

• 15P0095B6 •

# SINUS K LIFT

FULL DIGITAL INVERTER

## USER MANUAL -Installation and Programming Instructions-

Updated on 29/10/07  
R. 04  
SW Vers. 1.45x

*English*

- This manual is integrant and essential to the product. Carefully read the instructions contained herein as they provide important hints for use and maintenance safety.
- This device is to be used only for the purposes it has been designed to. Other uses should be considered improper and dangerous. The manufacturer is not responsible for possible damages caused by improper, erroneous and irrational uses.
- Elettronica Santerno is responsible for the device in its original setting.
- Any changes to the structure or operating cycle of the device must be performed or authorized by the Engineering Department of Elettronica Santerno.
- Elettronica Santerno assumes no responsibility for the consequences resulting by the use of non original spare-parts.
- Elettronica Santerno reserves the right to make any technical changes to this manual and to the device without prior notice. If printing errors or similar are detected, the corrections will be included in the new releases of the manual.
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SANTERNO**

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## 1. GENERAL DESCRIPTION

### 1.1. OVERVIEW

The inverters (V.V.V.F.) of the SINUS K series equipped with the LIFT Software are designed for the control of pulling motors for cable lifts. They are specifically designed for lifting applications and are not suitable for general-purpose applications.

The special software ensures the best comfort and an excellent floor approaching system, as well as easy startup and maintenance.

The sophisticated hardware includes IGBT modules of the latest generation and vector modulation features, allowing dramatically reducing both energy consumption and contractual power.

The current absorbed while accelerating and the power dissipated by the motor are considerably reduced; the motor rotation is noiseless and the motor overheating is negligible.

SINUS K LIFT inverters can be connected to motors with power ratings ranging from 1.3 kW to 74 kW. No transducer (tacho generator, encoder or resolver) is required for cage speed ratings up to 1.2 m/s. For cage speed values up to 2.5 m/s, an encoder is required.

The inverters of the SINUS K LIFT series can also be used to modernize existing lifting systems.

They offer the following benefits:

- Low operating costs.
- Low purchase costs.
- Enhanced performance, accuracy and comfort.
- Simple installation and maintenance.
- High reliability.

The inverters of the SINUS K LIFT series have been developed, designed and manufactured according to the "Low Voltage Directive" and the "EMC Directive" and are provided with the "CE" marking. They comply with the following standards:

EN81-1 lifts.	Safety regulations for the manufacture and installation of lifts and hoists. Electrical
EN61800-5-1	Adjustable speed electrical power drive systems. Part 5-1: Safety requirements – Electrical, thermal and energy.
EN61800-5-2	Adjustable speed electrical power drive systems. Part 5-2: Safety requirements – Functional.
EN60146-1-1 convertors.	Semiconductor convertors. General requirements and natural commutation
EN60146-2	Part 1-1: Specifications of basic requirements. Semiconductor convertors. Part 2: Self-commutated convertors with semiconductors incorporating direct DC convertors.
EN61800-2	Adjustable speed electrical power drive systems. Part 2: General requirements – Rating specifications for low voltage adjustable frequency AC power drive systems.
EN60204-1	Safety of machinery. Electrical equipment of machines. Part 1: General requirements.
EN60529	Degrees of protection provided by enclosures (IP Code).
EN50178	Electronic equipment for power systems.
EN12015	Electromagnetic compatibility. Product family standard for lifts, escalators, and passenger conveyors. Emission.
EN12016	Electromagnetic compatibility. Product family standard for lifts, escalators, and passenger conveyors. Immunity.



**CAUTION** Read and understand this manual before installing the SINUS K LIFT inverter.

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## 1.2. FEATURES OF SINUS K LIFT INVERTERS

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Inverters are electronic devices capable of driving asynchronous motors at adjustable speed. The speed of rotation of asynchronous motors depends on the voltage frequency of the motor power supply. To adjust the motor speed, the voltage frequency of the motor power supply must be adjusted accordingly. Inverters are voltage generators capable of adjusting both the voltage value and the relevant frequency value at a time. To enhance the motor operation at any speed value, the simultaneous variation of voltage and supply frequency must be obtained with particular criteria in order not to alter the torque characteristics of the torque produced by the connected motor.

Ratings, mounting and installation instructions, programming and startup are detailed in the next sections of this manual. This section describes the main features of the inverters of the SINUS K LIFT series. The inverter frame is made of painted steel sheet. This robust, small-sized frame with degree of protection IP20 may be mounted to a panel. The inverter frame always includes a braking module. An input EMC filter may be installed by request. Auxiliary circuit interfaces are power terminals and signal terminals, but each inverter is also provided with a standard-supplied serial interface to be connected to a computer, a modem, etc. The inverters of the SINUS K LIFT series are provided with forced air-cooling and can operate at ambient temperatures ranging from 0 to 40 °C (no derating) and up to 50 °C (derating); allowable relative humidity ranges from 5 to 95% (non-condensing).

The human interface is a remotable keypad.

The keypad allows setting up and adjusting the equipment, entering the motor parameters, selecting kinematic variables (acceleration and jerk speed), displaying failure messages/error messages. The equipment may be set up also through the serial interface and a computer equipped with the "Remote Drive" programming software (available by request).

Comfort depends on acceleration and jerk values. Acceleration values determine the maximum allowable constant acceleration obtained during the start stage or the stop stage (straight line in the S-shaped curve), while jerk values determine acceleration/deceleration variations (curve lines in the S-shaped curve). More details are given in the following sections. Two different commercial speed values are available along with a floor approach speed and a maintenance speed. All these values may be programmed via keypad. This allows obtaining the most suitable speed for different interfloors; in case of low interfloors, the inverter will adjust its speed based on the requirements of the lift plant. If the inverter is sent a slowing-down signal before reaching the preset speed, it will slow down with the preset acceleration and jerk values but with a cage speed allowing obtaining a proper stop distance.

Acceleration and jerk values may be set up via keypad. Factory setting is 0.6 m/s<sup>2</sup> (acceleration) and 0.6 m/s<sup>3</sup> (jerk)—with no encoder feedback; if encoder feedback is used, acceleration is set to 1.0 m/s<sup>2</sup> and jerk is set to 0.8 m/s<sup>3</sup>.

These parameters ensure excellent comfort for speeds up to 1.2 m/s. Factory-set acceleration and jerk values may be customized to fit specific requirements.

Other factory-set values are the following: second speed (low speed), floor approach speed and maintenance speed.





Preset values relate to the rated cage speed ( $V_n$ ) as follows:

	WITHOUT ENCODER FEEDBACK	WITH ENCODER FEEDBACK
Low speed	$V_b = 0.67 \times V_n$	$V_b = 0.32 \times V_n$
Approach speed	$V_a = 0.1 \times V_n$	$V_a = 0.1 \times V_n$
Maintenance speed	$V_m = 0.4 \times V_n$	$V_m = 0.2 \times V_n$
Commercial speed	$V_c = 1 \times V_n$	$V_c = 1 \times V_n$

Example: If rated speed is  $V_n = 1.2$  m/s with no ENCODER feedback, the following values are obtained:

$$V_b = 0.8 \text{ m/s}$$

$$V_a = 0.12 \text{ m/s}$$

$$V_m = 0.48 \text{ m/s}$$

$$V_c = 1.2 \text{ m/s}$$

**NOTE**

The speed values above, as well as acceleration and jerk values, are preset as a percentage of the rated speed of the lift cage for easier startup, thus allowing selecting only the rated speed of the lift cage.

However, all parameter values may be altered via keypad. The keypad display also shows the expected slowing-down distance for any preset speed. This allows the best accuracy in positioning slowing-down indicators for the lift cage.

Slowing-down indicators will match with the distance from the lift stop position, which is obtained by increasing the expected length by the desired approach distance. Example: if commercial speed  $V_c = 1.2$  m/sec (parameter P44), parameter M24 displays the expected stop distance of 1.8 m.

If a 0.15 m approach distance is set up, the slowing-down indicator will be fixed at a distance equal to or higher than 1.95 m from the stop position.

The slowing-down indicator will be placed at a distance exceeding 1.95 m (theoretical value) in order to avoid any errors due to a delay time or a hysteresis affecting the slowing-down signal. The longer the distance, the better the accuracy of the slowing-down indicator.

Increasing the slowing-down indicator distance with respect to the theoretical value increases the floor approach time. As a result, a long distance will have adverse effects on the time spent for a lift stroke. A cautious increase in the theoretical distance is then recommended.

The best performance is obtained by increasing the theoretical distance of the slowing-down indicator by a value ranging from 5% to 20%.

In the example above, if the slowing-down signal is increased by 10% from the stop position (including the approach distance), the slowing-down indicator will be placed at a distance of 2.15 m from the stop position  $(1.8+0.15) \times 1.1 = 1.95 \times 1.1 = 2.15$ .

The inverters manufactured by ELETTRONICA SANTERNO fully meet these adjustment and control requirements and incorporate a wide range of the latest technologies to fit any application requirement.

AVAILABLE SINUS K MODELS for LIFT applications:

Available SINUS K LIFT models range from 1.8kW to 74kW.



**NOTE**

The manufacturer reserves the right to change the technical features and the design of the models shown in the picture above. The proportion of one enclosure to the other is shown as an example and is not binding.



### 1.3. SINUS K: FEATURE LIST

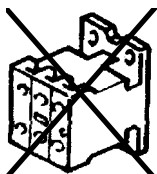
- One product, three functions:
  - Vector-modulation LIFT software for lift applications (in compliance with EN 81-1 and lift directive) (V/f pattern);
  - Vector-modulation IFD software for general-purpose applications (V/f pattern) (NOT COVERED IN THIS MANUAL) (\*);
  - Sensorless vector VTC software for high torque performance (direct torque control) (NOT COVERED IN THIS MANUAL) (\*);

(\*) To be stated when ordering the equipment. This feature can also be programmed via serial link on a dedicated connector or via the JTAG programming interface.

- Wide range of supply voltage (200VAC ~ 500VAC) for stand-alone models. Standard power supply: 280VDC ~ 705VDC.
- Wide range of voltage ratings and power ratings for the electrical motor to be connected to any single inverter size. Stand-alone model: up to 1,200kW. LIFT application: up to 74kW.

	MODEL	LIGHT	STANDARD	HEAVY	STRONG
SINUS K	0025 4TBA2X2	22kW	18.5kW	15kW	11kW

- Built-in filters for the whole SINUS K range in compliance with regulation EN61800-3, issue 2 concerning emission limits.



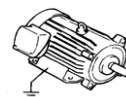
- No line contactor included. The new hardware configuration is standard supplied with a safety system including redundant contacts for the inhibition of firing pulses in the power circuit, in compliance with the latest requirements of the safety regulations in force. (However, respect the specific rules of the field of application).

- Beyond performance enhancement, the new series of SINUS K models are more compact than the prior models. The overall dimensions have been reduced up to 50% in order to install the inverter in small-sized, light-weight control panels. A compact, book-like structure allows easy side-by-side installation. The SINUS K may be installed in cabinets and its system design offers a better price/performance ratio.

- Automatic control of the cooling system. The ventilation system activates only when required and indicates any failures of the cooling fan. This ensures greater energy saving, lower wear of the cooling fans and weaker noise. In case of equipment failure, it is possible to adjust the system speed in order not to stop the equipment and to limit dissipated power.

- Built-in braking module.

- Noiseless operation ensured by high modulation frequency programmable up to 16kHz.



- Control panel with LCD display showing full words for easier comprehension of the operation parameters; six function keys allowing parameter programming and alteration.

- Window-structured programming menu for easy and quick control of any functionality.

- Preset parameters for the most used applications.
- PC interface for WINDOWS environment with the REMOTE DRIVE software in six foreign languages.
- RS485 MODBUS RTU serial communications for serial links to PC, PLC and control interfaces.
- Optional field buses of any type (Profibus DP, Can Bus, Device Net, Ethernet, etc.)

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## 1.4. PRODUCTS COVERED IN THIS MANUAL

---

This User Manual covers all the inverters of the SINUS K series provided with the LIFT software; size: S05 to S20; supply voltage: 200VAC to 500VAC. This manual includes three main parts:

**PART 1 -Installation Instructions-** includes the following:

- Feature list and ratings
- Accessories
- Instructions for the inverter mechanical and electrical installation and the equipment commissioning.

**PART 2- Programming Instructions-** includes the following:

- Inverter functions and relevant parameters
- Programming via keypad and display of all available parameters
- Remote programming via serial communications.

**PART 3 – Normative References** covers the following:

- Standards and regulations in force the product complies with.
- Declarations of Conformity.

# PART 1

## -Installation Instructions-

## 2. CAUTION STATEMENTS

This section contains safety statements. The non-observance of these safety instructions may cause serious injury or death and equipment failure. Carefully read the instructions below before installing, starting and operating the inverter.

Only competent personnel must carry out the equipment installation.

### SYMBOLS:



**DANGER** Indicates operating procedures that, if not correctly performed, may cause serious injury or death due to electrical shock.



**CAUTION** Indicates important instructions that, if not followed, may cause serious equipment failure.



**NOTE** Indicates important hints concerning the equipment operation.

### SAFETY STATEMENTS TO FOLLOW WHEN INSTALLING AND OPERATING THE EQUIPMENT:



**NOTE** Always read this instruction manual before starting the equipment.  
The ground connection of the motor casing should follow a separate path to avoid possible interferences.



**DANGER** ALWAYS PROVIDE PROPER GROUNDING OF THE MOTOR CASING AND THE INVERTER FRAME.



**DANGER** The inverter may generate an output frequency up to 800Hz; if a 4-pole motor is used, this may cause a motor rotation speed up to 16 (sixteen) times the rated motor speed: never use the motor at a higher speed than the max. allowable speed stated on the motor nameplate.



**DANGER** ELECTRICAL SHOCK HAZARD – Never touch the inverter electrical parts when the inverter is on; always wait at least 5 minutes after the inverter is shut off.



**DANGER** Never perform any operation on the connected motor when the inverter is on.



**DANGER** Do not perform electrical connections on the motor or the inverter if the inverter is on. Electrical shock hazard exists on output terminals (U,V,W) and on terminals +, -, B, even when the inverter is disabled. Wait at least 5 minutes after switching off the inverter before operating on the electrical connection of the motor or the inverter.



**DANGER** MECHANICAL MOTION – The inverter determines mechanical motion. It is the operator's responsibility to ensure that this does not give rise to any dangerous situations.



**DANGER** EXPLOSION AND FIRE – Explosion and fire hazard exists if the equipment is installed in presence of flammable fumes. Do not install the inverter in places exposed to explosion and fire hazard, even if the motor is installed there.

Do not connect supply voltages exceeding the equipment rated voltage to avoid damaging the internal circuits.

Do not connect the equipment power supply to the output terminals (U,V,W), and on terminals +, -, B, and to the control terminals. The equipment power supply must be connected only to terminals R,S,T.

Do not short-circuit terminals (+) and (-) and terminals (+) and (B); do not connect any braking resistors with lower ratings than the required ratings.

Do not start or stop the motor using a contactor for the inverter power supply.

Operate the inverter only if a proper grounding is provided.

In case of alarm trip, a comprehensive review of the DIAGNOSTICS section is recommended. Restart the equipment only after removing the cause responsible of the alarm trip.



**CAUTION**

Do not perform any insulation test between the power terminals or the control terminals.

Make sure that the fastening screws of the control terminal board and the power terminal board are properly tightened.

Do not connect single-phase motors.

Always use a motor thermal protection (use the inverter motor thermal model or a thermoswitch installed in the motor).

Respect the environmental requirements for the equipment installation.

The bearing surface for the inverter must be capable of withstanding high temperatures (up to 90°C).

The inverter electronic boards contain components which may be affected by electrostatic discharges. Do not touch them unless it is strictly necessary. Always be very careful so as to prevent any damages caused by electrostatic discharges.



### 3. EQUIPMENT DESCRIPTION AND INSTALLATION

#### 3.1. BASIC FEATURES OF THE SINUS K LIFT SERIES

The inverters of the SINUS K series are full digital inverters for the speed regulation of asynchronous motors up to 74 kW.

The inverters of the SINUS K series are designed and manufactured in Italy by the technicians of Elettronica Santerno; they incorporate the most advanced features offered by the latest electronic technologies.

SINUS K inverters fit any application thanks to their advanced features, among which: 16-bit multiprocessor control board; vector modulation; power control with the latest IGBTs; high immunity to radio interference; high overload capability.

Any variable required for the equipment operation may be easily programmed through the keypad, the alphanumeric display and the parameter menus and submenus.

The inverters of the SINUS K series are provided with the following standard features:

- power supply from 200-500VAC mains (-15%, +10%);
- EMC filters for industrial environment incorporated in any inverter Size;
- EMC filters for domestic environment incorporated in Sizes S05, S10 and S12;
- possibility of DC power supply;
- built-in braking module;
- RS485 serial interface with communications protocol according to the MODBUS RTU standard;
- IP20 degree of protection;
- 3 analog inputs,  $0 \pm 10\text{VDC}$ ,  $0(4) \div 20\text{mA}$ ;
- 8 optoisolated, configurable digital inputs (NPN/PNP);
- 2 configurable analog outputs,  $0 \div 10\text{V}$ ,  $4 \div 20\text{mA}$ ,  $0 \div 20\text{mA}$ ;
- 1 static, "open collector" digital output (optoisolated);
- 2 configurable relay digital outputs with reverse contacts.

A comprehensive set of diagnostic messages allows a quick fine-tuning of the parameters during the equipment starting and a quick resolution of any problem during the equipment operation.

The inverters of the SINUS K series have been designed and manufactured in compliance with the requirements of the "Low Voltage Directive", the "Machine Directive" and the "Electromagnetic Compatibility Directive".

### 3.2. INSPECTION UPON RECEIPT OF THE GOODS

Make sure that the equipment is not damaged and that it complies with the equipment you ordered by referring to the nameplate located on the inverter side. The inverter nameplate is described below. If the equipment is damaged, contact the supplier or the insurance company concerned. If the equipment does not comply with the one you ordered, please contact the supplier as soon as possible.

SINUS	K	0005	4	T	B	A2	X	2
1	2	3	4	5	6	7	8	9

1	Product line: SINUS stand-alone inverter SINUS BOX inverter contained inside a box (unavailable for the Sinus K LIFT version) SINUS CABINET inverter contained inside a cabinet (unavailable for the Sinus K LIFT version)
2	"K" type of control with three types of software installed: LIFT = Space vector modulation with special software for lift applications (vector modulation PWM with V/f pattern) IFD = Space vector modulation for general-purpose applications (vectorial modulation PWM with V/f pattern - NOT COVERED IN THIS MANUAL) VTC = Vector Torque Control for high torque demanding applications (Sensorless vectorial control with direct torque control - NOT COVERED IN THIS MANUAL)
3	Inverter size
4	Supply voltage 2 = 200÷240VAC; 280÷340VDC power supply 4 = 380÷500VAC; 530÷705VDC power supply
5	Type of power supply T = Three-phase S = Single-phase (available by request)
6	Braking module X = no braking chopper (optional external braking chopper) B = built-in braking chopper
7	Type of EMC filter: I = No filter, A2 = integrated filter complying with EN61800-3 (second environment), EN61800-3 (first environment, category C2, up to Size 0086 included), EN55011 cl. A gr.2 (industrial environment), EN55011 cl. A gr.1 (industrial environment, up to size 0086 included), EN12015 (concerning lifts). A1 = integrated filter complying with the same standards as for A2 and with EN61800-3 (first environment, category C1), EN55011 cl. B (residential environment), EN61000-6-3 (residential environment).
8	Control panel X = without any control panel K = with control panel, back-lit, 16x2 characters LCD display.
9	Degree of protection 0 = IP00 2 = IP20 3 = IP24 (unavailable for the Sinus K LIFT version) 5 = IP54 (unavailable for the Sinus K LIFT version)

If the equipment is stored before being started, make sure that the ambient conditions do not exceed the ratings mentioned in the INSTALLATION section. The equipment guarantee covers any manufacturing defect. The manufacturer has no responsibility for possible damages due to the inverter transportation or unpacking. The manufacturer is not responsible for possible damages or faults caused by improper and irrational uses; wrong installation; improper conditions of temperature, humidity, or the use of corrosive substances. The manufacturer is not responsible for possible faults due to the inverter operation at values exceeding the inverter ratings and is not responsible for consequential and accidental damages. The equipment is covered by a 3-year guarantee starting from the date of delivery.



### 3.2.1. INVERTER NAMEPLATE

Example of a nameplate placed on a 2T Sinus K inverter

**ZZ0097025**      32000  IFD      **SINUS K 0049 2T BA2K2**  
 32001  VTC  
 32002  LIFT

input AC3PH 200..240V +10/-15% 50/60Hz	80,0 A	size S20
output AC3PH 0..240V 0..800Hz	I nom. (A) 80	I max (A) 96
<b>UL ratings@500Vac</b>	69,0 kVA max (drive)	54,0 kW/ 72 Hp (motor)
Short Circuit Rating: 10000 Arms@500Vac		
Aux. Contact Ratings: 5A@250Vac (resistive) 3A@250Vac 5A@30vdc		
FOR FURTHER DETAILS SEE USER MANUAL		
Fuse (A) <b>100</b>	Circ.breaker (A) <b>100</b>	Cont. AC1 (A) <b>100</b> Wire size (sqmm) <b>25</b> AWG4

motor voltage	application table <sup>kw</sup> / <sub>Hp</sub>			
	light	standard	heavy	strong
220-240V	<b>25</b>	<b>22</b>	<b>18,5</b>	<b>15</b>
	35	30	25,0	20

**IND.CONT.EQ.**  
**2YF1**  
**E195081**



MADE IN ITALY

P000792-0

**PART 1**



Example of a nameplate placed on a 4T Sinus K inverter

**ZZ0097025**      34000  IFD  
 34001  VTC      **SINUS K 0049 4T BA2K2**  
 34002  LIFT

input AC3PH 380..500V +10/-15% 50/60Hz	<b>80,0 A</b>	size S20
output AC3PH 0..500V 0..800Hz	I nom. (A) <b>80</b>	I max (A) <b>96</b>
<b>UL ratings@500Vac</b>	<b>69,0 kVA max (drive)</b>	<b>54,0 kW/ 72 Hp (motor)</b>
Short Circuit Rating: 10000 Arms@500Vac		
Aux. Contact Ratings: 5A@250Vac (resistive) 3A@250Vac 5A@30vdc		
FOR FURTHER DETAILS SEE USER MANUAL		
Fuse (A) <b>100</b>	Circ.breaker (A) <b>100</b>	Cont. AC1 (A) <b>100</b> Wire size (sqmm) <b>25</b> AWG4

motor voltage	application table <sup>kW</sup> / <sub>Hp</sub>			
	light	standard	heavy	strong
380-415V	<b>45</b>	<b>37</b>	<b>30</b>	<b>25</b>
	60	50,0	40	35
440-460V	<b>50</b>	<b>45</b>	<b>37</b>	<b>30</b>
	65,0	60	50	40
480-500V	<b>57</b>	<b>50</b>	<b>43</b>	<b>37</b>
	78,0	69,0	58,0	50,0

**IND.CONT.EQ.**  
**2YF1**  
**E195081**



MADE IN ITALY

P000793-0

### 3.3. INSTALLATION

The inverters of the SINUS K series— IP20 degree of protection—can be installed inside a cubicle. The inverter must be installed vertically.

The ambient conditions, the instructions for the mechanical assembly and the electrical connections of the inverter are detailed in the sections below.



**CAUTION** Do not install the inverter horizontally or upside-down.



**CAUTION** Do not mount any heat-sensitive components on top of the inverter to prevent them from damaging due hot exhaust air.



**CAUTION** The inverter bottom may reach high temperatures; make sure that the inverter bearing surface is not heat-sensitive.

#### 3.3.1. ENVIRONMENTAL REQUIREMENTS FOR THE EQUIPMENT INSTALLATION, STORAGE AND TRANSPORT

Operating ambient temperatures	0-40°C with no derating. From 40°C to 50°C with a 2% derating of the rated current for each degree beyond 40°C
Ambient temperatures for storage and transport	- 25°C - +70°C
Installation environment	Pollution degree 2 or higher. Do not install in direct sunlight and in places exposed to conductive dust, corrosive gases, vibrations, water sprinkling or dripping; do not install in salty environments.
Altitude	Up to 1000 m above sea level. For higher altitudes, derate the output current of 1% every 100m above 1000m (max. 4000m).
Operating ambient humidity	From 5% to 95%, from 1g/m <sup>3</sup> to 25g/m <sup>3</sup> , non condensing and non freezing (class 3k3 according to EN50178).
Storage ambient humidity	From 5% to 95%, from 1g/m <sup>3</sup> to 25g/m <sup>3</sup> , non condensing and non freezing (class 1k3 according to EN50178).
Ambient humidity during transport	Max. 95%, up to 60g/m <sup>3</sup> ; condensation may appear when the equipment is not running (class 2k3 according to EN50178).
Storage and operating atmospheric pressure	From 86 to 106 kPa (classes 3k3 and 1k4 according to EN50178).
Atmospheric pressure during transport	From 70 to 106 kPa (class 2k3 according to EN50178).



**CAUTION** Ambient conditions strongly affect the inverter life. Do not install the equipment in places that do not have the above-mentioned ambient conditions. The equipment must be delivered in its original package.

### 3.3.2. AIR COOLING

Make sure to allow adequate clearance around the inverter for the free circulation of air through the equipment. The table below shows the min. clearance to leave with respect to other devices installed near the inverter. The different sizes of the inverter are considered.

Size	A – Side clearance (mm)	B – Side clearance between two inverters (mm)	C – Bottom clearance (mm)	D – Top clearance (mm)
S05	20	40	50	100
S10	30	60	60	120
S12	30	60	60	120
S15	30	60	80	150
S20	50	100	100	200

The air circulation through the enclosure must avoid warm air intake. Make sure to provide adequate air cooling through the inverter. The technical data related to dissipated power are shown in the ratings table.

The air delivery required may be calculated as follows:

$$\text{air delivery } Q = (\text{Pdiss} / \Delta t) * 3.5 \text{ (m}^3/\text{h)}$$

**Pdiss** is the sum of the values, expressed in W, of the power dissipated by all the components installed in the enclosure;  $\Delta t$  is the difference between the temperature measured inside the enclosure and the ambient temperature (temperatures are expressed in degrees centigrade).

**Example:**

Enclosure with no other component installed, **SINUS K 0086**, free surface.

Total power to be dissipated within the enclosure, **Pti**:

generated by the inverter **Pi** 1500 W

generated by other components **Pa** 0 W

$$\text{Pti} = \text{Pi} + \text{Pa} = 1500 \text{ W}$$

Temperatures:

Max. internal temperature desired **Ti** 40 °C

Max. external temperature **Te** 35 °C

Difference between **Ti** and **Te** **Δt** 5 °C

Size of the enclosure (meters):

width **W** 0.6m

height **H** 1.8m

depth **D** 0.4m

Free external surface of the enclosure **S**:

$$\text{S} = (\text{W} \times \text{H}) + (\text{W} \times \text{H}) + (\text{D} \times \text{H}) + (\text{D} \times \text{H}) + (\text{D} \times \text{W}) = 2.64 \text{ m}^2$$

External thermal power dissipated by the enclosure, **Pte** (metallic enclosure only):

$$\text{Pte} = 5.5 \times \Delta t \times \text{S} = 72.6 \text{ W}$$

**Pdiss. left** :

$$\text{Pdiss.} = \text{Pti} - \text{Pte} = 1427.4 \text{ W}$$

To dissipate **Pdiss. left**, provide a ventilation system with the following air delivery **Q**:

$$\text{Q} = (\text{Pdiss.} / \Delta t) \times 3.5 \text{ C} = 1000 \text{ m}^3/\text{h}$$

(considering ambient temperature of 35°C at 1000m above sea level).

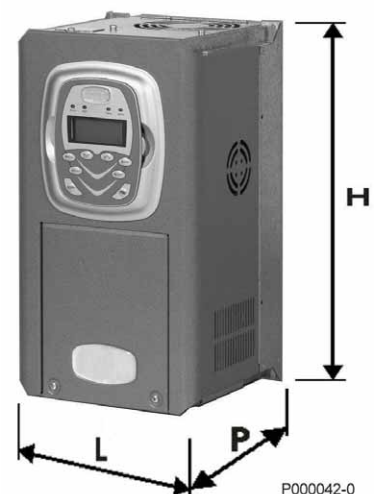


### 3.3.3. SIZE, WEIGHT AND DISSIPATED POWER

#### 3.3.3.1. STAND-ALONE MODELS, IP20 AND IP00 (S05 – S20) 2T CLASS

Size	MODEL	W	H	D	Wgt	Power Dissipated at Inom.
		mm	mm	mm	kg	W
S05	SINUS K 0007	170	340	175	7	160
	SINUS K 0008				7	170
	SINUS K 0010				7	220
	SINUS K 0013				7	220
	SINUS K 0015				7	230
	SINUS K 0016				7	290
	SINUS K 0020				7	320
S10	SINUS K 0016	215	391	216	10.5	330
	SINUS K 0017				10.5	380
	SINUS K 0020				10.5	420
	SINUS K 0025				11.5	525
	SINUS K 0030				11.5	525
	SINUS K 0035				11.5	525
S12	SINUS K 0023	215	401	225	11	390
	SINUS K 0033				12	500
	SINUS K 0037				12	560
S15	SINUS K 0038	225	466	331	22.5	740
	SINUS K 0040				22.5	820
	SINUS K 0049				22.5	950
S20	SINUS K 0049	279	610	332	33.2	950
	SINUS K 0060				33.2	1050
	SINUS K 0067				33.2	1250
	SINUS K 0074				36	1350
	SINUS K 0086				36	1500

**PART 1**

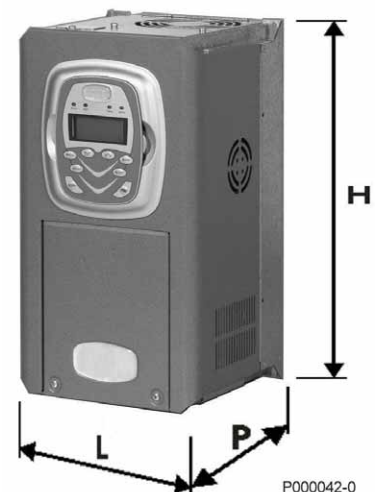


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**3.3.3.2. STAND-ALONE MODELS, IP20 AND IP00 (S05 – S20) 4T CLASS**

Size	MODEL	W	H	D	Wgt	Power Dissipated at Inom.
		mm	mm	mm	kg	W
S05	SINUS K 0005	170	340	175	7	215
	SINUS K 0007				7	240
	SINUS K 0009				7	315
	SINUS K 0011				7	315
	SINUS K 0014				7	315
S10	SINUS K 0016	215	391	218	10.5	350
	SINUS K 0017				10.5	380
	SINUS K 0020				10.5	420
	SINUS K 0025				11.5	525
	SINUS K 0030				11.5	525
	SINUS K 0035				11.5	525
S12	SINUS K 0016	215	401	225	10.5	430
	SINUS K 0017				10.5	490
	SINUS K 0020				10.5	490
	SINUS K 0025				11.5	520
	SINUS K 0030				11.5	520
	SINUS K 0034				12.5	680
	SINUS K 0036				12.5	710
S15	SINUS K 0038	225	466	331	22.5	750
	SINUS K 0040				22.5	820
	SINUS K 0049				22.5	950
S20	SINUS K 0060	279	610	332	33.2	950
	SINUS K 0067				33.2	1250
	SINUS K 0074				36	1350
	SINUS K 0086				36	1500



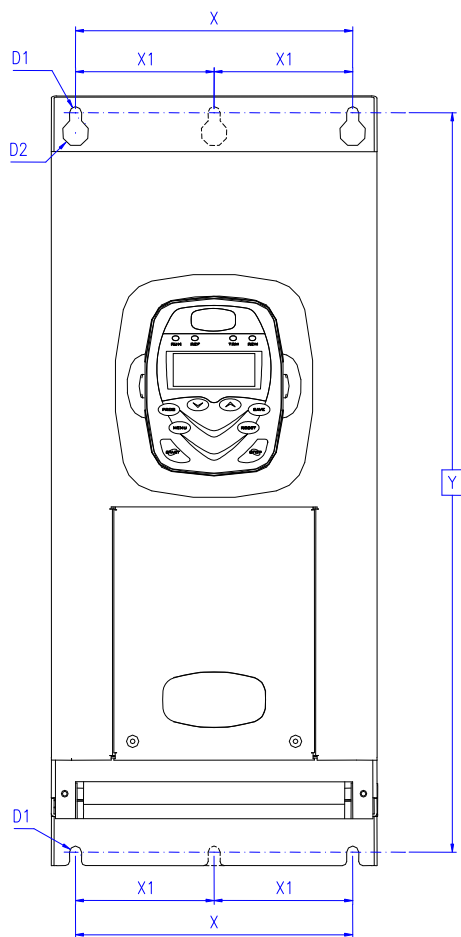
P000042-0



### 3.3.4. STANDARD MOUNTING AND PIERCING TEMPLATES

SINUS K Size	Fixing Templates (mm) (Standard Mounting)					Fastening Screws
	X	X1	Y	D1	D2	
S05	156	-	321	4.5	-	M4
S10	192	-	377	6	12.5	M5
S12	192	-	377	6	12.5	M5
S15	185	-	449	7	15	M6
S20	175	-	593	7	15	M6

**PART 1**



### 3.3.5. THROUGH-PANEL ASSEMBLY AND PIERCING TEMPLATES

#### SINUS K S05

For this inverter size, the air flow of the power section is segregated from the air flow of the control section thanks to the installation of two optional mechanical parts to be assembled with five (5) M4 self-forming screws (see Figure 1).

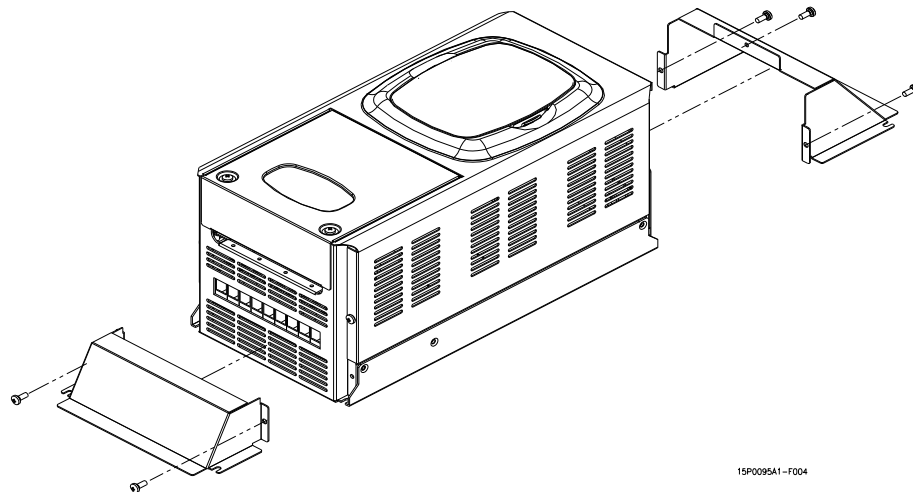


Figure 1: Mounting the accessories for SINUS K S05 through-panel assembly.

The equipment height becomes 488 mm with the two additional components (see Figure 2). Figure 2 also shows the piercing template of the mounting panel, including four M4 holes for the inverter mounting and two slots (142 x 76 mm and 142 x 46 mm) for the air-cooling of the power section.

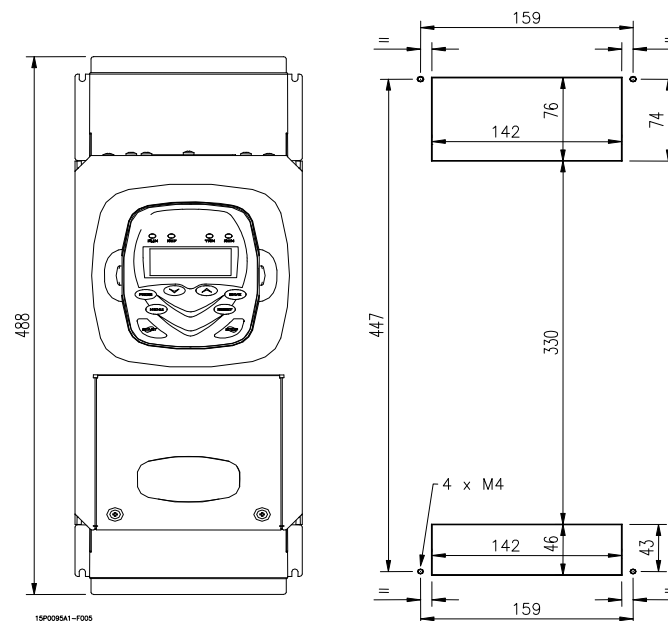
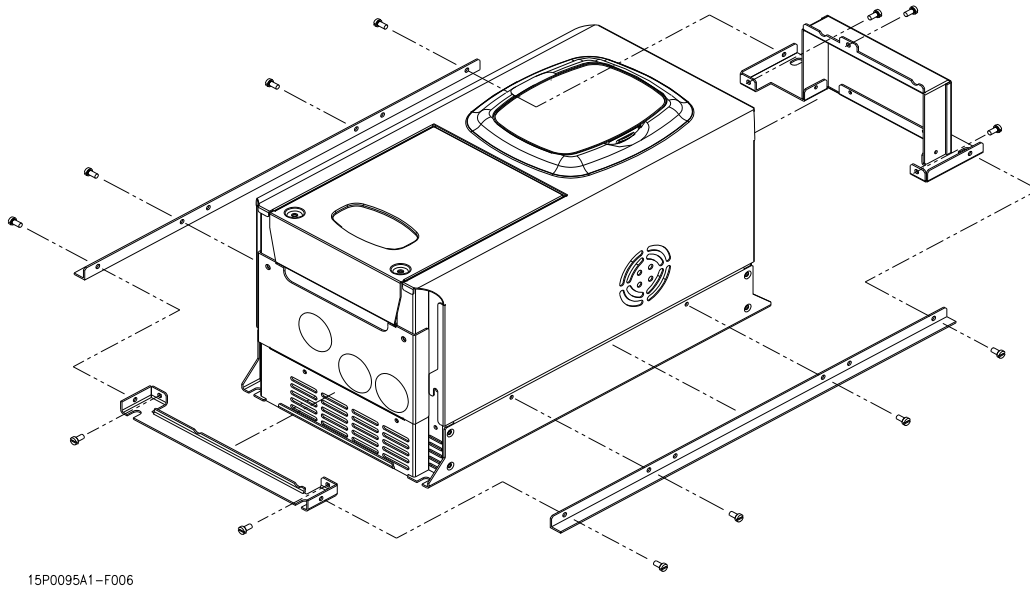


Figure 2: Piercing template of the mounting panel for SINUS K S05 through-panel assembly.

SINUS K S10

The through-panel assembly is possible for this inverter size. A special kit is to be assembled on the inverter (see Figure 3). No. 13 self-forming screws are used for this type of assembly.



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Figure 3: Mounting the accessories for SINUS K S10 through-panel assembly.

The overall dimensions of the equipment including the through-panel assembly kit are 452 x 238 mm (see Figure 4). Figure shows the piercing template of the mounting panel, including four M5 holes and a rectangular slot (218 x 420 mm) as well as the equipment side view with two air flows (air flow "A" for the control section and air flow "B" for the power section).

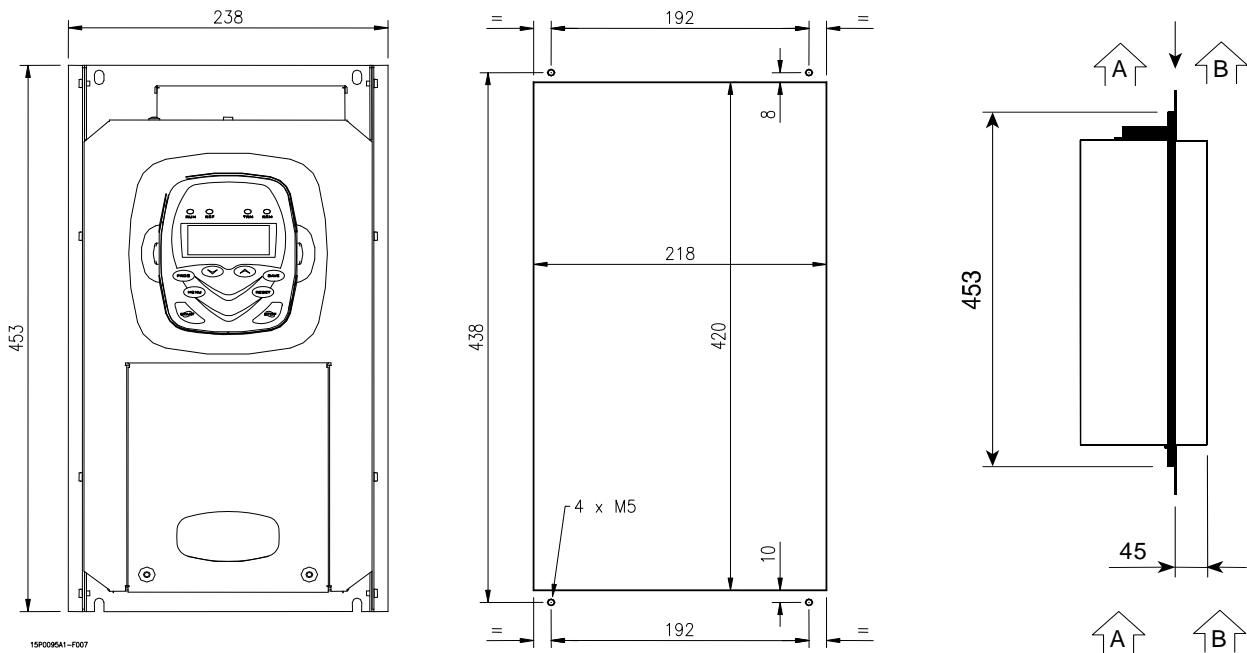
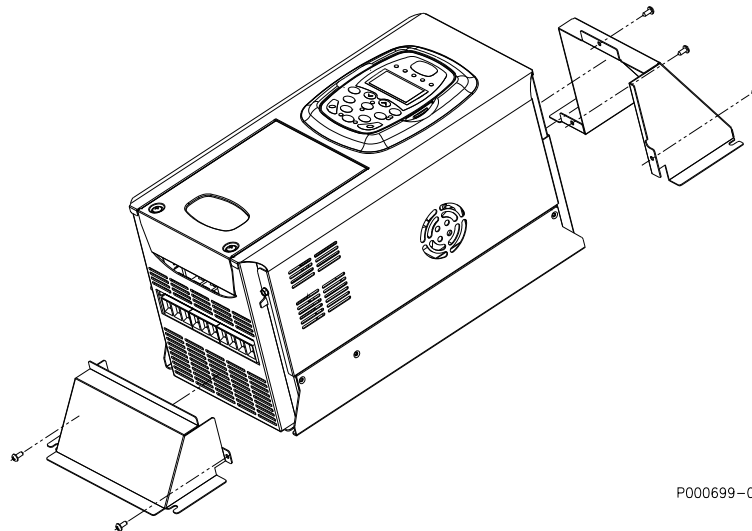


Figure 4: Piercing template of the mounting panel for SINUS K S10 through-panel assembly.

**SINUS K S12**

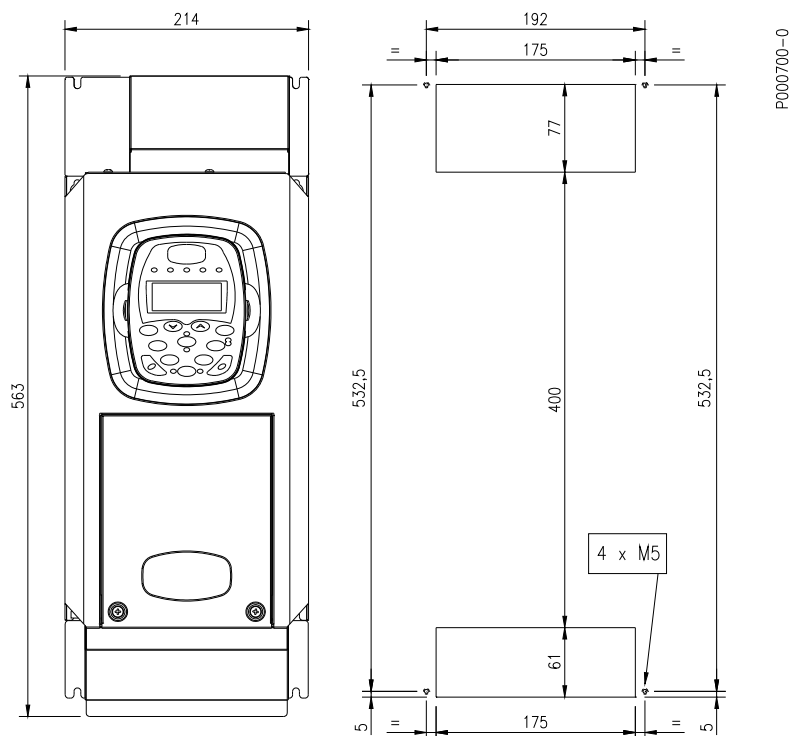
For this inverter size, no actual through-panel assembly is used, but the air flow of the power section is segregated from the air flow of the control section by installing two optional mechanical parts to be assembled with five (5) M4 self-forming screws (see Figure 5).



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**Figure 5: Mounting the accessories for SINUS K S12 through-panel assembly.**

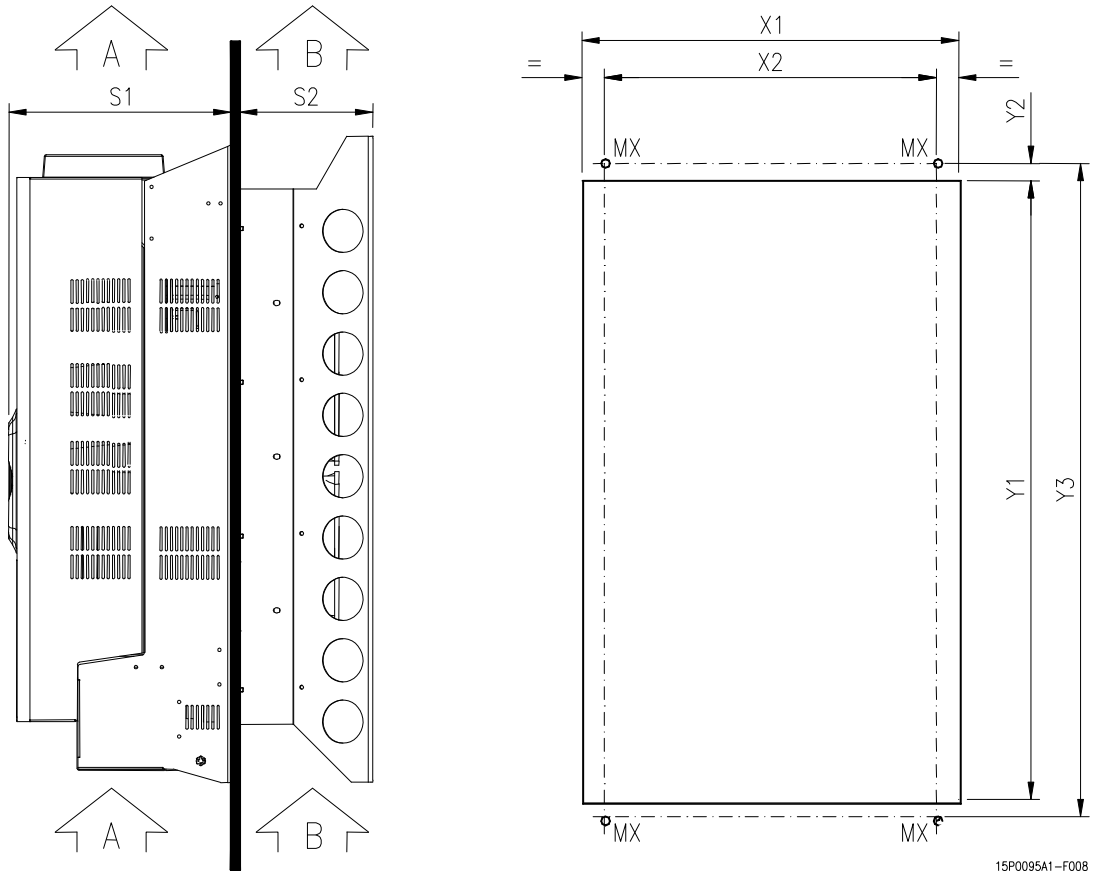
The equipment height becomes 583 mm when the two additional components are installed (see Figure 6). The same figure below also shows the piercing template of the mounting panel, including four M4 holes for the inverter mounting and two slots (175 x 77 mm and 175 x 61 mm) for the air-cooling of the power section.



**Figure 6: Piercing template of the mounting panel for SINUS K S12 through-panel assembly.**

SINUS K S15-S20

No additional mechanical component is required for the through-panel assembly of these SINUS K sizes. The piercing template shown in the figure below is to be made on the mounting panel. Measures are shown in the table. The figure below also shows the side view of the through-panel assembly of the equipment. The air flows and the front and rear projections are highlighted as well (see measures in the table).



15P0095A1-F008

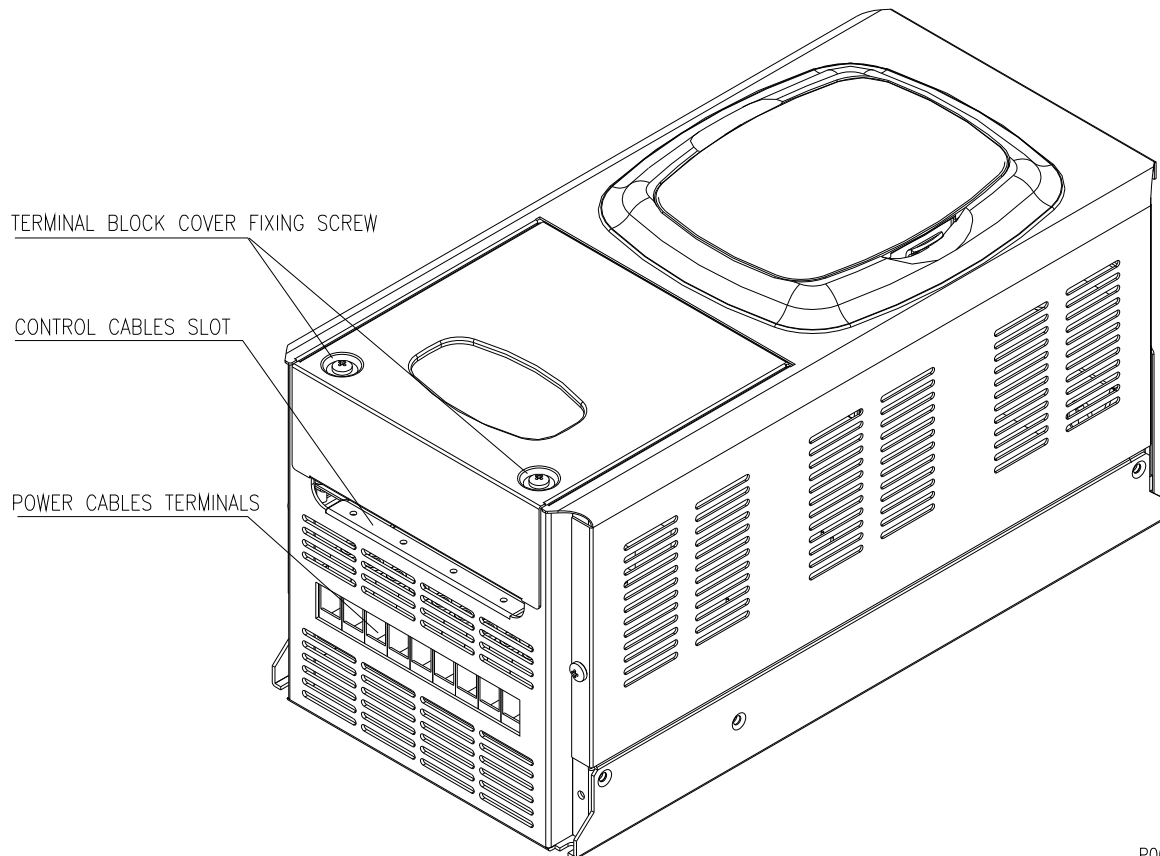
Figure 7: Through-panel assembly and piercing templates for SINUS K S15 and S20.

Inverter size	Front and rear projection		Slot size for through-panel assembly		Templates for fastening holes			Thread and fastening screws
	S1	S2	X1	Y1	X2	Y2	Y3	MX
S15	256	75	207	420	185	18	449	4 x M6
S20	256	76	207	558	250	15	593	4 x M6

**PART 1**

### 3.4. Connections to Control Terminals and Power Terminals (IP20/IP00)

To access to the control terminals, remove the cover by removing its fastening screws (see figure below).



P000052-B

Figure 8: Access to the control terminals and power terminals.

Sizes S05 to S15: remove the cover of the control terminal board to reach the fastening screws of the power terminal board. For greater sizes, the terminal board cover allows accessing to control terminals only; power terminals can be reached from the outside.



**DANGER**

Before operating on the control/power terminals, remove voltage from the inverter at wait at least 5 minutes. Electrical shock hazard exists even when the inverter is disabled (wait for the complete discharge of the internal capacitors).



**CAUTION**

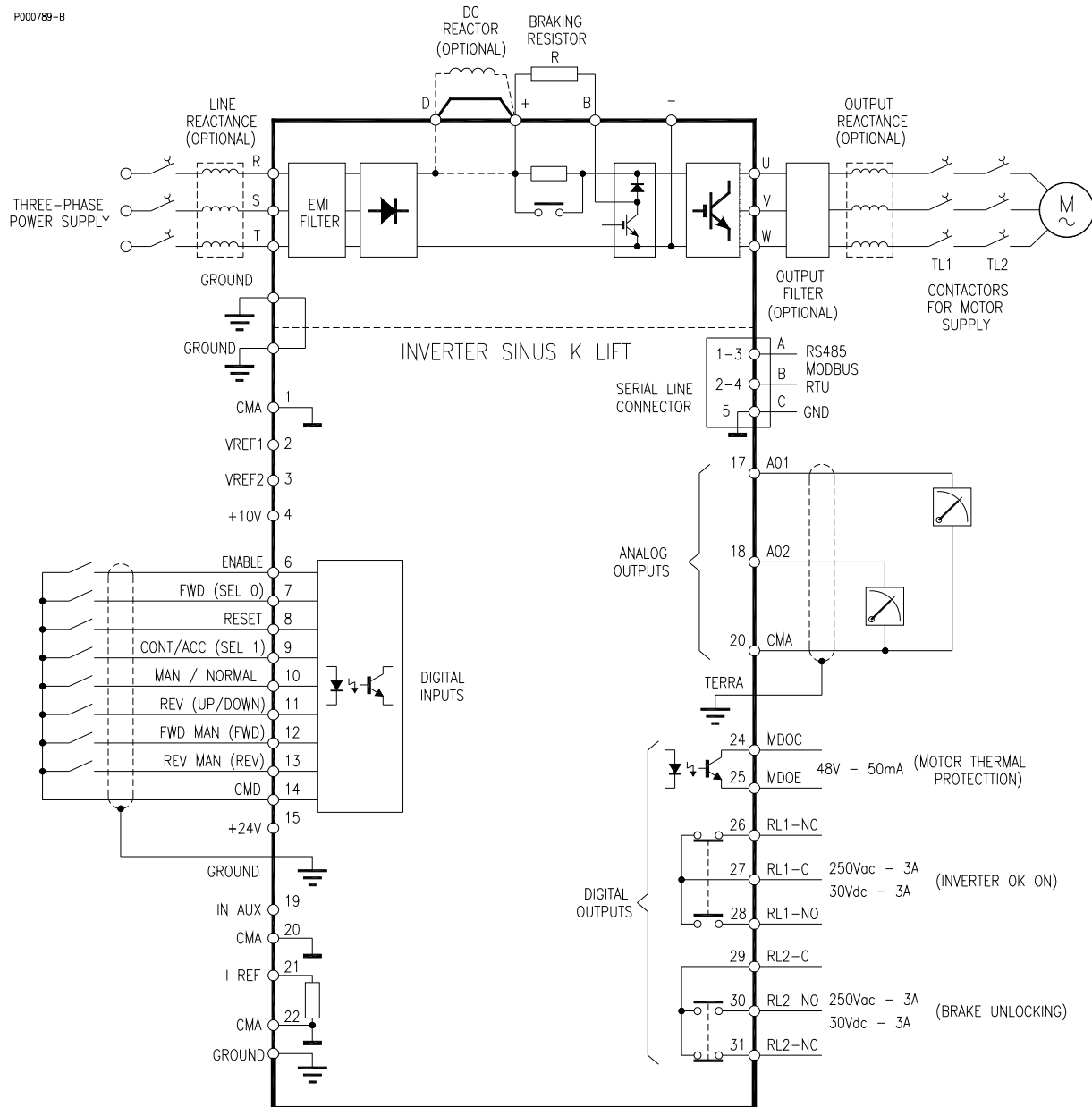
Do not connect or disconnect signal terminals or power terminals when the inverter is supplied, to avoid electrical shock hazard and to avoid damaging the equipment.



### 3.5. WIRING

#### 3.5.1. WIRING DIAGRAM

P000789-B



**PART 1**

Functionality of digital inputs 7, 9, and 11 depends on parameter C21 setting. Functionality with C21= single speed (factory setting) is out of brackets; functionality with C21= dual speed is in brackets.



**NOTA**

The wiring diagram relates to the factory setting.  
 Connection terminals of the braking resistor: terminals “+” and “B”.  
 Terminals for inverter power supply from DC source: : terminals “+” and “-”.  
 Connection terminals for DC reactance: terminals + and D. If no DC reactance is used, terminals + and D must be short-circuited (factory setting).  
 Terminal D is not provided for Sizes S05 (2T), S10 and S15. As per Size S20, terminal D may be requested when ordering the equipment.



### 3.5.2. CONTROL TERMINALS

Term.	Name	Description	I/O Features	Jumper on Control Board	LIFT Param.	
1	CMA	0V <b>NOT USED WITH LIFT SW</b>	Control board zero volt			
2	VREF1	0-10V analog input <b>NOT USED WITH LIFT SW</b>	Vmax: ±10V, Rin: 40kΩ Resolution: 10 bits			
3	VREF2	0-10V analog input <b>NOT USED WITH LIFT SW</b>				
4	+10V	Power supply for external potentiometer <b>NOT USED WITH LIFT SW</b>	+10V Imax: 10mA			
6	ENABLE	Active input: inverter enabled. Inactive input: inverter disabled (motor idles and stops).	Optois. digital input	J10 (NPN/PNP)	C59	
7	<b>MULTIFUNCTION</b>		Optois. digital input	J10 (NPN/PNP)	C21, P40, P41, P42	
	Terminal 10 condition	Par. C21 progr.				Function
	Inactive (Normal operation)	Single speed (default setting)				FWD
	Inactive (Normal operation)	Dual speed				SELO
	Inactive (Normal operation)	Dual speed A				SELO
Active (mainten.)	Any	NOT USED				





**PART 1**

Term.	Name			Description	I/O Features	Jumper on Control Board	LIFT Param.
8	RESET			Active input: the inverter operation is reset after an alarm trips if the cause responsible for the alarm has disappeared.	Optois. digital input	J10 (NPN/PNP)	C50, C51, C52, C53.
9	MULTIFUNCTION				Optois. digital input	J10 (NPN/PNP)	C21, P40, P41
	Terminal 10 condition	Param. C21 setting	Function				
	Inactive (Normal operation)	Single speed (default setting)	CONT/ACC	Active input: contractual speed (P41) is selected; inactive input: approach speed is selected (P40).			
	Inactive (Normal operation)	Dual speed	SEL1	Along with terminal 7 (SEL 0) it determines the operating mode and the active reference based on the table below (0: inactive terminal, 1: active terminal): SEL0 SEL1 State and reference 0 0 stop 1 0 running at approach speed (P40) 0 1 running at low speed (P42) 1 1 running at contractual speed (P41) With this configuration (dual speed), the running direction depends on terminal 11 (UP/DOWN)			
	Inactive (Normal operation)	Dual speed A	SEL1	Along with terminal 7 (SELO), it determines the active reference based on the table below (0: inactive terminal, 1: active terminal): SELO SEL1 Reference 0 0 approach speed (P40) 1 0 contractual speed (P41) 0 1 low speed (P42) 1 1 no active reference With this configuration (dual speed A), the operating mode and the running direction depend on terminal 12 (FWD) and 13 (REV) respectively.			
	Active (Maint.)	Any	NOT USED				
10	MAN/NORMAL			Active input: Maintenance mode is selected, terminals 12 (FWD MAN) and 13 (REV MAN) are selected and the reference set through par. P43 is selected. Inactive input: Normal mode is selected; depending on C21 programming: C21 = single speed, terminals 7 (FWD), 9 (CONT/ACC), 11 (REV) are active; C21 = dual speed, terminals 7 (SELO), 9 (SEL1), 11 (UP/DOWN) are active, C21 = dual speed A, terminals 7 (SELO), 9 (SEL1), 12 (FWD), and 13 (REV) are active.	Optois. digital input	J10 (NPN/PNP)	C21, P43



Term.	Name			Description	I/O Features	Jumper on Control Board	LIFT Param.															
11	MULTIFUNCTION						C21, P40, and P41															
	Terminal 10 condition	Par. C21 setting	Function																			
	Inactive (Normal operation)	Single speed (default setting)	REV	Active input: downstroke (reference selected through terminal 9 is active); inactive input: frequency reference is reset (motor stops during ramp down).																		
	Inactive (Normal operation)	Dual speed	UP/DOWN	Active input: downstroke selection; inactive input: upstroke selection (operating mode and inverter condition are selected through terminals 7 and 9).																		
	Inactive (Normal operation)	Dual speed A	NOT USED																			
	Active (Maint.)	Any	NOT USED																			
12	MULTIFUNCTION						J10 (NPN/ PNP)															
	Terminal 10 condition	Par. C21 setting	Function																			
	Inactive (Normal operation)	Single speed (default setting)	NOT USED																			
	Inactive (Normal operation)	Dual speed	NOT USED																			
	Inactive (Normal operation)	Dual speed A	FWD	Along with terminal 13 (REV), it determines the operating mode and running direction based on the table below (0: inactive input, 1: active input) <table border="1" style="margin-left: 20px;"> <tr> <td>FWD</td> <td>REV</td> <td>Reference</td> </tr> <tr> <td>0</td> <td>0</td> <td>stop</td> </tr> <tr> <td>1</td> <td>0</td> <td>upstroke</td> </tr> <tr> <td>0</td> <td>1</td> <td>downstroke</td> </tr> <tr> <td>1</td> <td>1</td> <td>stop</td> </tr> </table> Reference depends on terminals 7 (SEL0) and 9 (SEL1).	FWD	REV		Reference	0	0	stop	1	0	upstroke	0	1	downstroke	1	1	stop		
	FWD	REV	Reference																			
0	0	stop																				
1	0	upstroke																				
0	1	downstroke																				
1	1	stop																				
Active (Maint.)	Any	FWD MAN	Active input: inverter in upstroke maintenance condition (reference set through par. P43 is active); inactive input: frequency reference is reset (motor stops during ramp up).																			



**PART 1**

Term.	Name			Description	I/O Features	Jumper on Control Board	LIFT Param.
13	MULTIFUNCTION						
	Terminal 10 condition	Par. C21 setting	Function				
	Inactive (Normal operation)	Single speed (default setting)	NOT USED				
	Inactive (Normal operation)	Dual speed	NOT USED				
	Inactive (Normal operation)	Dual speed A	REV	Along with terminal 12 (FWD), it determines the operating mode and running direction based on the table below (0: inactive terminal, 1: active terminal) FWD REV Reference 0 0 stop 1 0 upstroke 0 1 downstroke 1 1 stop Reference depends on terminals 7 (SEL0) and 9 (SEL1)		J10 (NPN/ PNP)	C21
	Active (Maint.)	Any	REV MAN	Active input: Downstroke maintenance mode (reference set through par. P43 is active); inactive input: frequency reference is reset (motor stops during ramp down)			
14	CMD			0V optoisolated digital inputs. If jumper J10 is set to NPN, close a digital input to terminal 14 to activate it. ACTIVATION MODE FOR NPN DIGITAL INPUTS.	Optois. digital input zero volt	J10 (NPN/ PNP)	
15	+24V			Auxiliary supply for optoisolated digital inputs: if the jumper is set to PNP, close an input to terminal 15 to activate it. ACTIVATION MODE FOR PNP DIGITAL INPUTS	+24V I <sub>max</sub> : 100mA	J10 (NPN/ PNP)	
17	AO1			Multifunction analog output 1. Factory setting: Fout.	0 ÷ 10V I <sub>max</sub> : 4mA, 4-20mA or 0-20mA Resolution: 7 bits	J5, J7, J8 (voltage/ current)	P30, P32, P33, P34, P35, P36, P37.
18	AO2			Multifunction analog output 2. Factory setting: Iout.	0 ÷ 10V I <sub>max</sub> : 4mA, 4-20mA or 0-20mA Resolution: 8 bits	J3, J4, J6 (voltage/ current)	P31, P32, P33, P34, P35, P36, P37.
19	INAUX			Auxiliary analog input. NOT USED	V <sub>max</sub> : ±10V R <sub>in</sub> : 20kΩ Resolution: 10 bits		
20	CMA			0V for auxiliary analog input. NOT USED	Control board zero volt		



Term.	Name	Description	I/O Features	Jumper on Control Board	LIFT param.
21	IREF	Current input (0÷20mA, 4÷20mA). NOT USED	Rin: 100Ω Resolution: 10 bits		
22	CMA	0V for current input. NOT USED	Control board zero volt		
24	MDOC	Programmable digital output "Open collector" (collector terminal). Factory setting: motor thermal protection trip.	NPN/PNP open collector Vmax: 48V Imax: 50mA		P60, P63, P64, P69, P70
25	MDOE	Programmable digital output "Open collector" (emitter terminal).			
26	RL1-NC	Programmable relay digital output 1 (NC contact) Factory setting: energized relay with inverter ready.	250 Vac, 3A 30 Vdc, 3A		P61, P65, P66, P71, P72
27	RL1-C	Programmable relay digital output 1 (common contact).			
28	RL1-NO	Programmable relay digital output 1 (NO contact).			
29	RL2-C	Programmable relay digital output 2 (common contact). Factory setting: energized relay for brake unlocking.	250 Vac, 3A 30 Vdc, 3A		P62, P67, P68, P73, P74
30	RL2-NO	Programmable relay digital output 1 (NO contact).			
31	RL2-NC	Programmable relay digital output 1 (NC contact).			

### 3.5.3. ES778 CONTROL BOARD SIGNALS AND PROGRAMMING

**PART 1**

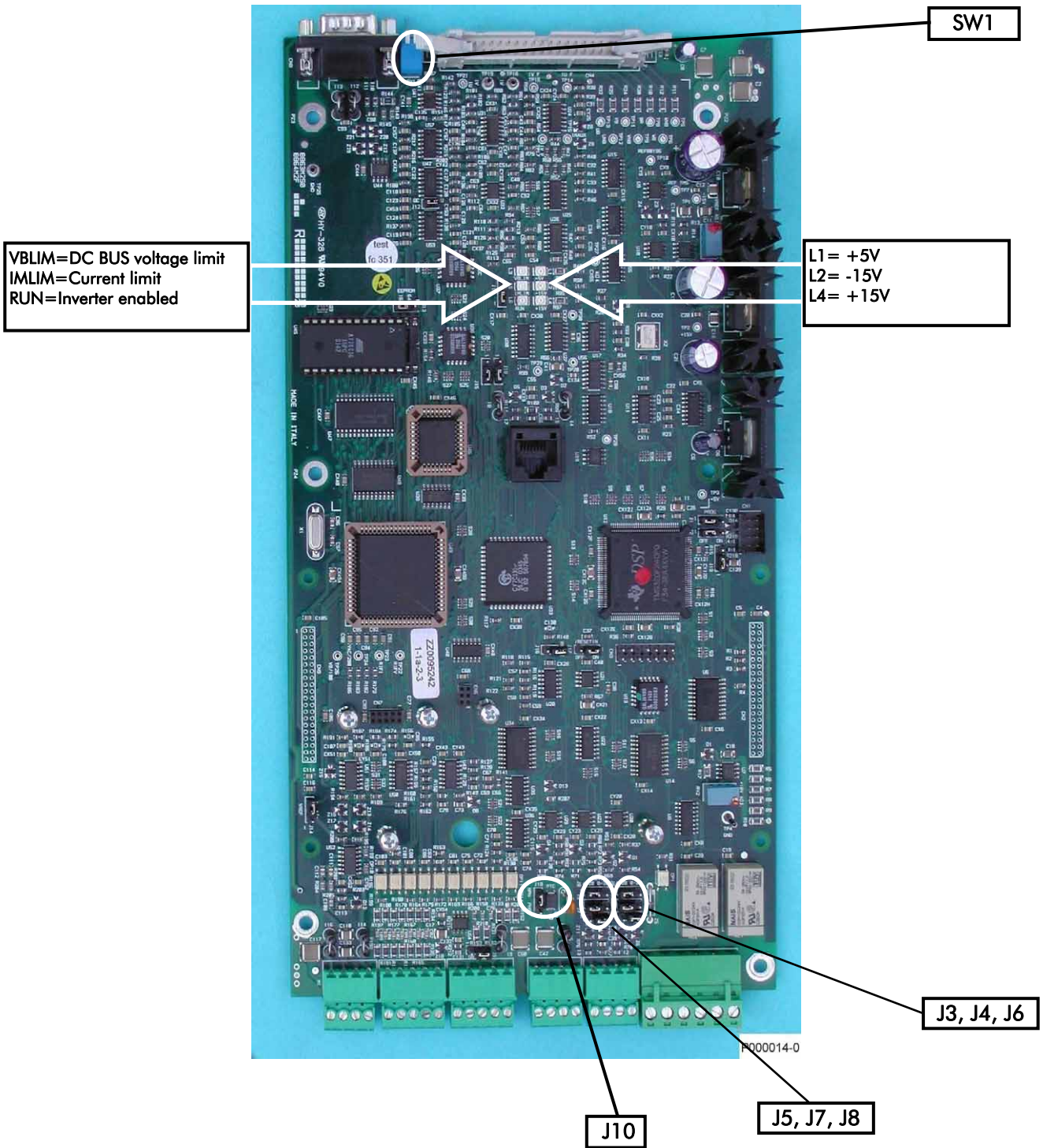


Figure 9: Control Board

### 3.5.3.1. INDICATOR LEDS

LED L3	red (VBLIM)	<u>Voltage limiting activation during deceleration</u> ; "on" when VDC within the equipment exceeds by 20% the rated value during dynamic braking.
LED L5	red (IMLIM)	<u>Current limiting activation during acceleration or due to overload conditions</u> ; "on" if the motor current exceeds the values set in C41 and C43 (Limits submenu) during acceleration and at constant frequency respectively. This Led is on even when the torque needed exceeds the value set in C42, Limits submenu.
LED L6	green (RUN)	<u>Inverter enabled</u> ; "on" when the inverter is running or is enabled only (fluxed motor)
LED L1	green (+5V)	Control board +5V power supply on.
LED L2	green (-15V)	Control board -15V power supply on
LED L4	green (+15V)	Control board +15V power supply on.

### 3.5.3.2. JUMPERS AND DIP SWITCH

J3	(1-2) 4-20mA in AO2 (2-3) 0-20mA in AO2
J4	(2-3) V in AO2 (1-2) mA in AO2
J5	(1-2) 4-20mA in AO1 (2-3) 0-20mA in AO1
J6	(1-2) 4-20mA in AO2 (2-3) 0-20mA in AO2
J7	(2-3) V in AO1 (1-2) mA in AO1
J8	(1-2) 4-20mA in AO1 (2-3) 0-20mA in AO1
J10	(1-2) PNP inputs (2-3) NPN inputs
SW1	(on) RS485 termination and bias resistors ON (off) RS485 termination and bias resistors OFF

### 3.5.4. FEATURES OF THE DIGITAL INPUTS (TERMINALS 6 TO 15)

All digital inputs are galvanically isolated with respect to zero volt of the inverter control board (ES778). Consider power supply on terminals 14 and 15 before activating the inverter digital inputs. Depending on the position of jumper J10, signals may be activated both to zero volt (NPN-type command) and to + 24 Volts (PNP-type command). The figure below shows the different control modes based on the position of jumper J10. Auxiliary power supply +24 VDC (terminal 15) is protected by a self-resetting fuse.

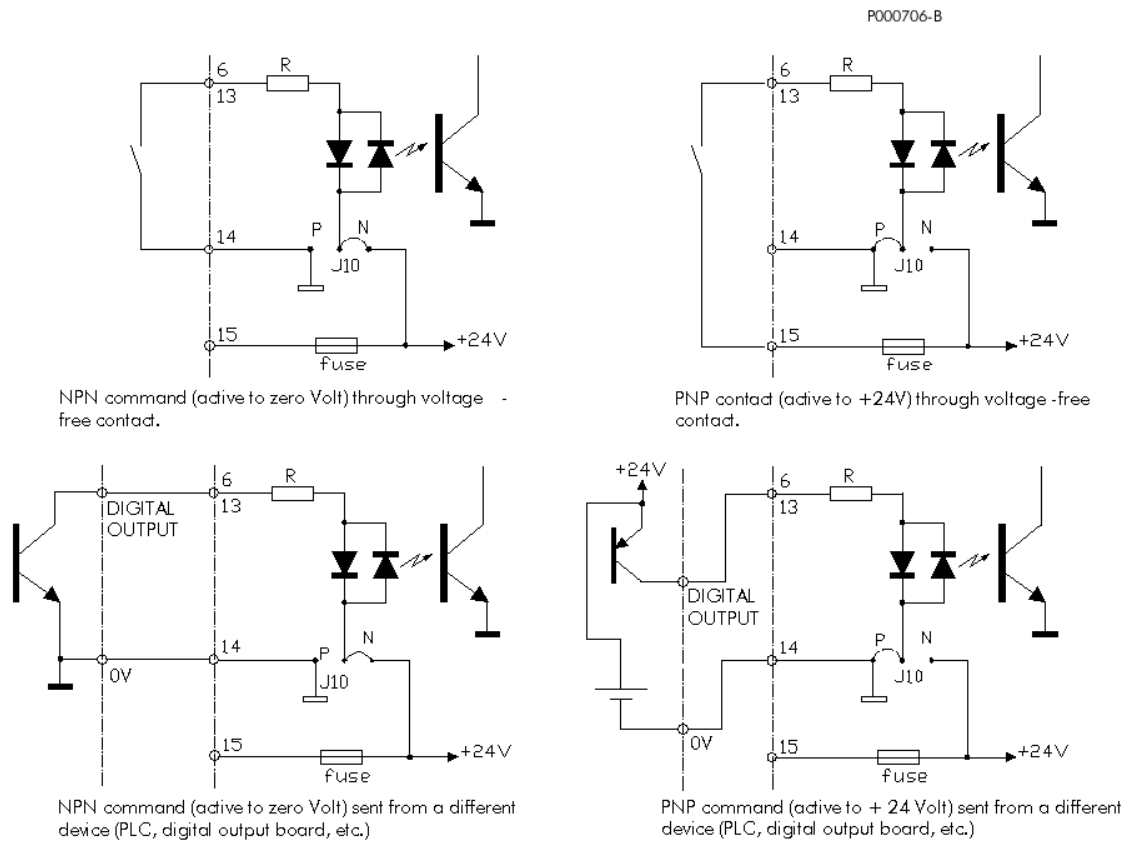


Figure 10: Digital input control modes.



**NOTE**

Terminal 14 (CMD – digital input zero volt) is galvanically insulated from terminals 1, 20, 22 (CMA – control board zero volt) and from terminal 25 (MDOE = emitter terminal of multifunction digital output).

#### 3.5.4.1. ENABLE (TERMINAL 6)

The ENABLE input must always be activated to enable the inverter operation independently of the control mode.

If the ENABLE input is disabled, the inverter output voltage is set to zero, so the motor performs a coast to stop. If the ENABLE command is active at power on, the inverter will not start until terminal 6 is opened and closed again. This safety measure may be disabled through parameter C59.



**NOTE**

When the ENABLE command is active, alarms A11 (Bypass Failure), A25 (Mains Loss), A30 (DC Overvoltage) and A31 (DC Undervoltage) are enabled as well.

### 3.5.4.2. RESET (TERMINAL 8)

If an alarm trips, the inverter stops, the motor performs a coast to stop and the display shows an alarm message (see the DIAGNOSTICS section). Open the Reset input for a while or press the RESET key to reset the alarm. This happens only if the cause responsible for the alarm has disappeared and the display shows "Inverter OK". If factory setting is used, enable and disable the ENABLE command to restart the inverter. If parameter C59 is set to [YES], the inverter is reset *and* restarts.



**DANGER**

Shock hazard persists even when the inverter is locked on output terminals (U, V, W) and on the terminals +, -, B.



**CAUTION**

If an alarm trips, see the Diagnostics section and reset the equipment after detecting the cause responsible for the alarm.



**NOTE**

Factory setting does not reset alarms at power off. Alarms are stored and displayed at next power on and the inverter is locked. To reset the inverter, turn it off and set parameter C53 to [YES].



### 3.5.5. FEATURES OF THE DIGITAL OUTPUTS

An OPEN COLLECTOR output is available on terminals 24 (collector) and 25 (common terminal). The OC output is galvanically isolated from zero volt of the control board and is capable of driving a load up to 50mA with 48V power supply.

The output functionality is determined by parameter P60 in the "Digital Outputs" submenu.

The output enabling/disabling delay may be programmed through the parameters below:

- P63 MDO ON Delay
- P64 MDO OFF Delay.

The factory setting is the following:

Motor thermal protection trip: the transistor activates if the inverter locks due to the motor thermal protection trip.

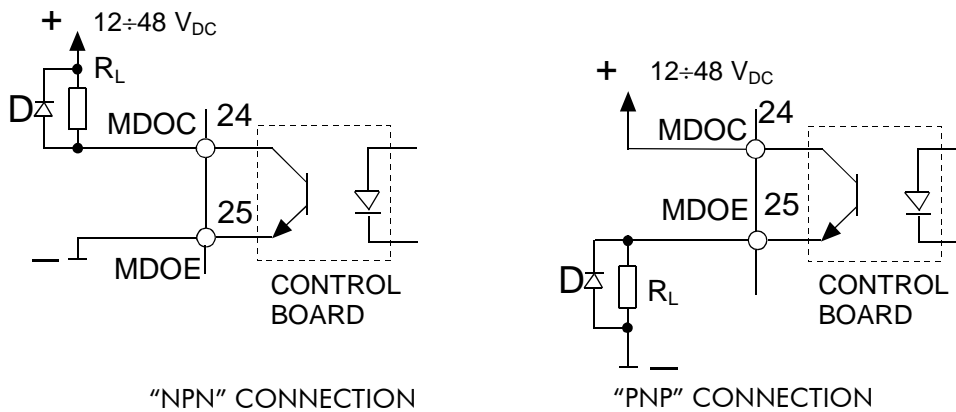


Figure 11: Wiring a relay to the OPEN COLLECTOR output.

The Figure 11 is an example of a relay connected to the OC output.



**CAUTION** Always use a freewheeling diode (D) for inductive loads (e.g. relay coils).



**CAUTION** Never exceed max. allowable voltage and max. allowable current values.



**NOTE** Terminal 25 is galvanically insulated from terminals 1, 20, 22, (CMA – control board zero volt) and from terminal 14 (CMD – digital input zero volt).



**NOTE** Voltage in terminal 15 (+24V) and terminal 14 (CMD) (control terminals) may be used as "auxiliary power supply". Max. allowable current: 100mA.

### 3.5.5.1. RELAY OUTPUTS

Two relay outputs are available:

- terminals 26, 27, 28: relay RL1; reverse contact (250 VAC, 3A; 30 VDC, 3A)
- terminals 29, 30, 31: relay RL2; reverse contact (250 VAC, 3A; 30 VDC, 3A)

Parameters P61 (RL1 Opr) and P62 (RL2 Opr) in the Digital Outputs submenu affect the relay output functionality. Relay energizing and de-energizing may be delayed through the following parameters:

- P65 RL1 Delay ON
- P66 RL1 Delay OFF
- P67 RL2 Delay ON
- P68 RL2 Delay OFF

Factory-setting is as follows:

RL1: "Inv. O.K. ON" relay (terminals 26, 27, 28); the relay energizes when the inverter is ready to supply the motor.

At power on, the equipment takes some seconds before initializing; the relay deenergizes when an alarm trips. The alarm tripped locks the inverter.

RL2: "Frequency/level" relay (terminals 29, 30, 31); the relay energizes when the output frequency attains the level set through the "Digital Outputs" menu (parameters P73 "RL2 level", P74 "RL2 Hyst."). Factory setting: the contacts of this relay may be used to unlock the electromechanical brake.



**CAUTION**

Never exceed max. voltage values and max. current values allowed by relay contacts.



**CAUTION**

Use a freewheeling diode for DC inductive loads.  
Use antidisturbance filters for AC inductive loads.

### 3.5.6. FEATURES OF THE ANALOG OUTPUTS (TERMINALS 17-18)

Two analog outputs are located on terminal 17 and terminal 18. Analog outputs may be used to connect additional devices or to generate a signal to be sent to other devices. Some particular configuration jumpers located on control board ES778 allow selecting the type of output signal (0-10V, 4-20mA or 0-20mA).

Output Type	Terminal 17 AO1		Terminal 18 AO2	
	Configuration Jumper		Configuration Jumper	
	J7	J5-J8	J4	J3-J6
0-10V	pos 2-3	X	pos 2-3	X
4-20mA	pos 1-2	pos 1-2	pos 1-2	pos 1-2
0-20mA	pos 1-2	pos 2-3	pos 1-2	pos 2-3

X=any position

From the Output Monitor Menu P3x, set the variable for the analog output and the ratio between the value of the output signal and the measured variable.

The ratio between the output signal and the measured variable is expressed as the ratio between the variable value and the relevant voltage value on the analog output (e.g. Hz/V). When setting the jumpers to configure the output as 4-20mA or 0-20mA, multiply by 10 the value set to obtain the variable value when the output delivers 20mA (e.g.: if P32=10Hz/V, the analog output will deliver 20mA when the inverter delivers 100Hz).



#### CAUTION

Never deliver input voltage to analog outputs. Do not exceed max. allowable current.

### 3.5.7. LAYOUT OF THE POWER TERMINALS

LEGEND	
41/R – 42/S – 43/T	Input for three-phase power supply (the phase sequence is not binding).
44/U – 45/V – 46/W	Output for motor three-phase power supply.
47/+	Link to the DC voltage positive pole. It can be used for DC voltage supply, the DC reactor, the external braking.
47/D	Link to the positive pole of the continuous AC rectified voltage. It can be used for the DC reactor—if no DC reactor is used, terminal 47/D must be short-circuited to terminal 47/+ using a cable having the same cross-section as the cables used for power supply; factory setting.
48/B	Connect the IGBT brake for the braking resistor.
49/-	Link to the negative pole of the DC voltage. It can be used for DC power supply and the external braking resistor.

Terminal board in S05 (4T)-S10-S15-S20:

41/R	42/S	43/T	44/U	45/V	46/W	47/+	48/B	49/-
------	------	------	------	------	------	------	------	------

Terminal board in S05 (2T):

41/R	42/S	43/T	44/U	45/V	46/W	47/+	47/D	48/B	49/-
------	------	------	------	------	------	------	------	------	------

Terminal board in S12:

41/R	42/S	43/T	47/+	47/D	48/B	49/-	44/U	45/V	46/W
------	------	------	------	------	------	------	------	------	------

**DANGER**

Before changing the equipment connections, shut off the inverter and wait at least 5 minutes to allow for the discharge of the heatsinks in the DC-link.

**DANGER**

Use only B-type differential circuit breakers.

Connect the power supply line to supply terminals only. The connection of the power supply line to any other terminal will damage the inverter.

Always make sure that the supply voltage ranges between the limits stated in the inverter nameplate.

Always connect the ground terminal to avoid electrical shock hazard and to limit disturbance.

The user has the responsibility to provide a grounding system in compliance with the regulations in force.

After connecting the equipment, check the following:

**CAUTION**

- all wires must be properly connected;
- no link is missing;
- no short-circuit is occurring between the terminals and between the terminals and the ground.

Do not start or stop the inverter using a contactor installed on the inverter power supply line.

The inverter power supply must always be protected by fast fuses or by a thermal/magnetic circuit breaker.

Do not apply single-phase voltage.

Please contact Elettronica Santerno if only single-phase power supply is available.

Always mount antistat filters on the contactor coils and the solenoid valve coils.

### 3.5.8. CROSS-SECTIONS OF POWER CONNECTION WIRES AND SIZE OF PROTECTIVE DEVICES

#### 3.5.8.1. 2T VOLTAGE CLASS

Size	SINUS K Model	Inverter Rated Current	Terminal Cross-section	Wire Stripping	Tightening Torque	Wire Cross-section Mains Side and Motor Side	Fast Fuses (700V)+ Disconnect. Switches	Magnetic Circuit Breaker	AC1 Contactor
		A	sqmm (AWG/kcmils)	mm	Nm	sqmm (AWG/kcmils)	A	A	A
S05	0007	12.5	0.5÷10 (20÷6AWG)	10	1.2-1.5	2.5 (13AWG)	16	16	25
	0008	15		10	1.2-1.5		16	16	25
	0010	17		10	1.2-1.5	4 (10AWG)	25	25	25
	0013	19		10	1.2-1.5		32	32	30
	0015	23		10	1.2-1.5		32	32	30
	0016	27		10	1.2-1.5	10 (6AWG)	40	40	45
	0020	30		10	1.2-1.5		40	40	45
S10	0016	26	0.5÷10 (20÷6 AWG)	10	1.2-1.5	10 (6AWG)	40	40	45
	0017	30		10	1.2-1.5		40	40	45
	0020	30		10	1.2-1.5		40	40	45
	0025	41		10	1.2-1.5		63	63	55
	0030	41		10	1.2-1.5		63	63	60
	0035	41		10	1.2-1.5		100	100	100
S12	0023	38	.5÷25 (20÷4 AWG)	18	2.5	10 (6AWG)	63	63	60
	0033	51		18	2.5	16 (5WG)	100	100	100
	0037	65		18	2.5	25 (4AWG)	100	100	100
S15	0038	65	0.5÷25 (20÷4 AWG)	15	2.5	25 (4AWG)	100	100	100
	0040	72		15	2.5		100	100	100
	0049	80	4÷25 (12÷4 AWG)	15	2.5	25 (4AWG)	125	100	100
S20	0060	88	25÷50 (6÷1/0 AWG)	24	6-8	35 (2AWG)	125	125	125
	0067	103		24	6-8	50 (1/0AWG)	125	125	125
	0074	120		24	6-8		160	160	145
	0086	135		24	6-8		200	160	160



**CAUTION**

Always use the correct cable cross-sections and activate the protective devices provided for the inverter. Failure to do so will cause the non-compliance to standard regulations of the system where the inverter is installed.



3.5.8.2. 4T VOLTAGE CLASS

**PART 1**

Size	SINUS K Model	Inverter Rated Current	Terminal Cross-section	Wire Stripping	Tightening Torque	Wire Cross-section Mains Side and Motor Side	Fast Fuses (700V)+ Disconnect. Switches	Magnetic Circuit Breaker	AC1 Contactor
		A	sqmm (AWG/kcmils)	mm	Nm	sqmm (AWG/kcmils)	A	A	A
S05	0005	10.5	0.5÷10 (20÷6AWG)	10	1.2-1.5	2.5 (13AWG)	16	16	25
	0007	12.5		10	1.2-1.5		16	16	25
	0009	16.5		10	1.2-1.5	4 (10AWG)	25	25	25
	0011	16.5		10	1.2-1.5		25	25	25
	0014	16.5		10	1.2-1.5		32	32	30
S10	0016	26	0.5÷10 (20÷6 AWG)	10	1.2-1.5	10 (6AWG)	40	40	45
	0017	30		10	1.2-1.5		40	40	45
	0020	30		10	1.2-1.5		40	40	45
	0025	41		10	1.2-1.5		63	63	55
	0030	41		10	1.2-1.5		63	63	60
	0035	41		10	1.2-1.5		100	100	100
S12	0016	26	0.5÷10 (20÷6 AWG)	10	1.2-1.5	10 (6AWG)	40	40	45
	0017	30		10	1.2-1.5		40	40	45
	0020	30		10	1.2-1.5		40	40	45
	0025	41		10	1.2-1.5		63	63	55
	0030	41		10	1.2-1.5		63	63	60
	0034	57	0.5÷25 (20÷4 AWG)	18	2.5	16 (5AWG)	100	100	100
	0036	60		18	2.5	25 (4AWG)	100	100	100
S15	0038	65	0.5÷25 (20÷4 AWG)	15	2.5	25 (4AWG)	100	100	100
	0040	72		15	2.5		100	100	100
	0049	80	4÷25 (12÷4 AWG)	15	2.5	25 (4AWG)	125	100	100
S20	0060	88	25÷50 (6÷1/0 AWG)	24	6-8	35 (2AWG)	125	125	125
	0067	103		24	6-8	50 (1/0AWG)	125	125	125
	0074	120		24	6-8		160	160	145
	0086	135		24	6-8		200	160	160



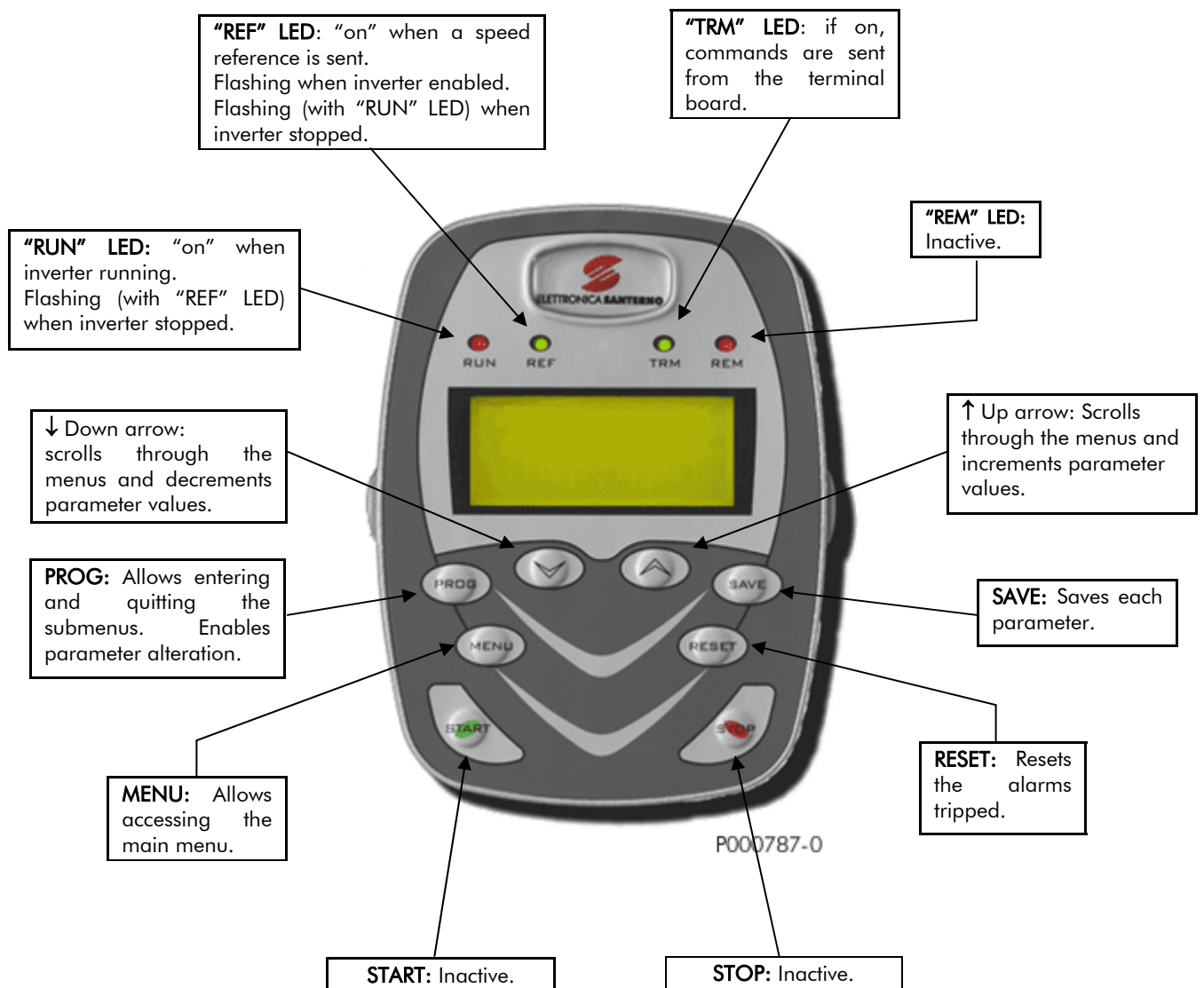
**CAUTION**

Always use the correct cable cross-sections and activate the protective devices provided for the inverter. Failure to do so will cause the non-compliance to standard regulations of the system where the inverter is installed.





### 3.6. OPERATING THE KEYPAD

For the parameter programming and view a keypad is located on the front part of SINUS K inverters. The keypad includes 4 LEDs, an LCD display and 8 function keys. During the inverter operation, the display shows the parameter values, the alarm messages (if any) and the value of the measures processed by the inverter.





The keypad includes the following keys: **PROG**, **↓**, **↑**, **SAVE**, **MENU**, **RESET**, **START**, **STOP**. They are detailed below.

<b>PROG</b>	Allows entering and quitting the menus and submenus and enables altering the inverter parameters (when switching from parameter display to parameter programming, the cursor starts flashing);
	Down arrow; scrolls through the menus and submenus, the pages in a submenu or the parameters in descending order. During programming, it decrements the parameter value;
	Up arrow; scrolls through the menus and submenus, the pages in a submenu or the parameters in ascending order. During programming, it increments the parameter value;
<b>SAVE</b>	In programming mode, this key saves to non-volatile memory (EEPROM) the value of the parameter being altered. This prevents any parameter modification from being cleared in case of mains loss;
<b>MENU</b>	If pressed once, allows accessing the main menu; if pressed twice, allows returning to the prior condition;
<b>RESET</b>	Resets the alarms tripped;
<b>START</b>	Inactive;
<b>STOP</b>	Inactive;

- **RETURN TO THE FIRST PAGE OF A SUBMENU:** simultaneously press **PROG** and **↓**.



**NOTE**

The inverter operation is affected by the active parameter set. The parameter being altered with **↑** and **↓** immediately replaces the prior parameter value, even if the **SAVE** key is not pressed. The new parameter value will be cleared at power off.

The keypad also includes the LEDs below:

- “RUN” LED** If on and not flashing, it indicates that the inverter is running: the inverter is enabled, Enable is closed and the lift cage upstroke or downstroke is selected;  
If flashing (along with the “REF” LED), it indicates that the inverter is stopping.
- “REF” LED** Indicates a speed reference other than 0;  
If flashing (along with the “RUN” LED), it indicates that the inverter is stopping.  
If flashing, it indicates that the inverter is enabled (ENABLE CLOSED) and no operating mode for the lift cage is selected.
- “TRM” LED** It indicates that the START commands and the commands relating to multifunction digital inputs MDI1 ÷ MDI5 are sent from the terminal board.
- “REM” LED** Inactive.

### 3.6.1. ADJUSTING THE DISPLAY CONTRAST

Press the **SAVE** key for more than 5 seconds; **\*\*\* TUNING \*\*\*** is displayed; the indicator Leds come on and configure as a 5-dot bar extending proportionally to the contrast value set. Press **↓** or **↑** to adjust the display contrast. Press **SAVE** for at least 2 seconds to store the new contrast setting.



## 3.7. SERIAL COMMUNICATIONS

### 3.7.1. OVERVIEW

The inverters of the SINUS K series may be connected to peripheral devices through a serial link. This enables both reading and writing all the parameters normally accessed through the display and the 4 keys (see Section 2 in this manual). Two-wire RS485 is used, which ensures a better immunity to disturbance even on long cable paths, thus limiting communications errors.

The inverter will typically behave as a slave device (i.e. it only answers to queries sent by another device). A master device (typically a computer) is then needed to start serial communications. The inverter may be connected directly to a computer or a multidrop network of inverters controlled by a master computer (see Figure 12).

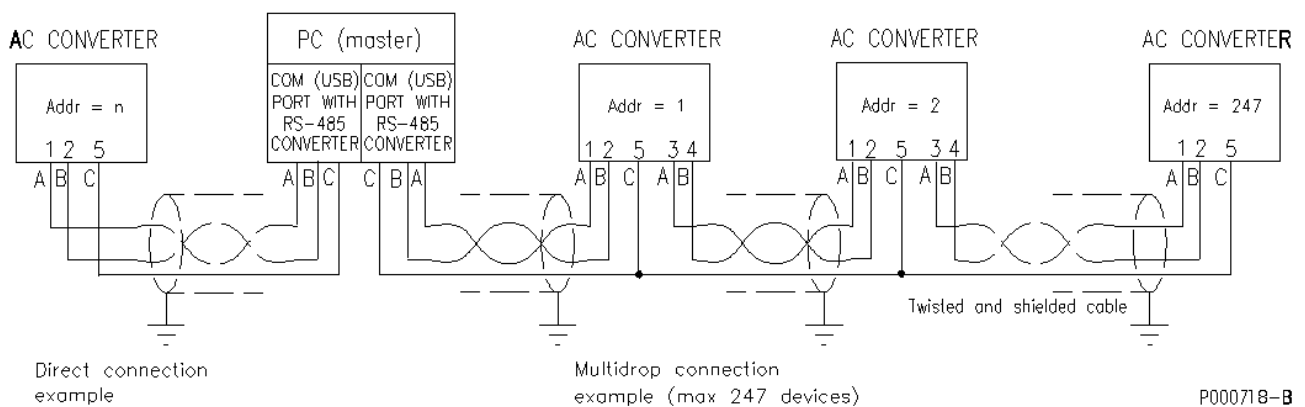


Figure 12: Example of multidrop and direct connection.

The Sinus K is supplied with a connector which is equipped with 2 pins for each signal of the RS485 pair, thus allowing easier multidrop links with no need to connect two conductors to the same pin, and thus avoiding creating a star network, which is not recommended for this type of bus.



Any information sent to/from the inverter through the display/keypad unit may be obtained also via serial link using the RemoteDrive software offered by Elettronica Santerno. RemoteDrive allows the following functions: image acquisition, keypad simulation, oscilloscope functions and multifunction tester, table compiler including operation data log, parameter setup and data reception-transmission-storage from and to a computer, scan function for the automatic detection of the connected inverters (up to 247 inverters may be connected). Please refer to the RemoteDrive Instruction Manual for the inverters of the SINUS K series manufactured by Elettronica Santerno.

### 3.7.2. DIRECT CONNECTION

RS485 electrical standard may be connected directly to the computer if this is provided with a special port of this type. In case your computer is provided with an RS232-C serial port or a USB port, an RS232-C/ RS485 converter or a USB/RS485 converter is required.

Elettronica Santerno may supply both converters as optional components.

Logic "1" (normally called a MARK) means that terminal TX/RX A is positive with respect to terminal TX/RX B (vice versa for logic "0" , normally called a SPACE).

### 3.7.3. MULTIDROP NETWORK CONNECTION

The inverters of the SINUS K series may be connected to a network through RS485 electrical standard, allowing a bus-type control of each device. Up to 247 inverters may be interconnected depending on the link length and baud rate.

Each inverter has its own ID number that can be set up in the Serial Network submenu.

### 3.7.3.1. CONNECTION

For the connection to the serial link, use the 9-pole, male D connector located on the control board (sizes S05..S15) or on the inverter bottom besides the terminal board (size S20).

The D connector pins are the following.

PIN	FUNCTION
1 – 3	(TX/RX A) Differential input/output A (bidirectional) depending on RS485 standard. Positive polarity with respect to pins 2 – 4 for one MARK.
2 – 4	(TX/RX B) Differential input/output B (bidirectional) depending on RS485 standard. Negative polarity with respect to pins 1 – 3 for one MARK.
5	(GND) control board zero volt.
6 – 7 – 8	Not connected.
9	+5 V



#### NOTE

The line terminator of the farthest inverter from the master computer (or the only inverter in case of direct connection to the master computer) shall be enabled: SW1 dip switch, selector switches 1 and 2 in position ON (default setting). The line terminator of the other inverters in intermediate positions shall be disabled: SW1 dip switch, selector switches 1 and 2 in position OFF(see Figure 9: Control Board).

### 3.7.4. THE SOFTWARE

The serial communications protocol is the MODBUS RTU standard.

Parameters are queried as they are read using the keys and the display. Parameter alteration is also managed along with the keypad and the display. Note that the inverter will always consider the latest value set either via serial link or from the inverter.

For more details concerning the communications software, refer to Part 2 (Programming Instructions) in this manual.

### 3.7.5. COMMUNICATION RATINGS

		LIFT SW Param.
Baud rate:	configurable between 1200..9600 bps (default baud rate: 9600 bps)	C93
Data format:	8 bits	
Start bit:	1	
Parity:	NO	
Stop bits:	2	
Protocol:	MODBUS RTU	
Supported functions:	03h (Read Holding Registers) 10h (Preset Multiple Registers)	
Device address:	configurable between 1 and 247 (default address: 1)	C90
Electrical standard:	RS485	
Inverter response delay:	configurable between 0 and 2000 ms (default delay: 0 ms)	C91
End of message timeout:	configurable between 0 and 2000 ms (default timeout: 0 ms)	C92

## 4. COMMISSIONING



### DANGER

Before changing the equipment connections, shut off the inverter and wait at least 5 minutes to allow for the discharge of the heatsinks in the DC-link.



### DANGER

At startup, if the connected motor rotates in the wrong direction, send a low frequency reference and check to see if the direction of rotation is correct.



### CAUTION

When an alarm message is displayed, find the cause responsible for the alarm trip before restarting the equipment.

Follow the instructions below to start up the equipment:

1) **Connection:** Install the equipment as stated in the following sections: CAUTION STATEMENTS, INSTALLATION and ACCESSORIES.

2) **Power on:** The link to terminal 6 (inverter disabled) is to be open when the inverter is started.

3) **Parameter alteration:** Set parameter P01 to 1.

4) **Motor parameters:** The inverters of the SINUS K LIFT series are capable of starting lift cages pulled by 400V/50Hz three-phase asynchronous motors. If the connected motor is a 400V/50Hz three-phase asynchronous motor, set the rated motor current in parameter C04 (Inom) and go to step 5. Otherwise, set the rated motor frequency in parameter C05 (Fmot), set a frequency value equal to C05x1.2 in parameter C06 (Fomax), and set the rated motor voltage in parameter C08 (Vmot).

5) **ENCODER parameters** (only if a speed transducer is used). Set C22 - ENCODER to YES and C23 ENCODER PULSES to a value equal to the pulse/rev number of the connected ENCODER.



### CAUTION

Whenever C22 is switched from YES to NO and vice versa, parameters P07, P08, P09, P10, P42, P43, P44 are automatically restored to the default value set to C22 (ENCODER fitted or not). Therefore, parameter C22 should be programmed before setting the other parameters. Before starting the motor, always check if P07 (ACCELERATION), P08 (DECELERATION), P09 (RAMP DOWN), P10 (JERK), P42 (LOW SPEED), P43 (MAINTENANCE SPEED) and P44 (RATED SPEED) are set up with the desired values.

6) **Selection of the operating mode:** if the operating mode is "single commercial speed and approach speed", go to step 7. If the operating mode is "dual commercial speed and approach speed", access the OPERATION METHOD menu and set parameter C21 (Standard Speed) as "Double" or "DoubleA".

7) **Speed setting:** access the Speed menu and calculate the motor synchronous speed ( $n_0$ ):

C05 = Rated motor frequency.

C73 = N. of motor poles.

Calculate the max. cage speed  $V_{max}$  corresponding to synchronous speed  $n_0$  and set it in parameter P44 (Rated Speed);

$$n_0 = \frac{f_{mot}(C05) * 120}{numero\ di\ poli\ (C73)}$$

*Synchronous speed of the connected motor (rpm)*

$$P44 = \frac{n_0}{60 * C_R * T} * 3.14 * \Phi$$

*Rated speed of the lift cage (m/s)*

where:

Cr: derating ratio of the winch Cr:1

T: Number of cable transmission.

$\Phi$ : Diameter of the winch pulley in m.

Once the max. cage speed is defined, the available speed values are expressed as a percentage of the rated speed (P44) and are the following (factory setting):

Commercial speed = P41 (factory setting: 100% of P44).

Second commercial speed (low speed) = P42 (factory setting = 67% of P44 or 32% of P44 if the ENCODER is used).

Approach speed = P40 (factory setting: 10% of P44).

Maintenance speed = P43 (factory setting: 40% of P44 or 20% of P44 if the ENCODER is used).

If these values are correct, go to step 8; if not, alter speed parameter/s as described below to obtain the desired speed values.

Set approach speed in parameter P40 (Approach Speed) as a percentage of the maximum speed:

$$P40 = \frac{\text{approach speed}}{P44} \times 100$$

Set the desired commercial speed in parameter P41 (Standard Speed):

$$P41 = \frac{\text{Comm.speed}}{P44} \times 100$$

Set the second commercial speed (if any) in parameter P42 (Lower fl. Speed):

$$P42 = \frac{\text{second speed}}{P44} \times 100$$

Set the desired maintenance speed in parameter P43 (Maint. Speed):

$$P43 = \frac{\text{Maintenance speed}}{P44} \times 100$$

**8) Positioning the slowing-down indicators and the stopping indicators:** access the Path menu; parameter M24 (Stop sp.) indicates the expected stop distance.

If the stop distance is too long, increase acceleration and jerk parameters (P07, P08, P10). Note that high values in these parameters may affect comfort.

Place slowing-down indicators at the distance set in M24 increased by 10 ÷ 20 cm (slowing-down stroke) and additionally increased by 10%.

Then, place the stopping indicators next to each floor, thus allowing the cage lift to perfectly align with each floor when stopping.

If the cage is running in the wrong direction, remove voltage from the inverter and reverse two of the motor phases.

If startup fails, access the V/F Pattern menu and increase parameters C09 (boost) and C11 (autoboost). To alter acceleration/deceleration parameters in maintenance mode, access the Acceleration Submenu and change parameters P05 and P06.

**(9) First programming of slip compensation parameters:** Access the Slip.comp. menu. In C74 (Motor Power), set the power of the connected motor; in C75 (No load Power), set the motor no-load power (2÷5% of the rated power); in C77 (High Speed Slip), set the rated motor slip as follows:

$$C77 = \frac{n_0 - n_{\text{targa}}}{n_0} \times 100$$

In C76 (Low Speed Slip), set the motor slip when operating at the approach frequency.

**10)** If a speed transducer is fitted, reset parameters P51, P53, P57 in the Speed Loop Menu.

**11) Checking the forward gear:** Start up the cage at the approach speed, check if the frequency displayed is positive and if the forward gear of the lift cage is really "up".

If a negative frequency value is displayed, check the commands of the terminal board (parameter M08 Term. B. in the Measures Menu).

If the frequency is positive but the forward gear is "down", stop the inverter and reverse two of the motor phases in terminals U, V, W.

**12) Checking the encoder wiring:** If no speed transducer is fitted, go to step 13; otherwise, do the following: Start up the cage at approach speed and compare parameter M10 (Speed Ref.) in the Measures Menu with parameter M11 (Speed Nout) in the Measures Menu. One of the following conditions will occur:

1. M11 = M10: Encoder Wiring OK
2. M11 = 0: One or more channels missing.
3. M11 = -M10: Reversed wiring of the encoder; reverse A and B.

**13) Setting slip compensation at high speed:** Perform some upstrokes/downstrokes; use a rev counter to read the motor speed of rotation; increase or decrease the value set in C77 to obtain the same speed for the two running directions.

If a speed transducer is provided, parameters M10 (Speed Ref) and M11 (Speed Nout) in the Measures Menu can be used.

**14) Adjusting slip compensation at low speed:** Access the Speed Menu and decrease the commercial speed (parameter P41) to obtain a long approach distance and to easily measure the motor speed of rotation. Perform some upstrokes/downstrokes and measure the approach speed. Use parameter C76 (Low Speed Slip) in the Slip Comp Menu to obtain the same approach speed values.

**15) Restore commercial speed** at the desired value (parameter P41 in the Speed Menu).

**16) Restore** parameters P51, P53 and P57 in the Speed Loop menu.

**17) Adjust the position** of the stopping indicator to obtain the desired floor approach distance.

**18) If the lift cage does not run smoothly,** decrease acceleration and jerk parameters P07, P08, P09, and make sure that the slowing-down distance (M24) is correct.

If the ENCODER is used, adjust speed loop parameters (P51 ÷ P58).

## 5. TECHNICAL SPECIFICATIONS

### Power Range

- Applicable motor kW /voltage range
 

1.8~32kW	200÷240Vac, 3phase
2.2~55kW	380÷415Vac, 3phase
3.0~65kW	440÷460Vac, 3phase
3.7~74kW	480÷500Vac, 3phase
- Degree of protection/size  
STAND ALONE: IP20.

### Motor Specifications

- Motor voltage range/precision  
0÷V<sub>mains</sub>, ±2%
- Current/torque to motor/time  
105÷200% for 120s every 20min.
- Starting torque/max. time  
240% for a short time
- Output frequency/resolution  
0÷800Hz, resolution 0.01Hz
- Braking torque  
DC braking 30% × C<sub>n</sub>  
Braking while decelerating up to 20% × C<sub>n</sub> (with no braking resistors)  
Braking while decelerating up to 150% × C<sub>n</sub> (with braking resistors)
- Adjustable carrier frequency with silent random modulation.  
S05÷S15 = 0.8÷16kHz  
S20 = 0.8÷12.8kHz

### Mains

- VAC supply voltage/tolerance  
200÷240Vac, 3phase, -15% +10%  
380÷500Vac, 3phase, -15% +10%
- VDC supply voltage/tolerance  
280÷360Vdc, -15% +10%  
530÷705Vdc, -15% +10%
- Supply frequency Hz/tolerance  
50÷60Hz, ±10%

### Environmental Requirements

- Ambient temperature :  
0÷40°C no derating  
(40°C to 50°C derating 2% of rated current every degree beyond 40°C)
- Storage temperature:  
-25÷+70°C
- Humidity:  
5÷95% (non condensing)
- Altitude:  
Up to 1000m a.s.l.  
For higher altitudes, derate the output current of 1% every 100m beyond 1000m (max. 4000m)
- Vibrations:  
Lower than 5.9m/sec<sup>2</sup> (=0.6G)
- Installation environment:  
Do not install in direct sunlight and in places exposed to conductive dust, corrosive gases, vibrations, water sprinkling or dripping (if not protected by an adequate degree of protection). Do not install in salty environments.
- Operating atmospheric pressure:  
86÷106kPa
- Cooling system:  
Forced air-cooling





<b>CONTROL</b>	Control method	LIFT = Space vector modulation (vector modulation PWM with V/f pattern)	
	Frequency/speed setting resolution	Analog reference 10bit: 1024 if compared to max. speed.	
	Speed precision	Open loop: 2% of max. speed. Closed loop (with encoder): < 0.5% of max. speed.	
	Overload capacity	Up to 2 times the rated current for 120sec.	
	Starting torque	Up to 200% Cn for 120sec and 240% Cn for a short duration.	
	Torque boost	Programmable for a rated torque increase.	
<b>OPERATION</b>	<b>Input signals</b>	Operation method	Operation through terminals, keypad, serial communications.
		Analog inputs	Not used
		Digital inputs	8 NPN/PNP digital inputs
	<b>Output signals</b>	Digital outputs	3 configurable digital outputs with setting of internal timers for activation/deactivation delay: 2 relay outputs with reverse contacts 250VCA, 30VDC, 3A 1 open collector output, NPN/PNP 5 ÷ 48VDC, 50mA max.
		Auxiliary voltage	24VDC ± 5%, 100mA
		Analog outputs	2 configurable analog outputs, 0 ÷ 10VDC and 0(4) ÷ 20mA, resolution 8bits
<b>PROTECTIONS</b>	Alarms	Inverter thermal protection, motor thermal protection, mains failure, overvoltage, undervoltage, overcurrent at constant speed or ground failure, overcurrent while accelerating, overcurrent while decelerating, auxiliary trip from digital input, serial communications failure, Eeprom failure, control board failure, precharge circuit failure, inverter overload conditions for long duration, unconnected motor, encoder failure.	
	Warnings	INVERTER OK, INVERTER ALARM, acceleration, constant rpm, deceleration, current/torque limiting, POWER DOWN, DC braking.	
<b>COMMUNICATIONS DISPLAY</b>	Operating data	Frequency/torque/speed reference, output frequency, motor speed, required torque, generated torque, current to motor, voltage to motor, DC bus voltage, motor-absorbed power, digital input condition, digital output condition, fault list (last 5 alarms), operating time, (lift cage speed reference, cage speed, cage acceleration time, length covered by the cage while accelerating, cage deceleration time, length covered by the cage while decelerating).	
	Serial communications	Incorporated multidrop RS485, 247 drops. MODBUS RTU communications protocol.	
	Fieldbus	AB Communicator: optional MODBUS/fieldbus converter (Profibus DP; Can Bus; Device Net; Ethernet; etc.). Each device may control up to 32 inverters.	
<b>SAFETY</b>		EN 61800-5-1, EN61800-5-2, EN50178, EN60204-1,	
<b>CE-UL-Gorst Mark</b>		Yes	

## 5.1. CHOOSING THE PRODUCT

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The inverters of the SINUS K series are dimensioned based on allowable current and overload.  
The torque/current overload has a duration of 120sec every 20min:

**LIFT** Overload up to 175%; may be connected to heavy loads with constant torque (lifts, injection presses, mechanical presses, translation and lifting of cranes, bridge cranes, mills, etc.).

The SINUS K series is dimensioned with 2 current values: "Imot" current, for the stated torque overload, and "Inom" current, representing the max. deliverable continuous current.  
The rated current of the connected motor should be lower than "Inom" (tolerance: +5%). If multiple motors are connected, the sum of the rated current values must not exceed "Inom" (output inductance is recommended in that case).



### 5.1.1. TECHNICAL SHEET FOR LIFT APPLICATIONS: OVERLOAD UP TO 175%

Size	SINUS K Model	Applicable Motor Power								Inverter Inom A	Inverter Imax A
		200-240Vac		380-415Vac		440-460Vac		480-500Vac			
		kW	HP	kW	HP	kW	HP	kW	HP		
S05	SINUS K 0005	-	-	3	4	3.7	5	4.5	6	10.5	11.5
	SINUS K 0007	1.8	2.5	4	5.5	4.5	6	5.5	7.5	12.5	13.5
	SINUS K 0008	2.2	3	-	-	-	-	-	-	15	16
	SINUS K 0009	-	-	4.5	6	5.5	7.5	7.5	10	16.5	17.5
	SINUS K 0010	3	4	-	-	-	-	-	-	17	19
	SINUS K 0011	-	-	5.5	7.5	7.5	10	9.2	12.5	16.5	21
	SINUS K 0013	3.7	5	-	-	-	-	-	-	19	21
	SINUS K 0014	-	-	7.5	10	9.2	12.5	11	15	16.5	25
	SINUS K 0015	4	5.5	-	-	-	-	-	-	23	25
	SINUS K 0016	4.5	6	-	-	-	-	-	-	27	30
	SINUS K 0020	5.5	7.5	-	-	-	-	-	-	30	36
S10	SINUS K 0016	5,5	7,5	9,2	12,5	11	15	13,1	17,8	26	30
	SINUS K 0017	5,5	7,5	9,2	12,5	11	15	13,9	18,9	30	32
	SINUS K 0020	7,5	10	11	15	15	20	15,8	21,5	30	36
	SINUS K 0025	9,2	12,5	15	20	18,5	25	21	28	41	48
	SINUS K 0030	11	15	18,5	25	22	30	24	32	41	56
	SINUS K 0035	12,5	17	22	30	25	35	28	38	41	72
S12	SINUS K 0016	-	-	9.2	12.5	11	15	12.5	17	27	30
	SINUS K 0017	-	-	9.2	12.5	11	15	12.5	17	30	32
	SINUS K 0020	-	-	11	15	15	20	15	20	30	36
	SINUS K 0023	7.5	10	-	-	-	-	-	-	38	42
	SINUS K 0025	-	-	15	20	18.5	25	18.5	25	41	48
	SINUS K 0030	-	-	18.5	25	22	30	22	30	41	56
	SINUS K 0033	11	15	-	-	-	-	-	-	51	56
	SINUS K 0034	-	-	22	30	25	35	28	38	57	63
	SINUS K 0036	-	-	25	35	30	40	30	40	60	72
	SINUS K 0037	15	20	-	-	-	-	-	-	65	72
S15	SINUS K 0038	15	20	25	35	30	40	34	47	65	75
	SINUS K 0040	15	20	25	35	30	40	34	47	72	75
	SINUS K 0049	18,5	25	30	40	37	50	43	58	80	96
S20	SINUS K 0049	18,5	25	30	40	37	50	43	58	80	96
	SINUS K 0060	22	30	37	50	45	60	51	69	88	112
	SINUS K 0067	25	35	45	60	50	70	56	76	103	118
	SINUS K 0074	30	40	48	65	55	75	69	93	120	144
	SINUS K 0086	32	45	55	75	65	90	74	100	135	155
Inverter Supply Voltage		200-240Vac; 280-360Vdc		380-500Vac; 530-705Vdc							

**PART 1**

Legend:

**Inom** = Rated continuous current of the inverter.

**Imax** = Max. current that the inverter can deliver for 120 sec every 20 min.



## 5.2. CARRIER FREQUENCY SETTING AND PEAK CURRENT

The continuous current generated by the inverter in "S1" continuous operation at 40°C depends on the carrier frequency.

Do not exceed the carrier values stated in the table below. Carrier values may be set through parameters C01 and C02 in the "Carrier Frequency" submenu.

Size	MODEL	Max. Recommended Carrier Frequency (Parameters C01 and C02)		Peak Current	
		HEAVY	Max. Carrier	@ 3s	Instant.
		(kHz)	(kHz)	(A <sub>RMS</sub> )	(A <sub>peak</sub> )
S05	SINUS K 0005	16	16	14	28
	SINUS K 0007	16	16	16	33
	SINUS K 0008	16	16	19,5	44
	SINUS K 0009	16	16	21	47
	SINUS K 0010	16	16	23	51
	SINUS K 0011	16	16	25	56
	SINUS K 0013	16	16	25	56
	SINUS K 0014	12.8	16	30	67
	SINUS K 0015	16	16	30	67
	SINUS K 0016	16	16	36	73
SINUS K 0020	16	16	43	87	
S10	SINUS K 0016	12.8	16	36	72
	SINUS K 0017	12.8	16	38	77
	SINUS K 0020	12.8	16	43	87
	SINUS K 0025	12.8	16	58	114
	SINUS K 0030	10	16	67	133
	SINUS K 0035	10	16	86	167
S12	SINUS K 0016	12.8	16	36	72
	SINUS K 0017	12.8	16	38	77
	SINUS K 0020	12.8	16	43	87
	SINUS K 0023	10	16	51	100
	SINUS K 0025	12.8	16	58	114
	SINUS K 0030	10	16	67	133
	SINUS K 0033	8	16	68	137
	SINUS K 0034	8	16	76	153
	SINUS K 0036	6	16	86	173
SINUS K 0037	6	16	86	173	
S15	SINUS K 0038	12.8	16	90	170
	SINUS K 0040	12.8	16	90	173
	SINUS K 0049	12.8	12.8	115	228
S20	SINUS K 0049	12.8	12.8	134	228
	SINUS K 0060	12.8	12.8	142	266
	SINUS K 0067	12.8	12.8	173	280
	SINUS K 0074	12.8	12.8	186	347
SINUS K 0086	10	12.8	134	373	

## 6. ACCESSORIES

### 6.1. BRAKING RESISTORS

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The braking resistor is to be installed externally to the inverter and connected to terminals B and + (see the "WIRING" section). The braking module is enabled through programming parameter C55 (Special Functions submenu).

Two duty cycles are possible:

1) **STANDARD DUTY CYCLE:**

Cage speed under 1.0 m/sec; starts/hour lower than or equal to 120 starts/h (90 - 120); max. stop number ranging from 6 to 8. A standard duty cycle is ideal for not very crowded buildings.

2) **HEAVY DUTY CYCLE:**

Cage speed equal to or higher than 1.0 m/sec; starts/hour over 120 starts/h (180 - 240); stop number higher than 6/8. A heavy duty cycle is ideal for very crowded buildings, such as hotels, hospitals, etc.

Kinetic energy stored while decelerating is to be dissipated in the form of heat. A different braking resistor dimensioning is then needed for the two types of duty cycles (standard and heavy) to avoid overheating.

A well-dimensioned braking resistor will always reach working temperatures higher than ambient temperatures. Therefore, braking resistors should be placed outside the control panel in a sheltered and ventilated location, thus avoiding accidental burning.

The following pages contain application tables stating the resistors to be used depending on the inverter size, the application requirements and the supply voltage. The braking resistor power is stated as an approximate value. The correct dimensioning of the braking resistor is based on the equipment duty cycle and the power regenerated during the braking stage.

## 6.1.1. BRAKING RESISTORS FOR STANDARD DUTY-CYCLE

### 6.1.1.1. 2T VOLTAGE CLASS - 200-240VAC SUPPLY VOLTAGE

Size	Sinus K Model		Min. Resistor to be Connected to the Inverter $\Omega$	Standard Duty-cycle: Cage Speed <1m/s, Starts/h $\leq$ 120, Stops $\leq$ 8	
				Degree of Protection IP54 or IP55 up to 50 $\Omega$ /2200W included, IP20 for higher power ratings	Code
S05	SINUS K 0007	2T BA2X2	25.0	56 $\Omega$ -350W	RE2643560
	SINUS K 0008	2T BA2X2	25.0	56 $\Omega$ // 56 $\Omega$ -350W (note 1)	2*RE2643560
	SINUS K 0010	2T BA2X2	25.0	56 $\Omega$ // 56 $\Omega$ -350W (note 1)	2*RE2643560
	SINUS K 0013	2T BA2X2	20.0	56 $\Omega$ // 56 $\Omega$ -350W (note 1)	2*RE2643560
	SINUS K 0015	2T BA2X2	20.0	56 $\Omega$ // 56 $\Omega$ -350W (note 1)	2*RE2643560
	SINUS K 0016	2T BA2X2	20.0	56 $\Omega$ // 56 $\Omega$ -350W (note 1)	2*RE2643560
	SINUS K 0020	2T BA2X2	20.0	56 $\Omega$ // 56 $\Omega$ -350W (note 1)	2*RE2643560
S10	SINUS K 0016	2T BA2X2	25.0	56 $\Omega$ // 56 $\Omega$ -350W (note 1)	2*RE2643560
	SINUS K 0017	2T BA2X2	25.0	56 $\Omega$ // 56 $\Omega$ -350W (note 1)	2*RE2643560
	SINUS K 0020	2T BA2X2	25.0	56 $\Omega$ // 56 $\Omega$ -350W (note 1)	2*RE2643560
	SINUS K 0025	2T BA2X2	10.0	15 $\Omega$ -1100W	RE3083150
	SINUS K 0030	2T BA2X2	10.0	15 $\Omega$ -1100W	RE3083150
	SINUS K 0035	2T BA2X2	10.0	15 $\Omega$ -1100W	RE3083150
S12	SINUS K 0023	2T BA2X2	15.0	56 $\Omega$ // 56 $\Omega$ -350W (note 1)	2*RE2643560
	SINUS K 0033	2T BA2X2	10.0	15 $\Omega$ -1100W	RE3083150
	SINUS K 0037	2T BA2X2	10.0	10 $\Omega$ -1500W	RE3093100
S15	SINUS K 0038	2T BA2X2	7.5	15 $\Omega$ //15 $\Omega$ -1100W (note 2)	2*RE3083150
	SINUS K 0040	2T BA2X2	7.5	15 $\Omega$ //15 $\Omega$ -1100W (note 2)	2*RE3083150
	SINUS K 0049	2T BA2X2	5.0	5 $\Omega$ -4000W	RE3482500 $\circ$ RE3472500
S20	SINUS K 0049	2T BA2X2	5.0	5 $\Omega$ -4000W	RE3482500 $\circ$ RE3472500
	SINUS K 0060	2T BA2X2	5.0	5 $\Omega$ -4000W	RE3482500 $\circ$ RE3472500
	SINUS K 0067	2T BA2X2	5.0	5 $\Omega$ -4000W	RE3482500 $\circ$ RE3472500
	SINUS K 0074	2T BA2X2	4.2	5 $\Omega$ -4000W	RE3482500 $\circ$ RE3472500
	SINUS K 0086	2T BA2X2	4.2	5 $\Omega$ -4000W	RE3482500 $\circ$ RE3472500

(note 1): Two parallel-connected resistors, 56 $\Omega$ /350W

(note 2): Two parallel-connected resistors, 15 $\Omega$ /1100W



**DANGER** Braking resistors may reach temperatures higher than 200°C.

Power dissipated by braking resistors may be equal to approx. 10% of the rated power of the connected motor. Use a proper air-cooling system. Do not install braking resistors near heat-sensitive equipment or objects.



**CAUTION**

Do not connect any braking resistor with an Ohm value lower than the value stated in the table above.



6.1.1.2. 4T VOLTAGE CLASS - 380-500VAC SUPPLY VOLTAGE

Size	Sinus K MODEL		Min. Resistor to be Connected to the Inverter $\Omega$	Standard Duty-cycle: Cage Speed <1m/s, Starts/h $\leq$ 120, Stop Number $\leq$ 8	
				Degree of Protection IP54 or IP55 up to 25 $\Omega$ /1800W included IP20 for higher power ratings	Code
S05	SINUS K 0005	4T BA2X2	50	75 $\Omega$ -550W	RE3063750
	SINUS K 0007	4T BA2X2	50	75 $\Omega$ -550W	RE3063750
	SINUS K 0009	4T BA2X2	50	50 $\Omega$ -1100W	RE3083500
	SINUS K 0011	4T BA2X2	50	50 $\Omega$ -1100W	RE3083500
	SINUS K 0014	4T BA2X2	50	50 $\Omega$ -1100W	RE3083500
S10	SINUS K 0016	4T BA2X2	50	50 $\Omega$ -1100W	RE3083500
	SINUS K 0017	4T BA2X2	50	50 $\Omega$ -1100W	RE3083500
	SINUS K 0020	4T BA2X2	50	50 $\Omega$ -1100W	RE3083500
	SINUS K 0025	4T BA2X2	20	25 $\Omega$ -1800W	RE3103250
	SINUS K 0030	4T BA2X2	20	25 $\Omega$ -1800W	RE3103250
	SINUS K 0035	4T BA2X2	20	25 $\Omega$ -1800W	RE3103250
S12	SINUS K 0016	4T BA2X2	40	50 $\Omega$ -1500W	RE3093500
	SINUS K 0017	4T BA2X2	40	50 $\Omega$ -1500W	RE3093500
	SINUS K 0020	4T BA2X2	40	50 $\Omega$ -1500W	RE3093500
	SINUS K 0025	4T BA2X2	20	25 $\Omega$ -1800W	RE3103250
	SINUS K 0030	4T BA2X2	20	25 $\Omega$ -1800W	RE3103250
	SINUS K 0034	4T BA2X2	20	25 $\Omega$ -1800W	RE3103250
	SINUS K 0036	4T BA2X2	20	20 $\Omega$ -4000W	RE3483200 $\circ$ RE3473200
S15	SINUS K 0038	4T BA2X2	15	15 $\Omega$ -4000W	RE3483150 $\circ$ RE3473150
	SINUS K 0040	4T BA2X2	15	15 $\Omega$ -4000W	RE3483150 $\circ$ RE3473150
	SINUS K 0049	4T BA2X2	10	15 $\Omega$ -4000W	RE3483150 $\circ$ RE3473150
S20	SINUS K 0060	4T BA2X2	10	15 $\Omega$ -4000W	RE3483150 $\circ$ RE3473150
	SINUS K 0067	4T BA2X2	10	10 $\Omega$ -8000W	RE3763100 $\circ$ RE3753100
	SINUS K 0074	4T BA2X2	8.5	10 $\Omega$ -8000W	RE3763100 $\circ$ RE3753100
	SINUS K 0086	4T BA2X2	8.5	10 $\Omega$ -8000W	RE3763100 $\circ$ RE3753100

**PART 1**



**DANGER** Braking resistors may reach temperatures higher than 200°C.



**CAUTION**

Power dissipated by braking resistors may be equal to approx. 10% of the rated power of the connected motor. Use a proper air-cooling system. Do not install braking resistors near heat-sensitive equipment or objects.

Do not connect any braking resistors with an Ohm value lower than the value stated in the table above.



## 6.1.2. BRAKING RESISTORS FOR HEAVY DUTY-CYCLE

### 6.1.2.1. 2T VOLTAGE CLASS - 200-240VAC SUPPLY VOLTAGE

Size	Sinus K Model		Min. Resistor to be Connected to the Inverter $\Omega$	Heavy Duty-cycle: Cage Speed $\geq 1\text{m/s}$ , Starts/h $> 120$ , Stops $> 8$	
				Degree of Protection IP54 or IP55 up to 25 $\Omega$ /1800W included, IP20 for higher power ratings	Code
S05	SINUS K 0007	2T BA2X2	25.0	100 $\Omega$ // 100 $\Omega$ -350W (note 1)	2*RE2644100
	SINUS K 0008	2T BA2X2	25.0	56 $\Omega$ // 56 $\Omega$ -350W (note 1)	2*RE2643560
	SINUS K 0010	2T BA2X2	25.0	56 $\Omega$ // 56 $\Omega$ -350W (note 1)	2*RE2643560
	SINUS K 0013	2T BA2X2	20.0	56 $\Omega$ // 56 $\Omega$ -350W (note 1)	4*RE2644100
	SINUS K 0015	2T BA2X2	20.0	56 $\Omega$ // 56 $\Omega$ -350W (note 1)	4*RE2644100
	SINUS K 0016	2T BA2X2	20.0	100 $\Omega$ // 100 $\Omega$ // 100 $\Omega$ // 100 $\Omega$ -350W (note 2)	4*RE2644100
	SINUS K 0020	2T BA2X2	20.0	100 $\Omega$ // 100 $\Omega$ // 100 $\Omega$ // 100 $\Omega$ -350W (note 2)	4*RE2644100
S10	SINUS K 0016	2T BA2X2	25.0	100 $\Omega$ // 100 $\Omega$ // 100 $\Omega$ // 100 $\Omega$ -350W (note 2)	4*RE2644100
	SINUS K 0017	2T BA2X2	25.0	100 $\Omega$ // 100 $\Omega$ // 100 $\Omega$ // 100 $\Omega$ -350W (note 2)	4*RE2644100
	SINUS K 0020	2T BA2X2	25.0	25 $\Omega$ -1800W	RE3103250
	SINUS K 0025	2T BA2X2	10.0	75 $\Omega$ // 75 $\Omega$ // 75 $\Omega$ // 75 $\Omega$ // 75 $\Omega$ // 75 $\Omega$ -550W (note 3)	6*RE3063750
	SINUS K 0030	2T BA2X2	10.0	75 $\Omega$ // 75 $\Omega$ // 75 $\Omega$ // 75 $\Omega$ // 75 $\Omega$ // 75 $\Omega$ -550W (note 3)	6*RE3063750
	SINUS K 0035	2T BA2X2	10.0	75 $\Omega$ // 75 $\Omega$ // 75 $\Omega$ // 75 $\Omega$ // 75 $\Omega$ // 75 $\Omega$ -550W (note 3)	6*RE3063750
S12	SINUS K 0023	2T BA2X2	15.0	25 $\Omega$ -1800W	RE3103250
	SINUS K 0033	2T BA2X2	10.0	75 $\Omega$ // 75 $\Omega$ // 75 $\Omega$ // 75 $\Omega$ // 75 $\Omega$ // 75 $\Omega$ -550W (note 3)	6*RE3063750
	SINUS K 0037	2T BA2X2	10.0	25 $\Omega$ // 25 $\Omega$ -1800W (note 4)	2*RE3103250
S15	SINUS K 0038	2T BA2X2	7.5	25 $\Omega$ // 25 $\Omega$ -1800W (note 4)	2*RE3103250
	SINUS K 0040	2T BA2X2	7.5	25 $\Omega$ // 25 $\Omega$ -1800W (note 4)	2*RE3103250
	SINUS K 0049	2T BA2X2	5.0	5 $\Omega$ -4000W	RE3482500 or RE3472500
S20	SINUS K 0049	2T BA2X2	5.0	5 $\Omega$ -4000W	RE3482500 or RE3472500
	SINUS K 0060	2T BA2X2	5.0	5 $\Omega$ -8000W	RE3762500 or RE3752500
	SINUS K 0067	2T BA2X2	5.0	5 $\Omega$ -8000W	RE3762500 or RE3752500
	SINUS K 0074	2T BA2X2	4.2	5 $\Omega$ -8000W	RE3762500 or RE3752500
	SINUS K 0086	2T BA2X2	4.2	5 $\Omega$ -8000W	RE3762500 or RE3752500

(note 1): Two parallel-connected resistors, 100 $\Omega$ /350W

(note 2): Four parallel-connected resistors, 100 $\Omega$ /350W

(note 3): Six parallel-connected resistors, 75 $\Omega$ /550W

(note 4): Two parallel-connected resistors, 25 $\Omega$ /1800W



**DANGER** Braking resistors may reach temperatures higher than 200°C.

Power dissipated by braking resistors may be equal to approx. 20% of the rated power of the connected motor. Use a proper air-cooling system. Do not install braking resistors near heat-sensitive equipment or objects.



**CAUTION**

Do not connect any braking resistor with an Ohm value lower than the value stated in the tables.





6.1.2.2. 4T VOLTAGE CLASS - 380-500VAC SUPPLY VOLTAGE

**PART 1**

Size	Sinus K MODEL		Min. Resistor to be Connected to the Inverter $\Omega$	Heavy Duty-cycle: Cage Speed $\geq 1$ m/s, Starts/h $> 120$ or Stop Number $> 8$	
				Degree of Protection IP54 or IP55 up to 50 $\Omega$ /2200W included, IP20 for higher power ratings	Code
S05	SINUS K 0005	4T BA2X2	50	50 $\Omega$ -1100W	RE3083500
	SINUS K 0007	4T BA2X2	50	50 $\Omega$ -1100W	RE3083500
	SINUS K 0009	4T BA2X2	50	50 $\Omega$ -1100W	RE3083500
	SINUS K 0011	4T BA2X2	50	50 $\Omega$ -1500W	RE3093500
	SINUS K 0014	4T BA2X2	50	50 $\Omega$ -2200W	RE3113500
S10	SINUS K 0016	4T BA2X2	50	50 $\Omega$ 2200W	RE3113500
	SINUS K 0017	4T BA2X2	50	50 $\Omega$ 2200W	RE3113500
	SINUS K 0020	4T BA2X2	50	50 $\Omega$ -4000W	RE3483500 o RE3473500
	SINUS K 0025	4T BA2X2	20	25 $\Omega$ -4000W	RE3483250 o RE3473250
	SINUS K 0030	4T BA2X2	20	25 $\Omega$ -4000W	RE3483250 o RE3473250
S12	SINUS K 0035	4T BA2X2	20	25 $\Omega$ -4000W	RE3483250 o RE3473250
	SINUS K 0016	4T BA2X2	40	50 $\Omega$ -2200W	RE3113500
	SINUS K 0017	4T BA2X2	40	50 $\Omega$ -2200W	RE3113500
	SINUS K 0020	4T BA2X2	40	50 $\Omega$ -4000W	RE3483500 o RE3473500
	SINUS K 0025	4T BA2X2	20	25 $\Omega$ -4000W	RE3483250 o RE3473250
	SINUS K 0030	4T BA2X2	20	25 $\Omega$ -4000W	RE3483250 o RE3473250
	SINUS K 0034	4T BA2X2	20	25 $\Omega$ -4000W	RE3483250 o RE3473250
S15	SINUS K 0036	4T BA2X2	20	20 $\Omega$ -4000W	RE3483200
	SINUS K 0038	4T BA2X2	15	15 $\Omega$ -4000W	RE3483150 o RE3473150
	SINUS K 0040	4T BA2X2	15	15 $\Omega$ -4000W	RE3483150 o RE3473150
	SINUS K 0049	4T BA2X2	10	10 $\Omega$ -8000W	RE3763100 o RE3753100
	SINUS K 0060	4T BA2X2	10	10 $\Omega$ -8000W	RE3763100 o RE3753100
	SINUS K 0067	4T BA2X2	10	10 $\Omega$ -12000W	RE4023100 o RE4013100
	SINUS K 0074	4T BA2X2	8.5	10 $\Omega$ -12000W	RE4023100 o RE4013100
	SINUS K 0086	4T BA2X2	8.5	10 $\Omega$ -12000W	RE4023100 o RE4013100



**DANGER**

Braking resistors may reach temperatures higher than 200°C.



**CAUTION**

Power dissipated by braking resistors may be equal to approx. 20% of the connected rated motor power. Use a proper air-cooling system. Do not install braking resistors near heat-sensitive equipment or objects.

Do not connect any braking resistor with an Ohm value lower than the value stated in the table above.

### 6.1.3. AVAILABLE MODELS OF BRAKING RESISTORS

#### 6.1.3.1. 56-100Ω/350W MODEL

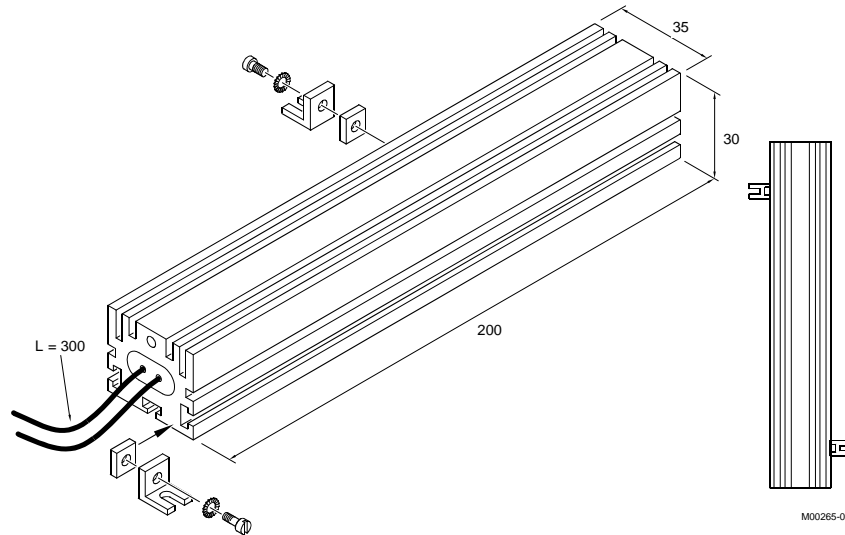
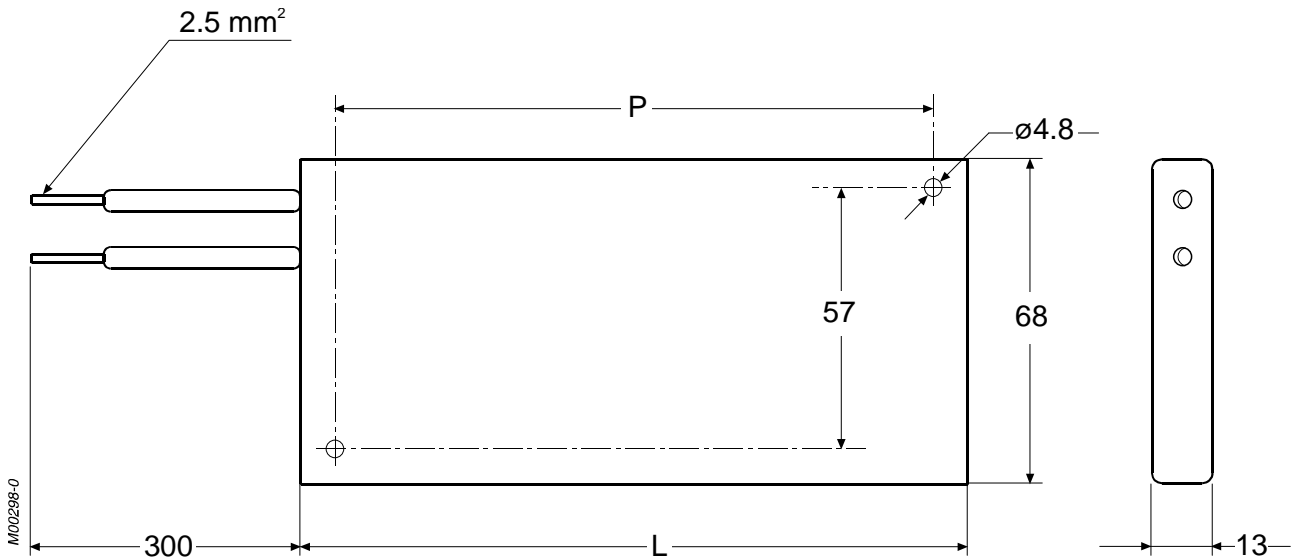


Figure 13: Overall dimensions, 56-100Ω/350W resistor.

Type	Wgt (g)	Degree of protection	Mean Power to be Dissipated (W)	Max. Duration of Continuous Operation for 200-240VAC (s)*
56Ω/350W RE2643560	400	IP55	350	3.5
100Ω/350W RE2644100	400	IP55	350	3.5

(\*) Max. value to be set for parameter Brake Enable (C57). Set Brake Disable (C56) so as not to exceed the max. power to be dissipated by the braking resistor. Set Brake Disable=0 in order not to limit the operation of the built-in braking module.

6.1.3.2. 75OHM/1300W MODEL



**PART 1**

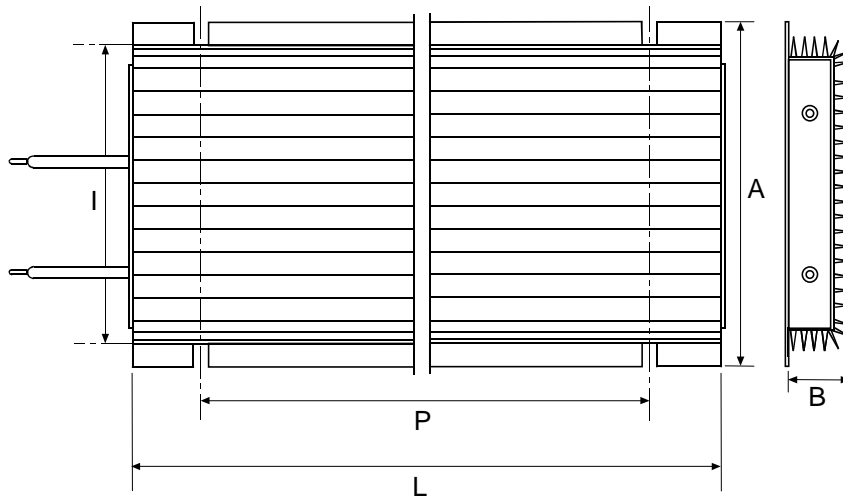
Figure 14: Overall dimensions and ratings for 75Ω/1300W braking resistor.

Type	L (mm)	D (mm)	Wgt (g)	Degree of Protection	Mean Power to be Dissipated (W)	Max. Duration of Continuous Operation for 380-500Vac (s)*
75Ohm/550W RE3063750	195	174	500	IP33	550	2.25

(\*) Max. value to be set for parameter Brake Enable (C57). Set Brake Disable (C56) so as not to exceed the max. power to be dissipated by the braking resistor. Set Brake Disable=0 in order not to limit the operation of the built-in braking module.



### 6.1.3.3. MODELS 1100W TO 2200W



M00619-0

Figure 15: Overall dimensions and mechanical features for braking resistors from 1100W to 2200W.

Type	A (mm)	B (mm)	W (mm)	H (mm)	D (mm)	Wgt (g)	Degree of Protection	Mean Power to be Dissipated (W)	Max. Duration of Continuous Operation	
									380- 500Vac (s)*	380- 500Vac (s)*
15Ohm/1100W RE3083150	95	30	320	80- 84	240	1250	IP55	950	not applicable	6
50Ohm/1100W RE3083500									5	20
10Ohm/1500W RE3093100	120	40	320	107- 112	240	2750	IP54	1100	not applicable	4,5
50Ohm/1500W RE3093500									4,5	18
25Ohm/1800W RE3103250	120	40	380	107- 112	300	3000	IP54	1300	3	12
50Ohm/2200W RE3113500	190	67	380	177- 182	300	7000	IP54	2000	8	not restricted
Wire standard length: 300mm										

(\*) max. value to be set for parameter Brake Enable (C57). Set Brake Disable (C56) so as not to exceed the max. power to be dissipated by the braking resistor. Set Brake Disable=0 in order not to limit the operation of the built-in braking module.



6.1.3.4. 4kW-8kW-12kW MODELS

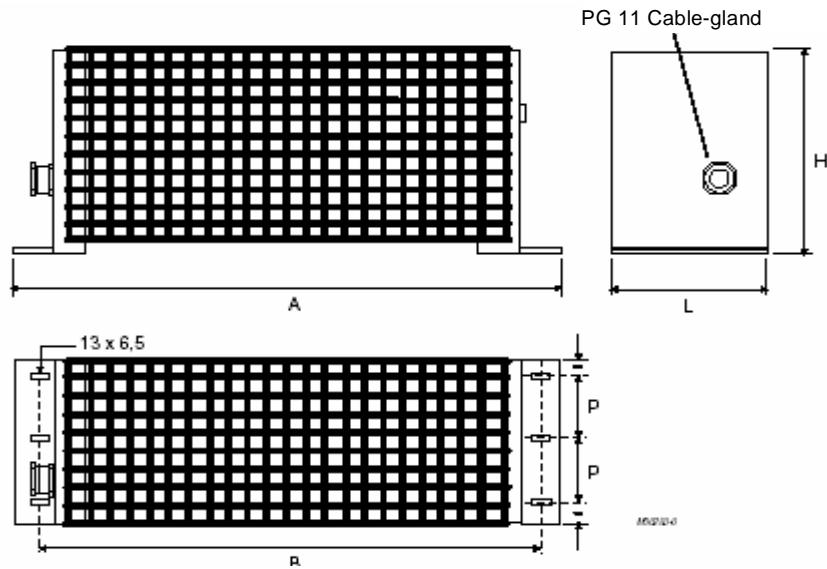


Figure 16: Overall dimensions, 4kW, 8kW, and 12kW braking resistors.

**PART 1**

RESISTOR	A (mm)	B (mm)	W (mm)	H (mm)	D (mm)	Wgt (Kg)	Degree of protection	Mean Power to be Dissipated (W)	Max. Duration of Continuous Operation		Wire Cross-section (mm <sup>2</sup> )**
									380-500Vac (s)*	200-240Vac (s)*	
5Ω4kW RE3482500	620	600	100	250	40	5,5	IP20	4000	not applic.	10	10
15Ω4kW RE3483150 ○ RE3473150									5	100	6
25Ω4kW RE3483250									20	not restricted	6
50Ω4kW RE3483500 ○ RE3473500									90		4
5Ω/8kW RE3762500	620	600	160	250	60	10,6	IP20	8000	not applicable	40	10
10Ω/8kW RE3763100 ○ RE3753100									2	100	10
10Ω/12kW RE4023100 ○ RE4013100	620	600	200	250	80	13,7	IP20	12000	12	not restricted	10

(\*) Max. value to be set in parameter Brake Enable (C57). Set Brake Disable (C56) so as not to exceed the max. power to be dissipated by the braking resistor. Set Brake Disable=0 in order not to limit the operation of the built-in braking module.

(\*\*) cross sections refer to the applications covered in this manual.

## 6.2. REMOTING KIT

The REMOTING KIT is required to remote the keypad. The remoting kit includes:

- Plastic shell
- Keypad mounting plate
- Fastening brackets
- Remoting wire

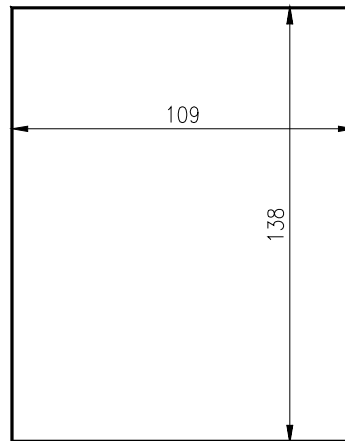


**NOTE**

The cable length can be 3m or 5m (state cable length when ordering the equipment).

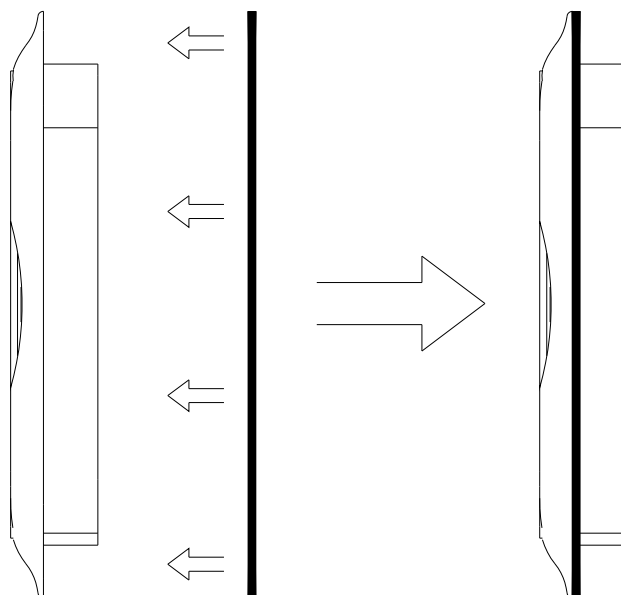
Do the following:

Pierce the holes as shown in the figure (rectangular template: 138 x109 mm).



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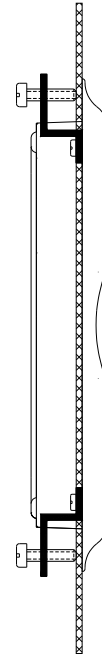
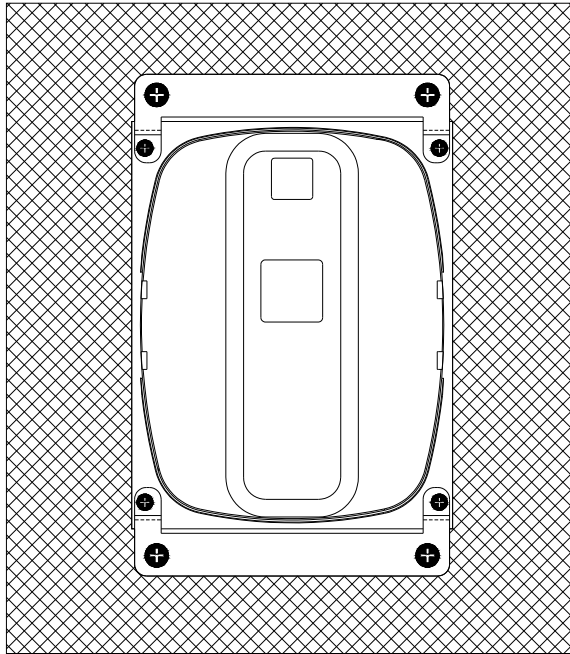
2 – Apply the self-adhesive mounting plate on the rear part of the plastic shell between the shell and the cabinet; make sure that holes coincide.



P000565-0

3 – Fit the plastic shell in the relevant slot.

4 - Fasten the plastic shell using the brackets supplied and tighten the fastening screws. Four self-threaded screws are supplied to fasten the brackets to the mounting plate; four fastening screws are also supplied to fix the shell to the panel.



P000563-0

5 – Remove the display/keypad from the inverter (see figure below). A short wire with 8-pole telephone connectors is used to connect the display/keypad to the inverter. Press the cable tab to disconnect it.

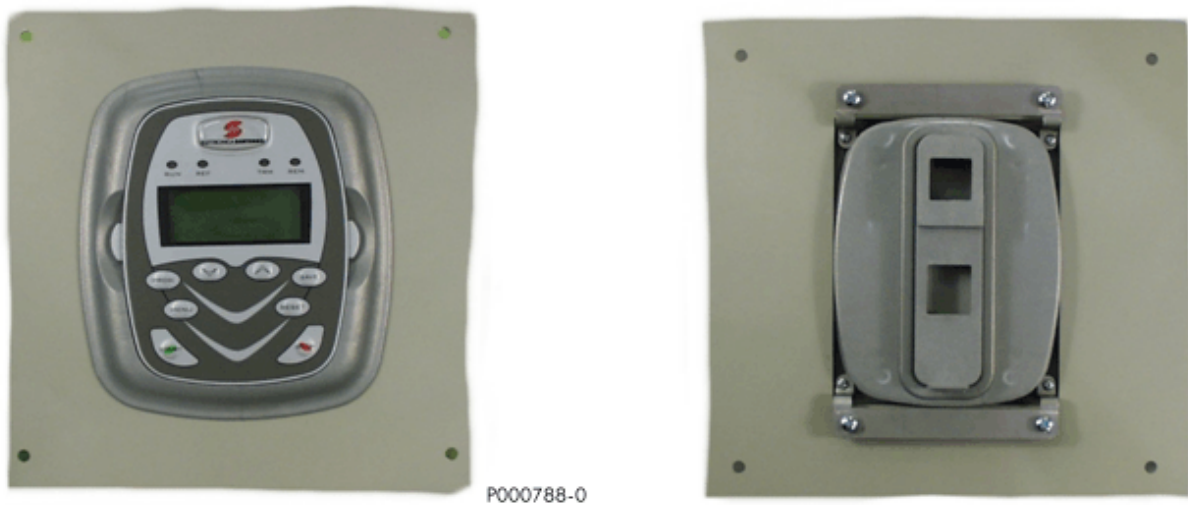


Figure 17: Removing the display/keypad.

6 - Connect the keypad to the inverter using the wire supplied. On the keypad side, the wire is provided with a telephone connector and a loop lug connected to the wire screening braiding. Fasten the loop to the panel grounding using one of the mounting jig fastening screws. Tighten the screw in an uncoated area of the panel, to ensure it is electrically connected to the ground. Panel grounding must comply with the safety regulations in force.

7 - Fit the display/keypad to its housing (side tabs snap); make sure that the telephone connector is connected both to the keypad and to the inverter. Avoid stretching the keypad wire.

The remoting kit ensures degree of protection IP54 for the front panel.



**Figure 18: Front view/rear view of the keypad.**



**CAUTION**

Never connect and disconnect the keypad when the inverter is on. Temporary overload may lock the inverter due to alarm trip.



**CAUTION**

Only use wires supplied by Elettronica Santerno for the keypad wiring. Wires with a different contactor arrangement will cause irreparable damages to the inverter and the display/keypad. A remoting wire with different specifications may cause disturbance and affect communications between the inverter and the display/keypad.



**CAUTION**

Properly connect the remoting wire by grounding its braiding as explained above. The remoting wire must not be parallel-connected to the power wires connecting the motor or feeding the inverter. This will reduce disturbance between the inverter and the display/keypad connection to a minimum.



## 6.3. REACTANCE

### 6.3.1. INPUT REACTOR

We suggest that a three-phase inductance, or a DCBUS DC inductance be installed on the supply line to obtain the following benefits:

- limit input current peaks on the input circuit of the inverter and value  $di/dt$  due to the input rectifier and to the capacitive load of the capacitors set;
- reducing supply harmonic current;
- increasing power factor, thus reducing line current;
- increasing the duration of line capacitors inside the inverter.

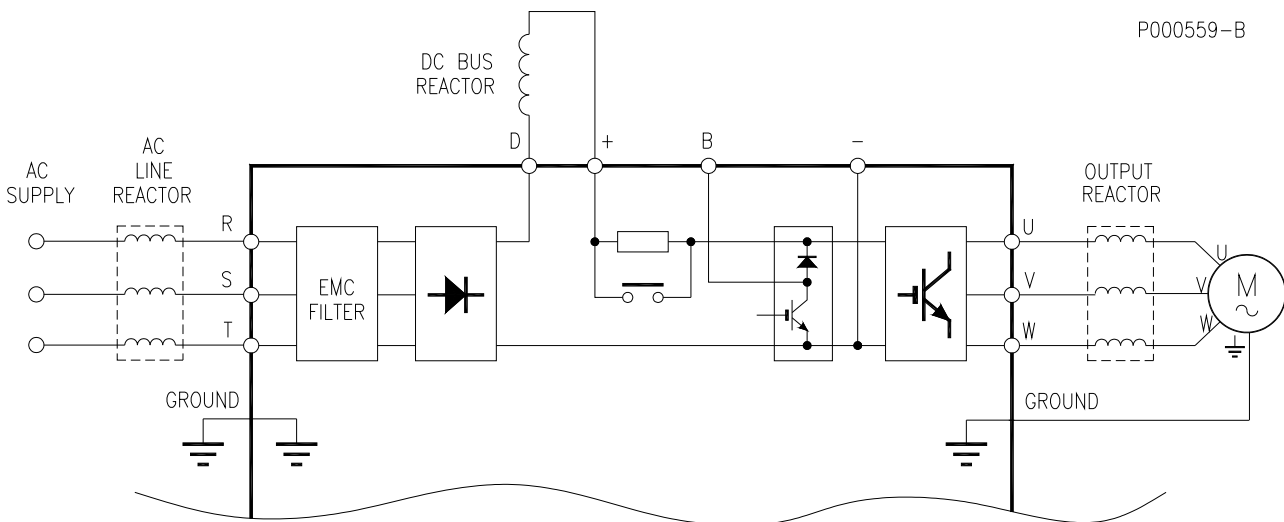


Figure 19: Wiring diagram for optional inductance.

#### Harmonic currents

The shapes of the different waves (current or voltage) may be expressed as the sum of the basic frequency (50 or 60Hz) and its multiples. In balanced, three-phase systems, only odd harmonic current exists, as even current is neutralized by symmetrical considerations.

Harmonic current is generated by non linear loads absorbing non-sinusoidal current. Typical sources of this type are bridge rectifiers (power electronics), switched mode power supply and fluorescent lamps. Three-phase rectifiers absorb line current with a harmonic content  $n=6K\pm 1$  with  $K=1,2,3,\dots$  (e.g. 5th,7th,11th,13th,17th,19th, etc.).

Harmonic current amplitude decreases when frequency increases. Harmonic current carries no active power; it is additional current carried by electrical cables. Typical effects are: conductor overload, power factor decrease and measurement systems instability. Voltage generated by current flowing in the transformer reactance may also damage other appliances or interfere with mains-synchronized switching equipment.





### Solving the problem

Harmonic current amplitude decreases when frequency increases; as a result, reducing high-amplitude components determines the filtering of low-frequency components. The better way is to increase low-frequency impedance by installing an inductance. Power drive systems with no mains-side inductance generate larger harmonic currents than power drives which do have an inductance.

The inductance may be installed both on AC-side, as a 3-phase inductance on the supply line, and on DC-side, as a single-phase inductance installed between the rectifier bridge and the capacitor bank inside the inverter. Even greater benefits are obtained if inductance is installed both on AC-side and on DC-side.

Unlike DC inductance, AC inductance filters also high-frequency components with greater efficiency.



**NOTE**

Connecting a DC-side inductance is possible only for certain models of Sinus K Lift inverters. For more details, please refer to the Applying the Inductance to the Inverter section.

### Harmonic currents

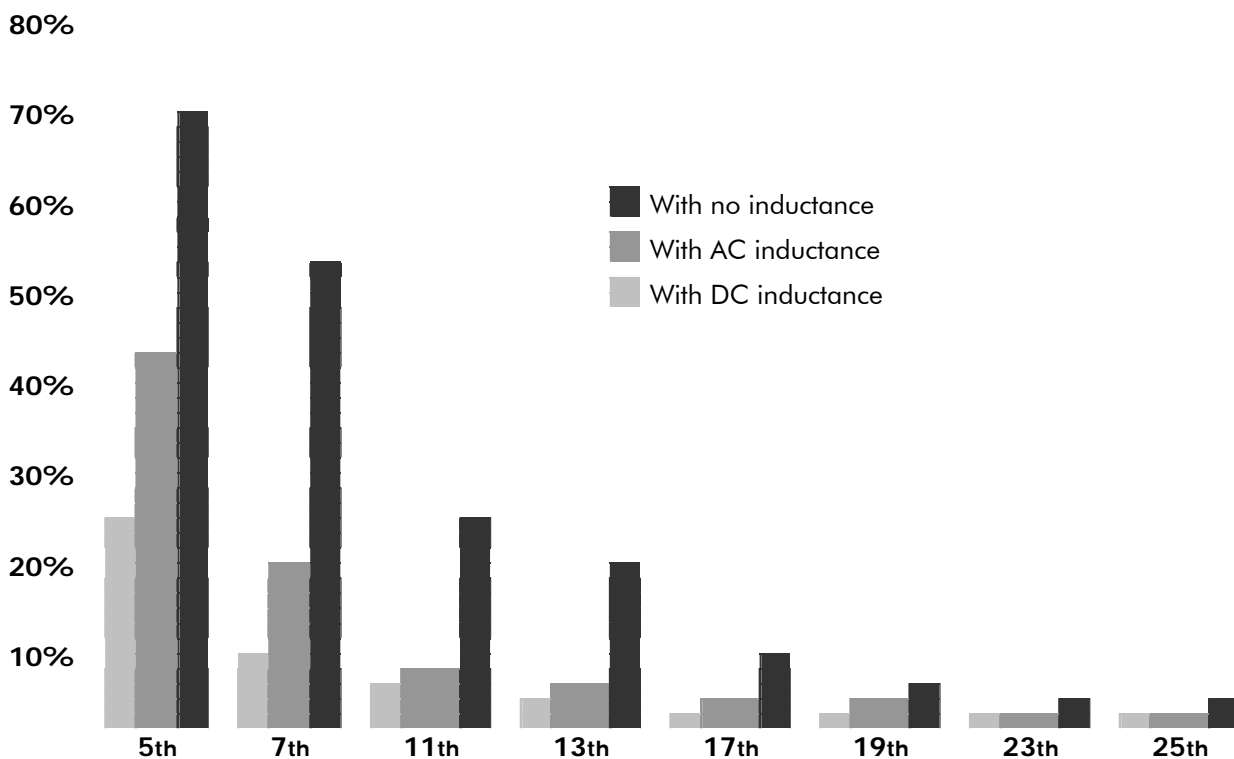


Figure 20: Amplitude of harmonic currents (approximate values)



**CAUTION**

Always use an input inductance under the following circumstances: mains instability; converters installed for DC motors; loads generating strong voltage variations at startup; power factor correction systems; mains rated power exceeding 500 KVA.



**NOTE**

The amplitude of harmonic currents and their distortion of the mains voltage is strongly affected by the features of the mains where the equipment is installed. The ratings stated in this manual fit most applications. For special applications, please contact Elettronica Santerno's After-sales service.

The ratings of optional inductance recommended based on the inverter size are detailed in section Applying the Inductance to the Inverters.

### 6.3.2. OUTPUT INDUCTANCE

Installations requiring a longer distance between the inverter and the motor may cause overcurrent protections to frequently trip. This is due to the wire parasite capacity generating current pulses at the inverter output. This current peak may be limited by an inductance installed on the inverter output. Screened cables even have a higher capacity and may have problems with a shorter length. The recommended output inductance is the same that can be installed at the inverter input. The max. distance between the motor and the inverter is given as an example, as parasite capacity is also affected by the type of wiring path and wiring system. For instance, when several inverters and their connected motors are networked, segregating the inverter wires from the motor wires will avoid capacitive couplings between the wiring of each motor. In that case, a reactance should be installed at the output of each inverter.

#### Motor wiring with unscreened cables

**2-4-6-pole MOTORS**

Size							
Up toS12							
Up toS20							
Cable Length	30	60	90	120	150	> 150	mt.

**8-10 pole MOTORS**

Size						
Up toS12						
Up toS20						
Cable Length	30	60	90	120	>120	mt.

No output inductance is required  
 Output inductance is required



**CAUTION**

Inductance stated in the tables above may be used when the inverter output frequency does not exceed 60 Hz. For a higher output frequency a special inductance for the max. allowable operating frequency must be used; please contact Elettronica Santerno S.p.A.



**NOTE**

When using > 10 - pole motors an output inductance is always required.



**NOTE**

When using parallel-connected motors, always consider the total length of the cables being used (sum of the cable length of each motor).



Motor wiring with screened cables

2-4-6-pole MOTORS

Size					
Up toS12					
Up toS20					
Cable Length	20	40	80	>80	mt.

8-10 pole MOTORS

Size					
Up toS12					
Up toS20					
Cable Length	20	40	60	80	> 80
					mt.

No output inductance is required  
 Output inductance is required



**CAUTION**

Inductance stated in the tables above may be used when the inverter output frequency does not exceed 60 Hz. For a higher output frequency a special inductance for the max. allowable operating frequency must be used; please contact Elettronica Santerno S.p.A.



**NOTE**

When using > 10 - pole motors an output inductance is always required.



**NOTE**

When using parallel-connected motors, always consider the total length of the cables being used (sum of the cable length of each motor).

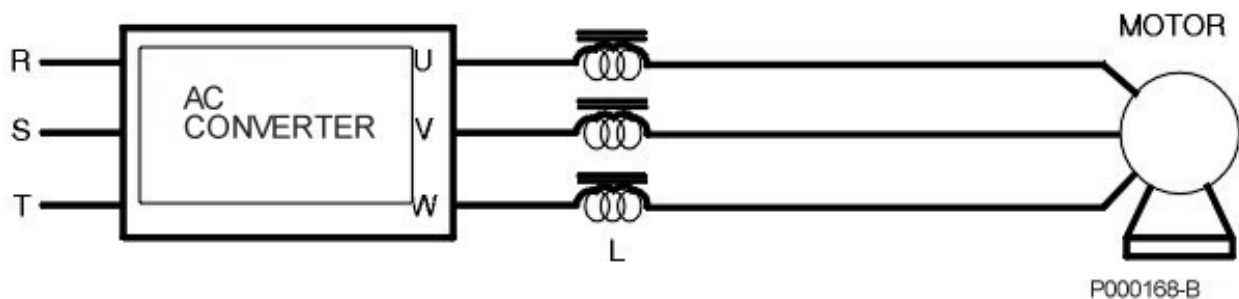


Figure 21: Connection of an output inductance.



### 6.3.3. APPLYING THE INDUCTANCE TO THE INVERTERS

#### 6.3.3.1. 2T CLASS – AC / DC INDUCTANCE

INVERTER SIZE	INVERTER MODEL	INPUT AC 3-PHASE INDUCTANCE	DC SINGLE-PHASE INDUCTANCE	OUTPUT INDUCTANCE
S05	0007	IM0126004 2.0mH–11Arms	IM0140054 8mH-10.5Arms/12.8Apeak	IM0126004 2.0mH–11Arms (AC 3 phase)
	0008	IM0126044 1.27mH–17Arms	IM0140104 5.1mH-17Arms/21Apeak	IM0126044 1.27mH–17Arms (AC 3 phase)
	0010			
	0015	IM0126084 0.7mH–32Arms	IM0140154 2,8mH– 32,5Arms/40,5Apeak	IM0126084 0.7mH–32Arms (AC 3 phase)
	0016			
0020				
S10	0016	IM0126084 0.7mH–32Arms	Not applicable	IM0126084 0.7mH–32Arms (AC 3 phase)
	0017			
	0020			
	0025	IM0126124 0.51mH – 43Arms	Not applicable	IM0126124 0.51mH–43Arms (AC 3 phase)
	0030			
0035				
S12	0023	IM0126124 0.51mH – 43Arms	IM0140204 2,0mH–47Arms/58,5 Apeak	IM0126124 0.51mH–43Arms (AC 3 phase)
	0033	IM0126144 0.3mH–68Arms	IM0140254 1,2mH–69Arms/87Apeak	IM0126144 0.32mH–68Arms (AC 3 phase)
	0037			
S15	0038	IM0126164 0.24mH–92Arms	Not applicable	IM0126164 0.24 mH–92Arms (AC 3 phase)
	0040			
	0049			
S20	0060	IM0126204 0.16mH–142Arms	IM0140304 0.64mH– 160Arms/195Apeak	IM0126204 0.16mH–142Arms (AC 3 phase)
	0067			
	0074			
	0086			

**PART 1**



**CAUTION**

Always use a 3-phase inductance under the following circumstances: mains instability; thyristor converters, loads generating strong voltage variations at startup; power factor correction systems; mains power exceeding 500 KVA.



**NOTA**

For size S20 inverters, you should state whether you intend to apply a DC inductance when ordering the equipment.

**6.3.3.2. 4T CLASS – AC / DC INDUCTANCE**

INVERTER SIZE	INVERTER MODEL	INPUT AC 3-PHASE INDUCTANCE	DC SINGLE-PHASE INDUCTANCE	OUTPUT INDUCTANCE
S05	0005	IM0126004 2.0mH–11Arms	Not applicable	IM0126004 2.0mH–11Arms (AC 3 phase)
	0007	IM0126044 1.27mH – 17Arms	Not applicable	IM0126044 1.27mH–17Arms (AC 3 phase)
	0009			
	0011			
	0014			
S10	0016	IM0126084 0.7mH–32Arms	Not applicable	IM0126084 0.7mH–32Arms (AC 3 phase)
	0017			
	0020			
	0025	IM0126124 0.51mH – 43Arms	Not applicable	IM0126124 0.51mH–43Arms (AC 3 phase)
	0030			
	0035			
S12	0016	IM0126084 0.7mH–32Arms	IM0140154 2,8mH– 32,5Arms/40,5Apeak	IM0126084 0.7mH–32Arms (AC 3 phase)
	0017			
	0020			
	0025	IM0126124 0.51mH – 43Arms	IM0140204 2,0mH–47Arms/58,5 Apeak	IM0126124 0.51mH–43Arms (AC 3 phase)
	0030			
	0034			
S15	0036	IM0126144 0.3mH–68Arms	IM0140254 1,2mH–69Arms/87Apeak	IM0126144 0.32mH–68Arms (AC 3 phase)
	0038			
	0040			
S20	0049	IM0126164 0.24mH–92Arms	Not applicable	IM0126164 0.24 mH–92Arms (AC 3 phase)
	0060			
	0067			
S20	0074	IM0126204 0.16mH–142Arms	IM0140304 0.64mH– 160Arms/195Apeak	IM0126204 0.16mH–142Arms (AC 3 phase)
	0086			



**CAUTION**

Always use a 3-phase inductance under the following circumstances: mains instability; thyristor converters, loads generating strong voltage variations at startup; power factor correction systems; mains power exceeding 500 KVA.



**NOTA**

For size S20 inverters, you should state whether you intend to apply a DC inductance when ordering the equipment.



6.3.3.3. 3-PHASE INDUCTANCE RATINGS

INDUCTANCE MODEL	INDUCTANCE TYPE	INDUCTANCE RATINGS		DIMENSIONS							HOLE TYPE	WGT L	LEAKAGE H
		mH	A	TYPE	L	H			mH	A			
IM0126004	AC 3-PHASE	2.0	11	A	120	125	75	25	67	55	5	2.9	29
IM0126044	AC 3-PHASE	1.27	17	A	120	125	75	25	67	55	5	3	48
IM0126084	AC 3-PHASE	0.70	32	B	150	130	115	50	125	75	7x14	5.5	70
IM0126124	AC 3-PHASE	0.51	43	B	150	130	115	50	125	75	7x14	6	96
IM0126144	AC 3-PHASE	0,3	68	B	180	160	150	60	150	82	7x14	9	150
IM0126164	AC 3-PHASE	0.24	92	B	180	160	150	60	150	82	7x14	9.5	183
IM0126204	AC 3-PHASE	0.16	142	B	240	210	175	80	200	107	7x14	17	272

**PART 1**

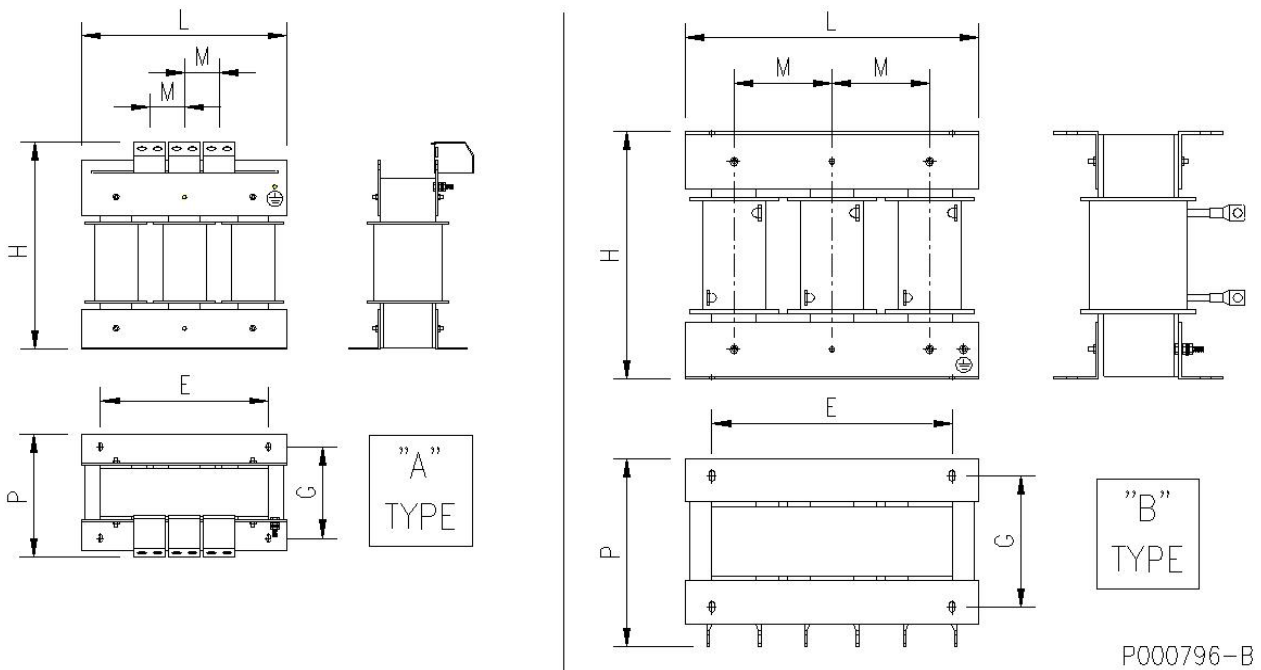


Figure 22: Mechanical features of an AC 3-phase inductance.

## 6.4. ES836/2 Encoder Board

Board for incremental, bidirectional encoder to be used as a speed feedback for inverters of the SINUS series. It allows the acquisition of encoders with power supply ranging from 5 to 15VDC (adjustable output voltage) with complementary outputs (line driver, push-pull, TTL outputs). It can also be connected to 24VDC encoders with both complementary and single-ended push-pull or PNP/NPN outputs.

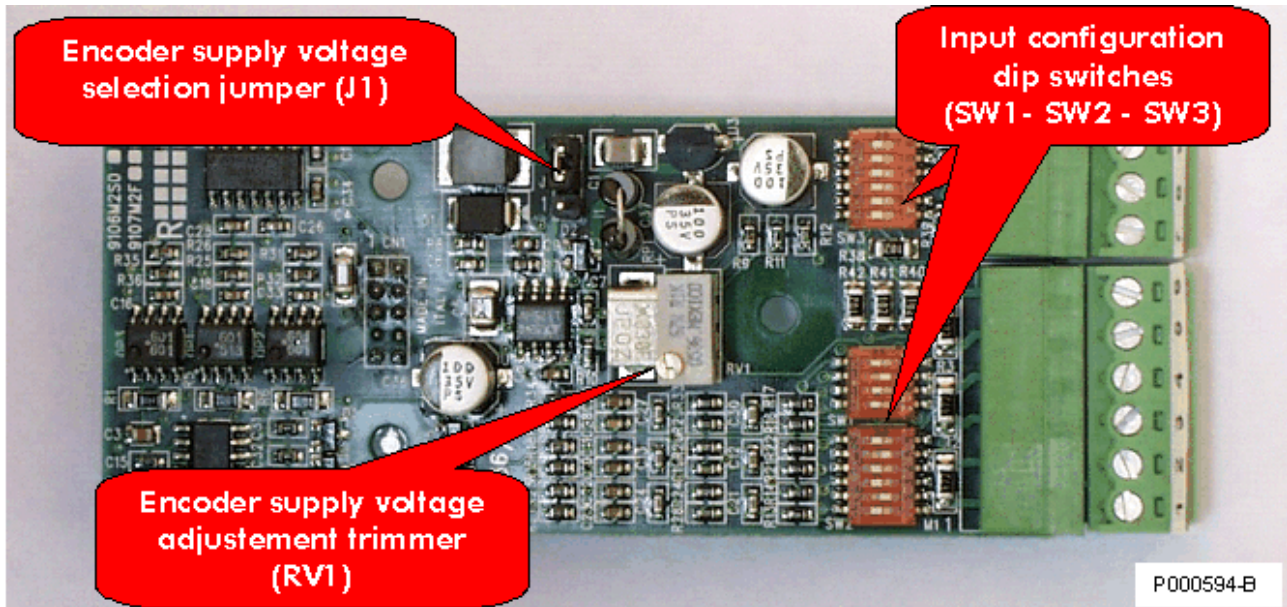


Figure 23: ES836/2 Encoder board.

DESCRIPTION	CODE	COMPATIBLE ENCODERS	
		POWER SUPPLY	OUTPUT
Encoder board ES836/2	ZZ009583 4	5VDC to 15VDC, 24VDC	Complementary LINE DRIVER, NPN, PNP, PUSH-PULL outputs and single-ended NPN, PNP, PUSH-PULL outputs

### 6.4.1. ENVIRONMENTAL REQUIREMENTS

Operating temperature	0 to + 50° C ambient temperature (contact Elettronica Santerno for higher ambient temperatures)
Relative humidity	5 to 95% (non condensing)
Max. operating altitude	4000 m (a.s.l.)



## 6.4.2. ELECTRICAL SPECIFICATIONS

<i>Electrical Specifications</i>	<i>Ratings</i>			
	<i>Min.</i>	<i>Type</i>	<i>Max.</i>	<i>Unit</i>
Encoder supply current, + 24 V, protected with resettable fuse			200	mA
Electronically protected encoder supply current, +12V			350	mA
Electronically protected encoder supply current, +5V			900	mA
Adjustment range for encoder supply voltage (5V mode)	4.4	5.0	7.3	V
Adjustment range for encoder supply voltage (12V mode)	10.3	12.0	17.3	V
Input channels	Three channels: A, B, and zero notch Z			
Type of input signals	Complementary or single-ended			
Voltage range for encoder input signals	4		24	V
Pulse max. frequency with noise filter "on"	77kHz (1024pls @ 4500rpm )			
Pulse max. frequency with noise filter "off"	155kHz (1024pls @ 9000rpm)			
Input impedance in NPN or PNP mode (external pull-up or pull-down resistors required)		15k		$\Omega$
Input impedance in push-pull or PNP and NPN mode when internal load resistors (at max. frequency) are connected		3600		$\Omega$
Input impedance in line-driver mode or complementary push-pull signals with internal load resistors activated via SW3 (at max. frequency)		780		$\Omega$

### INSULATION:

The encoder supply line and inputs are galvanically insulated from the inverter control board grounding for a 500 VAC test voltage for 1 minute. Encoder supply grounding is in common with control board digital inputs available in the terminal board.

### 6.4.3. INSTALLING THE ENCODER BOARD ON THE INVERTER

- 1) Remove voltage from the inverter and wait at least 5 minutes.
- 2) Remove the cover allowing gaining access to the inverter control terminals. The fixing spacers and the signal connector are located on the left.

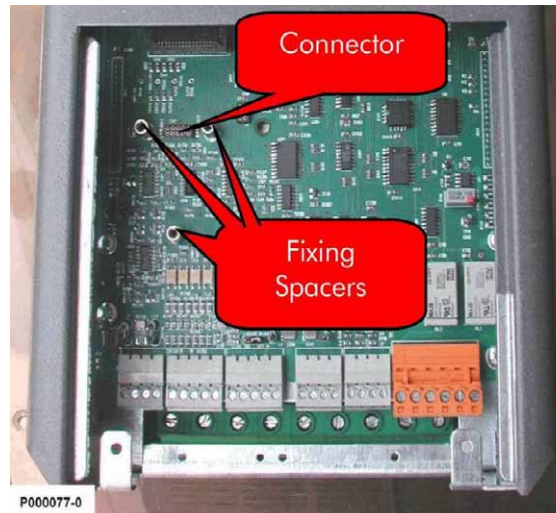


Figure 24: Position of the slot for the installation of the encoder board.

- 3) Fit the encoder board and make sure that all contacts enter the relevant housings in the signal connector. Fasten the encoder board to the metal columns using the screws supplied.
- 4) Configure the dip-switch and the jumper located on the encoder board based on the type of encoder being used. Check if the supply voltage in the terminal board output is correct.
- 5) Turn on the inverter and set the parameters relating to the encoder feedback (see Part 2, Programming Instructions).



Figure 25: Encoder board fastened to its slot.

### 6.4.4. ENCODER BOARD TERMINALS

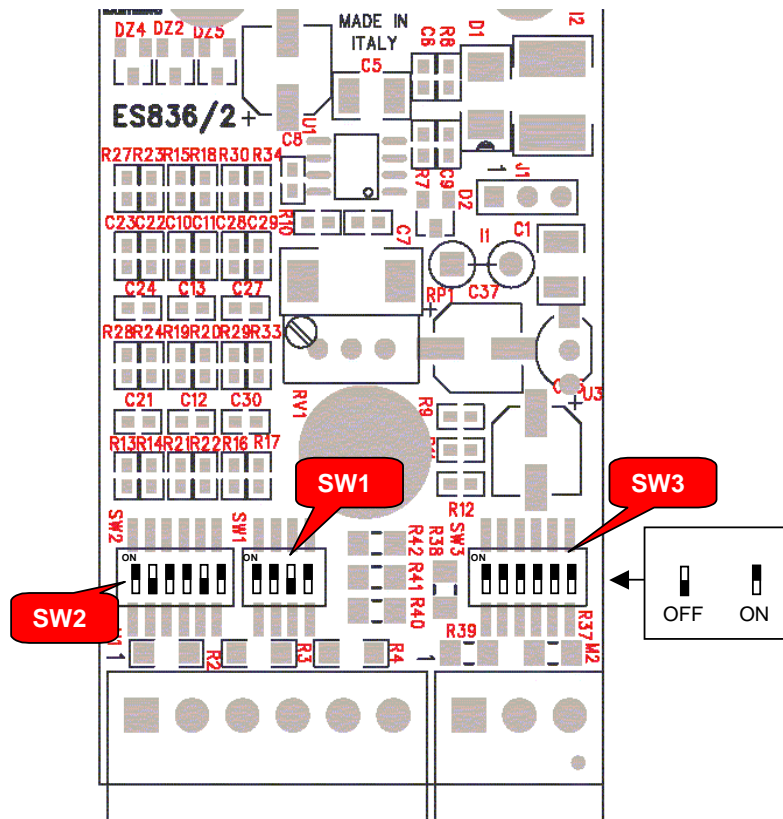
A 9-pole terminal block is located on the front part of ES836/2 board for the encoder connection.

Terminal board, 3.81 mm pitch in two separate extractable sections (6-pole and 3-pole sections)		
Terminal	Signal	Type and Features
1	CHA	Encoder input channel A true polarity
2	$\overline{\text{CHA}}$	Encoder input channel A inverse polarity
3	CHB	Encoder input channel B true polarity
4	$\overline{\text{CHB}}$	Encoder input channel B inverse polarity
5	CHZ	Encoder input channel Z (zero notch) true polarity
6	$\overline{\text{CHZ}}$	Encoder input channel Z (zero notch) inverse polarity
7	+VE	Encoder supply output 5V...15V or 24V
8	GNDE	Encoder supply ground
9	GNDE	Encoder supply ground

For the encoder connection to the encoder board, see wiring diagrams on the following pages.

### 6.4.5. CONFIGURATION DIP-SWITCHES

ES836/2 Encoder board is provided with two dip-switch banks to be set up depending on the type of connected encoder. The dip-switches are located in the front left corner of ES836/2 and are adjusted as shown in the Figure 26.



P000589-B

Figure 26: Positions and default settings of the configuration dip-switches.



Dip-switch functionality and factory-settings are detailed in the table below.

Switch (factory- setting)	OFF - open	ON - closed
SW2.1 (on)	Channel B, type NPN or PNP	Channel B, type Line driver or Push-Pull
SW2.2 (off)	Channel B with complementary signals	Channel B with only one single-ended signal
SW2.3 (on)	Channel B with no band limit	Channel B with band limit
SW2.4 (on)	Channel Z, type NPN or PNP	Channel Z, type Line driver or Push-Pull
SW2.5 (off)	Channel Z with complementary signals	Channel Z with only one single-ended signal
SW2.6 (on)	Channel Z with no band limit	Channel Z with band limit
SW1.1 (on)	12V Supply voltage (J1 in pos. 2-3)	5V Supply Voltage (J1 in pos. 2-3)
SW1.2 (on)	Channel A, type NPN or PNP	Channel A, type Line driver or Push-Pull
SW1.3 (off)	Channel A with complementary signals	Channel A with only one single-ended signal
SW1.4 (on)	Channel A with no band limit	Channel A with band limit
SW3.1 (on)	Load resistors disabled	Load resistors towards ground enabled for all encoder signals (required for 5V Line driver or Push-pull encoders, especially if long cables are used).
SW3.2 (on)		
SW3.3 (on)		
SW3.4 (on)		
SW3.5 (on)		
SW3.6 (on)		



**CAUTION**

Put SW3 contacts to ON only if a complementary Push-pull or Line-driver encoder is used (power supply: 5V or 12V). Otherwise, put SW3 contacts to OFF.



**NOTE**

Put ALL contacts in dip-switch SW3 to ON or OFF. Different configurations may cause the malfunctioning of the encoder board.

### 6.4.6. JUMPER FOR ENCODER SUPPLY

Two-position jumper J1 installed on ES836/2 allows setting the encoder supply voltage. It is factory-set based on the encoder board version. Set J1 to position 1-2 to select non-tuned, 24V encoder supply voltage. Set J1 to position 2-3 to select tuned, 5/12V encoder supply voltage. Supply values of 5V or 12V are to be set through SW1.1 dip-switch (see table above).

### 6.4.7. TUNING TRIMMER

“RV1” trimmer installed on ES836/2 allows adjusting the encoder supply voltage. This can be useful for encoders with intermediate voltage values if compared with factory-set voltage and can compensate voltage drops in case of a long distance between the encoder and the encoder board.

Adjustment procedure:

- Put a tester on the encoder supply connector (encoder side of the connecting cable); make sure that the encoder is on.
- Rotate the trimmer clockwise to increase supply voltage. The trimmer is factory-reset to obtain 5V and 12V voltage (depending on the dip-switch setting) in supply terminals. 5V configuration: power supply can range from 4.4V to 7.3V; 12V configuration: power supply can range from 10.3V to 17.3V.



**NOTE**

Output voltage cannot be adjusted by RV1 trimmer (jumper J1 in pos. 1-2) for 24V power supply.



**CAUTION**

Power supply values exceeding the encoder ratings may damage the encoder. Always use a tester to check voltage delivered from ES836 board before wiring.



**CAUTION**

Do not use the encoder supply output to power other devices. Failure to do so would increase the hazard of control interference and short-circuits and might cause an uncontrolled motor operation due to the lack of feedback.



**CAUTION**

The encoder supply output is isolated from the common terminal of the analog signals incoming to the terminals of the control board (CMA). Do not link the two common terminals together.

### 6.4.8. ENCODER WIRING AND CONFIGURATION EXAMPLES

The figures below illustrate the electrical schematics and the dip-switch setup for the most popular encoder models.



**CAUTION**

A wrong encoder-board connection may damage both the encoder and the board.



**NOTE**

In all the figures below, dip-switches SW1.4, SW2.3, SW2.6 are set to ON, i.e. 77 kHz band limit is on. If a connected encoder requires a higher output frequency, set dip-switches to OFF.



**NOTE**

The max. length of the encoder wire depends on the encoder outputs, not on ES836 encoder board. See encoder ratings.



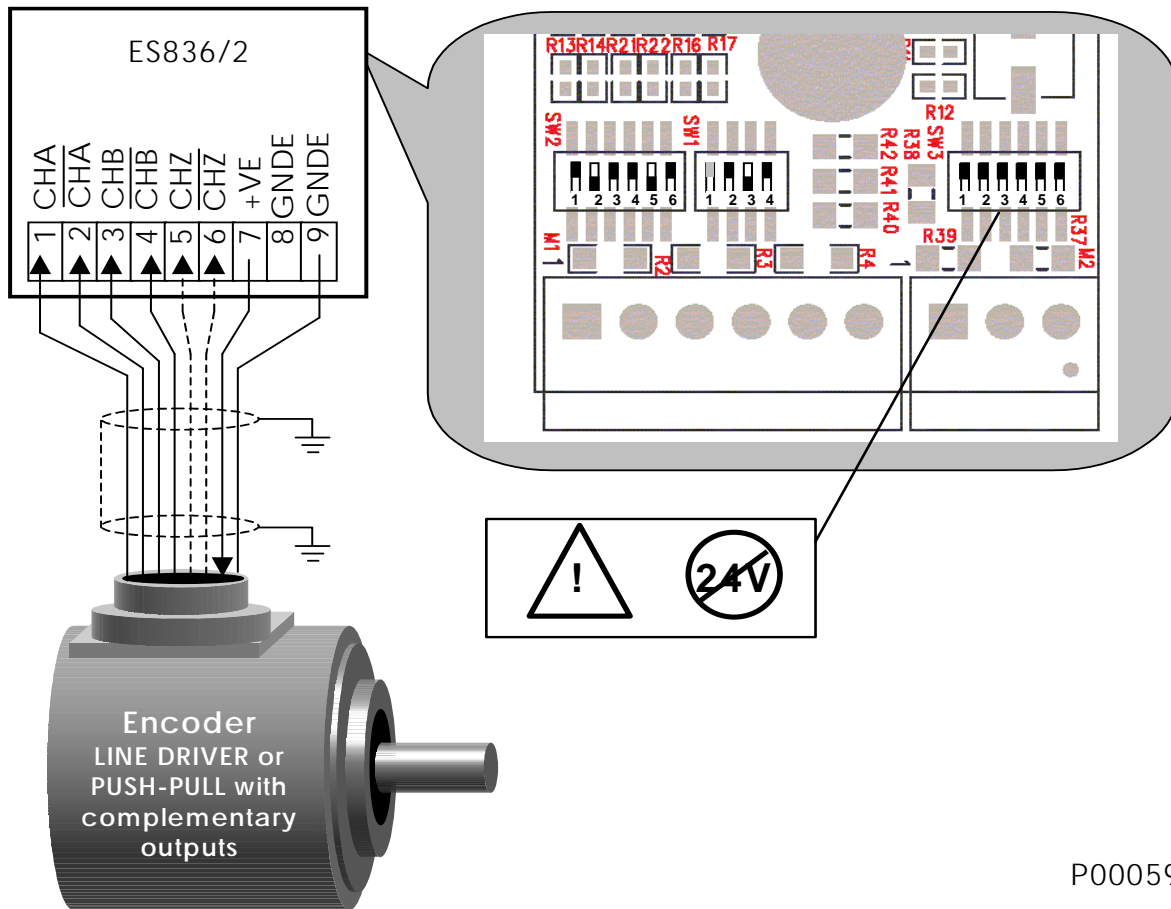
**NOTE**

SW1.1 dip-switch is not shown in the figures below because its setting depends on the supply voltage required by the encoder. Please refer to the dip-switch setting table to set SW1.1.



**NOTE**

Zero notch connection is optional and is required only for particular software applications. However, for those applications that do not require any zero notch, its connection does not affect the inverter operation. See Part 2, Programming Instructions for details.



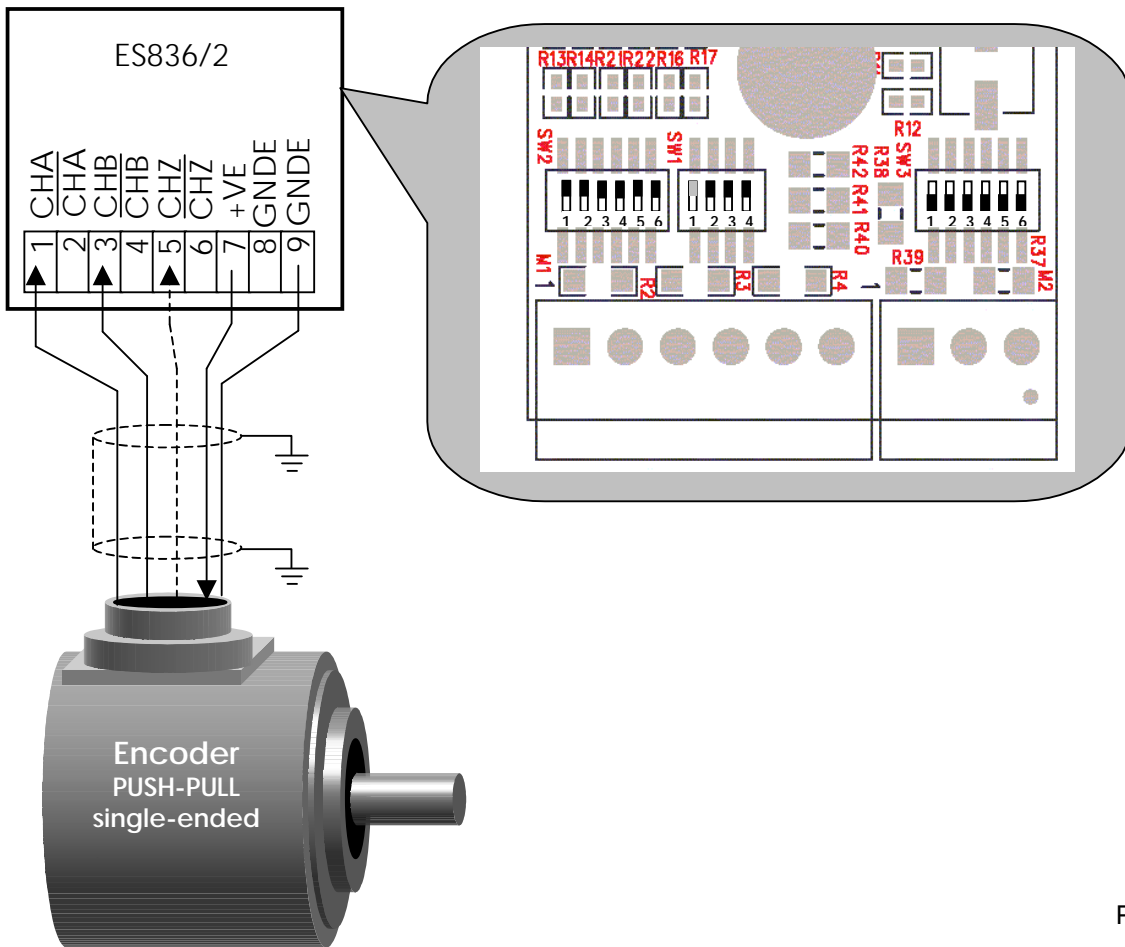
P000590-B

Figure 27: LINE DRIVER or PUSH-PULL encoder with complementary outputs.



**CAUTION**

Put SW3 contacts to ON only if a complementary Push-pull or Line driver encoder is used (power supply: 5V or 12V). If a 24V push-pull encoder is used, put contacts to OFF.



P000591-B

Figure 28: PUSH-PULL encoder with single-ended outputs.



**CAUTION**

Because settings required for a single-ended encoder deliver a reference voltage to terminals 2, 4, 6, the latter are not to be connected. Failures will occur if terminals 2, 4, 6 are connected to encoder conductors or to other conductors.



**NOTE**

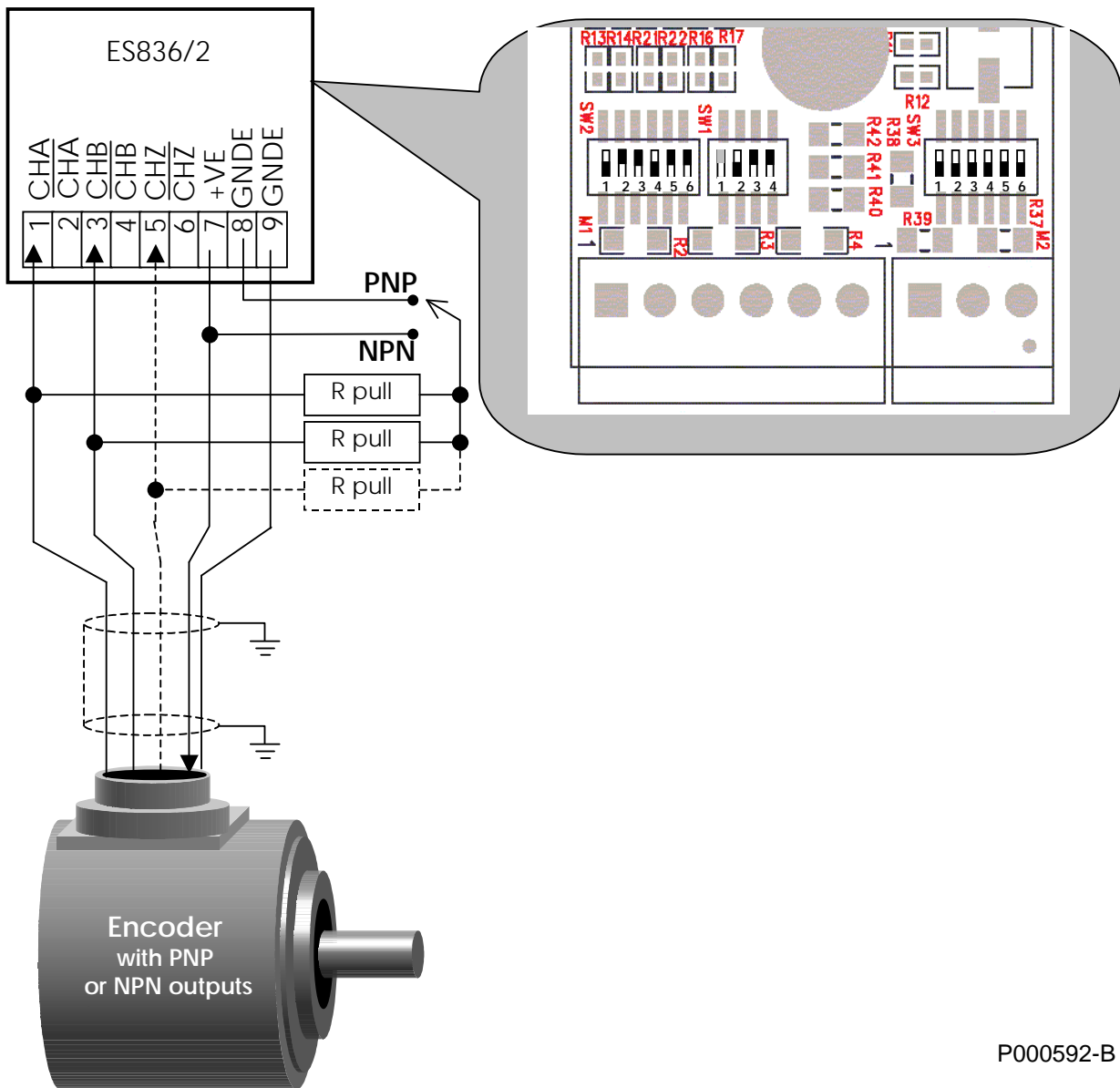
Only push-pull, single-ended encoders may be used, with an output voltage equal to the supply voltage. Only differential encoders may be connected if their output voltage is lower than the supply voltage.



**NOTE**

Some manufacturers use the acronym HTL for push-pull outputs with power supply ranging from 18Vdc to 30Vdc. For the acquisition of this type of encoder, the same configuration used for push-pull inverters shall be used for the encoder board.





P000592-B

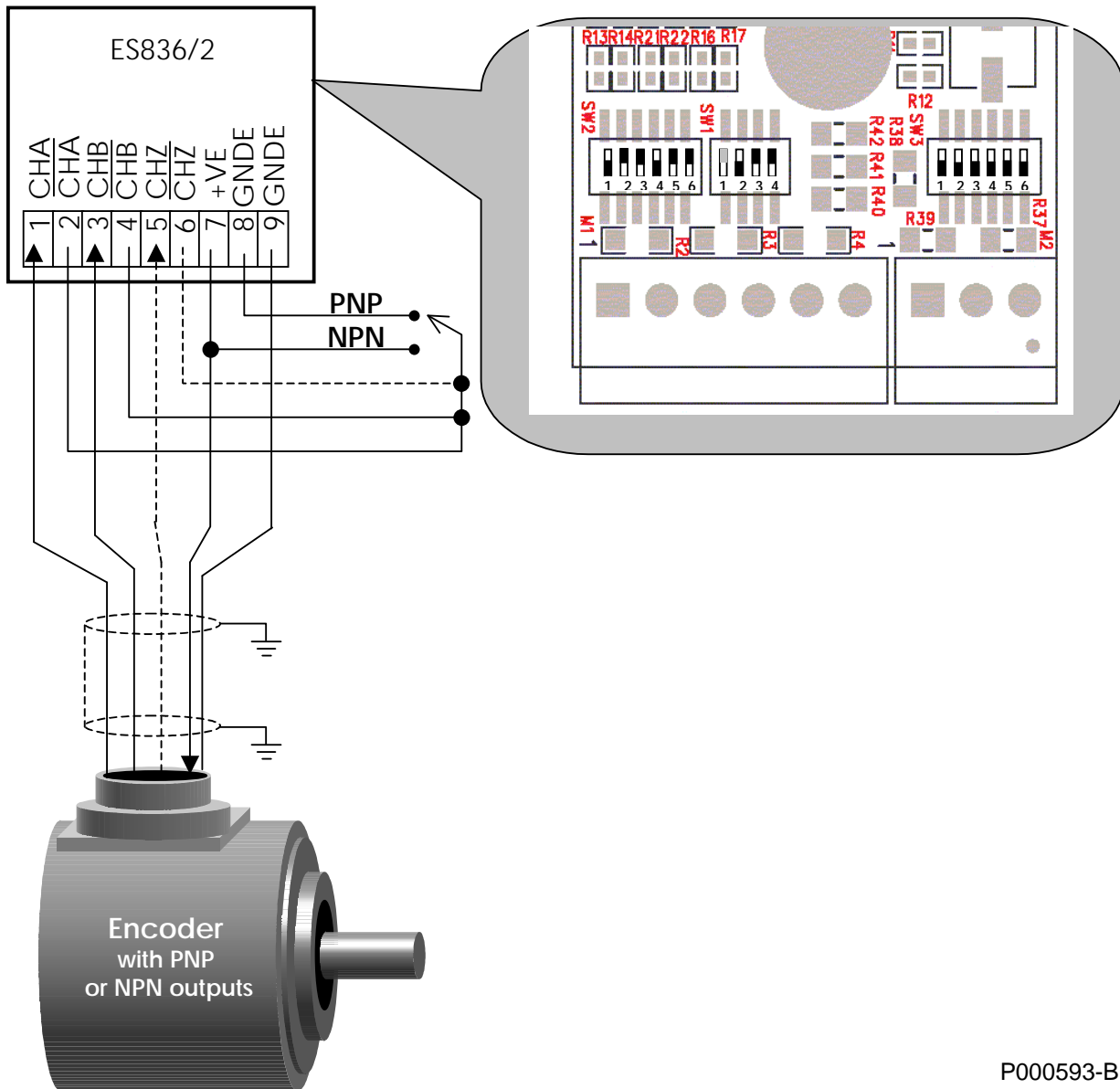
Figure 29: PNP or NPN encoder with single-ended outputs and load resistors with external wiring.



**NOTE**

NPN or PNP encoder outputs require a pull-up or pull-down resistive load to the supply or to the common. As load resistor ratings are defined by the manufacturer of the encoder, external wiring is required, as shown in the figure above. Connect the resistor common to the supply line for NPN encoder supply or to the common for PNP encoders.





P000593-B

Figure 30: PNP or NPN encoder with single-ended outputs and internal load resistors.



**NOTE**

Incorporated load resistors may be used only if NPN or PNP encoders are compatible with external pull-up or pull-down resistors (4.7kΩ).



**NOTE**

NPN or PNP encoders cause pulse distortions due to a difference in ramp up and ramp down edges. Distortion depends on the load resistor ratings and the wire stray capacitance. PNP or NPN encoders should not be used for applications with an encoder output frequency exceeding a few kHz dozens. For such applications, use encoders with Push-Pull outputs, or better with a differential line-driver output.

### 6.4.9. WIRING THE ENCODER CABLE

Use a screened cable to connect the encoder to the board. Screening should be grounded to both ends of the cable. Use the special clamp supplied to fasten the encoder wire and ground the cable screening to the inverter.



**Figure 31: Wiring the encoder cable.**

Do not stretch the encoder wire along with the motor supply cable.  
Connect the encoder directly to the inverter using a cable with no intermediate devices, such as terminals or return connectors.

Use a model of encoder suitable for your application (as for connection length and max. rev number).  
Preferably use encoder models with complementary LINE-DRIVER or PUSH-PULL outputs. Non-complementary PUSH-PULL, PNP or NPN open-collector outputs offer a lower immunity to noise.  
The encoder electrical noise occurs as difficult speed adjustment or uneven operation of the inverter; in the worst cases, it can lead to the inverter stop due to overcurrent conditions.

## 6.5 EU850 AUXILIARY UNIT FOR EMERGENCY POWER SUPPLY

EU850 unit is a device designed for powering SINUS K LIFT inverters in case of mains failure. In particular, EU850 is capable of operating the cage lift—connected to a SINUS K LIFT inverter—at reduced power, thus allowing the lift cage to reach the nearest floor when a black-out occurs.

EU850 unit is powered from a lead battery with voltage ratings ranging from 48Vdc to 70Vdc and can deliver 850W to the DC voltage input (600Vdc) of a Sinus K Lift inverter for 2 minutes (operating mode for 4T class Sinus K Lift inverters).

EU850 can also be configured to deliver 350Vdc voltage when power is reduced to 600W (operating mode for 2T class Sinus K Lift inverters).

When it does not operate as a power supply unit, EU850 is used for battery recharging.

Max. four EU850 units can be parallel-connected to deliver up to 3.4kW (for 4T class Sinus K Lift inverters).

More details are given in the User Manual for EU850.



P000790-0

Figure 32: EU850 unit from terminals-side.



P000794-B

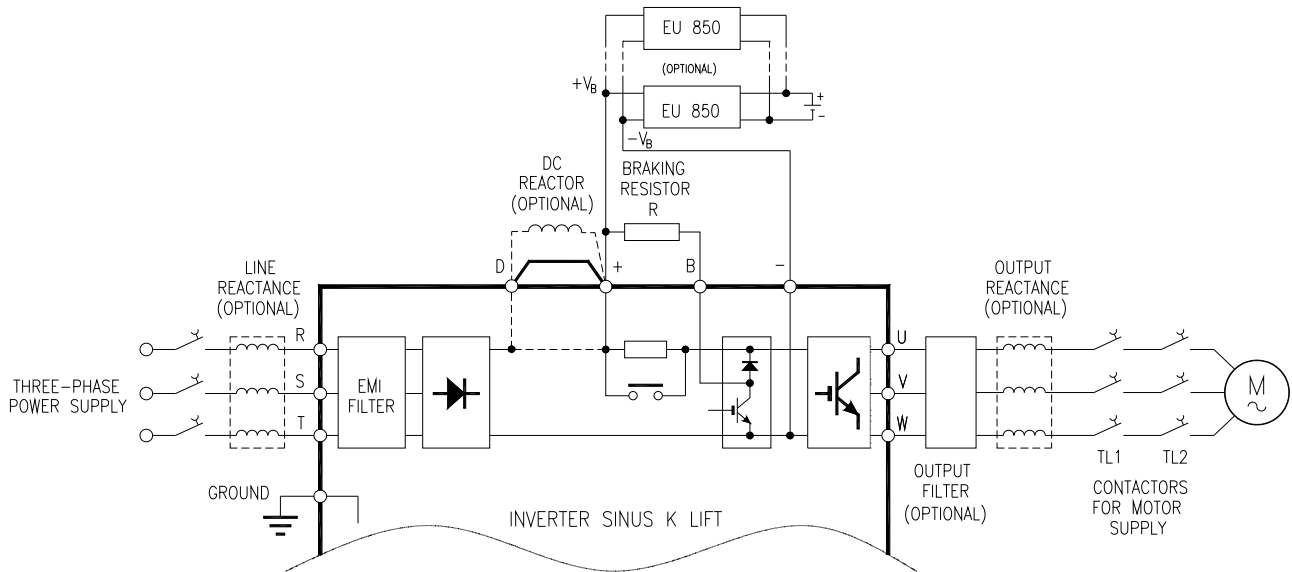


Figure 33: Wiring diagram for EU850 unit.

**PART 2**  
**-Programming Instructions-**

## 7. PROGRAMMABLE FUNCTIONS

### 7.1. USING THE TRANSDUCER (ENCODER)

The inverters of the SINUS LIFT series may operate either with or without a transducer (ENCODER). A transducer is recommended when the cage speed exceeds 1.2 m/sec. In that case, ES836 optional control board must be installed. See section ES836/2 Encoder Board for the description of the control board.

The number of pulse/rev may range from 100 to 10,000, but the max. input allowable frequency (150 kHz) must never be exceeded. The signal frequency of the encoder is calculated as follows:  $f_{max} = (\text{pulse/rev} * n_{max}) / 60$  e.g.  $f_{max} = (1024\text{pls/rev} * 3000\text{rpm}) / 60 = 51,200 \text{ Hz}$

After installing the ENCODER, program parameters C22 ENCODER and C23 ENCODER PULSES and adjust speed regulator parameters when required (see the Speed Loop Menu P5x – P5x). The speed regulator is used for the frequency reference compensation.



**NOTE**

Change parameter C22 ENCODER programming from NO to YES to alter the cage speed, acceleration and jerk. First define the operating mode, then enter speed values and acceleration values.

Figure 34 shows a block diagram for the speed regulator. The diagram demonstrates that a speed transducer ensures a high accuracy for the cage speed, because the required speed is compared to the real speed and the speed correction—if any—is sent to the frequency reference.

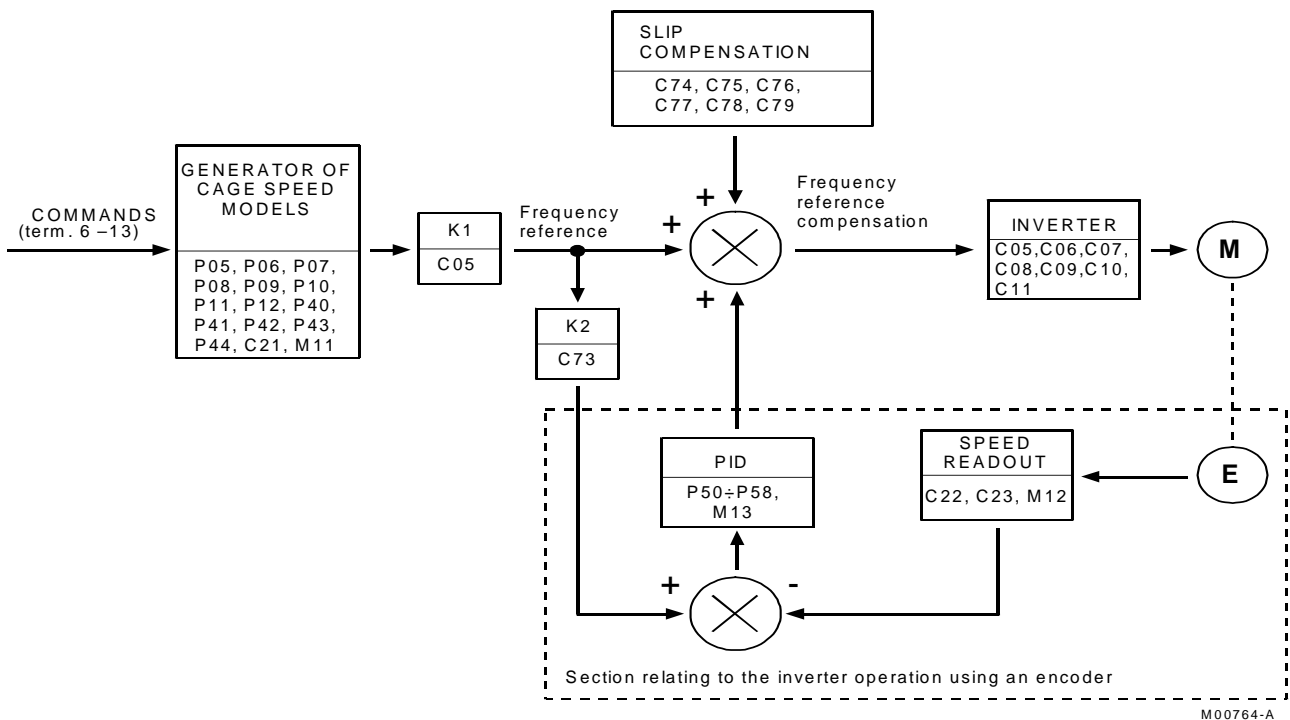


Figure 34: Block diagram of the speed regulator.

## 7.2. COMMERCIAL SPEED

SINUS LIFT inverters allow using two different values of commercial speed:

- high speed or contractual speed (parameter P41, which is factory-set to 100% of the rated speed)
- low speed, factory-set to 67% of the rated speed if no speed transducer is used, or factory-set to 32% if a speed transducer is used.

Default values may be altered where required.



### NOTE

This section details the conditions when both speed values are recommended or required.

Commercial speed to be used depends not only on traffic demand, but is also affected by the stroke length and the selected acceleration and jerk values. One commercial value only is not sufficient for several interfloors or proper speed, acceleration and jerk values, even with constant interfloor distance.

A single speed may be used if the commercial speed is low enough, the distance between the floors is constant and acceleration and jerk values are properly chosen.

Following is a series of example applications, where acceleration and jerk values are factory-set for the inverter operation with no speed transducer: 0.6 m/sec<sup>2</sup> and 0.6 m/sec<sup>3</sup>. These speed values are the most suitable for stop distance optimisation.

Note that choosing one or two commercial speed values depends on the commercial speed, the distance between two contiguous floors, and the minimum start and stop distance. Long strokes between two distant floors are not affected by those factors.

For symmetry, the start distance value is equal to the stop distance value. The start distance value is the distance that the cage covers from startup to commercial speed. The stop distance is the distance covered by the cage from slowing down to stop, following the slowing-down pattern.

It is now possible to check the minimum distance the cage can cover for different commercial speed values. The minimum distance is the sum of the start and stop distance; this occurs when the commercial speed is reached but is not maintained because the cage begins slowing down.

The following examples show how to determine the min. distance for different commercial speed values:

$$V_c = 1.2 \text{ m/sec. (P41} = 100\%, \text{ P44} = 1.2 \text{ m/s)}$$

Parameter M24 indicates the expected stop distance:  $D_a = 1.8 \text{ m}$

Supposing to use an approach speed of 0.15 m and increasing the overall stop distance by 10%, the min. distance value ( $D_{min}$ ) is obtained:

$$D_{min} = 1.8 + (1.8 + 0.15) \times 1.1 = 3.95 \text{ m}$$

Similarly, the following values are obtained:

$V_c = 1.0 \text{ m/sec.}$	$D_{min} = 1.34 + (1.34 + 0.15) \times 1.1 = 2.98 \text{ m}$
$V_c = 0.8 \text{ m/sec.}$	$D_{min} = 0.94 + (0.94 + 0.15) \times 1.1 = 2.14 \text{ m}$
$V_c = 0.6 \text{ m/sec.}$	$D_{min} = 0.60 + (0.60 + 0.15) \times 1.1 = 1.43 \text{ m}$

The examples above show that if the min. distance must not exceed the distance between two contiguous floors, in case of constant interfloor distance only one commercial speed under 1.0 m/sec may be used for an interfloor distance over 3.0 m.





By contrast, using 1.2 m/sec commercial speed with a constant interfloor distance ranging from 2.8 m to 3.3 m, two speed values are required, i.e. high speed for strokes between non-contiguous floors and low speed for strokes between contiguous floors (E.g.  $V_c = 1.2$  m/sec  $V_b = 0.8$  m/sec).

Using two different speed values is required for different interfloors.

Set parameter C21 as "Double" or "Double A" to enable both commercial speed values.

If both speed values cannot be used—e.g. they cannot be managed by the lift control panel—the inverter will respond to the slowing-down signal it receives before reaching the preset speed value, without changing acceleration or jerk values, i.e. without altering those parameters affecting lift comfort.

In a plant with a constant interfloor distance equal to 3.0 m, with  $V_c = 1.2$  m/sec and a slowing-down signal set at 2.15 m from the stop point, if the lift is called from a contiguous floor, the lift cage will be sent the slowing-down signal after covering a distance of 0.85m from the start point, before reaching the preset speed value.

In that case, the cage will slow down without reaching the preset speed and will stop to respond to the call.

The stop distance must be higher than the previous distance, because the lift cage will cover a distance with a decreasing acceleration but with an increasing speed before slowing-down in order not to alter acceleration and jerk values.

If the slowing-down signal may be sent anywhere in the starting pattern, so even at the end of a constant acceleration stage, the expected stop distance will be increased by the following:

$$S_0 = \frac{VA}{J} - \left( \frac{1}{6} \cdot \frac{A^3}{J^2} \right)$$

where A = acceleration, J = jerk, and V = speed.

In the example above, if  $S_0$  is 1.1 m, the slowing-down expected distance from the stop point must be equal to:  $1.8 + 1.1 = 2.9$  m.

This allows adopting either solutions depending on the logic of the control panel.

When the slowing down signal is acquired during the acceleration stage, the speed model may be adjusted by changing the jerk value when switching from acceleration to slowing-down (parameter P12) and by setting a delay time for the slowing-down signal acquisition (while accelerating only, parameter C63).



### 7.3. OPERATION BASED ON THE SELECTED SPEED PATTERN (C21)

#### 7.3.1. "SINGLE" SPEED OPERATING MODE

Parameter C21 (Operation Method Menu C1x - C2x):

**Standard Speed**

Parameter value:

**Single**

In Single Speed operating mode, **Normal** operation and **Maintenance** operation are separate (no common input contact). In **Normal** operating mode, two contacts select the lift cage running direction and a third contact selects the lift cage speed between the contractual speed and the approach speed (P41 and P40 respectively). In **Maintenance** operating mode, the running direction of the lift cage is determined by two additional contacts and the lift cage speed is the maintenance speed (P43).

A separate contact selects Normal/Maintenance operation.

The table below shows the operation of the digital inputs in **Single** speed operating mode.

MAN/NORMAL Term.10	FWD Term.7	REV Term.11	CONT/ACC Term.9	FWD_MAN Term.12	REV_MAN Term.13	
0 (Normal operation)	0	0				Stop
	1	1				
	1	0	0			Upstroke at approach speed (P40)
	1	0	1			Upstroke at contractual speed (P41)
	0	1	0			Downstroke at approach speed (P40)
	0	1	1			Downstroke at contractual speed (P41)
1 (Maintenance operation)				0	0	Stop
				1	1	
				1	0	Mainten. speed upstroke (P43)
				0	1	Mainten. speed downstroke (P43)



Any position

PART 2

### 7.3.2. "DOUBLE" SPEED OPERATING MODE

Parameter C21 (Operation Method Menu):

**Standard Speed**

Parameter value:

**Double**

Operating mode at two speed values plus approach speed value. **Normal** operation and **Maintenance** operation are separate (no common input contact). In **Normal** operation, two contacts select the cage speed and the cage stop (selectable speed values: P40 Approach Speed; P41 Contractual Speed; P42 Low Speed) and a contact (Up/Down) selects the running direction of the lift cage. In **Maintenance** operation, only one cage speed is available (P43) and two contacts determine the running direction of the lift cage. A separate contact selects Normal/Maintenance operation.

The table below shows the operation of the digital inputs in **Double** speed operating mode.

MAN/NORMAL Term.10	SEL_0 Term.7	SEL_1 Term.9	Up/Down Term.11	FWD_MAN Term.12	REV_MAN Term.13	
0 (Normal operation)	0	0				Stop
	1	0	0 (Up)			Upstroke at approach speed (P40)
	0	1				Upstroke at low speed (P42)
	1	1				Upstroke at contractual speed (P41)
	1	0	1 (Down)			Downstroke at approach speed (P40)
	0	1				Downstroke at low speed (P42)
	1	1				Downstroke at contractual speed (P41)
1 (Maintenance operation)				0	0	Stop
				1	1	
				1	0	Upstroke at Maintenance speed (P43)
				0	1	Downstroke at Maintenance speed (P43)



Any position

### 7.3.3. "DOUBLE A" SPEED OPERATING MODE

Parameter C21 (Operation Method Menu):

**Standard Speed**

Parameter value:

**Double A**

Operating mode at two speed values plus approach speed value. Each running direction is selected by a dedicated input. The "Upstroke" input enables the lift cage upstroke at a speed selected by a combination of other inputs; the "Downstroke" input enables the lift cage downstroke at a speed selected by a different combination of the same inputs.

**Normal** operation and **Maintenance** operation are no longer separate. One input is used to select one of the two operating modes, whereas the inputs for the selection of maintenance upstroke and maintenance downstroke in *Single* and *Double* speed modes, in *Double A* mode enable the cage upstroke and downstroke in **Normal** operation as well.

The table below shows the operation of the digital inputs in **Double A** speed operating mode.

MAN/NORMAL Term.10	FWD Term.12	REV Term.13	SEL_0 Term.7	SEL_1 Term.9	
0 (Normal operation)	0	0			Stop
	1	1			
	1	0	0	0	Upstroke at approach speed (P40)
			1	0	Upstroke at contractual speed (P41)
			0	1	Upstroke at low speed (P42)
			1	1	No active reference
	0	1	0	0	Downstroke at approach speed (P40)
			1	0	Downstroke at contractual speed (P41)
			0	1	Downstroke at low speed (P42)
			1	1	No active reference
1 (Maintenance operation)	0	0			Stop
	1	1			
	1	0			Upstroke at Maintenance speed (P43)
	0	1			Downstroke at Maintenance speed (P43)

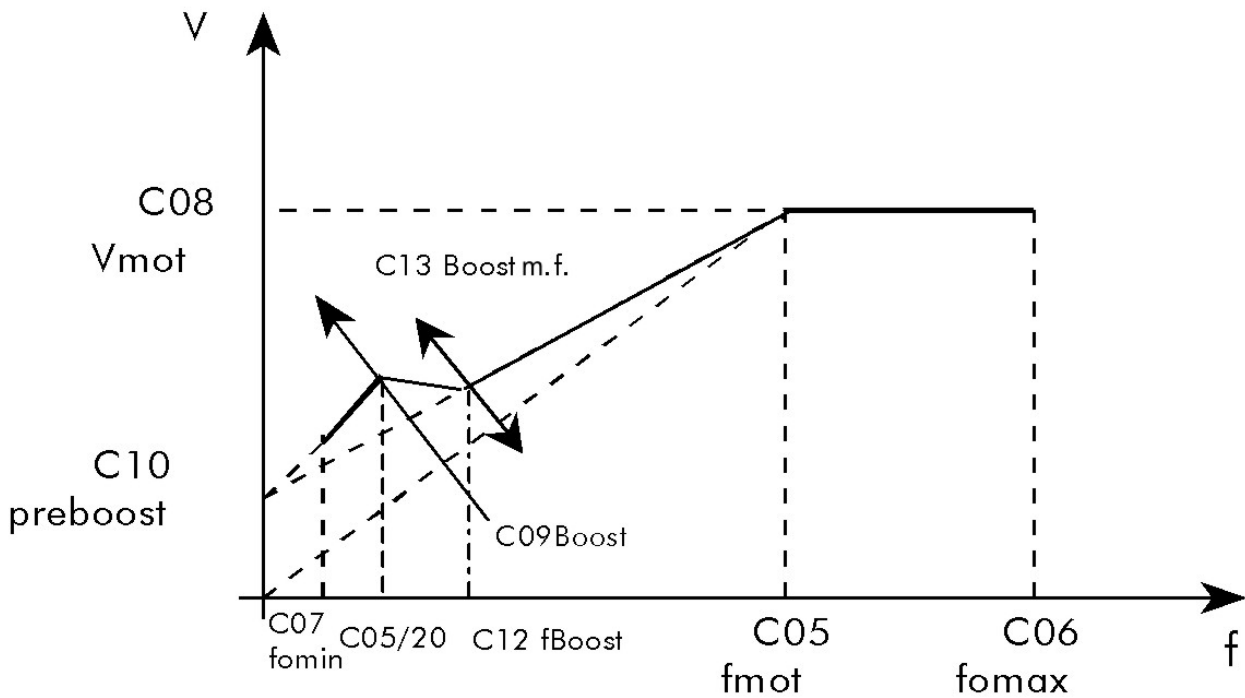


Any position

## 7.4. V/F PATTERN

The voltage/frequency pattern produced by the inverter may be customized based on the requirements of your application.

All relevant parameters are included in the V/f patterns submenu (Configuration menu).



**Figure 35: Parameters relating to voltage/frequency pattern.**

Considering Figure 35, the configurable parameters for the V/f pattern are the following:

C05	<b>Fmot</b>	Rated motor frequency; determines switching from constant-torque operation to constant-power operation.
C06	<b>Fomax</b>	Maximum output frequency produced by the inverter.
C07	<b>Fomin</b>	Minimum output frequency produced by the inverter (always contact Elettronica Santerno before altering this value).
C08	<b>Vmot</b>	Rated motor voltage; this is the voltage obtained with the rated motor frequency.
C09	<b>BOOST</b>	Determines the variation of the output rated voltage at low frequency. (Boost>0 determines an increase in the output voltage to increase the starting torque.)
C10	<b>PREBOOST</b>	Increases the rated output voltage at 0 Hz.
C11	<b>AUTOBOOST</b>	Increases voltage with respect to motor torque.
C12	<b>FREQ. BOOST</b>	Determines the frequency level (expressed as a percentage of C05) for the voltage increase set in C13.
C13	<b>B.mf.</b>	Determines the variation of rated output voltage C12. (Boost > 0 determines an increase in the rated output voltage).

Example 1:

Programming the V/f pattern of a 380V/50Hz asynchronous motor to be used up to 80 Hz.

C05 = 50 Hz

C06 = 80 Hz

C07 = 0.5 Hz

C08 = 380 V

C09 = depending on the required starting torque.

C10 = 2.5%

C11 = 5.0%

C12 = 50%

C13 = depending on the required starting torque.

Besides forcing a compensation depending on operating frequency, voltage may be increased/decreased (depending on actuated torque sign) with respect to the motor stress. This compensation results from:

$$\Delta V = C08 \times \frac{C11}{100} \times \frac{T}{T_n}$$

Where T is the motor torque and T<sub>n</sub> is the rated motor torque calculated as follows:

$$T_n = \frac{P_n}{2\pi f} = \frac{C74}{2\pi} \frac{(C73/2)}{(C05)}; \text{ [Nm]}$$

C74 Rated motor power.

C73 Motor pole number.

C11 (AutoBoost): variable torque compensation expressed as a percentage of the rated motor voltage. The value set for C11 is the voltage increment when the motor runs at rated torque.

## 7.5. CARRIER FREQUENCY

Carrier frequency may be programmed based on output frequency, as shown in the figure below, by adjusting the parameters in the “Carrier Freq” submenu (Configuration menu):

C01	MIN CARRIER	Minimum value of PWM modulation frequency.
C02	MAX CARRIER	Maximum value of PWM modulation frequency.
C03	PULSE NUMBER	Number of output pulses produced when switching from the minimum value to the maximum value.

Factory setting is dependent on the inverter size, but is always C01 = C02, C03 = 24. Always do the following:

- never exceed the maximum allowable carrier frequency (automatically actuated by the inverter)
- do not set a low pulse number (10÷15) for asynchronous modulation.

Note that:

- asynchronous modulation occurs with a constant carrier frequency independently of the output frequency
- synchronous modulation occurs with a constant pulse number
- the pulse number is equal to: 
$$\frac{\text{carrier frequency}}{\text{output frequency}}$$

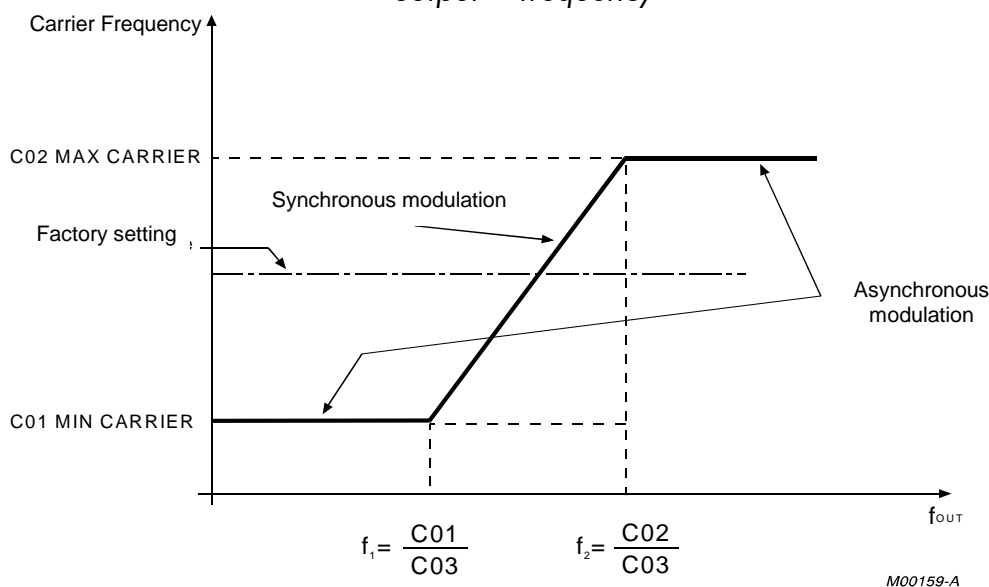


Figure 36: Carrier frequency depending on output frequency.

- For  $f_{OUT} < f_1$ , carrier frequency is kept constant and equal to C01 independently of the output frequency;
- For  $f_1 < f_{OUT} < f_2$ , carrier frequency increases in a linear way because the pulse number is constant; carrier frequency is  $f_c = C03 * f_{OUT}$ ;
- For  $f_{OUT} > f_2$ , carrier frequency is kept constant and equal to C02.



Decreasing the carrier frequency improves the motor performance at low rpm but implies louder noise. Because carrier frequency  $f_c$  can never exceed 16,000 Hz, if a high output frequency is required, set C03 = 12 to obtain synchronous modulation when maximum output frequency is attained. The diagram shows an example of the carrier frequency recommended to obtain a maximum output frequency of 800 Hz. C02 is expected to be 10,000 Hz (factory setting).

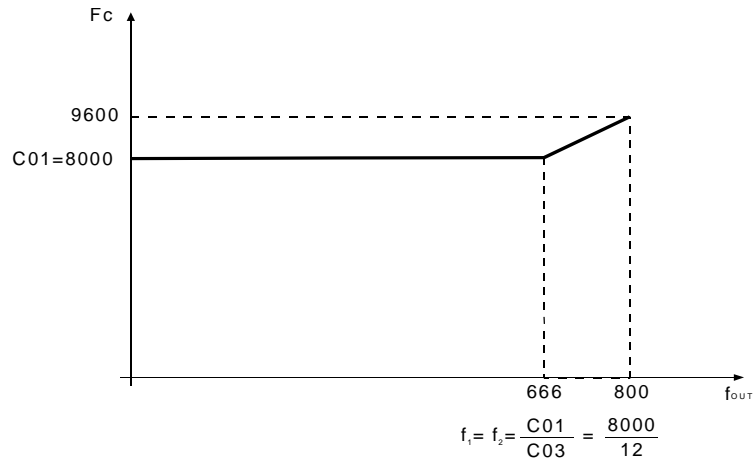


Figure 37: Carrier frequency with the recommended setup for  $f_{OUT} = 800$  Hz.

## 7.6. SLIP COMPENSATION

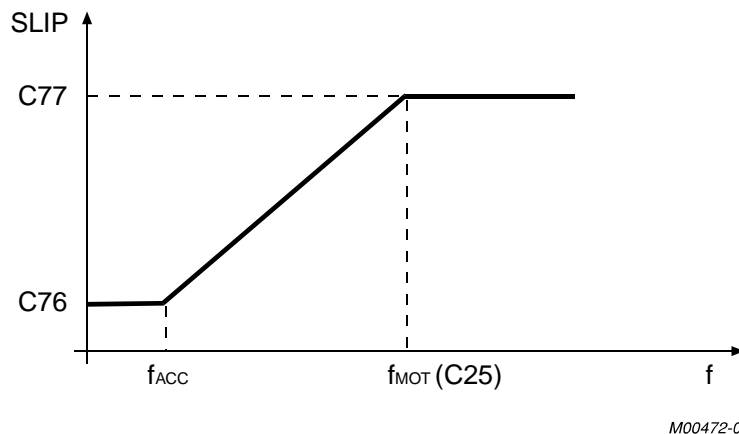
The Slip Compensation function compensates the decrease of the asynchronous motor speed when the mechanical load is increased.

The inverter calculates the slip frequency based on the estimated motor torque. The following parameters are used for slip compensation:

- C74: Rated motor power (used to compute rated torque  $C_{nom}$ )
- C75: No-load power
- C78: Stator phase resistance (estimated by the inverter during DC braking)
- C77: Slip ratio at rated frequency
- C76: Slip ratio at approach frequency

Parameters C75 and C78 are used to calculate mechanical power based on electrical power supplied. The inverter is then capable of estimating output motor torque "Cmot" and slip frequency "fs".

The slip value is determined by the interaction of C76 and C77.



**Figure 38: Slip compensation based on the produced frequency.**



**NOTE**

Because stator resistance is estimated during DC braking, DC braking must always be performed (at least 150 ÷ 200 ms). If no adequate DC braking at stop is possible, enable DC braking at start (C81 = YES and C83 = 0.2 ms).



## 7.7. DC BRAKING

DC current is injected to stop the connected motor. This can automatically be performed at stop and/or start or through a command sent via terminal board.

All parameters relating to this function are included in the DC BRAKING submenu (Configuration menu).

The intensity of direct current is determined by the value of C85 constant as a percentage of the rated motor current.

### 7.7.1. DC BRAKING AT STOP

To activate this function, set parameter C80 to YES. DC braking occurs after sending a ramp stop command if the output frequency is other than 0 when the command is sent.

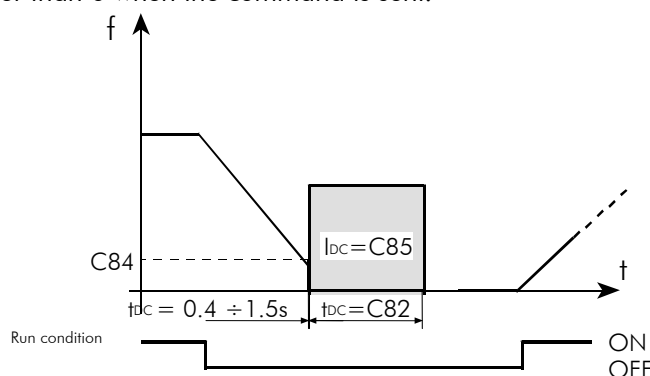


Figure 39: Output frequency/speed and DC braking current when the DC BRAKING AT STOP function is enabled.

Use the following parameters to set this function:

<b>C80</b>	Function enable;
<b>C82</b>	Braking time period;
<b>C84</b>	Output frequency determineng DC braking;
<b>C85</b>	Braking current intensity.

Time interval  $t_0$  between the end of the deceleration ramp and the beginning of DC braking depends on the inverter size.



**NOTE** Stator resistance is estimated during DC current application stage.

**PART 2**

### 7.7.2. DC BRAKING AT START

Set C81 to YES to activate this function. DC braking is activated by sending a START command—independently of the running direction—with a frequency/speed reference other than zero and before the acceleration ramp is performed.

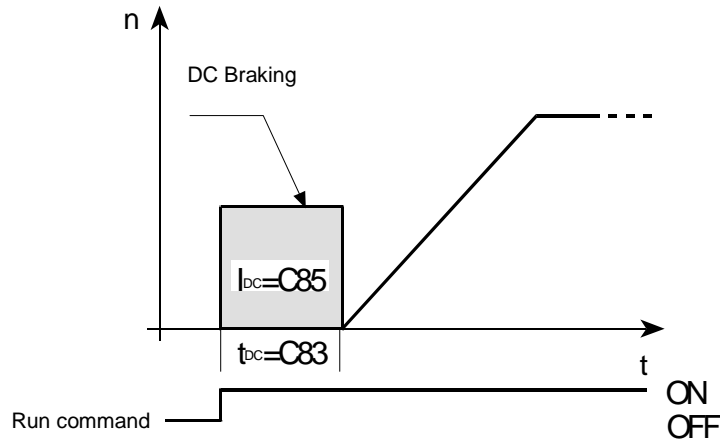


Figure 40: Output frequency/speed and braking DC current when the DC BRAKING AT START function is enabled.

Use the following parameters to program this function:

C81	Function enable
C83	Braking time
C85	Braking current intensity



**NOTE** Stator resistance is estimated during DC current application stage.



## 7.8. MOTOR THERMAL PROTECTION

The Motor Thermal Protection function protects the motor against possible overloads. The Motor Thermal Protection is activated through parameter C70 in the **Motor Thermal Protection** submenu.

Four functions for the motor cooling systems are available. They can be selected through parameter C70.

- NO The function is locked (factory setting);
- YES The function is active; pick-up current is independent of the operating frequency;
- YES A The function is active; pick-up current is depending on the operating frequency with a special derating for motors provided with forced air-cooling system;
- YES B The function is active; pick-up current is depending on the operating frequency with a special derating for motors provided with a fan keyed to the shaft.

The heating of a motor where constant current  $I_o$  flows depends on time and current intensity:

$$q(t) = K \cdot I_o^2 \cdot (1 - e^{-t/T})$$

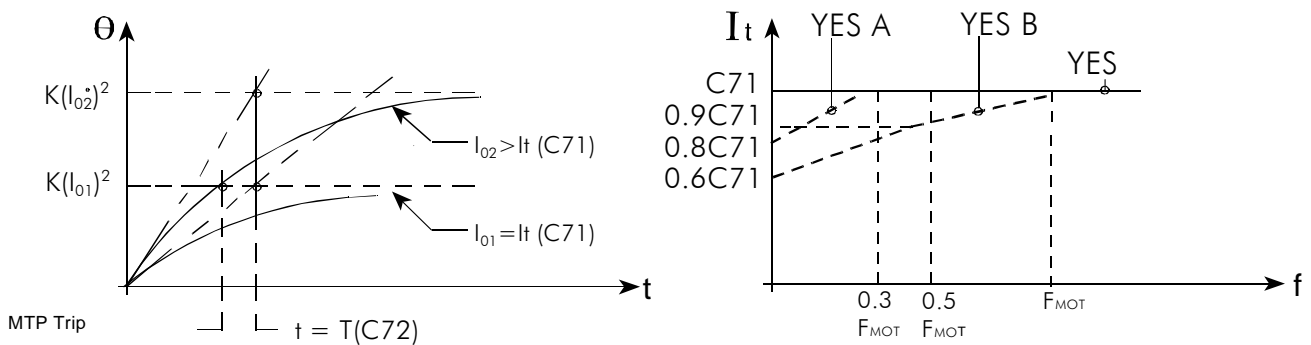
where T is the motor thermal time constant (C72).

The motor heating is proportional to  $I_o^2$  (delivered current)

$K \cdot I_o^2 / T$  is the curve slope in the origin.

The Motor thermal protection trips if the current flowing in the motor determines a higher temperature than the allowable asymptotic value.

**PART 2**



**Figure 41: Motor heating with two different, constant current values and pick-up current  $I_t$  of the motor thermal protection with respect to the frequency/speed depending on the configuration of parameter C70.**

If the motor thermal protection trips, multifunction digital output set as “Thermal prot.” (default MDO) activates. If no digital output is set as “Thermal prot”, alarm A22 trips.

If thermal time constant T is not known, enter a value equal to 1/3 of the time interval needed to obtain a constant motor temperature.

Use the following parameters to program this function:

<b>C70</b>	Function enable
<b>C71</b>	Pick-up current
<b>C72</b>	Motor thermal time constant



**CAUTION**

Always provide the motor with a thermal protection (use the inverter thermal protection or install a thermistor in the motor).

## 8. PROGRAMMING PARAMETERS

Operating parameters and variables are divided into four main menus, including a tree structure of submenus.

Submenus also include:

- access pages, allowing accessing the different parameter levels (for example, access pages allow accessing the submenus from the main menus);
- first page of a submenu, allowing quitting a submenu and accessing the upper level of the tree structure (from within a submenu, the first page of a submenu allows accessing the different submenus forming a main menu).

Two shortcuts are available:

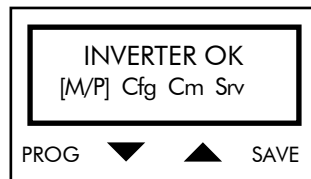
- Press ↑ and ↓ or the MENU key to access directly to the main menu access page; press ↑ and ↓ or MENU again to return to the previous page;
- press PROG and ↓ at a time to access directly to the first page of the submenu.

## 8.1. MAIN MENUS

The main menus are the following:

- M/P (Measures/Parameters): relates to the values displayed and to the parameters that can be altered when the inverter is running;
- Cfg (Configuration): includes those parameters that cannot be altered when the inverter is running;
- Cm (Commands): includes the pages relating to the inverter operation handled via keypad;
- Srv (Service): the Service menu cannot be accessed by the user.

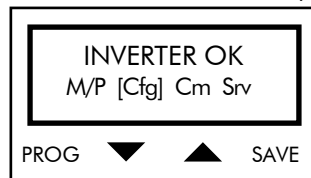
At power on, the access page to the main menus is displayed (this is the factory setting programming if no failure occurs):



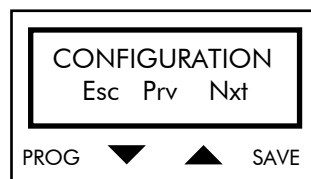
The active menu is in square brackets. Use the arrow keys ( $\uparrow$  and  $\downarrow$ ) to select a different menu. Press the PROG key to access the selected menu.

Example

Select the Cfg (Configuration) menu with  $\uparrow$  and  $\downarrow$ ; the inverter display shows:



Press PROG to access the selected menu; the first page of the Configuration menu is displayed:



From the first page, press  $\uparrow$  and  $\downarrow$  to access the access pages of the different submenus. Press PROG to return to the main menu.



Press  $\uparrow$  and  $\downarrow$  to select a different submenu (in square brackets), then press PROG to access the selected submenu.

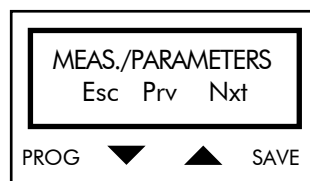
## 8.2. SUBMENUS

Press  $\uparrow$  and  $\downarrow$  from the first page of a main menu to scroll through the submenu access pages. Press PROG to access the page displayed. The first page of the submenu appears. Press  $\uparrow$  and  $\downarrow$  to scroll through the parameters in the submenu. To alter a parameter value, set key parameter P01 to 1, select the parameter to alter and press the PROG key; a flashing cursor appears; press  $\uparrow$  and  $\downarrow$  to increase or decrease the parameter value. Press SAVE to store the new value; press PROG to store the new value until the inverter is turned off. To quit the submenu, scroll the different parameters up to the first page of the submenu (or simultaneously press PROG and  $\downarrow$ ); press PROG to access the submenu level.

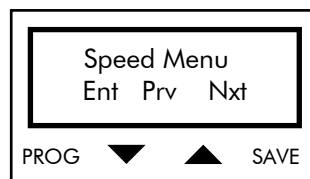
Example:

Programming parameter P44 (Rated speed of the lift cage).

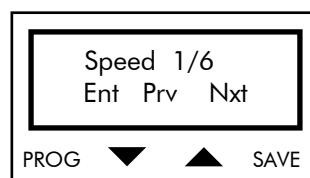
Access the M/P (Measures/Parameters) menu; the first page of the M/P menu is displayed;



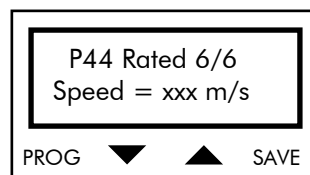
use  $\uparrow$  (Nxt) and  $\downarrow$  (Prv) to scroll the submenus up to the access page of the "Speed" submenu:



Press PROG to access the submenu. The first page of the submenu appears:



Press  $\uparrow$  (Nxt) and  $\downarrow$  (Prv) to scroll through the parameters up to parameter P44:



**Press PROG; the flashing cursor appears and allows altering the parameter value.**

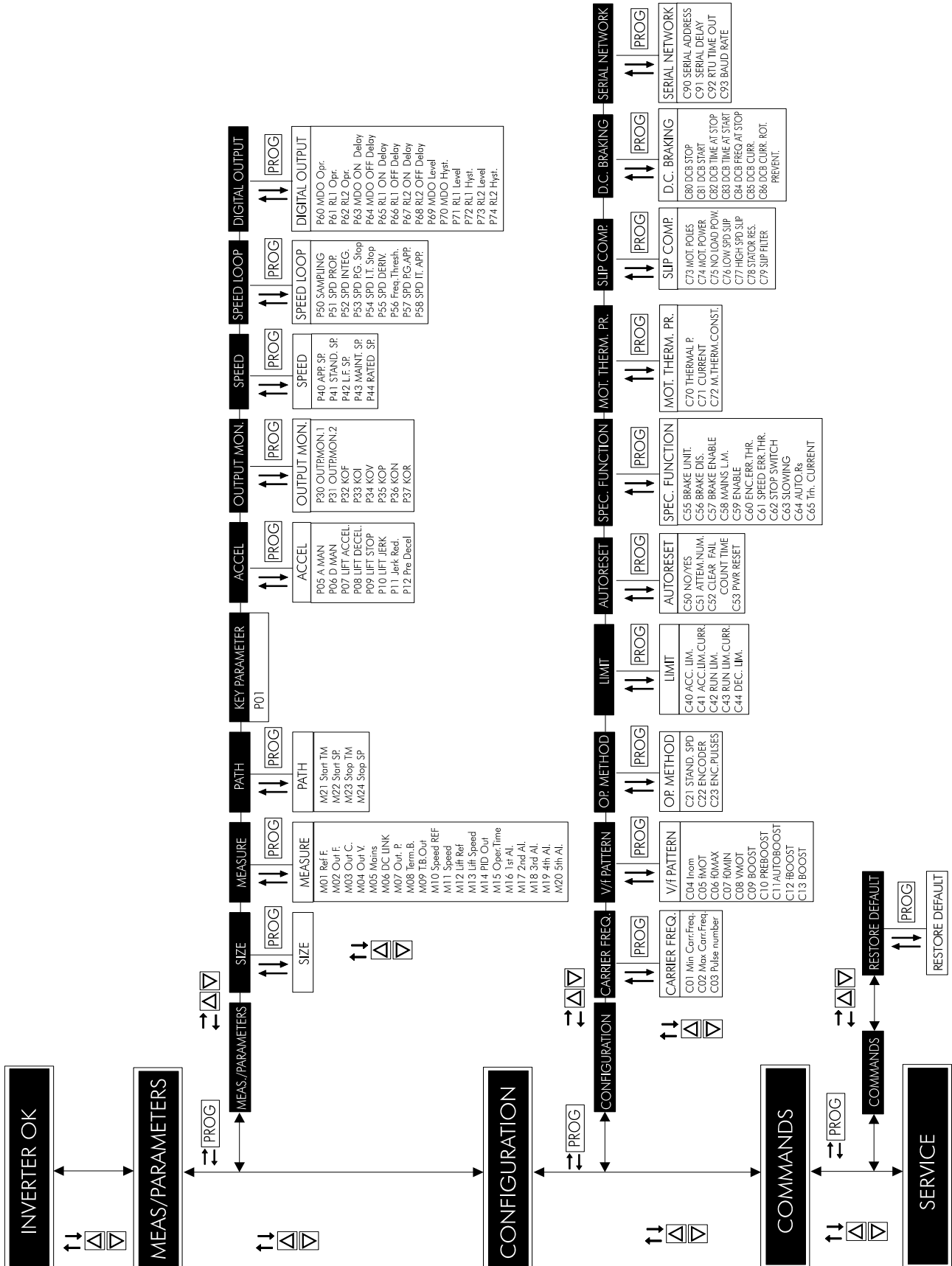
Press  $\uparrow$  and  $\downarrow$  to increase or decrease the parameter value.

Press SAVE to store the new value to non-volatile memory.

Press PROG to store the new value until the inverter is turned off. At next power on, the inverter will use the last value saved to non-volatile memory.



### 8.3. MENU AND SUBMENU TREE STRUCTURE



**PART 2**

## 9. MENU LIST

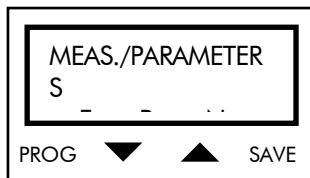
Each parameter includes the following items:

P	⇒	Parameter number
R	⇒	Allowable programmable range
D	⇒	Factory setting (default setting)
F	⇒	Function

### 9.1. MEASURES/PARAMETERS MENU

The Measures/Parameters menu includes the operating variables and the parameters that can be altered when the inverter is running. Always set P01=1 to enable parameter alteration.

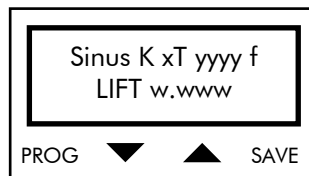
#### First page



Press PROG to return to the main menu selection page; press ↑ and ↓ to scroll the submenus. All parameters are included in different submenus, except for key parameter P01 and the parameters relating to the inverter ratings. Scroll the submenus to directly access these parameters.

#### 9.1.1. INVERTER RATINGS - SIZE

Displays the main ratings of the inverter.



Field x:	Supply voltage (2=200÷240Vac, 4=380÷500Vac)
Field yyyy:	Size (0005÷0086)
	Fan control mode:
	B=no fan control mode
Field f:	S=fan condition readout only
	P=fan condition readout + command depending on thermoswitch
	N= fan condition readout + command depending on NTC
Field w.www:	FLASH software version (user interface)
Field z.zzz:	DSP software version (motor control)



#### NOTE

If software version w.www of the human interface is incompatible with software version z.zzz for the motor control, alarm A01 Wrong Software trips.

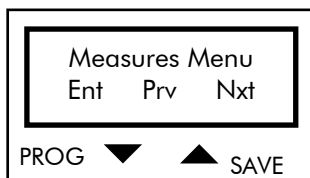
Press MENU to quit the submenu.



### 9.1.2. MEASURES SUBMENU

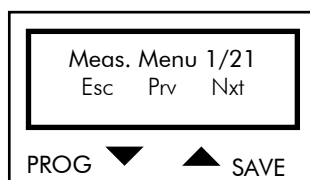
The Measures submenu contains the variables displayed when the inverter is running.

#### Access page



Press PROG to access the first page of the Measures submenu. Press  $\uparrow$  and  $\downarrow$  to scroll through the submenus.

#### First page



Press PROG to return to the Measures submenu access page. Press  $\uparrow$  and  $\downarrow$  to scroll through the parameters.

PARAMETERS IN THE MEASURES SUBMENU

M01 Ref.Freq 2/21	P	M01
Fref=**.**.Hz	R	+/- 800 Hz
	F	Value of the inverter input frequency reference.

M02 Out.Freq 3/21	P	M02
Fout=**.**.Hz	R	+/- 800 Hz
	F	Output frequency value.

M03 Out.curr. 4/21	P	M03
Iout=*** A	R	Depending on the inverter model.
	F	Output current value.

M04 Out.volt. 5/21	P	M04
Vout=*** V	R	Depending on the inverter class (2T e 4T).
	F	Output voltage value.

M05 Mains 6/21	P	M05
Vmn=*** V	R	Depending on the inverter class (2T e 4T).
	F	Mains voltage value.

M06 D.C.link 7/21	P	M06
Vdc=*** V	R	Depending on the inverter class (2T e 4T).
	F	Value of DC link voltage.

M07 OUT. P. 8/21	P	M07
POUT=*** kW	R	Depending on the inverter model.
	F	Value of active power delivered to the load.

M08 Term.Brd.9/21	P	M08
* * * * *	F	Condition of digital inputs in the terminal board (display sequence: terminals 6, 7, 8, 9, 10, 11, 12, 13). If an input is active, the number of the relevant terminal in hexadecimal notation is displayed. Otherwise, "0" is displayed.

M09 T.B.Out 10/21	P	M09
* * *	F	Condition of digital outputs in the terminal board (display sequence: terminals 24, 27, 29). If an output is active, the number of the relevant terminal in decimal notation is displayed. Otherwise, "0" is displayed.

M10 Speed 11/21	P	M10
Ref = *** rpm	R	±4000rpm
	F	Motor speed reference expressed in rpm.



<u>M11</u> Speed 12/21	P	M11
Nout = *** rpm	R	±4000rpm
	F	Motor speed value expressed in rpm

<u>M12</u> Lift 13/21	P	M12
Ref = *.*/m/s	R	± 2.5 m/s
	F	Displays the lift cage speed reference expressed in m/s.

<u>M13</u> Lift 14/21	P	M13
Speed = *.*/m/s	R	± 2.5 m/s
	F	Displays the lift cage speed expressed in m/s.

<u>M14</u> PID 15/21	P	M14
Out = **.* %	R	± 20%
	F	Expresses the speed regulator correction over the output frequency.

<u>M15</u> Oper 16/21	P	M15
Time = ****.* h	R	0 ÷ 238.000 h
	F	Time period of the inverter operation in RUN mode.

<u>M16</u> 1st al. 17/21	P	M16
A** ****.* h	R	A01 ÷ A34
	F	Stores the last alarm tripped and the relevant M15 value.

<u>M17</u> 2nd al. 18/21	P	M17
A** ****.* h	R	A01 ÷ A34
	F	Stores the penultimate alarm tripped and the relevant M15 value.

<u>M18</u> 3rd al. 19/21	P	M18
A** ****.* h	R	A01 ÷ A34
	F	Stores the last-but-two alarm tripped and the relevant M15 value.

<u>M19</u> 4th al. 20/21	P	M19
A** ****.* h	R	A01 ÷ A34
	F	Stores the last-but-three alarm tripped and the relevant M15 value.

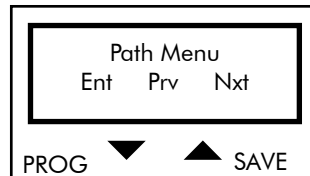
<u>M20</u> 5th al. 21/21	P	M20
A** ****.* h	R	A01 ÷ A34
	F	Stores the last-but-four alarm tripped and the relevant M15 value.

### 9.1.3. PATH SUBMENU

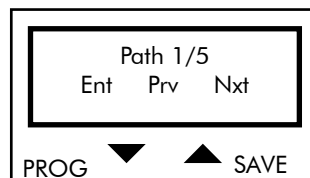
The Path submenu contains the expected start/stop distance and start/stop time intervals.

#### Access page

Press PROG to access the first page of the Path submenu; press ↓ and ↑ to scroll through the submenus.



#### First page



Press PROG to return to the Path submenu access page. Press ↑ and ↓ to scroll through the parameters.

#### PARAMETERS IN THE PATH SUBMENU

<u>M21</u> Start TM 2/5	P	M21
Tstt = *.** s	R	0÷20sec
	F	START TIME: Time period of the cage acceleration from speed 0 to commercial speed ( P41 * P44 )/100.

<u>M22</u> Start SP 3/5	P	M22
Sstt = *.** m	R	0÷10 m
	F	START SPACE: Distance covered by the cage while accelerating from speed 0 to commercial speed ( P41 * P44 )/100.

<u>M23</u> STOP TIME 4/5	P	M23
Tstp = *.** s	R	0÷20sec
	F	STOP TIME: Time period of the cage deceleration from commercial speed ( P41 * P44 )/100 to speed 0.

<u>M24</u> Stop Sp 5/5	P	M24
Sstp = *.** m	R	0÷10 m
	F	STOP SPACE: Distance covered by the cage while decelerating from commercial speed ( P41 * P44 )/100 to speed 0.

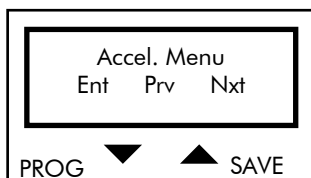
### 9.1.4. KEY PARAMETER

Key parameter	P	P01
P01=* PRDF	R	0 ÷ 1
	D	0
	F	0: only parameter P01 may be altered. P01 is always set to 0 at power on; 1: all parameters may be altered (parameters included in the Configuration menu can be altered only if the inverter is disabled).

### 9.1.5. ACCELERATION SUBMENU

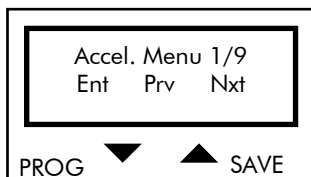
The Acceleration submenu includes the variables defining speed models obtained while accelerating and decelerating and relating to each operating condition.

Access page



Press PROG to enter the Acceleration submenu. Press ↑ and ↓ to scroll through the other submenus.

First page



**ATTENZIONE**

Whenever parameter C22 "ENCODER" programming is changed from Yes to No and vice versa, parameters P07, P08, P09, P10, P42, P43, P44 are automatically restored to their default values as for C22 programming (with or without an encoder). First program C22, then alter the other parameter values.

#### PARAMETERS IN THE ACCELERATION SUBMENU

P05 Acceler. 2/9	P	P05
A MAN=*.**m/s <sup>2</sup>	R	0.1 ÷ 2.55 m/s <sup>2</sup>
	D	0.6 m/s <sup>2</sup>
	F	ACCELERATION RAMP: Acceleration ramp in <b>Maintenance</b> operating mode. Cage acceleration from speed 0 to maintenance speed P43 (model without solution of continuity). Describes the speed model adopted while starting when terminal FWD MAN (or REV MAN) closes.

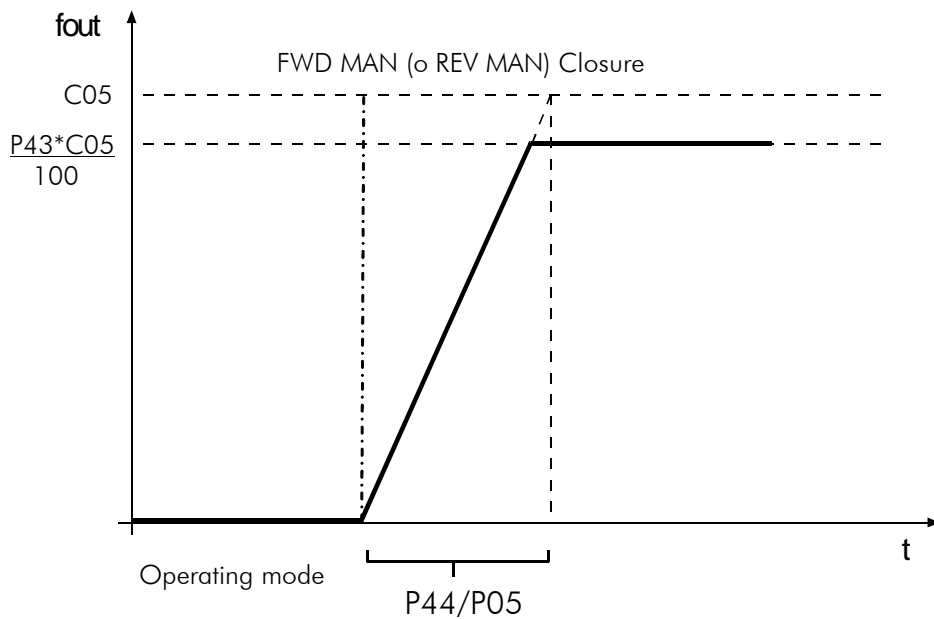


Figure 42: Frequency produced during startup in maintenance mode.

P06 Deceler. 3/9	P	P05
D MAN=*.**m/s <sup>2</sup>	R	0.1 ÷ 2.55 m/s <sup>2</sup>
	D	2.5 m/s <sup>2</sup>
	F	DECELERATION RAMP: Deceleration ramp in <b>Maintenance</b> operating mode. This is the lift cage deceleration when stopping from speed P43 (model without solution of continuity). Describes the speed model adopted while stopping when terminal FWD MAN (or REV MAN) closes.

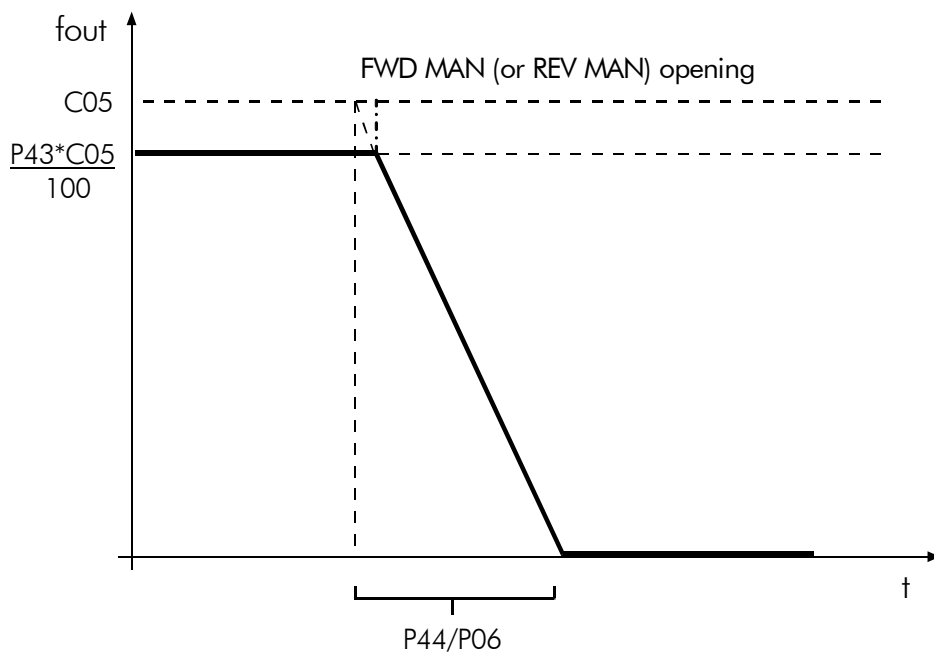


Figure 43: Frequency produced during slowing down in maintenance mode.



P07 Lift 4/9	P	P07
Accel. = *. * m/s <sup>2</sup>	R	0.1 ÷ 1 m/s <sup>2</sup> (with no speed sensor); 0.1 ÷ 2 m/s <sup>2</sup> (with a speed sensor);
	D	0.6 m/s <sup>2</sup> (with no speed sensor); 1.0 m/s <sup>2</sup> (with a speed sensor);
	F	LIFT CAGE ACCELERATION: Acceleration in <b>Normal</b> operating mode. Max. lift cage speed derivative while accelerating from 0 to preset speed for P41 or P42. Describes the speed model adopted for normal start and is linked with an "S" model according to the Jerk parameter.

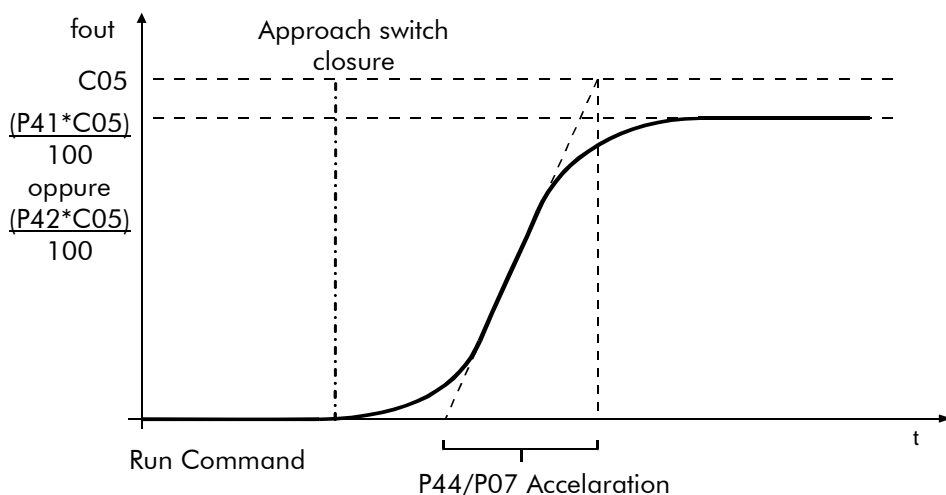


Figure 44: Frequency produced during startup in Normal operating mode.

P08 Lift 5/9	P	P08
Decel. = *. * m/s <sup>2</sup>	R	0.1 ÷ 1 m/s <sup>2</sup> (with no speed sensor); 0.1 ÷ 2 m/s <sup>2</sup> (with a speed sensor);
	D	0.6 m/s <sup>2</sup> (with no speed sensor); 1.0 m/s <sup>2</sup> (with a speed sensor);
	F	LIFT CAGE DECELERATION: Deceleration in <b>Normal</b> slowing down. Max. deceleration of the cage for approach speed (P40). Describes the speed model adopted for normal slowing-down and is linked with an "S" model according to the Jerk parameter.

**PART 2**

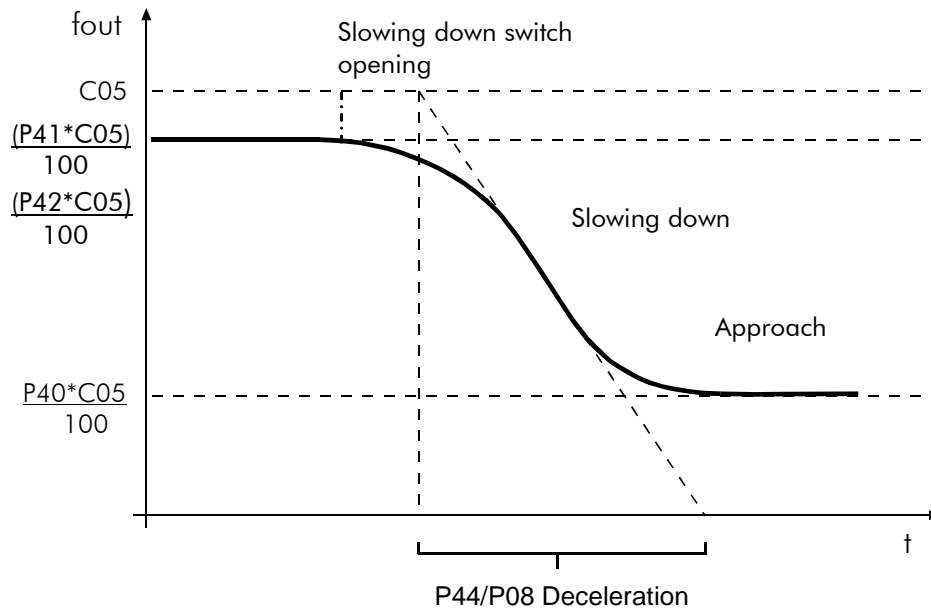


Figure 45: Frequency produced during slowing down in Normal operating mode.

P09 Lift 6/9	P	P09
Stop=*. * m/s <sup>2</sup>	R	0.1 ÷ 1 m/s <sup>2</sup> (with no speed sensor); 0.1 ÷ 2 m/s <sup>2</sup> (with a speed sensor);
	D	0.6 m/s <sup>2</sup> (with no speed sensor); 1.0 m/s <sup>2</sup> (with a speed sensor);
	F	LIFT CAGE STOP: Deceleration in <b>Normal</b> stop. Max. deceleration of the cage while stopping from approach speed (P40). Describes the speed model adopted while stopping (at the end of the approach stage).

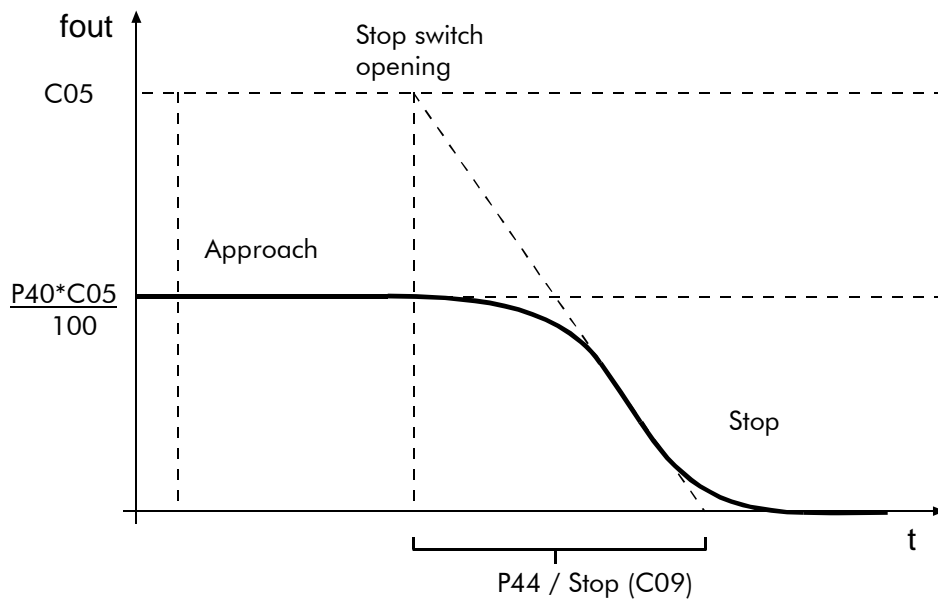


Figure 46: Frequency produced while stopping in Normal operating mode.





<u>P10</u> Lift 7/9	P	P10
Jerk=*** m/s <sup>3</sup>	R	0.15 ÷ 1.27 m/s <sup>3</sup>
	D	0.6 m/s <sup>3</sup> (with no speed sensor) 0.8 m/s <sup>3</sup> (with a speed sensor)
	F	LIFT CAGE JERK: Derivative of the cage acceleration while accelerating/decelerating in <b>Normal</b> operating mode.

<u>P11</u> Jerk red. 8/9	P	P11
at st *	R	0 ÷ 5
	D	3
	F	Jerk decrease at start in Normal operating mode expressed as a power of 2. The actual jerk at start will be as follows: $Jerk = \frac{P10}{2^{P11}}$

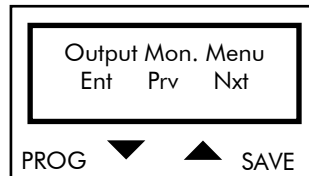
<u>P12</u> Pre-decel 9/9	P	P12
Jerk *	R	-1 ÷ 5
	D	2
	F	Jerk increase due to early acceleration expressed as a power of 2. The actual jerk will be as follows: $Jerk = P10 \cdot 2^{P12}$

**PART 2**

## 9.1.6. OUTPUT MONITOR SUBMENU

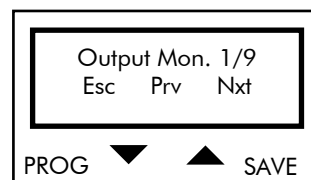
The Output Monitor submenu determines the variables for multifunction digital inputs (terminals 17, 18).

Access page



Press PROG to enter the Output Monitor submenu. Press ↑ and ↓ to scroll through the other submenus.

First page



Press PROG to quit the Output Monitor submenu. Press ↑ and ↓ to scroll through the parameters.

### PARAMETERS IN THE OUTPUT MONITOR SUBMENU

<b>P30</b> Output 2/9	<b>P</b>	P30
Monitor 1 ***	<b>R</b>	Fref, Fout, Iout, Vout, Pout, Fout_r, Nout, PID 0, PID F.B.
	<b>D</b>	Fout
	<b>F</b>	Selects the variable for the first multifunction analog output (terminal 17) among Fref (frequency reference), Fout (output reference), Iout (output current), Vout (output voltage), Pout (output power), Fout_r (frequency reference after ramp reference), Nout (rpm), PID 0. (frequency reference connection after ramp expressed as a percentage of the rated motor frequency), PID F.B. (motor speed read by the encoder and expressed as a percentage of the rated motor speed).
<b>P31</b> Output 3/9	<b>P</b>	P31
Monitor 2 ****	<b>R</b>	Fref, Fout, Iout, Vout, Pout, Fout_r, Nout, PID 0, PID F.B.
	<b>D</b>	Iout
	<b>F</b>	Selects the variable for the second multifunction analog output (terminal 18) among Fref (frequency reference), Fout (output reference), Iout (output current), Vout (output voltage), Pout (output power), Fout_r (frequency reference after ramp reference), Nout (rpm), PID 0. (frequency reference connection after ramp expressed as a percentage of the rated motor frequency), PID F.B. (motor speed read by the encoder and expressed as a percentage of the rated motor speed).



P32 Out. Mon. 4/9	P	P32
	R	1.5 ÷ 100 Hz/V
	D	10 Hz/V
	F	Ratio between the output frequency and the output voltage in terminals (17 and 18).

P33 Out. Mon. 5/9	P	P33
KOI = *** A/V	R	Depending on the inverter model.
	D	Depending on the inverter model.
	F	Ratio between inverter output current and output voltage at terminals 17 and 18.

P34 Out. Mon. 6/9	P	P34
KOV = *** V/V	R	20 ÷ 100V/V
	D	100 V/V
	F	Ratio between inverter output voltage and output voltage at terminals 17 and 18.

P35 Out. Mon. 7/9	P	P35
KOP = *** kW/V	R	Depending on the inverter model.
	D	Depending on the inverter model.
	F	Ratio between power delivered by the inverter and output voltage at terminals 17 and 18.

P36 Out. Mon. 8/9	P	P36
KON*** rpm/V	R	10 ÷ 10000 rpm/V
	D	200 rpm/V
	F	Ratio between motor RPM and output voltage at terminals 17 and 18.



**NOTE**

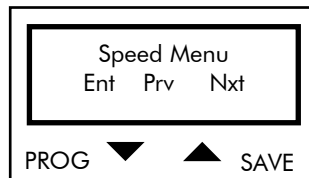
That speed value is given by the product between output frequency  $F_{out}$  multiplied by constant  $60 \times 2 / C73$  (Poles in the Special Function submenu) without considering the motor slip.

P37 Out. Mon. 9/9	P	P37
KOR = **.* %/V	R	2.5 ÷ 50 %/V
	D	10 %/V
	F	Ratio between output voltage at terminals 17 & 18 and PID regulator output (expressed as a percentage) and ratio between output voltage at terminals 17 and 18 and PID regulator feedback value expressed as a percentage.

### 9.1.7. SPEED SUBMENU

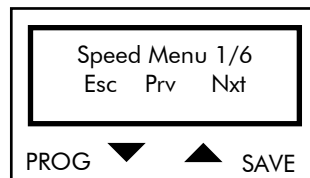
The Speed submenu determines values and configurations of the speed references that can be output through the multifunction digital inputs.

#### Access page



Press PROG to enter the Speed submenu. Press ↑ and ↓ to scroll through the other submenus.

#### First page



Press PROG to quit the Speed submenu. Press ↑ and ↓ to scroll through the parameters.

#### PARAMETERS IN THE SPEED SUBMENU



#### CAUTION

Whenever parameter C22 "ENCODER" programming is changed from Yes to No and vice versa, parameters P07, P08, P09, P10, P42, P43, P44 are automatically restored to their default values as for C22 programming (with or without an encoder). First program C22, then alter the other parameter values.

P40 Approach 2/6	P	P40
Speed = ***%	R	1% ÷ 120%
	D	10%
	F	APPROACH SPEED: Lift cage speed expressed as a percentage of rated speed P44 during the floor approach stage.
P41 Standard 3/6	P	P41
Speed = ***%	R	1% ÷ 120%
	D	100%
	F	STANDARD SPEED: Contractual speed, lift cage speed, expressed as a percentage of rated speed P44 while moving from one floor to another.



P42 Lower 4/6	P	P42
Speed = ***%	R	1% ÷ 120%
	D	67% (with no speed sensor); 32% (with a speed sensor).
	F	LOWER FLOOR SPEED: Low speed, lift cage speed, expressed as a percentage of rated speed P44 when moving among lower floors.

P43 Mainten. 5/6	P	P43
Speed = ***%	R	1% ÷ 120%
	D	40% (with no speed sensor); 20% (with a speed sensor).
	F	MAINTENANCE SPEED: Cage speed, expressed as a percentage of rated speed P44, in Maintenance operating mode. It is selected by closing terminal FWD MAN (or REV MAN).



**NOTE** Maintenance speed is limited to 0.67 m/s.

P44 Rated 6/6	P	P44
Speed = ****m/s	R	0.15 ÷ 1.5 m/s (with no speed sensor); 0.15 ÷ 2.5 m/s (with a speed sensor).
	D	1.2 m/s (with no speed sensor); 2.5 m/s (with a speed sensor).
	F	RATED SPEED: Rated speed of the lift cage when the motor rotates at rated synchronous speed. $\left[ \frac{f_{mot}(C05) * 60}{\text{pole - pairs } (C73)} \right]$

**PART 2**

### 9.1.8. SPEED LOOP SUBMENU

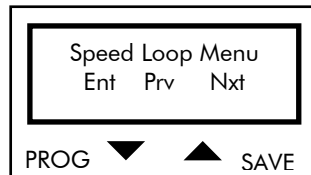
The Speed Loop submenu includes the parameters relating to the adjustment of the speed regulator.



**NOTE**

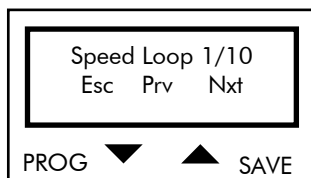
Parameters in the Speed Loop submenu are activated only if a speed sensor is installed.

**Access page**



Press PROG to enter the Speed Loop submenu. Press  $\uparrow$  and  $\downarrow$  to scroll through the other submenus.

**First page**



Press PROG to quit the Speed Loop submenu. Press  $\uparrow$  and  $\downarrow$  to scroll through the parameters.

**PARAMETERS IN THE SPEED LOOP SUBMENU**

<b>P50</b> Sampling 2/10	<b>P</b>	P50
Tc = ***	<b>R</b>	0.002 ÷ 4s
	<b>D</b>	0.002s
	<b>F</b>	PID regulator duty cycle (e.g. set 0.002s to execute PID regulator every 0.002s).

<b>P51</b> SPD Prop. 3/10	<b>P</b>	P51
Gain = ***	<b>R</b>	0 ÷ 31.999
	<b>D</b>	0.35
	<b>F</b>	Multiplicative constant of PID regulation proportional term. PID regulator output % is equal to the difference between reference and feedback expressed as a value percent multiplied by P51.

<b>P52</b> SPD Integ. 4/10	<b>P</b>	P52
Time = ** Tc	<b>R</b>	3 ÷ 1024 Tc; NONE
	<b>D</b>	200 Tc
	<b>F</b>	Constant dividing PID regulator integral term. It is expressed as a multiple value of the sampling time. SPD Integ. Time = NONE (value following 1024) to override integral action.



P53 SPD P.G. 5/10	P	P53
Stop = ***	R	0÷31.999
	D	1
	F	Multiplicative constant of PID regulator proportional term used during the stop stage.

P54 SPD I.T. 6/10	P	P54
Stop = ****Tc	R	3÷1024 Tc; NONE
	D	50 Tc
	F	Constant dividing PID regulator integral term used during the stop stage. SPD Integ. Time = NONE (value following 1024) to override integral action.

P55 Deriv. 7/10	P	P55
Time = ***Tc	R	0÷4Tc
	D	0Tc
	F	Constant multiplying PID regulator derivative term. It is expressed as a multiple value of the sampling time. Set Deriv. Time = 0 to override derivative action.

P56 Freq. 8/10	P	P56
Thresh. = *** Hz	R	0÷800 Hz
	D	10 Hz
	F	Inverter output frequency determining the activation of PID regulator integral term.

P57 SPD P.G. 10/10	P	P57
Appz***	R	0÷31.999
	D	0.35
	F	Multiplicative constant of PID regulator integral term used during the approach stage.

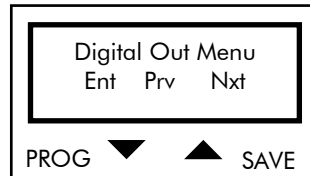
P58 I.T.APP 10/10	P	P58
Stop = ****Tc	R	3÷1024 Tc; NONE
	D	200 Tc
	F	Constant dividing PID regulator integral term used during the approach stage. SPD Integ. Time = NONE (value following 1024) to override integral action.

**PART 2**

### 9.1.9. DIGITAL OUTPUTS SUBMENU

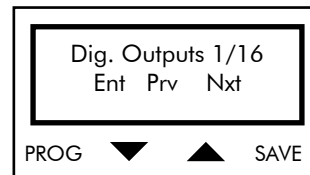
The Digital Outputs submenu sets the parameters relating to digital outputs.

Access page



Press PROG to enter the Digital Outputs submenu. Press ↑ and ↓ to scroll through the other submenus.

First page



Press PROG to quit the Digital Outputs submenu. Press ↑ and ↓ to scroll through the parameters.

#### PARAMETERS IN THE DIGITAL OUTPUTS SUBMENU

P60 MDO opr. 2/16	P	P60
***	R	Inv O.K. ON, INV O.K. OFF, Inv RUN Trip, Reference Level, Frequency Level, Forward Running, Reverse Running, Fout O.K., Current Level, Limiting, Motor Limiting, Generator Limiting, Frequency Level2 Thermal prot., Power Level, Motor Contact. Idc Freq.Level, Fan Fault
	D	Thermal prot.
	F	Determines the configuration of Open Collector digital output (terminals 24 and 25). Press ↓ and ↑ to select the inverter condition to be associated to the digital output: Inv. O.K. ON: active output; the inverter is ready to run. Inv. O.K. OFF: active output; the inverter is in emergency mode (any condition locking the RUN command; see the note at the end of the description of parameter P60). Inv run trip: active output if inverter in emergency mode due to a protection trip. Reference Level: active output; the speed reference at the inverter input is higher than the speed reference set with P69 (see Figure 47). Frequency Level: active output; the inverter is generating a higher frequency than the frequency set with P69, independently of the motor direction of rotation (see Figure 48). Forward Running: active output; the inverter is generating a higher frequency than the frequency set with P69 (positive reference; see Figure 48). Reverse Running: active output; the inverter is generating a higher frequency than the frequency set with P69 (negative reference; see Figure 48). Fout O.K.: active output; the absolute value of the difference between the frequency reference and the output frequency is lower than the value set with P69 "MDO Level" (see Figure 49).





	<p>Current Level: active output; the inverter output current exceeds the value set with P69 "MDO Level" (see Figure 50).                  Limiting: active output; inverter in limiting stage.                  Motor limiting: active output; the inverter is limited by the motor.</p>
	<p>Generator lim.: active output; limit during regeneration stage.                  Frequency Level2: like Frequency Level, but with a hysteresis in the reversed deactivation level, thus allowing unlocking the electromechanical brake at a lower frequency than the brake locking frequency (see Figure 51).                  Thermal protection: inactive output with motor thermal protection trip.                  Power Level: active output if the delivered power is lower than a threshold expressed as a percentage of the rated motor power (C74).                  Motor Contact.: (output for motor contactor command); output activated as soon as the inverter starts; the motor start is delayed by "ton" delay time.                  Idc Freq.Level: active output when the braking direct current at start reaches the value set in C86. This output deactivation is similar to the Frequency Level operation.                  Fan Fault: active output when a fan fault occurs ("P" or "N" models); active output when a fan fault occurs, or when fans are off ("S" models); the output is inactive in any other operating conditions (see Inverter Ratings).</p>



**NOTE**

Select "INV OK OFF" to activate a digital output in an emergency (protection trip; inverter switched off when in emergency mode; inverter turned on with ENABLE contact - terminal 6 - closed and parameter C59 set to [NO]). If "INV OK OFF" is selected, the digital output may be used to control an indicator light or to send emergency signals to the PLC. If "Inv run trip" is selected, the digital output activates only if the inverter enters the emergency mode due to a protection trip. Turn off and on the equipment in emergency mode to deactivate the digital output. In this operating mode, the digital output may be used to control a relay activating a contactor installed on the inverter supply line.



**NOTE**

Use parameter P70 to set a hysteresis for the commutation of a digital output.



**NOTE**

Set C81=YES to enable Idc Freq. Level operating mode. If C81 is not set to Yes, operation in Idc Freq. Level mode is the same as Frequency level.



P61 RL1 opr. 3/16	P	P61
***	R	Inv O.K. ON, INV O.K. OFF, Inv RUN Trip, Reference Level, Frequency Level, Forward Running, Reverse Running, Fout O.K., Current Level, Limiting, Motor Limiting, Generator Limiting, Frequency Level2, Thermal prot., Power Level, Motor Contact. Idc Freq.Level, Fan Fault
	D	Inv. O.K. ON
	F	<p>Configuration of relay digital output RL1 (terminals 26, 27, and 28). Use ↓ and ↑ to select the inverter condition to be associated with the digital output condition:</p> <p>Inv. O.K. ON: active output; the inverter is ready to run.</p> <p>Inv. O.K. OFF: active output; the inverter is in emergency mode (any condition locking the RUN command; see the note at the end of the description of parameter P61).</p> <p>Inv run trip: active output if inverter in emergency mode due to a protection trip.</p> <p>Reference Level: active output; the speed reference at the inverter input is higher than the speed reference set with P71 (see Figure 47).</p> <p>Frequency Level: active output; the inverter is generating a higher frequency than the frequency set with P71, independently of the motor direction of rotation (see Figure 48).</p> <p>Forward Running: active output; the inverter is generating a higher frequency than the frequency set with P71 (positive reference; see Figure 48).</p> <p>Reverse Running: active output; the inverter is generating a higher frequency than the frequency set with P71 (negative reference; see Figure 48).</p> <p>Fout O.K.: active output; the absolute value of the difference between the frequency reference and the output frequency is lower than the value set with P71 "RL1 Level" (see Figure 49).</p> <p>Current Level: active output; the inverter output current exceeds the value set with P71 "RL1 Level" (see Figure 50).</p> <p>Limiting: active output; inverter in limiting stage.</p> <p>Motor limiting: active output; the inverter is limited by the motor.</p> <p>Generator lim.: active output; limit during regeneration stage.</p> <p>Frequency Level2: like Frequency Level, but with a hysteresis in the reversed deactivation level, thus allowing unlocking the electromechanical brake at a lower frequency than the brake locking frequency (see Figure 51).</p> <p>Thermal protection: inactive output with motor thermal protection trip.</p> <p>Power level: active output if the delivered power is lower than a threshold expressed as a percentage of the rated motor power (C74).</p> <p>Motor Contact.: (output for motor contactor command); output activated as soon as the inverter starts; the motor start is delayed by "ton" delay time.</p> <p>Idc Freq.Level: active output when the braking direct current at start reaches the value set in C86. This output deactivation is similar to the Frequency Level operation.</p> <p>Fan Fault: active output when a fan fault occurs ("P" or "N" models); active output when a fan fault occurs, or when fans are off ("S" models); the output is inactive in any other operating conditions (see Inverter Ratings).</p>



**NOTE**

Select "INV OK OFF" to activate a digital output in an emergency (protection trip; inverter switched off when in emergency mode; inverter turned on with ENABLE contact - terminal 6 - closed and parameter C59 set to [NO]). If "INV OK OFF" is selected, the digital output may be used to control an indicator light or to send emergency signals to the PLC. If "Inv run trip" is selected, the digital output activates only if the inverter enters the emergency mode due to a protection trip. Turn off and on the equipment in emergency mode to deactivate the digital output. In this operating mode, the digital output may be used to control a relay activating a contactor installed on the inverter supply line.



**NOTE**

Use parameter P72 to set a hysteresis for the commutation of a digital output.



**NOTE**

Set C81=YES to enable Idc Freq. Level operating mode. If C81 is not set to Yes, operation in Idc Freq. Level mode is the same as Frequency Level.

P62 RL2 opr. 4/16	<b>P</b>	P62
***	<b>R</b>	<p>Inv O.K. ON, INV O.K. OFF, Inv RUN Trip, Reference Level, Frequency Level, Forward Running, Reverse Running, Fout O.K., Current Level, Limiting, Motor Limiting, Generator Limiting, Frequency Level2, Thermal prot., Power Level, Motor Contact. Idc Freq.Level, Fan Fault</p> <p><b>D</b> Frequency level (used to control the electromechanical brake)</p> <p><b>F</b> Configuration of relay digital output RL2 (terminals 29, 30, and 31). Use ↓ and ↑ to select the inverter condition to be associated with the digital output condition:</p> <p>Inv. O.K. ON: active output; the inverter is ready to run.</p> <p>Inv. O.K. OFF: active output; the inverter is in emergency mode (any condition locking the RUN command; see the note at the end of the description of parameter P62).</p> <p>Inv run trip: active output if inverter in emergency mode due to a protection trip.</p> <p>Reference Level: active output; speed reference at the inverter input is higher than the speed reference set with P73 (see Figure 47).</p> <p>Frequency Level: active output; the inverter is generating a higher frequency than the frequency set with P73, independently of the motor direction of rotation (see Figure 48).</p> <p>Forward Running: active output; the inverter is generating a higher frequency than the frequency set with P73 (positive reference; see Figure 48).</p> <p>Reverse Running: active output; the inverter is generating a higher frequency than the one set with P73 (negative reference; see Figure 48).</p> <p>Fout O.K.: active output; the absolute value of the difference between the frequency reference and the output frequency is lower than the value set with P73 "RL2 Level" (Figure 49).</p> <p>Current Level: active output; the inverter output current exceeds the value set with P73 "RL2 Level" (see Figure 50).</p> <p>Limiting: active output; inverter in limiting stage.</p> <p>Motor limiting: active output; the inverter is limited by the motor.</p> <p>Generator lim.: active output; limit during regeneration stage.</p> <p>Frequency Level2: like Frequency Level, but with a hysteresis in the reversed deactivation level, thus allowing unlocking the electromechanical brake at a lower frequency than the brake locking frequency (see Figure 51).</p> <p>Thermal protection: inactive output with motor thermal protection trip.</p>



		Power Level: active output if the delivered power is lower than a threshold expressed as a percentage of the rated motor power (C74).
		Motor Contact.: (output for motor contactor command); output activated as soon as the inverter starts; the motor start is delayed by "ton" delay time. Idc Freq.Level: active output when the braking direct current at start reaches the value set in C86. This output deactivation is similar to the Frequency Level operation. Fan Fault: active output when a fan fault occurs ("P" or "N" models); active output when a fan fault occurs, or when fans are off ("S" models); the output is inactive in any other operating conditions (see Inverter Ratings).



**NOTE**

Select "INV OK OFF" to activate a digital output in an emergency (protection trip; inverter switched off when in emergency mode; inverter turned on with ENABLE contact - terminal 6 - closed and parameter C59 set to [NO]). If "INV OK OFF" is selected, the digital output may be used to control an indicator light or to send emergency signals to the PLC. If "Inv run trip" is selected, the digital output activates only if the inverter enters the emergency mode due to a protection trip. Turn off and on the equipment in emergency mode to deactivate the digital output. In this operating mode, the digital output may be used to control a relay activating a contactor installed on the inverter supply line.



**NOTE**

Use parameter P74 to set a hysteresis for the commutation of a digital output.



**NOTE**

Set C81=YES to enable Idc Freq. Level operating mode. If C81 is not set to Yes, operation in Idc Freq. Level mode is the same as Frequency Level.

<b>P63 MDO ON 5/16</b>	<b>P</b>	P63
delay = **. * s	<b>R</b>	0.0 ÷ 60.0 s
	<b>D</b>	0.0s
	<b>F</b>	Determines the activation delay of the Open Collector digital output.

<b>P64 MDO OFF 6/16</b>	<b>P</b>	P64
delay = **. * s	<b>R</b>	0.0 ÷ 60.0 s
	<b>D</b>	0s
	<b>F</b>	Determines the deactivation delay of the Open Collector digital output.

<b>P65 RL1 ON 7/16</b>	<b>P</b>	P65
delay = **. * s	<b>R</b>	0.0 ÷ 60.0 s
	<b>D</b>	0.0s
	<b>F</b>	Determines the energizing delay of relay RL1.



<u>P66</u> RL1 OFF 8/16	<b>P</b>	P66
delay = *.* s	<b>R</b>	0.0 ÷ 60.0 s
	<b>D</b>	0.0s
	<b>F</b>	Determines the de-energizing delay of relay RL1.

<u>P67</u> RL2 ON 9/16	<b>P</b>	P67
delay = *.* s	<b>R</b>	0.0 ÷ 60.0 s
	<b>D</b>	0.0s
	<b>F</b>	Determines the energizing delay of relay RL2 (electromechanical brake unlocking).

<u>P68</u> RL2 OFF 10/16	<b>P</b>	P68
delay = *.* s	<b>R</b>	0.0 ÷ 60.0 s
	<b>D</b>	0.2s
	<b>F</b>	Determines the de-energizing delay of relay RL2 (electromechanical brake locking).

<u>P69</u> MDO 11/16	<b>P</b>	P69
Level = *.* %	<b>R</b>	0.0 ÷ 200.0%
	<b>D</b>	0.0%
	<b>F</b>	Determines the value for the activation of the Open collector digital output for the following settings: "Reference Level", "Frequency Level", "Frequency Level2", "Forward Running", "Reverse Running", "Current level", "Fout O.K.".

<u>P70</u> MDO. Fr. 12/16	<b>P</b>	P70
hyst. = *.* %	<b>R</b>	0.0 ÷ 200.0%
	<b>D</b>	0.0%
	<b>F</b>	When the Open Collector digital output is set as "Reference Level", "Frequency Level", "Forward Running", "Reverse Running", "Current Level", "Fout O.K.", this parameter determines the digital output hysteresis range. If the hysteresis is other than 0, the value set with P69 when the variable set with P60 increases determines the output commutation; when the output decreases, commutation occurs when the value set in P69-P70 is reached (Example: Set P60 = "Frequency Level", P69 = 50%, P70 = 10%; the digital output activates when 50% of the maximum preset output frequency is reached and deactivates when 40% is reached). If P70 = 0, commutation occurs when the value set in P69 is reached.

<u>P71</u> RL1 13/16	<b>P</b>	P71
Level = *.* %	<b>R</b>	0.0 ÷ 200.0%
	<b>D</b>	0.0 %
	<b>F</b>	Determines the value for the activation of relay digital output RL1 for the following settings: "Reference Level", "Frequency Level", "Frequency Level2", "Forward Running", "Reverse Running", "Current Level", "Fout O.K.".



<u>P72 RL1 14/16</u>	<b>P</b>	P72
hyst. = ***.* %	<b>R</b>	0.0 ÷ 200.0%
	<b>D</b>	0.0 %
	<b>F</b>	When digital output relay RL1 is set as "Reference Level", "Frequency Level", "Forward Running", "Reverse Running", "Current Level", "Fout O.K.", this parameter determines the digital output hysteresis range. If the hysteresis is other than 0, the value set with P71 when the variable set with P61 increases determines the output commutation; when the output decreases, commutation occurs when the value set in P71-P72 is reached (Example: Set P61 = "Frequency Level", P71 = 50%, P72 = 10%; the digital output activates when 50% of the maximum preset output frequency is reached and deactivates when 40% is reached). If P72 = 0, commutation occurs when the value set in P71 is reached.

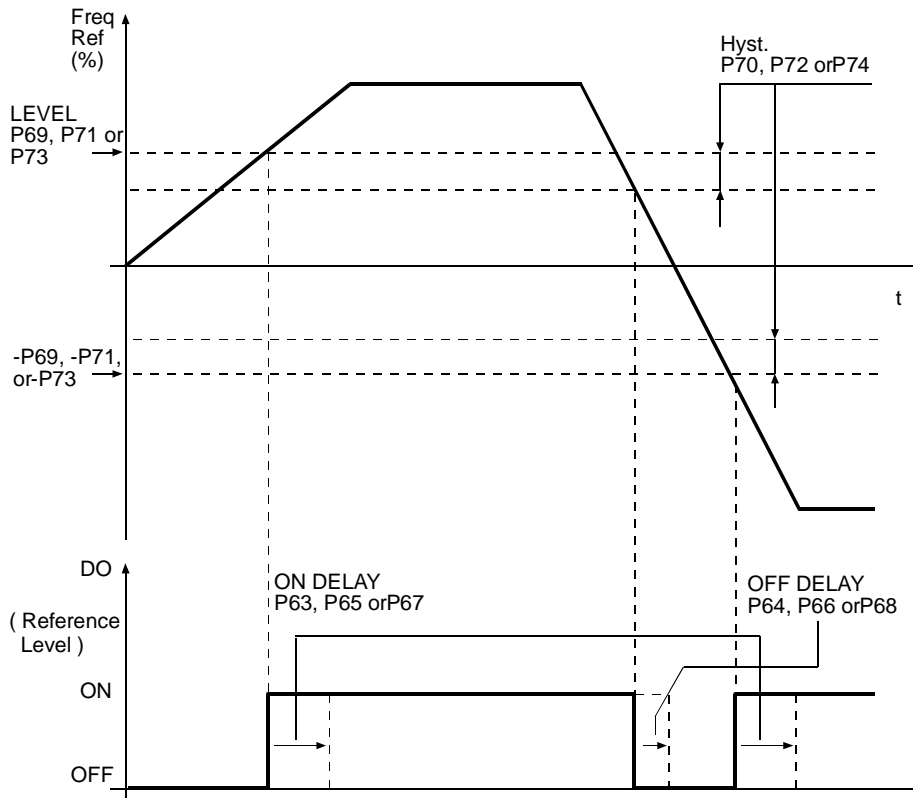
<u>P73 RL2 15/16</u>	<b>P</b>	P73
level = ***.* %	<b>R</b>	0 ÷ 200%
	<b>D</b>	0.2 %
	<b>F</b>	Determines the value for the activation of relay digital output RL2 for the following settings: "Reference Level", "Frequency Level", "Frequency Level2", "Forward Running", "Reverse Running", "Current Level", "Fout O.K.". <b>(Level enabling brake unlocking)</b>

<u>P74 RL2 16/16</u>	<b>P</b>	P74
hyst. = *.*** %	<b>R</b>	0 ÷ 200%
	<b>D</b>	0.1 %
	<b>F</b>	When relay digital output RL2 is set as "Reference Level", "Frequency Level", "Forward Running", "Reverse Running", "Current Level", "Fout O.K.", this parameter determines the digital output hysteresis range. If the hysteresis is other than 0, the value set with P73 when the variable set with P62 increases determines the output commutation; when the output decreases, commutation occurs when the value set in P73-P74 is reached (Example: Set P62 = "Frequency level", P73 = 50%, P74 = 10%; the digital output activates when 50% of the maximum preset output frequency is reached and deactivates when 40% is reached). If P74 = 0, commutation occurs when the value set in P73 is reached. <b>(Hysteresis disabling brake unlocking)</b>



**NOTE**

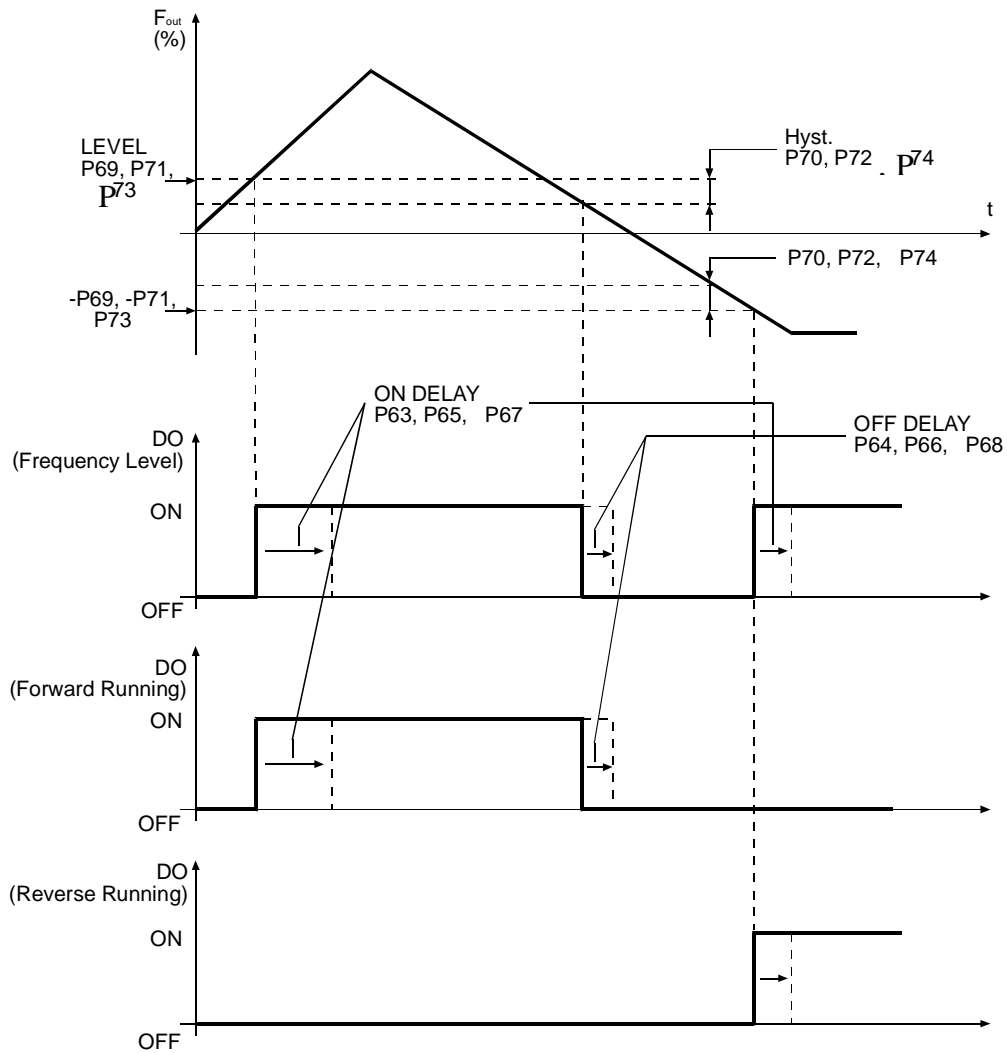
The figures below show the characteristics of a digital output for particular settings.



**PART 2**

Figure 47: Characteristics of a digital output programmed as "Reference Level" and characteristics of the frequency reference in respect to time.

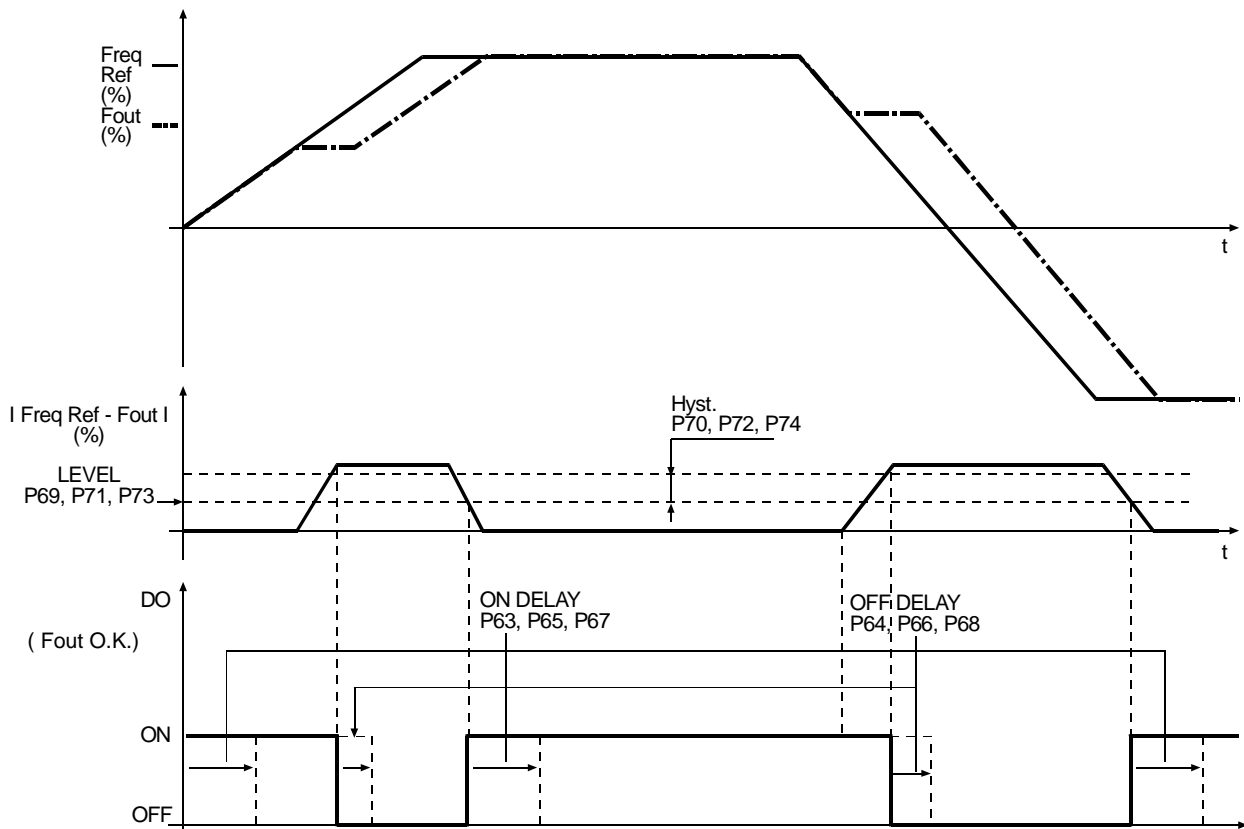
Parameters used: P63 "MDO ON Delay", P64 "MDO OFF Delay", P65 "RL1 ON Delay", P66 "RL1 OFF Delay", P67 "RL2 ON Delay", P68 "RL2 OFF Delay", P69 "MDO Level", P70 "MDO Hyst", P71 "RL1 Level", P72 "RL1 Hyst.", P73 "RL2 Level", P74 "RL2 Hyst."



**Figure 48: Characteristics of a digital output programmed as "Frequency Level", as "Forward Running", and as "Reverse Running" of the output frequency in respect to time.**

A negative output frequency reverses the direction of rotation. Parameters used: P63 "MDO ON Delay", P64 "MDO OFF Delay", P65 "RL1 ON Delay", P66 "RL1 OFF Delay", P67 "RL2 ON Delay", P68 "RL2 OFF Delay", P69 "MDO Level", P70 "MDO Hyst", P71 "RL1 Level", P72 "RL1 Hyst.", P73 "RL2 Level", P74 "RL2 Hyst."

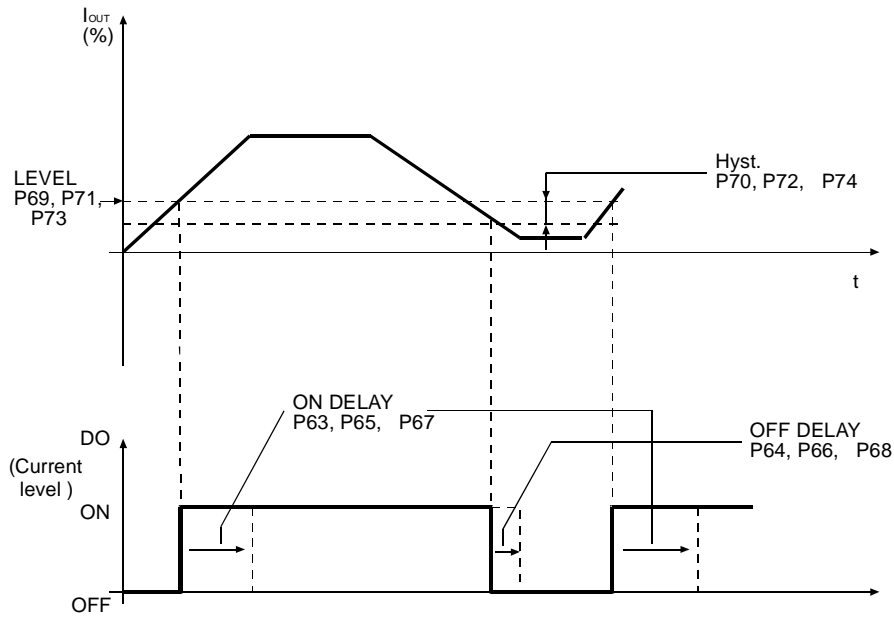




**PART 2**

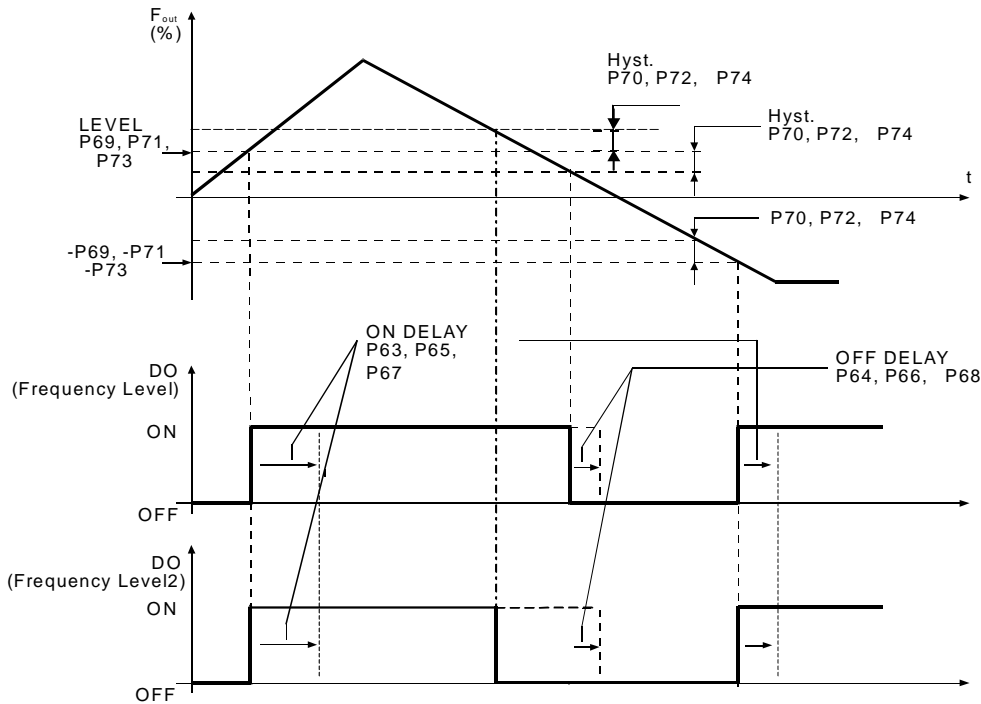
**Figure 49: Characteristics of a digital output programmed as "Fout O.K.", characteristics of the frequency reference, characteristics of the output frequency, and characteristics of the difference between reference and output frequency in respect to time.**

Parameters used: P63 "MDO ON Delay", P64 "MDO OFF Delay", P65 "RL1 ON Delay", P66 "RL1 OFF Delay", P67 "RL2 ON Delay", P68 "RL2 OFF Delay", P69 "MDO Level", P70 "MDO Hyst.", P71 "RL1 Level", P72 "RL1 Hyst.", P73 "RL2 Level", P74 "RL2 Hyst."



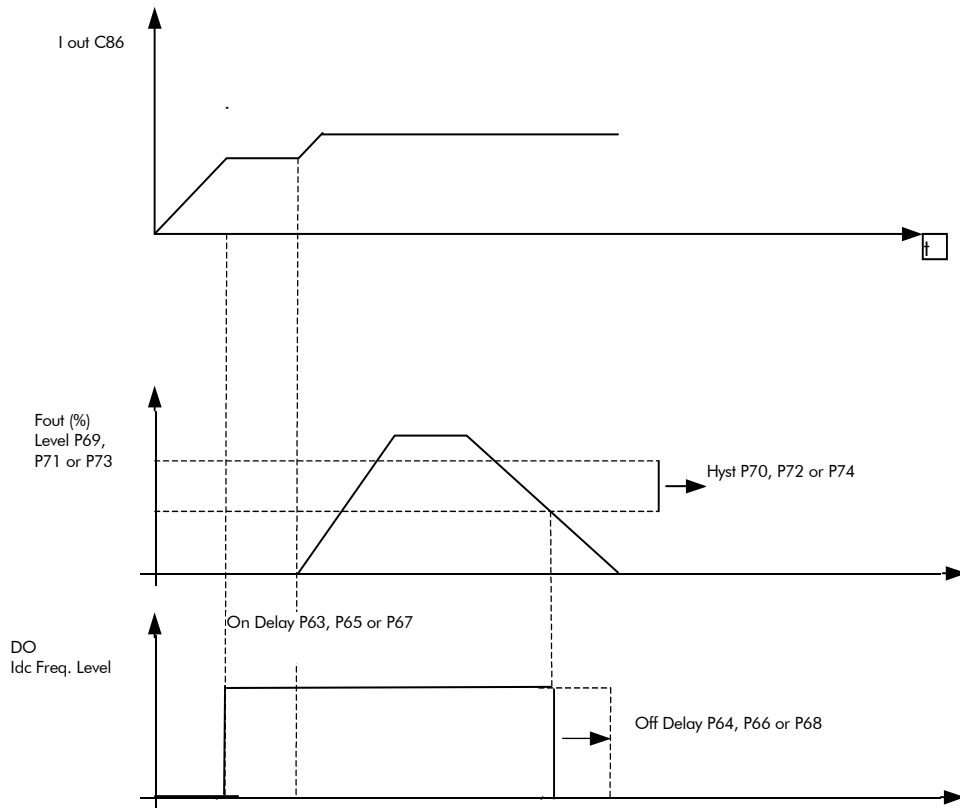
**Figure 50: Characteristics of a digital output programmed as "Current Level" and characteristics of the output frequency in respect to time.**

Parameters used: P63 "MDO ON Delay", P64 "MDO OFF Delay", P65 "RL1 ON Delay", P66 "RL1 OFF Delay", P67 "RL2 ON Delay", P68 "RL2 OFF Delay", P69 "MDO Level", P70 "MDO Hyst", P71 "RL1 Level", P72 "RL1 Hyst.", P73 "RL2 Level", P74 "RL2 Hyst."



**Figure 51: Characteristics of a digital output programmed as "Frequency Level" compared to "Frequency Level2" programming in respect to output frequency variation in time.**

A negative output frequency reverses the direction of rotation. For "Frequency Level2", the digital output deactivates at a frequency level higher than the freq. level for the activation of the variable defined in the hysteresis parameter. Parameters used: P63 "MDO ON Delay", P64 "MDO OFF Delay", P65 "RL1 ON Delay", P66 "RL1 OFF Delay", P67 "RL2 ON Delay", P68 "RL2 OFF Delay", P69 "MDO Level", P70 "MDO Hyst", P71 "RL1 Level", P72 "RL1 Hyst.", P73 "RL2 Level", P74 "RL2 Hyst."



**PART 2**

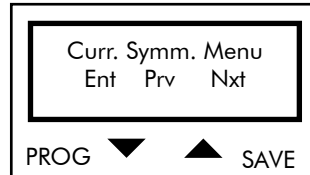
**Figure 52: Characteristics of a digital output programmed as "Idc Freq. Level" in respect to output current variations and output frequency variations in time.**

Parameters used: P63 "MDO ON DELAY", P64 "MDO OFF DELAY", P65 "RL1 On Delay", "RL1 ON DELAY", P68 "OFF DELAY", P69 "MDO LEVEL", P70 "MDO HYST", P71 "RL1 LEVEL", P72 "RL1 HYST", P73 "RL2 LEVEL" P74 RL2 HYST", C86 "DCB Start CURR".

## 9.1.10. CURRENT SYMMETRY SUBMENU

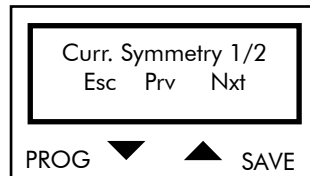
The Current Symmetry submenu allows adjusting the waveform of the output current.

### Access page



Press PROG to enter the Carrier Symmetry submenu. Press  $\uparrow$  and  $\downarrow$  to scroll through the other submenus.

### First page



Press PROG to quit the Carrier Symmetry submenu; press  $\downarrow$  and  $\uparrow$  to scroll through the parameters.

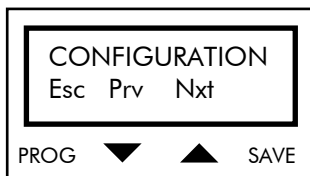
### PARAMETERS IN THE CURRENT SYMMETRY SUBMENU

P80 Current 2/2	<b>P</b>	P80
Symmetry = *** %	<b>R</b>	-100% ÷ +100%
	<b>D</b>	0%
	<b>F</b>	This parameter affects 3-phase output current balancing. It should be used when current dissymmetry occurs in the connected motor, especially in no-load conditions and when the motor rotates at low rpm.

## 9.2. CONFIGURATION MENU

The Configuration menu contains the Cxx parameters that can be altered when the inverter is not running. P00 must always be =1 (default) to enable parameter alteration.

First page

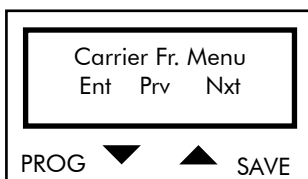


Press PROG to return to the page for the selection of the main menus; press ↑ and ↓ to scroll through the submenus.

### 9.2.1. CARRIER FREQUENCY SUBMENU

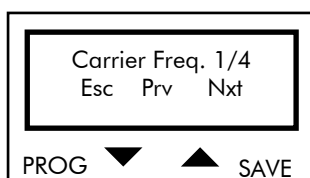
The Carrier Frequency submenu determines the frequency for PWM modulation generated by the inverter.

Access page



Press PROG to enter the Carrier Frequency submenu. Press ↑ and ↓ to scroll through the other submenus.

First page



Press PROG to quit the Carrier Frequency submenu; press ↓ and ↑ to scroll through the parameters.

#### PARAMETERS IN THE CARRIER FREQUENCY SUBMENU

C01 Min Carr. 2/5	P	C01
Freq = *** kHz	R	0.6 kHz ÷ C02
	D	Column "Carrier def" in configuration table for LIFT SW parameters (see Table 1).
	F	Minimum value of PWM modulation frequency.

C02 Max Carr. 3/5	P	C02
Freq = **. * kHz	R	C01 ÷ Column "Carrier max" in configuration table for LIFT SW parameters (see Table 1).
	D	Column "Carrier def" in configuration table for LIFT SW parameters (see Table 1).
	F	Maximum value of PWM modulation frequency.

**PART 2**



C03 Pulse 4/5	<b>P</b>	C03
Number **	<b>R</b>	12, 24, 48, 96, 192, 384
	<b>D</b>	24
	<b>F</b>	Number of pulses generated by PWM modulation when switching from the min. frequency of PWM modulation to the max. frequency of PWM modulation.
C03a Silent M. 5/5	<b>P</b>	C03a
NO [YES]	<b>R</b>	NO, YES
	<b>D</b>	YES
	<b>F</b>	Allows silent PWM modulation.



**NOTE** Parameter C03a = YES must be set to output frequency values under 200Hz.



**NOTE** Increasing carrier frequency increases the inverter leakage. The carrier increase in respect to the default value may cause the inverter protection to trip. Carrier should be increased in the following cases only: uneven operation, output current lower than rated current, supply voltage lower than maximum voltage, ambient temperature lower than 40°C.

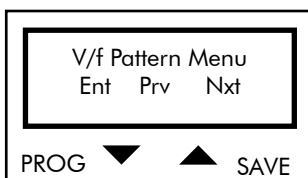


**NOTE** See the CARRIER FREQUENCY section for more details.

### 9.2.2. V/F PATTERN SUBMENU

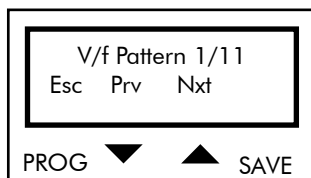
The V/f pattern submenu determines the V/f characteristic for the inverter operation. See the V/F PATTERN section for more details.

**Access page**



Press PROG to enter the V/F Pattern submenu. Press ↓ and ↑ to scroll through the other submenus of the Configuration menu.

**First page**



Press PROG to quit the V/F Pattern submenu. Press ↓ and ↑ to scroll through the parameters.

**PARAMETERS IN THE V/F PATTERN SUBMENU**

<u>C04</u> V/f Patt. 2/11	<b>P</b>	C04
I mot. = *** A	<b>R</b>	1A ÷ Column "Inom" in configuration table for LIFT SW parameters (see Table 1).
	<b>D</b>	Column "Imot" in configuration table for LIFT SW parameters (see Table 1).
	<b>F</b>	Rated current of the connected motor.

<u>C05</u> V/f Patt. 3/11	<b>P</b>	C05
Fmot = *** Hz	<b>R</b>	12.6 ÷ 800 Hz
	<b>D</b>	50 Hz
	<b>F</b>	Rated motor frequency relating to the v/f pattern. Determines switching from the inverter operation at constant V/f to the inverter operation at constant V.

<u>C06</u> V/f Patt. 4/11	<b>P</b>	C06
Fomax = *** Hz	<b>R</b>	12.6 ÷ 800 Hz
	<b>D</b>	60 Hz
	<b>F</b>	Maximum output current relating to the voltage/frequency pattern. Inverter output frequency at maximum reference value.

**PART 2**



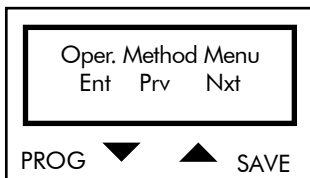
<u>C07</u> V/f Patt. 5/11	<b>P</b>	C07
Fomin = *** Hz	<b>R</b>	0.1 ÷ 5Hz
	<b>D</b>	0.1 Hz
	<b>F</b>	Minimum output frequency relating to the V/f pattern. Minimum frequency generated at the inverter output (can be altered only after contacting Elettronica Santerno).
<u>C08</u> V/f Patt. 6/11	<b>P</b>	C08
Vmot = *** V	<b>R</b>	5 ÷ 500V (2T, 4T class)
	<b>D</b>	230V for 2T class 400V for 4T class
	<b>F</b>	Rated motor frequency relating to the V/f pattern. Determines output voltage at rated motor frequency.
<u>C09</u> V/f Patt. 7/11	<b>P</b>	C09
BOOST = *** %	<b>R</b>	-100% ÷ +400%
	<b>D</b>	50 %
	<b>F</b>	Torque compensation at low rpm. Determines output voltage increment at low output frequency in respect to a constant V/f ratio.
<u>C10</u> V/f Patt. 8/11	<b>P</b>	C10
PREBOOST = *.* %	<b>R</b>	0.0 ÷ 5.0%
	<b>D</b>	1.0%
	<b>F</b>	Torque compensation at low rpm. Determines output voltage at 0Hz.
<u>C11</u> V/f Patt. 9/11	<b>P</b>	C11
Auto bst = *** %	<b>R</b>	0.0 ÷ 10.0%
	<b>D</b>	2.5 %
	<b>F</b>	AUTOBOOST: variable torque compensation expressed as a percentage of the rated motor voltage (C08). The value set for C11 represents the voltage increment when the motor runs with the rated torque.
<u>C12</u> V/f Patt. 10/11	<b>P</b>	C12
Freqbst = *** %	<b>R</b>	6 ÷ 99 %
	<b>D</b>	50%
	<b>F</b>	FREQ.BOOST: Frequency (expressed as a percentage of C05) for which increment voltage is equal to the value set in C13.
<u>C13</u> V/f Patt. 11/11	<b>P</b>	C13
B. mf = *** %	<b>R</b>	-100% ÷ +400%
	<b>D</b>	3 %
	<b>F</b>	Torque compensation at intermediate frequency C12. Determines the increase of the output voltage at intermediate frequency with a constant frequency voltage.



### 9.2.3. OPERATION METHOD SUBMENU

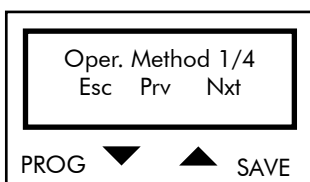
The Operation Method submenu determines the inverter control mode and the speed sensor ratings.

Access page



Press PROG to enter the Operation Method submenu. Press ↓ and ↑ to scroll through the other submenus of the Configuration menu.

First page



Press PROG to quit the Operation Method submenu. Press ↓ and ↑ to scroll through the parameters.

#### PARAMETERS IN THE OPERATION METHOD SUBMENU

<u>C21</u> Standard 2/4	P	C21
Speed = ***	R	Single, Double, Double A
	D	Single
	F	STANDARD SPEED: Toggles between single contractual speed P41 and dual contractual speed: standard speed (P41) and low speed (P42) (this parameter is useful for low interfloors).

<u>C22</u> ENCODER 3/4	P	C22
NO [YES]	R	YES, NO
	D	NO
	F	Enables speed sensor readout and speed regulator operation.



**CAUTION**

Whenever C22 is set from YES to NO and vice versa, parameters P07, P08, P09, P10, P42, P43, P44 are automatically restored to their default value relating to C22 programming (encoder installed or not installed). Parameter C22 is always to be programmed first. Before starting the motor, always make sure that P07 (ACCELERATION), P08 (DECELERATION), P09 (STOP RAMP), P10 (JERK), P42 (LOW SPEED), P43 (MAINTENANCE SPEED), and P44 (RATED SPEED) are set at the desired value.



**NOTE**

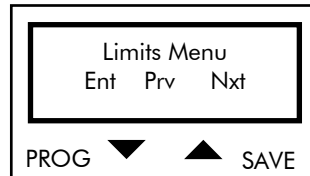
If set to YES, parameter C22 enables ENCODER alarms: A15 Encoder Failure and A16 Speed Error.

<u>C23</u> ENCODER 4/4	P	C23
PULSES = ***ppr	R	100 ÷ 10000 ppr
	D	1024 ppr
	F	Encoder pls/rev.

## 9.2.4. LIMITS SUBMENU

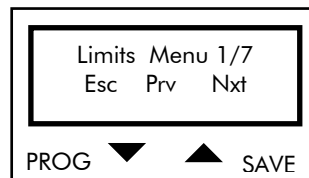
The Limits submenu determines current limit operation while accelerating and at constant frequency, and determines the voltage limit operation while decelerating.

### Access page



Press PROG to enter the Limits submenu. Press ↓ and ↑ to scroll through the other submenus of the Configuration menu.

### First page



Press PROG to quit the Limits submenu. Press ↓ and ↑ to scroll through the parameters.

### PARAMETERS IN THE LIMITS SUBMENU

<u>C40</u> Acc. Lim. 2/7	<b>P</b>	C40
NO [YES]	<b>R</b>	NO, YES
	<b>D</b>	YES
	<b>F</b>	Enables current limit while accelerating.

<u>C41</u> Acc. Lim. 3/7	<b>P</b>	C41
Curr. = *** %	<b>R</b>	50 ÷ 400% Important: the maximum programmable value is equal to (Imax/Imot)*100. See configuration table for LIFT SW parameters (see Table 1).
	<b>D</b>	Column C41 Default in configuration table for LIFT SW parameters (see Table 1).
	<b>F</b>	Current limit while accelerating expressed as a percentage of the rated motor current.

<u>C42</u> Run. Lim. 4/7	<b>P</b>	C42
No [YES]	<b>R</b>	NO, YES
	<b>D</b>	YES
	<b>F</b>	Enables current limit at constant frequency.

<u>C43</u> Run. Lim. 5/7	<b>P</b>	C43
Curr. = *** %	<b>R</b>	50 ÷ 400% Important: the maximum programmable value is equal to (Imax/Imot)*100. See configuration table for LIFT SW parameters (see Table 1).
	<b>D</b>	Column C43 Default in configuration table for LIFT SW parameters (see Table 1).
	<b>F</b>	Current limit while accelerating expressed as a percentage of the rated motor current.

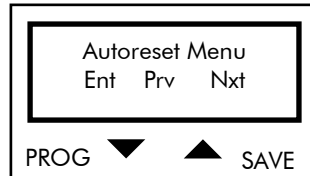


C44 Dec. Lim. 6/7 NO [YES]	P	C44
	R	NO, YES
	D	YES
	F	Enables voltage/current limit while decelerating. If current exceeds the value set in C43 or DC bus voltage exceeds a given value (voltage class function), the deceleration ramp will be longer.
C45 Dec. Lim. 7/7 Curr. = *** %	P	C45
	R	50÷400% Important: the maximum programmable value is equal to $(I_{max}/I_{mot}) \cdot 100$ . See configuration table for LIFT SW parameters (see Table 1).
	D	Column C43 Default in configuration table for LIFT SW parameters (see Table 1).
	F	Current limit while decelerating expressed as a percentage of the rated motor current.

## 9.2.5. AUTORESET SUBMENU

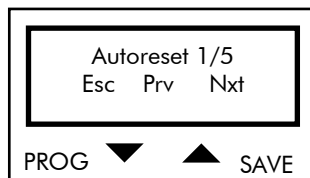
The Autoreset submenu enables the automatic reset of the equipment when alarms trip. Autoreset attempts may be set in a given time interval.

### Access page



Press PROG to enter the Autoreset submenu. Press ↓ and ↑ to scroll through the other submenus of the Configuration menu.

### First page



Press PROG to quit the Autoreset submenu. Press ↓ and ↑ to scroll through the parameters.

### PARAMETERS IN THE AUTORESET SUBMENU

<u>C50</u> Autores. 2/5	P	C50
[NO] YES	R	NO, YES
	D	NO
	F	Activates or deactivates the autoreset function.

<u>C51</u> Attempts 3/5	P	C51
Number = *	R	1 ÷ 10
	D	4
	F	Determines the number of automatic reset operations performed before locking the autoreset function. Autoreset count starts from 0 after a time period longer than the one set in C52.
<u>C52</u> Clear fail 4/5	P	C52
count time ***s	R	1 ÷ 999s
	D	300s
	F	Determines the time interval clearing the autoreset count if no alarm trips.

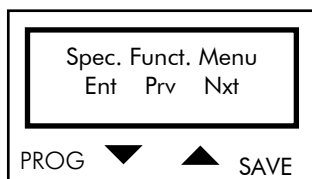
<u>C53</u> PWR 5/5	P	C53
Reset ***	R	NO, YES
	D	NO
	F	Set this parameter to YES to automatically reset an alarm by switching off and on the inverter.

## 9.2.6. SPECIAL FUNCTION SUBMENU

The Special Function submenu includes the following:

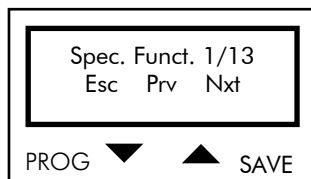
- storage of mains failure alarm if mains failure causes the equipment power off;
- operating mode of built-in braking module (if any);
- operating mode of the ENABLE command;
- page displayed at power on.

### Access page



Press PROG to enter the Special Function submenu. Press ↓ and ↑ to scroll through the other submenus of the Configuration menu.

### First page



Press PROG to quit the Special Function submenu. Press ↓ and ↑ to scroll through the parameters.



**PARAMETERS IN THE SPECIAL FUNCTION SUBMENU**

C54 MainsNom 2/13 ***	P	C54
	R	200÷240V cannot be altered (2T class) 380÷480V, 481÷500V (4T class)
	D	200÷240V (2T class) 380÷480V (4T class)
	F	This parameter sets the range for the rated mains voltage. It affects the following: Undervoltage and Overvoltage alarms; Mains Loss alarm; control of the braking unit; voltage limiting.

C55 Brake U. 3/13 [NO] YES	P	C55
	R	YES, NO
	D	YES
	F	Braking module enabling or disabling (built-in or external braking module).

C56 Brake 4/13 Disab. = *****ms	P	C56
	R	0÷65400 ms
	D	30000 ms
	F	"OFF" time of the built-in braking module. C56=0 means that the braking module is always ON; if also C57=0, the braking module is always OFF.

C57 Brake U. 5/13 Enable = *****ms	P	C57
	R	0÷65400 ms
	D	30000 ms
	F	"ON" time of the built-in braking module. C57=0 means that the braking module is always OFF (regardless of C56 programming).



**DANGER**

Do not exceed the values stated in the BRAKING RESISTORS section for the programming of C56 and C57.



C58 Mains L.M. 6/13	P	C58
[NO] YES *	R	NO, YES
	D	NO
	F	Stores any alarm relating to mains failure (A30 and A31) causing the equipment power off. When power supply is restored, send a RESET command to reset the alarms tripped.

C59 ENABLE 7/13	P	C59
[NO] YES	R	NO, YES
	D	NO
	F	Operation of ENABLE command (terminal 6) at power on or when a RESET command is sent. YES: ENABLE activated at power on; if terminal 6 is closed and a speed reference other than 0 is sent, that starts the equipment, the motor starts a few seconds after the equipment is powered on (or after a RESET command is executed). NO: ENABLE command deactivated at power on or after RESET; if terminal 6 is closed and a speed reference other than 0 is sent, that starts the equipment, the motor does not start at power on or after an alarm RESET until terminal 6 is opened and closed again. When this occurs, the display shows "TO START OPEN AND CLOSE TERM 6".



**DANGER**

Setting parameter C59 to YES may start the motor as soon as the inverter is turned on!

C60 Encoder 8/13	P	C60
Err.Thr = ***%	R	0 ÷ 100%
	D	0%
	F	Maximum ratio of the difference between the expected speed and the measured speed for Encoder Failure alarm (A15) trip. Set C60 = 0 to disable alarm A15.

C61 Speed 9/13	P	C61
Err.Thr = ****rpm	R	0 ÷ 4000rpm
	D	0
	F	Determines the speed value for alarm A16 ("Speed Error") trip. Set C61 = 0 to disable the alarm.



**NOTE**

C60 and C61 are effective only if C22 is set to YES. If C22 is set to NO, alarms A15 and A16 are locked.

C62 STOP 10/13	P	C62
SWITCH = ****mm	R	0 ÷ 200mm
	D	0
	F	Max. distance covered by the cage after the stop switch. Set C62 = 0 to disable this function. This function is effective only if the ENCODER is installed.



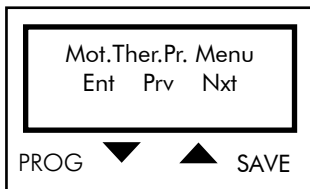
<u>C63</u> Slowing 11/13	<b>P</b>	C63
Down D.	<b>R</b>	0 ÷ 4000 ms
	<b>D</b>	0 ms
	<b>F</b>	Acquisition delay of slowing-down command.
<u>C64</u> Auto.Rs. 12/13	<b>P</b>	C64
	<b>R</b>	NO; YES
	<b>D</b>	[YES]
	<b>F</b>	Enables stator resistance autotuning. Stator resistance autotuning is performed whenever DC braking occurs.
<u>C65</u> Current 13/13	<b>P</b>	C65
Thr. = *** %	<b>R</b>	0 ÷ 100%
	<b>D</b>	0
	<b>F</b>	Current threshold (expressed as a percentage of C04) for the activation of alarm A24 when one of the digital outputs is allocated to the control of the electromechanical brake. If set to 0, alarm A24 is locked.



### 9.2.7. MOTOR THERMAL PROTECTION SUBMENU

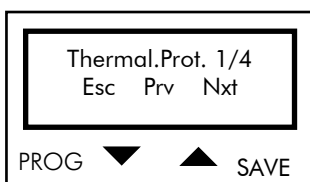
The Motor Thermal Protection submenu determines the parameters relating to the software thermal protection of the motor. See the MOTOR THERMAL PROTECTION section for details.

Access page



Press PROG to enter the Motor Thermal Protection submenu. Press ↓ and ↑ to scroll through the other submenus of the Configuration menu.

First page



Press PROG to quit the Motor Thermal Protection submenu. Press ↓ and ↑ to scroll through the parameters.

#### PARAMETERS IN THE MOTOR THERMAL PROTECTION SUBMENU

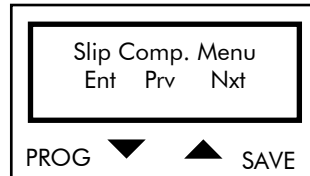
<u>C70</u> Thermal P. 2/4	<b>P</b>	C70
***	<b>R</b>	NO, YES, YES A, YES B
	<b>D</b>	NO
	<b>F</b>	Activates the motor thermal protection. NO: Motor thermal protection disabled. YES: Motor thermal protection enabled with pick-up current independent of output frequency. YES A: Motor thermal protection enabled with pick-up current depending on output frequency, with forced air-cooling system. YES B: Motor thermal protection enabled with pick-up current depending on output frequency, with a fan keyed to the motor shaft.
<u>C71</u> Motor 3/4	<b>P</b>	C71
current =****%	<b>R</b>	1% ÷ 120%
	<b>D</b>	105%
	<b>F</b>	Determines the pick-up current expressed as a percentage of the rated motor current.
<u>C72</u> M. Therm. 4/4	<b>P</b>	C72
const. =****s	<b>R</b>	5 ÷ 3600s
	<b>D</b>	600s
	<b>F</b>	Determines the motor thermal time constant.

**PART 2**

## 9.2.8. SLIP COMPENSATION SUBMENU

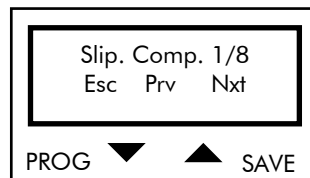
The Slip Compensation submenu determines the parameters relating to the slip compensation function. See the SLIP COMPENSATION section for more details.

### Access page



Press PROG to enter the Slip Compensation submenu. Press ↓ and ↑ to scroll through the submenus of the Configuration menu.

### First page



Press PROG to quit the Slip Compensation submenu. Press ↓ and ↑ to scroll through the parameters.

### PARAMETERS IN THE SLIP COMPENSATION SUBMENU

<u>C73</u> Motor 2/8	<b>P</b>	C73
Poles = **	<b>R</b>	2, 4, 6, 8, 10, 12, 14, 16
	<b>D</b>	4
	<b>F</b>	Number of the motor poles. It determines the rated motor speed in conjunction with the rated frequency.

<u>C74</u> Motor 3/8	<b>P</b>	C74
Power =****kW	<b>R</b>	0 ÷ 1000 kW
	<b>D</b>	Column Pnom in Table 1.
	<b>F</b>	Motor Power: rated motor power. Determines the rated torque in conjunction with the rated frequency (C05).

<u>C75</u> No Load 4/8	<b>P</b>	C75
Power =**.*kW	<b>R</b>	0 ÷ 1000 kW
	<b>D</b>	0.0kW
	<b>F</b>	No load power: No-load power of the motor running at rated frequency. In conjunction with Joule loss (estimated based on stator resistance C78 and stator current detection), it allows mechanical power estimation.

<u>C76</u> Low Speed 5/8	<b>P</b>	C76
Slip = ***%	<b>R</b>	0 ÷ 17.5%
	<b>D</b>	0%
	<b>F</b>	Low speed slip: rated current slip at approach speed (P40).



C77 High speed 6/8	P	C77
Sleep =***%	R	0 ÷ 17.5%
	D	0%
	F	High speed slip: rated slip (slip at rated current and rated frequency (C05) ).

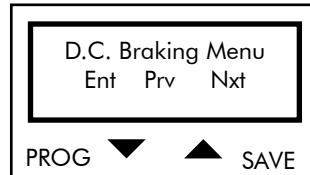
C78 Stator 7/8	P	C78
Res =*. *Ohm	R	0 ÷ 8.5 Ω
	D	See C78 in config. table for LIFT SW parameters (see Table 1).
	F	Stator resistance: stator phase resistance (may vary during autotuning).

C79 Slip 8/8	P	C79
Ffilter =***	R	-20 ÷ 100
	D	10
	F	Slip filter: number of samples per digital filter over estimated motor torque.

### 9.2.9. D.C. BRAKING SUBMENU

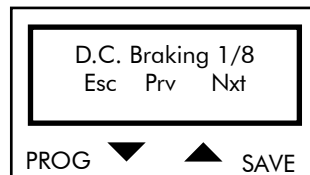
The D.C. Braking submenu includes the parameters relating to direct current braking. See the DC BRAKING section for details.

Access page



Press PROG to enter the D.C. Braking submenu. Press ↓ and ↑ to scroll through the other submenus of the Configuration menu.

First page



Press PROG to quit the D.C. Braking submenu. Press ↓ and ↑ to scroll through the parameters.

#### PARAMETERS IN THE D.C. BRAKING SUBMENU

<u>C80</u> DCB Stop 2/9	<b>P</b>	C80
[NO] YES	<b>R</b>	NO, YES
	<b>D</b>	YES
	<b>F</b>	Determines if DC braking is enabled at the end of the deceleration ramp.

<u>C81</u> DCB Start 3/9	<b>P</b>	C81
[NO] YES	<b>R</b>	NO, YES
	<b>D</b>	NO
	<b>F</b>	Determines if DC braking is enabled before performing the acceleration ramp.

<u>C82</u> DCB Time 4/9	<b>P</b>	C82
at STOP =*.**s	<b>R</b>	0.1 ÷ 50s
	<b>D</b>	1s
	<b>F</b>	Determines DC braking time after the deceleration ramp.

<u>C83</u> DCB Time 5/9	<b>P</b>	C83
at Start =*.**s	<b>R</b>	0.1 ÷ 50s
	<b>D</b>	0.5s
	<b>F</b>	Determines DC braking time before the acceleration ramp.



C84 DCB Freq 6/9 at STOP =*. ** Hz	P	C84
	R	0 ÷ 10 Hz
	D	0.50 Hz
	F	Determines the output frequency for DC braking at stop.

C85 DCB Curr. 7/9 ldcb = ***%	P	C85
	R	1 ÷ 400% Important: the maximum programmable value is equal to (Imax/Imot)*100 (see Table 1).
	D	140%
	F	Determines DC braking intensity expressed as a percentage of the rated motor current.

C86 DCB Start 8/9 Curr = MAX%	P	C87
	R	0 ÷ 400% Important: the maximum programmable value is equal to (Imax/Imot)*100 (see Table 1).
	D	140%
	F	Determines the intensity of DC braking at start expressed as a percentage of the rated motor current.

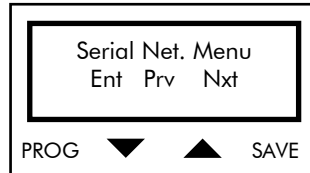
C87 DCB Curr. 9/9 Rot.Pprevent. ***	P	C86
	R	0 ÷ 40
	D	0
	F	Determines a command locking the motor rotation after a stop command. The preset value is the intensity of this manoeuvre. This parameter is effective only if DC braking at stop is enabled (C80=YES) and C85 is other than zero.

**PART 2**

## 9.2.10. SERIAL NETWORK SUBMENU

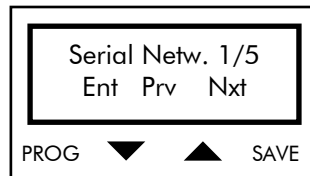
The Serial Network submenu determines the parameters relating to serial communications.

### Access page



Press PROG to enter the Serial Network submenu. Press ↓ and ↑ to scroll through the other submenus of the Configuration menu.

### First page



Press PROG to quit the Serial Network submenu. Press ↓ and ↑ to scroll through the parameters.

### PARAMETERS IN THE SERIAL NETWORK SUBMENU

<u>C90</u> Serial Netw. 2/5	<b>P</b>	C90
Address = *	<b>R</b>	1 ÷ 247
	<b>D</b>	1
	<b>F</b>	Determines the address assigned to the inverter networked through RS485.

<u>C91</u> Serial 3/5	<b>P</b>	C91
Delay = *** ms	<b>R</b>	0 ÷ 2000 ms
	<b>D</b>	0 ms
	<b>F</b>	Determines the inverter response delay after a master query through RS485 link.

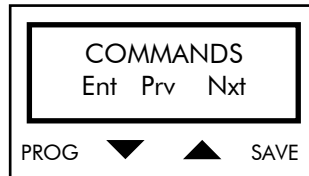
<u>C92</u> RTU Time 4/5	<b>P</b>	C92
Out= *** ms	<b>R</b>	0 ÷ 2000 ms
	<b>D</b>	0 ms
	<b>F</b>	When the inverter is ready to receive a message, if no character is sent for the preset time period, the message sent from the master device is considered as complete.

<u>C93</u> Baud Rate 5/5	<b>P</b>	C93
Rate= *** baud	<b>R</b>	1200, 2400, 4800, 9600 baud
	<b>D</b>	9600 baud
	<b>F</b>	Sets the baud rate expressed in bits per second.

### 9.3. COMMANDS MENU

Enables restoring factory setting (Restore Default Submenu) and storing all the inverter parameters (Save User's Parameters Submenu).

First page

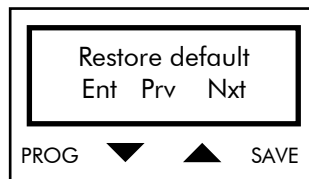


Press PROG to return to the page for the selection of the main menus; press ↑ and ↓ to scroll through the submenus.

#### 9.3.1. RESTORE DEFAULT SUBMENU

The Restore Default submenu allows the default parameters in the MEAS/PARAMETERS menu and the CONFIGURATION menu to be automatically restored.

Access page



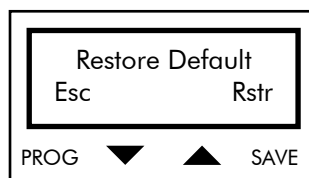
Press PROG to access the submenu: press ↑ and ↓ to scroll through the other submenus of the Commands menu.



**NOTE**

To access the Restore Default submenu, set parameter P01 ( see section Key Parameter) to 1. The inverter must not be in RUN mode.

First page

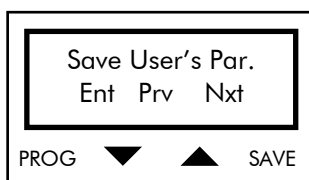


Press PROG (Esc) to quit the Restore Default submenu. Press SAVE to automatically restore the default parameters. The square brackets indicate that parameter restoration is occurring; when square brackets disappear (after a few seconds), parameter restoration is over.

### 9.3.2. SAVE USER'S PARAMETERS SUBMENU

The Save User's Parameters submenu allows storing all the active parameters to non-volatile memory (EEPROM).

#### Access page



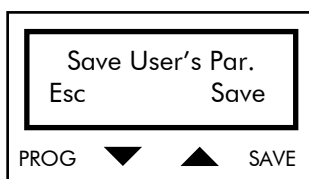
Press PROG to enter the Save User's Parameters submenu. Press ↑ and ↓ to scroll through the other submenus.



#### NOTE

To access the Save User's Parameters submenu, set parameter P01 (see section Key Parameter) to 1. The inverter must not be in RUN mode.

#### First page



Press PROG to quit the Save User's Parameters submenu; press SAVE to save all the parameters. The square brackets indicate that parameters are being saved to Eeprom; when square brackets disappear (after a few seconds), parameter saving is over.





## 9.4. CONFIGURATION TABLE FOR LIFT SW PARAMETERS

SIZE	SINUS K MODEL	C04 (Imot) def [A]	Inverter Inom [A]	Inverter Imax [A]	C01/02 (Carrier) [kHz]		C74 (Pnom) def [kW]		C41/43/ 45 def [%]	C78 (Rstat) def [Ω]	
					def	max	@4T	@2T		@4T	@2T
S05	0005	6.4	10.5	11.5	10	16	3	1.7	150	2.500	1.443
	0007	8.4	12.5	13.5	10	16	4	2.3	150	2.000	1.154
	0008	8.5	15	16	10	16	3.9	2.2	150	1.733	1.000
	0009	9	16.5	17.5	10	16	4.5	2.5	150	1.600	0.923
	0010	11	17	19	10	16	5.3	3	150	1.386	0.800
	0011	11.2	16.5	21	10	16	5.5	3.1	150	1.300	0.750
	0013	13.2	19	21	10	16	6.5	3.7	150	1.126	0.650
	0014	14.8	16.5	25	10	16	7.5	4.3	150	1.000	0.577
S05/ S10/S12	0015	15	23	25	10	16	7	4	150	1.040	0.600
	0016	17.9	30	32	10	16	9.2	5.3	150	0.800	0.461
S10/S12	0020	17.9	27	30	10	16	9.2	5.3	150	0.800	0.461
	0017	21	30	36	10	16	11	6.3	150	0.600	0.346
	0023	25.7	38	42	10	16	13	7.5	150	0.520	0.300
	0025	29	41	48	10	16	15	8.6	150	0.400	0.230
	0030	35	41	56	3	16	18.5	10.6	150	0.300	0.173
	0033	36	51	56	10	16	19.2	11	150	0.347	0.200
	0034	41	57	63	3	16	22	12.7	150	0.250	0.144
	0035	41	41	72	10	16	22	12.7	150	0.250	0.144
S15	0036	46	60	72	10	16	25	14.4	150	0.250	0.144
	0037	50	65	72	10	16	26	15	144	0.174	0.100
	0038	46	67	75	10	16	25	14.4	150	0.200	0.115
S20	0040	46	72	80	10	16	25	14.4	150	0.200	0.115
	0049	55	80	96	10	12.8	30	17.3	150	0.150	0.086
	0060	67	88	112	10	12.8	37	21.3	150	0.120	0.069
	0067	80	103	118	10	12.8	45	25.9	147	0.100	0.057
S20	0074	87	120	144	10	12.8	50	28.8	150	0.080	0.046
	0086	98	135	155	10	12.8	55	31.7	150	0.060	0.034

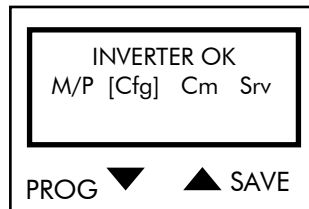
Table 1 : Configuration table for LIFT SW parameters.

## 10. DIAGNOSTICS

### 10.1. INVERTER OPERATING CONDITIONS

When the inverter runs smoothly, the following messages are displayed in the main menu page:

- 1) if the output frequency is equal to zero:

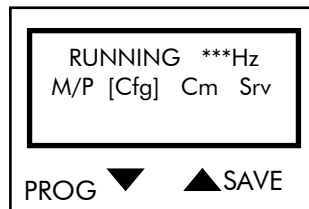


This occurs if the inverter is disabled or no run command is sent or the frequency reference is equal to zero.

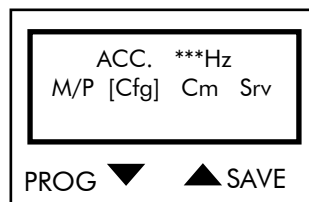
- 2) If the equipment is enabled when the ENABLE input is closed and parameter C59 is set to [NO], the following message is displayed:



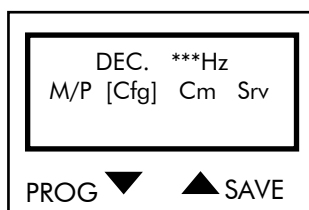
- 3) If the output frequency is constant, other than zero and equal to the reference:



- 4) If the inverter is accelerating:

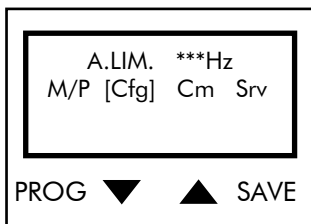


- 5) If the inverter is decelerating:

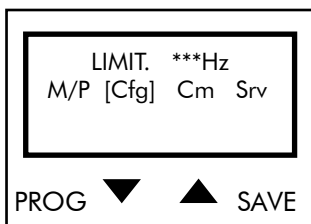




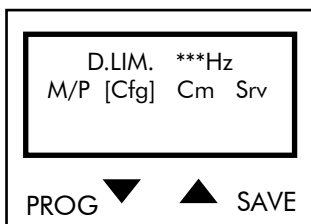
6) If the output frequency is constant while accelerating due to current limit activation while accelerating:



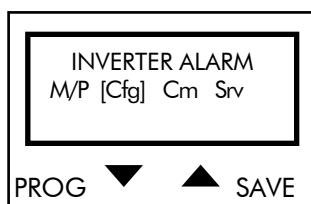
7) If the output frequency is under the reference value for current limit activation at constant frequency:



8) If, during deceleration, current or DC bus voltage activate limit while decelerating, i.e. a longer deceleration ramp:



If failures occur, the display will show



The display LEDs start flashing; alarm messages detailed in section ALARM MESSAGES may be displayed.



**NOTE**

Factory setting: the inverter shuts off but the alarm is not cleared, as it is stored to EEPROM. The alarm tripped is displayed at next power on and the inverter is still locked. Close the Reset contact or press the RESET key. Alarm reset is also possible by turning off and on the inverter and by setting parameter C53 to [YES].

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## 10.2. ALARM MESSAGES

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### A01 Wrong Software

The software version of FLASH memory (human interface) is incompatible with DSP version (motor control).  
WHAT TO DO: Try to reset the alarm. If the problem persists, please contact ELETTRONICA SANTERNO's AFTER-SALES SERVICE for a new programming of ES778 control board.

### A03 EEPROM Absent

EEPROM is not installed, is blank or damaged. EEPROM memory contains all the customized parameters.  
WHAT TO DO: Check to see if EEPROM is properly installed (U45 in ES778 control board) and if jumper J13 is correctly positioned (pos.1-2 for 28C64; pos.2-3 for 28C16). If so, ES778 control board is to be replaced. Please contact ELETTRONICA SANTERNO's AFTER-SALES SERVICE.

### A05 NO Imp. Opcode A06 UC Failure

Microcontroller failure.  
WHAT TO DO: Reset the alarm. If the alarm persists, please contact ELETTRONICA SANTERNO's AFTER-SALES SERVICE.

### A11 Bypass Circ. Failure

Faulty relay or contactor for the short-circuit of precharge resistors for DC link capacitors.  
WHAT TO DO: Reset the alarm. If the alarm persists, please contact ELETTRONICA SANTERNO's AFTER-SALES SERVICE.

### A14 Continuous Dec. Lim.

While slowing down or stopping, the inverter has been locked in voltage limit while decelerating (DEC LIM xxxHz) for more than 4sec.  
WHAT TO DO: Decrease torque compensation parameters C09, C10, C11 in the V/f Pattern menu, if the limit was due to high voltage; check the brake resistance if the limit was due to intermediate voltage or to high voltage.

### A15 Encoder Failure

Alarm A15 is active only when parameter C22 "ENCODER" is set to "YES". Alarm 15 trips if the encoder is faulty, disconnected or its phases are reversed.  
WHAT TO DO: Check the signals sent from the ENCODER and compare the value displayed for M10 with the real motor rpm.  
Check to see if the ENCODER phases are reversed, if the encoder is faulty or is not properly connected. If the encoder is not faulty, adjust parameter C60 "Enc. Err. Thr."

### A16 Speed Error

Speed exceeds the maximum allowable value set through parameter C61.  
WHAT TO DO: Make sure that the preset threshold is not too close to the lift cage expected speed. Alarm A16 trips only if C22 "ENCODER" is set to YES. Factory setting: Alarm A16 is disabled.

### A17 Wrong Command

When the inverter was running, its operating mode was changed from “Normal Speed” to “Maintenance Speed” and vice versa.

### A18 Fan Fault Overtemperature

Power heatsink overheated; fan locked.

WHAT TO DO: Replace faulty fan.

If the problem persists, please contact ELETTRONICA SANTERNO’s AFTER-SALES SERVICE.

### A19 2nd Sensor Overtemperature

Power heatsink overheated; fan off.

WHAT TO DO: Failure in the temperature and/or air-cooling control devices. Please contact ELETTRONICA SANTERNO’s AFTER-SALES SERVICE.

### A20 Inverter Overload

Output current exceeds the inverter rated current - persistent condition:  $I_{max} + 20\%$  for 3 seconds or  $I_{max}$  for 120 seconds. See column “ $I_{max}$ ” in Table 1.

WHAT TO DO: Check the inverter output current under normal operating conditions (par. M03, MEASURES submenu) and any mechanical condition of the load (overload or load locked during duty cycle).

### A21 Heatsink Overheated

Power heatsink overheated; fan running smoothly.

WHAT TO DO: Make sure that the ambient temperature in the location where the inverter is installed is under 40°C, that the motor current setting is correct and that the carrier frequency has not exceeded its allowable threshold.

### A22 Motor Overheated

Software thermal protection of the connected motor tripped. The output current has been exceeding the rated motor current for a long time.

WHAT TO DO: Check the mechanical conditions of the load. When A22 trips, it depends on programming of parameters C70, C71, C72. Make sure that these parameters were properly set at the inverter startup (see the MOTOR THERMAL PROTECTION section).

### A24 Motor not connected

When starting the lift cage through one of the digital outputs controlling the electromechanical brake, the starting current has not exceeded the threshold set in parameter C65 in the Special Functions menu.

WHAT TO DO: Check conditions of contactors and wiring between the inverter and the connected motor.

### A25 Mains loss

Mains failure.

### **A30 D.C. Link Overvoltage**

DC link overvoltage.

WHAT TO DO: Make sure that the supply voltage is not over 240VAC + 10% for 2T class, 480VAC + 10% for 4T class.

A highly inertial load and/or the deactivation of the braking module may activate A30. Increase deceleration ramp time.

### **A31 D.C. Link Undervoltage**

Supply voltage has dropped below 200VAC – 25% for 2T class, 380VAC – 35% for 4T class.

WHAT TO DO: Make sure that voltage is supplied to all three phases (terminals 32, 33, 34) and that the measured value is not under the above-mentioned voltage values.

A31 may trip even if the supply voltage temporarily drops below 200VAC (e.g. load direct connection).

If voltage values are normal, please contact ELETTRONICA SANTERNO's AFTER-SALES SERVICE.

### **A26 SW Running Overcurrent**

#### **A32 Running Overcurrent**

Instant current limit at constant speed. This alarm trips in case of sudden load variations, output short-circuit or ground short-circuit, disturbance and radiated interference.

WHAT TO DO: Make sure that no short-circuit is present between two phases or a phase and the grounding connection at the inverter output (terminals U, V, W) (for a quick inspection, disconnect the motor and operate the inverter in no-load condition).

Make sure that command signals are sent to the inverter through screened cables where required (see the WIRING section in Part 1).

Check wiring and antidisturbance filters on contactor and solenoid valve coils installed in the cabinet (if any).

### **A28 SW Accel. Overcurrent**

#### **A33 Accelerating Overcurrent**

Instant current limit while accelerating.

See alarm A32. Alarm A33 may also trip when a too short acceleration ramp is programmed. If so, decrease acceleration (P05, P07, ACCELERATION submenu) and decrease BOOST and PREBOOST when required (parameters C10 and C11, V/F PATTERN submenu).

### **A29 SW Decel. Overcurrent**

#### **A34 Decelerating Overcurrent**

Instant current limit while decelerating.

WHAT TO DO: This alarm trips if a too short deceleration ramp is programmed. If so, set longer deceleration time periods (P06, P08, ACCELERATION submenu) and decrease BOOST and PREBOOST (V/F PATTERN submenu, parameters C09 or C10).

### **Not recognized failure**

Unknown alarm.

WHAT TO DO: Reset the alarm. If the alarm condition persists, please contact ELETTRONICA SANTERNO's AFTER-SALES SERVICE.

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### 10.3. DISPLAY AND INDICATOR LEDS

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Additional failures may occur that are indicated by the keypad and the indicator Leds located on ES778 control board:

- The inverter display shows POWER ON and no LED is flashing: failure in the microcontroller of the control board.
- The inverter display shows POWER ON and the VL Led is flashing: communication failure between microcontroller and control board DSP.
- The inverter display shows POWER ON and IL Led is flashing: failure of the control board RAM.
- The inverter display shows POWER ON and both VL and IL Leds are flashing: the human interface (FLASH) is not programmed with the same SW as the motor control (DSP)
- The inverter display shows LINK MISMATCH: no communication link between the inverter and the keypad (check wiring cable as well).

Do the following:

Turn off and on the inverter. If the alarm conditions persist, please contact ELETTRONICA SANTERNO's AFTER-SALES SERVICE to replace ES778 control board.

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## 11. SERIAL COMMUNICATIONS

### 11.1. GENERAL FEATURES

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The inverters of the SINUS K series may be connected to other devices through a serial link. This allows reading (download) and writing (upload) the parameters accessed via remotable keypad.

Elettronica Santerno also supplies the RemoteDrive software package for the inverter control through a computer connected via serial link.

The RemoteDrive offers the following functions:

- image copy,
- keypad emulation,
- oscilloscope functions and multifunction tester,
- history data table compiler, parameter setting and data reception-transmission-storage from and to a computer,
- scan function for the automatic detection of the connected inverters (up to 247 connected inverters).



Please refer to the RemoteDrive Instruction Manual for the inverters of the Sinus PENTA series manufactured by Elettronica Santerno.



## 11.2. MODBUS-RTU PROTOCOL

Messages and data are sent by means of standard protocol MODBUS in RTU mode. This standard protocol performs control procedures using an 8-bit binary representation.

In RTU mode, a message begins with a silence interval equal to 3.5 times the transmission time of a character. If the character transmission stops for a time equal to 3.5 times the transmission time of a character, the controller will consider this time interval as the end of the message. Similarly, a message starting with a shorter silence time is considered as a part of the previous message.

Message beginning	Address	Function	Data	Error control	End of message
T1-T2-T3-T4	8 bit	8 bit	n x 8 bit	16 bit	T1-T2-T3-T4

Use parameter C92 to increase the silence time interval up to max. 2000ms.

### Address

The address field acknowledges any value ranging from 1 to 247 as the address of the slave peripheral device. The master device queries the peripheral device specified in the address field; the peripheral device will respond with a message containing its address to let the master device know the slave source of the response. A master device query with address "0" is addressed to all slave devices, which will not respond (broadcast mode).

### Function

The function related to the message may be chosen within the legal field ranging from 0 to 255. A response of the slave device to a message of the master device will simply return the function code to the master device if no error took place; otherwise, the most significant bit in this field is set to 1.

Functions 03h and 10h are allowed only (see following sections).

### Data

The data field contains any additional information for the function being used.

### Error Control

The error control is performed with the CRC (Cyclical Redundancy Check) method. The 16-bit value of the relevant field is computed when the message is sent by the transmitter and is then re-computed and checked by the receiver.

Register CRC is computed as follows:

1. Register CRC is set to FFFFh.
2. Exclusive OR is executed between register CRC and the first 8 bits of the message; the result is saved to a 16-bit register.
3. This register is right-shifted of one place.
4. If the right bit is 1, exclusive OR is executed between the 16-bit register and value 1010000000000001b.
5. Steps 3 and 4 are repeated until 8 shifts are performed.
6. Exclusive OR is performed between the 16-bit register and the next 8 bits of the message.
7. Steps 3 to 6 are repeated until all message bytes are processed.
8. The result is a CRC, that is attached to the message by sending the less significant byte as the first byte.



**Supported Functions**

**03h: Read Holding Register**

Allows reading the register state of the slave device. This function does not allow the broadcast mode (address "0"). Additional parameters are the address of the basic digital register to be read and the output number to be read.

QUERY	RESPONSE
Slave address	Slave address
Function 03h	Function 03h
Register address (high)	Byte number
Register address (low)	Data
Register No. (high)	...
Register No. (low)	Data
Error correction	Error correction

**10h: Preset Multiple Register**

Allows setting the state of multiple registers for the slave device. In broadcast mode (address "0"), the state of those registers is set in all connected slave devices. Additional parameters are the basic register address, the number of registers to be set, the relevant value and the number of bytes used for the data items.

QUERY	RESPONSE
Slave address	Slave address
Function 10h	Function 10h
Register addr. (Hi)	Register addr. (Hi)
Register addr. (Lo)	Register addr. (Lo)
Register No. (Hi)	Register No. (Hi)
Register No. (Lo)	Register No. (Lo)
Byte number	Error correction
Register value (Hi)	
Register value (Lo)	
...	
Register value (Hi)	
Register value (Lo)	
Error correction	

**Error Messages**

If a message error is detected, the inverter will send a message to the master:

Slave address	Function (MSB = 1)	Error code	Error correction
---------------	--------------------	------------	------------------

The error code meaning is the following:

Code	Name	Meaning
01	ILLEGAL FUNCTION	The function is not implemented in the slave device
02	ILLEGAL DATA ADDRESS	The address specified in the relevant field is illegal for the slave device
03	ILLEGAL DATA VALUE	The value is not allowable for the specified location

### 11.3. GENERAL FEATURES AND EXAMPLES

Parameters are queried along with the readout performed through the inverter keypad and display. Parameter alteration is also managed along with the inverter keypad and display. Not that the inverter will always use the latest value set (sent both via serial link or from the inverter itself).

When writing (10h function: Preset Multiple Register), the inverter will check value ranges only if failures may occur. If illegal ranges are detected, the inverter will respond with the error message "ILLEGAL DATA VALUE" (see table above).

The same error message is displayed if the user attempts to change a locked parameter, particularly if they try to write a Read Only parameter or the CONFIGURATION parameters of Cxx type when the inverter is in RUN mode.

Data are read/written as 16-bit, full data (words) based on scaling factors (K) stated in the tables below.

#### 11.3.1. SCALING

The scaling constant (K) is as follows:

true value = value read by MODBUS / K  
 value written to MODBUS = true value \* K

	Name	Description	Addr. (dec) R/W	Addr. (hex) R/W	Def	Min	Max	K	Unit of meas.
P05	AMAN	Acceleration in Maintenance mode	0	0	60	10	255	100	m/s <sup>2</sup>
P06	DMAN	Deceleration in Maintenance mode	1	1	250	10	255	100	m/s <sup>2</sup>

Because K=10, the readout of address 0 with a value equal to 250 (dec) is to be intended as acceleration equal to 250/100 = 2.5m/s<sup>2</sup>

Alternatively, to set a deceleration value equal to 0.20 m/s<sup>2</sup>, send value 0.20\*100 = 20 (dec) to address 1 via serial link.

Some variables related to the inverter size (current) and/or class (voltage) are grouped as follows:

Table T000[]: index (SW3) to address 477 (1DDh)

	I full-scale (tenths of A)	max freq out	def carrier	max carrier	C10 def Preboost
	T000[0]	T000[1]	T000[2]	T000[3]	T000[4]
0	25	800	10	12	1
1	50	800	10	12	1
2	50	800	10	12	1
...	...	...	...	...	...

Table reading:

	Name	Description	Addr. (dec) READ	Addr. (hex) READ	Min	Max	K	Unit of measure
M03	IOUT	Output current	1026	402			50*65536/(T000[0]*1307)	A

PART 2



Because  $K=50*65536/(T000[0]*1307)$ , do the following to convert current reading to A:

- 1) read address 477 (dec) for full-scale "I"; the result is the index of array T000[]. For this parameter, consider column T000[0], as other columns refer to different parameters. One reading is sufficient;
- 2) read address 1026 (dec).

If address 477 reading returns "2" ( $\Rightarrow 65A$ ) and if address 1026 returns "1000", the output current will be equal to  $1000 / K = 1000 / (50*65536/(T000[0]*1307)) = 1000 / (50*65536/(65*1307)) = 25.9 A$ .

### 11.3.2. BIT PARAMETERS

Bit parameters are different in reading and writing.

	Name	Description	Addr. (dec) WRITE	Addr. (hex) WRITE	Addr. (dec) READ	Addr. (hex) READ	Def	Min	Max
C40	ACC.LIM.	Enabling current limit while accelerating	520	208	770.8	302.8	1	0	1

**To read parameter C40**, just read address 770 (dec) and parse bit 8 of the returned value (0=LSB, 15=MSB).

**To set parameter C40**, write 1 to address 520 (dec); write 0 to the same address to reset C40.

For peculiar reading/writing, refer to the **Notes** in the following tables.



## 12. PARAMETERS SENT VIA SERIAL LINK

### 12.1. MEASURES PARAMETERS (Mxx) (Read Only)

#### 12.1.1. MEASURES MENU M0X – M2X

	Name	Description	Addr. (dec) READ	Addr. (hex) READ	Min	Max	K	Unit of measure
M01	FREF	Current reference	1024	400			10	Hz
M02	FOUT	Output frequency	1025	401			40	Hz
M03	IOUT	Output current	1026	402			50*65536/(T000[0]*1307)	A
M04	VOUT	Output voltage	1027	403			65536/2828	V
M05	VMN	Mains voltage	1028	404			512/1111	V
M06	VDC	Bus voltage	1029	405			1024/1000	V
M07	POUT	Output power	1030	406			5000*65536/(T000[0]*3573)	kW
M08	Term. B.	Digital inputs	1031	407			Note 1	-
M09	T.B.Out	Digital outputs	1032	408			Note 2	
M10	Spd Ref	Speed reference	1033	409			C73/12	rpm
M11	NOUT	Motor speed	1034	40A			1	rpm
M12	Speed Ref	Lift cage speed reference	1035	40B			10*C05/P44	m/s
M13	Speed	Lift cage speed	1036	40C			100	m/s
M14	PID Out	Speed regulator correction	1037	40D			20	%
M15	OP.T.	Work time	1038 1039	40E 40F			5 Note 3	s
M16	1st alarm	Trip log 1	1040 1041	410 411			5 Note 4	s
M17	2nd alarm	Trip log 2	1042 1043	412 413			5 Note 4	s
M18	3rd alarm	Trip log 3	1044 1045	414 415			5 Note 4	s
M19	4th alarm	Trip log 4	1046 1047	416 417			5 Note 4	s
M20	5th alarm	Trip log 5	1048 1049	418 419			5 Note 4	s

**PART 2**

Note 1: State of digital inputs in the terminal board (1 = active input) based on the table below:

Bit	
0	TERM.9
1	MAN/NORMAL
2	TERM.11
3	TERM.12
4	TERM.7
5	ENABLE
6	TERM.13
7	RESET

**Note 2:** State of digital outputs in the terminal board (1 = active output) based on the table below:

Bit	
2	OC
3	RL1
4	RL2

**Note 3:** The Work time is represented by a double word (32 bits). It is sent using two addresses formatted as follows: most significant word to higher address (1039); less significant word to lower address (1038).

**Note 4:** The Trip log is sent using two addresses formatted as follows:

higher address (e.g.1041)	Alarm number	Time instant – bit 16÷23
lower address (e.g. 1040)	Time instant – bit 0÷15	

The time instant relating to the alarm number is a 24-bit value with a 0.2s basic time. Its most significant portion (bit 16÷23) can be read in the lower byte of the word to the higher address, whereas its less significant portion (bit 0÷15) can be read in the word to the lower address.

The higher byte of the word to the higher address includes the alarm number coded as in Note 8 (inverter state) (see Note 12).

The last alarm displayed in parameter M12 is the alarm with the longest time period. The other alarms are displayed up to M16 with the shortest time period.

### 12.1.2. PATH MENU M2x

	Name	Description	Addr. (dec) READ	Addr. (hex) READ	Def	Min	Max	K	Unit of measure
M21	Start time	Lift cage acceleration time	1050	41A	0	0	20	100	s
M22	Start space	Lift cage acceleration distance	1051	41B	0	0	9.99	100	m
M23	Stop time	Lift cage deceleration time	1052	41C	0	0	20	100	s
M24	Stop space	Lift cage deceleration distance	1053	41D	0	0	9.99	100	m



## 12.2. PROGRAMMING PARAMETERS (Pxx) (Read/Write)

### 12.2.1. 12.2.1 ACCELERATION MENU P0x - P1x

	Name	Description	Addr. (dec) R/W	Addr. (hex) R/W	Def	Min	Max	K	Unit of meas.
P05	Aman.	Accel. in Maintenance mode	0	0	0.6	0.1	6500	100	m/s <sup>2</sup>
P06	Dman.	Decel. in Maintenance mode	1	1	2.5	0.1	6500	100	m/s <sup>2</sup>
P07	Lift Accel.	Acceleration in Normal mode	2	2	IF C22=1 (Def=1) ELSE (Def=0.6)	0.1	IF C22=1 (Def=2) ELSE (Def=1)	100	m/s <sup>2</sup>
P08	Lift Decel.	Deceleration in Normal slowing-down stage	3	3	IF C22=1 (Def=1) ELSE (Def=0.6)	0.1	IF C22=1 (Def=2) ELSE (Def=1)	100	m/s <sup>2</sup>
P09	Lift Stop	Deceleration in Normal stop stage	4	4	IF C22=1 (Def=1) ELSE (Def=0.6)	0.1	IF C22=1 (Def=2) ELSE (Def=1)	100	m/s <sup>2</sup>
P10	Lift Jerk	Lift cage Jerk in Normal operation	5	5	IF C22=1 (Def=0.8) ELSE (Def=0.6)	0.15	1.27	100	m/s <sup>3</sup>
P11	Lift Red.Strt	Jerk reduction in Norm. start stage	6	6	3	0	6500	1	%
P12	Predec Jerk	Predeceleration Jerk increase	7	7	2	-1	6500	1	%

### 12.2.2. OUTPUT MONITOR MENU P3x

	Name	Description	Addr. (dec) R/W	Addr. (hex) R/W	Def	Min	Max	K	Unit of meas.
P30	OMN1	Analog output 1 functionality	8	8	1	0	8	List	-
P31	OMN2	Analog output 2 functionality	9	9	2	0	8	List	-
P32	KOF	Constant for analog output (frequency)	10	A	10	1.5	100	10	Hz/V
P33	KOI	Constant for analog output (current)	11	B	25*T000[0]/500	6*T000[0]/500	100*T000[0]/500	500/T000[0]	A/V
P34	KOV	Constant for analog output (voltage)	12	C	100	20	100	1	V/V
P35	KOP	Constant for analog output (power)	13	D	25*T000[0]/500	6*T000[0]/500	40*T000[0]/500	500/T000[0]	kW/V
P36	KON	Constant for analog output (speed)	14	E	200	10	10000	1	rpm/V
P37	KOR	Constant for analog output (PID output)	15	F	10	2.5	50	10	%/V



List for parameters P30 and P31:

0: Fref
1: Fout
2: Iout
3: Vout
4: Pout
5: Fout_r
6: Nout
7: PID O.
8: PID FB

### 12.2.3. SPEED MENU P4X – P4X

	Name	Description	Addr. (dec) R/W	Addr. (hex) R/W	Def	Min	Max	K	Unit of meas.
P40	ApproachSpd	Approach speed	16	10	100	1	120	1	%
P41	Standard Spd	Contractual speed	17	11	100	1	120	1	%
P42	LowFloorSpd	Low contractual speed	18	12	IF C22=1 (Def=32) ELSE (Def=67)	1	120	1	%
P43	Maint.Spnd	Speed in Maintenance mode	19	13	IF C22=1 (Def=20) ELSE (Def=40)	1	120	1	%
P44	Rated Spd	Rated speed	20	14	IF C22=1 (Def=2.5) ELSE (Def=1.2)	0.15	IF C22=1 (Def=2.5) ELSE (Def=1.5)	100	.m/s

### 12.2.4. SPEED LOOP MENU P5X – P5X

	Name	Description	Addr. (dec) R/W	Addr. (hex) R/W	Def	Min	Max	K	Unit of meas.
P50	SAMP.T.	Sampling time	21	15	0.002	0.002	4	500	S
P51	KP	Proportional term	22	16	0.349	0	31.999	1024	
P52	TI	Integral time	23	17	200	3	1025 Note 5	1	Tc
P53	KP STOP	Proportional term during stop stage	24	18	1	0	31.999	1024	
P54	TI STOP.	Integral time during stop stage	25	19	50	3	1025 Note 5	1	Tc
P55	TD	Derivative time	26	1A	0	0	4 Note 5	256	Tc
P56	FREQ TH.	Integral unlocking threshold	27	1B	10	0	T000[1]	10	Hz
P57	KP APPROACH	Proportional term during approach stage	28	1C	0.349	0	31.999	1024	
P58	TI APPROACH	Integral time during approach stage	29	1D	200	3	1025 Note 5	1	Tc

Note 5: Integral time and derivative time are expressed as multiple values of sampling time P50. For example, the real time is P50\*P52; the upper value is 1024; 1025 disables integral regulation.





### 12.2.5. DIGITAL OUTPUTS MENU P6X - P7X

	Name	Description	Addr. (dec) R/W	Addr. (hex) R/W	Def	Min	Max	K	Unit of meas.
P60	MDO OP.	O.C. output operation	31	1F	13	0	17	List	-
P61	RL1 OP.	Relay output RL1 operation	32	20	0	0	17	List	-
P62	RL2 OP.	Relay output RL2 operation	33	21	4	0	17	List	-
P63	MDO ON DELAY	O.C. output enabling delay	34	22	0	0	60	10	s
P64	MDO OFF DELAY	O.C. output disabling delay	35	23	0	0	60	10	s
P65	RL1 ON DELAY	Relay output RL1 enabling delay	36	24	0	0	60	10	s
P66	RL1 OFF DELAY	Relay output RL1 disabling delay	37	25	0	0	60	10	s
P67	RL2 ON DELAY	Relay output RL2 enabling delay	38	26	0	0	60	10	s
P68	RL2 OFF DELAY	Relay output RL2 disabling delay	39	27	0.2	0	60	10	s
P69	MDO LEVEL	O.C. output enabling level	40	28	0	0	200	10	%
P70	MDO HYS	O.C. output disabling hysteresis	41	29	0	0	200	10	%
P71	RL1 LEVEL	Relay output RL1 enabling level	42	2A	0	0	200	10	%
P72	RL1 HYS	Relay output RL1 disabling hysteresis	43	2B	0	0	200	10	%
P73	RL2 LEVEL	Relay output RL2 enabling level	44	2C	0.2	0	200	10	%
P74	RL2 HYS	Relay output RL2 disabling hysteresis	45	2D	0.1	0	200	10	%

**PART 2**

List for parameters P60, P61, and P62:

0: Inv. O.K. on
1: Inv. O.K. off
2: Inv. run. trip
3: Reference level
4: Frequency level
5: Forward running
6: Reverse running
7: Fout O.K.
8: Current level
9: Limiting
10: Motor limiting
11: Generator lim.
12: Freq. Level 2
13: Thermal Prot.
14: Power Level
15: Motor Contactor
16: Idc Freq. Level
17: Fan Fault

### 12.2.6. CURRENT SYMMETRY MENU P8X

	Name	Description	Addr. (dec) R/W	Addr. (hex) R/W	Def	Min	Max	K	Unit of meas.
P80	CURRSYMMETRY	3-phase current symmetry regulation	30	1E	0	-100	100	1	%

## 12.3. CONFIGURATION PARAMETERS (Cxx) (Read/Write with Inverter Disabled, Read Only with Inverter in RUN Mode)

### 12.3.1. CARRIER FREQUENCY MENU C0X

	Name	Description	Addr. (dec) R/W	Addr. (hex) R/W	Def	Min	Max	K	Unit of meas.
C01	FCARR	Min. carrier frequency	1280	500	T000[2]	0	C02	List	-
C02	FC. MAX	Max. carrier frequency	1281	501	T000[2]	C01	T000[3]	List	-
C03	PULSE N.	Pulse number	1282	502	1	0	5	List	-

List for parameters C01 and C02

0: 0.8 kHz
1: 1.0 kHz
2: 1.2 kHz
3: 1.8 kHz
4: 2.0 kHz
5: 3.0 kHz
6: 4.0 kHz
7: 5.0 kHz
8: 6.0 kHz
9: 8.0 kHz
10: 10.0 kHz
11: 12.8 kHz
12: 16.0 kHz

List for parameter C03

0: 12
1: 24
2: 48
3: 96
4: 192
5: 384

#### Carrier Frequency Menu C0x: Bit parameters

	Name	Description	Addr. (dec) R/W	Addr. (hex) R/W	Def	Min	Max	K	Unit of meas.
C03a	SILENT MODUL.	Silent modulation	529	211	771.1	303.1	1	0	1



### 12.3.2. V/F PATTERN MENU C0x - C1x

	Name	Description	Addr. (dec) R/W	Addr. (hex) R/W	Def	Min	Max	K	Unit of meas.
C04	MOT.CUR.	Rated motor current 1	1283	503	T002[0]	1	T002[1]	10	A
C05	FMOT	Rated motor frequency 1	1284	504	50	12.6	T000[1]	10	Hz
C06	FOMAX	Max. output frequency 1	1285	505	60	12.6	T000[1]	10	Hz
C07	FOMIN	Min. output frequency 1	1286	506	0.1	0.1	5	10	Hz
C08	VMOT	Rated motor voltage 1	1287	507	T001[0]	5	500	1	V
C09	BOOST	Torque compensation 1	1288	508	50	-100	400	1	%
C10	PREBST	Torque compensation (at 0Hz) 1	1289	509	T000[4]	0	5	10	%
C11	AutoBoost	Vout increase at rated torque	1290	50A	2.5	0	10	10	%
C12	FreqBoost	Freq. for torque comp. activation	1322	52A	5	0	100	1	%
C13	Boost mf	Boost at intermediate frequency	1323	52B	3	-100	400	1	%

### 12.3.3. OPERATION METHOD MENU C1x - C2x

	Name	Description	Addr. (dec) R/W	Addr. (hex) R/W	Def	Min	Max	K	Unit of meas.
C23	Pulse N.	Encoder pulse/rev	1291	50B	1024	100	10000	1	Ppr

**PART 2**

#### Operation Method Menu C2x: Bit parameters

	Name	Description	Addr. (dec) WRITE	Addr. (hex) WRITE	Addr. (dec) READ	Addr. (hex) READ	Def	Min	Max
C21	Standard	Selection of dual contractual speed, bit 770.0	512	200	770.0	302.0	0	0	1
C21	Standard	Selection of dual contractual speed, bit 770.4	516	204	770.4	302.4	1	0	1
C22	Encoder	Encoder fitted	537	219	771.9	303.9	0	0	1

C21:

	bit 770.4	bit 770.0
Double	0	0
Single	1	X
Double A	0	1



### 12.3.4. LIMITS MENU C4x

	Name	Description	Addr. (dec) R/W	Addr. (hex) R/W	Def	Min	Max	K	Unit of meas.
C41	ACC. CURR.	Acceleration lim. current	1292	50C	MIN((T002[2]* 100/C04),150)	50	MIN((T002[2]* 100/C05),400)	1	%
C43	RUN. CURR.	Lim. current at constant frequency	1293	50D	MIN((T002[2]* 100/C04),150)	50	MIN((T002[2]* 100/C05),400)	1	%
C45	DEC. CURR.	Lim. current while decelerating	1325	52D	MIN((T002[2]* 100/C04),150)	50	MIN((T002[2]* 100/C04),400)	1	%

#### Limits Menu C4x: Bit parameters

	Name	Description	Addr. (dec) WRITE	Addr. (hex) WRITE	Addr. (dec) READ	Addr. (hex) READ	Def	Min	Max
C40	ACC. LIM.	Acceleration limit enable	520	208	770.8	302.8	1	0	1
C42	RUN. LIM.	Constant freq. limit enable	521	209	770.9	302.9	1	0	1
C44	DEC. LIM.	Deceleration limit enable	535	217	771.7	303.7	0	0	1

### 12.3.5. AUTORESET MENU C5x

	Name	Description	Addr. (dec) R/W	Addr. (hex) R/W	Def	Min	Max	K	Unit of meas.
C51	ATT.N.	Autoreset attempt number	1294	50E	4	1	10	1	-
C52	CL.FAIL T.	Attempt reset time	1295	50F	300	1	999	50	s

#### Autoreset Menu C4x: Bit parameters

	Name	Description	Addr. (dec) WRITE	Addr. (hex) WRITE	Addr. (dec) READ	Addr. (hex) READ	Def	Min	Max
C50	AUTORESET	Autoreset available	522	20A	770.10	302.10	0	0	1
C53	PWR RESET	Alarm RST at PWR off	531	213	771.3	303.3	0	0	1



### 12.3.6. SPECIAL FUNCTIONS MENU C5X - C6X

	Name	Description	Addr. (dec) R/W	Addr. (hex) R/W	Def	Min	Max	K	Unit of meas.
C56	BrakeDisab	Brake disabling time	1296	510	30000	0	65400	1	ms
C57	BrakeEnab	Brake enabling time	1297	511	30000	0	65400	1	ms
C60	Enc ErrThres.	Error threshold for encoder alarm	1298	512	0	0	100	1	%
C61	Spd ErrThres.	Error threshold for speed alarm	1299	513	0	0	4000	1	rpm
C62	Stop Switch	Lim. distance beyond stop switch	1300	514	0	0	200	1	mm
C63	SlowDwnD.	Slowing-down command acquisition delay	1301	515	0	0	4000	0.05	ms
C65	Current thr.	Current threshold for alarm A24	1324	52C	0	0	100	1	%

**PART 2**

#### Special Functions Menu C5x - C6x: Bit parameters

	Name	Description	Addr. (dec) WRITE	Addr. (hex) WRITE	Addr. (dec) READ	Addr. (hex) READ	Def	Min	Max
C54	HIGH V	Rated mains voltage	541	21D	771.13	303.13	0	0	1
C55	BRAKE UNIT	Braking module provided	515	203	770.3	302.3	0	0	1
C58	MAIN LOSS MEM.	Mains loss storage	523	20B	770.11	302.11	0	0	1
C59	ENABLE OPER.	ENABLE terminal operation	527	20F	770.15	302.15	1	0	1
C64	Autotar Res.	Stator resistance autotuning enable	513	201	770.1	302.1	0	0	1

### 12.3.7. MOTOR THERMAL PROTECTION MENU C7X

	Name	Description	Addr. (dec) R/W	Addr. (hex) R/W	Def	Min	Max	K	Unit of meas.
C70	THR.PRO.	Thermal protection enable	1302	516	0	0	3	List	-
C71	MOT.CUR.	Thermal protection pick-up current	1303	517	105	1	120	1	%
C72	TH.C.	Motor thermal constant	1304	518	600	5	3600	1	s

List for parameter C70:

0: No
1: Yes
2: Yes A
3: Yes B



### 12.3.8. SLIP COMPENSATION MENU C7X

	Name	Description	Addr. (dec) R/W	Addr. (hex) R/W	Def	Min	Max	K	Unit of meas.
C73	POLES	Motor pole number	1305	519	4	2	16	0.5	
C74	MOTOR SLIP	Rated motor power	1306	51A	IF SW5=0 (Def=T002[4]) ELSE (Def=T002[3])	0	400	10	kW
C75	NO LOAD	Motor no-load power	1307	51B	0	0	400	10	kW
C76	LOW SLIP	Motor slip at low speed	1308	51C	0	0	17.5	10	%
C77	HIGH SLIP	Motor slip at rated speed	1309	51D	0	0	17.5	10	%
C78	STAT. RES.	Stator resistance	1310	51E	IF SW5=0 (Def=T002[6]) ELSE (Def=T002[5])	0	8.5	100	Ohm
C79	SLIP FILT.	Filter over slip compensation	1311	51F	10	MAX (SW6; SW7)+1	100	1	

### 12.3.9. D.C. BRAKING MENU C8X

	Name	Description	Addr. (dec) R/W	Addr. (hex) R/W	Def	Min	Max	K	Unit of meas.
C82	DCB T.SP.	DCB at STOP time period	1312	520	1	0.1	50	10	s
C83	DCB T.ST	DCB at START time period	1313	521	0.5	0.1	50	10	s
C84	DCB FR.	DCB at STOP starting frequency	1314	522	0.5	0.1	10	10	Hz
C85	DCB CUR.	DCB current	1315	523	140	1	MIN((T002[2]* 100/C04),400)	1	%
C86	DCB Start CUR	DCB at START current	1316	524	100	1	MIN((T002[2]* 100/C04),400)	1	%
C87	CUR RotPr	Prevention of shaft counter-rotation	1317	525	0	0	50	1	

#### D.C. Braking Menu C8x: Bit parameters

	Name	Description	Addr. (dec) WRITE	Addr. (hex) WRITE	Addr. (dec) READ	Addr. (hex) READ	Def	Min	Max
C80	DCB AT STOP	DCB at STOP enable	525	20D	770.13	302.13	0	0	1
C81	DCB AT START	DCB at START enable	526	20E	770.14	302.14	0	0	1



### 12.3.10. SERIAL LINK MENU C9X

	Name	Description	Addr. (dec) R/W	Addr. (hex) R/W	Def	Min	Max	K	Unit of meas.
C90	ADDRESS	Inverter address	1318	526	1	1	247	1	-
C91	S. DELAY	Response delay	1319	527	0	0	2000	0.05	ms
C92	RTU Timeout	MODBUS RTU serial timeout	1320	528	20	1	2000	1	ms
C93	BaudRate	Serial link baud rate	1321	529	3	0	3	List	-

List for parameter C93:

0	1200 bps
1	2400 bps
2	4800 bps
3	9600 bps

## 12.4. SPECIAL PARAMETERS (SPxx) (Read Only)

	Description	Addr. (dec)	Addr. (hex)	Min	Max	K
SP03	Configuration bit	770	302			Note 6
SP04	Configuration bit	771	303			Note 7
SP05	Inverter condition	772	304	0	28	Note 8

Note 6: SP03 Configuration bit: address 770 (302 hex)

	Bit		
C21 Standard	0	Along with bit 4	
C64 AUTO.RESIST.	1	0 Not provided	1 Provided
C55 BRAKE UNIT	3	0 Not provided	1 Provided
C21 Standard	4	Along with bit 0	
C40 ACCELERATION LIM.	8	0 Disabled	1 Enabled
C42 RUNNING LIM.	9	0 Disabled	1 Enabled
C50 AUTORESET	10	0 Disabled	1 Enabled
C58 MAINS LOSS MEM.	11	0 Not stored	1 Stored
C80 DCB AT STOP	13	0 Disabled	1 Enabled
C81 DCB AT START	14	0 Disabled	1 Enabled
C59 ENABLE OPERATION	15	0 Activated after opening	1 Immediately activated

Note 7: SP04 Configuration bit: address 771 (303 hex)

	Bit		
C03a SILENT MODUL.	1	0 Disabled	1 Enabled
C53 PWR RESET	3	0 Disabled	1 Enabled
C44 DECELERATION LIM.	7	0 Disabled	1 Enabled
C22 Encoder	9	0 Not present	1 Present
C54 HIGH V	13	0 Not present	1 Present

Note 8: Inverter condition: address 772 (304 hex)

0	INVERTER OK	15	Not Used
1	A30 D. C. Link Overvoltage	16	A21 Heatsink Overheated
2	A31 D. C. Link Undervoltage	17	A06 Microcontroller Failure
3	A18 Fan Fault Overtemperature	18	A32 Running Overcurrent
4	A22 Motor Overheated	19	A33 Accelerating Overcurrent
5	A20 Inverter Overload	20	A34 Decelerating Overcurrent
6	A05 No Implemented Opcode	21	Not Used
7	A03 EEPROM Absent	22	Not Used
8	A19 Second Sensor Overtemperature	23	A28 SW Accelerating Overcurrent
9	A25 Mains Loss	24	A29 SW Decelerating Overcurrent
10	A17 Wrong Command	25	A15 Encoder Failure
11	A11 Bypass Circ. Failure	26	A16 Speed Error
12	A01 Wrong Software	27	A14 Continuous Dec. Limit.
13	A26 SW Running Overcurrent	28	A24 Motor Not Connected
14	To Start Open And Close Termó		





## 12.5. SPECIAL PARAMETERS (SWxx) (Read Only)

	Description	Addr. (dec)	Addr. (hex)	Min	Max	K
SW1	Software version	475	1DB			Note 9
SW2	Product ID	476	1DC			Note 10
SW3	AT Full-scale value	477	1DD	0	15	index of T000[]
SW4	Model	478	1DE	0	26	index of T002[]
SW5	Voltage class	479	1DF	0	1	index of T001[]
SW6	Acceleration filter	480	1E0	-20	100	1
SW7	Deceleration filter	481	1E1	-20	100	1

Note 9: Decimal number corresponding to the inverter firmware version.

Example:

Response 1450 = version V1.450

Note 10: ASCII code corresponding to 'LK': 4C4Bh.

## 12.6. SPECIAL PARAMETERS (SPxx) (Write Only)

	Description	Addr. (dec)	Addr. (hex)	K
SP06	Parameter saving	773	30A	Note 11
SP07	Restore default	774	30B	Note 12

Note 11: Any writing with any data item forces the inverter to store to EEPROM all new parameter values.

Note 12: Any writing with any data forces the inverter to restore default programming (factory setting).

Table T000[]: index (SW3) to address 477 (1DDh)

	I full-scale (tenths of A)	max freq out	def carrier	max carrier	C10 def Preboost
	T000[0]	T000[1]	T000[2]	T000[3]	T000[4]
0	25	800	10	12	1
1	50	800	10	12	1
2	50	800	10	12	1
3	65	800	10	12	1
4	65	800	10	12	1
5	65	800	10	12	1
6	100	800	10	12	1
7	100	800	10	12	1
8	125	800	10	12	1
9	125	800	5	12	1
10	125	800	10	12	1
11	125	800	10	12	1
12	130	800	10	12	1
13	130	800	10	12	1
14	210	800	10	11	1
15	280	800	10	11	1



Table T001[]: index (SW5) to address 479 (1DFh)

	Class	
		T001[0]
0	2T	230
1	4T	400

Table T002[]: index (SW4) to address 478 (1DEh)

	Sinus K Model	Imot	Inom	Imax	Pnom @ 400V	Pnom @ 230V	Stat.Res. @ 400V	Stat.Res. @ 230V
		T002[0]	T002[1]	T002[2]	T002[3]	T002[4]	T002[5]	T002[6]
0	0005	6.4	10.5	11.5	3	1.7	2.500	1.443
1	0007	8.4	12.5	13.5	4	2.3	2.000	1.154
2	0008	8.5	15	16	3.9	2.2	1.733	1.000
3	0009	9	16.5	17.5	4.5	2.5	1.600	0.923
4	0010	11	17	19	5.3	3	1.386	0.800
5	0011	11.2	16.5	21	5.5	3.1	1.300	0.750
6	0013	13.2	19	21	6.5	3.7	1.126	0.650
7	0014	14.8	16.5	25	7.5	4.3	1.000	0.577
8	0015	15	23	25	7	4	1.040	0.600
9	0016	17.9	27	30	9.2	5.3	0.800	0.461
10	0017	17.9	30	32	9.2	5.3	0.800	0.461
11	0020	21	30	36	11	6.3	0.600	0.346
12	0023	25.7	38	42	13	7.5	0.520	0.300
13	0025	29	41	48	15	8.6	0.400	0.230
14	0030	35	41	56	18.5	10.6	0.300	0.173
15	0033	36	51	56	19.2	11	0.347	0.200
16	0034	41	57	63	22	12.7	0.250	0.144
17	0035	41	41	72	22	12.7	0.250	0.144
18	0036	46	60	72	25	14.4	0.250	0.144
19	0037	50	65	72	26	15	0.174	0.100
20	0038	46	67	75	25	14.4	0.200	0.115
21	0040	46	72	75	25	14.4	0.200	0.115
22	0049	55	80	96	30	17.3	0.150	0.086
23	0060	67	88	112	37	21.3	0.120	0.069
24	0067	80	103	118	45	25.9	0.100	0.057
25	0074	87	120	144	50	28.8	0.080	0.046
26	0086	98	135	155	55	31.7	0.060	0.034



## PART 3

### -Normative reference-

### 13. NORMATIVE REFERENCES

Electromagnetic Compatibility 89/336/CEE and following amendments 92/31/CEE, 93/68/CEE, and 93/97/CEE.

In most systems, the processing control also requires additional devices, such as computers, sensors, and so on, that are usually installed one next to the other, thus causing disturbance:

- Low frequency – harmonics.
- High frequency – electromagnetic interference (EMI)

#### High frequency interference

High frequency interference is disturbance or radiated interference with >9kHz frequency. Critical values range from 150kHz to 1000MHz.

Interference is often caused by commutations to be found in any device, i.e. switching feeders and drive output modules. High frequency disturbance may interfere with the correct operation of the other devices. High frequency noise produced by a device may cause malfunctions in measurement systems and communications systems, so that radio receivers only receive electrical noise. This may cause unexpected faults.

Electromagnetic compatibility is about immunity (i.e. when a device is not damaged from electromagnetic interference) and emission (the type and intensity of the disturbance caused by a device when operating in normal conditions).

The standards concerning electromagnetic compatibility are the following: EN55011 gr. 1 and 2 cl. A, EN12015/2005, EN 12016/2005, EN61800-3 and EN61000-6-x.

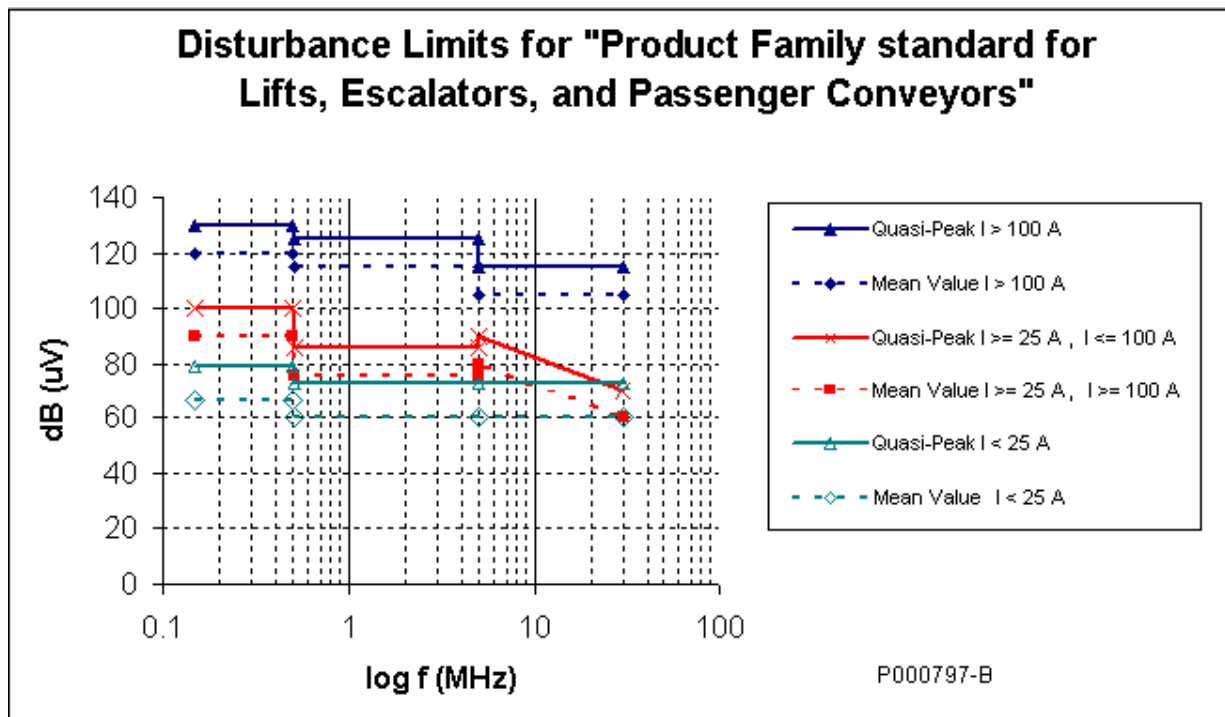
Standards EN55011 and 61800-3, as well as standards EN12015 ed EN12016, define immunity and emission levels required for devices designed to operate in different environments. The drives manufactured by ELETTRONICA SANTERNO S.p.A. are designed to operate under the most different conditions, so they all ensure high immunity against RFI and high reliability in any environment.

#### Emission Limits

**For lift applications, standard UNI EN 12015 relating to electromagnetic compatibility requires incorporated A2-type filters.**

Standard EN 12015 defines allowable emission levels for lift applications.

The diagram below shows emission limits according to standard EN 12015:





**Immunity**

Electromagnetic disturbance is caused by harmonics, semiconductor commutations, voltage variation-fluctuation-dissymmetry, mains failures and frequency variations. The electrical equipment must be immune from electromagnetic disturbance.

According to standard EN12016, immunity is provided by the following tests:

<p><b>Electromagnetic Compatibility (89/336/CEE and following amendments, 92/31/CEE, 93/68/CEE, and 93/97/CEE)</b></p>	<p>- Immunity:                      EN61000-4-2/IEC1000-4-2 Electromagnetic Compatibility (EMC). Part 4: Testing and Measurement Techniques.                      Section 2: Electrostatic Discharge Immunity Test. Basic EMC Publication.</p> <p>EN61000-4-3/IEC1000-4-3 Electromagnetic Compatibility (EMC). Part 4: Testing and Measurement Techniques.                      Section 3: Radiated, Radio-frequency, Electromagnetic Field Immunity Test.</p> <p>EN61000-4-4/IEC1000-4-4 Electromagnetic Compatibility (EMC). Part 4: Testing and Measurement Techniques.                      Section 4: Electrical Fast Transient/Burst Immunity Test. Basic EMC Publication.</p> <p>EN61000-4-5/IEC1000-4-5 Electromagnetic Compatibility (EMC). Part 4: Testing and Measurement Techniques.                      Section 5: Surge Immunity Test.</p> <p>EN61000-4-6/IEC1000-4-6 Electromagnetic Compatibility (EMC). Part 4: Testing and Measurement Techniques.                      Section 6: Immunity from Radiofrequency Fields Induced Disturbance.</p>
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ELETTRONICA SANTERNO certifies all its products in compliance with the immunity standards in force. All classes are provided with the CE Declaration of European Conformity according to Electromagnetic Compatibility 89/336/CEE – 92/31/CEE – 23/68/CEE-93/97/CEE (see EUROPEAN UNION DIRECTIVES AND DECLARATIONS OF CONFORMITY).



<p><b>Low Voltage Directive (73/23/CEE and amendment 93/68/CEE) following</b></p>	EN81-1	Safety requirements for the manufacture and installation of lifts and hoists. Electrical lifts.
	EN61800-5-1	Adjustable speed electrical power drive systems. Part 5-1: Safety requirements – Electrical, thermal and energy.
	EN 61800-5-2	Adjustable speed electrical power drive systems. Part 5-2: Safety requirements-Functional.
	EN60146-1-1/IEC146-1-1	Semiconductor convertors. General Requirements and line-commutated convertors. Part 1-1: Specifications of basic requirements.
	EN60146-2/IEC1800-2	Semiconductor convertors. Part 2: Self-commutated convertors with semiconductors incorporating direct DC convertors.
	EN61800-2/IEC1800-2	Adjustable speed electrical power drive systems. Part 2: General requirements – Rating specifications for low voltage adjustable frequency AC power drive systems.
	EN60204-1/IEC204-1	Safety of machinery. Electrical equipment of machines. Part 1: General requirements.
	EN60529/IEC529	Degrees of protection provided by enclosures (IP Code).
	EN50178	Electronic equipment for power systems.

ELETTRONICA SANTERNO is capable of providing the CE Declaration of Conformity according to the requirements of the LOW VOLTAGE DIRECTIVE 73/23/CEE-93/68/CEE (see EUROPEAN UNION DIRECTIVES AND DECLARATIONS OF CONFORMITY).

ELETTRONICA SANTERNO is also capable of providing a Manufacturer's Declaration according to the MACHINES DIRECTIVE, 89/392/CEE, 91368/CEE-93/44/CEE and a Manufacturer Declaration according to Article 4, Paragraph 3 of the Decree of the President of the Republic, 30th April 1999, N. 162 (see EUROPEAN UNION DIRECTIVES AND DECLARATIONS OF CONFORMITY).

## 13.1. RADIOFREQUENCY DISTURBANCE

Radiofrequency disturbance (RFI) may occur where the inverter is installed.

Electromagnetic emissions produced by the electrical components installed inside a cabinet may occur as conduction, radiation, inductive coupling or capacitive coupling.

Emissions disturbance can be the following:

- Radiated interference from electrical components or power wiring cables inside the cabinet;
- Disturbance and radiated interference from outgoing cables (feeder cables, motor cables, signal cables).

The figure shows how disturbance takes place:

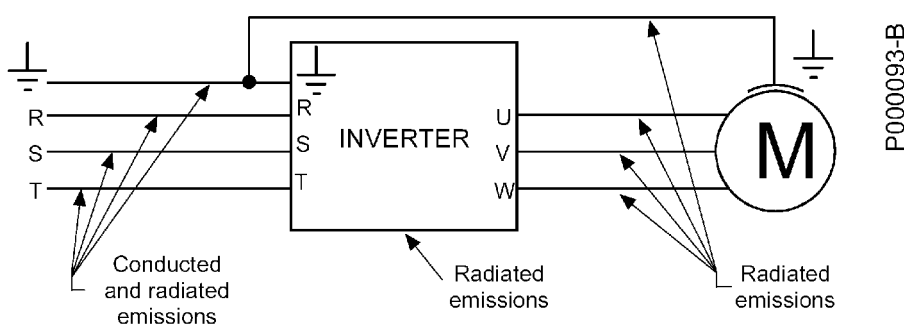


Figure 53: Disturbance sources in a power drive system equipped with an inverter.

The measures to be taken to suppress disturbance include: grounding enhancement; changes made to the cabinet structure; installation of mains filters on the line and installation of output toroid filters on the motor cables; optimization of the wiring and cable screening.

Always restrict as much as possible the area exposed to disturbance, so as to limit interferences with the other components installed in the cabinet.

### Grounding

Disturbance occurring in the grounding circuit affects the other circuits through the grounding mains or the casing of the connected motor.

Disturbance may interfere with the following appliances which are installed on the machines and which are sensitive to radiated interference, as they are measurement circuits operating at low voltage ( $\mu V$ ) or current signal levels ( $\mu A$ ):

- transducers (tachos, encoders, resolvers);
- thermoregulators (thermocouples);
- weighing systems (loading cells);
- PLC or NC inputs/outputs;
- photocells or magnetic proximity switches.

Disturbance is mainly due to high-frequency currents flowing in the grounding mains and the machine metal components. Disturbance occurs in the sensitive sections of components (optical transducer, magnetic transducer, capacitive transducer). Disturbance may also occur in appliances installed on machines with the same grounding or metal and mechanical interconnections.

A possible solution is to enhance the inverter, motor and cabinet grounding, as high-frequency currents flowing in the grounding between the inverter and the motor (capacity distributed to the ground of the motor cable and casing) may cause a strong difference of potential in the system.

### 13.1.1. THE MAINS

Disturbance and radiated interference occur in the mains.

Limiting disturbance results in weakening radiated interference.

Disturbance on the mains may interfere with the devices installed on the machine or the devices installed even some hundred meters far from the machine and which are connected to the same mains.

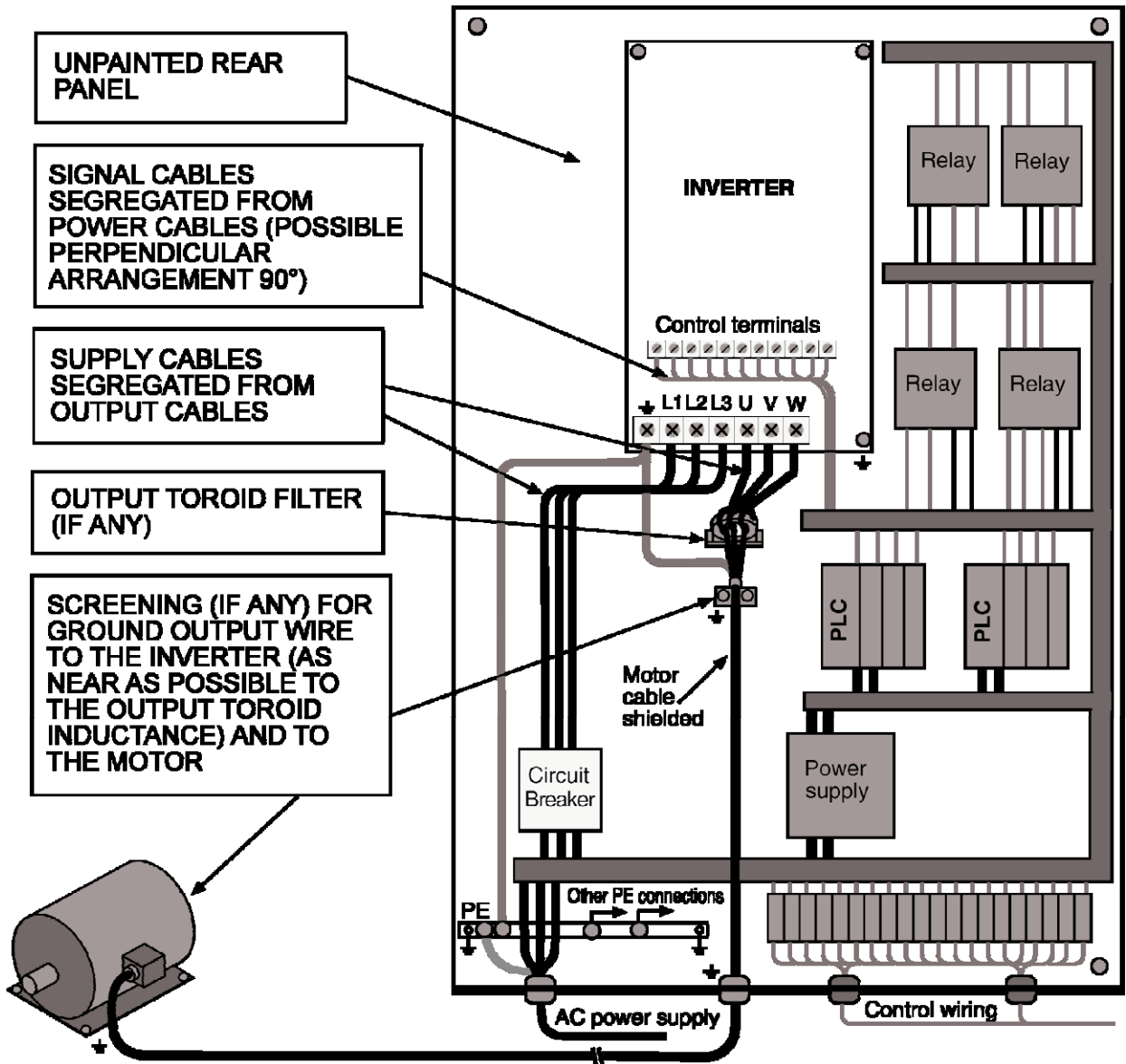
The following appliances are particularly sensitive to disturbance:

- computers;
- radio receivers and TV receivers;
- biomedical equipment;
- weighing systems;
- machines using thermoregulation systems;
- telephone systems.

Mains disturbance may be limited by installing a mains filter to reduce RFI.

ELETTRONICA SANTERNO adopted this solution to suppress RFI. Integrated filters are given in section Input and Output Filters.





P000795-B

**PART 3**

### 13.1.2. OUTPUT TOROID FILTERS

Ferrite is a simple radiofrequency filter. Ferrite cores are high-permeable ferromagnetic materials used to weaken cable disturbance:

- in case of three-phase conductors, all phases must go through the ferrite;
- in case of single-phase conductors (or 2-wire line) both phases must go through the ferrite (incoming and outgoing conductor cables that are to be filtered must go through the ferrite).

See section Input and Output Filters for the selection of the output toroid filter to weaken radiofrequency interference.

### 13.1.3. THE CABINET

To prevent input and output of electromagnetic emissions to and from the cabinet, draw particular attention to the cabinet doors, opening and cable paths.

A) Use a seam-welded metal frame ensuring electrical continuity.

Provide an unpainted, reference grounding support on the frame bottom. This steel sheet or metal grill is to be connected to the metal frame, which is also connected to the ground mains of the equipment. All components must be bolted directly to the grounding support.

B) Hinged parts or mobile parts (i.e. doors) must be made of metal and must be capable of restoring electrical conductivity once closed.

C) Segregate cables based on the type and intensity of electrical quantities and the type of devices which they are connected to (components that may generate electromagnetic disturbance and components that are particularly sensitive to disturbance):

<b>high sensitivity</b>	- analog inputs and outputs: voltage reference and current reference - sensors and measurement circuits (ATs and VTs) - DC supply (10V, 24V)
<b>low sensitivity</b>	- digital inputs and outputs: optoisolated commands, relay outputs
<b>low perturbation</b>	- filtered AC supply
<b>high perturbation</b>	- power circuits in general - inverter non-filtered AC supply - contactors - inverter-motor wires

Measures to take when wiring the cabinet or the system:

- Sensitive signals and perturbator signals must never exist within a cable.
- Avoid that cables carrying sensitive signals and perturbator signals run parallel at short distance: whenever possible, paths of cables carrying sensitive signals and perturbator signals should be reduced to a minimum.
- The distance between segregated cables should be proportional to the cable length. Whenever possible, cable crossing should be perpendicular.

Wires connecting the motor or load mainly generate disturbance. Disturbance is important in inverter power drive systems or the devices installed on the machine, and could interfere with local communication circuits located near the inverter (radiotelephones, mobile phones).

Follow the instructions below to solve these problems:

- Provide a motor cable path as short as possible.
- Screen the power cables to the motor; ground screening both to the inverter and to the motor. Excellent results are obtained using cables in which the protection connection (yellow-green cable) is external to the screening (this type of cables are available on the market with a cross-section up to 35sqmm per phase). If no screened cable having a suitable cross-section is available, segregate power cables in grounded, metal raceways.
- Screen signal cables and ground screening on the inverter side.
- Segregate power cable from signal cables.
- Leave a clearance of at least 0.5m between signal cables and motor cables.
- Series-connect a common mode inductance (toroid) (approx. 100 $\mu$ H) to the inverter-motor connection.

Limiting the disturbance in the motor cables will also limit mains disturbance.

Screened cables allow both signal sensitive cables and perturbator cables to run in the same raceway. When using screened cables, 360° screening is obtained with collars directly bolted to the ground support.

### 13.1.4. INPUT AND OUTPUT FILTERS

The inverters of the SINUS K LIFT series may be delivered with incorporated input filters; in that case, models are marked with A1 and A2 in the ID number.

If built-in filters are fitted, disturbance amplitude ranges between allowable emission limits as follows:

A2 = integrated filter complying with EN61800-3 (second environment), EN61800-3 (first environment, category C2, up to Size 0086 included), EN55011 cl. A gr.2 (industrial environment), EN55011 cl. A gr.1 (industrial environment, up to size 0086 included), EN12015 (concerning lifts).

A1 = integrated filter complying with the same standards as for A2 and with EN61800-3 (first environment, category C1), EN55011 cl. B (residential environment), EN61000-6-3 (residential environment).

To weaken disturbance, an output toroid filter (e.g. 2xK618 filter) can be installed on the Sinus K Lift models provided with integrated A1 filter. Make sure that the three cables between the motor and the inverter go through the core. An output toroid filter is particularly recommended when using a screened cable for the motor wiring.

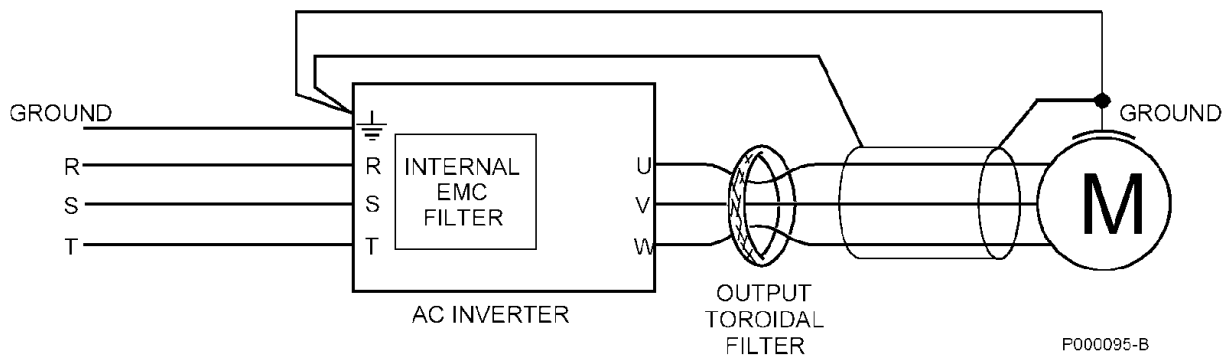


Figure 54: Wiring the toroid filter for the inverters of the SINUS K series.



**NOTE**

Install the output toroid filter near the inverter to comply with the standards in force (leave a minimum clearance for the cable connections); follow the instructions given for the connection of the ground terminals and the terminals of the filter, the motor and the inverter.



**NOTE**

Install the toroid filter by leading the connection cables between the motor and the inverter inside the toroid.



## 13.2. EUROPEAN UNION DIRECTIVES AND DECLARATIONS OF CONFORMITY



### EC DECLARATION OF CONFORMITY

Elettronica Santerno S.p.A.

Via G. Di Vittorio, 3 - 40020 Casalfiumanese (BO) - Italia

AS MANUFACTURER

#### DECLARE

UNDER OUR SOLE RESPONSABILITY

THAT THE DIGITAL THREE-PHASE AC INVERTER FROM

**SINUS K LIFT** LINE,

AND RELATED ACCESSORIES,

TO WHICH THIS DECLARATION RELATES,

APPLIED UNDER CONDITIONS SUPPLIED IN THE USER'S MANUAL,

ARE IN CONFORMITY TO WITH THE FOLLOWING STANDARDS:

EN 12015 (2005 - 02)	Electromagnetic compatibility. Product family standard for lifts, escalators and passengers conveyors. Emission.
EN 12016 (1998-05)	Electromagnetic compatibility. Product family standard for lifts, escalators and passengers conveyors. Immunity.

FOLLOWING THE PROVISIONS OF ELECTROMAGNETIC COMPATIBILITY  
DIRECTIVE 2004/108/CE

**PLACE AND DATE**  
Casalfiumanese, 04/10/2007

General Manager  
**BOMBARDA ING. GIORGIO**




**Elettronica Santerno Spa**  
Società soggetta all'attività di  
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Cap. Soc. € 2.500.000 i.v.  
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Cod. Mecc. PD 054138  
Cod. Ident. IVA Intracom.  
IT03686440284



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## EC DECLARATION OF CONFORMITY

Elettronica Santerno S.p.A.

Via G. Di Vittorio, 3 - 40020 Casalfiumanese (BO) - Italia

AS MANUFACTURER

### DECLARE

UNDER OUR SOLE RESPONSABILITY

THAT THE DIGITAL THREE-PHASE AC INVERTER FROM **SINUS K LIFT** LINE,  
AND RELATED ACCESSORIES, TO WHICH THIS DECLARATION RELATES,  
APPLIED UNDER CONDITIONS SUPPLIED IN THE USER'S MANUAL,  
ARE IN CONFORMITY TO WITH THE FOLLOWING STANDARDS:

EN 81 – 1 (2005)	Safety rules for the construction and installation of lifts. Part 1 : Electric Lifts
CEI EN 61800-5-1: (2005)	Adjustable speed electrical power drive systems. Part 5-1: Safety requirements – Electrical, thermal and energy.
EN 61800-5-2: (2007)	Adjustable speed electrical power drive systems. Part 5-2: Safety requirements – Functional.
EN 60146-1-1 (1995) + A1 (1998)	Semiconductor converters. General requirements and line commutated converters. Part 1-1: Specifications of basic requirements.
EN 60146-2 (2001)	Semiconductor converters. Part 2: Self-commutated semiconductor converters including direct d.c. converters.
CEI EN 61800-2 (1999)	Adjustable speed electrical power drive systems. Part 2: General requirements – Rating specifications for low voltage adjustable frequency a.c. power drive systems.
EN 60204-1 (2005 -10)	Safety of machinery – Electrical equipment of machines Part 1:General requirements
EN 60529 (1992) /IEC(1993) / A1(2000)	Degrees of protection provided by enclosures (IP Code).
IEC 62103 (2003)	Electronic equipment for use in power installations
EN 50178 (1999)	Electronic equipment for use in power installations

FOLLOWING THE PROVISIONS OF LOW VOLTAGE DIRECTIVE 2006/95/CE  
LAST TWO DIGITS OF THE YEAR IN WHICH THE CE MARKING WAS AFFIXED **CE: 03**

**PLACE AND DATE**  
Casalfiumanese, 04/10/2007

General Manager  
**BOMBARDA ING. GIORGIO**



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Cod. Mecc. PD 054138  
Cod. Ident. IVA Intracom.  
IT03686440284

ELETTRONICA  
**SANTERNO****MANUFACTURER'S DECLARATION**

Elettronica Santerno S.p.A.

Via G. Di Vittorio, 3 - 40020 Casalfiumanese (BO) - Italia

AS MANUFACTURER

**DECLARE**

UNDER OUR SOLE RESPONSABILITY

THAT THE DIGITAL THREE-PHASE AC INVERTER FROM

**SINUS K LIFT** LINE,

TO WHICH THIS DECLARATION RELATES,

APPLIED UNDER CONDITIONS SUPPLIED IN THE USER'S MANUAL,

ARE IN CONFORMITY TO WITH THE FOLLOWING STANDARDS:

<b>EN 60204-1</b> (1997)	Safety of machinery - Electrical equipment of machines – Part 1: General requirements
<b>EN 60204-1</b> Amendment 1 (1988)	Electrical equipment of industrial machines. Part 2: Item designation and examples of drawings, diagrams, tables and instructions.

AND MUST NOT BE PUT INTO SERVICE UNTIL THE MACHINERY INTO WHICH IT IS TO BE INCORPORATED HAS BEEN DECLARED IN CONFORMITY WITH THE PROVISIONS OF MACHINERY DIRECTIVE 89/392/EEC AND SUBSEQUENT AMENDMENTS 91/368/EEC, 93/44/EEC AND 93/68/EEC AND THEIR RIFUSION AS 2006/42/CE

**PLACE AND DATE**  
Casalfiumanese, 05/10/2007

General Manager  
**BOMBARDA ING. GIORGIO**



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ELETRONICA  
**SANTERNO**



## **MANUFACTURER'S DECLARATION**

**Elettronica Santerno S.p.A.**

Via G. Di Vittorio, 3 - 40020 Casalfiumanese (BO) - Italia

AS MANUFACTURER

### **DECLARE**

UNDER OUR SOLE RESPONSABILITY  
THAT THE DIGITAL THREE-PHASE AC INVERTER  
FOR LIFTS OF **SINUS K LIFT** TYPE,  
TO WHICH THIS DECLARATION RELATES,  
APPLIED UNDER CONDITIONS SUPPLIED IN THE USER'S MANUAL,  
IS TO BE INCORPORED INTO THE LIFT, IN CONFORMITY WITH THE  
PROVISION OF CHAPTER 1 ARTICLE 4 SUBCLAUSE 2 OF DIRECTIVE 95/16/EC  
AND MUST NOT BE PUT INTO SERVICE UNTIL THE LIFT INTO WHICH IT IS TO  
BE INCORPORED HAS BEEN DECLARED IN CONFORMITY WITH THE  
PROVISIONS OF DIRECTIVE 95/16/EC.

**PLACE AND DATE**  
Casalfiumanese, 05/10/2007

General Manager  
**BOMBARDA ING. GIORGIO**  
