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SINUS K LIFT

FULL DIGITAL INVERTER

USER MANUAL

-Installation and Programming Instructions-

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English

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OVERVIEW

Inverters (V.V.V.F.) of the SINUS K series equipped with LIFT SW 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 with an excellent floor approaching system, as well as easy startup and maintenance.
The sophisticated hardware includes IGBT modules of the latest generation and vectorial modulation, thus dramatically reducing both energy consumption and contractual power.
Current absorbed while accelerating and power dissipated by the motor are considerably reduced; motor rotation is noiseless; motor overheating is not remarkable.
SINUS K LIFT inverters can be connected to motors with power ratings ranging from 1.3 kW to 1200 kW with no transducer (tacho generator, encoder or resolver) for cage speed ratings up to 1.2 m/s. For cage speed values up to 5 m/s, an encoder is required.
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.

Inverters of the SINUS K LIFT series have been developed, designed and manufactured according to “Low Voltage Directive” and “EMC Directive” and are provided with “CE” marking. In particular, they comply with the following:

EN81-1	Safety regulations for the manufacture and installation of lifts and hoists. Electrical lifts.
IEC61800-5-1	Adjustable speed electrical power drive systems. Part 5-1: Safety requirements – Electrical, thermal and energy.
IEC 22G/109/NP	Adjustable speed electrical power drive systems. Part 5-2: Safety requirements – Functional.
EN60146-1-1	Semiconductor convertors. General requirements and natural commutation convertors. Part 1-1: Specifications of basic requirements.
EN60146-2	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 inverter.

FEATURES OF SINUS K LIFT INVERTERS

Ratings, mounting and installation instructions, programming and startup are detailed in the next sections of this manual. This section describes the mains 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 (up to Size S30 included). An input EMC filter may be installed by request.
For inverter sizes higher than size S30, a separate braking module is supplied.
Auxiliary circuit interfaces are power terminals and signal terminals, but each inverter is also provided with a serial interface to be connected to a computer, a modem, etc.
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 is separate from the inverter, but can also be installed on the inverter. The installer can install the keypad on the control board, but the keypad should be used for the equipment startup and maintenance.

NOTE!! The same keypad may be used for any inverter size.

The keypad allows to setup and adjust the equipment, enter the motor parameters, select kinematic variables (acceleration and jerk speed), display failure or 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).
See following sections for more details. Two different commercial speed values are available along with a floor approaching speed and a maintenance speed. All these values may be programmed via keypad.
This allows to obtain the most suitable speed for different interfloors; in case of low interfloors, the inverter will adjust its speed based on the lift plant requirements. 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 to obtain a proper stop distance.
Acceleration and jerk values may be set via keypad. Factory setting is 0.6 m/s^2 (acceleration) and 0.6 m/s^3 (jerk)— with no encoder feedback; if encoder feedback is used, acceleration is set to 1.0 m/s^2 and jerk is set to 0.8 m/s^3.
These parameters ensure an 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 cage rated speed (Vn) as follows:

	WITH ENCODER FEEDBACK	WITHOUT ENCODER FEEDBACK
- Low speed:	Vb = 0.67 x Vn	Vb = 0.32 x Vn
- Approach speed:	Va = 0.1 x Vn	Va = 0.1 x Vn
- Maintenance speed:	Vm = 0.4 x Vn	Vm = 0.2 x Vn
- Commercial speed:	Vc = 1 x Vn	Vc = 1 x Vn

Example: If rated speed is Vn = 1.2 m/s with no ENCODER feedback, the following values are obtained:
Vb = 0.8 m/s
Va = 0.12 m/s
Vm = 0.48 m/s
Vc = 1.2 m/s

NOTE!! The speed values above, as well as acceleration and jerk values, are preset for an easier startup, thus allowing to select only commercial speed values.

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 Vc = 1.2 m/sec (parameter P44), parameter M23 displays the expected stop distance of 1.8 m.

If a 0.15 m approach distance is set, 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 signal will be set at a distance exceeding 1.95 m (theoretical value) in order to avoid any error 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 signal.
Increasing the slowing-down signal 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 slowing-down signal theoretical distance 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 speed), the slowing-down signal will be set at 2.15 m from the stop position (1.8+0.15)x1.1 = 1,95x1.1 = 2.15.

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.

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 range from 1.3kW to 1,200kW.

AVAILABLE SINUS K MODELS:

NOTE!! It is possible to change some technical features and to customize the inverter enclosures shown in the picture. The proportion of one enclosure to the other is shown as an example and is not binding.

PRODUCTS COVERED IN THIS MANUAL

This Instruction Manual covers all inverters of the SINUS K series provided with LIFT software; size: S05 to S70; supply voltage: 200VAC to 690VAC. This manual includes two main sections:

SECTION 1-Installation Instructions- includes the following:

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

SECTION 2-Programming Instructions- includes the following:

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

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SECTION 1
-INSTALLATION INSTRUCTIONS-

FEATURE LIST

• One product, three functions:
- vectorial-modulation LIFT software for lift applications (in compliance with EN 81-1 and lift directive) (V/f curve);

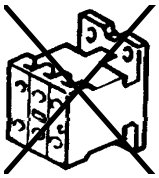
• Wide range of supply voltage (200VAC ~ 500VAC) for stand-alone models and up to 690VAC for models up to SINUS K 0250. Standard power supply: 280VDC ~ 705VDC. (970VDC for models up to SINUS K 0250).

• Wide range of voltage values and power values for the electrical motor to be connected to any single inverter size. Stand-alone model: up to 1200kW; cabinet: from 37 up to 1200kW.

	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.

CE



• 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).

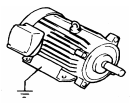
• Beyond performance enhancement, the new series of SINUS K models are more compact than the prior models. The overall dimensions have been reduced up to 50% in order to install the inverter in small-sized, light-weight control panels. A compact, book-like structure allows an easy side-by-side installation.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

• Automatic control of the cooling system (up to Size S30). The ventilation system activates only when required and indicates any failures of the cooling fan. This ensures a greater energy saving, a lower wear of the cooling fans and a 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 up to Size S30.

• Noiseless operation ensured by a high modulation frequency programmable up to 16kHz (LIFT SW, IFD SW).

• Integrated motor control through a PTC input.



• Control panel with LCD display showing full words for an easier comprehension of the operation parameters.

• Managing and programming panel provided with eight function keys.

• Window-structured programming menu for an easy and quick control of each functionality.

• Preset parameters for the most used applications.

- PC interface for WINDOWS environment with REMOTE DRIVE software in five foreign languages.
- PC compiled software for the programming of more than 20 application functions.
- Serial communication RS485 MODBUS RTU for serial links to PC, PLC and control interfaces.
- Optional field buses of any type (Profibus DP, Can Bus, Device Net, Ethernet, etc.)

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 operating procedures that, if not carried out, 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

NOTE!! The ground connection of the motor casing should follow a separate path to avoid possible interferences.

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

DANGER!! The inverter may generate an output frequency up to 800Hz (IFD SW); this may cause a motor rotation speed up to 16 (sixteen) times the motor rated 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 switching off the inverter.

DANGER!! Never perform any operation on the 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 resistive braking module 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 situation.

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.

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

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

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

CAUTION!! Do not start or stop the motor using a contactor over the inverter power supply.

CAUTION!! Do not install any contactor between the inverter and the motor. Do not connect any power factor correction capacitor to the motor.

CAUTION!! Operate the inverter only if a proper grounding is provided.

CAUTION!! In case of alarm trip, a comprehensive review of the Diagnostic section in the Programming Manual 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.

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

CAUTION!! Do not connect single-phase motors.

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

CAUTION!! Respect the environmental requirements for the equipment installation.

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

CAUTION!! 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 damage caused by electrostatic discharges.

1 EQUIPMENT DESCRIPTION AND INSTALLATION

1.1 BASIC FEATURES OF THE SINUS K SERIES

The inverters of the SINUS K series are full digital inverters for the speed regulation of asynchronous motors up to 1,200 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; vectorial modulation; power control with the latest IGBTs; high immunity to radio interference; high overload capability.
Any value of the quantities 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 380-500VAC mains (-15%,+10%) up to 690VAC for for models up to SINUS K 250;
- EMC filters for industrial environment incorporated in any inverter Size;
- EMC filters for domestic environment incorporated in Sizes S05 and S10;
- possibility of AC power supply;
- built-in braking module up to Size S30;
- serial interface RS485 with communications protocol according to standard MODBUS RTU;
- degree of protection IP20 up to Size S40;
- possibility of providing IP54 up to Size S30;
- 3 analog inputs 0±10VDC, 0(4)÷20mA;
- 8 optoisolated, configurable digital inputs (NPN/PNP);
- 2 configurable analog outputs 0÷10V, 4÷20mA, 0÷20mA;
- 1 static, "open collector" digital output (optoisolated);
- 2 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".

1.2 INSPECTION UPON RECEIPT OF THE GOODS

Make sure that the equipment is not damaged and complies with the equipment you ordered by referring to the nameplate located on the inverter front part. 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.

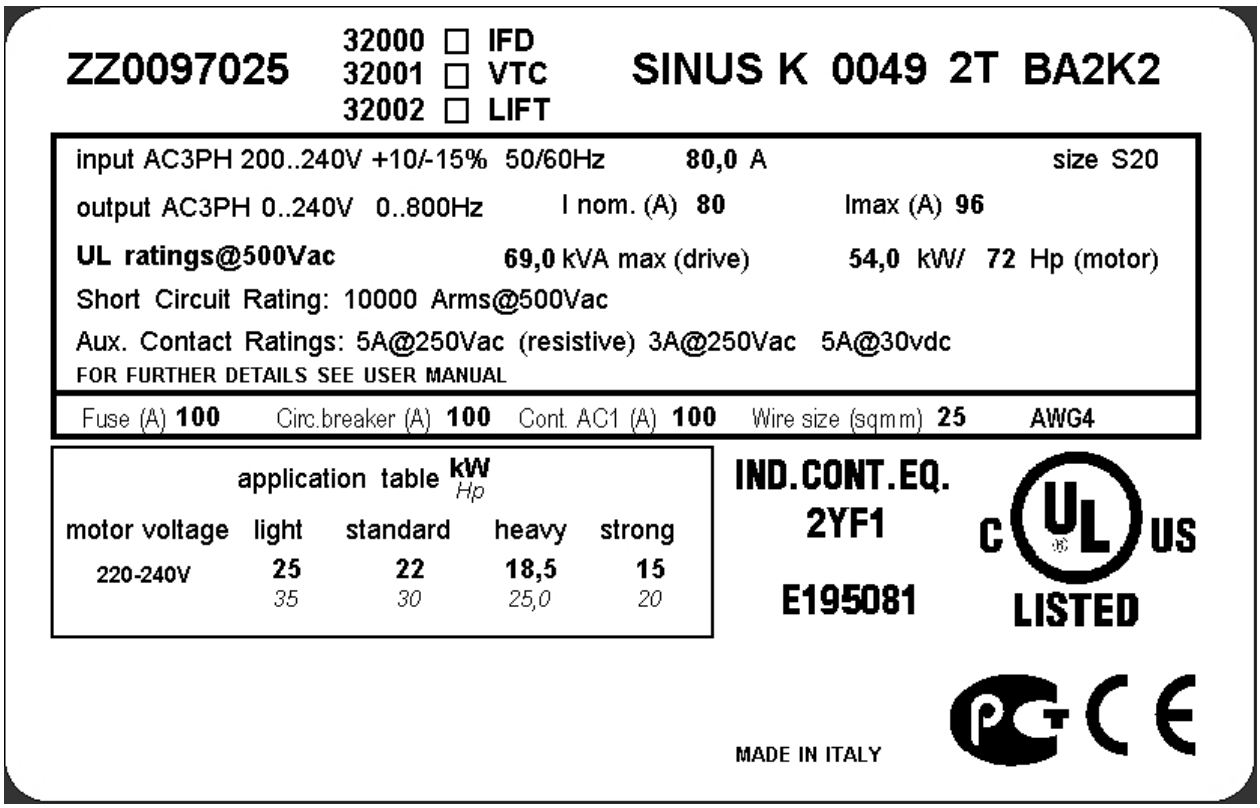
SINUS	K	0005	4	T	B	A2	X	2
1	2	3	4	5	6	7	8	9

1	Product line: SINUS stand-alone inverter SINUS BOX inverter contained inside a box SINUS CABINET inverter contained inside a cabinet
2	"K" type of control with three types of software installed: IFD = Space vector modulation for general-purpose applications (vectorial modulation PWM with V/f curve) (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) LIFT = Space vector modulation with a special software for lift applications (vectorial modulation PWM with V/f curve)
3	Inverter size
4	Supply voltage 2 = power supply 200÷240VAC; 280÷340VDC 4 = power supply 380÷500VAC; 530÷705VDC 5 = power supply 500÷575VAC, 705÷810VDC 6 = power supply 660÷690VAC; 930÷970VDC
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, EN50082-1, -2. A1 = integrated filter, EN 61800-3 issue 2 FIRST ENVIRONMENT Category C2, EN55011 gr.1 cl. A for industrial and domestic users, EN50081-2, EN50082-1, -2, EN61800-3-A11. A2 = integrated filter, EN 61800-3 issue 2 SECOND ENVIRONMENT Category C3, EN55011 gr.2 cl. A for industrial users, EN50082-1, -2, EN61800-3-A11. B = integrated input filter (type A1) plus external, output toroid filter, EN 61800-3 issue 2 FIRST ENVIRONMENT Category C1, EN55011 gr.1 cl. B for industrial and domestic users, EN50081-1,-2, EN50082-1, -2, EN61800-3-A11.
8	Control panel X = without control panel K = with control panel, back-lit, 16x2 characters LCD display.
9	Degree of protection 0 = IP00 2 = IP20 3 = IP24 5 = IP54

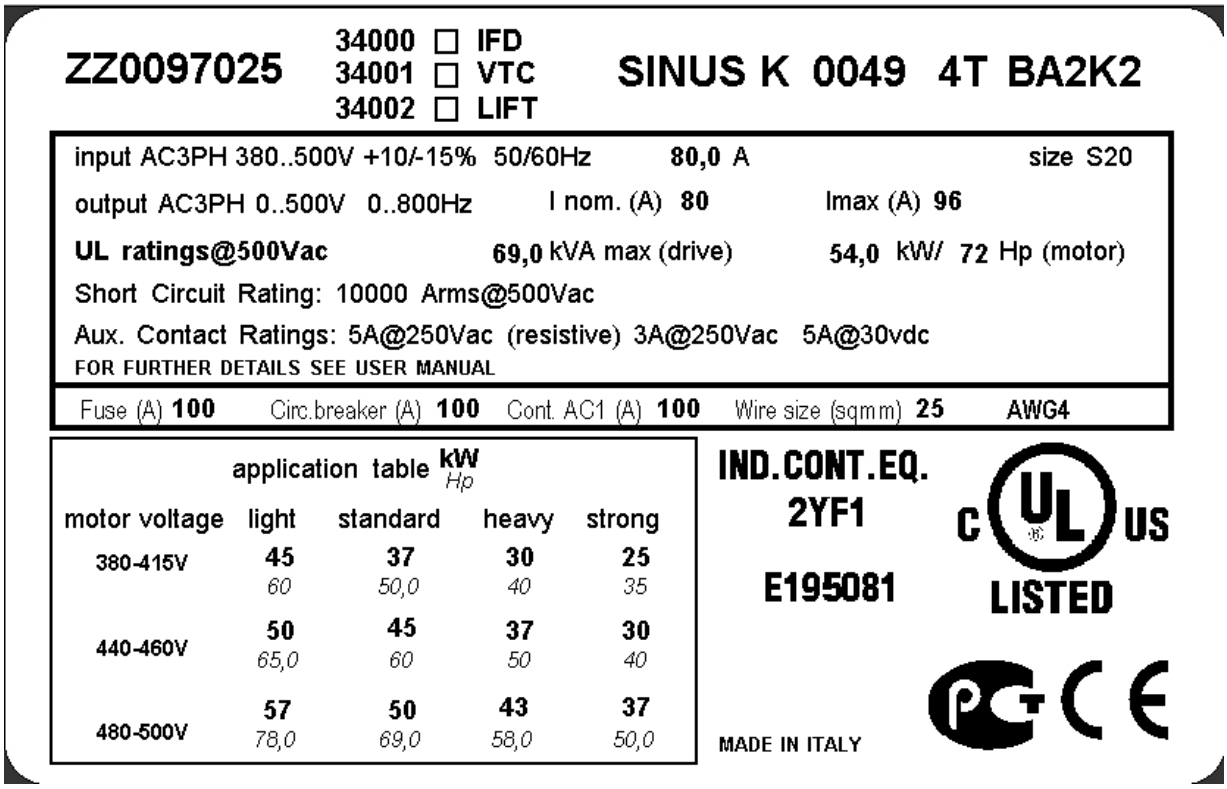
If the equipment is stored before being started, make sure that the ambient conditions do not exceed the ratings mentioned in Section 1.3 "Installation"). The equipment guarantee covers any manufacturing defect. The manufacturer has no responsibility for possible damages due to the inverter transportation 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.

1.2.1 Inverter Nameplate

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



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



1.3 INSTALLATION

The inverters of the SINUS K series—degree of protection IP20—are capable of being installed inside another enclosure. Only models with degree of protection IP54 may be wall-mounted.
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.

1.3.1 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 2% every 100m above 1000m (max. 4000m).
Operating ambient humidity	From 5% to 95%, from 1g/m^3 to 25g/m^3, non condensing and non freezing (class 3k3 according to EN50178)
Storage ambient humidity	From 5% to 95%, from 1g/m^3 to 25g/m^3, non condensing and non freezing (class 1k3 according to EN50178).
Ambient humidity during transport	Max. 95%, up to 60g/m^3; 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.

1.3.2 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
S15	30	60	80	150
S20	50	100	100	200
S30	100	200	200	200
S40	100	200	200	300
S50	100	200	200	300

The air circulation through the enclosure must avoid warm air intake. Make sure to provide an 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:
air delivery Q= (**Pdiss**/ Δt)*3.5 (m^3/h)

Pdiss is the sum of the values, expressed in W, of the power dissipated by all components installed in the enclosure; **Δt** 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 0113**.

Total power to be dissipated within the enclosure **Pti**:
generated by the inverter **Pi** 2150 W
generated by other components **Pa** 0 W
Pti = **Pi** + **Pa** = 2150 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 **L** 0.6m
height **H** 1.8m
depth **P** 0.6m

Free external surface of the enclosure **S:**
S = (**L** x **H**) + (**L** x **H**) + (**P** x **H**) + (**P** x **H**) + (**P** x **L**) = 4.68 m^2

External thermal power dissipated by the enclosure **Pte** (metallic enclosure only):
Pte = 5.5 x **Δt** x **S** = 128 W

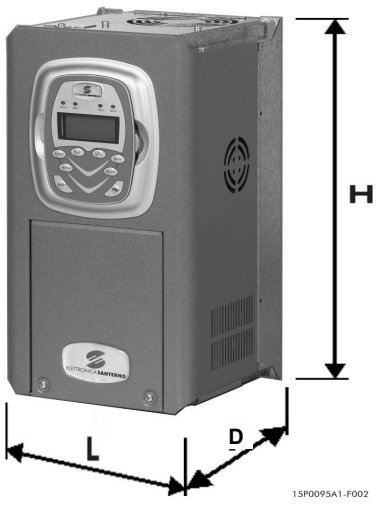
Pdiss. left :
Pdiss. = **Pti** - **Pte** = 2022 W

To dissipate **Pdiss.** left, provide a ventilation system with the following air delivery **Q:**
Q = (**Pdiss.** / **Δt**) x 3.5 = 1415 m^3/h
(with reference to ambient temperature of 35°C at 1000m above sea level).

1.3.3 SIZE, WEIGHT AND DISSIPATED POWER

1.3.3.1 MODELS STAND-ALONE IP20 AND IP00

Size	MODEL	L	H	D	Wgt	Dissipated power 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	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
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
S30	SINUS K 0113	302	748	421	51	2150
	SINUS K 0129				51	2300
	SINUS K 0150				51	2450
	SINUS K 0162				51	2700
S40	SINUS K 0179	630	880	381	112	3200
	SINUS K 0200				112	3650
	SINUS K 0216				112	4100
	SINUS K 0250				112	4250
S50	SINUS K 0312	666	1000	421	148	4900
	SINUS K 0366				148	5600
	SINUS K 0399				148	6400



1.3.3.2 MODELS STAND-ALONE IP54

Size	MODEL	L	H	D	Wgt	Dissipated Power at Inom.
		mm	mm	mm	kg	W
S05	SINUS K 0005	214	577	227	15,7	215
	SINUS K 0007				15,7	240
	SINUS K 0009				15,7	315
	SINUS K 0011				15,7	315
	SINUS K 0014				15,7	315
S10	SINUS K 0016	250	623	268	22,3	330
	SINUS K 0017				22,3	380
	SINUS K 0020				22,3	420
	SINUS K 0025				23,3	525
	SINUS K 0030				23,3	525
	SINUS K 0035				23,3	525
S15	SINUS K 0038	288	715	366	40	740
	SINUS K 0040				40	820
	SINUS K 0049				40	950
S20	SINUS K 0049	339	842	366	56	950
	SINUS K 0060				56	1050
	SINUS K 0067				56	1250
	SINUS K 0074				57	1350
	SINUS K 0086				57	1500
S30	SINUS K 0113	359	1008	460	72	2150
	SINUS K 0129				72	2300
	SINUS K 0150				76	2450
	SINUS K 0162				76	2700

1.3.3.3 MODELS BOX IP54*

Size	MODEL	L	H	D	Wgt	Dissipated power at Inom.
		mm	mm	mm	kg	W
S05B	SINUS BOX K 0005	400	600	250	27,9	215
	SINUS BOX K 0007				27,9	240
	SINUS BOX K 0009				27,9	315
	SINUS BOX K 0011				27,9	315
	SINUS BOX K 0014				27,9	315
S10B	SINUS BOX K 0016	500	700	300	48,5	330
	SINUS BOX K 0017				48,5	380
	SINUS BOX K 0020				48,5	420
	SINUS BOX K 0025				49,5	525
	SINUS BOX K 0030				49,5	525
	SINUS BOX K 0035				49,5	525
S15B	SINUS BOX K 0038	600	1000	400	78,2	740
	SINUS BOX K 0040				78,2	820
	SINUS BOX K 0049				78,2	950
S20B	SINUS BOX K 0049	600	1200	400	110,3	950
	SINUS BOX K 0060				110,3	1050
	SINUS BOX K 0067				110,3	1250
	SINUS BOX K 0074				112,3	1350
	SINUS BOX K 0086				112,3	1500

*Size and weight may vary depending on optional components required.

AVAILABLE OPTIONAL COMPONENTS:

Line magnetic circuit breaker with release coil.
Line contactor in AC1.
Front control through key-operated selector switch for LOCAL/REMOTE control and EMERGENCY push-button.
Line input impedance.
Motor-side output impedance.
Output toroid filter.
Motor fan-cooling circuit.
Anticondensation resistance.
Additional terminal board for input/output wires.

1.3.3.4 MODELS CABINET IP24 AND IP54*

Size	MODEL	L	H	D	Weight	Dissipated Power at Inom.
		mm	mm	mm	kg	W
S20C	SINUS CABINET K 0049	600	2000	450	155	950
	SINUS CABINET K 0060				155	1050
	SINUS CABINET K 0067				155	1250
	SINUS CABINET K 0074				157	1350
	SINUS CABINET K 0086				157	1500
S30C	SINUS CABINET K 0113	600	2000	600	188	2150
	SINUS CABINET K 0129				188	2300
	SINUS CABINET K 0150				192	2450
	SINUS CABINET K 0162				192	2700
S40C	SINUS CABINET K 0179	1000	2000	600	248	3200
	SINUS CABINET K 0200				248	3650
	SINUS CABINET K 0216				257	4100
	SINUS CABINET K 0250				257	4250
S50C	SINUS CABINET K 0312	1200	2000	600	348	4900
	SINUS CABINET K 0366				348	5600
	SINUS CABINET K 0399				348	6400

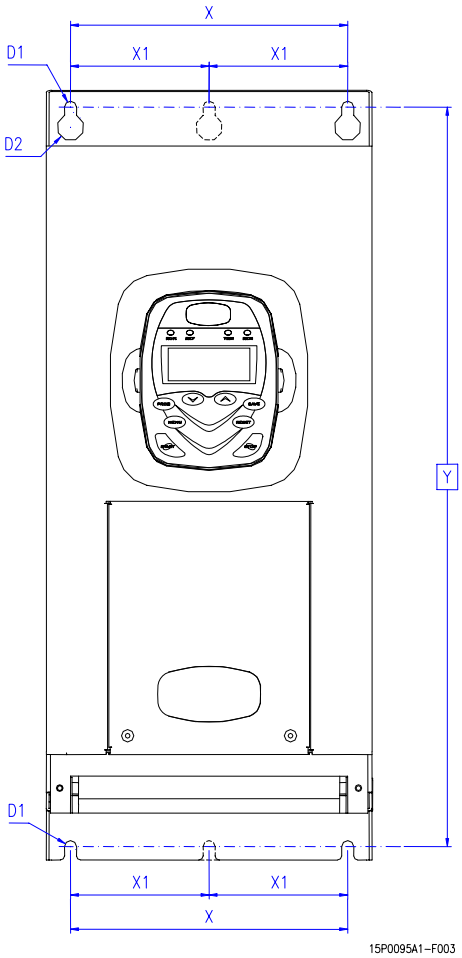
* Size and weight may vary depending on optional components required.

AVAILABLE OPTIONAL COMPONENTS:

- Disconnecting switch with line fast fuses.
- Line magnetic circuit breaker with release coil.
- Line contactor in AC1.
- Front control through key-operated selector switch for LOCAL/REMOTE control and EMERGENCY push-button.
- Line input impedance.
- Motor-side output impedance.
- Additional terminal board for input/output wires.
- Output toroidal filter.
- Motor fan-cooling circuit.
- Braking module for size ≥ S40.
- Anticondensation resistance.
- Devices PT100 for motor temperature control.
- Optional components by request.

1.3.4 STANDARD MOUNTING AND PIERCING TEMPLATES

Size SINUS K	Fixing templates (mm) (standard mounting)					
	X	X1	Y	D1	D2	Fastening screws
S05	156	-	321	4.5	-	M4
S10	192	-	377	6	12.5	M5
S15	185	-	449	7	15	M6
S20	175	-	593	7	15	M6
S30	213	-	725	9	20	M8
S40	540	270	857	9	20	M8
S50	560	280	975	11	21	M8-M10



1.3.5 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 through the installation of two optional mechanical parts to be assembled with five self-forming screws M4 (see Figure 1.1).

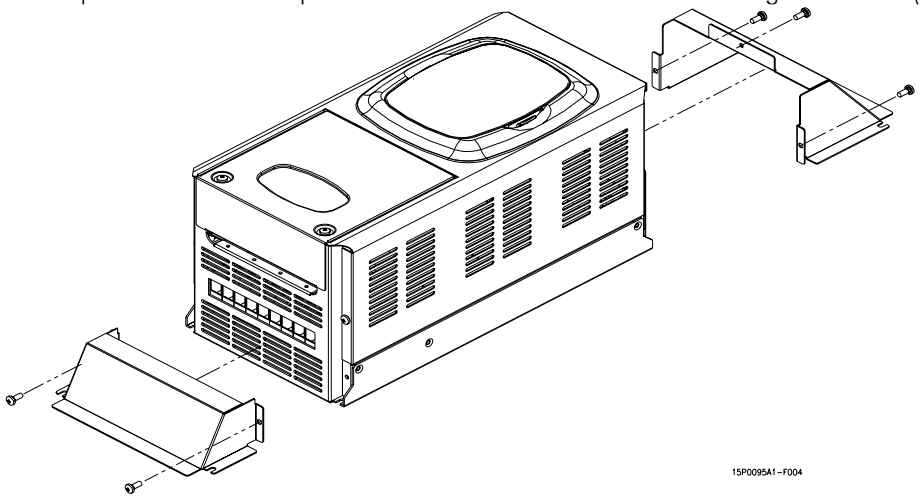


Fig. 1.1: Mounting the accessories for SINUS K S05 through-panel assembly

The equipment height becomes 488 mm with the two additional components (see figure on the left).
Figure 1.2 also shows the piercing template of the mounting panel, including four holes M4 for the inverter mounting and two slots (142 x 76 mm and 142 x 46 mm) for the air-cooling of the power section.

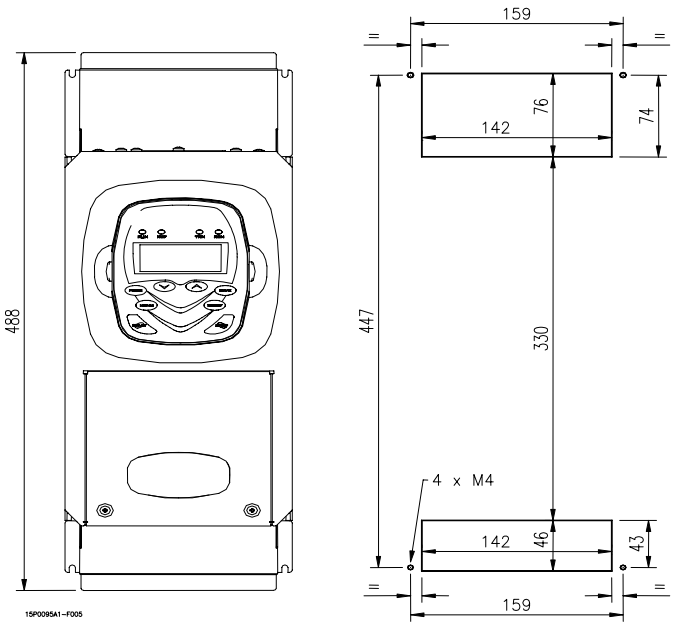


Fig. 1.2: Piercing template of the mounting panel for SINUS K S05 through-panel assembly

SINUS K S10

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

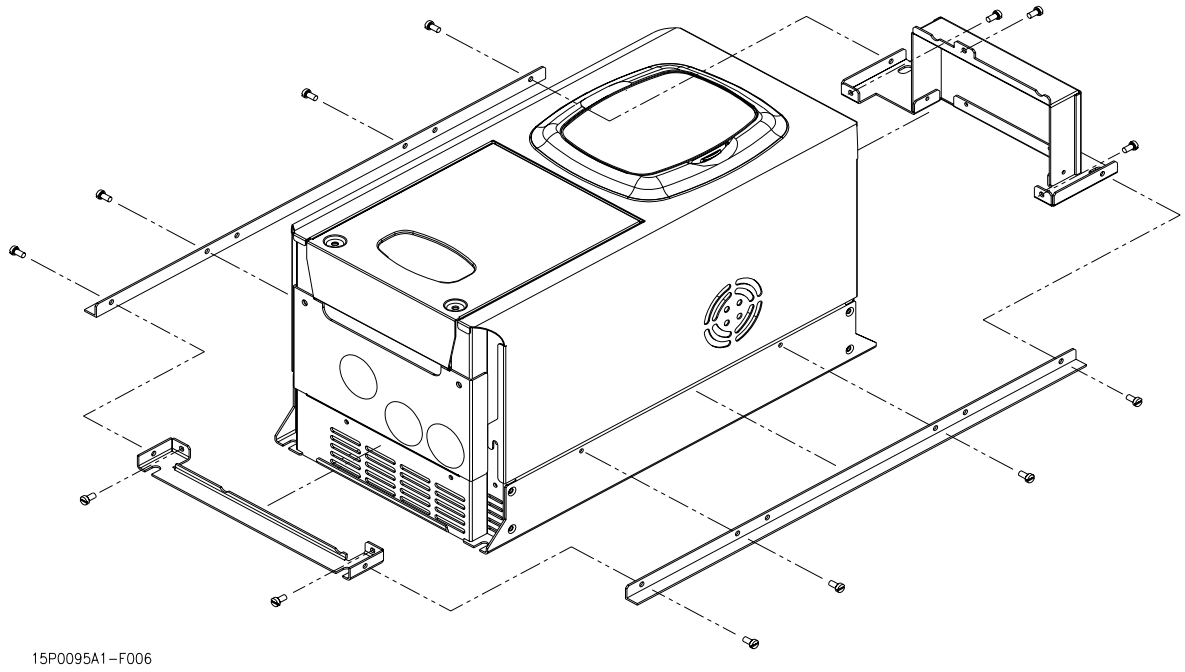


Fig. 1.3: Mounting the accessories for SINUS K S10 through-panel assembly

The overall dimensions of the equipment including the through-panel assembly kit is 452 x 238 mm (see Figure 1.4). The figure shows the piercing template of the mounting panel, including four holes M5 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).

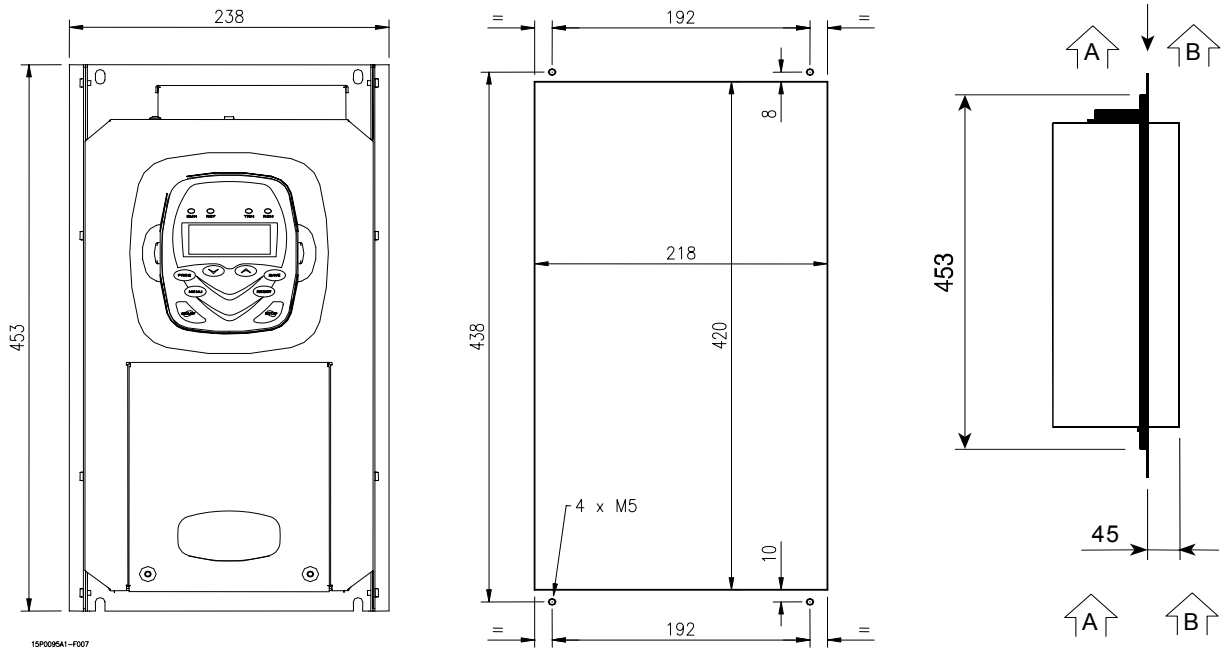


Fig.1.4: Piercing template of the mounting panel for SINUS K S10 through-panel assembly

SINUS K S15-S20-S30

No additional mechanical component is required for the through-panel assembly of these three 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).

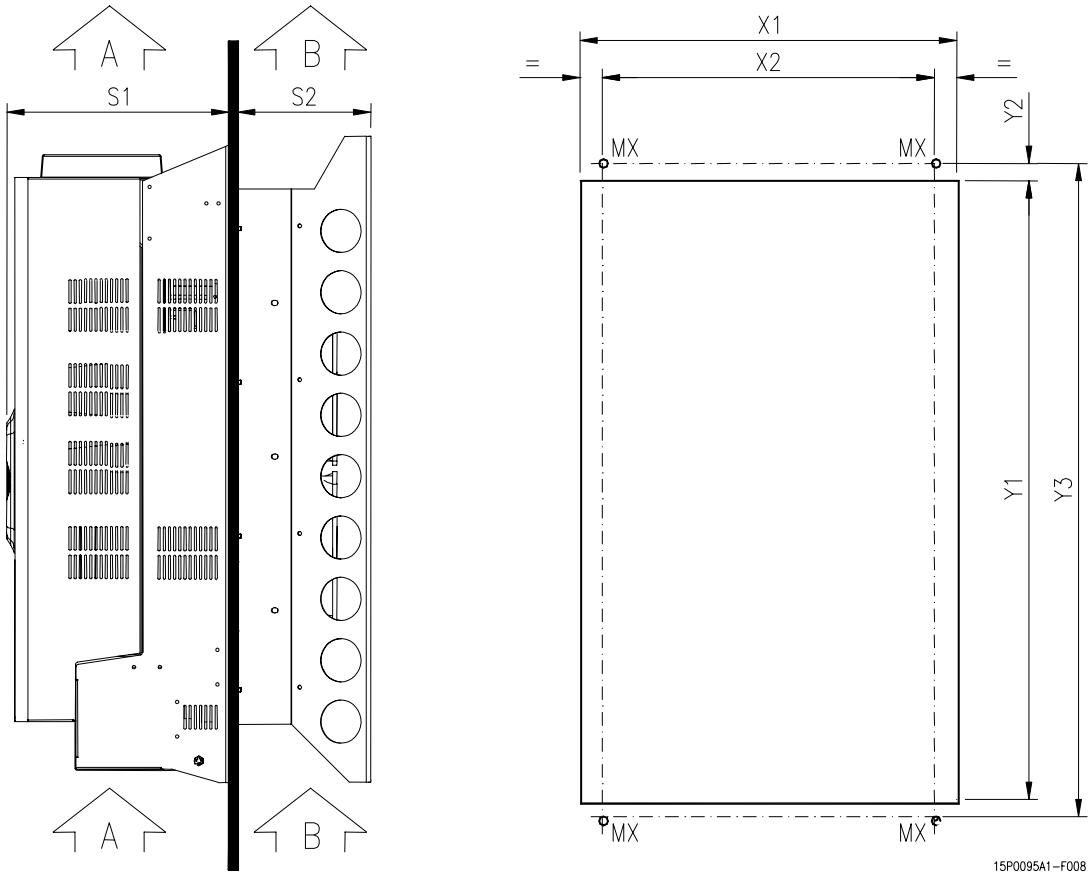
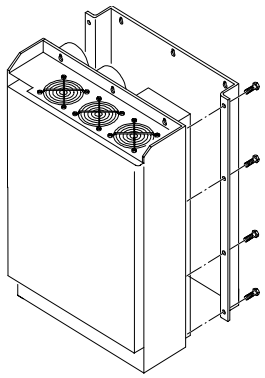


Fig.1.5: Through-panel assembly and piercing templates for SINUS K S15, S20, S50

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
S30	257	164	270	665	266	35	715	4 x M8

SINUS K S40

For the through-panel assembly of this inverter size, remove the bottom mounting plate. The figure below shows how to disassemble the mounting plate.



To disassemble the mounting plate, remove 8 screws M6 (Figure 1.6 shows 4 screws on one side of the inverter).

Fig.1.6: Removing the mounting plate from SINUS K S40 for the through-panel assembly

The piercing template shown in Figure 1.7 is to be made on the mounting panel (see relevant measures). The figure also shows the side view of the equipment through-panel assembly. The air flows and the front and rear projections are highlighted as well (with relevant measures).

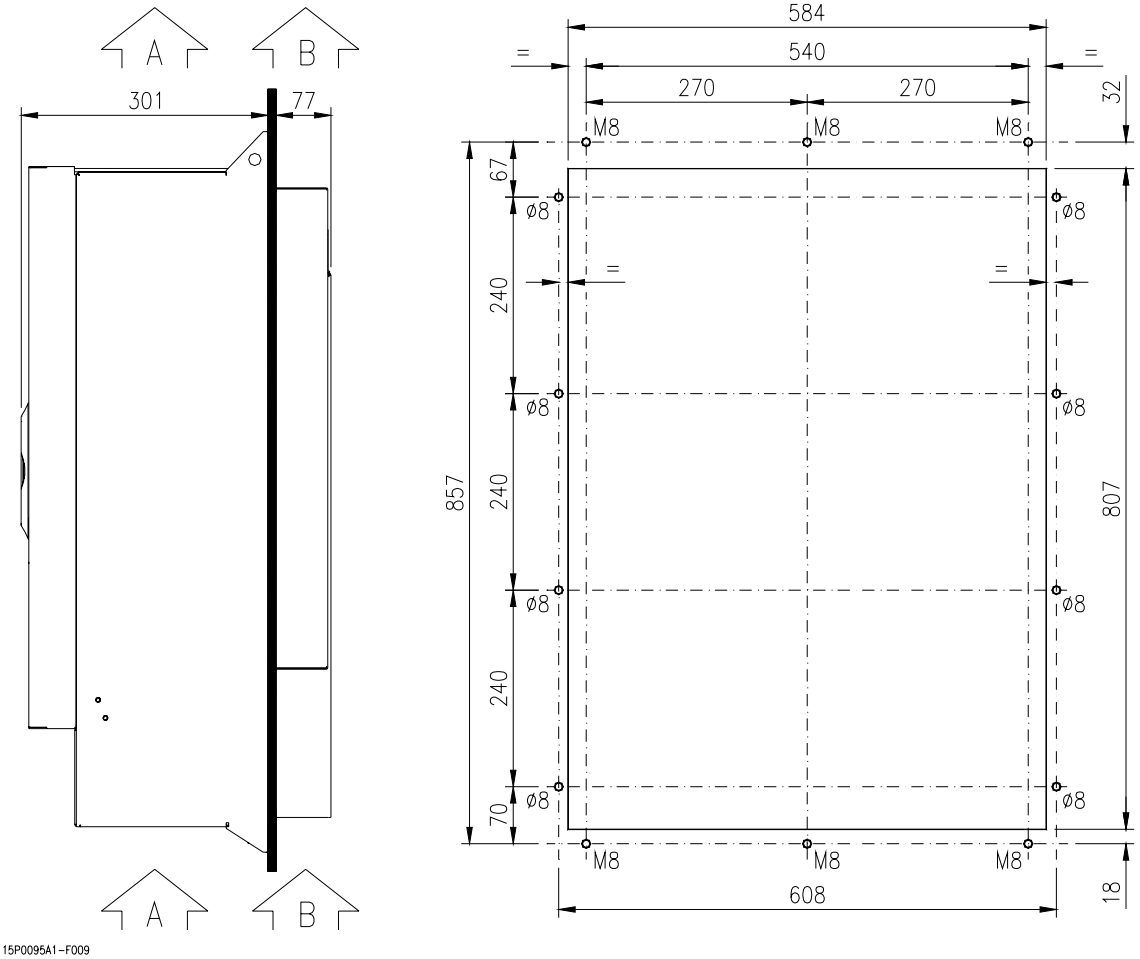
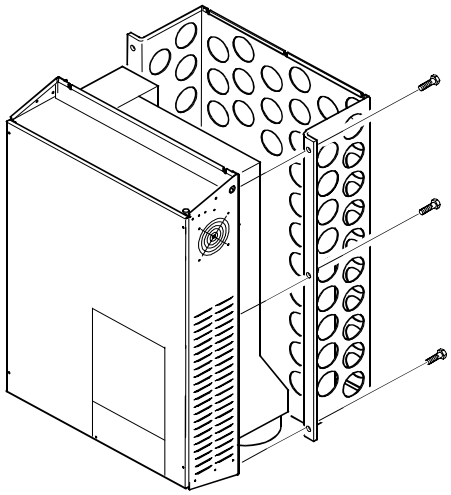


Fig.1.7: Through-panel assembly and piercing templates for SINUS KS40

SINUS K S50

For the through-panel assembly of this inverter size, remove the bottom mounting plate. Figure 1.8 shows how to disassemble the mounting plate.

Fig. 1.8: Removing the mounting plate from SINUS K S50 for the through-panel assembly.



To disassemble the mounting plate, remove 6 screws M8 (the figure shows the three screws in one side of the inverter).

The piercing template shown in the Figure 1.9 (right) is to be made on the mounting panel (see relevant measures). The figure 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 (with relevant measures).

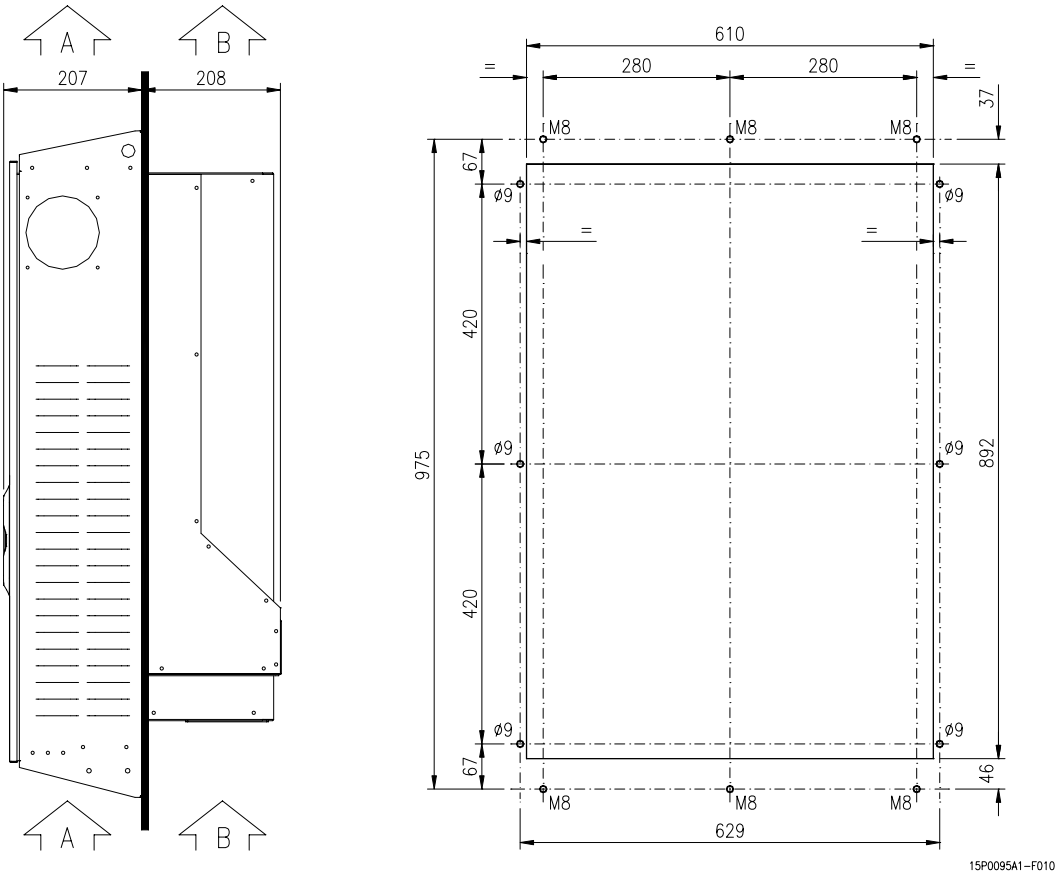
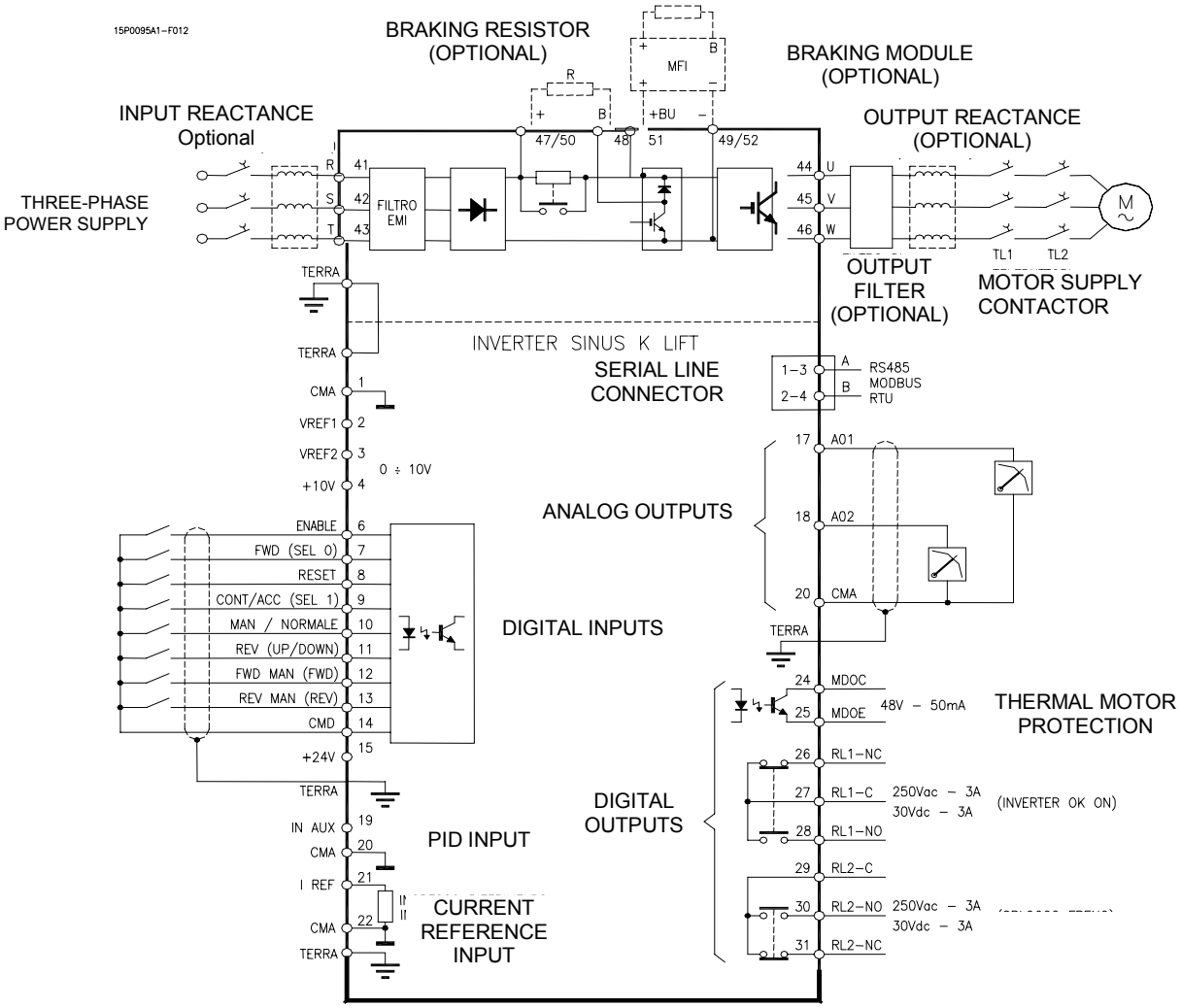


Fig.1.9: Through-panel assembly and piercing templates for Sinus K S50

1.4 WIRING

1.4.1 WIRING DIAGRAM



- Functionality of digital inputs 7, 9, and 11 depends on parameter C21 programming. Functionality with C21=single speed (factory setting) is out of brackets; functionality with C21=dual speed is in brackets.
- The wiring diagram relates to the factory setting.
- Connection terminals of the braking resistor: from Size S05 to Size S20 (terminals 47 and 48; Size S30 terminals 50 and 48).
- Connection terminals of the external braking module: Size S40: terminals 51 and 52; Size S50: terminals 51 and 49.
- Terminals for inverter power supply from DC source: terminals 47 and 49.

1.4.2 CONTROL TERMINALS

Term.	Name			Description	I/O Features	Jumper	LIFT Param.
1	CMA			0V NOT USED WITH LIFT SW	Control board zero volt		
2	VREF1			0-10V analog input NOT USED WITH LIFT SW	Vmax: ±10V, Rin: 40kΩ Resolution: 10 bits		
3	VREF2			0-10V analog input NOT USED WITH LIFT SW			
4	+10V			Power supply for external potentiometer NOT USED WITH LIFT SW	+10V Imax: 10mA		
6	ENABLE			Active input: inverter enabled. Inactive input: inverter disabled (motor stops in neutral)	Optois. digital input	J10 (NPN/ PNP)	C59
7	MULTIFUNCTION				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	Active input: upstroke (reference selected through terminal 9 condition is active; parameters P40, approach speed, and P41, contractual speed). Inactive input: frequency reference is reset (motor stops during ramp up). With this configuration (single speed), disable terminal 7 and enable terminal 11 (REV) to obtain ordinary ramp down.			
	Inactive (Normal operation)	Dual speed	SEL0	Along with terminal 9 (SEL1), 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	SEL0	Along with terminal 9 (SEL1), it determines the active reference based on the table below (0 inactive terminal, 1 active terminal) SEL0 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 running direction and operating mode depend on terminals 12 (FWD) and 13 (REV)			
	Active (mainten.)	any	NOT USED				

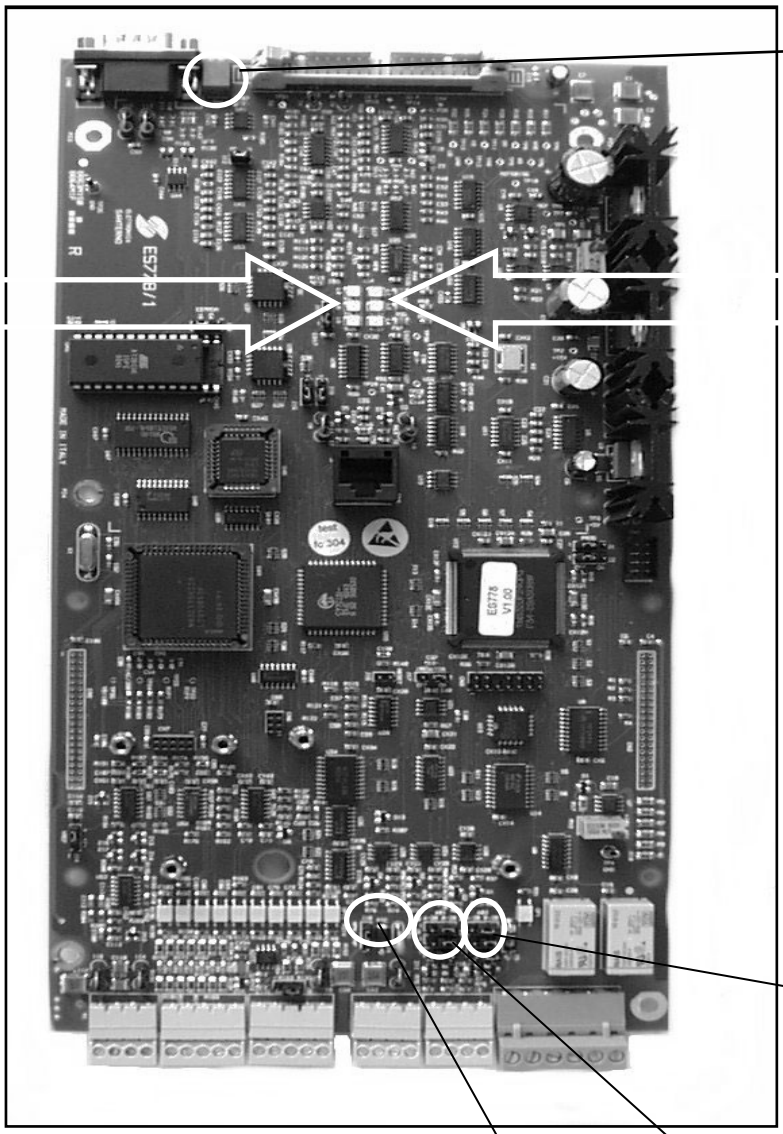
Term.	Name			Description	I/O Features	Jumper	LIFT Param.
8	RESET			Active input: the inverter operation is reset after an alarm trip if the cause responsible for the alarm has disappeared.	Optois. digital input	J10 (NPN/ PNP)	C50, C51, C52 C53.
9	MULTIFUNCTION				Optois. digital input	J10 (NPN/ PNP)	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 (SEL1), 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 (SEL0), it determines the active reference based on the table below (0: inactive terminal, 1: active terminal): SEL0 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 (SEL0) , 9 (SEL1), 11 (UP/DOWN) are active, C21 = dual speed A, terminals 7 (SEL0) , 9 (SEL1), 12 (FWD), and 13 (REV) are active.	Optois. digital input	J10 (NPN/ PNP)	C21, P43

<table>
<tr><th>Term.</th><th colspan="3">Name</th><th>Description</th><th>I/O Features</th><th>Jumper</th><th>LIFT Param.</th></tr>
<tr><td rowspan="6">11</td><td colspan="3">MULTIFUNCTION</td><td rowspan="2"></td><td rowspan="6"></td><td rowspan="6"></td><td rowspan="6">C21, P40, and P41</td></tr>
<tr><td>terminal 10 condition</td><td>par. C21 setting</td><td>Function</td></tr>
<tr><td>inactive (Normaloperation)</td><td>single speed (default setting)</td><td>REV</td><td>Active input: downstroke (reference selected through terminal 9 condition is active); inactive input: frequency reference is reset (motor stops during ramp down)</td></tr>
<tr><td>inactive (Normal operation)</td><td>dual speed</td><td>UP/DOWN</td><td>Active input: downstroke selection; inactive input: upstroke selection (operating mode and inverter condition are selected through terminals 7 and 9)</td></tr>
<tr><td>inactive (Normal operation)</td><td>dual speed A</td><td>NOT USED</td><td></td></tr>
<tr><td>active (Maint.)</td><td>any</td><td>NOT USED</td><td></td></tr>
<tr><td rowspan="6">12</td><td colspan="3">MULTIFUNCTION</td><td rowspan="2"></td><td rowspan="6"></td><td rowspan="6">J10 (NPN/ PNP)</td><td rowspan="6"></td></tr>
<tr><td>terminal 10 condition</td><td>par. C21 setting</td><td>Function</td></tr>
<tr><td>inactive (Normal operation)</td><td>single speed (default setting)</td><td>NOT USED</td><td></td></tr>
<tr><td>inactive (Normal operation)</td><td>dual speed</td><td>NOT USED</td><td></td></tr>
<tr><td>inactive (Normal operation)</td><td>dual speed A</td><td>FWD</td><td>Along with terminal 13 (REV), it determines the operating mode and running direction based on the table below (0: inactive input, 1: active input)
FWD REV Reference
0 0 stop
1 0 upstroke
0 1 downstroke
1 1 stop
Reference depends on terminals 7 (SEL0) and 9 (SEL1)</td></tr>
<tr><td>active (maint.)</td><td>any</td><td>FWD MAN</td><td>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)</td></tr>
</table>

Term.	Name			Description	I/O Features	Jumper	LIFT Param.
13	MULTIFUNCTION					J10 (NPN/ PNP)	C21
	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)			
	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.	Optois. digital inputs zero volt	J10 (NPN/ PNP)	
15	+24V			Auxiliary supply for optoisolated digital inputs: if jumper is set to PNP, close an input to terminal 15 to activate it.	+24V Imax: 100mA	J10 (NPN/ PNP)	
17	AO1			Multifunction analog output 1. Factory setting: Fout.	0÷10V Imax: 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 Imax: 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	Vmax: ±10V Rin: 20kΩ Resolution: 10 bits		P21, P22, C29, C30: (factory setting: PID regulator feedback).
20	CMA			0V for auxiliary analog input. NOT USED	Control board zero volt		

Term.	Name	Description	I/O Features	Jumper	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)			

1.4.3 SIGNALS AND PROGRAMMING ON (CONTROL BOARD ES778)



1.4.3.1 INDICATORS LEDS

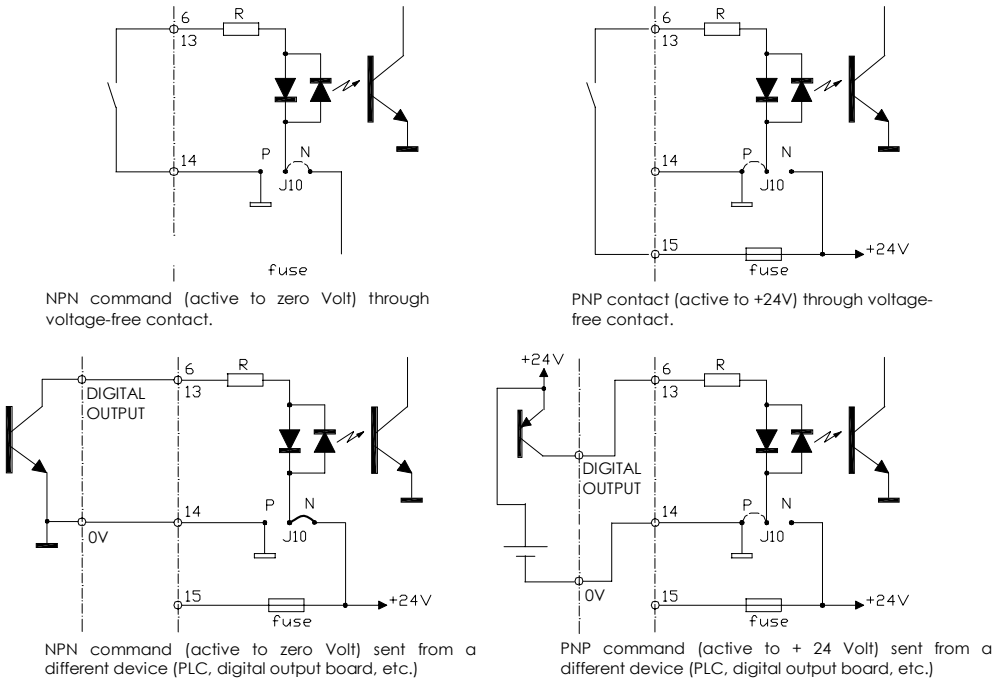
LED L3	red (VBLIM)	voltage limiting activation during deceleration; "on" when VDC within the equipment exceeds by 20% the rated value during dynamic braking.
LED L5	red (IMLIM)	current limiting activation during acceleration or due to overload conditions; "on" if the motor current exceeds the values 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)	Inverter enabled; "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.

1.4.3.2 JUMPERS AND DIP SWITCH

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

1.4.4 DIGITAL INPUT FEATURES (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.



NPN command (active to zero Volt) through voltage-free contact.

PNP contact (active to +24V) through voltage-free contact.

NPN command (active to zero Volt) sent from a different device (PLC, digital output board, etc.)

PNP command (active to + 24 Volt) sent from a different device (PLC, digital output board, etc.)

Fig.1.10: 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).

1.4.4.1 ENABLE (TERMINAL 6)

ENABLE input is <u>always to be activated</u> to enable the inverter operation independently of the control mode.
If ENABLE input is disabled, the inverter output voltage is set to zero, so the motor performs a cost 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.

1.4.4 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 section 6 "DIAGNOSTICS"). 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.

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].

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

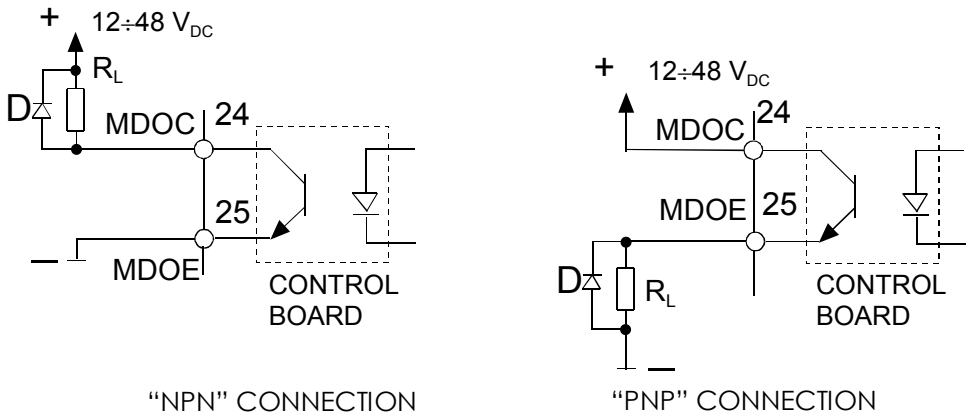
DANGER!! Shock hazard persists even when the inverter is locked on output terminals (U, V, W) and on the terminals used for the connection of resistive braking devices (+, -, B)..

1.4.5 DIGITAL OUTPUT FEATURES

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 Output" 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.



The figure shows an example of a relay connected to the output.

Fig.1.11 – Connecting a relay to the OPEN COLLECTOR output.

CAUTION!! Always use 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!! As an auxiliary power supply, voltage at terminal 15 (+24V) and terminal 14 (CMD) (control terminals) may be used. Max. allowable current: 100mA

1.4.5.1 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 Output 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: relay "ready" (terminals 26, 27, 28); energizes when the inverter is ready to supply the motor.
At power on, the equipment takes some seconds before initializing; the relay energizes when an alarm trips. The alarm trip locks the inverter.

RL2: "frequency/speed threshold" relay (terminals 29, 30, 31); energizes when the output frequency attains the level set through the "Digital Output" 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 and max. current values allowed by relay contacts.

CAUTION!! Use freewheeling diode for DC inductive loads.
Use antidisturbance filters for AC inductive loads.

1.4.6 ANALOG OUTPUT FEATURES (TERMINALS 17 AND 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 to select 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		J7
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

Through the OUTPUT MONITOR menu, set the quantity for the analog output and the ratio between the value of the output signal and the measured quantity.
The ratio between the output signal and the measured quantity is expressed as the ratio between the quantity 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 quantity 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.

1.4.7 Power Terminals Arrangement

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 supply.

Terminals S05-S10-S15-S20:

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

Important: Terminals 47/+ and 48/B connect the braking resistor.
Terminals 47/+ and 49/- may be used for the inverter DC voltage supply.

Terminals S30:

41/R	42/S	43/T	44/U	45/V	46/W	47/+	49/-	48/B	50/+

Important: Terminals 50/+ and 48/B connect the braking resistor.
Terminals 47/+ and 49/- may be used for the inverter DC voltage supply.

Terminals S40

41/R	42/S	43/T	44/U	45/V	46/W	47/+	49/-	51/+	52/-

Important: Terminals 51/+ and 52/- connect the bus to the external braking module.
Terminals 47/+ and 49/- may be used for the inverter DC voltage supply.

Terminals S50:

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

IMPORTANT: Terminals 47/+ and 49/- may be used both for DC voltage supply of the inverter and for the connection of the braking module.

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

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

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

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

CAUTION !! 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.

CAUTION !! After connecting the equipment, check the following:

- 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.

CAUTION !! Do not start or stop the inverter using a contactor installed over the inverter power supply line.

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

CAUTION !! Do not apply single-phase voltage.

CAUTION !! Always mount antidisturbance filters on the contactor coils and the solenoid valve coils.

1.4.8 Cross-sections of Power Connection Wires and Size of Protection Devices

Size	Class	Inverter Rated Current	Terminal Cross-section	Wire Peeling	Tightening Torque	Wire Cross-section Mains Side and Motor Side	Fast Fuses. + Disconnecting switch	Magnetic switch	AC1 Contactor
		Ampere	mm^2	mm	Nm	mm^2	Ampere	Ampere	Ampere
S05	SINUS K 0005	10,5	0,5÷10	10	1,2-1,5	2,5	16	16	25
	SINUS K 0007	12,5	0,5÷10	10	1,2-1,5	2,5	16	16	25
	SINUS K 0009	16,5	0,5÷10	10	1,2-1,5	4	25	25	25
	SINUS K 0011	16,5	0,5÷10	10	1,2-1,5	4	25	25	25
	SINUS K 0014	16,5	0,5÷10	10	1,2-1,5	4	32	32	30
S10	SINUS K 0016	26	0,5÷10	10	1,2-1,5	10	40	40	45
	SINUS K 0017	30	0,5÷10	10	1,2-1,5	10	40	40	45
	SINUS K 0020	30	0,5÷10	10	1,2-1,5	10	40	40	45
	SINUS K 0025	41	0,5÷10	10	1,2-1,5	10	63	63	55
	SINUS K 0030	41	0,5÷10	10	1,2-1,5	10	63	63	60
	SINUS K 0035	41	0,5÷10	10	1,2-1,5	10	100	100	100
S15	SINUS K 0038	65	4÷25	15	2,5	25	100	100	100
	SINUS K 0040	72	4÷25	15	2,5	25	100	100	100
	SINUS K 0049	80	4÷25	15	2,5	25	100	100	100
S20	SINUS K 0049	80	25÷50	24	6-8	25	100	100	100
	SINUS K 0060	88	25÷50	24	6-8	35	125	125	115
	SINUS K 0067	103	25÷50	24	6-8	50	125	125	125
	SINUS K 0074	120	25÷50	24	6-8	50	160	160	145
	SINUS K 0086	135	25÷50	24	6-8	50	200	160	160
S30	SINUS K 0113	180	35÷155	30	10	95	250	200	250
	SINUS K 0129	195	35÷155	30	10	120	250	250	250
	SINUS K 0150	215	35÷155	30	10	120	315	400	275
	SINUS K 0162	240	35÷155	30	10	120	400	400	275
S40	SINUS K 0179	300	70÷240	40	25-30	185	400	400	350
	SINUS K 0200	345	70÷240	40	25-30	210	400	400	400
	SINUS K 0216	375	70÷240	40	25-30	240	500	630	450
	SINUS K 0250	390	70÷240	40	25-30	240	630	630	450
S50	SINUS K 0312	480	Bar	-	3	2x150	800	630	550
	SINUS K 0366	550	Bar	-	3	2x210	800	800	600
	SINUS K 0399	630	Bar	-	3	2x240	800	800	700

1.5 OPERATING AND REMOTING 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.

LED "REF": "on" when a speed reference is sent.
Flashing when inverter enabled.
Flashing (with "RUN" LED) when inverter stopped.

LED RUN: "on" when inverter running.
Flashing (with "REF" LED) when inverter stopped.

↓ Down arrow:
scrolls through the menus and decrements parameter values.

PROG allows to enter and quit the submenus. Enables parameter alteration.

MENU allows to access the main menu.

LED "TRM": if on, commands are sent from terminal board.

LED "REM": if on, commands are sent from serial link (inactive with LIFT SW).

↑ Up arrow:
scrolls through the menus and increments parameter values.

SAVE saves each parameter.

RESET resets the alarms tripped.

START starts the motor (inactive with LIFT SW).

STOP stops the motor (inactive with LIFT SW).

The keypad includes the following keys: **PROG**, ↓, ↑, **SAVE, MENU, RESET, START, STOP**. They are detailed below.
- **PROG** allows to enter and quit 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;
- **SAVE** 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;
- **MENU** if pressed once, allows to access the main menu; if pressed twice, allows to return to the prior condition;
- **RESET** resets the alarms tripped;
- **START** NOT USED WITH LIFT SOFTWARE;
- **STOP** NOT USED WITH LIFT SOFTWARE;
  - 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:

LED "**RUN**": If on and not flashing, indicates that the inverter is running: the inverter is enabled, Enable is closed and the cage upstroke or downstroke is selected;
If flashing (along with LED "REF") indicates that the inverter is stopping.

LED "**REF** indicates a speed reference other than 0;
If flashing (along with LED "RUN") indicates that the inverter is stopping.
If flashing, indicates that the inverter is enabled (ENABLE CLOSED) and no cage operating mode is selected.

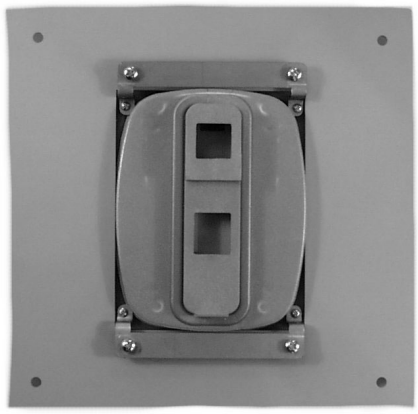
LED "**TRM** indicates that the START commands and the commands relating to multifunction digital inputs MDI1÷MDI5 are sent from terminal board (only this operating mode is possible with LIFT SW);

LED "**REM** inactive with LIFT SW

1.5.1 REMOTING KEYPAD

The REMOTING KIT is required to remote the keypad. The remoting kit includes:
- Keypad mounting jig
- Remoting wire (length: 5m).

Front view



Rear view

Disassemble the jig by disconnecting the wire connecting the keypad to the control board.
Pierce the holes as shown in the figure (template 138 x109 mm).
Fix the keypad using the special jig supplied by Elettronica Santerno.
Connect the keypad to the inverter using the special wire.

CAUTION!! Never connect and disconnect the keypad when the inverter is on.

1.6 SERIAL COMMUNICATION

1.6.1 GENERAL FEATURES

The inverters of the SINUS K series may be connected to peripheral devices through a serial link. This enables both reading and writing of all parameters normally accessed through the display and the 4 keys (see Programming Manual). Two-wire RS485 is used, which ensures a better immunity to disturbance even on long cable paths, thus limiting communication 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 a serial communication. The inverter may be connected directly to a computer or a multidrop network of inverters controlled by a master computer (see diagram below).

1.6.2 DIRECT CONNECTION

Electrical standard RS485 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 a serial port RS232-C or a USB port, an RS232-C/ RS485 converter or a USB/RS485 converter is required.

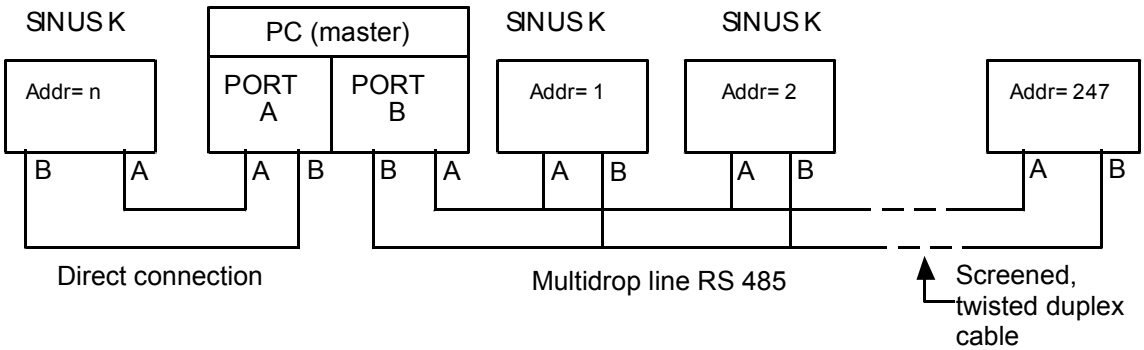
Elettronica Santerno may supply both converters as optional components.

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

1.6.3 NETWORK CONNECTION

The inverters of the SINUS K series may be connected to a network through electrical standard RS485, 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 in the Serial network submenu.



M00780-A

1.6.4 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 (sizes ≥ S20).

The D connector pins are the following.

PIN	FUNCTION
1 – 3	(TX/RX A) Differential input/output A (bidirectional) depending on standard RS485. Positive polarity with respect to pins 2 – 4 for one MARK.
2 – 4	(TX/RX B) Differential input/output B (bidirectional) depending on standard RS485. 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 a direct connection to the master computer) shall be enabled: dip switch SW1, selector switches 1 and 2 in position ON (default setting).
The line terminator of the other inverters in intermediate positions shall be disabled: dip switch SW1, selector switches 1 and 2 in position OFF.

1.6.5 THE SOFTWARE

The serial communication protocol is 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 by the inverter.

1.6.6 COMMUNICATION RATINGS

		LIFT SW Param.
Baud rate:	configurable between 1200..9600 bps (default 9600 bps)	C93
Data format:	8 bits	
Start bit:	1	
Parity:	NO	
Stop bit:	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 address: 0 ms)	C91
End of message timeout:	configurable between 0 and 2000 ms (default address: 0 ms)	C92

2 STARTUP PROCEDURES

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.

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

Follow the instructions below to startup the equipment:

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

2) Power on: 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: 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 motor rated current in parameter C04 (Inom) and go to step 5. Otherwise, set the motor rated frequency in parameter C05 (Fmot), set a frequency value equal to C05x1.2 in parameter C06 (Fomax), and set the motor rated voltage in parameter C08 (Vmot).

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

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

6) Operating mode selection: 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:

$$n_0 = \frac{C05 \times 120}{pole}$$

C05 = motor rated frequency.

Calculate the max. cage speed Vmax corresponding to synchronous speed n_0 and set it in parameter P44 (Rated Speed);
“Rated Speed” means the cage speed with th motor roating at its syncro-speed

$$N_{Srpm} = \frac{\text{fmot(C05)} * 60}{\text{pole(C72)}}$$

$$\left[P44 = \frac{N_{Srpm}}{60 * C_R * T} * 3.14 * \Phi \right]$$

where:
Cr: derating ratio of the winchCr:1
T: Number of cable transmission.
Φ:Diameter of the winch pulley in m.

Once the max. cage speed is defined, the available speed values are the following (factory setting):
Commercial speed = P44
Second commercial speed (low speed) = 0.67 x P44 or 0.32 x P44 if the ENCODER is used.
Approach speed = 0.1 x P44
Maintenance speed = 0.4 x P44 or 0.2 if the ENCODER is used.
If these values are correct, go to step 8; if not, alter speed parameter/s as follows 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):

$$P41 = \frac{speed}{P44} \times 100$$

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

$$P42 = \frac{\text{secondspeed}}{P44} \times 100$$

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

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

8) Positioning the slowing-down microswitch: access the Path menu; parameter M23 (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 microswitches at the distance indicated by M23 increased by 10 ÷ 20 cm (slowing-down stroke) and additionally increased by 10%.
Position stop microswitches.
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 Ramps menu and change parameters P05 and P06.

(9) Firt programming of compensation and sliding parameters: Access the Slip.comp. menu and set in C74 (Motor Power) the power of the motor, in C75 (No load Power) set the loadless motor power (2÷5% of the nominal power) in C76 (Low speed slip) and in C77 (High speed slip) set the motor nominal sliding as follows:

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

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

11) Check of the foward gear: Start up the cage at the approaching speed, check that the frequency on the display is positive and that the forward gear of the cage is really up.
If the frequency on the display is negative check the commands of the terminal board (using parameter M08 Term. B. of the Measure Menu).
If the frequency is positive but the forward gear is down, stop the invertr and after few minutes change the fase of the terminals U, V, W.

12) Check the encoder wiring: If there is not the speed trasducer go to point 13, otherwise:
Spart up the cage at approaching speed and check the M10 parameter Speed Ref. Of the Menu Measure with the parameter Speed Nout of menu Measure. You can have the following situation:
1. M11 = M10:Encoder wiring OK
2. M11 = 0: It lacks one or more channels.
3. M11 = -M10: Wiring of the encoder reversed, ch'ange the A with B.

13) Settino the 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 parametet M10 Speed Ref e M11 Speed Nout of Measure Menu ca be used.

14) Adjusting slip compensation at low speed: access the Speed menu and decrease 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).

16) Restore parameters P51,P50 and P57 of the menù Speed Loop.

17) Adjust the position of the stop microswitches to obtain the desired floor approach distance.

18) If the cage does not run smoothly, decrease acceleration and jerk parameters P07, P08, P09, and make sure that slowing-down distance (M23) is correct.
If the ENCODER is used, adjust speed loop parameters (P51÷P58).

3 TECHNICAL SPECIFICATIONS

Power Range

• kW connected motor/voltage range
1.5~400kW 200÷240Vac, 3phase
2.2~630kW 380÷415Vac, 3phase
3.0~780kW 440÷460Vac, 3phase
3.7~852kW 480÷500Vac, 3phase
230~1010kW 575Vac, 3phase
270~1210kW 660÷690Vac, 3phase
• Degree of protection/size
STAND ALONE: IP20 from Size S05 to Size S40, IP00 from Size S50 to Size S70, IP54 from Size S05 to Size S30
BOX: IP54
CABINET: IP24 and IP54.

Motor Specifications

• Motor voltage range/precision
0÷Vmains, +/-2%
• Current/torque to motor/time
105÷200% for 2min. every 20min. up to S30.
105÷200% for 1min. every 10min. from S40.
• Starting torque/max. time
240% for a short time
• Output frequency/resolution
0÷800Hz (120Hz for VTC SW), resolution 0.01Hz
• Braking torque
DC braking 30%*Cn
Braking while decelerating up to 20%*Cn (with no braking resistor)
Braking while decelerating up to 150%*Cn (with braking resistors)
• Adjustable carrier frequency with silent random modulation.
SW LIFT:
S05÷S15 = 0.8÷16kHz
S20 = 0.8÷12.8kHz
S30 = 0.8÷10kHz (5kHz for 0150 and 0162)
≥S40 = 0.8÷4kHz

Mains

• VAC supply voltage/tolerance
200÷240VAC, 3phase, -15% +10%
380÷500VAC, 3phase, -15% +10%
500÷575VAC, 3phase, -15% +10%
660÷690VAC, 3phase, -15% +10%
• VDC supply voltage/tolerance
280÷360VDC, -15% +10%
530÷705VDC, -15% +10%
705÷810VDC, -15% +10%
930÷970VDC, -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 2% every 100m beyond 1000m (max. 4000m)
• Vibrations
Lower than 5.9m/sec^2 (=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

CONTROL	Control method		IFD – LIFT = Space vector modulation (vectorial modulation PWM with V/f curve) VTC = Vector Torque Control (Sensorless vectorial, direct torque control)
	Frequency/speed setting resolution		Digital reference: 0.1Hz (IFD SW); 1 rpm (VTC SW) Analog reference 10bit: 0.01% resolution of maximum output frequency/speed with respect to max. speed
	Speed precision		Open loop: 0.5% of max. speed (2% for IFD SW and LIFT) Closed loop (with encoder): < 0.5% of max. speed
	Overload capacity		Up to 2 times 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
OPERATION	Input signals	Operation method	Operation through terminals, keypad, serial communication
		Analog inputs	4 analog inputs: 2 voltage sum inputs, resolution 10bits 1 current input, resolution 10bits 1 voltage input, resolution 10bits Analog: 0÷10VDC, +/-10VDC, 0 (4) ÷20mA. Digital: from keypad, serial communication
		Digital inputs	8 NPN/PNP digital inputs: 3 fixed inputs (ENABLE, START, RESET) and 5 programmable inputs
		Multi frequency/ Multispeed	IFD: 15 programmable frequency sets +/-800Hz VTC: 7 programmable speed sets +/-9000rpm LIFT: 4 programmable speed sets 0÷2.5m/sec
		Ramps	4 + 4 accel./decel. ramps, 0 to 6500sec; possibility to set user-defined curves.
	Output signals	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
		Potentiometer voltage	+10Vdc –0% + 2%, 10mA
		Analog outputs	2 configurable analog outputs, 0÷10VDC and 0(4)÷20mA, resolution 8bits
PROTECTIONS	Alarms		Inverter thermal protection, motor thermal protection, mains failure, overvoltage, undervoltage, overcurrent at constant speed or ground failure, overcurrent while accelerating, overcurrent while decelerating, overcurrent during speed search (IFD SW only), auxiliary trip from digital input, serial communication failure, Eeprom failure, control board failure, precharge circuit failure, inverter overload conditions for long duration, unconnected motor, encoder failure (VTC SW and LIFT SW only), overspeed (VTC SW only).
	Warnings		INVERTER OK, INVERTER ALARM, acceleration, constant rpm, deceleration, current/torque limiting, POWER DOWN, SPEED SEARCHING (IFD SW only), DC braking, autotuning (VTC SW only).
COMMUNICATION DISPLAY	Operating data		Frequency/torque/speed reference, output frequency, motor speed, required torque, generated torque, current to motor, voltage to motor, bus DC voltage, motor-absorbed power, digital input condition, digital output condition, trip log (last 5 alarms), operating time, auxiliary analog input value, PID reference, PID feedback, PID error value, PID regulator output, PID feedback with programmable multiplying factor (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) (*). (*)LIFT SW only
	Serial communication		Standard incorporated RS485 multidrop 247 drops MODBUS RTU communication protocol
	Field bus		AB Communicator: optional MODBUS/field bus converter (Profibus DP; Can Bus; Device Net; Ethernet; etc.). Each device may control up to 4 inverters.
SAFETY			EN 61800-5-1, EN50178, EN60204-1, IEC 22G/109/NP
CE Mark			Yes

3.1 CHOOSING THE PRODUCT

The inverters of the SINUS K series are dimensioned based on allowable current and overload.
Each inverter model may be connected to 4 different motor power sizes depending on load performance.
Four types of torque/current overload are available; their duration is 120sec every 20min up to S30 and 60 sec every 10min from S40 to S70:

LIGHT overload up to 120%; may be connected to light loads with constant/quadratic torque (pumps, fans, etc.);

STANDARD overload up to 140%; may be connected to standard loads with constant torque (conveyors, mixers, extruders, etc.);

HEAVY 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.);

STRONG overload up to 200%; may be applied to very heavy loads with constant torque (mandrels, axis control, etc.).

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

Only Heavy overload (lift applications) sheet is contained in this manual.

3.1. TECHNICAL SHEET FOR HEAVY APPLICATIONS: OVERLOAD UP TO175%

Size	Inverter Model	Applicable motor power								Inom. inverter A	Imax inverter A
		200-240Vac kW	200-240Vac HP	380-415Vac kW	380-415Vac HP	440-460Vac kW	440-460Vac HP	480-500Vac kW	480-500Vac HP		
S05	SINUS K 0005	1,8	2,5	3	4	3,7	5	4,5	6,1	10,5	11,5
	SINUS K 0007	2,2	3	4	5,5	4,5	6	5,5	7,5	12,5	13,5
	SINUS K 0009	3	4	4,5	6	5,5	7,5	7,3	9,9	16,5	17,5
	SINUS K 0011	3,7	5	5,5	7,5	7,5	10	8,8	12,0	16,5	21
	SINUS K 0014	4,5	6	7,5	10	9,2	12,5	10,8	14,6	16,5	25
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
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
S30	SINUS K 0113	45	60	75	100	75	100	93	126	180	200
	SINUS K 0129	50	70	80	110	90	125	100	135	195	215
	SINUS K 0150	55	75	90	125	110	150	124	169	215	270
	SINUS K 0162	65	90	110	150	132	180	137	186	240	290
S40	SINUS K 0179	75	100	120	165	150	200	160	218	300	340
	SINUS K 0200	80	110	132	180	160	220	175	237	345	365
	SINUS K 0216	90	125	150	200	185	250	204	277	375	430
	SINUS K 0250	100	135	185	250	220	300	231	314	390	480
S50	SINUS K 0312	132	180	220	300	260	350	289	393	480	600
	SINUS K 0366	150	200	250	340	300	400	326	443	550	660
	SINUS K 0399	160	220	280	380	330	450	348	473	630	720
Inverter power supply		200-240Vac; 280-360Vdc		380-500Vac; 530-705Vdc							

Available from September 2004

Legend:
Inom = continuous rated current of the inverter
Imax = max. current the inverter can deliver for 120 sec every 20 min up to S30, for 60 sec every 10 min for S40 and higher

3.2 CARRIER FREQUENCY SETTING AND PEAK CURRENT SETTING

The continuous current generated by the inverter in continuous operation type S1 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, Carrier Frequency submenu.

Size	MODEL	Max. recommended carrier frequency (parameters C01 and C02)		Peak current	
		HEAVY	Max carrier	@ 100ms	Instant current
		(kHz)	(kHz)	(A_{RMS})	(A_{peak})
S05	SINUS K 0005	16	16	15	28
	SINUS K 0007	16	16	17	33
	SINUS K 0009	16	16	24	47
	SINUS K 0011	16	16	29	56
	SINUS K 0014	12.8	16	35	67
S10	SINUS K 0016	12.8	16	36	72
	SINUS K 0017	12.8	16	40	77
	SINUS K 0020	12.8	16	45	87
	SINUS K 0025	12.8	16	59	114
	SINUS K 0030	10	16	69	133
	SINUS K 0035	10	16	87	167
S15	SINUS K 0038	12.8	16	88	170
	SINUS K 0040	12.8	16	90	173
	SINUS K 0049	12,8	12,8	118	228
S20	SINUS K 0049	12,8	12,8	118	228
	SINUS K 0060	12,8	12,8	138	266
	SINUS K 0067	12,8	12,8	146	280
	SINUS K 0074	12,8	12,8	180	347
	SINUS K 0086	10	12,8	194	373
S30	SINUS K 0113	10	10	251	484
	SINUS K 0129	10	10	270	520
	SINUS K 0150	5	5	310	596
	SINUS K 0162	5	5	333	640
S40	SINUS K 0179	4	4	420	807
	SINUS K 0200	4	4	450	867
	SINUS K 0216	4	4	537	1033
	SINUS K 0250	4	4	599	1153
S50	SINUS K 0312	4	4	751	1444
	SINUS K 0366	4	4	826	1589
	SINUS K 0399	4	4	901	1733

4 ACCESSORIES

4.1 BRAKING RESISTORS

From size S05 to size S30 included, SINUS K inverters are supplied with a built-in braking module. The braking resistor is to be incorporated in the inverter and connected to terminals B and + (see section 1.4 "Wiring") For IFD SW and LIFT SW only, 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 protected 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. A correct dimensioning of the braking resistor is based on the equipment duty cycle and the power regenerated during the braking stage.
For more details on the connection and features of the external braking module, refer to the braking module instruction manual.

4.1.1 BRAKING RESISTORS FOR STANDARD DUTY CYCLE AND 380-500VAC SUPPLY VOLTAGE.

Size	MODEL			Min. resistor to be connected to the inverter Ω	Standard duty cycle: cage speed <1m/s, starts/h ≤120, stop number ≤8	
					Degree of protection **IP54 or IP55** up to 25Ω/1800W included IP20 for higher power ratings	Code
S05	SINUS K	0005	4T BA2X2	50	75Ω-550W	RE3063750
	SINUS K	0007	4T BA2X2	50	75Ø-550W	RE3063750
	SINUS K	0009	4T BA2X2	50	75Ø-550W	RE3063750
	SINUS K	0011	4T BA2X2	50	75Ø-550W	RE3063750
	SINUS K	0014	4T BA2X2	50	50Ø-1100W	RE3083500
S10	SINUS K	0016	4T BA2X2	50	50Ø-1100W	RE3083500
	SINUS K	0017	4T BA2X2	50	50Ø-1100W	RE3083500
	SINUS K	0020	4T BA2X2	50	50Ø-1100W	RE3083500
	SINUS K	0025	4T BA2X2	20	25Ø-1800W	RE3103250
	SINUS K	0030	4T BA2X2	20	25Ø-1800W	RE3103250
	SINUS K	0035	4T BA2X2	20	25Ø-1800W	RE3103250
S15	SINUS K	0038	4T BA2X2	15	15Ø-4000W	RE3483150
	SINUS K	0040	4T BA2X2	15	15Ø-4000W	RE3483150
	SINUS K	0049	4T BA2X2	10	15Ø-4000W	RE3483150
S20	SINUS K	0049	4T BA2X2	10	15Ø-4000W	RE3483150
	SINUS K	0060	4T BA2X2	10	15Ø-4000W	RE3483150
	SINUS K	0067	4T BA2X2	10	10Ø-8000W	RE3763100
	SINUS K	0074	4T BA2X2	8.5	10Ø-8000W	RE3763100
	SINUS K	0086	4T BA2X2	8.5	10Ø-8000W	RE3763100
S30	SINUS K	0113	4T BA2X2	6	6.6Ø-12000W	RE4022660
	SINUS K	0129	4T BA2X2	6	6.6Ø-12000W	RE4022660
	SINUS K	0150	4T BA2X2	5	6.6Ø-12000W	RE4022660
	SINUS K	0162	4T BA2X2	5	6.6Ø-12000W	RE4022660
S40	SINUS K	0179	4T XA2X2	2*MFI-E 4T 90	10Ø-10Ø-8000W **(note 1)**	2*RE3763100
	SINUS K	0200	4T XA2X2	2*MFI-E 4T 90	6.6Ø-6.6Ø-12000W **(note 1)**	2*RE4022660
	SINUS K	0216	4T XA2X2	2*MFI-E 4T 90	6.6Ø-6.6Ø-12000W **(note 1)**	2*RE4022660
	SINUS K	0250	4T XA2X2	2*MFI-E 4T 90	6.6Ø-6.6Ø-12000W **(note 1)**	2*RE4022660
S50	SINUS K	0312	4T XA2X0	3*MFI-E 4T 90	6.6Ø-6.6Ø-6.6Ø-12000W **(note 1)**	3*RE4022660
	SINUS K	0366	4T XA2X0	3*MFI-E 4T 90	6.6Ø-6.6Ø-6.6Ø-12000W **(note 1)**	3*RE4022660
	SINUS K	0399	4T XA2X0	3*MFI-E 4T 90	6.6Ø-6.6Ø-6.6Ø-12000W **(note 1)**	3*RE4022660

(note 1):): For the connection of MFI and braking resistors, see manual relating to MFI braking module.

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

CAUTION!! Power dissipated by braking resistors may be equal to approx. 10% of the connected motor rated power. 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.

4.1.2 BRAKING RESISTORS FOR HEAVY DUTY CYCLE AND 380-500VAC SUPPLY VOLTAGE

Size	MODEL			Min. resistor to be connected to the inverter Ω	Heavy duty cycle: cage speed □1m/s, starts/h>120, stop number >8	
					Degree of protection IP54 or IP55 up to 25Ω/1800W included IP20 for higher power ratings	Code
S05	SINUS K	0005	4T BA2X2	50	50 Ω -1100W	RE3083500
	SINUS K	0007	4T BA2X2	50	50 Ω -1100W	RE3083500
	SINUS K	0009	4T BA2X2	50	50 Ω -1100W	RE3083500
	SINUS K	0011	4T BA2X2	50	50 Ω -1500W	RE3093500
	SINUS K	0014	4T BA2X2	50	50 Ω -2200W	RE3113500
S10	SINUS K	0016	4T BA2X2	50	50 Ω 2200W	RE3113500
	SINUS K	0017	4T BA2X2	50	50 Ω 2200W	RE3113500
	SINUS K	0020	4T BA2X2	50	50 Ω -4000W	RE3483500
	SINUS K	0025	4T BA2X2	20	25 Ω -4000W	RE3483250
	SINUS K	0030	4T BA2X2	20	25 Ω -4000W	RE3483250
	SINUS K	0035	4T BA2X2	20	25 Ω -4000W	RE3483250
S15	SINUS K	0038	4T BA2X2	15	15 Ω -4000W	RE3483150
	SINUS K	0040	4T BA2X2	15	15 Ω -4000W	RE3483150
	SINUS K	0049	4T BA2X2	10	10 Ω -8000W	RE3763100
S20	SINUS K	0049	4T BA2X2	10	10 Ω -8000W	RE3763100
	SINUS K	0060	4T BA2X2	10	10 Ω -8000W	RE3763100
	SINUS K	0067	4T BA2X2	10	10 Ω -12000W	RE4023100
	SINUS K	0074	4T BA2X2	8.5	10 Ω -12000W	RE4023100
	SINUS K	0086	4T BA2X2	8.5	10 Ω -12000W	RE4023100
S30	SINUS K	0113	4T BA2X2	6	3.3 Ω +3.3 Ω -12000W **(note 1)**	2*RE4022330
	SINUS K	0129	4T BA2X2	6	3.3 Ω +3.3 Ω -12000W **(note 1)**	2*RE4022330
	SINUS K	0150	4T BA2X2	5	10 Ω //10 Ω -12000W **(note 2)**	2*RE4023100
	SINUS K	0162	4T BA2X2	5	10 Ω //10 Ω -12000W **(note 2)**	2*RE4023100
S40	SINUS K	0179	4T XA2X2	2*MFI-E 4T 90	6.6 Ω –6.6 Ω -12000W **(note 3)**	2*RE4022660
	SINUS K	0200	4T XA2X2	2*MFI-E 4T 90	6.6 Ω –6.6 Ω -12000W **(note 3)**	2*RE4022660
	SINUS K	0216	4T XA2X2	3*MFI-E 4T 90	6.6 Ω -6.6 Ω -6.6 Ω -12000W **(note 3)**	3*RE4022660
	SINUS K	0250	4T XA2X2	3*MFI-E 4T 90	6.6 Ω -6.6 Ω -6.6 Ω –12000W **(note 3)**	3*RE4022660
S50	SINUS K	0312	4T XA2X0	4*MFI-E 4T 90	6.6 Ω 6.6 Ω -6.6 Ω -6.6 Ω -12000W **(note 3)**	4*RE4022660
	SINUS K	0366	4T XA2X0	4*MFI-E 4T 90	6.6 Ω -6.6 Ω -6.6 Ω -6.6 Ω -12000W **(note 3)**	4*RE4022660
	SINUS K	0399	4T XA2X0	4*MFI-E 4T 90	6.6 Ω -6.6 Ω -6.6 Ω -6.6 Ω -12000W **(note 3)**	4*RE4022660

(note 1): Two series-connected resistors, 3.3Ohm/8,000W
(note 2): Two parallel-connected resistors, 10Ohm/12,000W
(note 3): For the connection of MFI and braking resistors, see manual relating to MFI braking module.

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 motor rated power. 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.

4.1.3 BRAKING RESISTORS FOR STANDARD DUTY CYCLE AND 200-240VAC SUPPLY VOLTAGE

Size	MODEL			Min. resistor to be connected to the inverter Ω	Standard duty cycle: cage speed <1m/s, starts/h ≤120, stop number ≤8	
					Degree of protection IP54 or IP55 up to 50Ω/2200W IP20 for higher power ratings	**Code**
S05	SINUS K	0005	2T BA2X2	25.0	56Ω-350W	RE2643560
	SINUS K	0007	2T BA2X2	25.0	56 Ω -350W	RE2643560
	SINUS K	0009	2T BA2X2	25.0	56⦸//56 Ω -350W **(note 1)**	2*RE2643560
	SINUS K	0011	2T BA2X2	25.0	56⦸//56 Ω -350W **(note 1)**	2*RE2643560
	SINUS K	0014	2T BA2X2	25.0	56⦸//56 Ω -350W **(note 1)**	2*RE2643560
S10	SINUS K	0016	2T BA2X2	25.0	56⦸//56 Ω -350W **(note 1)**	2*RE2643560
	SINUS K	0017	2T BA2X2	25.0	56⦸//56 Ω -350W **(note 1)**	2*RE2643560
	SINUS K	0020	2T BA2X2	25.0	56⦸//56 Ω -350W **(note 1)**	2*RE2643560
	SINUS K	0025	2T BA2X2	10.0	15 Ω -1100W	RE3083150
	SINUS K	0030	2T BA2X2	10.0	15 Ω -1100W	RE3083150
	SINUS K	0035	2T BA2X2	10.0	15 Ω -1100W	RE3083150
S15	SINUS K	0038	2T BA2X2	7.5	15 Ω //15 Ω -1100W **(note 2)**	2*RE3083150
	SINUS K	0040	2T BA2X2	7.5	15 Ω //15 Ω -1100W **(note 2)**	2*RE3083150
	SINUS K	0049	2T BA2X2	5.0	5 Ω -4000W	RE3482500
S20	SINUS K	0049	2T BA2X2	5.0	5 Ω -4000W	RE3482500
	SINUS K	0060	2T BA2X2	5.0	5 Ω -4000W	RE3482500
	SINUS K	0067	2T BA2X2	5.0	5 Ω -4000W	RE3482500
	SINUS K	0074	2T BA2X2	4.2	5 Ω -4000W	RE3482500
	SINUS K	0086	2T BA2X2	4.2	5 Ω -4000W	RE3482500
S30	SINUS K	0113	2T BA2X2	3	3.3 Ω -8000W	RE3762330
	SINUS K	0129	2T BA2X2	3	3.3 Ω -8000W	RE3762330
	SINUS K	0150	2T BA2X2	2.5	3.3 Ω -8000W	RE3762330
	SINUS K	0162	2T BA2X2	2.5	3.3 Ω -8000W	RE3762330
S40	SINUS K	0179	2T XA2X2	2*MFI-E 2T 45	3.3 Ω -3.3 Ω -8000W **(note 3)**	2*RE3762330
	SINUS K	0200	2T XA2X2	2*MFI-E 2T 45	3.3 Ω -3.3 Ω -8000W **(note 3)**	2*RE3762330
	SINUS K	0216	2T XA2X2	2+MFI-E 2T 45	3.3 Ω -3.3 Ω -8000W **(note 3)**	2*RE3762330
	SINUS K	0250	2T XA2X2	2*MFI-E 2T 45	3.3 Ω -3.3 Ω -8000W **(note 3)**	2*RE3762330
S50	SINUS K	0312	2T XA2X0	3*MFI-E 2T 45	3.3 Ω -3.3 Ω -3.3 Ω -8000W **(note 3)**	3*RE3762330
	SINUS K	0366	2T XA2X0	3*MFI-E 2T 45	3.3 Ω -3.3 Ω -3.3 Ω 8000W **(note 3)**	3*RE3762330
	SINUS K	0399	2T XA2X0	3*MFI-E 2T 45	3.3 Ω 3.3 Ω -3.3 Ω 8000W **(note 3)**	3*RE3762330

(note 1): Two parallel-connected resistors, 56Ohm/350W
(note 2): Two parallel-connected resistors, 15Ohm/1100W
(note 3): For the connection of MFI and braking resistors, see manual relating to MFI braking module.

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

CAUTION!! Power dissipated by braking resistors may be equal to approx. 10% of the connected motor rated power. 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.

4.1.4 BRAKING RESISTORS FOR HEAVY DUTY CYCLE AND 200-240VAC SUPPLY VOLTAGE

Size	MODEL			Min. resistor to be applied to the inverter Ω	Heavy duty cycle: cage speed ≤1m/s, starts/h>120, stop number >8	
					Degree of protection IP54 or IP55 up to 25Ω/1800W IP20 for higher ratings	**Code**
S05	SINUS K	0005	2T BA2X2	25.0	56Ω–350W	RE2643560
	SINUS K	0007	2T BA2X2	25.0	100Ω//100Ω–350W **(note 1)**	2*RE2644100
	SINUS K	0009	2T BA2X2	25.0	56Ω//56Ω–350W	2*RE2635560
	SINUS K	0011	2T BA2X2	25.0	56Ω//56Ω–350W	2*RE2635560
	SINUS K	0014	2T BA2X2	25.0	100Ω//100Ω//100Ω//100Ω–350W **(note 2)**	4*RE2644100
S10	SINUS K	0016	2T BA2X2	25.0	100Ω//100Ω//100Ω//100Ω–350W **(note 2)**	4*RE2644100
	SINUS K	0017	2T BA2X2	25.0	100Ω//100Ω//100Ω//100Ω–350W **(note 2)**	4*RE2644100
	SINUS K	0020	2T BA2X2	25.0	25Ω–1800W	RE3103250
	SINUS K	0025	2T BA2X2	10.0	75Ω//75Ω//75Ω//75Ω//75Ω//75Ω–550W **(note 3)**	6*RE3063750
	SINUS K	0030	2T BA2X2	10.0	75Ω//75Ω//75Ω//75Ω//75Ω//75Ω–550W **(note 3)**	6*RE3063750
	SINUS K	0035	2T BA2X2	10.0	75Ω//75Ω//75Ω//75Ω//75Ω//75Ω–550W **(note 3)**	6*RE3063750
S15	SINUS K	0038	2T BA2X2	7.5	25Ω//25Ω–1800W **(note 4)**	2*RE3103250
	SINUS K	0040	2T BA2X2	7.5	25Ω//25Ω–1800W **(note 4)**	2*RE3103250
	SINUS K	0049	2T BA2X2	5.0	5Ω–4000W	RE3482500
S20	SINUS K	0049	2T BA2X2	5.0	5Ω–4000W	RE3482500
	SINUS K	0060	2T BA2X2	5.0	5Ω–8000W	RE3762500
	SINUS K	0067	2T BA2X2	5.0	5Ω–8000W	RE3762500
	SINUS K	0074	2T BA2X2	4.2	5Ω–8000W	RE3762500
	SINUS K	0086	2T BA2X2	4.2	5Ω–8000W	RE3762500
S30	SINUS K	0113	2T BA2X2	3.0	3.3Ω–12000W	RE4022330
	SINUS K	0129	2T BA2X2	3.0	3.3Ω–12000W	RE4022330
	SINUS K	0150	2T BA2X2	2.5	3.3Ω–12000W	RE4022330
	SINUS K	0162	2T BA2X2	2,5	3.3Ω–12000W	RE4022330
S40	SINUS K	0179	2T XA2X2	MFI-E 2T 45	3.3Ω–3.3Ω–8000W **(note 5)**	2*RE3762330
	SINUS K	0200	2T XA2X2	MFI-E 2T 45	3.3Ω–3.3Ω–8000W **(note 5)**	2*RE3762330
	SINUS K	0216	2T XA2X2	MFI-E 2T 45	3.3Ω–3.3Ω–12000W **(note 5)**	2*RE4022330
	SINUS K	0250	2T XA2X2	MFI-E 2T 45	3.3Ω–3.3Ω–12000W **(note 5)**	2*RE4022330
S50	SINUS K	0312	2T XA2X0	MFI-E 2T 45	3.3Ω–3.3Ω–3.3Ω–12000W **(note 5)**	3*RE4022330
	SINUS K	0366	2T XA2X0	MFI-E 2T 45	3.3Ω–3.3Ω–3.3Ω–12000W **(note 5)**	3*RE4022330
	SINUS K	0399	2T XA2X0	MFI-E 2T 45	3.3Ω–3.3Ω–3.3Ω–12000W **(note 5)**	3*RE4022330

(note 1): Two parallel-connected resistors, 100Ohm/350W
(note 2): Four parallel-connected resistors, 100Ohm/350W
(note 3): Six parallel-connected resistors, 75Ohm/550W
(note 4): Two parallel-connected resistors, 25Ohm/1800W
(note 5): For the connection of MFI and braking resistors, see manual relating to MFI braking module.

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 motor rated power. 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.

4.1.5 AVAIBLE MODELS (BRAKING RESISTORS)

4.1.5.1 MODEL 56-100OHM/350W

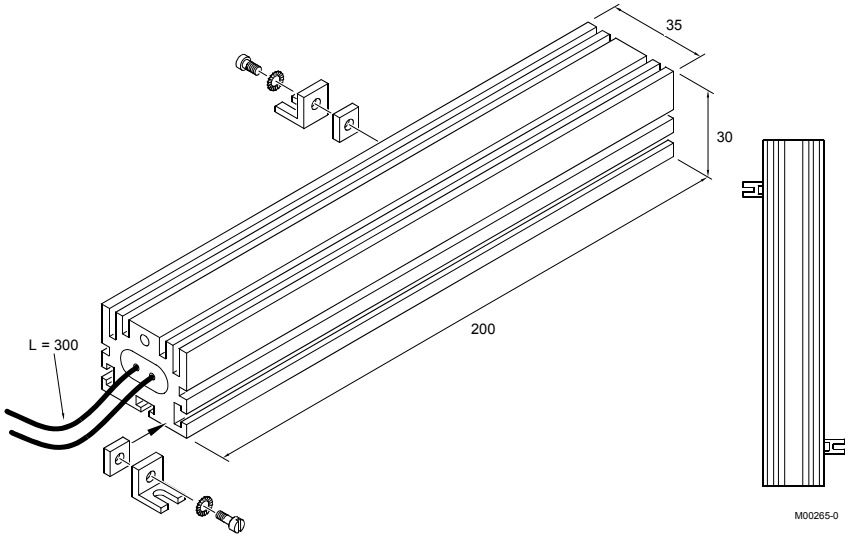


Fig. 4.1: Overall dimensions, resistor 56-100Ω/350W

Type	Wgt (g)	Degree of protection	Mean power to be dissipated (W)	Max. duration of continuous operation for 200-240VAC (s)*
56Ohm/350W RE2643560	400	IP55	350	3.5
100Ohm/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 and Brake enableγ0 not to limit the operation of the built-in braking module.

4.1.5.2 MODEL 75OHM/1300W

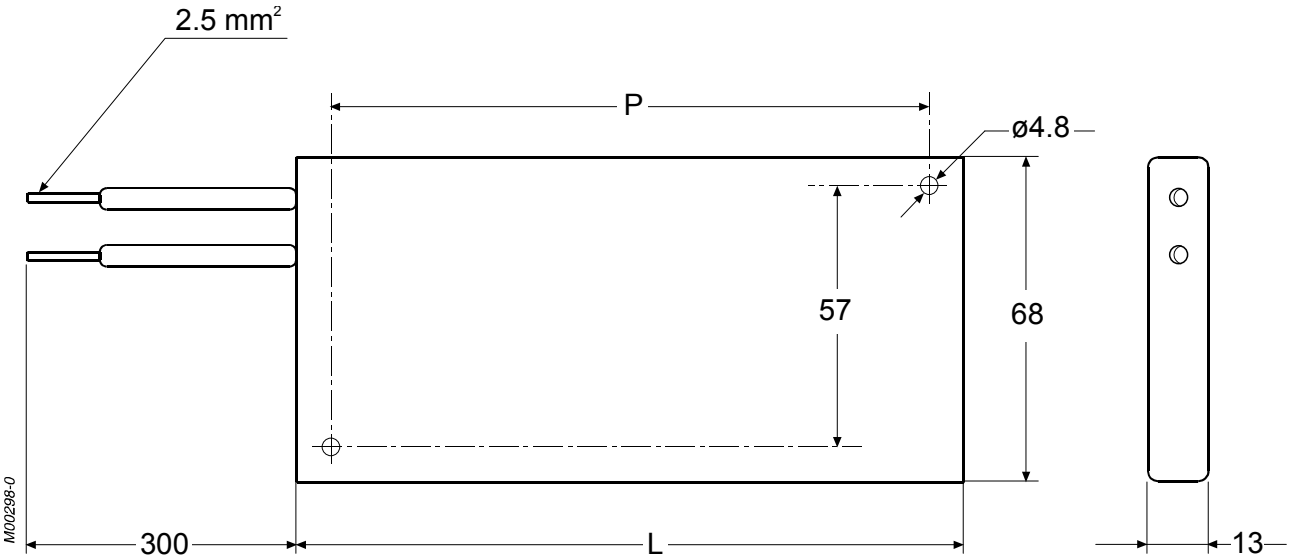


Fig.4.2: Overall dimensions and ratings for braking resistor 75Ω/1300W

Type	L (mm)	P (mm)	Wgt (g)	Degree of protection	Mean power to be dissipated (W)	Max. duration of continuous operation for 380-500Vac (s)*
75Ohm/750W 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 and Brake enableγ0 not to limit the operation of the built-in braking module.

4.1.5.3 MODELS 1100W TO 2200W

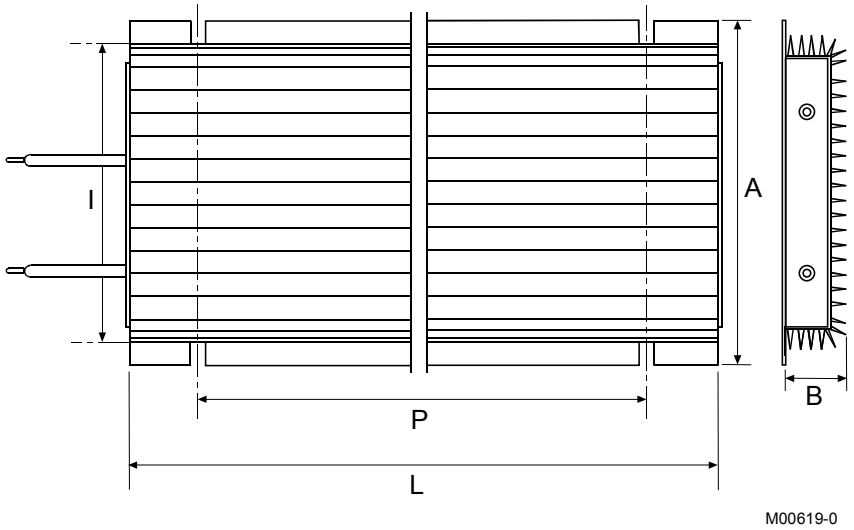


Fig.4.3: Overall dimensions and mechanical features for braking resistors from 1100W to 2200 W

Type	A (mm)	B (mm)	L (mm)	I (mm)	P (mm)	Wgt (g)	Degree of protection	Mean power to be dissipated (W)	Max. duration of continuous operation	
									380-500Vac (s)*	200-240Vac (s)*
15Ohm/1100W RE3083150	95	30	320	80-84	240	1250	IP55	950	not applic.	6
20Ohm/1100W RE3083500									not applic.	8
50Ohm/1100W RE3083500									5	20
10Ohm/1500W RE3093100	120	40	320	107-112	240	2750	IP54	1100	not applic.	4,5
39Ohm/1500W RE3093390									4.5	18
50Ohm/1500W **RE3093500**										
25Ohm/1800W RE310250	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
75Ohm/2200W RE3113750									11	
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 and Brake enable>0 not to limit the operation of the built-in braking module..

4.1.5.4 MODELS 4KW-8KW-12KW

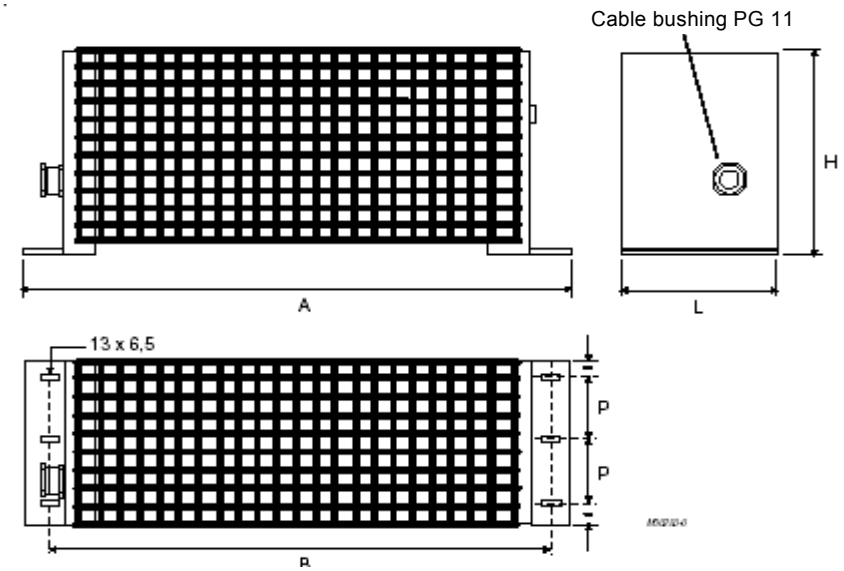


Fig.4.4: Overall dimensions, 4kW, 8kW, and 12kW

RESISTOR	A (mm)	B (mm)	L (mm)	H (mm)	P (mm)	Wgt (Kg)	Degree of protection	Mean power to be dissipated (W)	Max. duration of continuous operation	
									380-500Vac (s)*	200-240Vac (s)*
5Ω4KW RE3482500	620	600	100	250	40	5,5	IP20	4000	not applic.	10
15Ω4KW RE3483150									5	100
25Ω4kW RE3483250									20	not limited
39Ω4kW RE3483390									60	
50Ω4kW **RE3483500**									90	
3.3Ω/8kW RE3762330	620	600	160	250	60	10,6	IP20	8000	not applic.	5
5Ω/8kW RE3762500									not applic.	40
10Ω/8kW RE3763100									2	100
3.3 Ω/12kW RE4022330	620	600	200	250	80	13,7	IP20	12000	not applic.	70
6.6Ω/12kW RE4022660									5	200
10Ω/12kW **RE4023100**									12	not limited

(*) 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 and Brake enableγ0 not to limit the operation of the built-in braking module.

4.1.5.5 Models – Box Resistors IP23, 4KW-64kW.

OVERALL DIMENSIONS

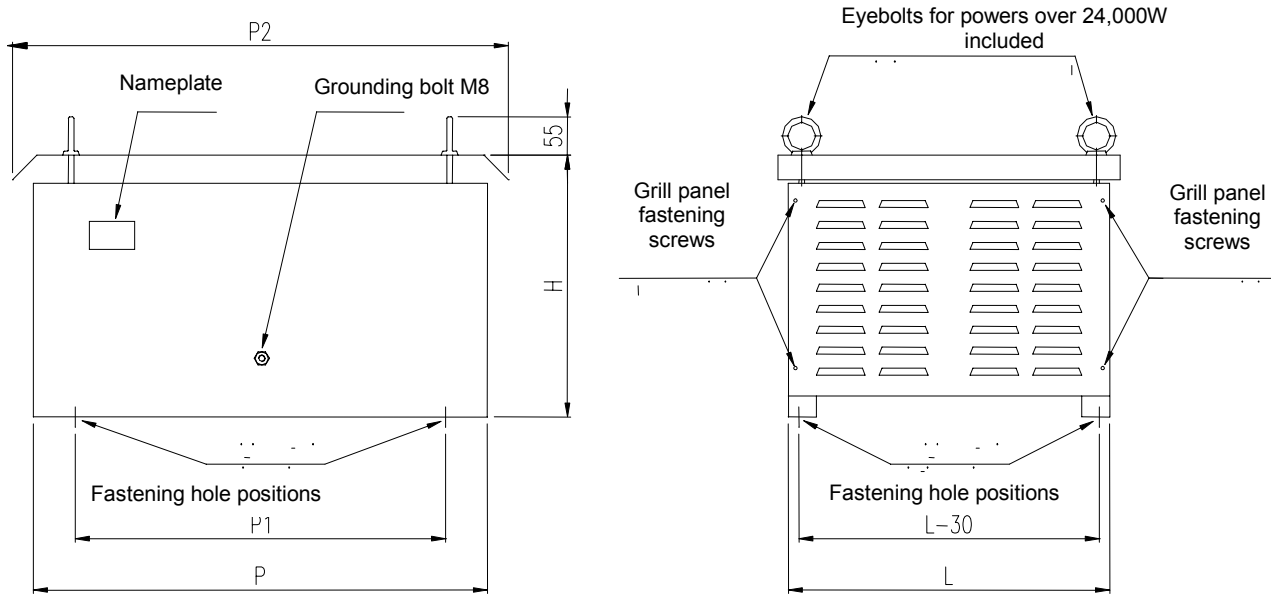


Fig.4.5: Box resistors IP23

WIRING

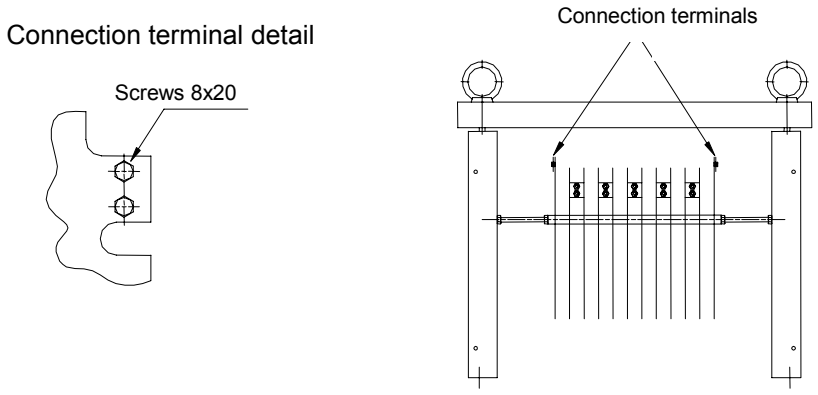


Fig.4.6 Position of electrical connections in box resistors

Remove grids to gain access to wiring terminals.
Important: Figure shows resistor 20Ohm/12kW. For certain models, remove both panels to gain access to wiring terminals.

RESISTOR	P (mm)	P1 (mm)	P2 (mm)	L (mm)	H (mm)	Wgt (Kg)	Degree of protection	Mean power to be dissipated (W)	Max. duration of continuous operation (s)*	
									380-500Vac	200-240Vac
50Ω/4KW RE3503500	650	530	710	320	375	20	IP23	4000	30	not limited
50Ω/8KW RE3783500	650	530	710	380	375	23	IP23	8000	50	not limited
20Ω/12KW RE4053200	650	530	710	460	375	34	IP23	12000	50	not limited
15Ω/16KW RE4163150	650	530	710	550	375	40	IP23	16000	58	not limited
10Ω /24kW RE4293100	650	530	710	750	375	54	IP23	24000	62	not limited
6.6Ω/32kW RE4362660	650	530	710	990	375	68	IP23	32000	62	not limited
6Ω/48kW **RE4452600**	650	530	710	750	730	101	IP23	48000	90	not limited
5Ω/64kW **RE4552500**	650	530	710	990	730	128	IP23	64000	106	not limited

(*) max. value to be set for parameter Brake Enable (C68 (IFD SW) or C60 (VTC SW)). Set Brake Disable C67 (IFD SW) or C59 (VTC SW) so as not to exceed the max. power to be dissipated by the braking resistor. Set Brake Disable=0 and Brake enable>0 not to limit the operation of the built-in braking module.

4.2 BRAKING MODULE

A braking module is available to be connected to terminals + and – (see section 1.4 "Wiring") of the inverter for sizes S40 to S70. Braking modules can be used when a high braking torque is needed, particularly when a prompt braking is needed for high inertial loads (e.g. fans).

4.3 REMOTING KIT

The inverter keypad may be remoted. A special kit is supplied, which includes the following:
- mounting plate for the keypad fastening to the cabinet door,
- remoting wire (length: 5m).

For any details on the keypad remoting, see section 1.5 "Operating and Remoting the Keypad".

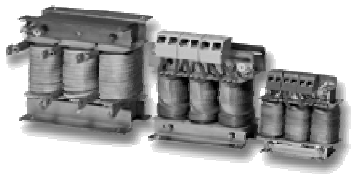
4.4 REACTANCE

4.4.1 INPUT INDUCTANCE

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

- limit input current peaks and improve input current shape;
- reducing supply harmonic current;
- increasing power factor, thus reducing line current;
- increasing the duration of line capacitors inside the inverter.

Harmonic current



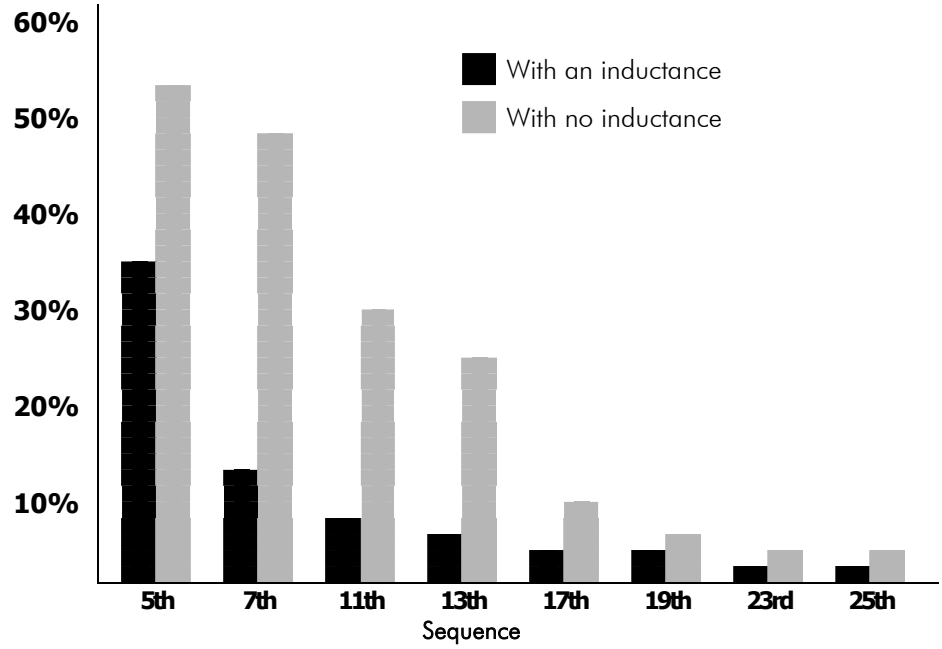
The shapes of the different waves (current or voltage) may be expressed as the sum of the basic frequency (50 or 60Hz) and its multiples. In balanced, three-phase systems, only odd harmonic current exists, as even current is neutralized by symmetrical considerations.
Harmonic current is generated by non linear loads absorbing non-sinusoidal current. Typical sources of this type are bridge rectifiers (power electronics), switching feeders and fluorescent lamps. Three-phase rectifiers absorb line current with a harmonic content $n=6K\pm1$ with $K=1,2,3,\ldots$ (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. Unlike DC inductance, AC inductance suppresses most harmonic currents and protects the rectifier from supply voltage peaks.

For >500kW drives, a *12-pulse* inductance is normally used. This suppresses the lowest harmonic current in the supply line. In a 12-pulse inductance, the lowest harmonics are the 11th and the 13th, followed by the 23th, the 25th and so on, with their relevant low levels. The supply current shape is very similar to a sinusoid.

Harmonic currents



Input reactance L2 and L4 are available, having a different inductance value. The sections below detail the inductance ratings based on the inverter size.

4.4.1.1 INDUCTANCE RATINGS (MH)

INVERTER	MODEL	INVERTER CURRENT	Type L2	Code	Type L4	Code
			MH		mH	
S05	0005	10.5	1.1	IM0120204	0.15	3x IM0100354
	0007	12.5	1.1	IM0120204	0.15	3x IM0100354
	0009	16.5	1.1	IM0120204	0.15	3x IM0100354
	0011	16.5	1.1	IM0120204	0.15	3x IM0100354
	0014	16.5	1.1	IM0120204	0.15	3x IM0100354
S10	0016	26	0.3	IM0120254	0.045	IM0122104
	0017	30	0.3	IM0120254	0.045	IM0122104
	0020	30	0.3	IM0120254	0.045	IM0122104
	0025	41	0.3	IM0120254	0.045	IM0122104
	0030	41	0.3	IM0120254	0.045	IM0122104
	0035	41	0.3	IM0120254	0.045	IM0122104
S15	0038	65	0.3	IM0120254	0.045	IM0122104
	0040	72	0.3	IM0120254	0.045	IM0122104
	0049	80	0.18	IM0120304	0.03	IM0122154
S20	0049	80	0.18	IM0120304	0.03	IM0122154
	0060	88	0.18	IM0120304	0.03	IM0122154
	0067	103	0.18	IM0120304	0.03	IM0122154
	0074	120	0.18	IM0120304	0.03	IM0122154
	0086	135	0.12	IM0120354	0.02	IM0122204
S30	0113	180	0.09	IM0120404	0.015	IM0122254
	0129	195	0.09	IM0120404	0.015	IM0122254
	0150	215	0.09	IM0120404	0.015	IM0122254
	0162	240	0.062	IM0120504	0.01	IM0122304
S40	0179	300	0.062	IM0120504	0.01	IM0122304
	0200	345	0.04	IM0120604	0.0062	IM0122404
	0216	375	0.04	IM0120604	0.0062	IM0122404
	0250	390	0.04	IM0120604	0.0062	IM0122404
S50	0312	480	0.04	IM0120604	0.0062	IM0122404
	0366	550	0.025	IM0120704	0.0045	IM0122604
	0399	630	0.025	IM0120704	0.0045	IM0122604

CAUTION!! Always use L2 inductance under the following circumstances: mains instability; converters installed for DC motors; loads generating strong voltage variations at startup; mains power exceeding 500 KVA.

4.4.1.2 L2 REACTANCE RATINGS

Code	Power Loss	SIZE									Wgt
type L2	Watt	A	B	C	E	G	H	J	M	hole	kg
IM0120154	35	120	75	14	67	55	130	61	25	5	2.5
IM0120204	60	170	105	15	125	70	175	90	40	14x7	5
IM0120254	80	180	140	35	150	80	160	110	60	14x7	8
IM0120304	100	180	145	40	150	80	160	109	60	14x7	9
IM0120354	170	240	185	43	200	110	205	145	80	18x7	17
IM0120404	170	240	195	39	200	120	205	155	80	18x7	22
IM0120504	180	300	215	45	250	130	260	170	100	24x9	43
IM0120604	300	300	230	60	250	130	290	170	100	24x9	53
IM0120704	410	360	265	55	300	160	310	200	120	24x9	68

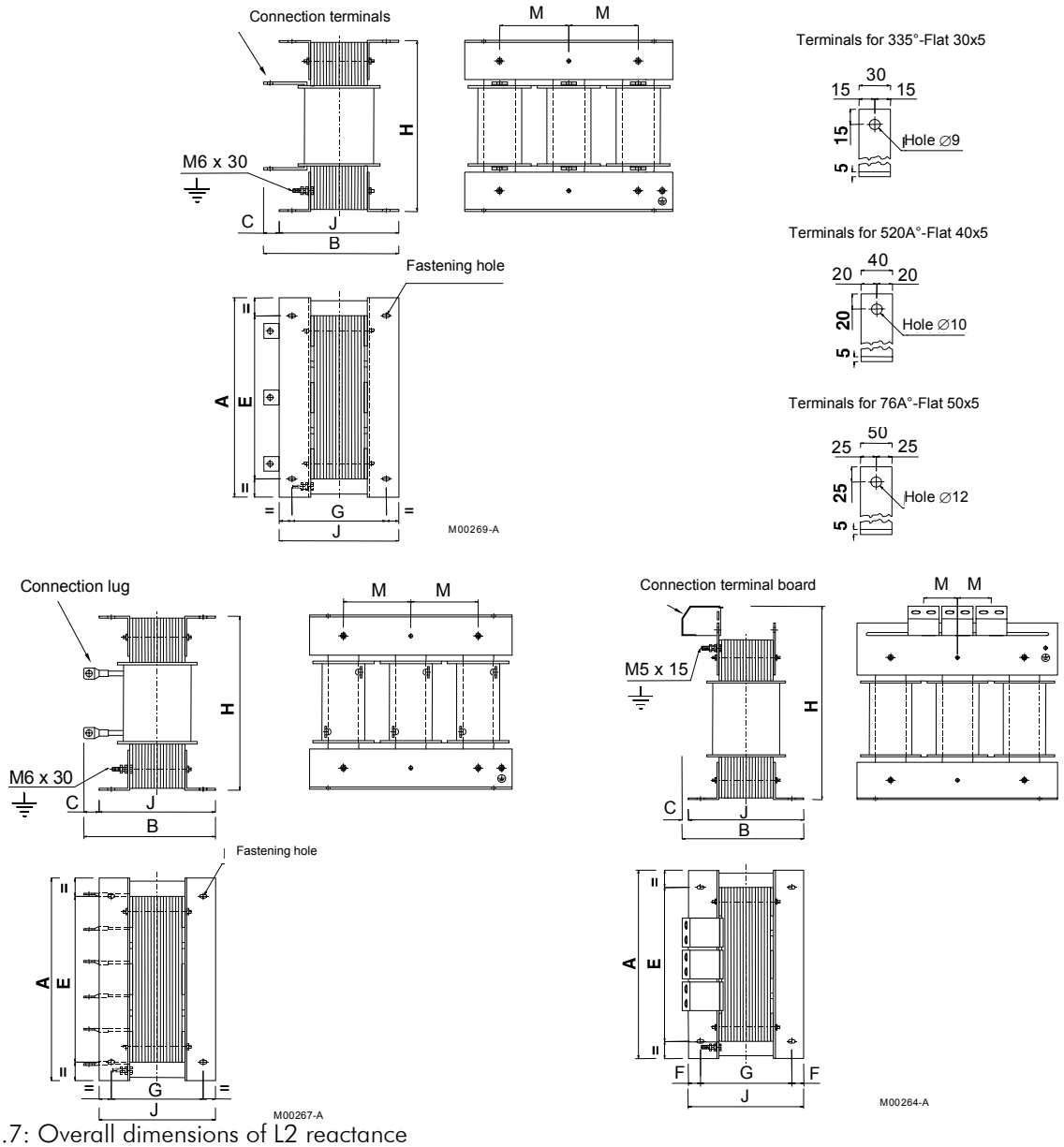


Fig.4.7: Overall dimensions of L2 reactance

4.4.1.3 L4 REACTANCE RATINGS

Code	Power loss	SIZE									Wgt
type L4	Watt	A	B	C	E	G	H	J	M	hole	kg
IM0122104	25	150	105	29	125	60	135	76	50	14x7	4
IM0122154	25	150	125	35	125	75	135	90	50	14x7	5
IM0122204	45	180	150	55	150	65	160	95	60	14x7	5.5
IM0122254	60	180	150	55	150	65	160	95	60	14x7	6
IM0122304	90	180	130	35	150	65	160	95	60	14x7	7.5
IM0122404	180	240	200	60	200	110	250	140	80	18x7	22
IM0122504	300	240	190	55	200	100	260	135	80	18x7	28

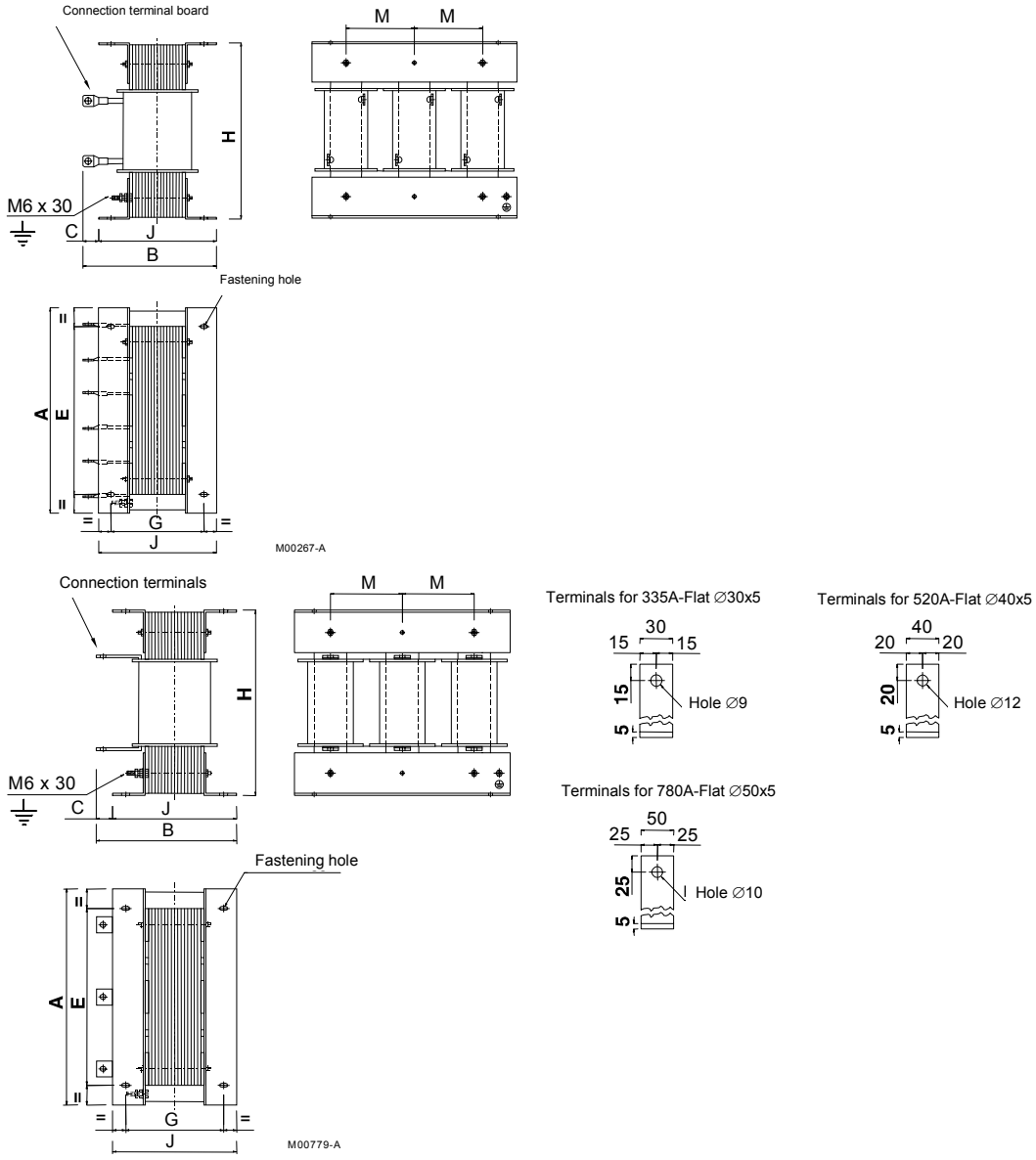


Fig.4.8 Overall dimensions of L4 reactance

4.4.1.4 L4 SINGLE PHASE REACTANCE RATINGS

Code	Power loss	SIZE								Wgt
type L4	Watt	A	B	C	E	H	W	J	hole	kg
IM0100354	6	95	58	12	80	0	34	-	8x4	1

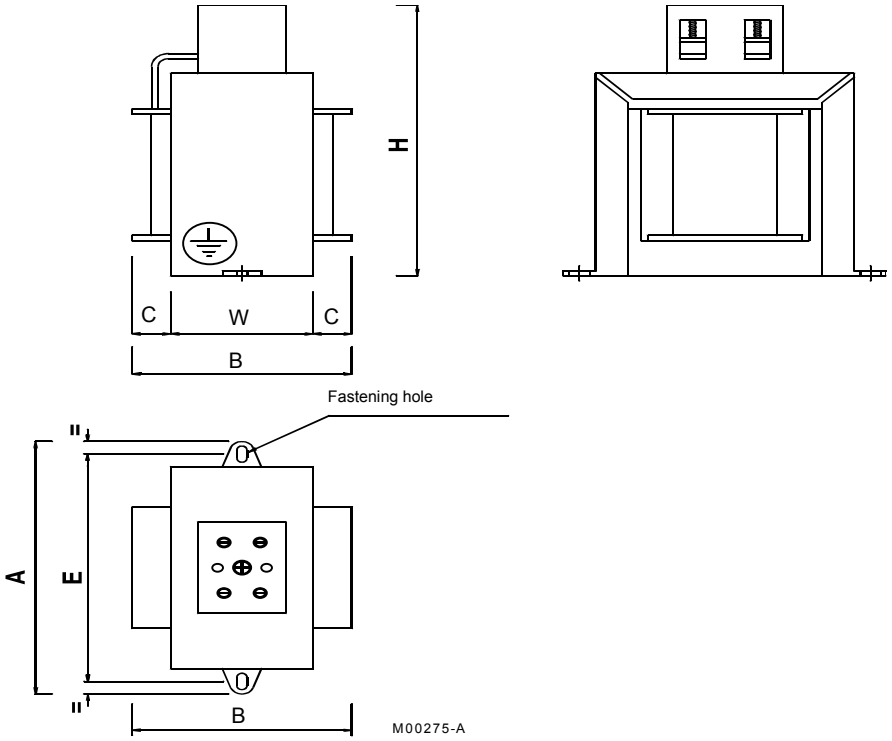


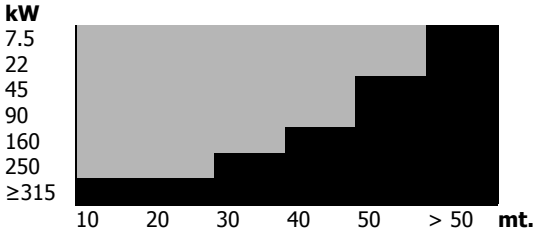
Fig.4.9: Overall dimensions of single-phase reactance L4

4.4.2 OUTPUT REACTANCE

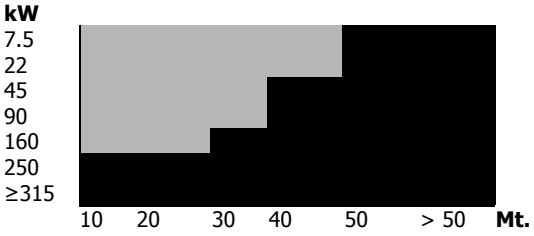
Installations requiring a longer distance between the inverter and the motor may cause overcurrent protections to frequently trip. This is due to the wire parasite capacity generating current pulses at the inverter output. These current peaks may be limited by an inductance installed on the inverter output. Screened cables even have a higher capacity and may have problems with a shorter length. L2 input inductance may also be installed on the inverter output (see previous section). 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 on the output of each inverter.

Motor wiring with unscreened cables

2-4-6 pole MOTORS

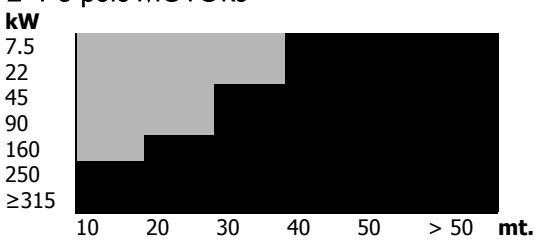


8-pole MOTORS

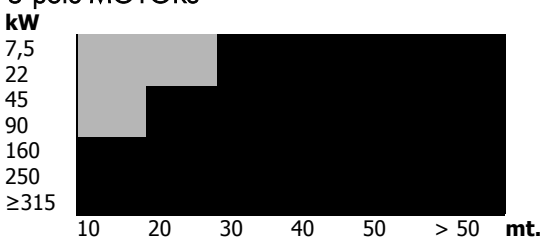


Motor wiring with screened cables

2-4-6 pole MOTORS

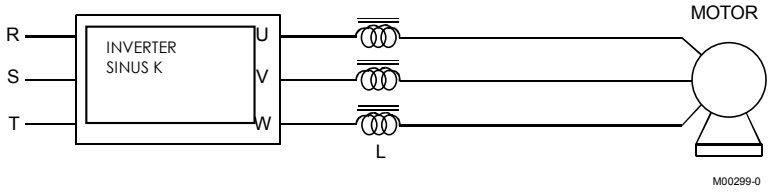


8-pole MOTORS



Always use an output inductance for >= 10-pole motors or parallel-connected motors controlled by a single inverter.

Output inductance NOT required
Output inductance REQUIRED



Output inductance wiring

CAUTION!! L2 inductance 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.

4.5 ENCODER BOARD ES836

Board for incremental, bidirectional encoder to be used as a speed feedback for inverters of the SINUS K/PENTA series.

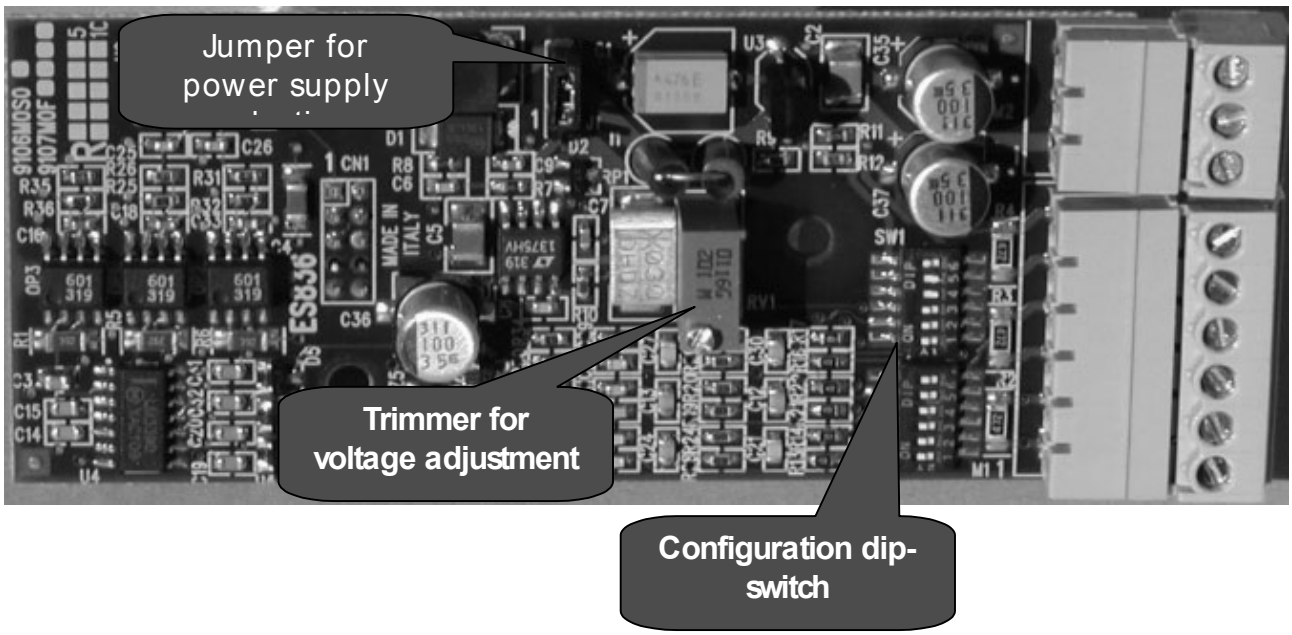


Fig. 4.10 Encoder board ES836

DESCRIPTION	ID NUMBER	COMPATIBLE ENCODERS	
		POWER SUPPLY	OUTPUT
Encoder board ES836	ZZ0095832	5V, 12V or 24V	LINE DRIVER, PNP, NPN, PUSH-PULL

4.5.1. 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 (a.s.l.)

4.5.2 ELECTRICAL FEATURES

Connection to encoder	*Value*			
	Min	*Typ*	*Max*	*Unit of m.*
Encoder supply current, +24V, protected with self-resetting 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	Differential or single-ended			
Voltage range for encoder input signals	4		24	V
Pulse max. frequency with noise filter setting on	77kHz (1024imp @ 4500rpm)			
Pulse max. frequency with noise filter setting off	155kHz (1024imp @ 9000rpm)			
Input impedance in NPN or PNP mode (auxiliary pullup or pulldown resistors required)		15k		Ω
Input impedance in line driver mode or push-pull mode		3600		Ω

ISOLATION:

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

4.5.3 INSTALLING THE ENCODER BOARD ON THE INVERTER

1) Turn off the inverter and wait at least 5 minutes.
2) Remove the cover allowing to gain access to the inverter control terminals. The mounting columns for the encoder board and signal connector are located on the left.

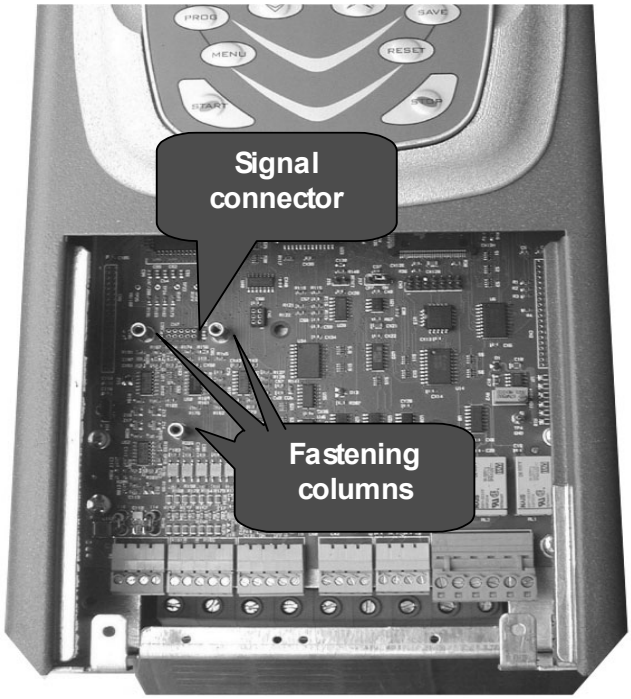


Fig. 4.11 Position of the slot for the encoder board installation

3) Fit the encoder board and make sure that all contacts enter the relevant housing in the signal connector. Fasten the encoder board to the metal columns using the screws supplied.
4) Configure dip-switches and the jumper located on the encoder board based on the connected encoder. Check that the supply voltage delivered to the terminal output is correct.
5) Turn on the inverter and set the parameters relating to the encoder feedback (see Programming Manual).

Fig. 4.12 Encoder board fastened to its slot

4.5.4 ENCODER BOARD TERMINALS

A 9-pole terminal board is located on the front side of the encoder board.

Terminal board, pitch 3.81 mm 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	~~CHA~~	Encoder input channel A inverse polarity
3	CHB	Encoder input channel B true polarity
4	~~CHB~~	Encoder input channel B inverse polarity
5	CHZ	Encoder input channel Z (zero notch) true polarity
6	~~CHZ~~	Encoder input channel Z (zero notch) inverse polarity
7	+VE	Encoder supply output 5V/12V/24V
8	GNDE	Encoder supply grounding
9	GNDE	Encoder supply grounding

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

Encoder board ES836 is provided with two dip-switch banks to be set up depending on the type of connected encoder. Dip-switches are located in the front left corner of encoder board ES836 and are adjusted as shown in the figure below:

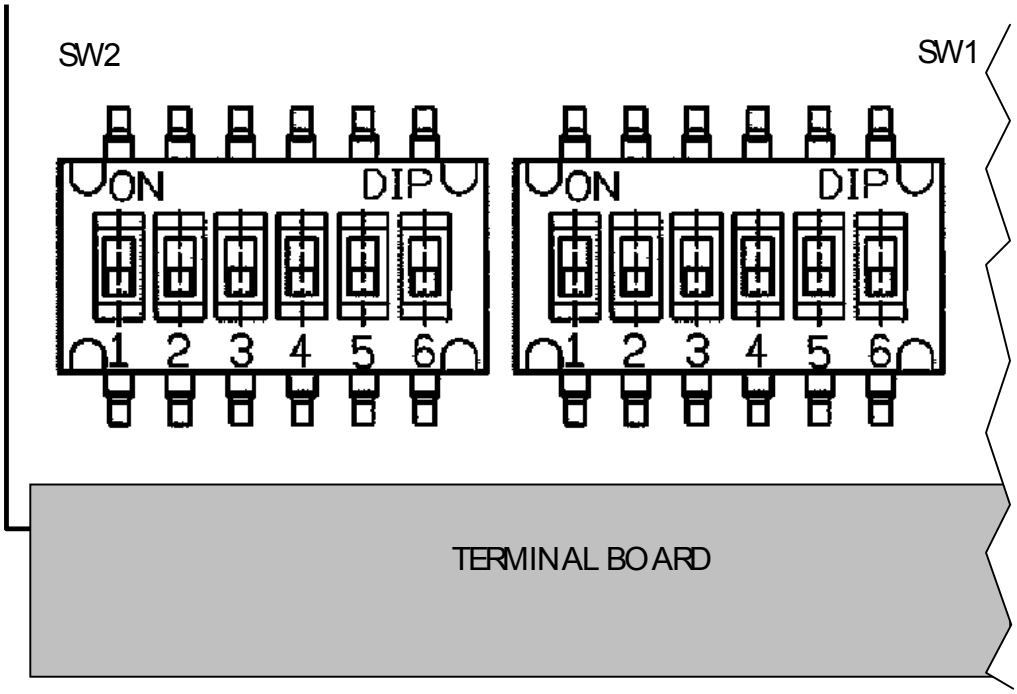


Fig.4.13. Position of dip-switches

Dip-switch functionality is detailed in the table below:

Switch	*OFF - open*	*ON - closed*
SW2 – 1	Channel Z, with no band limit	Channel Z, with band limit
SW2 – 2	Channel Z, differential Line driver	Channel Z, single-ended
SW2 – 3	Channel Z, type NPN or PNP	Channel Z, Line driver or Push Pull
SW2 – 4	Channel B, with no band limit	Channel B, with band limit
SW2 – 5	Channel B, differential Line driver	Channel B, single-ended
SW2 – 6	Channel B, type NPN or PNP	Channel B, Line driver or Push Pull
SW1 – 1	Channel A, with no band limit	Channel A, with band limit
SW1 – 2	Channel A, differential Line driver	Channel A, type single-ended
SW1 – 3	Channel A, type NPN or PNP	Channel A, type Line driver or Push Pull
SW1 – 4	Not used	Not used
SW1 – 5	Not used	Not used
SW1 – 6	Supply voltage: 12V	Supply voltage: 5V

Two-position jumper J1 installed on control board ES836 allows to set the encoder supply voltage. Set jumper J1 to position 1-2 to select non-tuned, 24V encoder supply voltage.
Set jumper J1 to position 2-3 to select tuned, 5/12V encoder supply voltage. Supply values of 5V or 12V are to be set through dip-switch SW1-6 (see table above).

4.5.5 TRIMMER

Trimmer RV1 installed on board ES836 allows to adjust the encoder supply voltage. This can compensate voltage drops in case of long distance between the encoder and the encoder board, or allows to feed an encoder with intermediate voltage values if compared to factory-set values.

Adjustment procedure:

1. put a tester on the encoder supply connector (encoder side of the connecting cable); make sure the encoder is on.

2. rotate the trimmer clockwise to increase supply voltage. Trimmer is factory set to deliver 5V and 12V (depending on the dip-switch selection) to the power supply termination lugs. For a power supply of 5V, supply may range from 4.4V to 7.3V; for a power supply of 12V, supply may range from 10.3V to 17.3V.

NOTE

Output voltage cannot be adjusted by trimmer RV1 if 24V power supply of is delivered.

CAUTION:

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

4.5.6 ENCODER WIRING EXAMPLE

The figures below show how to connect and configure the dip-switches for the most popular encoder types.

CAUTION:	A wrong encoder-board connection may damage both the encoder and the board.
NOTE:	In all the figures below, dip-switches SW2-1, SW2-4, and SW1-1 are in position ON, i.e. 77kHz 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 encoder board ES836. See the encoder ratings.
NOTE:	Dip-switch SW1-6 is not shown in the figures because its setting depends on the supply voltage required by the encoder. See previous sections of this manual.
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 SINUS PENTA'S Programming Manual for any detail.

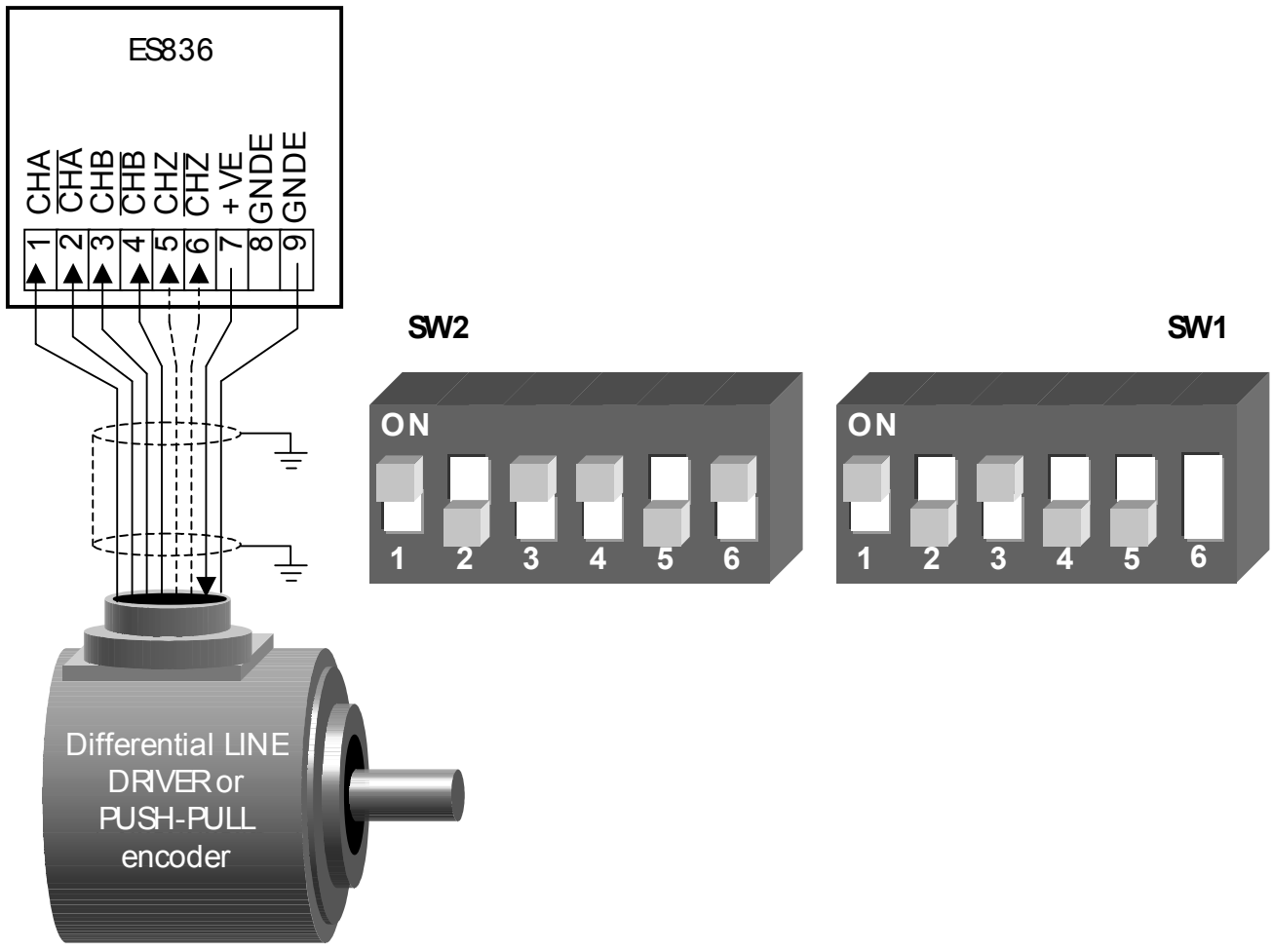


Fig. 4.14 LINE DRIVER or PUSH-PULL encoder with complementary outputs

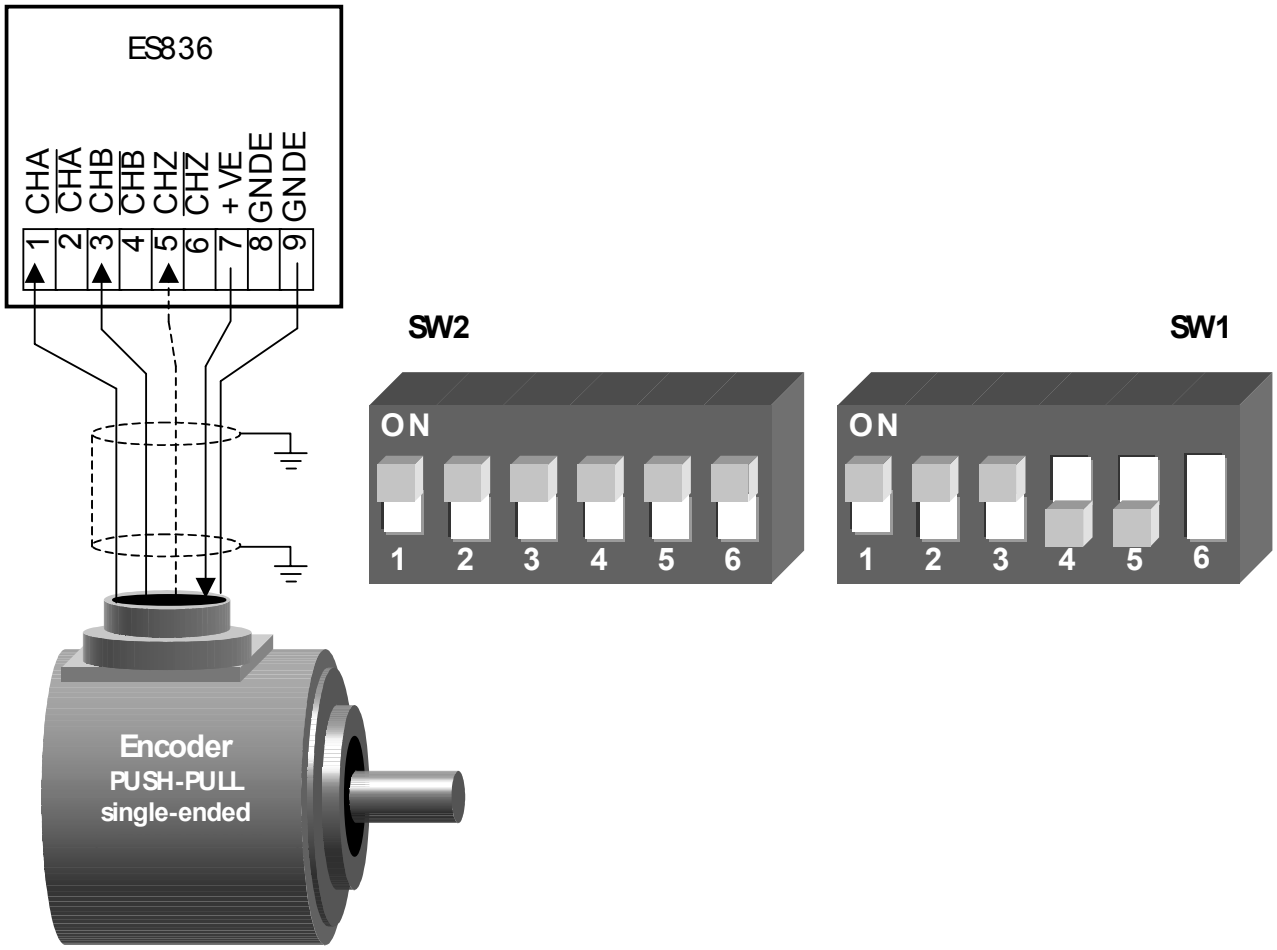


Fig. 4.15 PUSH-PULL encoder with single-ended outputs

CAUTION:

Because settings required for a single-ended encoder (dip-switches SW2-1, SW2-5, SW1-2 closed) 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.

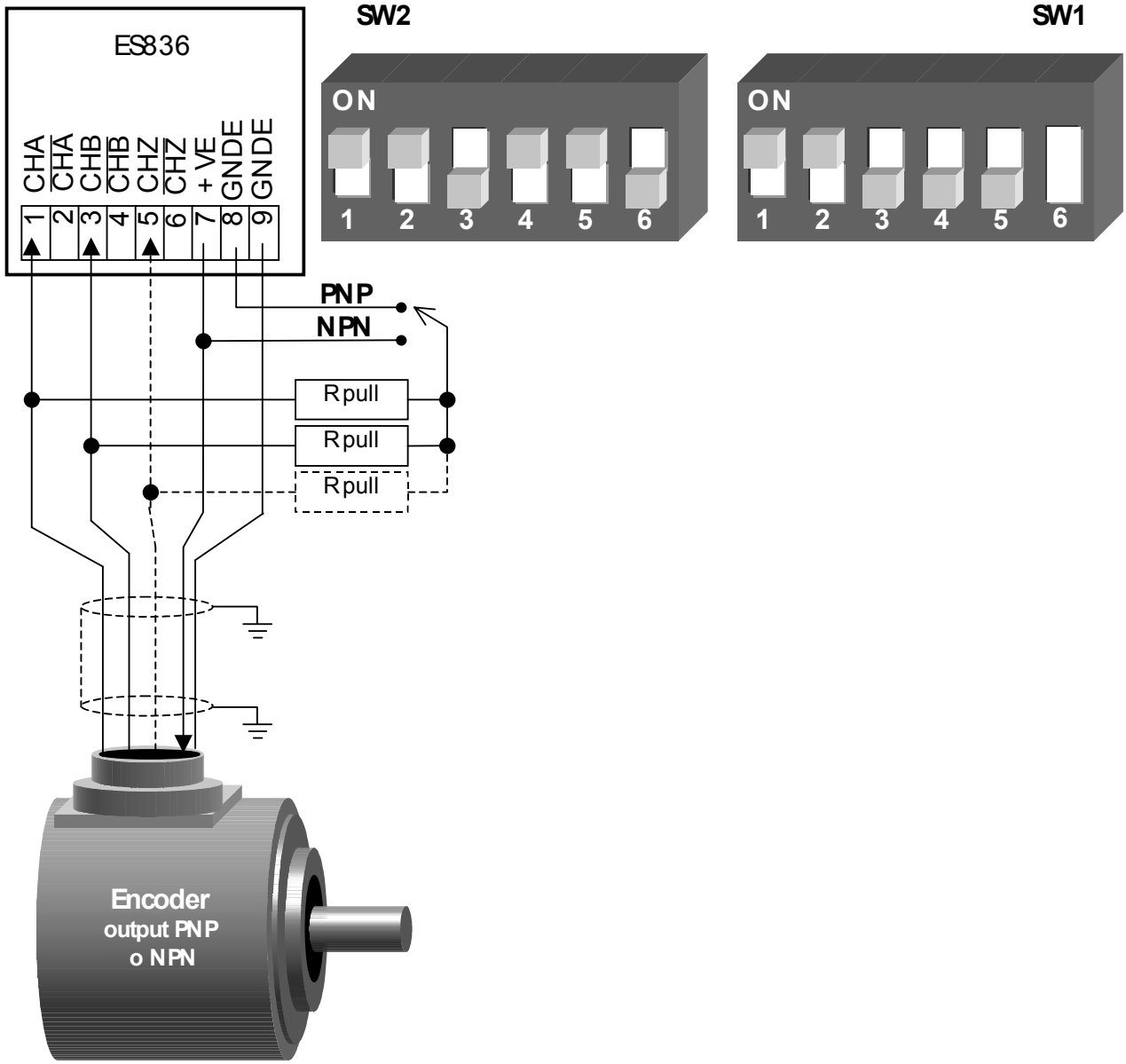


Fig. 4.16 PNP or NPN encoder with single-ended outputs and load resistors with external wiring

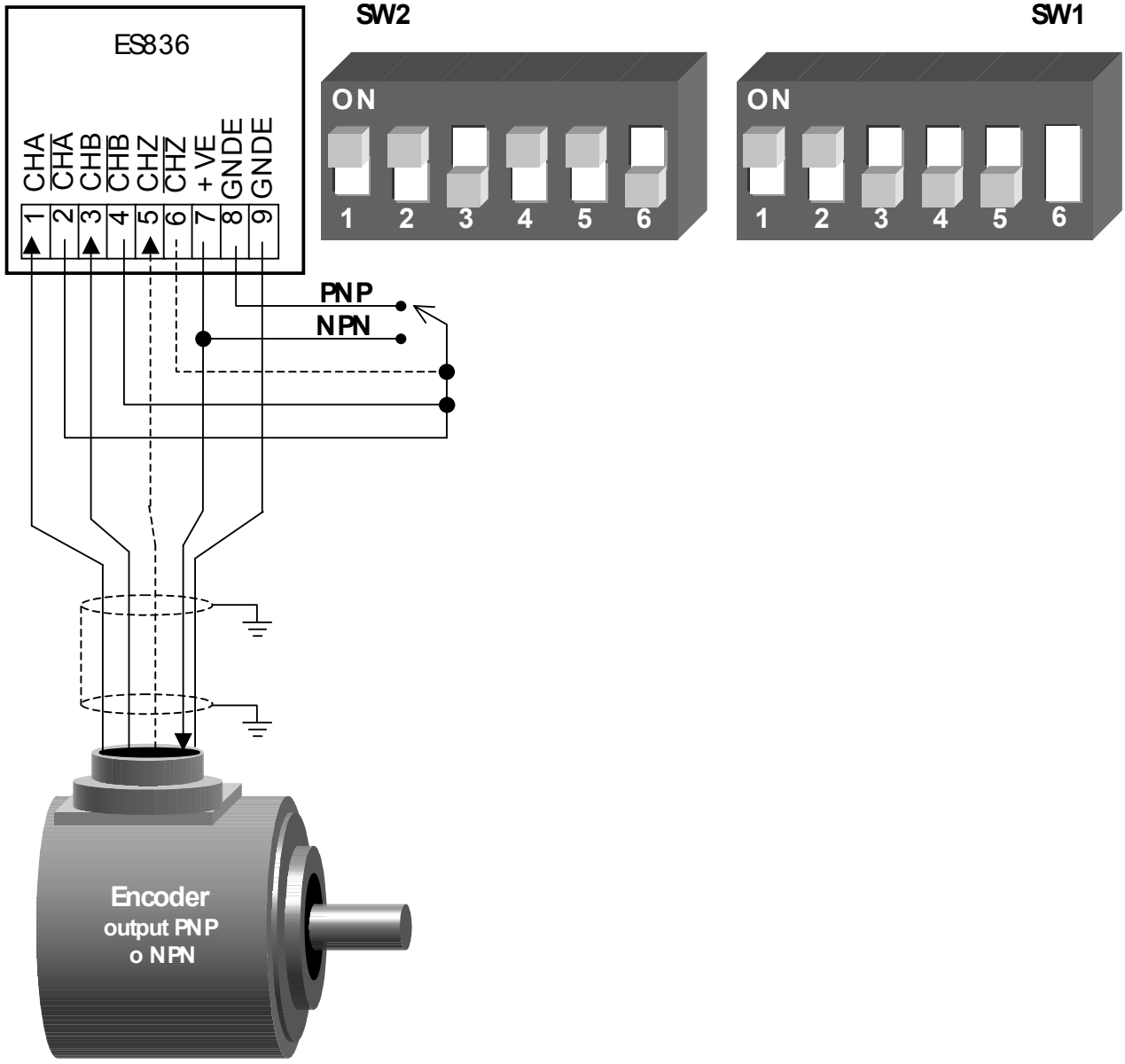


Fig. 4.17 PNP or NPN encoder with single-ended outputs and incorporated load resistors (4700Ω)

NOTE:

NPN or PNP encoders are provided with outputs requiring a resistive, pull-up or pull-down load towards the power supply or the common. Load resistors are to be externally connected because their ratings are defined by the encoder manufacturer. Connect the resistor common to the mains for a NPN encoder or to the common for a PNP encoder.
Incorporated load resistors may be used only if the encoder can operate with 4700Ω resistors. Their wiring is shown in Figure 4.16.

NOTE:

NPN or PNP encoders cause pulse distortions because ramps up and ramps down are different. Distortion depends on the load resistors 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.

4.5.7 WIRING

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 to fasten the encoder wire and ground the cable screening to the inverter.

Fig.4.18 – 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 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 a difficult speed adjustment or uneven operation of the inverter; in the worst cases, it can lead to the inverter stop due to overcurrent conditions.

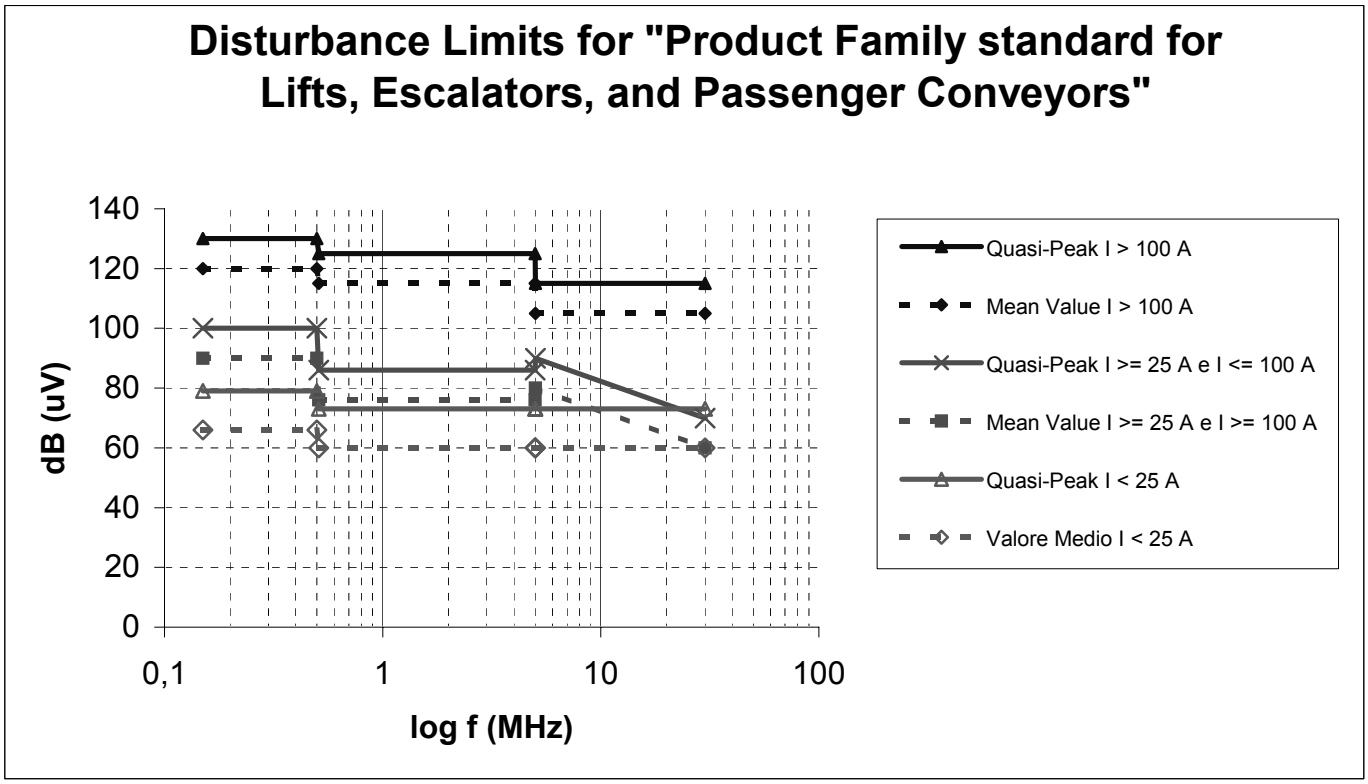
5 NORMATIVE REFERENCES

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 communication systems, so that radio receivers only receive electrical noise. This may cause unexpected faults.
Two fields may be concerned: immunity (EN50082-1-2, EN61800-3/A11 and following EN 61800-3 issue 2) and emissions (EN 55011group 1 and 2 cl. A, EN 55011 group 1 cl.B, EN61800-3-A11 and following EN 61800-3 issue 2).
Standards EN55011 and 50082, as well as standard EN61800-3, define immunity and emission levels required for devices designed to operate in different environments. Drives manufactured by ELETTRONICA SANTERNO 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 A1-type filters for currents under 25A and incorporated A2-type filters for currents over 25A.

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. Electrical equipment must be immune from electromagnetic disturbance.

According to standard EN12016, immunity is provided by the following tests:

Electromagnetic Compatibility (89/336/CEE and following amendments, 92/31/CEE, 93/68/CEE, and 93/97/CEE)	- 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. EN61000-4-3/IEC1000-4-3 Electromagnetic Compatibility (EMC). Part 4: Testing and Measurement Techniques. Section 3: Radiated, Radio-frequency, Electromagnetic Field Immunity Test. 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. EN61000-4-5/IEC1000-4-5 Electromagnetic Compatibility (EMC). Part 4: Testing and Measurement Techniques. Section 5: Surge Immunity Test. EN61000-4-6/IEC1000-4-6 Electromagnetic Compatibility (EMC). Part 4: Testing and Measurement Techniques. Section 6: Immunity from Radiofrequency Fields Induced Disturbance.

ELETTRONICA SANTERNO certifies all its products in compliance with immunity standards in force. All classes are provided with CE Declaration of European Conformity according to Electromagnetic Compatibility 89/336/CEE – 92/31/CEE – 23/68/CEE-93/97/CEE (see Section 5.2).

Low Voltage Directive (73/23/CEE and following amendment 93/68/CEE)	EN81-1	Safety requirements for the manufacture and installation of lifts and hoists. Electrical lifts.
	IEC61800-5-1	Adjustable speed electrical power drive systems. Part 5-1: Safety requirements – Electrical, thermal and energy.
	IEC-22G/109/NP	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 Declaration CE of Conformity according to the requirements of LOW VOLTAGE DIRECTIVE 73/23/CEE-93/68/CEE (see Section 5.2).

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 April1999, N. 162 (see section 5.2).

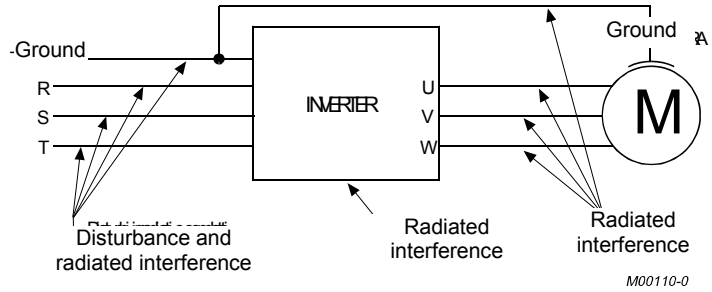
5.1 RADIOFREQUENCY DISTURBANCE

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:

a) Radiated interference from electrical components or power wiring cables inside the cabinet;

b) Disturbance and radiated interference from outgoing cables (feeder cables, motor cables, signal cables).

The figure shows how disturbance takes place:



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 toroidal 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 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 (μV) or current signal levels (μA):

- 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.

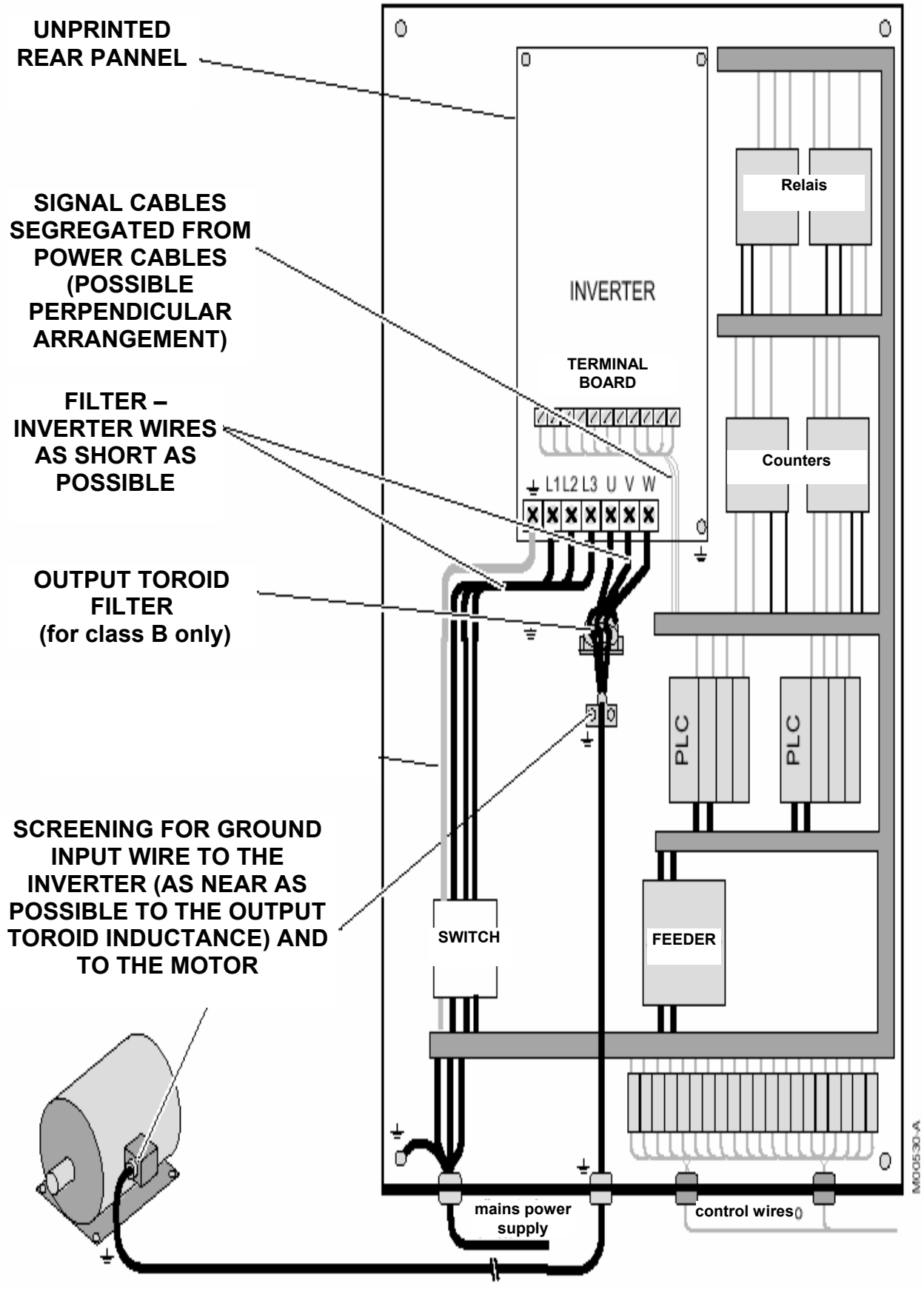
5.1.1 THE MAINS

Disturbance and radiated interference occur in the mains.
Limiting disturbance results in weakening radiated interference.
Disturbance on the mains may interfere with devices installed on the machine or 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;
- telephone systems.

Mains disturbance may be limited by installing a mains filter to reduce RFI.

ELETTRONICA SANTERNO adopted this solution to suppress RFI.


UNPRINTED REAR PANNEL
SIGNAL CABLES SEGREGATED FROM POWER CABLES (POSSIBLE PERPENDICULAR ARRANGEMENT)
FILTER – INVERTER WIRES AS SHORT AS POSSIBLE
OUTPUT TOROID FILTER (for class B only)
SCREENING FOR GROUND INPUT WIRE TO THE INVERTER (AS NEAR AS POSSIBLE TO THE OUTPUT TOROID INDUCTANCE) AND TO THE MOTOR
INVERTER
TERMINAL BOARD
L1 L2 L3 U V W
Relais
Counters
PLC
PLC
SWITCH
FEEDER
mains power supply
control wires
M0053D-A

5.1.2 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 ferrite;
- in case of single-phase conductors (or 2wire line) both phases must go through ferrite (incoming and outcoming conductor cables that are to be filtered must go through ferrite).

See section 5.2.4 for the selection of the output toroid filter to weaken radiofrequency interference.

5.1.3 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 capable of restoring electrical conductivity once closed.
C) Segregate cables bases 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):

high sensitivity	- analog inputs and outputs: voltage reference and current reference
	- sensors and measurement circuits (ATs and VTs)
	- DC supply (10V, 24V)
low sensitivity	- digital inputs and outputs: optoisolated commands, relay outputs
low perturbation	- filtered AC supply
high perturbation	- 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.

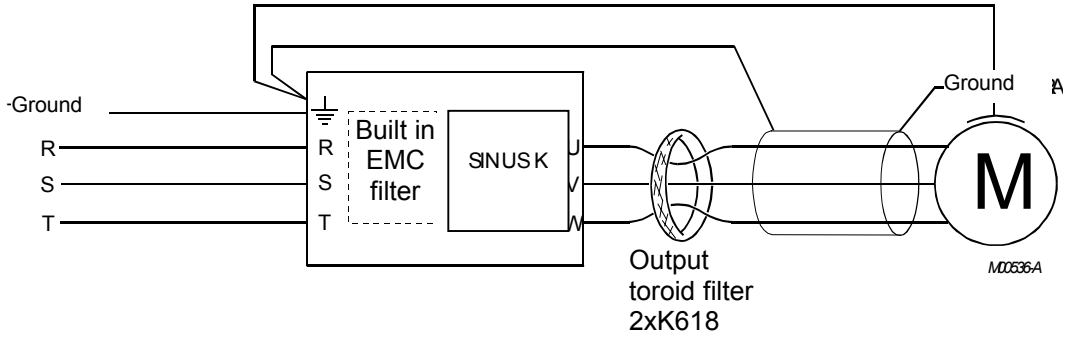
Wires connecting the motor or load mainly generate disturbance. Disturbance is important in inverter power drive systems or the devices installed on the machine, and could interfere with local communication circuits located near the inverter (radiotelephones, mobile phones).
Follow the instructions below to solve these problems:
- Provide for 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 35mm^2 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. 100μH) 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.

5.1.4 INPUT AND OUTPUT FILTERS

The inverters of the SINUS K series may be delivered with incorporated input filters; in that case, models are marked with A1, A2, B in the ID number.
If built-in filters are fitted, disturbance amplitude ranges between allowable emission limits (see section 5 "Provisions").
As for devices of group 1, class B for standard EN55011and VDE0875G, just install an additional output toroid filter (e.g. type 2xK618) on the models with incorporated filter A1. Make sure that the three cables between the motor and the inverter go through the core. The figure shows the wiring diagram for the line, the inverter and the motor.



Wiring the toroid filter for the inverter of the SINUS K series

NOTE!! Install the output 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 (see section 5.1.1).

NOTE!! Install the toroid filter by leading the connection cables between the motor and the inverter inside the toroid.

5.2 EUROPEAN UNION DIRECTIVES AND 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 FOR LIFTS OF **SINUS K LIFT** TYPE,

AND RELATED ACCESSORIES,

TO WHICH THIS DECLARATION RELATES,

APPLIED UNDER CONDITIONS SUPPLIED IN THE USER'S MANUAL,

CONFORMS TO THE FOLLOWING STANDARDS OR NORMATIVE DOCUMENTS:

EN 12015 (1998-05)	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.
EN 61000-4-2 (1995-03)	Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 2: Electrostatic discharge immunity test. Basic EMC Publication.
EN 61000-4-3 (1996-09)	Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 3: Radiated, radio-frequency, electromagnetic field immunity test.
EN 61000-4-4 (1995-03)	Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 4: Electrical fast transient/burst immunity test. Basic EMC Publication.
EN 61000-4-5 (1995-03)	Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 5: Surge immunity test.
EN 61000-4-6 (1996-07)	Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 6: Immunity to conducted disturbances, inducted by radio-frequency fields.

FOLLOWING THE PROVISIONS OF ELECTROMAGNETIC COMPATIBILITY DIRECTIVE 89/336/EEC

AND SUBSEQUENT AMENDMENTS 92/31/EEC, 93/68/EEC AND 93/97/EEC.

PLACE AND DATE OF ISSUE
Casalfiumanese, 07/05/2003

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Executive V. President
Zanarini Ing. Sergio

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 FOR LIFTS OF **SINUS K LIFT** TYPE,

TO WHICH THIS DECLARATION RELATES,

CONFORMS TO THE FOLLOWING STANDARDS OR NORMATIVE DOCUMENTS:

EN 81-1 (1998-08)	Safety rules for the construction and installation of lifts. Electric lifts.
IEC 61800-5-1: 2003	Adjustable speed electrical power drive systems. Part 5-1: Safety requirements – Electrical, thermal and energy.
IEC 22G/109/NP: 2002	Adjustable speed electrical power drive systems. Part 5-2: Safety requirements – Functional.
EN 60146-1-1 (1993-02)	Semiconductor convertors. General requirements and line commutated convertors. Part 1-1: Specifications of basic requirements.
EN 60146-2 (2000-02)	Semiconductor convertors. Part 2: Self-commutated semiconductor converters including direct d.c. converters.
EN 61800-2 (1998-04)	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 (1997-12)	Safety of machinery. Electrical equipment of machines. Part 1: General requirements.
EN 60204-1 Modifica 1 (1988-08)	Electrical equipment of industrial machines. Part 2: Item designation and examples of drawings, diagrams, tables and instructions.
EN 60529 (1991-10)	Degrees of protection provided by enclosures (IP Code).
EN 50178 (1997-10)	Electronic equipment for use in power installations.

FOLLOWING THE PROVISIONS OF LOW VOLTAGE DIRECTIVE 73/23/EEC AND SUBSEQUENT AMENDMENT 93/68/EEC.

LAST TWO DIGITS OF THE YEAR IN WHICH THE CE MARKING WAS AFFIXED: **03**

PLACE AND DATE OF ISSUE
Casalfiumanese, 07/05/2003

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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,

CONFORMS TO THE FOLLOWING STANDARDS OR NORMATIVE DOCUMENTS:

EN 60204-1 (1997-12)	Safety of machinery. Electrical equipment of machines. Part 1: General requirements.
EN 60204-1 Modifica 1 (1988-08)	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 INCORPORED 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.

PLACE AND DATE OF ISSUE
Casalfiumanese, 07/05/2003

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Executive V. President
Zanarini Ing. Sergio

MANUFACTURER'S DECLARATION

Elettronica Santerno S.p.A.
Via G. Di Vittorio, 3 - 40020 Casalfiumanese (BO) - Italy

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 OF ISSUE
Casalfiumanese, 07/05/2003

SIGNATURE
Executive V. President
Zanarini Ing. Sergio

SECTION 2
-Programming Instructions-

6 PROGRAMMABLE FUNCTIONS

6.1 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, optional control board ES836 must be installed. See section 4.5 (Section 1) for the control board description.

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

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

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

Figure 6.1 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.

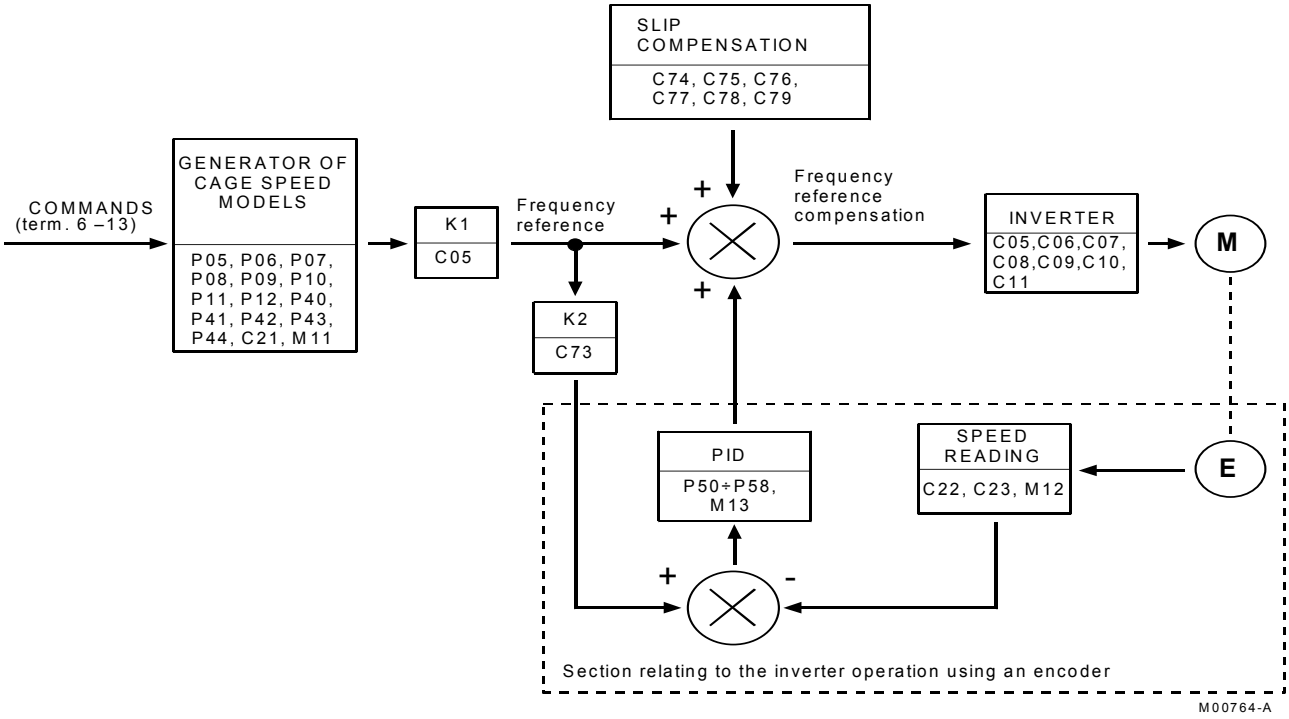


Figure 6.1. Block diagram of the speed regulator

6.2 COMMERCIAL SPEED

SINUS LIFT inverters allow to use two different values of commercial speed:

- high speed or contractual speed (parameter P41), 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^2 and 0.6 m/sec^3. 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 starting up to the 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 commercial speed is reached but is not maintained because the cage begins slowing-down.

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

Vc = 1.2 m/sec. (P41 = 100%, P44 = 1.2 m/s)

Parameter M23 indicates the expected stop distance: Da = 1.8 m
Supposing to use an approach speed of 0.15 m and an increasing total stop distance by 10%, min. distance value (Dmin) is obtained:

Dmin = 1.8 + (1.8 + 0.15) x 1.1 = 3.95 m

Similarly, the following values are obtained:

- Vc = 1.0 m/sec. Dmin = 1.34 + (1.34 + 0.15) x 1.1 = 2.98 m
- Vc = 0.8 m/sec. Dmin = 0.94 + (0.94 + 0.15) x 1.1 = 2.14 m
- Vc = 0.6 m/sec. Dmin = 0.60 + (0.60 + 0.15) x 1.1 = 1.43 m

Examples above show that if 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. Vc = 1.2 m/sec Vb = 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 parameters relating to comfort.
In a plant with a constant interfloor distance equal to 3.0 m, with Vc = 1.2 m/sec and slowing-down signal set at 2.15 m from the stop point, if lift is called from a contiguous floor, the lift cage will be sent the slowing-down signal after covering a 0.85 m distance 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 So is: So - 1.1 m, the slowing-down expected distance from the stop point must become equal to: 1.8 + 1.1 = 2.9 m.
This allows to adopt 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).

6.3 OPERATION BASED ON THE SELECTED SPEED PATTERN (C21)

6.3.1 "SINGLE" SPEED OPERATING MODE

Parameter C21 (Operation Method Menu):
Standard Speed
Parameter value:
Single

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

The table below shows digital input operation in Single speed operating mode.

<table>
<tr><th>MAN/NORMAL
Term.10</th><th>FWD
Term.7</th><th>REV
Term.11</th><th>CONT/ACC
Term.9</th><th>FWD_MAN
Term.12</th><th>REV_MAN
Term.13</th><th></th></tr>
<tr><td rowspan="5">0
(Normal operation)</td><td>0</td><td>0</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2">Stop</td></tr>
<tr><td>1</td><td>1</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td rowspan="3"></td><td rowspan="3"></td><td>Upstroke at approach speed (P40)</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Upstroke at contractual speed (P41)</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Downstroke at approach speed (P40)</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td></td><td></td><td>Downstroke at contractual speed (P41)</td></tr>
<tr><td rowspan="4">1
(Maintenance operation)</td><td colspan="3" rowspan="4"></td><td>0</td><td>0</td><td rowspan="2">Stop</td></tr>
<tr><td>1</td><td>1</td></tr>
<tr><td>1</td><td>0</td><td>Mainten. speed upstroke (P43)</td></tr>
<tr><td>0</td><td>1</td><td>Mainten. speed downstroke(P43)</td></tr>
</table>

Any position

6.3.2 "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 cage running direction. In Maintenance operation only one cage speed is available (P43) and two contacts determine the cage running direction.
A separate contact selects Normal/Maintenance operation.

The table below shows digital input operation 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	1				
	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

6.3.3 "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 cage upstroke at a speed selected by a combination of other inputs; the "Downstroke" input enables the 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 digital input operation 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)
	0	1	0	0	Downstroke at approach speed (P40)
			1	0	Downstroke at contractual speed (P41)
			0	1	Downstroke at low speed (P42)
1 (Maintenance operation)	0	0			Stop
	1	1			
	1	0			Upstroke at Maintenance speed (P43)
	0	1			Downstroke at Maintenance speed (P43)

Any position

SECTION 2

6.4 V/F PATTERN

The voltage/frequency pattern produced by the inverter may be customized based on application requirements.
All relevant parameters are included in the V/f patterns submenu (Configuration menu).

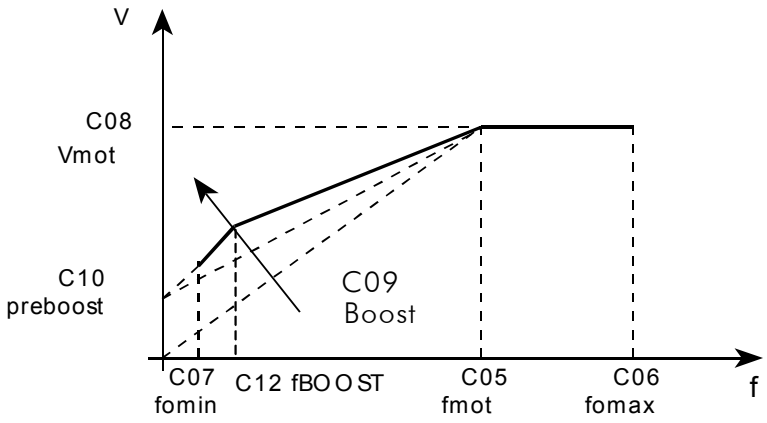


Fig 6.2 Parameters relating to voltage/frequency pattern

Considering Figure 6.2, the configurable parameters for the V/f pattern are the following:

C05 : fmot, motor rated frequency; determines switching from constant-torque operation to constant-power operation.
C06 : fomax, maximum output frequency produced by the inverter.
C07 : fomin, minimum output frequency produced by the inverter (always contact Elettronica Santerno before altering this value).
C08 : Vmot, motor rated voltage; this is the voltage obtained with the motor rated frequency.
C09: BOOST, 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: PREBOOST, increases the output rated voltage at 0 Hz.
C11: AUTOBOOST, increases voltage with respect to motor torque.
C12: FREQ. BOOST, determines the frequency level (expressed as a percentage of C05) for voltage increase set in C13.
C13 : BOOST, determines the changing of the nominal output voltage C12. (Boost > 0 determines an increase of nominal 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 starting couple needed .
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 derives from:

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

Where T is the motor torque and Tn is the motor rated torque calculated as follows:

$$Tn = \frac{Pn \quad p}{2\pi \quad f} = \frac{C74 \quad (C73/2)}{2\pi \quad (C05)}; \ [Nm]$$

C74 Motor rated power.
C73 Motor pole number.
C11 (AutoBoost): variable torque compensation expressed as a percentage of the motor rated voltage. The value set for C11 is the voltage increment when the motor runs at rated torque.

6.5 CARRIER FREQUENCY

Carrier frequency may be programmed based on output frequency as shown in Fig. 6.3. Adjust 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 constant carrier independently on output frequency
- synchronous modulation occurs with constant pulse number
- pulse number is equal to: $\frac{carrier\ \ frequency}{output\ \ frequency}$

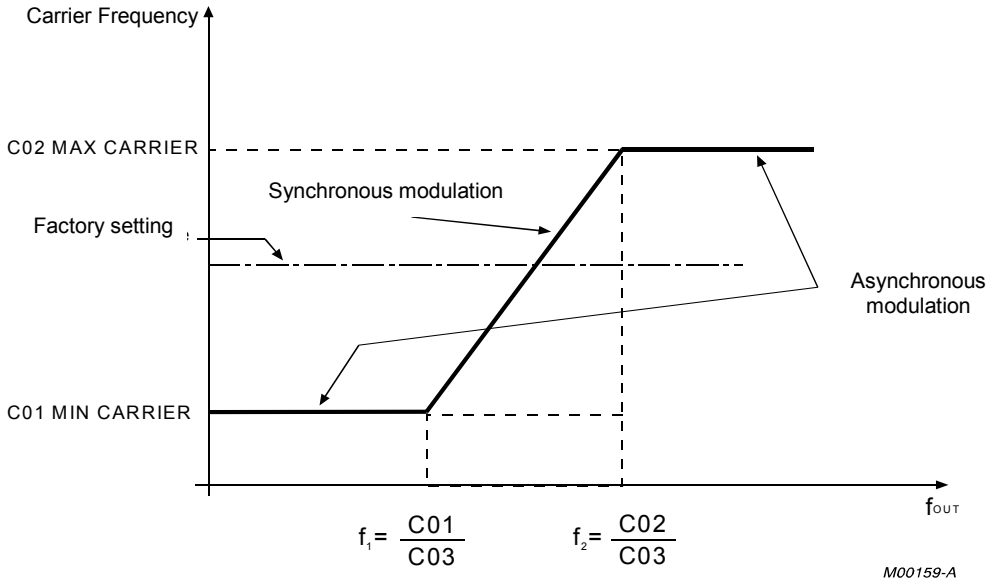


Fig. 6.3 Carrier frequency based on output frequency

- For $f_{OUT} < f_1$, carrier frequency is kept constant and equal to C01 independently on output frequency up to f_1 = C01 / C03;
- 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.

A decreasing carrier frequency improves the motor performance at low rpm but implies a 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).

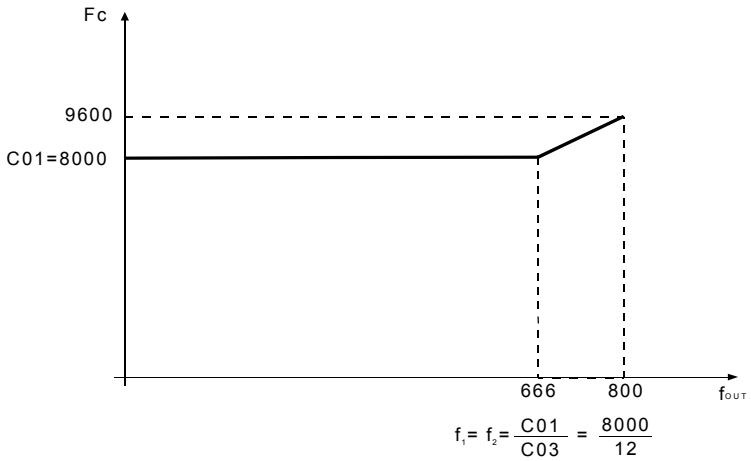


Fig. 6.4. – Carrier frequency with the recommended setup for f_{OUT} = 800 Hz.

6.6 SLIP COMPENSATION

This function allows to compensate for the decrease of the asynchronous motor speed when the mechanical load is increased (slip compensation).

The inverter calculates slip frequency based on the estimated motor torque. The following parameters are used for slip compensation:
- C74: Motor rated power (used to compute rated torque Cnom)
- 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.

Slip value is determined by the interaction of C76 and C77.

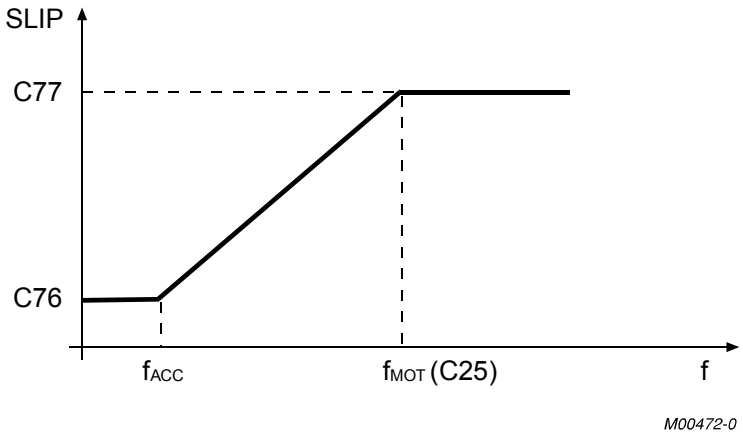


Fig.6.5 Slip compensation based on the produced frequency

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)

6.7 DC BRAKING

DC application is used to stop the connected motor. This can be automatically done 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).
DC intensity is determined by the value of C85 constant as a percentage of the motor rated current.

6.7.1 DC BRAKING AT STOP

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

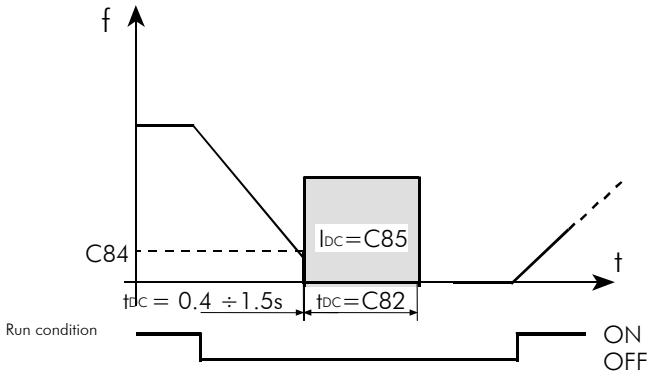


Figure 6.6 - Output frequency/speed and DC braking current when the DC BRAKING AT STOP function is enabled

Use the following parameters to set this function:
C80: Function enabling;
C82: Braking time period;
C84: Output frequency determining DC braking;
C85: 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.

SECTION 2

6.7.2 DC BRAKING AT START

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

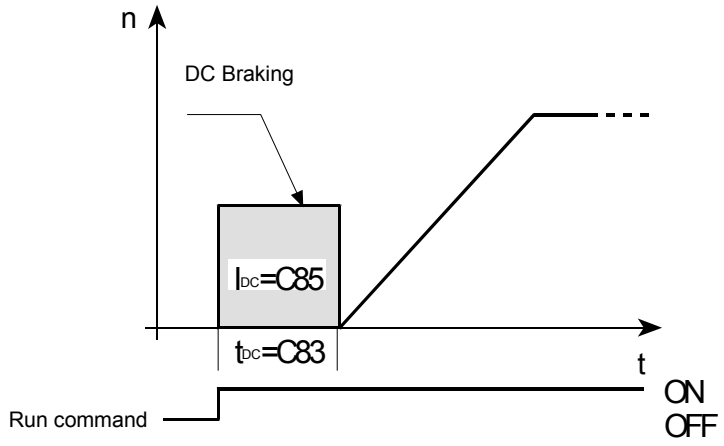


Figure 6.7 - Output frequency/speed and braking DC current when the DC BRAKING AT START function is active.

Use the following parameters to program this function:

C81: Function enabling;
C83: Braking time;
C85: Braking current intensity.

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

6.8 MOTOR THERMAL PROTECTION

MOTOR THERMAL PROTECTION

The Motor Thermal Protection function protects the motor against possible overloads. 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;
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.

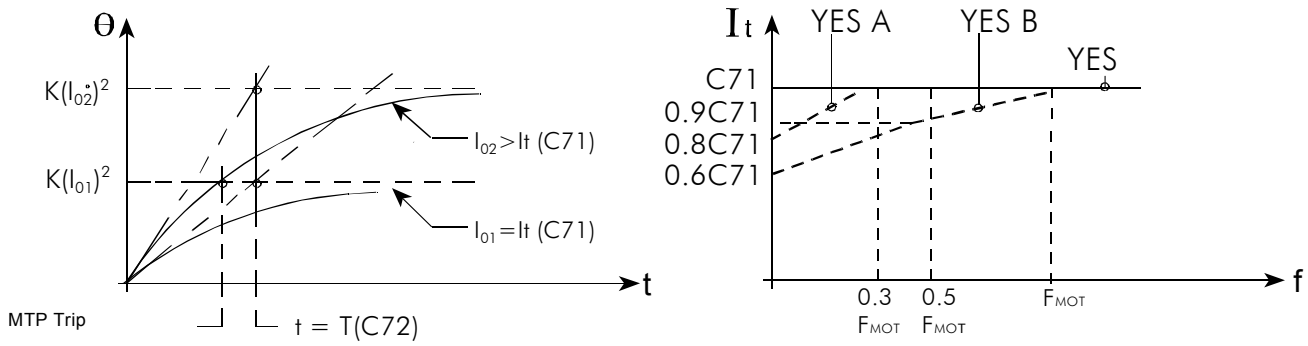


Figure 6.8 - Motor heating with two different, constant current values and pick-up current It of the motor thermal protection with respect to the frequency/speed depending on the configuration of parameter C70.

If 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:

- C70: Function enabling;
- C71: Pick-up current;
- C72: 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).

SECTION 2

7 PROGRAMMING PARAMETERS

Operating parameters and variables are included in four main menus. Main menus include a tree structure of submenus.

Submenus also include:

- access pages, allowing to access the different parameter levels (for example, access pages allow to access the submenus from the main menus);

- first page of a submenu, allowing to quit a submenu and to access the upper level of the tree structure (from within a submenu, the first page of a submenu allows to access 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;

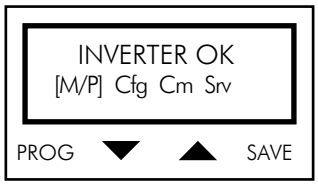
- press PROG and ↓ at a time to access directly to the first page of the submenu.

7.1 MAIN MENUS

Main menus are the following:

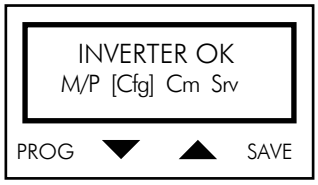
- M/P (measure/parameter): relates to the values displayed and to the parameters that can be altered when the inverter is running;
- Cfg (configuration): includes those parameters that cannot be altered when the inverter is running;
- Cm (commands): includes the pages relating to the inverter operation managed through the 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):

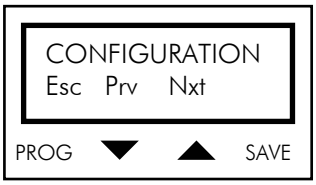


The active menu is in square brackets. Use the arrow keys (↑ and ↓) to select a different menu. Press the PROG key to access the selected menu.

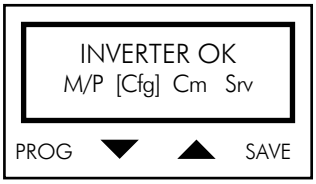
Example
Select the Cfg (configuration) menu with ↑ and ↓ ; the inverter display shows:



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



From the first page, press ↑ and ↓ to access the access pages of the different submenus. Press PROG to return to the main menu.
Press PROG from the first page of the Configuration menu to access another main menu, e.g. Measure/Parameter. The display shows:

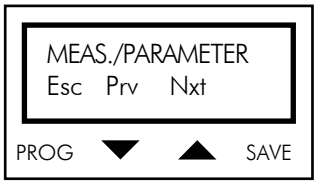


Press ↑ and ↓ to select M/P and press PROG to access the M/P menu.

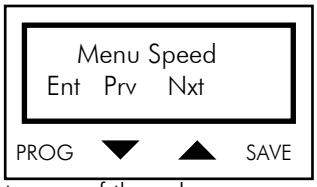
7.2 SUBMENUS

Press ↑ and ↓ 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 ↑ and ↓ to scroll through the parameters of 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 appear; press ↑ and ↓ 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 ↓); press PROG to access the submenu level.

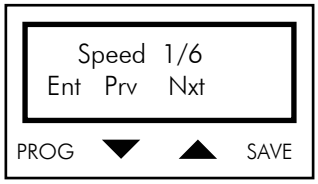
Example
Programming parameter P44 (cage rated speed).
Access the M/P menu (Measure/Parameter); the first page of the M/P menu is displayed;



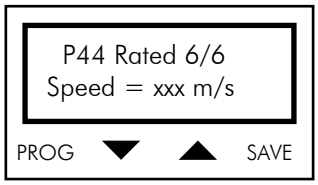
use ↑ (Nxt) and ↓ (Prv) to scroll the submenus up to the access page of the "Speed" submenu:



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



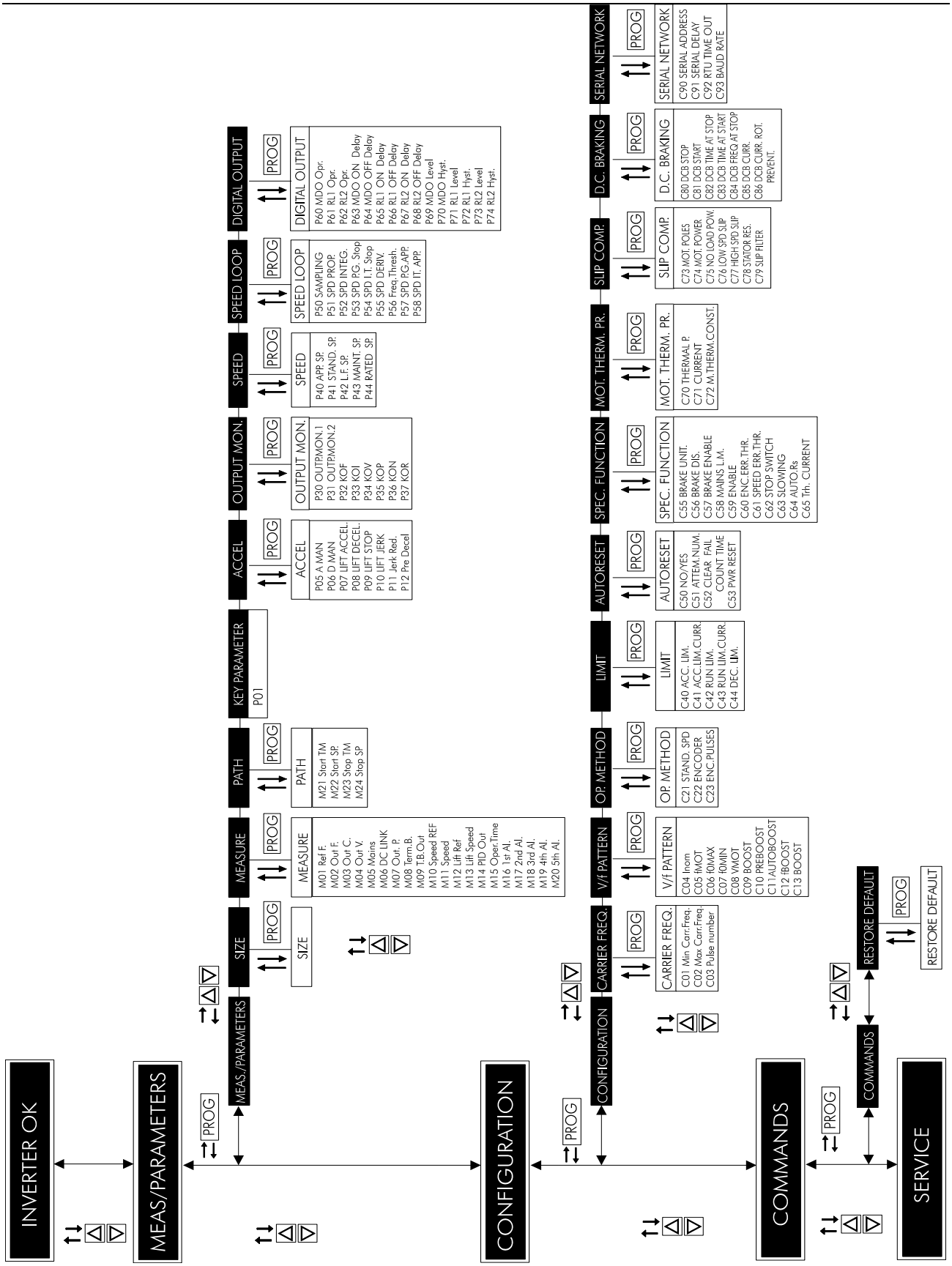
Press ↑ (Nxt) and ↓ (Prv) to scroll through the parameters up to parameter P44:



Press PROG; the flashing cursor appears and allows to alter the parameter value.
Press ↑ and ↓ 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.

7.3 MENU AND SUBMENU TREE STRUCTURE



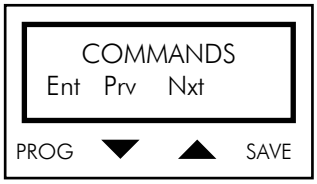
SECTION 2

8 LIST OF MENUS

8.1 COMMANDS MENU

Enables factory setting restoring (8.1.1 RESTORE DEFAULT) and the storage of all inverter parameters (8.1.2 SAVE USER'S PARAMETERS).

First page

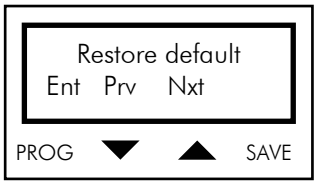


Press PROG to return to the page for the selection of the main menus; press ↑ and ↓ to scroll through the submenus.

8.1.1 RESTORE DEFAULT SUBMENU

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

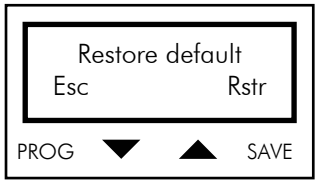
Access page



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 (MEAS/PARAMETERS, Key parameter) to 1. The inverter must not be in RUN mode.

First page

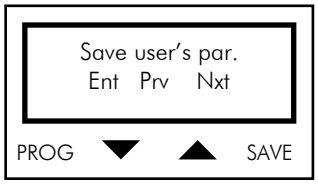


Press PROG (Esc) to quit the Restore Default submenu. Press SAVE (Rstr) for a few seconds to automatically restore the default parameters. Square brackets indicate that parameter restoration is occurring; when square brackets disappear (after a few seconds), parameter restoration is over.

8.1.2 SAVE USER'S PARAMETERS SUBMENU

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

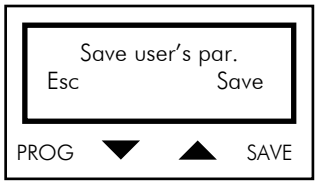
Access page



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

NOTE!! To access the Restore Default submenu, set parameter P01 (MEAS/PARAMETERS, Key parameter) to 1. The inverter must not be in RUN mode.

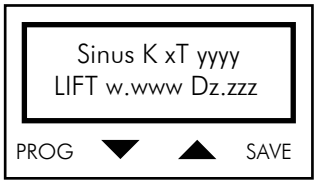
First page



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

8.2 INVERTER RATINGS

Displays the main ratings of the inverter.



Field x:	supply voltage (2=200÷240VAC, 4=380÷500VAC, 5=500÷575VAC, 6=600÷690VAC)
Field yyyy:	size (0005÷0831)
Field w.www:	FLASH software version (user interface)
Field z.zzz:	DSP software version (motor control)

IMPORTANT: 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 LIST OF SW PARAMETERS

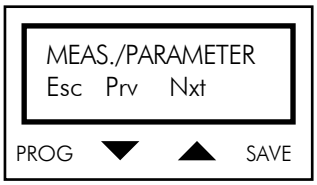
Each parameter includes the following items:

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

9.1 MEASURE/PARAMETERS MENU

The Measure/Parameter 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

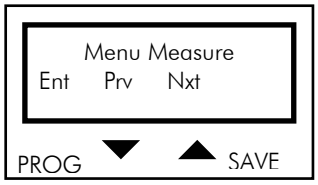


Press PROG to return to the main menu selection page; press ↑ and ↓ to scroll the submenus. All parameters are included in different submenus, except for key parameter P01 and the parameters relating to the inverter ratings. Scroll the submenus to directly access these parameters.

9.1.1 MEASURE SUBMENU

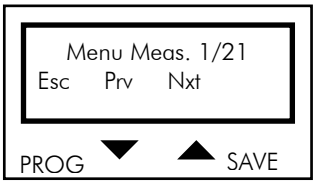
The Measure submenu contains the variables displayed when the inverter is running.

Access page



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

First page



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

PARAMETERS OF THE MEASURE 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 size
	F	Output current value.

M04 Out.volt. 5/21	P	M04
Vout=*** V	R	Depending on the inverter class
	F	Output voltage value.

M05 Mains 6/21	P	M05
Vmn=*** V	R	Depending on the inverter class
	F	Mains voltage value

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

M07 OUT. P. 8/21	P	M07
POUT=*** kW	R	Depending on the inverter size.
	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 order: 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 order: terminals 24, 27, 29). If an output is active, the number of the relevant terminal is displayed. Otherwise, "0" is displayed.

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

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

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

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

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

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

M16 1st al. 17/21	P	M16
A** ****:** h	R	A03÷A40
	F	Stores the last alarm tripped and relevant M15 value.

M17 2nd al. 18/21	P	M17
A** ****:** h	R	A03÷A40
	F	Stores the penultimate alarm tripped and relevant M15 value.

M18 3rd al. 19/21	P	M18
A** ****:** h	R	A03÷A40
	F	Stores the last-but-two alarm tripped and relevant M15 value.

M19 4th al. 20/21	P	M19
A** ****:** h	R	A03÷A40
	F	Stores the last-but-three alarm tripped and relevant M15 value

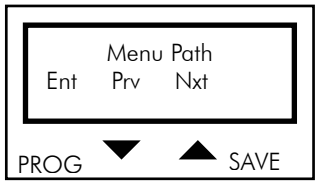
M20 5th al. 21/21	P	M20
A** ****:** h	R	A03÷A40
	F	Stores the last-but-four alarm tripped and relevant M15 value.

9.1.2 PATH SUBMENU

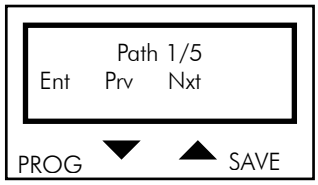
The Path submenu contains the expected start/stop distance and start/stop time intervals.

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 OF THE PATH SUBMENU

M21 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.

M22 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.

M23 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.

M24 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.

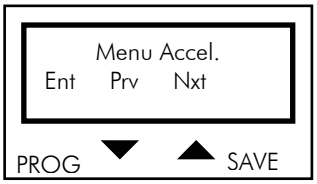
9.1.3 KEY PARAMETER

Key parameter	P	P01
P01=*	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).

9.1.4 ACCELERATION SUBMENU

The Acceleration submenu includes the quantities 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

PARAMETERS OF THE ACCELERATION SUBMENU

P05 Acceler. 2/9	P	P05
A MAN=*.**m/s^2	R	0.1÷2.55 m/s^2
	D	0.6 m/s^2
	F	ACCELERATION RAMP: Acceleration ramp in **Maintenance** 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.

SECTION 2

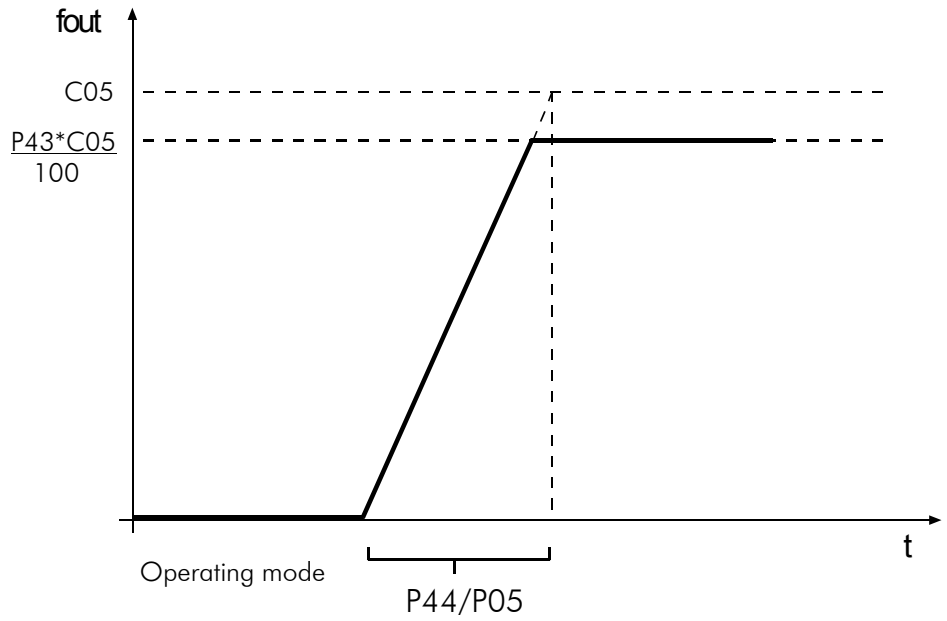


Figure 9.1
Fig.9.1 Frequency produced during the start up in maintenance mode

P06 Deceler. 3/9	P	P05
D MAN=*.**m/s^2	R	0.1÷2.55 m/s^2
	D	2.5 m/s^2
	F	DECELERATION RAMP: Deceleration ramp in **Maintenance** operating mode. 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.

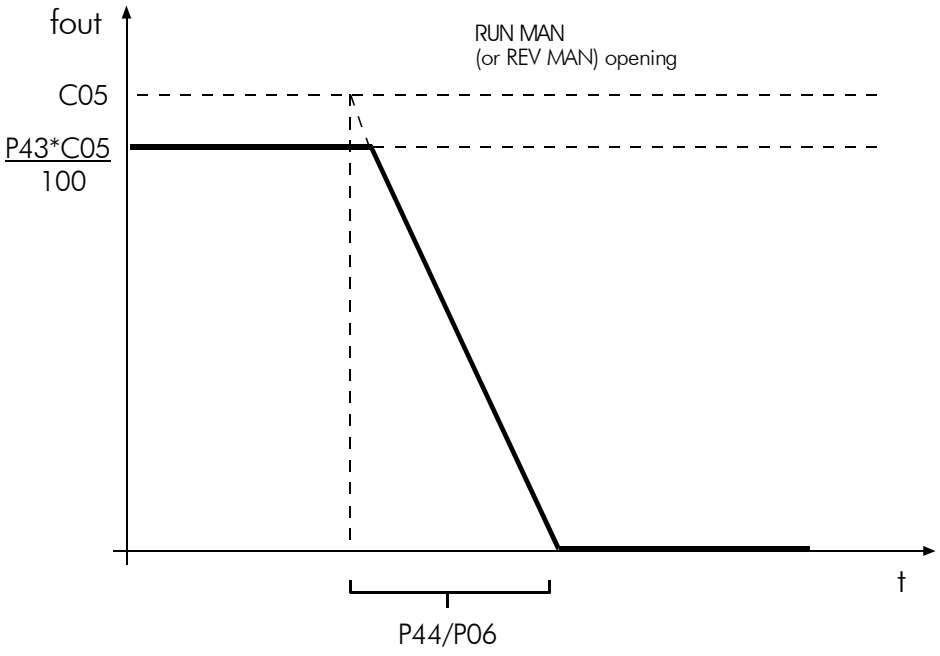


Fig.9.2 1 Frequency produced during the slowing down in maintenance mode

P07 Lift 4/9	P	P07
Accel.=*.* m/s^2	R	0.1÷ 1 m/s^2 (with no speed sensor); 0.1÷ 2 m/s^2 (with a speed sensor);
	D	0.6 m/s^2 (with no speed sensor); 1.0 m/s^2 (with a speed sensor);
	F	CAGE ACCELERATION: Acceleration in **Normal** operating mode. Max. speed of the cage 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 Jerk parameter.

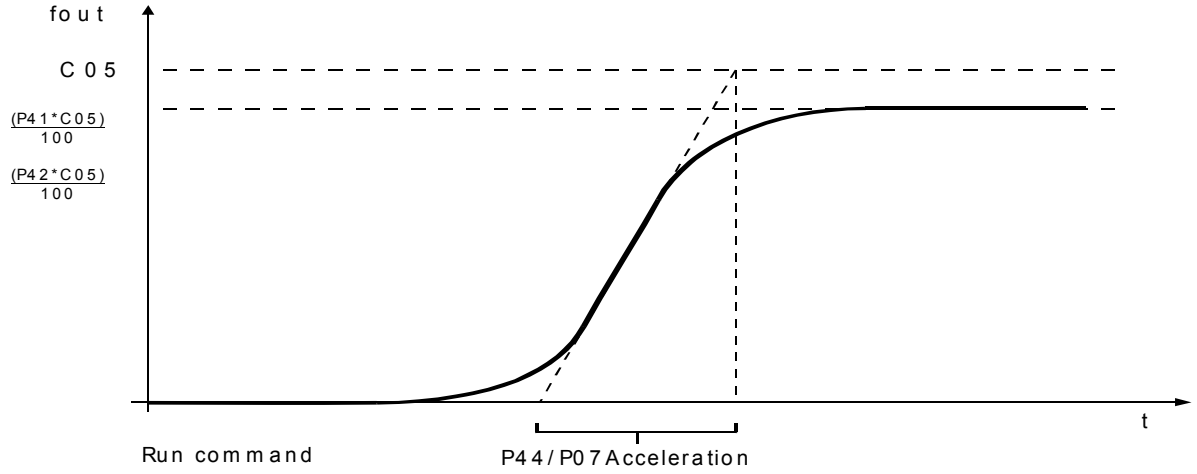


Fig.9.3 Frequency produced durino the starting up un normal operatin mode

P08 Lift 5/9	P	P08
Decel.=*.* m/s^2	R	0.1÷ 1 m/s^2 (with no speed sensor); 0.1÷ 2 m/s^2 (with a speed sensor);
	D	0.6 m/s^2 (with no speed sensor); 1.0 m/s^2 (with a speed sensor);
	F	CAGE DECELERATION: Deceleration in **Normal** 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 Jerk parameter.

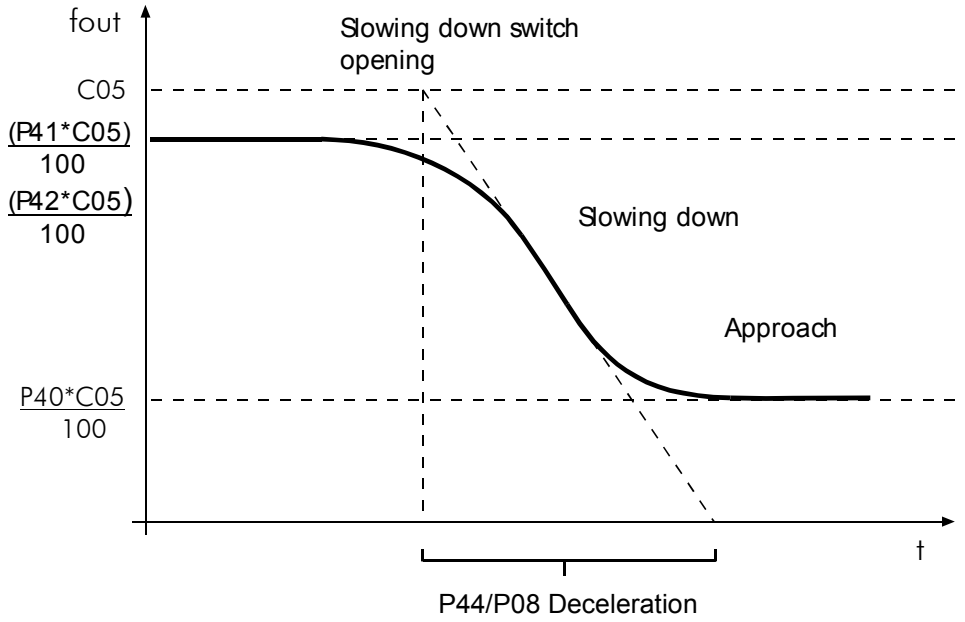


Figure 9.4 Frequency produced during the slowing down in normal operating mode

P09 Lift 6/9	P	P09
Stop=*.* m/s^2	R	0.1÷ 1 m/s^2 (with no speed sensor); 0.1÷ 2 m/s^2 (with a speed sensor);
	D	0.6 m/s^2 (with no speed sensor); 1.0 m/s^2 (with a speed sensor);
	F	CAGE STOP: Deceleration in **Normal** 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).

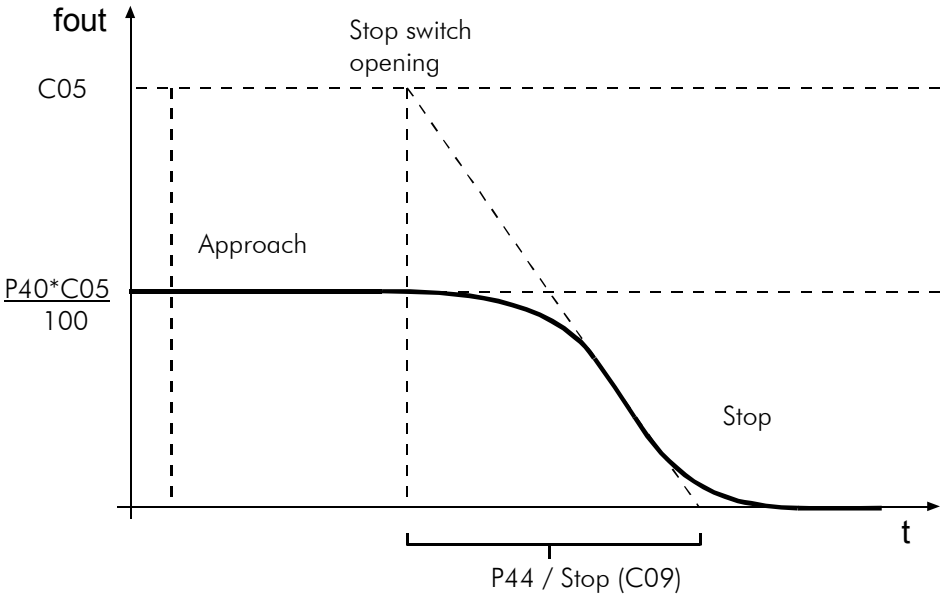


Fig.9.5 Frequency produced durino the stopping in normal operatin mode

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

P11 Jerk red. 8/9	P	P11
at st *	R	0÷5
	D	3
	F	Jerk reduction at start in normal mode raised to the second power. Real jerk at starting will be equal to: $Jerk = P10 / 2^{P11}$

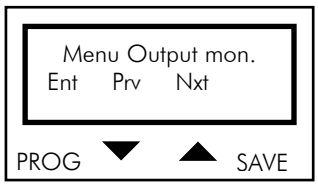
P12 Pre-decel 9/9	P	P12
Jerk *	R	-1÷5
	D	2
	F	Jerk increase for early deceleration raised to the second power. Real jerk will be equal to: $Jerk = P10 \cdot 2^{P12}$

SECTION 2

9.1.5 OUTPUT MONITOR SUBMENU

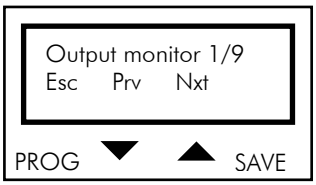
The Output Monitor submenu determines the quantities for multifunction digital inputs (terminals 17, 18).

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 OF THE OUTPUT MONITOR SUBMENU

P30 Output 2/9	P	P30
Monitor 1 ***	R	Fref, Fout, Iout, Vout, Pout, Fout_r, Nout, PID 0, PID F.B.
	D	Fout
	F	Selects the quantity 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 motor rated frequency), PID F.B. (motor speed read by the encoder and expressed as a percentage of the motor rated speed).

P31 Output 3/9	P	P31
Monitor 2 ****	R	Fref, Fout, Iout, Vout, Pout, Fout_r, Nout, PID 0, PID F.B.
	D	Iout
	F	Selects the quantity 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 motor rated frequency), PID F.B. (motor speed read by the encoder and expressed as a percentage of the motor rated speed).
P32 Out. mon. 4/9	P	P32
KOF = *** Hz/V	R	1.5÷100 Hz/V
	D	10 Hz/V
	F	Ratio between output voltage at terminals 17-18 and output frequency, and ratio between output voltage at terminals 17-18 and frequency reference.

P33 Out. mon. 5/9	P	P33
KOI = *** A/V	R	Depending on the inverter size.
	D	Depending on the inverter size.
	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 size.
	D	Depending on the inverter size.
	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!!

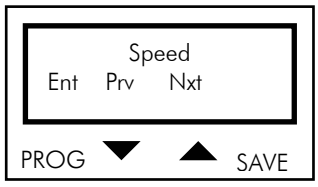
That speed value is given by the product between output frequency Fout multiplied by constant 60 x 2 / C58 (Poles in the Special function submenu) without considering the motor slip.

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.

9.1.6 SPEED SUBMENU

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

Access page



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

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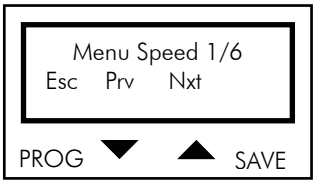


Press PROG to quit the Output Monitor submenu. Press ↑ and ↓ to scroll through the parameters.

PARAMETERS OF THE SPEED SUBMENU

P40 Approach 2/6	P	P40
Speed = ***%	R	1%÷120%
	D	10
	F	APPROACH SPEED: 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, 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, cage speed, expressed as a percentage of rated speed P44 when moving among low 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: Cage rated speed when the motor rotates at rated synchronous speed. $\frac{fmot(C05)*60}{pole-pairs(C72)}$

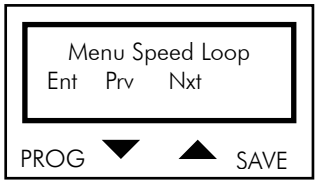
CAUTION!! Whenever parameter C22 "ENCODER" programming is changed from Yes to No and viceversa, parameters P07, P08, P09, P10, P42, P43, P44 are automatically restored to their default values as for C22 programming (with or without an encoder). First program C22, then alter the other parameter values.

9.1.7 SPEED LOOP SUBMENU

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

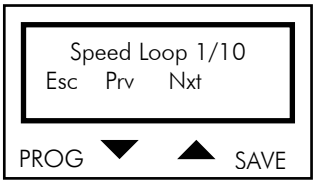
NOTE!! Parameters of the Speed Loop submenu are activated only if a speed sensor is provided.

Access page



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

First page



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

PARAMETERS OF THE SPEED LOOP SUBMENU

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

P51 SPD Prop. 3/10	P	P51
Gain = ***	R	0÷31.999
	D	0.35
	F	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.

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

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. Ponendo Integr. 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.

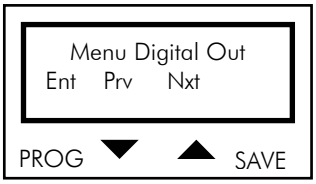
P56 Freq. 8/10	P	P56
Thresh. = *** Hz	R	0÷800 Hz for S05÷S30 0÷120 Hz for S40÷S70
	D	10 Hz
	F	Inverter output frequency determining the activation of PID regulator integral term.

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.

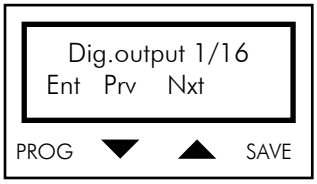
P58 I.T.APP 10/10	P	P58
Stop = ****Tc	R	3÷1024 Tc; NONE
	D	200 Tc
	F	Constant dividing PID regulator integral term used during the approach stage. Set Integr. Time = NONE (value following 1024) to override integral action Time = NONE (value following 1024) to override integral action.

9.1.8 DIGITAL OUTPUT SUBMENU

The Digital Output submenu determines the parameters relating to digital outputs.
Access page



Press PROG to enter the Digital Output submenu. Press ↑ and ↓ to scroll through the other submenus.
First page



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

PARAMETERS OF THE DIGITAL OUTPUT 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
	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 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; speed reference at the inverter input is higher than the one set with P69 (see Fig. 9.6). Frequency Level: active output; the inverter is generating a higher frequency than the one set with P69, independently of the motor direction of rotation (see Fig. 9.7). Forward Running: active output; the inverter is generating a higher frequency than the one set with P69 (positive reference; see Fig. 9.7). Reverse Running: active output; the inverter is generating a higher frequency than the one set with P69 (negative reference; see Fig. 9.7). 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 Fig. 9.8). Current Level: active output; the inverter output current exceeds the value set with P69 "MDO Level" (see Fig. 9.9). Limiting: active output; inverter in limiting stage. Motor limiting: active output; the inverter is limited by the motor.

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	Generator lim.: active output; limit during regeneration stage. Frequency Level2: like Frequency Level, but with a hysteresis in the reversed deactivation level, thus allowing to unlock the electromechanical brake at a lower frequency than the brake locking frequency (see Fig. 9.10). 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 motor rated 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 Frequency Level operation.

NOTE!! Select "INV OK OFF" to activate a digital output in the case of 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 Idl. Freq. Level operating mode. If C81 is not set to Yes, operation in Idl Frq. 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
	D	Inv. O.K. ON
	F	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: 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 note at the end of the description of parameter P61). Inv run trip: active output if inverter in emergency mode due to a protection trip. Reference Level: active output; speed reference at the inverter input is higher than the one set with P71 (see Fig. 9.6). Frequency Level: active output; the inverter is generating a higher frequency than the one set with P71, independently of the motor direction of rotation (see Fig. 9.7). Forward Running: active output; the inverter is generating a higher frequency than the one set with P71 (positive reference; see Fig. 9.7). Reverse Running: active output; the inverter is generating a higher frequency than the one set with P71 (negative reference; see Fig. 9.7). 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 Fig. 9.8). Current Level: active output; the inverter output current exceeds the value set with P71 "RL1 Level" (see Fig. 9.9). Limiting: active output; inverter in limiting stage. Motor limiting: active output; the inverter is limited by the motor. Generator lim.: active output; limit during regeneration stage. Frequency Level2: like Frequency Level, but with a hysteresis in the reversed deactivation level, thus allowing to unlock the electromechanical brake at a lower frequency than the brake locking frequency (see Fig. 9.10). Thermal protection: inactive output with motor thermal protection trip. Power Level: active output if the generated power is lower than the one given by the nominal power of the motor 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 Frequency Level operation.

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

NOTE!! Select "INV OK OFF" to activate a digital output in the case of 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!! Set C81=YES to enable Idl. Freq. Level operating mode. If C81 is not set to Yes, operation in Idl Frq. Level mode is the same as Frequency level.

P62 RL2 opr. 4/16	P	P62
***	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
	D	Frequency level (used to control the electromechanical brake)
	F	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: 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 note at the end of the description of parameter P62). Inv run trip: active output if inverter in emergency mode due to a protection trip. Reference Level: active output; speed reference at the inverter input is higher than the one set with P73 (see Fig. 9.6). Frequency Level: active output; the inverter is generating a higher frequency than the one set with P73, independently of the motor direction of rotation (see Fig. 9.7). Forward Running: active output; the inverter is generating a higher frequency than the one set with P73 (positive reference; see Fig. 9.7). Reverse Running: active output; the inverter is generating a higher frequency than the one set with P73 (negative reference; see Fig. 9.7). 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" (see Fig. 9.8). Current Level: active output; the inverter output current exceeds the value set with P73 "RL2 Level" (see Fig. 9.9). Limiting: active output; inverter in limiting stage. Motor limiting: active output; the inverter is limited by the motor. Generator lim.: active output; limit during regeneration stage. Frequency Level2: like Frequency Level, but with a hysteresis in the reversed deactivation level, thus allowing to unlock the electromechanical brake at a lower frequency than the brake locking frequency (see Fig. 9.10). 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 motor rated 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 Frequency Level operation.

NOTE!! Select "INV O.K. OFF" to activate a digital output in the case of 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 Idl. Freq. Level operating mode. If C81 is not set to Yes, operation in Idl Frq. Level mode is the same as Frequency level.

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

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

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

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

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

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

P69 MDO 11/16	P	P69
Level = ***.* %	R	0.0÷200.0%
	D	0.0%
	F	Determines the value for the activation of Open collector digital output for the following settings: “Reference level”, “Frequency level”, “Frequency level2”, “Forward Running”, “Reverse Running”, “Current level”, “Fout O.K.”.

P70 MDO. Fr. 12/16	P	P70
hyst. = ***.* %	R	0.0÷200.0%
	D	0.0%
	F	When 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 quantity 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 preset maximum output frequency is reached and deactivates when 40% is reached). If P70 = 0, commutation occurs when the value set in P69 is reached.

P71 RL1 13/16	P	P71
Level = ***.* %	R	0.0 ÷200.0%
	D	0.0 %
	F	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.".

P72 RL1 14/16	P	P72
hyst. = ***.* %	R	0.0÷200.0%
	D	0.0 %
	F	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 quantity 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 preset maximum output frequency is reached and deactivates when 40% is reached). If P72 = 0, commutation occurs when the value set in P71 is reached.

P73 RL2 15/16	P	P73
level = ***.* %	R	0 ÷200%
	D	0.2 %
	F	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.". (Level enabling brake unlocking)

P74 RL2 16/16	P	P74
hyst. = *.*** %	R	0÷200%
	D	0.1 %
	F	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 quantity 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 preset maximum output frequency is reached and deactivates when 40% is reached). If P74 = 0, commutation occurs when the value set in P73 is reached. (Hysteresis disabling brake unlocking)

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

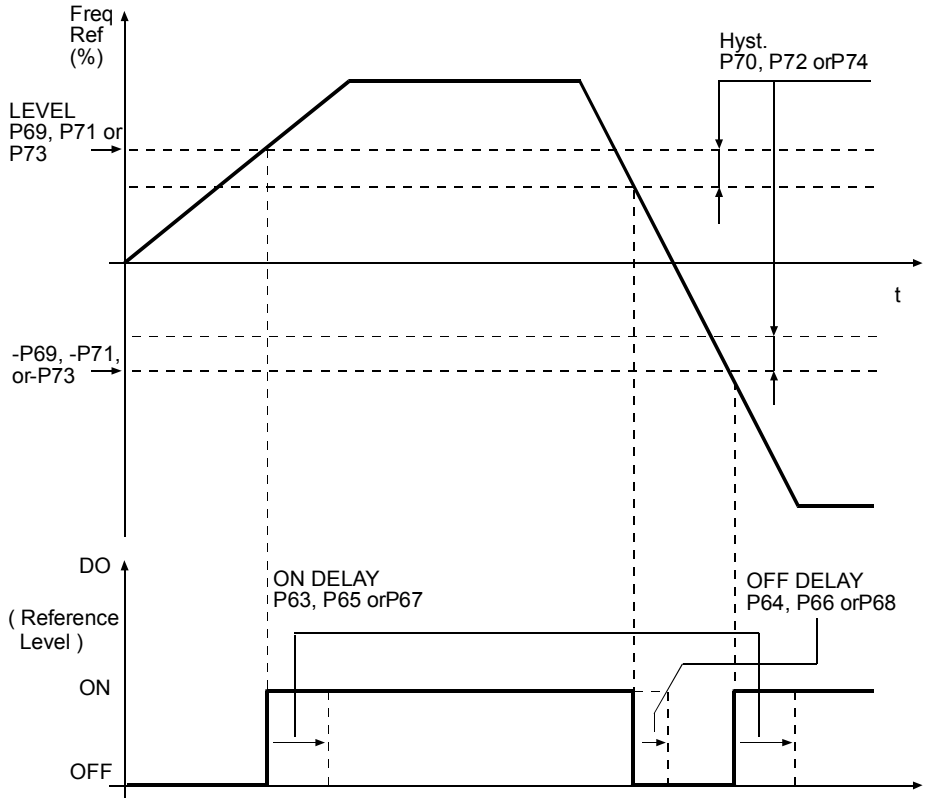


Figure 9.6 Characteristics of a digital output programmed as “Reference level” and characteristics of the frequency reference with respect to time. Parameters used: P63 “MDO ON delay”, P64 “MDO OFF delay”, P65 “RL1 ON delay”, P66 “RL1 OFF delay”, P67 “RL2 ON delay”, P68 “RL2 OFF delay”, P69 “MDO level”, P70 “MDO Hyst”, P71 “RL1 level”, P72 “RL1 Hyst.”, P73 “RL2 level”, P74 “RL2 Hyst.”.

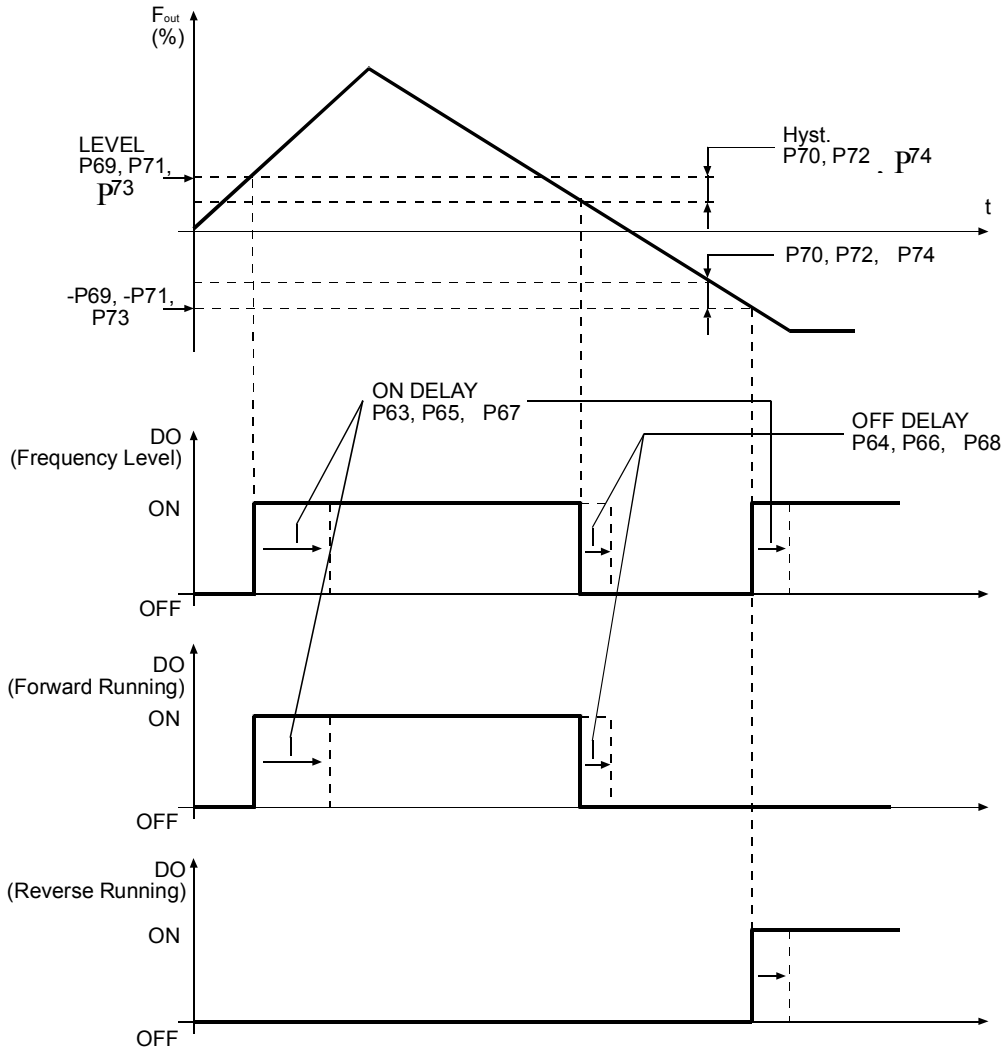


Figure 9.7 Characteristics of a digital output programmed as "Frequency level", as "Forward Running", and as "Reverse Running" of the output frequency with respect to time. A negative output frequency reverses the direction of rotation. Parameters used: P63 "MDO ON delay", P64 "MDO OFF delay", P65 "RL1 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.".

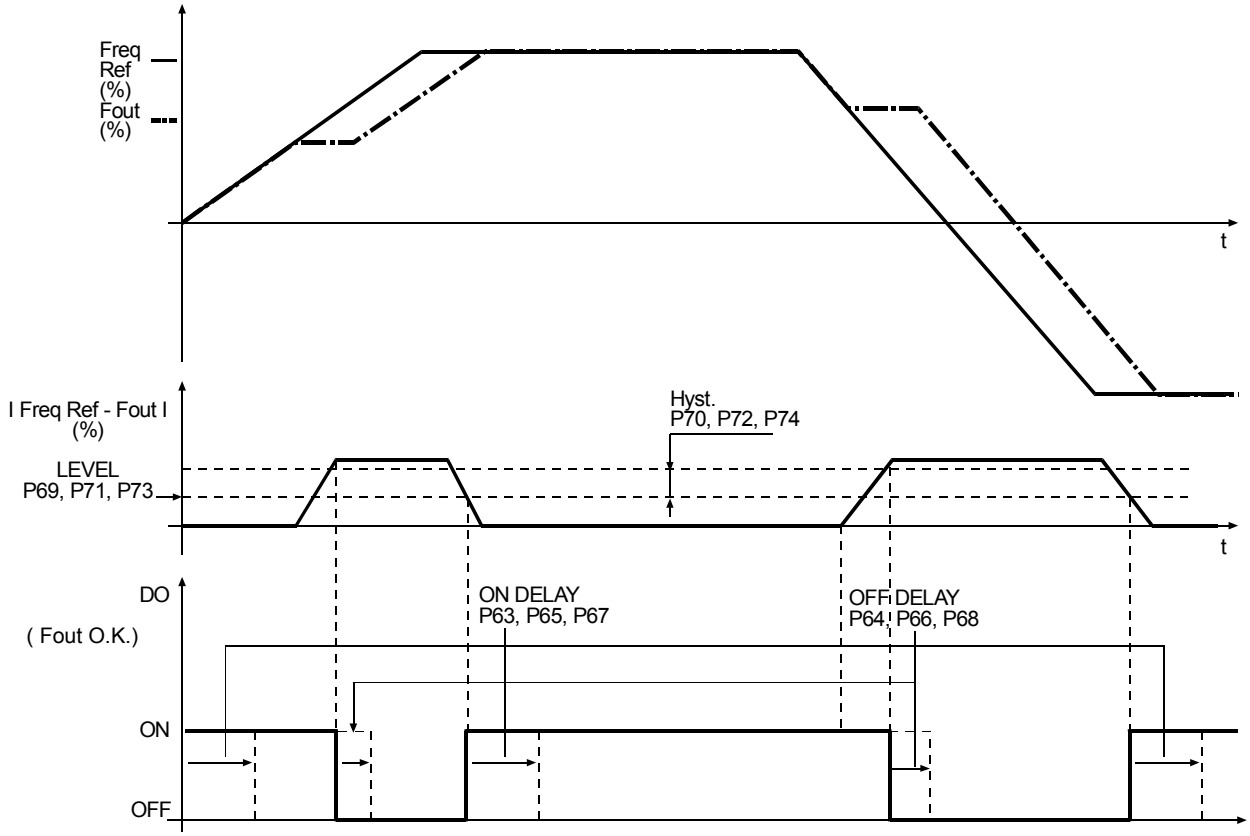


Figure 9.8 Characteristics of a digital output programmed as "Fout O.K.", characteristics of the frequency reference, characteristics of the output frequency, and characteristics of the difference between reference and output frequency with respect to time.
Parameters used: P63 "MDO ON delay", P64 "MDO 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.".

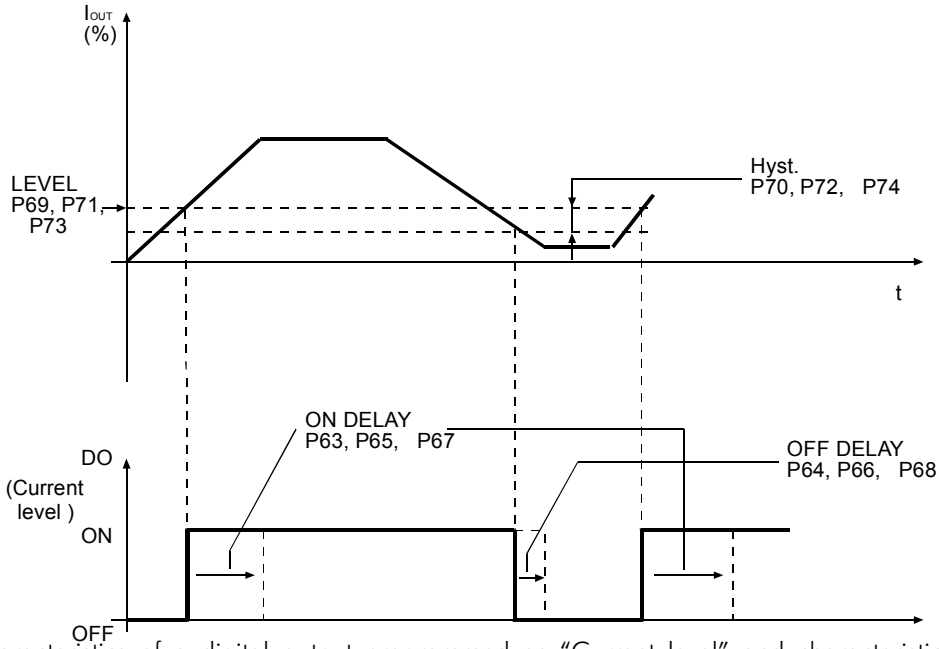


Figure 9.9 Characteristics of a digital output programmed as "Current level" and characteristics of the output frequency with respect to time. Parameters used: P63 "MDO ON delay", P64 "MDO OFF delay", P65 "RL1 ON delay", P66 "RL1 OFF delay", P67 "RL2 ON delay", P68 "RL2 OFF delay", P69 "MDO level", P70 "MDO Hyst", P71 "RL1 level", P72 "RL1 Hyst.", P73 "RL2 level", P74 "RL2 Hyst.".

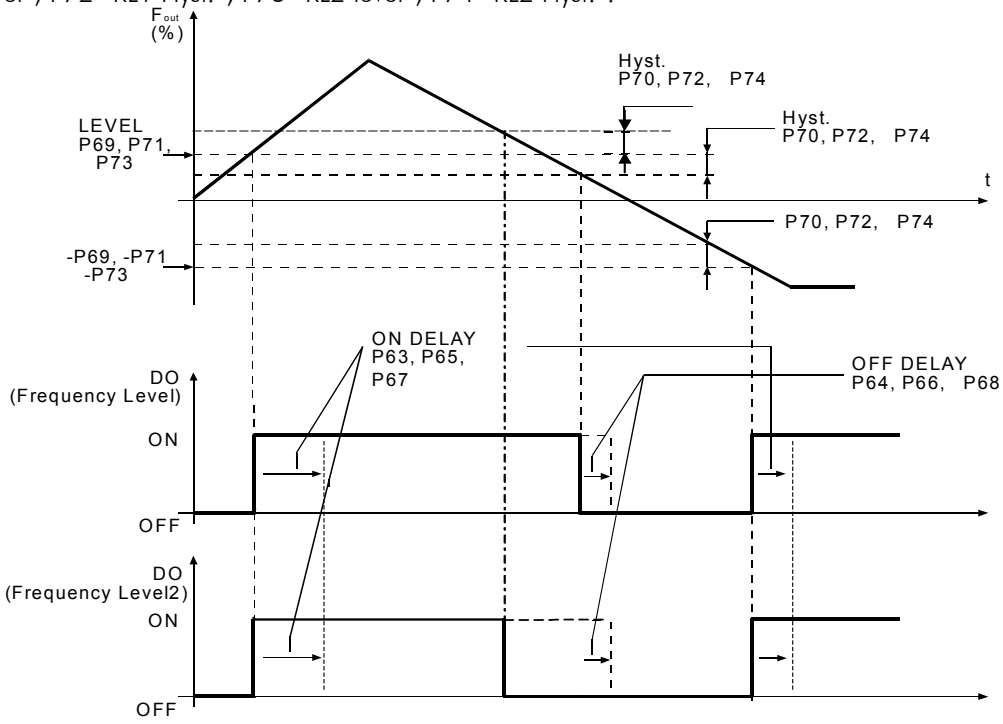


Figure 9.10 Characteristics of a digital output programmed as "Frequency level" compared to "Frequency Level2" programming with respect to output frequency variation in time. A negative output frequency reverses the direction of rotation. For "Frequency Level2", the digital output deactivates at a frequency level higher than the freq. level for the activation of the quantity 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.".

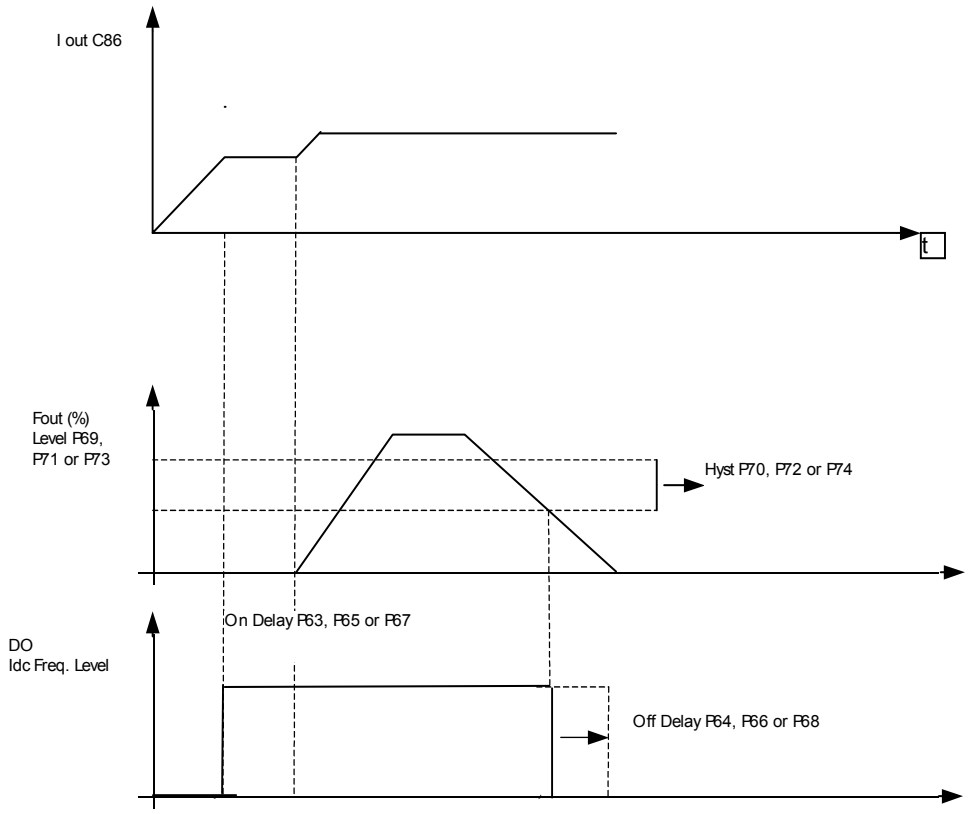
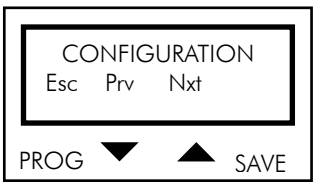


Figure 9.11 Characteristics of a digital output programmed as "IDL Freq.Level" with respect to output current variations and output frequency variations in time.
Parameters used: P63 "MDO ON DELAY", P64 "MDO OFF DELAY", P65 "RL1 on delay", "RL1 ON DELAY", P68 "OFF DELAY", P69 "MDO LEVEL", P70"MDO HYST, P71"RL1 LEVEL", P72 "RL1 HYST", P73 "RL2 LEVEL" P74 RL2 HYST", C86"DCB Start CURR".

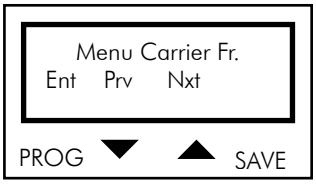
9.2 CONFIGURATION MENU



9.2.1 CARRIER FREQUENCY SUBMENU

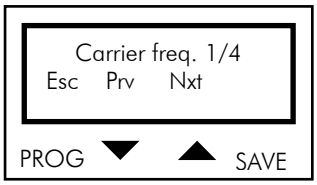
The Carrier Frequency submenu determines the frequency for PWM modulation generated by the inverter.

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 OF 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 (T5, section 9.3.)
	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 (T5, section 9.3.)
	D	Column "Carrier def" in configuration table for LIFT SW parameters (T5, section 9.3.)
	F	Maximum value of PWM modulation frequency.

C03 Pulse 4/5	P	C03
number **	R	12, 24, 48, 96, 192, 384
	D	24
	F	Number of pulses generated by PWM modulation when switching from the minimum frequency of PWM modulation freq. to the maximum frequency of PWM modulation.

SECTION 2

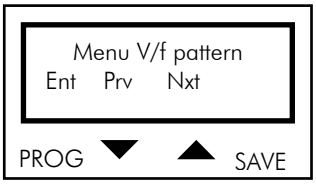
NOTE!!: An increase in carrier frequency determines an increase in the inverter leakage. The carrier increase with respect to the default value may cause the inverter protection to trip. Carrier should be increased in the following cases only: uneven operation, output current lower than rated current,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

NOTE!!: See section 6.5 for more details (Carrier Frequency).

9.2.2 V/F PATTERN SUBMENU

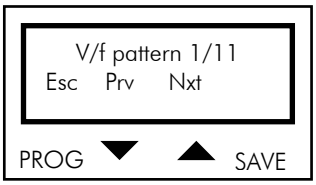
The V/f pattern submenu determines the V/f characteristic for the inverter operation. For more details, see section 2.4 (Voltage/Frequency Pattern).

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 OF THE V/F PATTERN SUBMENU

C04 V/f patt. 2/11	P	C04
I mot. = *** A	R	1°÷Column "Inom" in configuration table for LIFT SW parameters (T5, section 9.3).
	D	Column "Imot" in configuration table for LIFT SW parameters (T5, section 9.3).
	F	Rated current of the connected motor.

C05 V/f patt. 3/11	P	C05
Fmot = *** Hz	R	12.6÷800 Hz for S05÷S30
	R	12.6÷120 Hz for S40÷S70
	D	50 Hz
	F	Motor rated frequency relating to the v/f pattern. Determines switching from the inverter operation at constant V/f to the inverter operation at constant V.

C06 V/f patt. 4/11	P	C06
Fomax = *** Hz	R	3.5÷800 Hz for S05÷S30
	R	3.5÷120 Hz for S40÷S70
	D	60 Hz
	F	Maximum output current relating to the voltage/frequency pattern. Inverter output frequency at maximum reference value.

SECTION 2

C07 V/f patt. 5/11	P	C07
Fomin = *** Hz	R	0.1÷5Hz
	D	0.1 Hz
	F	Minimum output frequency relating to the V/f pattern. Minimum frequency generated at the inverter output (can be altered only after contacting Elettronica Santerno).

C08 V/f patt. 6/11	P	C08
Vmot = *** V	R	5÷500V (class 2T, 4T)
	R	5÷690V (class 5T, 6T)
	D	230V for class 2T. 400V for class 4T. 575V for class 5T 690V for class 6T
	F	Motor rated frequency relating to the V/f pattern. Determines output voltage at motor rated frequency.

C09 V/f patt. 7/11	P	C09
BOOST = *** %	R	-100% ÷ +400%
	D	50 %
	F	Torque compensation at low rpm. Determines output voltage increment at low output frequency with respect to a constant V/f ratio.

C10 V/f patt. 8/11	P	C10
PREBOOST = *.* %	R	0.0÷5.0%
	D	2.5% for S05÷S30 0.5% for S40÷S70
	F	Torque compensation at low rpm. Determines output voltage at 0Hz.

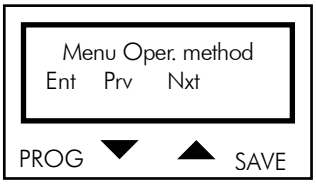
C11 V/f patt. 9/11	P	C11
Auto bst = *** %	R	0.0÷10.0%
	D	2.5 %
	F	AUTOBOOST: variable torque compensation expressed as a percentage of the motor rated voltage (C08). The value set for C11 represents the voltage increment when the motor runs with the rated torque.

C12 V/f patt. 10/11	P	C12
Freqbst = *** %	R	0÷100 %
	D	50%
	F	FREQ.BOOST: Frequency (expressed as a percentage of C05) for which increment voltage is equal to the value set in C13.
C13 V/f patt. 11/11	P	C09
B. mf = *** %	R	-100% ÷ +400%
	D	3 %
	F	Couple 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

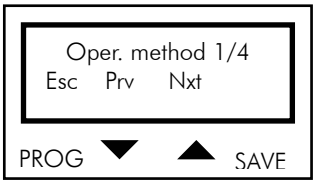
The Operation Method submenu determines the inverter control mode and the speed sensor ratings.

First 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 OF THE OPERATION METHOD SUBMENU

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

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

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

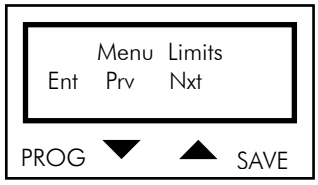
CAUTION!! Whenever C22 is set from YES to NO and viceversa, parameters P07, P08, P09, P10, P42, P43, P44 are automatically restored to their default value relating to C22 programming (encoder installed or not installed). Parameter C22 is always to be programmed first. Before starting the motor, always 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.

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

9.2.4 LIMITS SUBMENU

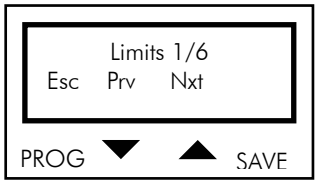
The Limits submenu determines current limit operation while accelerating and at constant frequency, and determines the voltage limit operation while decelerating.

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 OF THE LIMITS SUBMENU

C40 Acc. Lim. 2/6	P	C40
NO [YES]	R	NO, YES
	D	YES
	F	Enables current limit while accelerating.

C41 Acc. Lim. 3/6	P	C41
Curr.= *** %	R	50÷400% Important: the maximum programmable value is equal to (Imax/Imot)*100. See configuration table for LIFT SW parameters (T5, section 9.3).
	D	Column C41 Default in configuration table for LIFT SW parameters (T5, section 9.3).
	F	Current limit while accelerating expressed as a percentage of the motor rated current.

C42 Run. Lim. 4/6	P	C42
No [YES]	R	NO, YES
	D	YES
	F	Enables current limit at constant frequency.

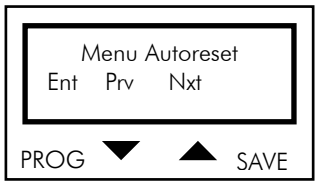
C43 Run. Lim. 5/6	P	C43
Curr.= *** %	R	50÷400% Important: the maximum programmable value is equal to (Imax/Imot)*100. See configuration table for LIFT SW parameters (T5, section 9.3).
	D	Column C41 Default in configuration table for LIFT SW parameters (T5, section 9.3).
	F	Current limit while accelerating expressed as a percentage of the motor rated current.

C44 Dec. Lim. 6/6	P	C44
NO [YES]	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.

9.2.5 AUTORESET SUBMENU

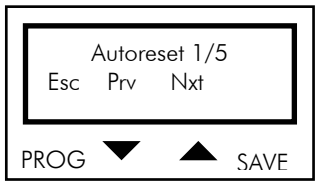
The Autoreset submenu enables the automatic reset of the equipment in case of alarms. Autoreset attempts may be set in a given time interval.

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 OF THE AUTORESET SUBMENU

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

C51 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.
C52 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.

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

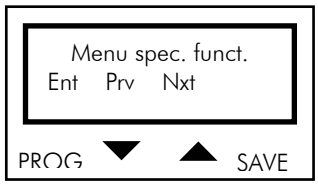
SECTION 2

9.2.6 SPECIAL FUNCTION SUBMENU

The Special Function submenu includes the following:

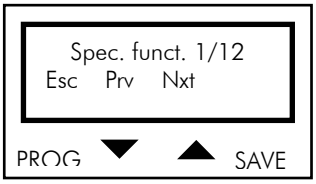
- storage of mains failure alarm if mains failure causes the equipment power off;
- operating mode of built-in braking module (if any);
- operating mode of the ENABLE command;
- page displayed at power on.

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 OF THE SPECIAL FUNCTION SUBMENU

C55 Brake U. 2/12	P	C55
[NO] YES	R	YES, NO
	D	YES
	F	Braking module enabling or disabling (built-in or external braking module).

C56 Brake 3/12	P	C56
Disab. = *****ms	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. 4/12	P	C57
Enable =*****ms	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).

NOTE!! Use the external braking module for applications requiring higher levels than the levels allowed by parameters C56 and C57 and by the inverter model (see section 4.1 "BRAKING RESISTORS" in the Installation manual).

DANGER!! Do not exceed values stated in section 4.1 "BRAKING RESISTORS" in the Installation Manual for the programming of C56 and C57.

C58 Mains l.m. 5/12	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 6/12	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 terminals 6 is closed and a speed reference other than 0 is sent, that starts the equipment, the motor starts at power on or after a few seconds a RESET command is sent. 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" (see Section 1).

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

C60 Encoder 7/12	P	C60
err.thr = ***%	R	0÷100%
	D	0%
	F	Maximum ratio of the difference between expected speed and measured speed for Encoder failure alarm (A15) trip. Set C60 = 0 to disable alarm A15.

C61 Speed 8/12	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 9/12	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.

C63 Slowing 10/12	P	C63
Down d.	R	0÷4000 ms
	D	0 ms
	F	Acquisition delay of slowing-down command.

C64 Auto.Rs. 11/12	P	C64
	R	No ; Yes
	D	[Yes]
	F	Enables stator resistance autotuning. Stator resistance autotuning is performed whenever DC braking occurs.

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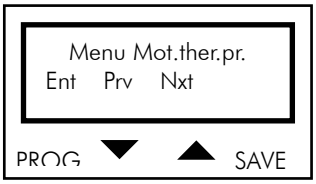
C65 Current 12/12	P	C65
Thr. = *** %	R	0÷100%
	D	0
	F	Voltage limit to start the C24 allarm when one digital output divres the brake. The value 0 enables the allarm.

9.2.7 MOTOR THERMAL PROTECTION

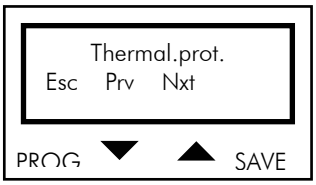
The Motor Thermal Protection submenu determines the parameters relating to the software thermal protection of the motor. See section 2.8 "MOTOR THERMAL PROTECTION" for more details.

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 OF THE MOTOR THERMAL PROTECTION SUBMENU

C70 Thermal p.2/4	P	C70
***	R	NO, YES, YES A, YES B
	D	NO
	F	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.

C71 Motor 3/4	P	C71
current =****%	R	1% ÷120%
	D	105%
	F	Determines the pick-up current expressed as a percentage of the motor rated current.

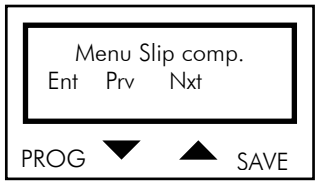
C72 M. Therm.4/4	P	C72
const. =****s	R	5÷3600s
	D	600s
	F	Determines the motor thermal time constant.

SECTION 2

9.2.8 SLIP COMPENSATION SUBMENU

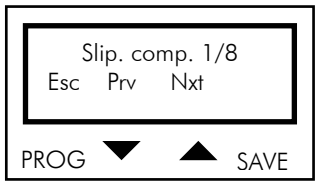
The Slip Compensation submenu determines the parameters relating to the slip compensation function. For more details, see section 2.6 "SLIP COMPENSATION".

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 OF THE SLIP COMPENSATION SUBMENU

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

C74 Motor 3/8	P	C74
Power =****kW	R	0 ÷ 400 kW
	D	Colonna Pnom in Table T5, section 9.3.
	F	Motor Power: motor rated power. Determines the rated torque in conjunction with the rated frequency (C05).

C75 No Load 4/8	P	C75
Power =**.*kW	R	0÷400 kW
	D	0.0kW
	F	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.

C76 Low speed 5/8	P	C76
slip = ***%	R	0÷17.5%
	D	0%
	F	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)).

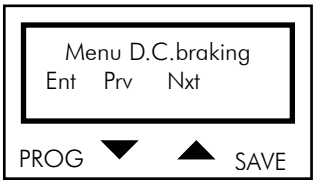
C78 Stator 7/8	P	C78
Res =*.*Ohm	R	0÷8.5 Ω
	D	See C78 in config. table for LIFT SW parameters (T5, section 9.3).
	F	Stator resistance: stator phase resistance (may vary during autotuning).

C79 Slip 8/8	P	C79
filter =***	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

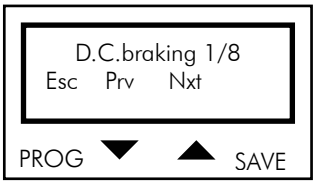
The D.C. Braking submenu includes the parameters relating to direct current braking. For more details, see section 2.7 “DIRECT CURRENT BRAKING”.

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 OF THE D.C. BRAKING SUBMENU

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

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

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

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

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

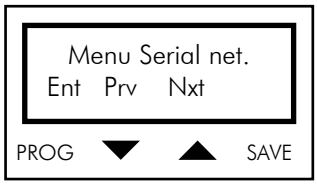
C85 DCB Curr. 7/9	P	C85
Idcb =***%	R	1÷400% Important: the maximum programmable value is equal to (Imax/Imot)*100 (see Table T5, section 9.3).
	D	140%
	F	Determines DC braking intensity expressed as a percentage of the motor rated current.

C86 DCB START 8/9	P	C87
Curr= MAX%	R	0÷400% Important: the maximum programmable value is equal to (Imax/Imot)*100 (see Table T5, section 9.3).
	D	140%
	F	Determines the intensity of DC braking at start expressed as a percentage of the motor rated current.

C87 DCB Curr. 9/9	P	C86
Rot.prevent. ***	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 different from zero.

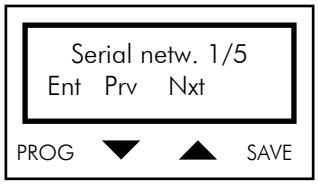
9.2.10 SERIAL NETWORK SUBMENU

The Serial Network submenu determines the parameters relating to the serial link.
Access page



Press PROG to enter the 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 other pages of the submenu.

PARAMETERS OF THE SERIAL NETWORK SUBMENU

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

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

C92 RTU Time 4/5	P	C93
Out= *** ms	R	0÷2000 ms
	D	0 ms
	F	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.

C93 Baud Rate 5/5	P	C92
Rate= *** baud	R	1200, 2400, 4800, 9600 baud
	D	9600 baud
	F	Sets the baud rate expressed in bits per second.

9.3 CONFIGURATION TABLE FOR LIFT SW PARAMETERS

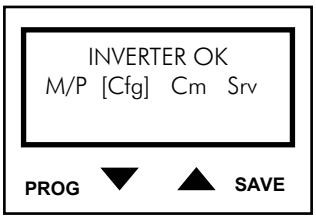
GRANDEZZA	MODELLO	Imot [A]	Inom [A]	Imax [A]	Carrier def [kHz]	Carrier max [kHz]	C74 def 4T [kW]	C74 def 2T [kW]	C41/43 def [%]	C78 def [%]
S05	0005	6,5	10,5	11,5	10	16	3	1.7	150	2.5
S05	0007	8,5	12,5	13,5	10	16	4	2.3	150	2
S05	0009	10,5	16,5	17,5	10	16	4.7	2.7	150	1.3
S05	0011	12,5	16,5	21	10	16	5.5	3.1	150	1
S05	0014	16,5	16,5	25	10	16	7.5	4.3	150	0.7
S10	0017	20	30	32	10	16	9.2	5.3	150	0.7
S10	0020	24	30	36	10	16	11	6.3	150	0.5
S10	0025	30	41	48	10	16	15	8.6	150	0.4
S10	0030	36,5	41	56	10	16	18.5	10.6	150	0.35
S10	0035	41	41	72	3	16	22	12.6	150	0.3
S15	0040	48	72	75	10	16	25	14.4	150	0.3
S20	0049	59	80	96	10	12.8	30	17.3	150	0.25
S20	0060	72	88	112	10	12.8	37	21.3	150	0.2
S20	0067	80	103	118	10	12.8	45	25.9	147	0.1
S20	0072	88	120	144	10	12.8	48	27.7	150	0.05
S20	0086	103	135	155	10	12.8	55	31.7	150	0.05
S30	0113	135	180	200	10	10	75	43.2	148	0.05
S30	0129	155	195	215	10	10	85	49.0	138	0.02
S30	0150	180	215	270	5	5	100	57.7	150	0.02
S30	0162	195	240	290	5	5	110	63.4	148	0.02
S40	0179	215	300	340	4	4	120	69.2	150	0.02
S40	0200	240	345	365	4	4	132	76.1	150	0.02
S40	0216	260	375	430	4	4	140	80.8	150	0.02
S40	0250	300	390	480	4	4	170	98.1	150	0.02
S50	0312	375	480	600	4	4	215	124.0	150	0.02
S50	0366	440	550	660	4	4	250	144.2	150	0.02
S50	0399	480	630	720	4	4	280	161.6	150	0.02

T5 : Configuration table for LIFT SW parameters

10 DIAGNOSTICS

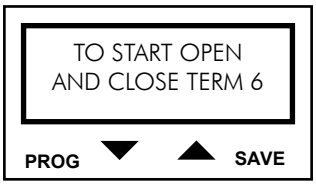
10.1 INVERTER OPERATING CONDITIONS

When the inverter runs smoothly, the following messages are displayed in the main menu page:
1) if the output frequency is equal to zero:

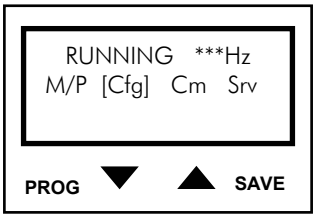


This occurs if the inverter is disabled or no run command is sent or the frequency reference is equal to zero.

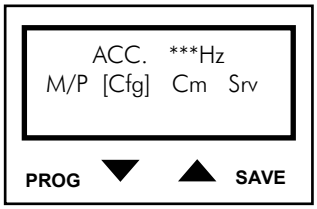
2) If the equipment is enabled when the ENABLE input is closed and parameter C59 is set to [NO], the following message is displayed:



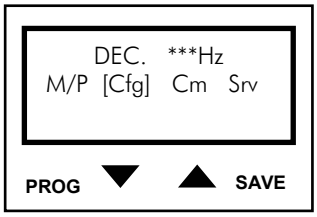
3) If the output frequency is constant, other than zero and equal to the reference:



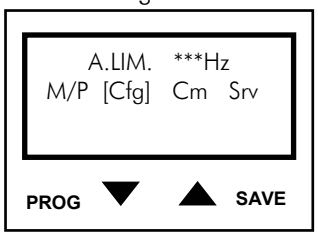
4) If the inverter is accelerating:



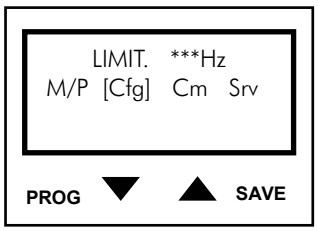
5) If the inverter is decelerating:



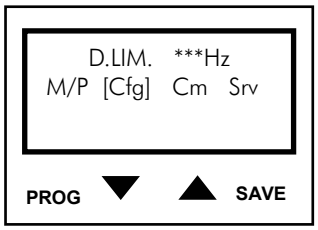
6) If the output frequency is constant while accelerating due to current limit activation while accelerating:



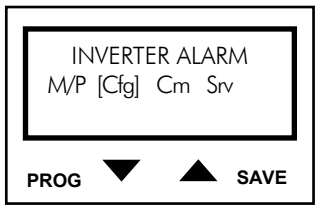
7) If the output frequency is under the reference value for current limit activation at constant frequency:



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 11.2 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 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].

SECTION 2

10.2 ALARM MESSAGES

A01 Wrong Software

The software version of FLASH memory (human interface) is incompatible with DSP version (motor control).

SOLUTIONS: Try to reset the alarm. If the problem persists, please contact ELETTRONICA SANTERNO's AFTER-SALES SERVICE for a new programming of control board ES778.

A03 EEPROM absent

EEPROM is not installed, is blank or damaged. EEPROM memory contains all customized parameters.
SOLUTION: Check to see if EEPROM is properly installed (U45 in board ES778) and if jumper J13 is positioned correctly (pos.1-2 for 28C64; pos.2-3 for 28C16). If so, control board ES778 is to be replaced. Please contact ELETTRONICA SANTERNO's AFTER-SALES SERVICE.

A05 NO imp. opcode
A06 UC failure

Microcontroller failure.
SOLUTION: Reset the alarm. If the alarm condition 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.
SOLUTION: Reset the alarm. If the alarm condition persists, please contact ELETTRONICA SANTERNO's AFTER-SALES SERVICE.

A14 Continuous dec. Lim.

The inverter, slowing down or stopping, has been blocked in voltage limit while decelerating (DEC LIM xxxHz sul display) for more than 4sec.
SOLUTION: Decrease the couple compensation parameter C09, C10, C11,V/f patternmenu, if the limit was due to high voltage; verify the the brake resistance if the limit was due to a 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.
SOLUTION: 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 it 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.
SOLUTIONS: 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

Has been set up the inverter from Normal mode to Maintenance mode while the inverter was working.

A19 Fan fault

Faulty air-cooling system.
SOLUTION: Check to see if fans are locked and/or if they are properly connected.

A20 Inverter Overload

Output current exceeds the inverter rated current - persistent condition: Imax +20% for 3 seconds; Imax for 60 seconds (S40÷S70); Imax for 120 seconds (S05÷S30). See column "Imax", Table 5 in section 5.3.
SOLUTION: Check the inverter output current under normal operating conditions (par. M03, MEASURE submenu) and any mechanical condition of the load (overload or load locked during duty cycle).

A21 Heatsink Overheated

Overheating of the power heatsink.
SOLUTION: Make sure that the ambient temperature in the location where the inverter is installed is under 40°C.

A22 Motor Overheated

Software thermal protection of the connected motor tripped. Output current has been exceeding the motor rated current for a long time.
SOLUTION: Check the load mechanical conditions. A22 trip depends on programming of parameters C70, C71, C72. Make sure that these parameters were properly set at the inverter startup (see section 2.8 "MOTOR THERMAL PROTECTION").

A24 Motor not connected

While starting the cage, with one of the digital output working for the brake, the voltage measure is less than the measure settled in C65 in Special function menu.
SOLUTION: Verify the wiring between inverter and motor.

A25 Mains loss

Mains failure.

A30 D.C. Link Overvoltage

DC link overvoltage.
SOLUTION: Make sure that supply voltage is not over 240VAC + 10% for class 2T, 480VAC + 10% for class 4T , 515VAC + 10% for class 5T, 630VAC + 10% for class 6T.
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 class 2T, 380VAC – 35% for class 4T, 500VAC – 15% for class 5T, 600VAC – 15% for class 6T.
SOLUTION: 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 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.
SOLUTION: 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 section WIRING in Section 1 of this User Manual).
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.
SOLUTION: 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.
SOLUTION: Reset the alarm. If the alarm condition persists, please contact ELETTRONICA SANTERNO's AFTER-SALES SERVICE.

10.3 DISPLAY AND INDICATOR LEDS

Additional failures may occur that are indicated by the keypad and the indicator Leds located on control board ES778:
- 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: 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 control board ES778.

11 SERIAL COMMUNICATION

11.1 GENERAL FEATURES

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 through remotable keypad.

Elettronica Santerno also supplies the RemoteDrive software package for the inverter control through a computer connected via serial link.

RemoteDrive offers the following functionalities: 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 automatic detection of the connected inverters (up to 247 connected inverters).

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 a 0 address is addressed to all slave devices, which will not respond at all (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. The16-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 to read 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 to set 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 reading 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^2
P06	DMAN	Deceleration in Maintenance mode	1	1	250	10	255	100	m/s^2

Because K=10, a reading of address 0 with a value equal to 250 (dec) is to be intended as acceleration equal to 250/100 = $2.5m/s^2$
Vice versa, to set a deceleration value equal to 0.20 m/s^2, 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	2.5
1	50	800	10	12	2.5
2	65	800	10	12	2.5
…	…	…	…	…	…

SECTION 2

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

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" (⇒ 65A) and if address 1026 returns "1000", 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 Notes in the following tables.

12 PARAMETERS SENT VIA SERIAL LINK

12.1 MEASURE PARAMETERS (Mxx) (Read Only)

12.1.1 MEASURE 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 reference	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 01	-
M09	T.B.Out	Digital outputs	1032	408			Note 02	
M10	Spd Ref	Speed reference	1033	409			C73/12	rpm
M11	NOUT	Motor speed	1034	40A			1	rpm
M12	Speed Ref	Cage speed reference	1035	40B			10*C05/P44	m/s
M13	Speed	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 03	s
M16	1st alarm	Trip log 1	1040 1041	410 411			5 Note 04	s
M17	2nd alarm	Trip log 2	1042 1043	412 413			5 Note 04	s
M18	3rd alarm	Trip log 3	1044 1045	414 415			5 Note 04	s
M19	4th alarm	Trip log 4	1046 1047	416 417			5 Note 04	s
M20	5th alarm	Trip log 5	1048 1049	418 419			5 Note 04	s

Note 01 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 02 State of digital outputs in the terminal board (1= active output) based on the table below:

Bit	
2	OC
3	RL1
4	RL2

SECTION 2

Note 03 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 lowest address (1038).

Note 04 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	

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 12 (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	Min	Max	K	Unit of measure	Name
M21	Start time	Cage acceleration time	1050	41A	0	0	20	100	s
M22	Start space	Cage acceleration distance	1051	41B	0	0	9.99	100	m
M23	Stop time	Cage deceleration time	1052	41C	0	0	20	100	s
M24	Stop space	Cage deceleration distance	1053	41D	0	0	9.99	100	m

12.2 PROGRAMMING PARAMETERS (Pxx) (Read/Write)

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/s2
P06	Dman.	Decel. in Maintenance mode	1	1	2.5	0.1	6500	100	m/s2
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/s2
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/s2
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/s2
P10	Lift Jerk	Cage Jerk in Normal operation	5	5	IF C22=1 (Def=0.8) ELSE (Def=0.6)	0.15	1.27	100	m/s3
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

SECTION 2

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.Spd	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 06	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 06	1	Tc
P55	TD	Derivative time	26	1A	0	0	4 Note 06	256	Tc
P56	FREQ TH.	Integral unlocking threshold	27	1B	10	0	T000[1]	10	Hz
P57	KP AVVICIN.	Proportional term during approach stage	28	1C	0.349	0	31.999	1024	
P58	TI AVVICIN.	Integral time during approach stage	29	1D	200	3	1025 Note 06	1	Tc

Note 06 Integral time and derivative time are expressed as multiple values of sampling time P50. For example, real time is P50*P52; 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	16	List	-
P61	RL1 OP.	Relay output RL1 operation	32	20	0	0	16	List	-
P62	RL2 OP.	Relay output RL2 operation	33	21	4	0	16	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	%

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

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

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.	Motor rated current 1	1283	503	T002[0]	1	T002[1]	10	A
C05	FMOT	Motor rated 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	Motor rated 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 a frequenza intermedia	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.
C21	Standard	Selection of dual contractual speed	516	204	1	0	2	List	-
C22	Pres. Encoder	Encoder provided	537	219	0	0	1	List	-
C23	n.pulse	Encoder pulse/rev	1291	50B	1024	100	10000	1	Ppr

List for parameter C21:

0: Speed D
1: Speed Single
2: Speed Double A

List for parameter C22:

0: No
1: Yes

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. CUR.	Constant freq. lim. enabling	1293	50D	MIN((T002[2]* 100/C04),150)	50	MIN((T002[2]* 100/C05),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 enabling	520	208	770.8	302.8	1	0	1
C42	RUN. LIM.	Constant freq. limit enabling	521	209	770.9	302.9	1	0	1
C44	DEC. LIM.	Deceleration limit enabling	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 provided	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.	Soglia di corrente per allarme A24	1324	52C	0	0	100	1	%

Special Functions Menu C5x - C6x: Bit Parameters

	Name	Description	Addr. (dec) WRITE	Addr. (hex) WRITE	Addr. (dec) READ	Addr. (hex) READ	Def	Min	Max
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 enabling	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 enabling	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	M.SLIP	Motor rated power	1306	51A	IF SW5=0 (Def=T 002[4]) ELSE (Def=T 002[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	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 enabling	525	20D	770.13	302.13	0	0	1
C81	DCB AT START	DCB at START enabling	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 C92:

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 10
SP04	Configuration bit	771	303			Note 11
SP05	Inverter condition	772	304	0	24	Note 12

Note 10 SP03 Configuration bit: address 770 (302 hex)

	Bit		
C64 AUTO.RESIST.	1	0 Not provided	1 Provided
C55 BRAKE UNIT	3	0 Not provided	1 Provided
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 11 SP04 Configuration bit: address 771 (303 hex)

	Bit		
C53 PWR RESET	3	0 Disabled	1 Enabled
C44 DECELERATION LIM.	7	0 Disabled	1 Enabled

Note 12 Inverter condition: address 772 (304 hex)

0	INVERTER OK
1	A30 D. C. Link Overvoltage
2	A31 D. C. Link Undervoltage
3	A19 Fan Fault
4	A22 Motor overheated
5	A20 Inverter overload
6	A05 Eprom reading error
7	A03 EEPROM absent
9	A25 Mains loss
10	A17 Wrong command
11	A11 Bypass circ. Failure
12	A01 Wrong software
13	A26 Running overcurrent SW
14	TO START OPEN AND CLOSE TERM6
15	A27 Searching overcurrent SW
16	A21 Heatsink overheated
17	A06 Microcontroller Failure
18	A32 Running overcurrent
19	A33 Accelerating overcurrent
20	A34 Decelerating overcurrent
21	A35 Searching overcurrent
22	A40 Serial comm. Error
23	A28 Accelerating overcurrent SW
24	A29 Decelerating overcurrent SW
25	A15 Encoder failure
26	A16 Speed error
27	A14 Continuous dec.. lim.
28	A24 Motor not connected

12.5 SPECIAL PARAMETERS (SWxx) (Read Only)

	Description	Addr. (dec)	Addr. (hex)	Min	Max	K
SW1	Software version	475	1DB			Note 13
SW2	Product ID	476	1DC			Note 14
SW3	AT Full-scale value	477	1DD	0	13	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 13 Decimal number corresponding to the inverter firmware version. Example:
Response 1000 = version V1.000

Note 14 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 17
SP07	Restore default	774	30B	Note 18

Note 17 Any writing with any data item forces the inverter to store to EEPROM all new parameter values.

Note 18 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	2.5
1	50	800	10	12	2.5
2	65	800	10	12	2.5
3	100	800	10	12	2.5
4	125	800	5	12	2.5
5	130	800	10	12	2.5
6	210	800	10	11	2.5
7	280	800	10	11	2.5
8	390	800	10	10	0.5
9	480	800	7	7	0.5
10	650	120	6	6	0.5
11	865	120	6	6	0.5
12	1300	120	6	6	0.5
13	1750	120	5	6	0.5
14	2550	120	5	6	0.5

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)

	Model	Imot	Inom	Imax	Pnom @ 400V	Pnom @ 230V	C78 def Stat.Res.
		T002[0]	T002[1]	T002[2]	T002[3]	T002[4]	T002[5]
0	K LIFT 0005	6.5	10.5	11.5	3	1.7	2.5
1	K LIFT 0007	8.5	12.5	13.5	4	2.3	2
2	K LIFT 0009	10.5	16.5	17.5	4.7	2.7	1.3
3	K LIFT 0011	12.5	16.5	21	5.5	3.1	1
4	K LIFT 0014	16.5	16.5	25	7.5	4.3	0.7
5	K LIFT 0017	20	30	32	9.2	5.3	0.7
6	K LIFT 0020	24	30	36	11	6.3	0.5
7	K LIFT 0025	30	41	48	15	8.6	0.4
8	K LIFT 0030	36.5	41	56	18.5	10.6	0.35
9	K LIFT 0035	41	41	72	22	12.6	0.3
10	K LIFT 0040	48	72	75	25	14.4	0.3
11	K LIFT 0049	59	80	96	30	17.3	0.25
12	K LIFT 0060	72	88	112	37	21.3	0.2
13	K LIFT 0067	80	103	118	45	25.9	0.1
14	K LIFT 0074	88	120	144	48	27.7	0.05
15	K LIFT 0086	103	135	155	55	31.7	0.05
16	K LIFT 0113	135	180	200	75	43.2	0.05
17	K LIFT 0129	155	195	215	85	49.0	0.02
18	K LIFT 0150	180	215	270	100	57.7	0.02
19	K LIFT 0162	195	240	290	110	63.4	0.02
20	K LIFT 0179	215	300	340	120	69.2	0.02
21	K LIFT 0200	240	345	365	132	76.1	0.02
22	K LIFT 0216	260	375	430	140	80.8	0.02
23	K LIFT 0250	300	390	480	170	98.1	0.02
24	K LIFT 0312	375	480	600	215	124.0	0.02
25	K LIFT 0366	440	550	660	250	144.2	0.02
26	K LIFT 0399	480	630	720	280	161.6	0.02