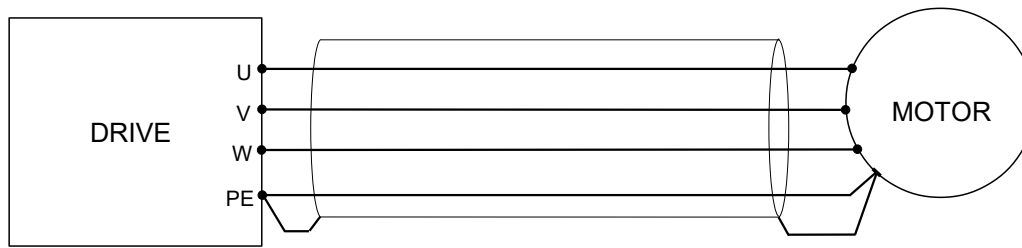
The conductor section size depends on the maximum current; in case of installation in the electrical panel of a machine, please consider that the EN 60204-1 standard does not allow the use of cables with a cross-section smaller than 0.75 mm² inside the housings and 1.0 mm² outside (0.75 mm² for multicore cables). To connect the motor, a shielded multicore cable with a cross-section of 0.75 mm² may be an excellent choice in most applications.

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



The conductors cross-section for connecting bus and brake resistor voltages must be large enough to handle the maximum short-circuit voltage on the power terminals of the servodrive/inverter.

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



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.

ATTENTION



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.

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.

Some versions of this servodrive/inverter are equipped with a stage for piloting a resistor used to generate dynamic braking. This function is useful when the motor must be abruptly decelerated (for example, during an emergency stop or due to the action of cams controlling operation). When a motor is abruptly braked, a flow of electric power is generated and directed to the servodrive/inverter; this energy is stored in the bus capacitors, thus increasing their voltage. If a dynamic brake stage is not included, the servodrive/inverter will be disabled and an error code will be generated, when the bus voltage reaches the safety threshold. In order to overcome this problem, the device incorporates an electronically controlled IGBT that is activated when a pre-set voltage threshold is exceeded, thus dissipating the energy of the external braking resistor.

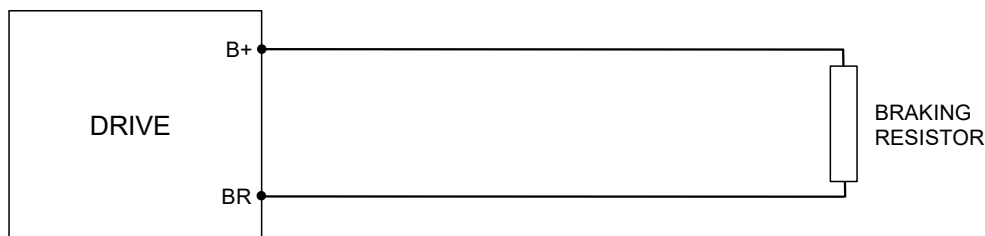
CAUTION

When a brake resistor is used, remember that the servodrive/inverter must be programmed with correct parameters. The use of incorrect parameters could damage the resistor and/or servodrive/inverter, besides causing a risk of fire.

ATTENTION

En utilisant une résistance de freinage, rappelez-vous que le servodrive/inverter variateur doit être programmé avec les paramètres corrects. L'utilisation de paramètres incorrects peut endommager la résistance et / ou le servodrive/inverter variateur, ainsi que les risques d'incendie.

The recommended connection diagram is shown in the following picture:



The bus voltage is available on the terminal board (contacts B+ and B-), for connecting a servodrive/inverter battery in parallel. This connection is advantageous from the standpoint of power dissipation in the braking resistors, because a portion of the power generated during braking can be used by another servodrive/inverter, instead of being dissipated in the braking resistor.



Using this type of connection is essential for ensuring that the power of all servodrives/inverters is connected and/or cut off at the same time, in order to avoid overloading the devices.

CAUTION

When connecting multiple servodrives/inverters to a common bus voltage, be sure to observe the polarity of the bus voltage; risk of damaging the servodrives/inverters and/or risk of fire.

ATTENTION

Lors du raccordement de plusieurs servodrive/inverter variateurs / inverseurs avec la tension de bus commune, respectez la polarité de la tension de bus; risque possible d'endommager les entraînements et / ou d'incendie.

	<p>When multiple servodrives/inverters are connected to a common bus voltage and the power to an individual device is switched off, it will continue to be electrically live; do not touch the terminal boards or perform any maintenance on the device; risk of electrocution.</p>
	<p>When multiple servodrives/inverters are connected to a common bus voltage and the power to an individual device is switched off, it will continue to be electrically live and therefore able to start the motor; do not perform any mechanical maintenance, due to the risk of injury to persons/property.</p> <p>When connecting multiple servodrives/inverters to a common bus voltage, the power on all devices must be switched on/off at the same time; risk of damaging the servodrives/inverters and/or risk of fire.</p>

The use of an external braking resistor or the bus voltage connection may damage the servodrive/inverter in case of short-circuit. Use protection devices that can limit the current value I^2t (see previous paragraph for more details).

5.3.2.3. 24V auxiliary and I/O power

This family of servo drives/inverters can be equipped with one or more connectors for connecting the 24V auxiliary power supply and any I/O. The following paragraphs show the pinout of the connectors provided for this purpose.

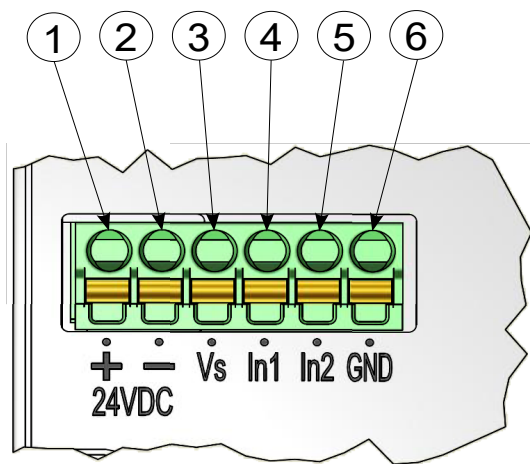
All servodrives/inverters versions feature removable spring-loaded connectors; the acceptable cross-sections of the cables to be used for wiring are as follows:

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

5.3.2.3.1. Connections (KZ010375 and KZ010376)

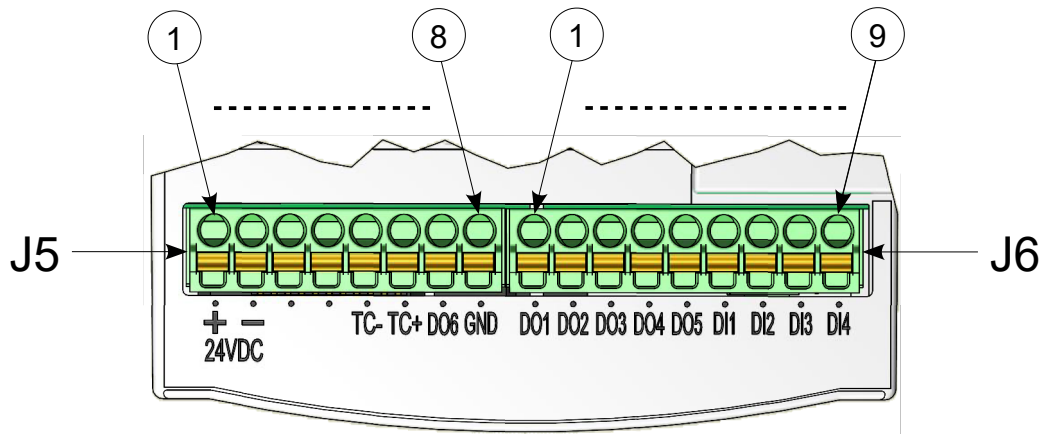
This version is equipped with a removable connector for wiring 24V auxiliary power and digital I/O power. Here is the pin configuration of the connector:



24V and I/O power		
pin	label	signal
1	24VDC +	24VDC power – positive side
2	24VDC -	24VDC power – negative side
3	Vs	24VDC sensor power
4	In1	digital input #1
5	In2	digital input #2
6	GND	earth

5.3.2.3.2. Connections (KZ010385)

This version is equipped with two removable connectors (J5 and J6) for wiring 24V auxiliary power and digital/analogue I/Os. Here is the pin configuration of the connectors:



24V and I/O power					
connector J5			connector J6		
pin	label	signal	pin	label	signal
1	24VDC +	24VDC power – positive side	1	D01	Digital output #1
2	24VDC -	24VDC power – negative side	2	D02	Digital output #2
3	-	NC	3	D03	Digital output #3
4	-	NC	4	D04	Digital output #4
5	TC-	thermocouple J input - negative	5	D05	Digital output #5
6	TC+	thermocouple J input - positive	6	DI1	Digital input #1
7	D06	Digital output #6	7	DI2	Digital input #2
8	GND	Earth on digital I/Os	8	DI3	Digital input #3
			9	DI4	Digital input #4

5.3.2.3.3. 24V power

Some versions of the servodrive/inverter require 24VDC auxiliary power to operate the control logic, the I/Os and other peripherals (such as encoder). If auxiliary power is absent, the servodrive/inverter will not operate, even though it is powered by 230VAC.

CAUTION



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).

ATTENTION



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).

The auxiliary voltage must be stable and within the limits of the servodrive/inverter (see specific paragraph). If this voltage is outside the prescribed limits, the servodrive/inverter may be damaged.

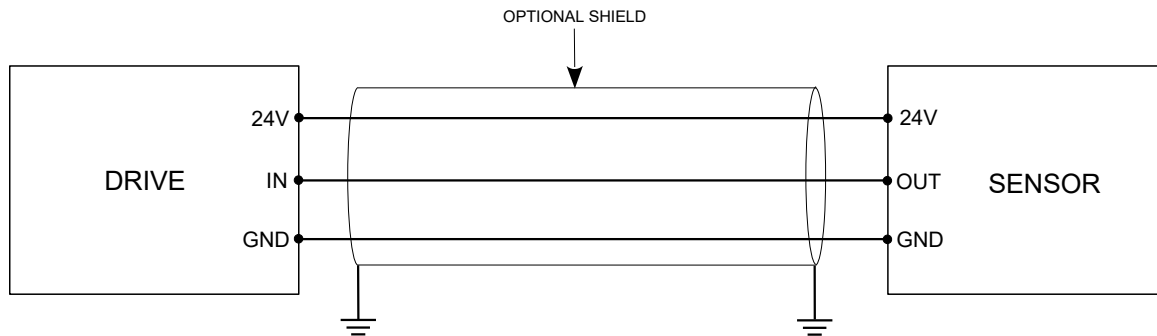


Check the polarity of the auxiliary power before connecting the servodrive/inverter; otherwise it may be damaged.

5.3.2.3.4. 24V digital inputs

The servodrives/inverters are equipped with a certain number of 24V general-purpose 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, servodrives/inverters, power supplies, relays, etc.

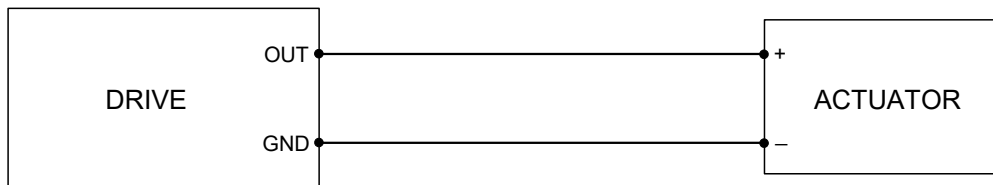


Check the sensor polarity before connection; inverted polarity may damage the sensor and/or servodrive/inverter.

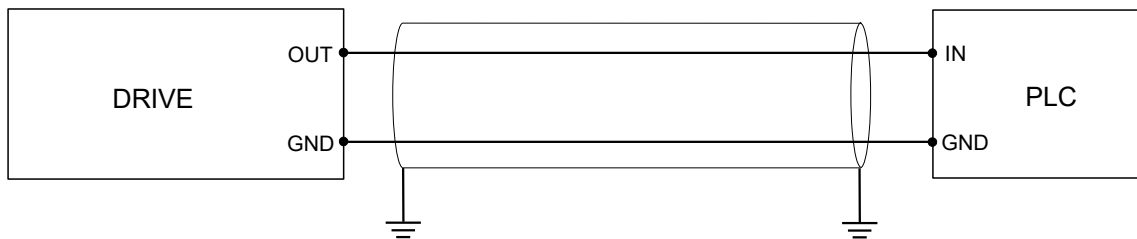
5.3.2.3.5. 24V digital outputs

The 3012-RA model is equipped with a certain number of 24V general-purpose digital outputs. They are typically used for piloting 24V actuators (such as solenoid valves, relay or contactor coils, lamps, etc.), or for generating digital signals (for example, for communicating with a PLC).

The following picture shows an example of actuator connection; in most applications, the wiring does not require a shielded cable, unless it interferes with nearby devices.



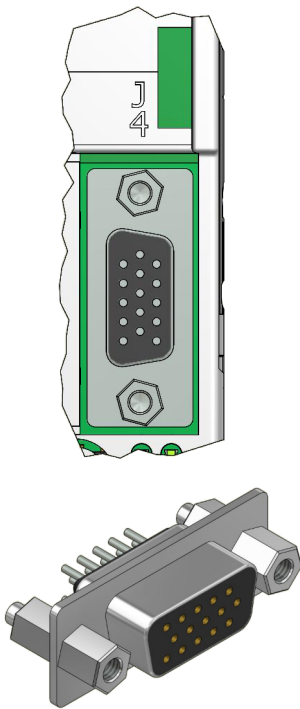
If a digital signal must be generated for communicating with another device (such as PLC, shown in the example), the recommended connection scheme is as follows:



In this case, electrical interference problems are more likely, therefore it is recommended to use a shielded cable for the connections. 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.

5.3.2.3.6. Incremental encoder

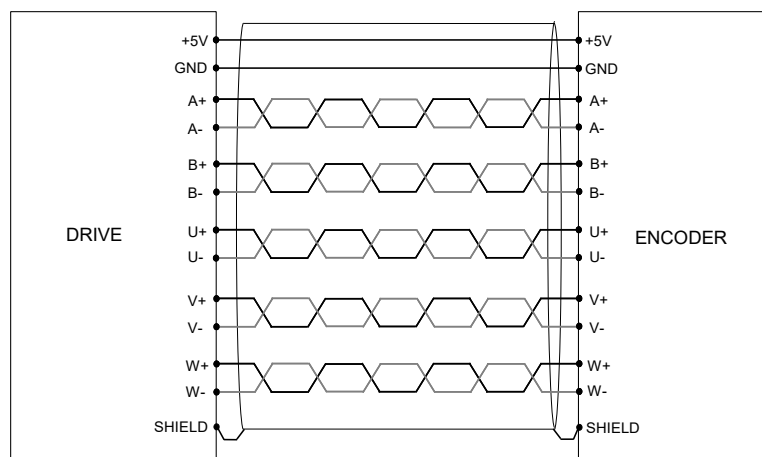
An encoder is used as a feedback device for reading and controlling the motor position and speed. These servodrives/inverters are equipped with a peripheral device that can acquire data from incremental digital encoders, which are powered by 5 VDC and have differential output signals. Differential outputs 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	Temperature sensor – pin 1
2	Temperature sensor – pin 2
3	+5VDC
4	GND
5	earth
6	A+ channel
7	B+ channel
8	Hall U+
9	Hall V+
10	Hall W+
11	A- channel
12	B- channel
13	Hall U-
14	Hall V-
15	Hall W-

The interface for the Hall sensors is only provided on version that can also pilot brushless motors. Carefully check the signal polarity before connecting the encoder; otherwise, the motor might rotate uncontrollably. Risk of electrical and/or mechanical damage to the system.

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 servodrive/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.

5.3.2.3.7. Motor temperature sensor

The servodrive/inverter is equipped with an input for reading the temperature sensors, which are often installed inside the windings, in order to protect them in case of overheating. This peripheral device is designed to acquire data from three different types of sensors:

- NTC, resistors whose resistance decreases as temperature increases
- PTC, resistors whose resistance increases as temperature increases
- Bi-metal switches, which open or close a contact when a temperature threshold is exceeded

The polarisation current is delivered directly by the servodrive/inverter; it is simply necessary to connect the sensor and program the servodrive/inverter correctly. Since these sensors are not polarized, the two terminals can be inverted with no adverse effect.

The servodrive/inverter must be programmed with the correct parameters for the sensor; otherwise the temperature value will be detected incorrectly. This may negatively affect the operation of the thermal protection system, with the risk of damaging the motor.

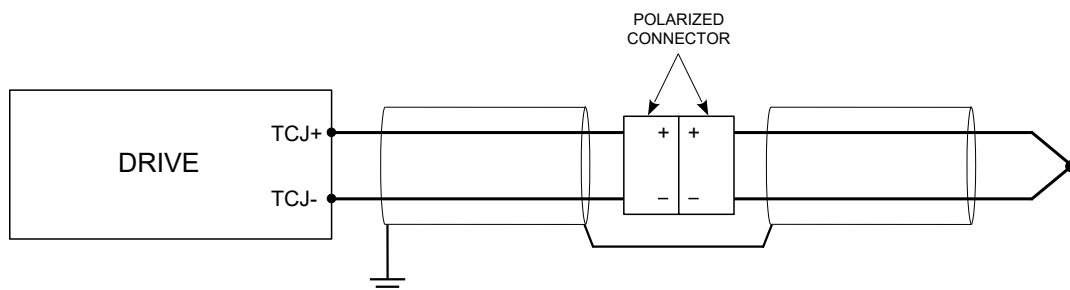
5.3.2.3.8. Thermocouple J input

The 3012-RA model is equipped with an input for reading type-J thermocouples; they are commonly used for temperature detection in several industrial applications. Since these sensors deliver a voltage signal depending on the different temperature of the hot joint and of the cold joint, it is necessary to measure the cold joint temperature by means of a different device, in order to obtain the absolute temperature of the hot joint (that is to say the sensor). The servodrive/inverter integrates an electronic temperature sensor, that is to say it compensates the cold joint temperature automatically. Since the sensors are polarized, be careful to the polarity during the wiring.

Thermocouples of different types are made of different alloys; therefore, the use of different thermocouples would imply a wrong detection. If the thermocouple cable should not be long enough, use the provided extension cables, made of the same material as of the thermocouple. Also the junctions must be made with the provided polarized connectors.

The thermocouples can be insulated or not insulated; in the latter case, the junction is electrically connected to the sheath. Since the acquisition stage is of non-insulated type, it is strictly recommended to use insulated thermocouples; otherwise, eddy currents may generate, due to imperfect equipotentiality between the thermocouple and the servodrive/inverter, with consequent errors of measurement.


The recommended connection scheme, including extension cable, is shown in the following picture.



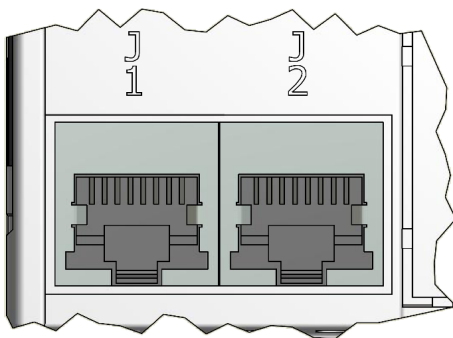
Since the amplitude of the signals delivered by the thermocouple is very low, the signals are particularly susceptible to electrical interference. For this reason, above all when the wiring extends over great distances, it is strictly recommended to use a shielded cable. If an extension cable is used, it is necessary to join the thermocouple shield and the extension cable (see picture).

5.3.2.4. Field bus

5.3.2.4.1. FLxIO versions

	Refer to the FLxIO bus integration and FLxMod system DK400076 manual for the correct definition of the connection topology of the FLxIO bus.
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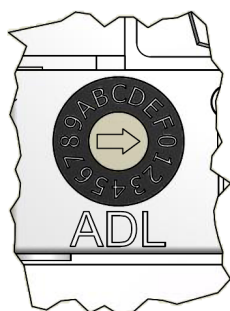
These versions of servodrive/inverter are equipped with an interface for FLxIO field bus. This bus, based on a RS485 electrical non-insulated interface, performs a reliable, real-time control of complex applications. The connections are made by means of RJ45 connectors, situated on the front panel; the following picture indicates the pin configuration.



FLEXIO 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	NC	6	NC
7	Internal use	7	Internal use
8	Internal use	8	Internal use

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 servodrive/inverter. In this way, only the last device terminates the cable; the other end is terminated by the master device.

Each slave in a FLxIO bus must have its address, which can be modified in a very easy way. To this purpose, the servodrive/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:



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

Address 0 can not be used; each device on the same bus must have a different address. The presence of two devices with the same address creates communication problems and may cause the system to behave uncontrollably.

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

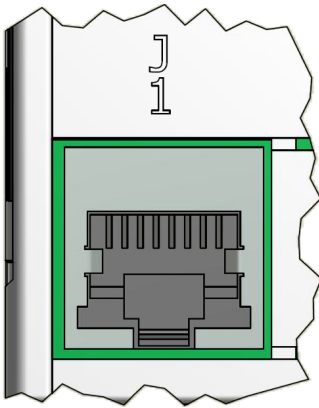


Vérifiez l'exactitude de l'adresse avant de mettre les périphériques sous tension, sinon le système pourrait avoir un comportement imprévisible. danger de dommages aux personnes et / ou aux choses.

5.3.2.4.2. Versione Modbus

The 3012-RA model is equipped with a RS485 serial non-insulated interface. It can be used for the control/diagnosis/parametrization of a device with MODBUS RTU protocol.

The connections are made by means of RJ45 connector on the front panel (J1); the following picture shows the pin configuration.



RS485 connector J1	
pin	signal
1	DATA+
2	DATA-
3	GND
4	NC
5	NC
6	NC
7	NC
8	NC

In order to avoid reflections, it is necessary to install a 120Ω termination resistor on the end of the wired section. The wiring can be made by means of Ethernet CAT 5E cable; otherwise, choose a shielded cable with typical impedance of 120Ω. The shield must be connected to both sides of the connector shell.

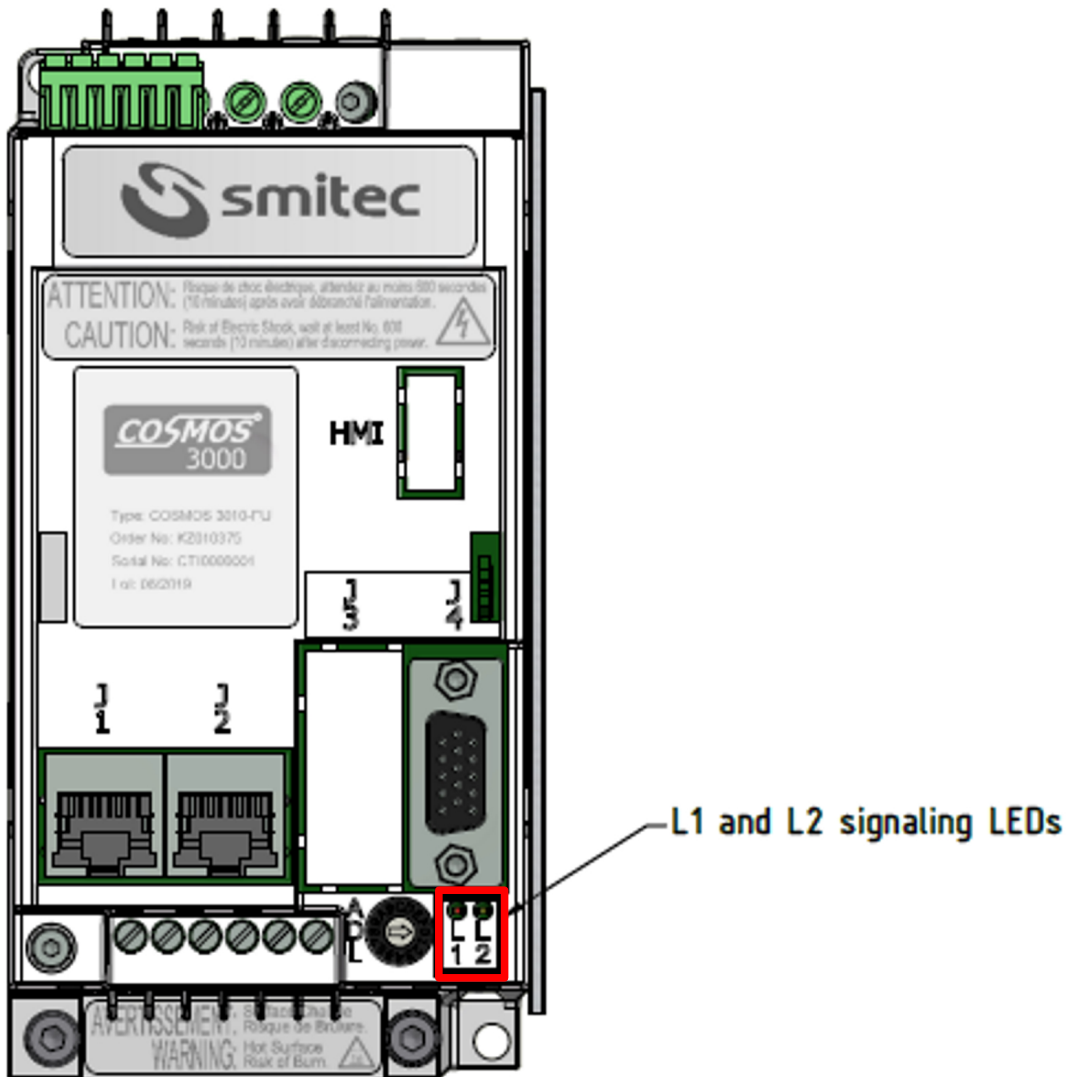
Please refer to the operation and programming manual for further information.

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 fieldbus status of the device; depending on the FixIO or Modbus field bus used, the signalling mode of the LEDs is different.



6.1.1 LEDs behavior for 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 the event of an error, the diagnostics are returned via the FlxIO bus; so if you need to know the type of error that occurred, you will need to query the system via the FlxIO bus.

6.1.2 LEDs behavior for Modbus field bus

Marking	Function
L1	Field bus status (2 LEDs; one amber and the other green)
L2	Field bus status (2 LEDs; one red and the other green)

They have the following meaning according to the Modbus standard, based on their switching on and off and the frequency with which they flash. The following table shows the signals implemented based on the status of the device:

Inverter status		L1 (amber/green LED)	L2 (red/green LED)	Function
Correct operation	it is not possible to enable ¹	OFF	Green ²	¹ : The inverter cannot be enabled if the DC bus voltage does not exceed 260 Vac. ² : If the inverter is not in error, the L2 LED turns GREEN and turns off briefly during Modbus communication.
	it is possible to enable	Amber		
	Enabled	Green		
Inverter in error recoverable		Error reporting sequence	OFF	The frequency of the error signal is 2 flashes every second
Inverter in unrecoverable error		Error reporting sequence	Red	The frequency of the error signal is 2 seconds for each flash
Firmware update		Green flashing	Red	The signalling frequency of the L1 LED is about 4 flashes per second

In the event of an error, the servodrive/inverter signals the number associated with the error that has occurred by means of a sequence of flashes carried out by L1. The error signalling sequence consists of a number of amber L1 flashes equal to tens of the number associated with the error, followed by a number of green L1 flashes equal to the units of the number associated with the error. The beginning of the sequence is recognizable by a pause lasting longer than the duration of the single flashes. For example, if the servodrive/inverter is in error due to an excessive motor temperature, the number associated with the type of error is 36. In this case, the signalling sequence generated by L1 will consist of 3 amber flashes followed by 6 green flashes and then a pause. If the error is irrecoverable, L2 is turned on with red color and the error number is reported via L1 but performed more slowly than in the previous case when the servodrive/inverter was in a recoverable error state.

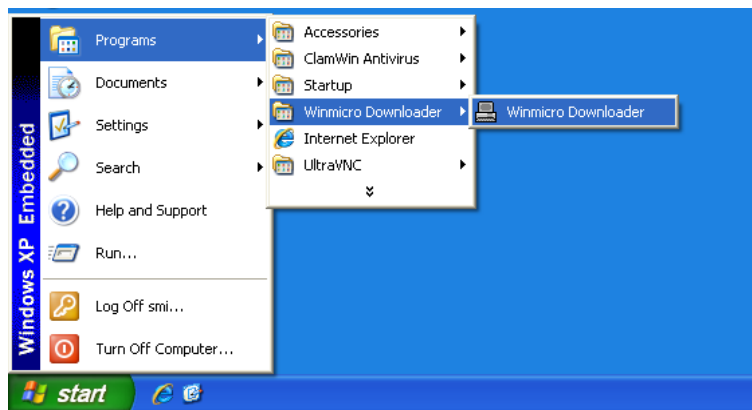
7 Updating the firmware

Due to improvements or additional functions, the servodrives/inverters can be upgraded with a more recent firmware version.

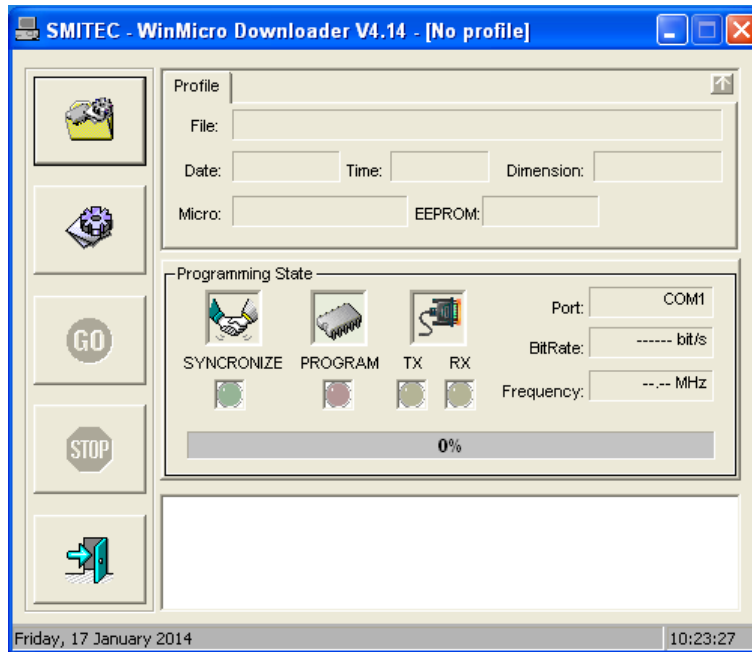
In models KZ010375/376, the upgrade is automatic, through Flextron/FLxIO bus and it is not possible to perform updating procedures directly on the device. By upgrading the firmware of the master device, all servodrives/inverters connected to the master device will be upgraded when they are started.

For the model code. KZ010385, the upgrading operation requires a PC with Windows XP or recent release, equipped with a free USB port; also the SMITEC Winmicro dedicated software must be already installed on the PC. In order to install this utility, refer to the guide included in the installation files. Also the RS-USB485 adapter (cod. KZ020087) and the programming cable (cod. KF131284) are required.

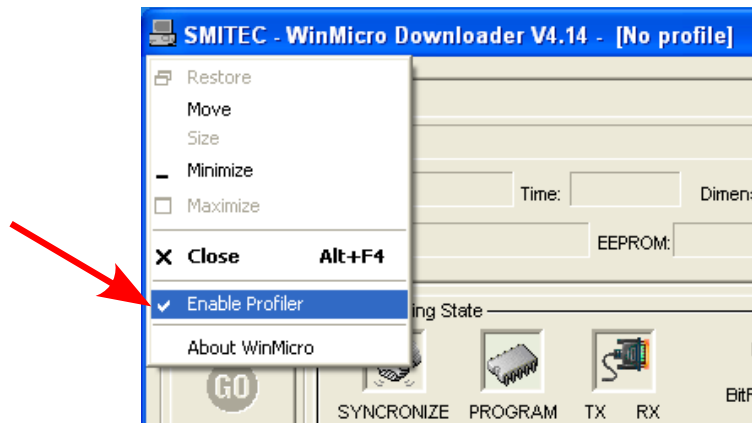
- Connect the USB-RS485 adapter (KZ020087) to a USB port on the computer, by means of the programming cable. If you use a commercial cable, its length must not exceed 3 metres.
- Connect the RS485 cable (cod. KF131284) to the connector J1 on the servodrive/inverter.
- Power up the servodrive/inverter.
- Start Winmicro from the programme menu, as indicated in the following picture:



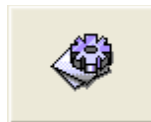
- After the software has been started, the following window will be displayed:



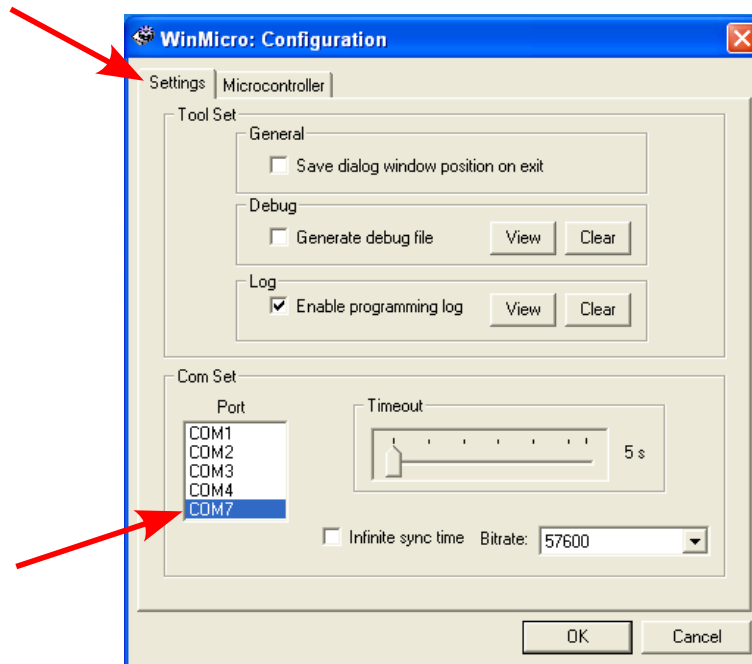
- Open the program menu by clicking on the icon at the top left and deselect the **Enable Profiler** item:



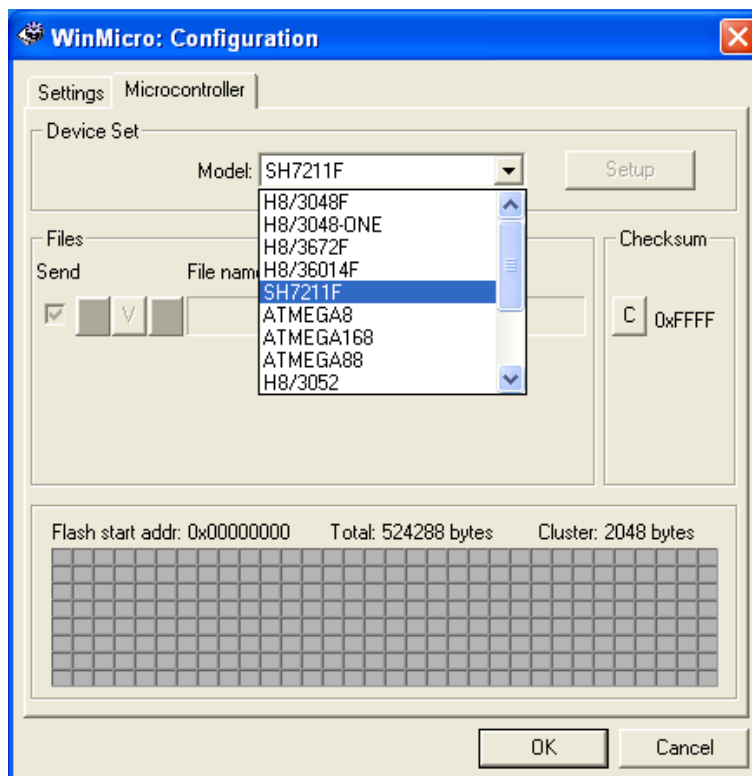
- Click on the configuration button:



- The configuration window will be displayed; in the section **Settings** select the COM port to be used (in general, you should select the COM with the highest value).



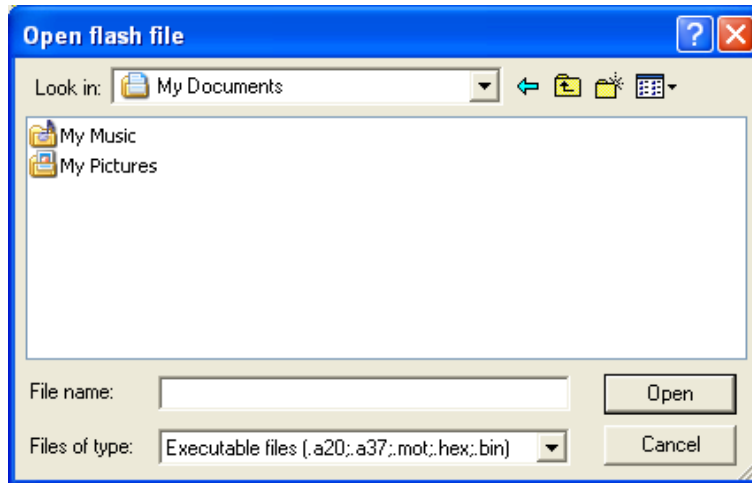
- Now it is necessary to set the type of microcontroller “RX62T...” in the **Model** drop-down list and then click on the **OK** button:



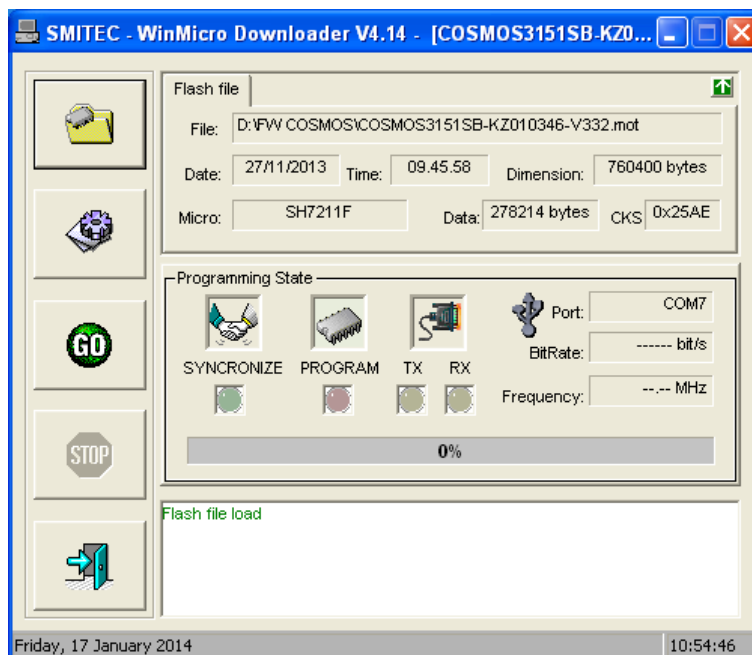
- In the main window click the following button:



- The following dialogue box will appear from which it will be possible to select the file to program; make sure you upload the correct file:



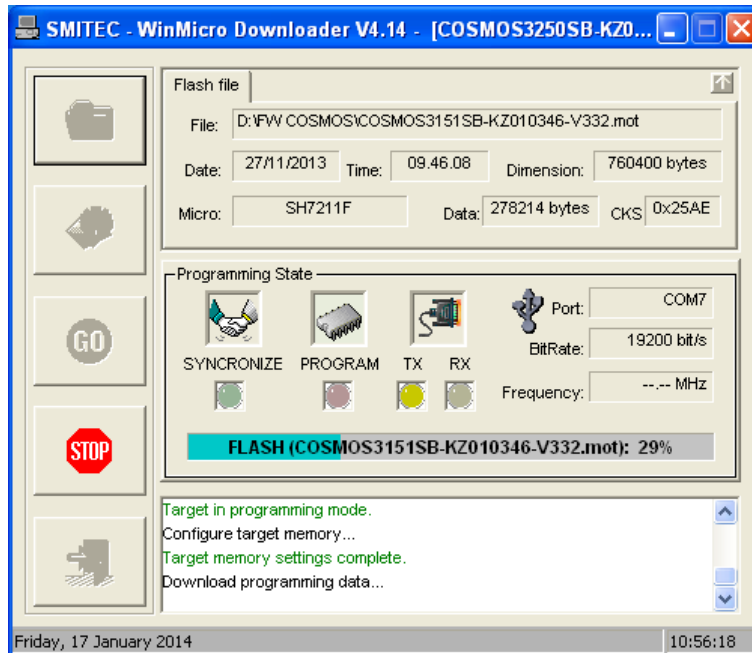
- Once the selected file has been uploaded, some information about the file and the controller will be displayed on Winmicro main window. If the port is correct, the symbol of the USB port will be displayed near the wording **Port:**



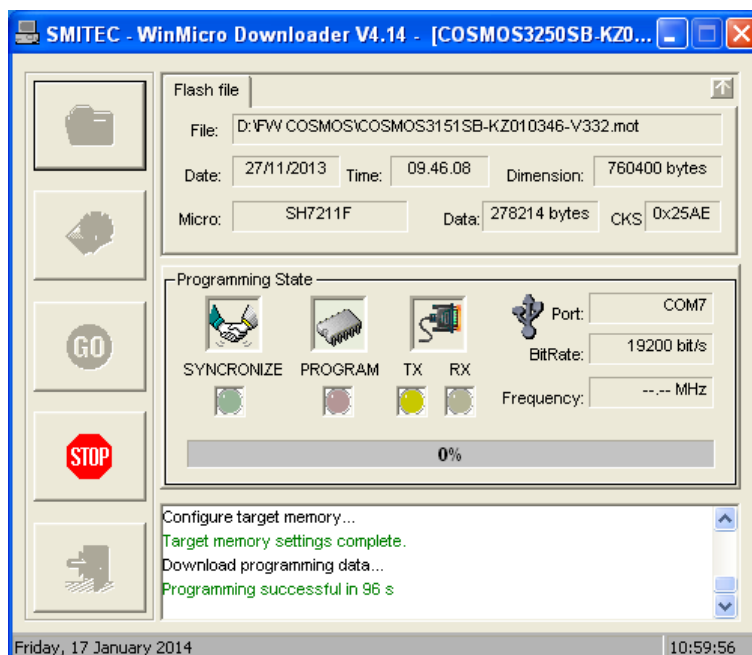
- Click the button **GO** to start programming.



- The programming procedure will start, clearly indicated by the progress bar:



- At the end of the programming procedure, a message will be displayed, indicating if the operation has been successful and the time required to perform it.



- In case of failure with message **Synchronization Error**, make sure the type of microcontroller, the file and the port number are correct.
- After the upgrades, leave the programme, by clicking on the button:



- Now the programming procedure is over; it is possible to disconnect all cables.

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 servodrives/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 servodrives/inverters; 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.