• 15P0095B2 •

SINUS K

FULL DIGITAL INVERTER

USER MANUAL

-Installation Instructions-

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English

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SANTERNO

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0. TABLE OF CONTENTS

0.1. Chapters

0.2. Figures

0.3. Tables

1. GENERAL DESCRIPTION

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 900kW.

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.

1.1. FEATURE LIST

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

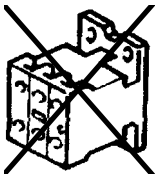
(*) Must be specified when ordering the equipment.

• Wide range of supply voltage: 200÷500VAC both for stand-alone models and cabinet models.
Standard DC power supply ranging from 280 to 705Vdc.
• Wide power range: 1 to 900kW.
• Wide range of voltage values and power values for the electrical motor to be connected to any single inverter size.

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

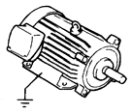
• Built-in filters for the whole SINUS K range in compliance with regulation EN61800-3, issue 2 concerning emission limits.

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 SINUS K models are more compact than the prior models. The overall dimensions have been reduced up to 50% in order to install the inverter in small-sized, light-weight control panels. A compact, book-like structure allows easy side-by-side installation. The SINUS K may be installed in cabinets and its system design offers a better price/performance ratio.
•Automatic control of the cooling system (up to Size S10). The ventilation system activates only when required and indicates any failures of the cooling fan. This ensures greater energy saving, lower wear of the cooling fans and weaker noise. In case of equipment failure, the customer may to adjust the system speed in order not to stop the equipment and to limit dissipated power.
•Built-in braking unit up to Size S30 included.
•Noiseless operation ensured by high modulation frequency programmable up to 16kHz (IFD SW).
•Integrated motor thermal protection through thermal relay and 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 function.
•Preset parameters for the most used applications.
•PC interface for WINDOWS environment with the REMOTE DRIVE software in five foreign languages.
•PC compiled software for the programming of more than 20 application functions.
• RS485 MODBUS RTU serial communications for serial links to PC, PLC and control interfaces.
•Optional field buses of any type (Profibus DP, Can Bus, Device Net, Ethernet, etc.)

1.2. EQUIPMENT DESCRIPTION AND INSTALLATION

The inverters of the SINUS K series are full digital inverters for the speed regulation of asynchronous motors up to 900 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 variables 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:

- wide power supply range: 380-500VAC (-15%,+10%) for 4T voltage class;
- two supply voltage classes available: 2T (200-240VAC) and 4T (380-500VAC);
- 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 (standard feature for all sizes);
- built-in braking unit up to Size S30;
- RS485 serial interface with communications protocol according to MODBUS RTU standard;
- IP20 degree of protection 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;
- air-cooling control up to Size S10.

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".

1.3. PRODUCTS COVERED IN THIS MANUAL

This manual covers any inverter of the SINUS K, SINUS K BOX, SINUS K CABINET series provided with IFD software or VTC software.

2. CAUTION STATEMENTS

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

SYMBOLS:

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

CAUTION Indicates 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.

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

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

The inverter may generate 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.

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 because electric energy accumulates within the electrical components.

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 unit 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.

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.

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

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

If the inverter is installed in environments exposed to flammable and/or explosive substances (zones AD according to standards IEC 64-2), please refer to IEC 64-2, EN 60079-10 and related standards.

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

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

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

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

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

Operate the inverter only if a proper grounding is provided.

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.

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

Do not connect single-phase motors.

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

Respect the environmental requirements for the equipment installation.

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

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

3. INSPECTION UPON RECEIPT OF THE GOODS

Make sure the equipment is not damaged and it 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.
If the equipment is stored before being started, make sure that the ambient conditions do not exceed the ratings (mentioned in chapter 7 "Installing the equipment"). 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.

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 pattern) VTC = Vector Torque Control for high torque demanding applications (Sensorless vectorial control with direct torque control) LIFT = Space vector modulation with a special software for lift applications (vectorial modulation PWM with V/f pattern - NOT COVERED IN THIS MANUAL)
3	Inverter Model
4	Supply voltage 2 = power supply 200÷240Vac; 280÷340Vdc. 4 = power supply 380÷500Vac; 530÷705Vdc.
5	Type of power supply C=Direct current supply T = three-phase D=12 Impulse Bridge S = single-phase (available by request)
6	Braking unit 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 = no control panel provided K = control panel provided (back-lit, 16x2 characters LCD display).
9	Degree of protection 0 = IP00 2 = IP20 3 = IP24 4 = IP42 5 = IP54

3.1. INVERTER NAMEPLATE

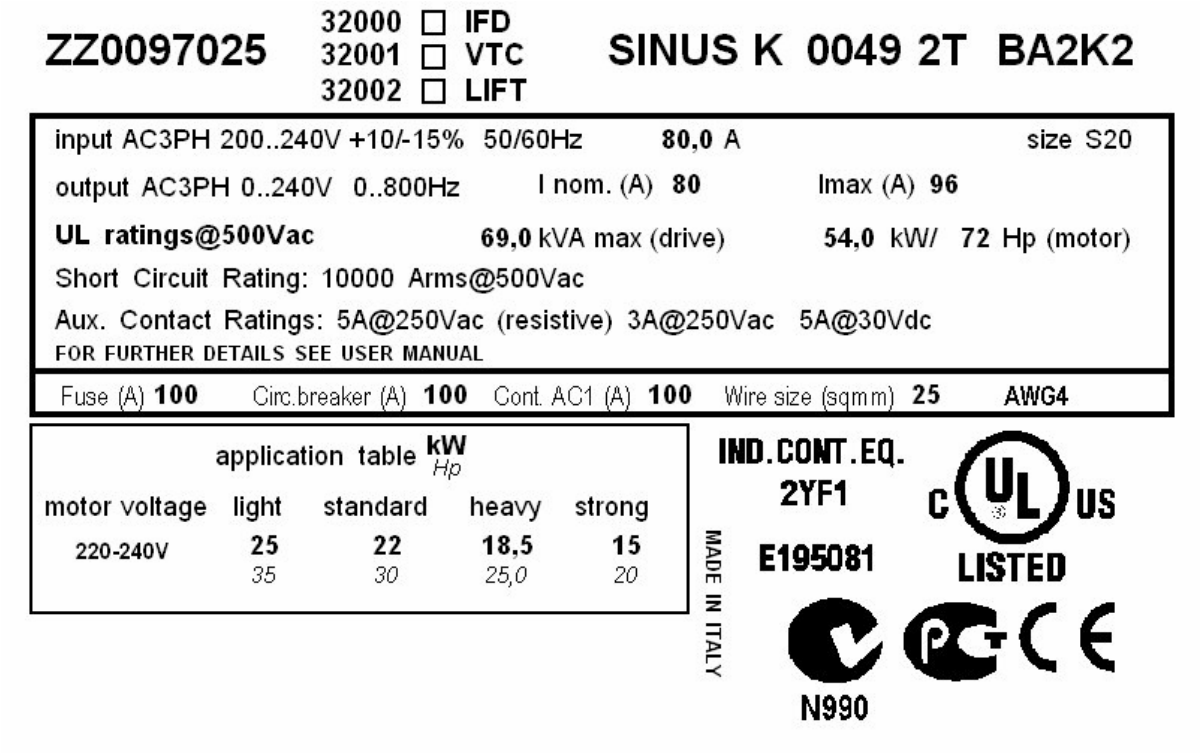


Figure 1: Example of a nameplate placed on a 2T SINUS K inverter.

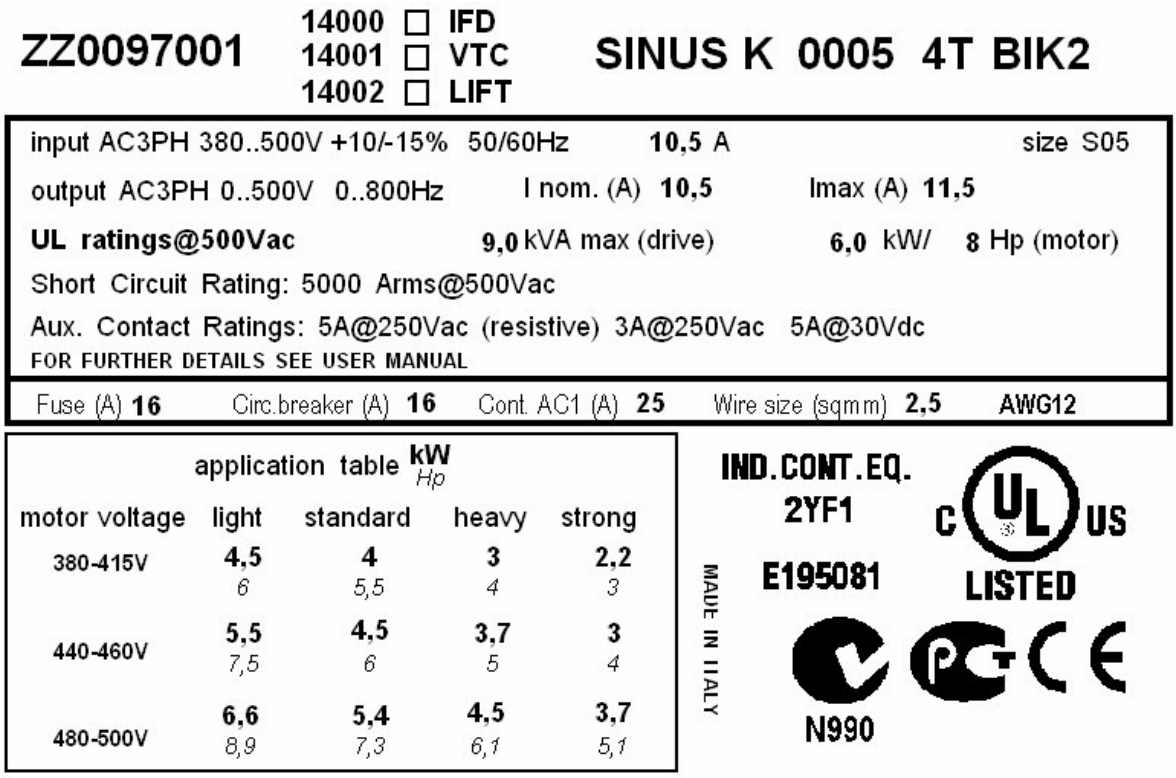


Figure 2: Example of a nameplate placed on a 4T SINUS K inverter.

4. USING THE DISPLAY/KEYPAD

For the parameter programming and view a display/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.

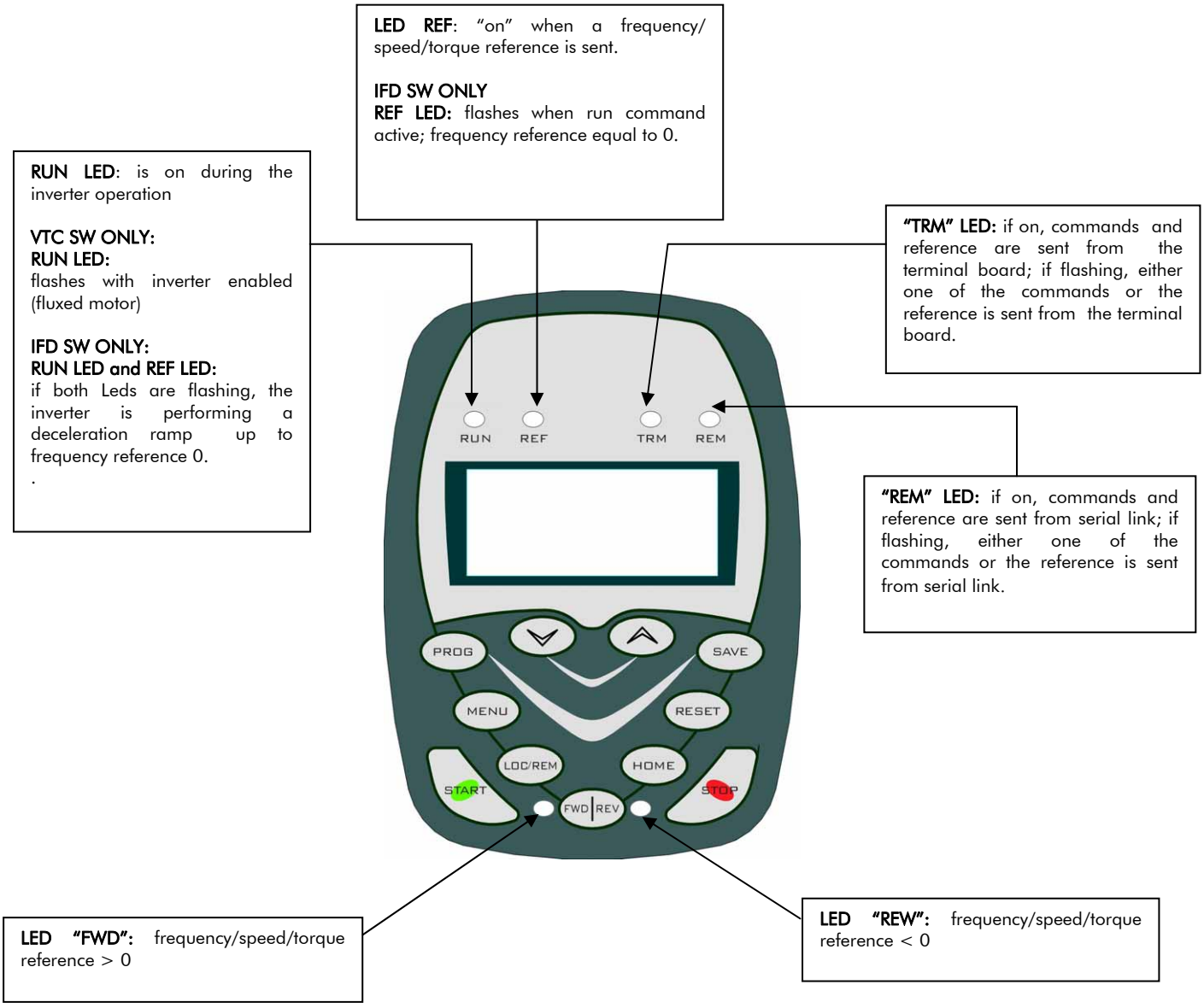


Figure 3: Keypad of SINUS K inverters.

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

PROG	allows entering and quitting the menus and submenus and enables altering the inverter parameters (when switching from parameter display to parameter programming, the cursor starts flashing);
⌄	down arrow; scrolls through the menus and submenus, the pages in a submenu or the parameters in descending order. During programming, it decrements the parameter value;
⌃	up arrow; scrolls through the menus and submenus, the pages in a submenu or the parameters in descending 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 accessing the main menu; if pressed twice, allows returning to the prior condition;
RESET	resets the alarms tripped;
START	if enabled, allows starting the motor;
STOP	if enabled, allows stopping the motor;
LOC | REM	press once to force commands and reference from keypad; press twice to return to any previous setting.
FWD/REW	pressing the key you reverse the motor direction rotation;
HOME	pressing the key, you return to the first page of a sub-menu;

NOTE START/STOP/FWD-REW are active in Keypad mode only.

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.

4.1. Adjusting the Display Contrast

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

5. STARTUP PROCEDURES

The startup procedures described below relate to commands sent via terminal board (factory setting). For the configuration of the terminal board, see the Control Terminals section.

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

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

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

5.1. Startup Procedure for IFD Software

1) Connection: Follow the instructions stated in the CAUTION STATEMENTS and WIRING sections.

2) Power on: Link to terminal 6 (ENABLE) is to be open when the inverter is started.

3) Parameter alteration: Use the PROG, ↓, ↑ and SAVE keys to access the other parameters. See the "Submenu Tree" in the Programming Manual.

4) Motor parameters: Access the V/f Pattern submenu and set the following: C05 (Imot) (motor rated current); C06 (fmot1) (motor rated frequency); C07 (fomax1) (maximum output frequency desired) and C09 (Vmot1) (motor rated voltage). Press SAVE each time a new parameter value is set. For loads producing a quadratic pattern of the torque with respect to rpm (turbo pumps, fans, etc..), set C11 (preboost) to 0%. Press SAVE to store the new parameter value.

5) Overload: Set parameters C41/C43/C45 in the Limits submenu based on the max. current desired.

6) Startup: Close terminals 6 (ENABLE) and 7 (START) and send a frequency reference: the RUN LED and REF LED will come on and the motor will start. Make sure the motor is rotating in the right direction. If not, operate on terminal 12 (CW/CCW) or open terminals 6 and 7. Shut off the inverter, wait a few minutes and reverse two of the motor phases.

7) Possible failures: If no failure occurred, go to step 8. Otherwise, check the inverter connections paying particular attention to supply voltages, DC link and input reference. Also check if alarm messages are displayed. In the Measure submenu, check the reference frequency (M01), the supply voltage to the control section (M05), the DC link voltage (M06), and the condition of terminals 6, 7, 8, 9, 10, 11, 12, and 13 (M08; a number other than 0 indicates the "activation" of the relevant terminal). Check to see if these readings match with the measured values.

8) Additional alterations: Note that you can change Cxx parameters in the CONFIGURATION menu only when the inverter is DISABLED or STOPPED.
You can write down any customized parameter in the table on the last pages of the Programming Manual.

9) Reset: If an alarm trips, find the cause responsible for the alarm and reset the equipment. Enable terminal 8 (RESET) for some time, or press the RESET key.

5.2. Startup Procedure for VTC Software

The startup procedures described below relate to commands sent via terminal board (factory setting). For the configuration of the terminal board, see the Control Terminals section.

1) Connection: Follow the instructions stated in the CAUTION STATEMENTS and WIRING sections.

2) Power on: Link to terminal 6 (ENABLE) is to be open when the inverter is started.

3) Parameter alteration: Use the PROG, ↓, ↑ and SAVE keys to access the other parameters. See the "Submenu Tree" in the Programming Manual.

4) Motor parameters: Access the VTC Pattern submenu and set the following: C01 (fmot) (motor rated frequency); C02 (Speedmax) (desired maximum speed); C03 (Vmot) (motor rated voltage); C04 (Pnom) (motor rated power); C05 (Imot) (motor rated current); and C06 (Speednom) (motor rated speed). Also set C07 (resistance of one stator phase for a star connection or one third of one phase resistance for a delta connection), C08 (resistance of one rotor phase for a star connection or one third of one phase resistance for a delta connection) and C09 (inductance of stator leakage of one phase for star connection or one third of the leakage of one phase for a delta connection). If values to be set in C07, C08, and C09 are not known, either use parameter C10 to perform the parameter autotuning (see step 5) or go to step 6. Press SAVE each time a new parameter value is set.

5) Overload: Set parameter C42 (Limits submenu) depending on the maximum torque that can be generated.

6) Vectorial control autotuning: Set C10 to [YES]: close the ENABLE contact (terminal 6) and wait approx. 30 sec. The inverter will compute the motor parameters. Open terminal 6.

7) Startup: Close terminals 6 (ENABLE) and 7 (START) and send a speed reference. The RUN LED and REF LED will come on and the motor will start. Make sure the motor is rotating in the right direction. If not, operate on terminal 12 (CW/CCW) or open terminals 6 and 7. Shut off the inverter, wait a few minutes and reverse two of the motor phases.

8) Speed regulator adjustment: If an overdisplacement occurs when the speed setpoint is reached or if a system instability is detected (irregular motor operation) adjust the parameters relating to the speed loop ("Speed loop" submenu; P100 Speed prop. Gain and P101 Speed integr. time). Set low values for P100 and high values for P101, then increase P100 until an overdisplacement takes place when the setpoint is reached. Decrease P100 by approx. 30%, then decrease P101 until an acceptable setpoint response is reached. Check that the motor runs smoothly at constant speed.

9) Possible failures: If no failure occurred, go to step 10. Otherwise, check the inverter connections paying particular attention to supply voltages, DC link and input reference. Also check if alarm messages are displayed. In the Measure submenu, check the speed reference(M01), the supply voltage of the control voltage (M08), the DC link voltage (M09), the condition of terminals 6,7,8,9,10,11,12, and 13 (M11; if a number other than 0 appears, this indicates the "activation" of the relevant terminal). Check to see if these readings match with the measured values.

10) Additional alterations: Note that you can change Cxx parameters in the CONFIGURATION menu only when the inverter is DISABLED.
You can write down any customized parameter in the table on the last pages of the Programming Manual.

11) Reset: If an alarm trips, find the cause responsible for the alarm and reset the equipment. Enable terminal 8 (RESET) for some time, or press the RESET key.

6. TECHNICAL SPECIFICATIONS

Power Range
• kW connected motor/voltage range
0.55~400kW 200÷240Vac, 3phase
1~710kW 380÷415Vac, 3phase
1~800kW 440÷460Vac, 3phase
1~900kW 480÷500Vac, 3phase
• Degree of protection/size
STAND ALONE: IP20 from Size S05 to Size S40, IP00 Size S50-S60, IP54 from Size S05 to Size S30
BOX: IP54
CABINET: IP24 and IP54.

Mains
• VAC supply voltage/tolerance
200÷240Vac, 3phase, -15% +10%
380÷500Vac, 3phase, -15% +10%
• Supply frequency (Hz)/tolerance
50÷60Hz, +/-20%
• VDC supply voltage/tolerance
280÷360Vdc, -15% +10%
530÷705Vdc, -15% +10%

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.
IFD SW:
S05÷S15 = 0.8÷16kHz
S20 = 0.8÷12.8kHz
S30 = 0.8÷10kHz (5kHz for 0150 and 0162)
≥S40 = 0.8÷4kHz
VTC SW:
5kHz

Environmental Requirements
• Ambient temperature
0÷40°C no derating; 40°÷50° with derating
(see the OPERATING TEMPERATURES BASED ON APPLICATION CLASSES section)
• Storage temperature
-25÷+70°C
• Humidity
5÷95% (non condensing)
• Altitude
Up to 1000m a.s.l.
For higher altitudes, derate the output current of 1% every 100m beyond 1000m (max. 4000m)
• Vibrations
Lower than 5.9m/sec^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

NOTE For DC supply of S60 and S65 SINUS K inverters, please contact Elettronica Santerno.

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, 8bits resolution
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 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 accelerating) (*). (*)LIFT SW only
	Serial communication		Standard incorporated RS485 multidrop, up to 247 devices 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
MARK			

6.1. Choosing the Product

Inverters of the SINUS K series are dimensioned based on allowable current and overload.
SINUS K series is characterized by two different current values:
- **Inom:** continuous current that can be produced.
- **Imax:** max. allowable current that can be produced when the inverter is overloaded, for a time of 120sec every 20min up to S30 and for a time of 60 sec every 10min from S40 to S65.

Each inverter model may be connected to 4 different motor power sizes depending on load performance. Typical applications have been divided into 4 overload categories to help choosing the most suitable inverter size.

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 table below indicates the overload class typically required for each application.
Dimensioning is not binding; the torque model required by the duty cycle of the connected machine should be known.

Application	OVERLOAD			
	LIGHT	STANDARD	HEAVY	STRONG
Atomizer, bottle washer, screw compressor (no-load), damped axial fan, undamped axial fan, centrifugal damped fan, undamped centrifugal fan, high-pressure fan, bore pumps, centrifugal pumps, positive displacement pumps, dust collector, grinder, etc.	*			
Slurry pump	*	*		
Agitator, centrifuge, piston compressor (no-load), screw compressor (loaded), roller conveyor, cone crusher, rotary crusher, vertical impact crusher, debarker, edger, hydraulic power pack, mixer, rotary table, sanding machine, bandsaw, disk saw, separator, shredder, chopper, twister/spinner, industrial washer, palletizer, extruder, etc.		*		
Conveyor belt, drier, slicer, tumbler, mechanical press, forming machine, shears, winding/unwinding machine, drawplate, calender, screw injection moulding machine, etc.		*	*	
Piston compressor (loaded), conveyor screw, crusher jaw, mill, ball mill, hammer mill, roller mill, planer, pulper, vibrating screen, hoist and crane displacement, loom, etc.			*	
Mandrel, axis control, lifting application, hydraulic power pack injection press, etc.			*	*

The tables contained in the following pages state the power of the motors to be connected to SINUS K inverters based on their overload classes.

NOTE The data items contained in the tables below apply to standard 4-pole motors.

6.1.1. TECHNICAL SHEET FOR LIGHT APPLICATIONS: OVERLOAD UP TO 120%

Size	Inverter Model	Applicable Motor Power												Inom	Imax	Ipeak (3 s.)
		200-240Vac			380-415Vac			440-460Vac			480-500Vac					
		kW	HP	A	kW	HP	A	kW	HP	A	kW	HP	A	A	A	A
S05	SINUS 0005	-	-	-	4.5	6	9.0	5.5	7.5	9.7	6.5	9	10.2	10.5	11.5	14
	SINUS 0007	3	4	11.2	5.5	7.5	11.2	7.5	10	12.5	7.5	10	11.8	12.5	13.5	16
	SINUS 0008	3.7	5	13.2	-	-	-	-	-	-	-	-	-	15	16	19.5
	SINUS 0009	-	-	-	7.5	10	14.5	9.2	12.5	16	9.2	12.5	14.3	16.5	17.5	21
	SINUS 0010	4	5.5	14.6	-	-	-	-	-	-	-	-	-	17	19	23
	SINUS 0011	-	-	-	7.5	10	14.8	9.2	12.5	16	11	15	16.5	16.5	21	25
	SINUS 0013	4.5	6	15.7	-	-	-	-	-	-	-	-	-	19	21	25
	SINUS 0014	-	-	-	7.5	10	14.8	9.2	12.5	16	11	15	16.5	16.5	25	30
	SINUS 0015	5.5	7.5	19.5	-	-	-	-	-	-	-	-	-	23	25	30
	SINUS 0016	7.5	10	25.7	-	-	-	-	-	-	-	-	-	27	30	36
	SINUS 0020	9.2	12.5	30	-	-	-	-	-	-	-	-	-	30	36	43
S10	SINUS 0016	7.5	10	26	11	15	21	15	20	25	15	20	23.2	26	30	36
	SINUS 0017	9.2	13	30	15	20	29	18.5	25	30	18.5	25	28	30	32	38
	SINUS 0020	9.2	13	30	15	20	29	18.5	25	30	18.5	25	28	30	36	43
	SINUS 0025	12.5	17	41	22	30	41	22	30	36	22	30	33	41	48	58
	SINUS 0030	12.5	17	41	22	30	41	22	30	36	25	35	37	41	56	67
	SINUS 0035	12.5	17	41	22	30	41	22	30	36	28	38	41	41	72	86
S12	SINUS 0016	-	-	-	11	15	21	15	20	25	15	20	23.2	27	30	36
	SINUS 0017	-	-	-	15	20	29	18.5	25	30	18.5	25	28	30	32	38
	SINUS 0020	-	-	-	15	20	29	18.5	25	30	18.5	25	28	30	36	43
	SINUS 0023	11	15	36	-	-	-	-	-	-	-	-	-	38	42	51
	SINUS 0025	-	-	-	22	30	41	22	30	36	22	30	33	41	48	58
	SINUS 0030	-	-	-	22	30	41	22	30	36	25	35	37	41	56	67
	SINUS 0033	16	20	50	-	-	-	-	-	-	-	-	-	51	56	68
	SINUS 0034	-	-	-	30	40	55	30	40	48	37	50	53	57	63	76
	SINUS 0036	-	-	-	30	40	55	37	50	58	37	50	53	60	72	86
	SINUS 0037	18.5	25	61	-	-	-	-	-	-	-	-	-	65	72	86
S15	SINUS 0038	18.5	25	61	30	40	55	37	40	58	45	60	64	65	75	90
	SINUS 0040	22	30	71	37	50	67	45	60	70	50	70	70	72	80	90
	SINUS 0049	25	35	80	45	60	80	50	65	75	55	75	78	80	96	115
S20	SINUS 0060	28	38	88	50	70	87	55	75	85	65	90	88	88	112	134
	SINUS 0067	30	40	96	55	75	98	65	90	100	75	100	103	103	118	142
	SINUS 0074	37	50	117	65	90	114	75	100	116	85	115	120	120	144	173
	SINUS 0086	45	60	135	75	100	133	90	125	135	90	125	127	135	155	186
S30	SINUS 0113	55	75	170	100	135	180	110	150	166	132	180	180	180	200	240
	SINUS 0129	65	90	195	110	150	191	125	170	192	140	190	195	195	215	258
	SINUS 0150	70	95	213	120	165	212	132	180	198	150	200	211	215	270	324
	SINUS 0162	75	100	231	132	180	228	150	200	230	175	238	240	240	290	348
S40	SINUS 0179	90	125	277	160	220	273	200	270	297	220	300	300	300	340	408
	SINUS 0200	110	150	332	200	270	341	220	300	326	250	340	337	345	365	438
	SINUS 0216	120	165	375	220	300	375	250	340	366	260	350	359	375	430	516
	SINUS 0250	132	180	390	230	315	390	260	350	390	280	380	390	390	480	576

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S50 [1]	SINUS	0312	160	220	475	280	380	480	315	430	459	355	480	471	480	600	720
	SINUS	0366	185	250	550	315	430	528	375	510	540	400	550	544	550	660	792
	SINUS	0399	200	270	593	375	510	621	400	550	591	450	610	612	630	720	864
S60 [1]	SINUS	0457	250	340	732	400	550	680	450	610	665	500	680	673	720	880	1056
	SINUS	0524	260	350	780	450	610	765	500	680	731	560	760	751	800	960	1152
S65 [1]	SINUS	0598	300	400	898	500	680	841	560	760	817	630	860	864	900	1100	1320
	SINUS	0748	330	450	985	560	760	939	630	860	939	710	970	960	1000	1300	1560
	SINUS	0831	400	550	1183	710	970	1200	800	1090	1160	900	1230	1184	1200	1440	1728
Inverter Supply Voltage			200-240Vac; 280-360Vdc.			380-500Vac; 530-705Vdc.											

The rated current of the applicable motor must not exceed 5% of Inom.

1) Input and output choke is required for these models.

Legend:

Inom = rated continuous current of the inverter.
Imax = max. current delivered by the inverter for 120 sec every 20 min up to S30, for 60 sec every 10 min for S40 and greater.
Ipeak = deliverable current for max. 3 seconds

6.1.2. TECHNICAL SHEET FOR STANDARD APPLICATIONS: OVERLOAD UP TO 140%

Size	Inverter Model	Applicable Motor Power												Inom	Imax	Ipeak (3 s.)
		200-240Vac			380-415Vac			440-460Vac			480-500Vac					
		kW	HP	A	kW	HP	A	kW	HP	A	kW	HP	A			
S05	SINUS 0005	-	-	-	4	5.5	8.4	4.5	6	7.8	5.5	7.5	9.0	10.5	11.5	14
	SINUS 0007	2.2	3	8.5	4.5	6	9.0	5.5	7.5	9.7	6.5	9	10.2	12.5	13.5	16
	SINUS 0008	3	4	11.2	-	-	-	-	-	-	-	-	-	15	16	19.5
	SINUS 0009	-	-	-	5.5	7.5	11.2	7.5	10	12.5	7.5	10	11.8	16.5	17.5	21
	SINUS 0010	3.7	5	13.2	-	-	-	-	-	-	-	-	-	17	19	23
	SINUS 0011	-	-	-	7.5	10	14.8	9.2	12.5	15.6	9.2	12.5	14.3	16.5	21	25
	SINUS 0013	4	5.5	14.6	-	-	-	-	-	-	-	-	-	19	21	25
	SINUS 0014	-	-	-	7.5	10	14.8	9.2	12.5	15.6	11	15	16.5	16.5	25	30
	SINUS 0015	4.5	6	15.7	-	-	-	-	-	-	-	-	-	23	25	30
	SINUS 0016	5.5	7.5	19.5	-	-	-	-	-	-	-	-	-	27	30	36
	SINUS 0020	7.5	10	25.7	-	-	-	-	-	-	-	-	-	30	36	43
S10	SINUS 0016	5.5	7.5	19.5	9.2	12.5	17.9	11	15	18.3	15	20	23.2	26	30	36
	SINUS 0017	7.5	10	25.7	11	15	21	11	15	18.3	15	20	23.2	30	32	38
	SINUS 0020	9.2	13	30	15	20	29	15	20	25	18.5	25	28	30	36	43
	SINUS 0025	11	15	36	18.5	25	35	18.5	25	30	22	30	33	41	48	58
	SINUS 0030	12.5	17	41	22	30	41	22	30	36	25	35	37	41	56	67
	SINUS 0035	12.5	17	41	22	30	41	25	35	40	28	38	41	41	72	86
S12	SINUS 0016	-	-	-	9.2	12.5	17.9	11	15	18.3	15	20	23.2	27	30	36
	SINUS 0017	-	-	-	11	15	21	11	15	18.3	15	20	23.2	30	32	38
	SINUS 0020	-	-	-	15	20	29	15	20	25	18.5	25	28	30	36	43
	SINUS 0023	9.2	12.5	30	-	-	-	-	-	-	-	-	-	38	42	51
	SINUS 0025	-	-	-	18.5	25	35	18.5	25	30	22	30	33	41	48	58
	SINUS 0030	-	-	-	22	30	41	22	30	36	25	35	37	41	56	67
	SINUS 0033	11	15	36	-	-	-	-	-	-	-	-	-	51	56	68
	SINUS 0034	-	-	-	25	35	46	30	40	48	30	40	44	57	63	76
	SINUS 0036	-	-	-	30	40	55	30	40	48	37	50	53	60	72	86
	SINUS 0037	15	20	50	-	-	-	-	-	-	-	-	-	65	72	86
S15	SINUS 0038	15	20	50	25	35	46	30	40	48	37	50	53	65	75	90
	SINUS 0040	18.5	25	61	30	40	55	37	50	58	40	55	58	72	80	90
	SINUS 0049	22	30	71	37	50	67	45	60	70	45	60	64	80	96	115
S20	SINUS 0060	25	35	80	45	60	80	55	75	85	55	75	78	88	112	134
	SINUS 0067	30	40	96	55	75	98	60	80	91	65	90	88	103	118	142
	SINUS 0074	37	50	117	65	90	114	70	95	107	75	100	103	120	144	173
	SINUS 0086	40	55	127	75	100	133	75	100	116	85	115	120	135	155	186
S30	SINUS 0113	45	60	135	90	125	159	90	125	135	90	125	127	180	200	240
	SINUS 0129	55	75	170	100	135	180	110	150	166	110	150	153	195	215	258
	SINUS 0150	65	90	195	110	150	191	132	180	198	150	200	211	215	270	324
	SINUS 0162	75	100	231	132	180	228	150	200	230	160	220	218	240	290	348
S40	SINUS 0179	80	110	250	150	200	264	160	220	237	185	250	257	300	340	408
	SINUS 0200	90	125	277	160	220	273	185	250	279	200	270	273	345	365	438
	SINUS 0216	110	150	332	200	270	341	220	300	326	250	340	337	375	430	516
	SINUS 0250	132	180	390	220	300	375	260	350	390	260	350	359	390	480	576

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S50 [1]	SINUS 0312	150	*200*	458	250	*340*	421	315	*430*	459	330	*450*	453	480	600	720
	SINUS 0366	160	*220*	475	280	*380*	480	355	*480*	512	375	*510*	497	550	660	792
	SINUS 0399	185	*250*	550	315	*430*	528	375	*510*	540	400	*550*	544	630	720	864
S60 [1]	SINUS 0457	220	*300*	661	400	*550*	680	450	*610*	665	500	*680*	673	720	880	1056
	SINUS 0524	260	*350*	780	450	*610*	765	500	*680*	731	560	*770*	751	800	960	1152
S65 [1]	SINUS 0598	300	*400*	898	500	*680*	841	560	*760*	817	630	*860*	864	900	1100	1320
	SINUS 0748	330	*450*	985	560	*760*	939	630	*860*	939	710	*970*	960	1000	1300	1560
	SINUS 0831	400	*550*	1183	630	*860*	1080	800	*1090*	1160	800	*1090*	1067	1200	1440	1728
Inverter Supply Voltage		**200-240Vac; 280-360Vdc.**			**380-500Vac; 530-705Vdc.**											

The rated current of the applicable motor must not exceed 5% of Inom.

1) Input and output choke is required for these models.

Legend:

Inom = continuous rated current of the inverter.

Imax = max. current delivered by the inverter for 120 sec every 20 min up to S30, for 60 sec every 10 min for S40 and greater

Ipeak = deliverable current for max. 3 seconds

6.1.3. TECHNICAL SHEET FOR HEAVY APPLICATIONS: OVERLOAD UP TO 175%

Size	Inverter Model	Applicable Motor Power												Inom	Imax	Ipeak (3 s.)
		200-240Vac			380-415Vac			440-460Vac			480-500Vac					
		kW	HP	A	kW	HP	A	kW	HP	A	kW	HP	A			
S05	SINUS 0005	-	-	-	3	4	6.4	3.7	5	6.6	4.5	6	7.2	10.5	11.5	14
	SINUS 0007	1.8	2.5	7.3	4	5.5	8.4	4.5	6	7.8	5.5	7.5	9.0	12.5	13.5	16
	SINUS 0008	2.2	3	8.5	-	-	-	-	-	-	-	-	-	15	16	19.5
	SINUS 0009	-	-	-	4.5	6	9.0	5.5	7.5	9.7	7.5	10	11.8	16.5	17.5	21
	SINUS 0010	3	4	11.2	-	-	-	-	-	-	-	-	-	17	19	23
	SINUS 0011	-	-	-	5.5	7.5	11.2	7.5	10	12.5	9.2	12.5	14.3	16.5	21	25
	SINUS 0013	3.7	5	13.2	-	-	-	-	-	-	-	-	-	19	21	25
	SINUS 0014	-	-	-	7.5	10	14.8	9.2	12.5	15.6	11	15	16.5	16.5	25	30
	SINUS 0015	4	5.5	16.6	-	-	-	-	-	-	-	-	-	23	25	30
	SINUS 0016	4.5	6	15.7	-	-	-	-	-	-	-	-	-	27	30	36
	SINUS 0020	5.5	7.5	19.5	-	-	-	-	-	-	-	-	-	30	36	43
S10	SINUS 0016	5.5	7.5	19.5	9.2	12.5	17.9	11	15	18.3	12.5	17	18.9	26	30	36
	SINUS 0017	5.5	7.5	19.5	9.2	12.5	17.9	11	15	18.3	12.5	17	18.9	30	32	38
	SINUS 0020	7.5	10	25.7	11	15	21	15	20	25	15	20	23.2	30	36	43
	SINUS 0025	9.2	12.5	30	15	20	29	18.5	25	30	18.5	25	28	41	48	58
	SINUS 0030	11	15	36	18.5	25	35	22	30	36	22	30	33	41	56	67
	SINUS 0035	12.5	17	41	22	30	41	25	35	40	28	38	41	41	72	86
S12	SINUS 0016	-	-	-	9.2	12.5	17.9	11	15	18.3	12.5	17	18.9	27	30	36
	SINUS 0017	-	-	-	9.2	12.5	17.9	11	15	18.3	12.5	17	18.9	30	32	38
	SINUS 0020	-	-	-	11	15	21	15	20	25	15	20	23.2	30	36	43
	SINUS 0023	7.5	10	25.7	-	-	-	-	-	-	-	-	-	38	42	51
	SINUS 0025	-	-	-	15	20	29	18.5	25	30	18.5	25	28	41	48	58
	SINUS 0030	-	-	-	18.5	25	35	22	30	36	22	30	33	41	56	67
	SINUS 0033	11	15	36	-	-	-	-	-	-	-	-	-	51	56	68
	SINUS 0034	-	-	-	22	30	41	25	35	40	28	38	41	57	63	76
	SINUS 0036	-	-	-	25	35	46	30	40	48	30	40	44	60	72	86
	SINUS 0037	15	20	50	-	-	-	-	-	-	-	-	-	65	72	86
S15	SINUS 0038	15	20	50	25	35	46	30	40	48	30	40	44	65	75	90
	SINUS 0040	15	20	50	25	35	46	30	40	48	37	50	53	72	80	90
	SINUS 0049	18.5	25	61	30	40	55	37	50	58	45	60	64	80	96	115
S20	SINUS 0060	22	30	71	37	50	67	45	60	70	50	70	70	88	112	134
	SINUS 0067	25	35	80	45	60	80	50	70	75	55	75	78	103	118	142
	SINUS 0074	30	40	96	50	70	87	55	75	85	65	90	88	120	144	173
	SINUS 0086	32	45	103	55	75	98	65	90	100	75	100	103	135	155	186
S30	SINUS 0113	45	60	135	75	100	133	75	100	116	90	125	127	180	200	240
	SINUS 0129	50	70	150	80	110	144	90	125	135	110	150	153	195	215	258
	SINUS 0150	55	75	170	90	125	159	110	150	166	132	180	180	215	270	324
	SINUS 0162	65	90	195	110	150	191	132	180	198	140	190	191	240	290	348
S40	SINUS 0179	75	100	231	120	165	212	150	200	230	160	220	218	300	340	408
	SINUS 0200	80	110	250	132	180	228	160	220	237	185	250	257	345	365	438
	SINUS 0216	90	125	277	160	220	273	185	250	279	200	270	273	375	430	516
	SINUS 0250	110	150	332	185	250	321	220	300	326	220	300	300	390	480	576

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S50 [1]	SINUS	0312	132	180	390	220	300	375	260	350	390	300	400	413	480	600	720
	SINUS	0366	150	200	458	250	340	421	300	400	449	330	450	453	550	660	792
	SINUS	0399	160	220	475	280	380	480	330	450	493	355	480	471	630	720	864
S60 [1]	SINUS	0457	200	270	593	315	430	528	375	510	540	450	610	612	720	880	1056
	SINUS	0524	220	300	661	355	480	589	450	610	665	500	680	673	800	960	1152
S65 [1]	SINUS	0598	250	340	732	400	550	680	500	680	731	560	760	751	900	1100	1320
	SINUS	0748	280	380	840	500	680	841	560	760	817	630	860	864	1000	1300	1560
	SINUS	0831	330	450	985	560	760	939	630	860	939	710	970	960	1200	1440	1728
Inverter Supply Voltage			200-240Vac; 280-360Vdc			380-500Vac; 530-705Vdc											

The rated current of the applicable motor must not exceed 5% of Inom.

1) Input and output choke is required for these models.

Legend:

Inom = continuous rated current of the inverter.
Imax = max. current delivered by the inverter for 120 sec every 20 min up to S30, for 60 sec every 10 min for S40 and greater.
Ipeak = deliverable current for max. 3 seconds.

6.1.4. TECHNICAL SHEET FOR STRONG APPLICATIONS: OVERLOAD UP TO 200%

Size	Inverter Model	Applicable Motor Power												Inom	Imax	Ipeak (3s)
		200-240Vac			380-415Vac			440-460Vac			480-500Vac					
		kW	HP	A	kW	HP	A	kW	HP	A	kW	HP	A			
S05	SINUS 0005	-	-	-	2.2	3	4.9	3	4	5.6	3.7	5	6.1	10.5	11.5	14
	SINUS 0007	1.5	2	6.1	3	4	6.4	3.7	5	6.6	4.5	6	7.2	12.5	13.5	16
	SINUS 0008	1.8	2.5	7.3	-	-	-	-	-	-	-	-	-	15	16	19.5
	SINUS 0009	-	-	-	4	5.5	8.4	4.5	6	7.8	5.5	7.5	9.0	16.5	17.5	21
	SINUS 0010	2.2	3	8.5	-	-	-	-	-	-	-	-	-	17	19	23
	SINUS 0011	-	-	-	4.5	6	9.0	5.5	7.5	9.7	7.5	10	11.8	16.5	21	25
	SINUS 0013	3	4	11.2	-	-	-	-	-	-	-	-	-	19	21	25
	SINUS 0014	-	-	-	5.5	7.5	11.2	7.5	10	12.5	9.2	12.5	14.3	16.5	25	30
	SINUS 0015	3.7	5	13.2	-	-	-	-	-	-	-	-	-	23	25	30
	SINUS 0016	4	5.5	14.6	-	-	-	-	-	-	-	-	-	27	30	36
	SINUS 0020	4.5	6	15.7	-	-	-	-	-	-	-	-	-	30	36	43
S10	SINUS 0016	4	5.5	14.6	7.5	10	14.8	9.2	12.5	15.6	11	15	16.5	26	30	36
	SINUS 0017	4.5	6	15.7	7.5	10	14.8	9.2	12.5	15.6	12.5	17	18.9	30	32	38
	SINUS 0020	5.5	7.5	19.5	9.2	12.5	17.9	11	15	18.3	12.5	17	18.9	30	36	43
	SINUS 0025	7.5	10	25.7	11	15	21	15	20	25	15	20	23.2	41	48	58
	SINUS 0030	9.2	12.5	30	15	20	29	18.5	25	30	18.5	25	28	41	56	67
	SINUS 0035	11	15	36	18.5	25	35	22	30	36	22	30	33	41	72	86
S12	SINUS 0016	-	-	-	7.5	10	14.8	9.2	12.5	15.6	11	15	16.5	27	30	36
	SINUS 0017	-	-	--	7.5	10	14.8	9.2	12.5	15.6	12.5	17	18.9	30	32	38
	SINUS 0020	-	-	-	9.2	12.5	17.9	11	15	18.3	12.5	17	18.9	30	36	43
	SINUS 0023	5.5	7.5	19.5	-	-	-	-	-	-	-	-	-	38	42	51
	SINUS 0025	-	-	-	11	15	21	15	20	25	15	20	23.2	41	48	58
	SINUS 0030	-	-	-	15	20	29	18.5	25	30	18.5	25	28	41	56	67
	SINUS 0033	7.5	10	25.7	-	-	-	-	-	-	-	-	-	51	56	68
	SINUS 0034	-	-	-	18.5	25	35	22	30	36	22	30	33	57	63	76
	SINUS 0036	-	-	-	22	30	41	25	35	40	28	38	41	60	72	86
	SINUS 0037	11	15	36	-	-	-	-	-	-	-	-	-	65	72	86
S15	SINUS 0038	12.5	17	41	22	30	41	25	35	40	28	38	41	65	75	90
	SINUS 0040	12.5	17	41	22	30	41	25	35	40	30	40	44	72	80	90
	SINUS 0049	15	20	50	25	35	46	30	40	48	37	50	53	80	96	115
S20	SINUS 0060	18.5	25	61	30	40	55	37	50	58	45	60	64	88	112	134
	SINUS 0067	20	27	66	32	45	59	40	55	63	50	70	70	103	118	142
	SINUS 0074	22	30	71	37	50	67	45	60	70	55	75	78	120	144	173
	SINUS 0086	25	35	80	45	60	80	55	75	85	65	90	88	135	155	186
S30	SINUS 0113	30	40	96	55	75	98	65	88	100	75	100	103	180	200	240
	SINUS 0129	37	50	117	65	90	114	75	100	116	85	115	120	195	215	258
	SINUS 0150	45	60	135	75	100	133	90	125	135	90	125	127	215	270	324
	SINUS 0162	55	75	170	90	125	159	110	150	166	110	150	153	240	290	348
S40	SINUS 0179	60	85	185	100	135	180	120	165	184	132	180	180	300	340	408
	SINUS 0200	65	90	195	110	150	191	132	180	198	150	200	211	345	365	438
	SINUS 0216	75	100	231	120	165	212	150	200	230	160	220	218	375	430	516
	SINUS 0250	90	125	277	132	180	228	185	250	279	200	270	273	390	480	576

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S50 [1]	SINUS	0312	110	150	332	185	250	321	220	300	326	250	340	337	480	600	720
	SINUS	0366	120	165	375	200	270	341	250	340	366	260	350	359	550	660	792
	SINUS	0399	132	180	390	220	300	375	260	350	390	300	400	413	630	720	864
S60 [1]	SINUS	0457	160	220	475	280	380	480	330	450	493	375	510	497	720	880	1056
	SINUS	0524	185	250	550	315	430	528	375	510	540	400	550	544	800	960	1152
S65 [1]	SINUS	0598	200	270	593	355	480	589	400	550	591	450	610	612	900	1100	1320
	SINUS	0748	250	340	732	400	550	680	500	680	731	560	760	751	1000	1300	1560
	SINUS	0831	280	380	840	450	610	765	560	760	817	630	860	864	1200	1440	1728
Inverter Supply Voltage			200-240Vac; 280-360Vdc.			380-500Vac; 530-705Vdc.											
The rated current of the applicable motor must not exceed 5% of Inom.																	
1) Input and output choke is required for these models.																	

Legend:

Inom = continuous rated current of the inverter.
Imax = max. current delivered by the inverter for 120 sec every 20 min up to S30, for 60 sec every 10 min for S40 and greater.
Ipeak = deliverable current for max. 3 seconds.

6.2. Carrier Frequency Setting (IFD SW only) and Peak Currents

The continuous current generated by the inverter in continuous operation type S1 at 40°C depends on 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. Alarm A21 (Heatsink overheated) can trip if higher carrier values are set up. Depending on the inverter model, peak current values represent transient maximum allowable current before overcurrent protections trip.

Size	SINUS K Model	Recommended Max. Carrier frequency (Parameters C001 and C002) CLASS: 2T - 4T					Peak Currents	
		LIGHT	STANDARD	HEAVY	STRONG	Max. Carrier	For 3s	Instant
		(kHz)	(kHz)	(kHz)	(kHz)	(kHz)	(A_{RMS})	(A_{peak})
S05	0005	8	10	16	16	16	14	28
	0007	8	10	16	16	16	16	33
	0008	8	10	16	16	16	19.5	
	0009	8	10	16	16	16	21	47
	0010	8	10	16	16	16	23	
	0011	8	10	16	16	16	25	56
	0013	8	10	16	16	16	25	
	0014	8	10	12.8	16	16	30	67
	0015	8	10	16	16	16	30	
	0016	8	10	16	16	16	36	
	0020	8	10	16	16	16	43	87
S10	0016	3	5	12.8	16	16	36	72
	0017	3	5	12.8	16	16	38	77
	0020	3	5	12.8	16	16	43	87
	0025	3	5	12.8	16	16	58	114
	0030	3	5	10	12.8	16	67	133
	0035	3	5	5	12.8	16	86	167
S12	0016	3	5	12.8	16	16	36	72
	0017	3	5	12.8	16	16	38	77
	0020	3	5	12.8	16	16	43	87
	0023	3	5	10	12.8	16	51	100
	0025	3	5	12.8	16	16	58	114
	0030	3	5	10	12.8	16	67	133
	0033	3	5	8	10	16	68	137
	0034	3	5	8	10	16	76	153
	0036	3	5	6	8	16	86	173
	0037	3	5	6	8	16	86	173
S15	0038	3	5	12.8	16	16	90	170
	0040	3	5	12.8	16	16	90	173
	0049	3	5	12.8	12.8	12.8	115	228

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S20	0060	3	5	12.8	12.8	12.8	134	266
	0067	3	5	12.8	12.8	12.8	142	280
	0074	3	5	12.8	12.8	12.8	173	347
	0086	3	5	10	12.8	12.8	186	373
S30	0113	3	5	10	10	10	240	484
	0129	3	5	10	10	10	258	520
	0150	3	4	5	5	5	324	596
	0162	3	4	5	5	5	348	640
S40	0179	3	4	4	4	4	408	807
	0200	3	4	4	4	4	438	867
	0216	2	3	4	4	4	516	1033
	0250	2	3	4	4	4	576	1153
S50	0312	2	3	4	4	4	720	1444
	0366	2	3	4	4	4	792	1589
	0399	2	3	4	4	4	864	1733
S60	0457	2	2	3	4	4	1056	2078
	0524	2	2	3	4	4	1152	2333
S65	0598	2	2	3	4	4	1320	2597
	0748	2	2	3	4	4	1560	3069
	0831	2	2	3	4	4	1728	3400

6.3. OPERATING TEMPERATURES BASED ON APPLICATION CLASSES

The operating temperature of the inverters of the SINUS K series is maximum 40 °C at rated current and can reach max. 50 °C if the operating current is reduced. The operating temperature of some SINUS K models can even exceed 40 °C at rated current. The maximum operating temperatures based on the inverter size and application class are detailed in the tables below.

NOTE The tables in this section apply to operating current values equal to or lower than the current rating stated in the relevant application sheet.

Size	SINUS K Model	APPLICATION - 2T-4T CLASS			
		LIGHT	STANDARD	HEAVY	STRONG
		Maximum operating temperature (°C)			
S05	0005	50	50	50	50
	0007	50	50	50	50
	0009	40	45	50	50
	0011	40	40	45	50
	0014	40	40	40	50
	0015	50	50	50	50
	0016	45	50	50	50
	0020	40	45	50	50
S10	0016	45	45	50	50
	0017	40	45	50	50
	0020	40	40	50	50
	0025	40	40	50	50
	0030	40	40	45	50
	0035	40	40	40	50
S12	0016	45	45	50	50
	0017	40	45	50	50
	0020	40	40	50	50
	0023	50	50	50	50
	0025	40	40	50	50
	0030	40	40	45	50
	0033	45	50	50	50
	0034	40	45	50	50
	0036	40	40	45	50
	0037	45	40	45	50
S15	0038	45	45	50	50
	0040	40	45	50	50
	0049	40	40	50	50
S20	0060	45	45	50	50
	0067	40	40	50	50
	0074	45	45	50	50
	0086	40	40	50	50
S30	0113	45	45	50	50
	0129	40	45	50	50
	0150	45	45	50	50
	0162	40	40	50	50

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S40	0179	45	50	50	50
	0200	40	45	50	50
	0216	40	45	50	50
	0250	40	40	50	50
S50	0312	50	50	50	50
	0366	45	45	50	50
	0399	40	40	50	50
S60	0457	45	45	50	50
	0524	40	40	50	50
S65	0598	50	50	50	50
	0748	45	45	50	50
	0831	40	40	50	50

7. INSTALLING THE EQUIPMENT

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 to hot exhaust air.

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

7.1. Environmental Requirements for the Equipment Installation, Storage and Transport

Operating ambient temperatures	0-40°C with no derating from 40°C to 50°C with a 2% derating of the rated current for each degree beyond 40°C
Ambient temperatures for storage and transport	- 25°C - +70°C
Installation environment	Pollution degree 2 or higher. Do not install in direct sunlight and in places exposed to conductive dust, corrosive gases, vibrations, water sprinkling or dripping; do not install in salty environments.
Altitude	Up to 1000 m above sea level. For higher altitudes, derate the output current of 1% every 100m above 1000m (max. 4000m).
Operating ambient humidity	From 5% to 95%, from 1g/m^3 to 29g/m^3, non condensing and non freezing (class 3k3 according to EN50178)
Storage ambient humidity	From 5% to 95%, from 1g/m^3 to 29g/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.

7.2. Air Cooling

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

Size	A – side clearance (mm)	B – side clearance between two inverters (mm)	C – bottom clearance (mm)	D – top clearance (mm)
S05	20	40	50	100
S10	30	60	60	120
S12	30	60	60	120
S15	30	60	80	150
S20	50	100	100	200
S30	100	200	200	200
S40	100	200	200	300
S50	100	200	200	300
S60	150	300	500	300

Size	Minimum side clearance between two inverter modules (mm)	Maximum side clearance between two inverter modules (mm)	Maximum side clearance between two supply modules (mm)	Maximum side clearance between inverters and supply modules (mm)	Top clearance (mm)	Bottom clearance (mm)	Clearance between two inverter units (mm)
S65	20	50	50	400	300	500	300

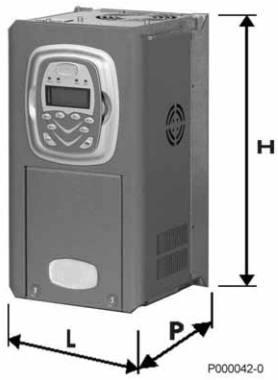
The air circulation through the enclosure must avoid warm air intake. Make sure to provide an adequate air cooling through the inverter. The technical data related to dissipated power are shown in the ratings table.
The air delivery required may be calculated as follows:
air delivery Q= (**Pdiss**/ Δt)*3.5 (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).

7.3. Size, Weight and Dissipated Power

7.3.1. IP20 AND IP00 STAND-ALONE MODELS (S05-S60) 2T CLASS

Size	MODEL	L	H	D	Wgt	Power Dissipated at Inom.
		mm	mm	mm	kg	W
S05	SINUS K 0007	170	340	175	7	160
	SINUS K 0008				7	170
	SINUS K 0010				7	220
	SINUS K 0013				7	220
	SINUS K 0015				7	230
	SINUS K 0016				7	290
	SINUS K 0020				7	320
S10	SINUS K 0016	215	391	218	10.5	350
	SINUS K 0017				10.5	380
	SINUS K 0020				10.5	420
	SINUS K 0025				11.5	525
	SINUS K 0030				11.5	525
	SINUS K 0035				11.5	525
S12	SINUS K 0023	215	401	225	11	390
	SINUS K 0033				12	500
	SINUS K 0037				12	560
S15	SINUS K 0038	225	466	331	22.5	750
	SINUS K 0040				22.5	820
	SINUS K 0049				22.5	950
S20	SINUS K 0060	279	610	332	33.2	950
	SINUS K 0067				33.2	1250
	SINUS K 0074				36	1350
	SINUS K 0086				36	1500
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
S60	SINUS K 0457	890	1310	530	260	7400
	SINUS K 0524				260	8400



7.3.2. IP20 AND IP00 STAND-ALONE MODELS (S05 – S60) 4T CLASS

Size	MODEL	L	H	D	Wgt	Power Dissipated at Inom.
		mm	mm	mm	kg	W
S05	SINUS K 0005	170	340	175	7	215
	SINUS K 0007				7	240
	SINUS K 0009				7	315
	SINUS K 0011				7	315
	SINUS K 0014				7	315
S10	SINUS K 0016	215	391	218	10.5	350
	SINUS K 0017				10.5	380
	SINUS K 0020				10.5	420
	SINUS K 0025				11.5	525
	SINUS K 0030				11.5	525
	SINUS K 0035				11.5	525
S12	SINUS K 0016	215	401	225	10.5	430
	SINUS K 0017				10.5	490
	SINUS K 0020				10.5	490
	SINUS K 0025				11.5	520
	SINUS K 0030				11.5	520
	SINUS K 0034				12.5	680
	SINUS K 0036				12.5	710
S15	SINUS K 0038	225	466	331	22.5	750
	SINUS K 0040				22.5	820
	SINUS K 0049				22.5	950
S20	SINUS K 0060	279	610	332	33.2	950
	SINUS K 0067				33.2	1250
	SINUS K 0074				36	1350
	SINUS K 0086				36	1500
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
S60	SINUS K 0457	890	1310	530	260	7400
	SINUS K 0524				260	8400

7.3.3. MODULAR IP00 STAND-ALONE MODELS (S65)

To obtain high-power inverters, the following individual modules are matched together:
- Control unit, containing ES821 control board and ES842 board
- Feeder module, composed of a 3-phase power rectifier and its control and power supply circuits
- Inverter module, composed of an inverter phase and its control circuits
- Braking unit.

Three types of inverter modules are available:

- Basic version;
- Version with integrated control unit;
- Version with integrated auxiliary power supply unit (to be used for Sinus K models which are not equipped with the feeder module—S64).

Match the elements above to obtain the proper inverter dimensioning for your application.

CAUTION Properly configure control board ES842 inside the control unit. When ordering the inverter, always state the inverter configuration you want to obtain.

a) Control unit
The control unit can be installed separately from the inverter modules or inside an inverter module (this option must be required when ordering the inverter).
Dimensions of the control unit (separate from the inverter):

EQUIPMENT	L	H	D	Weight	Dissipated power
	mm	mm	mm	kg	W
Control unit	222	410	189	6	100

NOTE In the standard configuration of Sinus K inverters, the control unit is integrated into an inverter module.

b) Inverter modules and supply modules

Configuration: power supply delivered from the mains

Size	SINUS K Model	Voltage Class	Modules		Dimensions		Weight			Power dissipated at Inom		
			Power Supply Modules	Inverter Modules	Single Module	Min. Overall Dimensions		Power Supply Module	Inverter Module	Single Module	Min. Overall Dimensions	
					LxHxD	LxHxD	kg	kg	kg	kW	kW	kW
S65	0598	2T-4T	1	3	230x1400x480 (*)	980x1400x560	110	110	440	2.25	2.5	9.75
	0748	2T-4T	1	3						2.5	2.75	10.75
	0831	2T-4T	1	3						3.0	3.3	12.9

(*) When housing the control unit, the module depth becomes 560 mm.

c) Inverter, feeder and braking unit

Configuration: mains power supply plus braking unit

Size	SINUS K Model	Voltage Class	Modules			Dimensions		Weight				Power dissipated at Inom		Power Dissipated with 50% Braking Duty Cycle	Overall Dissipated Power
			Power Supply Modules	Inverter Modules	Braking Modules	Single Module	Min. Overall Dimensions	Power Supply Module	Inverter Module	Braking Module	Overall Weight	Power Supply Module	Inverter Module	Braking Module	
						LxHxD	LxHxD	kg	kg	kg	kg	kW	kW	kW	kW
S65	0598	2T-4T	1	3	1	230x1400 x480 (*)	1230x1400 x560	110	110	110	550	2.25	2.5	0.8	10.55
	0748	2T-4T	1	3	1							2.5	2.75	0.9	11.65
	0831	2T-4T	1	3	1							3.0	3.3	1.0	13.9

(*) When housing the control unit, the module depth becomes 560 mm.

d) Inverter modules only

Configuration: inverter powered directly from a DC power supply source.

Size	SINUS K Model	Voltage Class	Modules		Dimensions		Weight			Power Dissipated at Inom	
			Inverter Modules with Auxiliary Power Supply Unit	Inverter Modules (**)	Single Module	Min. Overall Dimensions				Inverter Modules with Auxiliary Power Supply Unit	Inverter Modules (**)
					LxHxD	LxHxD	kg	kg	kg	kW	kW
S64	0598	2T-4T	1	2	230x1400 x480(*)	730x1400 x560	118	110	338	2.5	7.5
	0748	2T-4T	1	2						2.75	8.25
	0831	2T-4T	1	2						3.3	9.9

(*) When housing the control unit or the auxiliary power supply unit, the module depth is 560 mm.
(**) One inverter module must be provided with an integrated auxiliary power supply unit.

e) Inverter modules and braking module only

Configuration: inverter powered directly from a DC power supply source with a braking unit.

Size	SINUS K Model	Voltage Class	Modules			Dimensions		Weight				Power dissipated at Inom	Power Dissipated with 50% Braking Duty Cycle	Overall Dissipated Power
			Inverter Modules with Auxiliary Power Supply Unit	Inverter modules (**)	Braking Module	Single Module	Min. Overall Dimensions	Inverter Modules with Auxiliary Power Supply Unit	Inverter Module	Braking Module	Overall Weight	Inverter Module	Braking Module	
						LxHxD	LxHxD	kg	kg	kg	kg	kW	kW	kW
S64	0598	2T-4T	1	2	1	230x1400 x480 (*)	980x140 0x560	118	110	110	448	2.5	0.8	8.3
	0748	2T-4T	1	2	1							2.75	0.9	9.15
	0831	2T-4T	1	2	1							3.3	1.0	10.9

(*) When housing the control unit or the auxiliary power supply unit, the module depth is 560 mm.

7.3.4. IP54 STAND-ALONE MODELS (S05-S30) 2T CLASS

Size	MODEL	L	H	D	Wgt	Power Dissipated at Inom.
		mm	mm	mm	kg	W
S05	SINUS K 0007	214	577	227	15.7	160
	SINUS K 0008				15.7	170
	SINUS K 0010				15.7	220
	SINUS K 0013				15.7	220
	SINUS K 0015				15.7	230
	SINUS K 0016				15.7	290
	SINUS K 0020				15.7	320
S10	SINUS K 0016	250	622	268	22.3	350
	SINUS K 0017				22.3	380
	SINUS K 0020				22.3	420
	SINUS K 0025				23.3	525
	SINUS K 0030				23.3	520
	SINUS K 0035				23.3	525
S12	SINUS K 0023	250	622	268	23.3	390
	SINUS K 0033				23.3	500
	SINUS K 0037				23.8	560
S15	SINUS K 0038	288	715	366	40	750
	SINUS K 0040				40	820
	SINUS K 0049				40	950
S20	SINUS K 0060	339	842	366	54.2	1050
	SINUS K 0067				54.2	1250
	SINUS K 0074				57	1350
	SINUS K 0086				57	1500
S30	SINUS K 0113	359	1008	460	76	2150
	SINUS K 0129				76	2300
	SINUS K 0150				76	2450
	SINUS K 0162				76	2700

OPTIONAL FEATURES:

Front key-operated selector switch for
LOCAL/REMOTE control and EMERGENCY push-button.

NOTE When housing optional features, depth becomes 40mm.

7.3.5. IP54 STAND-ALONE MODELS (S05-S30) 4T CLASS

Size	MODEL	L	H	D	Wgt	Power Dissipated 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	622	268	22.3	350
	SINUS K 0017				22.3	380
	SINUS K 0020				22.3	420
	SINUS K 0025				23.3	525
	SINUS K 0030				23.3	520
	SINUS K 0035				23.3	525
S12	SINUS K 0016	250	622	268	22.3	430
	SINUS K 0017				22.3	490
	SINUS K 0020				22.3	490
	SINUS K 0025				23.3	520
	SINUS K 0030				23.3	520
	SINUS K 0034				24.3	680
	SINUS K 0036				24.3	710
S15	SINUS K 0038	288	715	366	40	750
	SINUS K 0040				40	820
	SINUS K 0049				40	950
S20	SINUS K 0060	339	842	366	54.2	1050
	SINUS K 0067				54.2	1250
	SINUS K 0074				57	1350
	SINUS K 0086				57	1500
S30	SINUS K 0113	359	1008	460	76	2150
	SINUS K 0129				76	2300
	SINUS K 0150				76	2450
	SINUS K 0162				76	2700

OPTIONAL FEATURES:

Front key-operated selector switch for
LOCAL/REMOTE control and EMERGENCY push-button.

NOTE When housing optional features, depth becomes 40mm.

7.3.6. IP54 BOX MODELS (S05-S20) 2T CLASS

Size	MODEL	L	H	D	Wgt	Power Dissipated at Inom.
		mm	mm	mm	kg	W
S05B	SINUS BOX K 0007	400	600	250	27.9	160
	SINUS BOX K 0008				27.9	170
	SINUS BOX K 0010				27.9	220
	SINUS BOX K 0013				27.9	220
	SINUS BOX K 0015				27.9	230
	SINUS BOX K 0016				27.9	290
	SINUS BOX K 0020				27.9	320
S10B	SINUS BOX K 0016	500	700	300	48.5	350
	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
S12B	SINUS BOX K 0023				48.5	390
	SINUS BOX K 0033	500	700	300	49.5	500
	SINUS BOX K 0037				49.5	560
S15B	SINUS BOX K 0038	600	1000	400	78.2	750
	SINUS BOX K 0040				78.2	820
	SINUS BOX K 0049				78.2	950
S20B	SINUS BOX K 0060	600	1200	400	109.5	1050
	SINUS BOX K 0067				109.5	1250
	SINUS BOX K 0074				112.3	1350
	SINUS BOX K 0086				112.3	1500

OPTIONAL FEATURES:

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

NOTE Dimensions and weights can vary depending on optional components required.

7.3.7. IP54 BOX MODELS (S05-S20) 4T CLASS

Size	MODEL	L	H	D	Wgt	Power Dissipated 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	350
	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	750
	SINUS BOX K 0040				78.2	820
	SINUS BOX K 0049				78.2	950
S20B	SINUS BOX K 0060		1200		109.5	1050
	SINUS BOX K 0067				109.5	1250
	SINUS BOX K 0074				112.3	1350
	SINUS BOX K 0086				112.3	1500

OPTIONAL FEATURES:

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

NOTE Dimensions and weights can vary depending on optional components required.

7.3.8. IP24 - IP54 CABINET MODELS (S15-S65)

Size	MODEL		Voltage Class	L	H	D	Weight	Power Dissipated at Inom.
				mm	mm	mm	kg	W
S15C	SINUS CABINET K	0049	2T-4T	600	2000	500	130	950
S20C	SINUS CABINET K	0060	2T-4T	600	2000	500	140	1050
	SINUS CABINET K	0067					140	1250
	SINUS CABINET K	0074					143	1350
	SINUS CABINET K	0086					143	1500
S30C	SINUS CABINET K	0113	2T-4T			600	162	2150
	SINUS CABINET K	0129					162	2300
	SINUS CABINET K	0150					162	2450
	SINUS CABINET K	0162					162	2700
S40C	SINUS CABINET K	0179	2T-4T	1000			279	3200
	SINUS CABINET K	0200					279	3650
	SINUS CABINET K	0216					279	4100
	SINUS CABINET K	0250					279	4250
S50C	SINUS CABINET K	0312	2T-4T	1200			350	4900
	SINUS CABINET K	0366					350	5600
	SINUS CABINET K	0399					350	6400
S60C	SINUS CABINET K	0457	2T-4T	1600	2350	800	586	7400
	SINUS CABINET K	0524					586	8400
S65C	SINUS CABINET K	0598	2T-4T	2000			854	9750
	SINUS CABINET K	0748					854	10750
	SINUS CABINET K	0831					854	12900

NOTE Dimensions and weights can vary depending on optional components required.

OPTIONAL FEATURES:

- Disconnecting switch with line fast fuses.
- Line magnetic circuit breaker with release coil.
- Line contactor in AC1.
- Front key-operated selector switch for **LOCAL/REMOTE** control and **EMERGENCY pushbutton**.
- Line input impedance.
- Motor-side output impedance.
- Additional terminal board for input/output wires.
- Output toroid filter.
- Motor forced-cooling circuit.
- Braking unit for size ≥ S40.
- Anticondensation resistance.
- PT100 instruments for motor temperature control.
- Optional features/components by request.

7.4. Standard Mounting and Fixing Points for IP20 and IP00 Stand-Alone Models (S05-S60)

SINUS K Size	Fixing Points (mm) (Standard Mounting)					
	X	X1	Y	D1	D2	Fastening Screws
S05	156	-	321	4.5	-	M4
S10	192	-	377	6	12.5	M5
S12	192	-	377	6	12.5	M5
S15	185	-	449	7	15	M6
S20	175	-	593	7	15	M6
S30	213	-	725	9	20	M8
S40	540	270	857	9	20	M8
S50	560	280	975	11	21	M8-M10
S60	570	285	1238	13	28	M10-M12

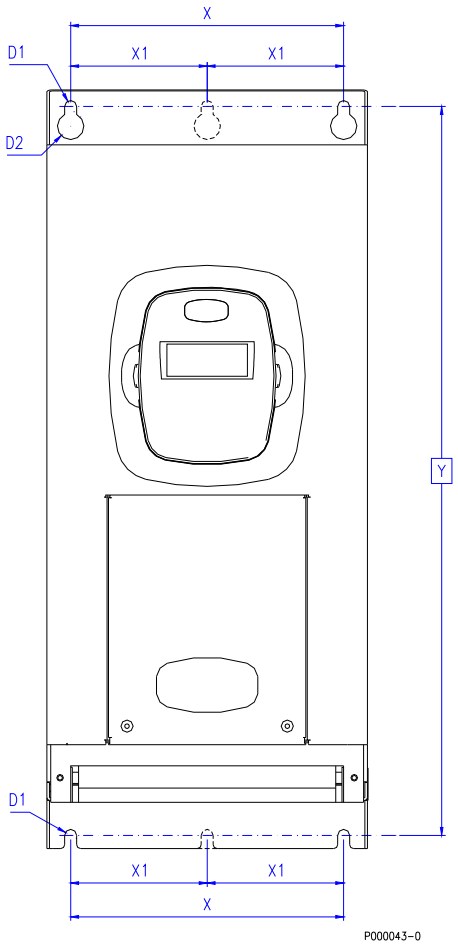


Figure 4: Fixing points for STAND-ALONE models from S05 to S50 included.

Size S60 has an IP00 open cabinet and can be installed only inside the equipment enclosure.

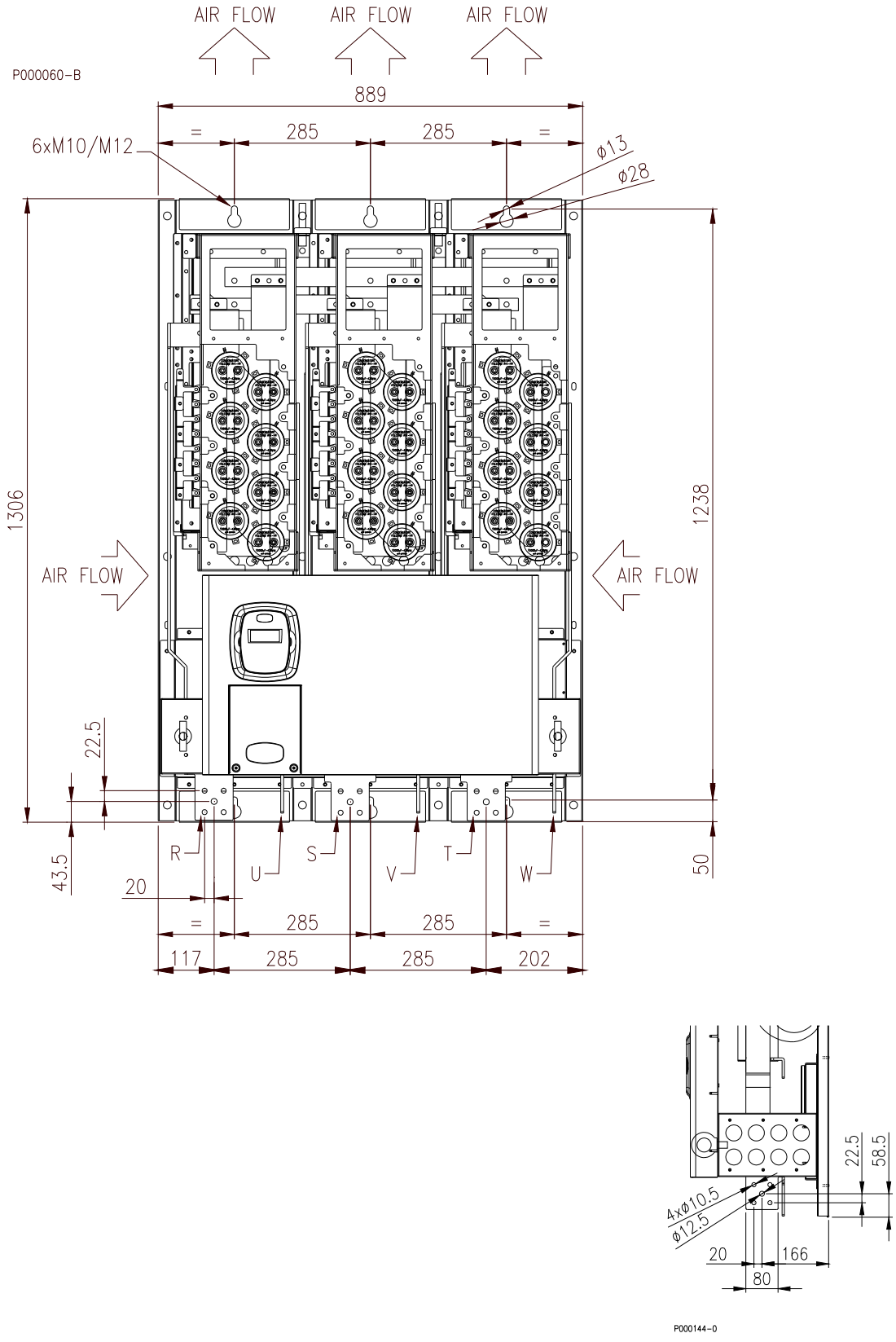


Figure 5: Fixing points for stand-alone models (S60).

7.5. Standard Mounting and Fixing Points for IP00 Modular Stand–Alone Models (S64-S65)

High-power inverters include single function modules.

Their control unit may be installed separately or inside a module.
Mounting options are shown below:

a) Control unit integrated into the inverter

MODULE	Fixing Templates (mm) (Single Module)					Modules Fitted Inverter Size					
	X	Y	D1	D2	Fastening Screws	S64	S65	S70	S74	S75	S80
FEEDER	178	1350	11	25	M10	-	1	2	-	2	3
INVERTER	178	1350	11	25	M10	1	2	2	-	2	2
INVERTER WITH INTEGRATED CONTROL UNIT	178	1350	11	25	M10	1	1	1	1	1	1
INVERTER WITH INTEGRATED AUXILIARY POWER SUPPLY UNIT	178	1350	11	25	M10	1	-	-	2	-	-

b) Control unit separate from the inverter module

MODULE	Fixing Templates (mm) (Single Module)					Modules Fitted Inverter Size					
	X	Y	D1	D2	Fastening Screws	S64	S65	S70	S74	S75	S80
FEEDER	178	1350	11	25	M10	-	1	2	-	2	3
INVERTER	178	1350	11	25	M10	2	3	3	1	3	3
INVERTER WITH INTEGRATED AUXILIARY POWER SUPPLY UNIT	178	1350	11	25	M10	1	-	-	2	-	-
CONTROL UNIT	184	396	6	14	M5	1	1	1	1	1	1

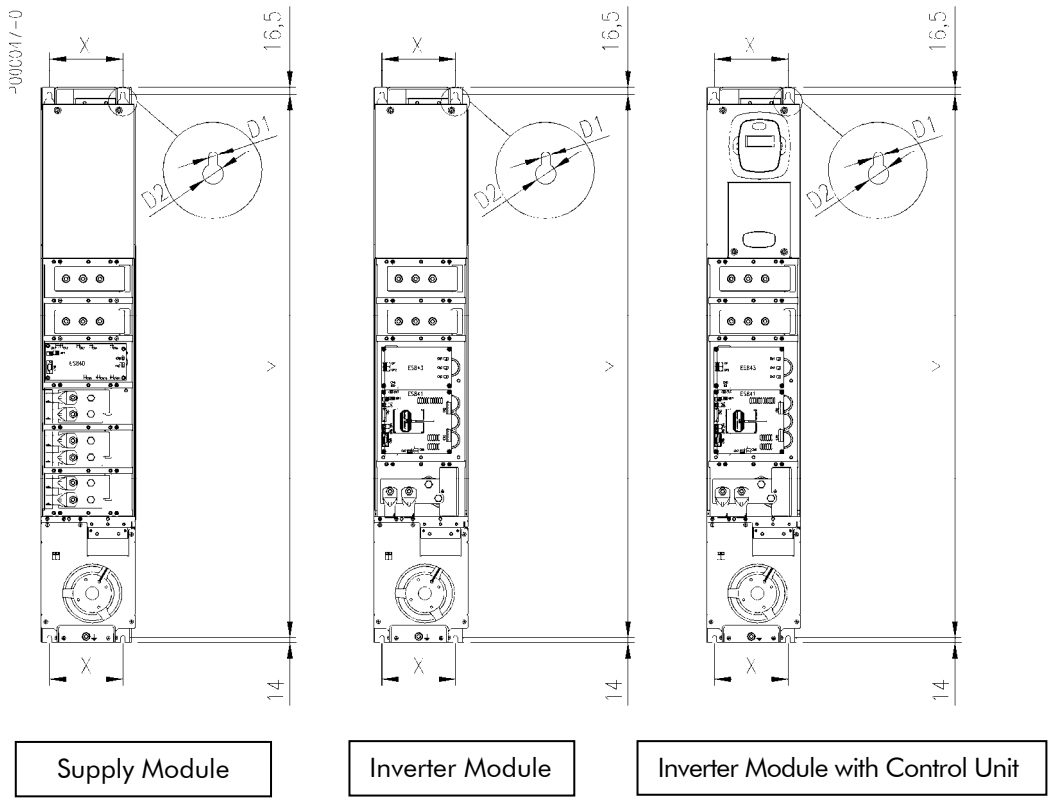


Figure 6: Fixing points for modular units.

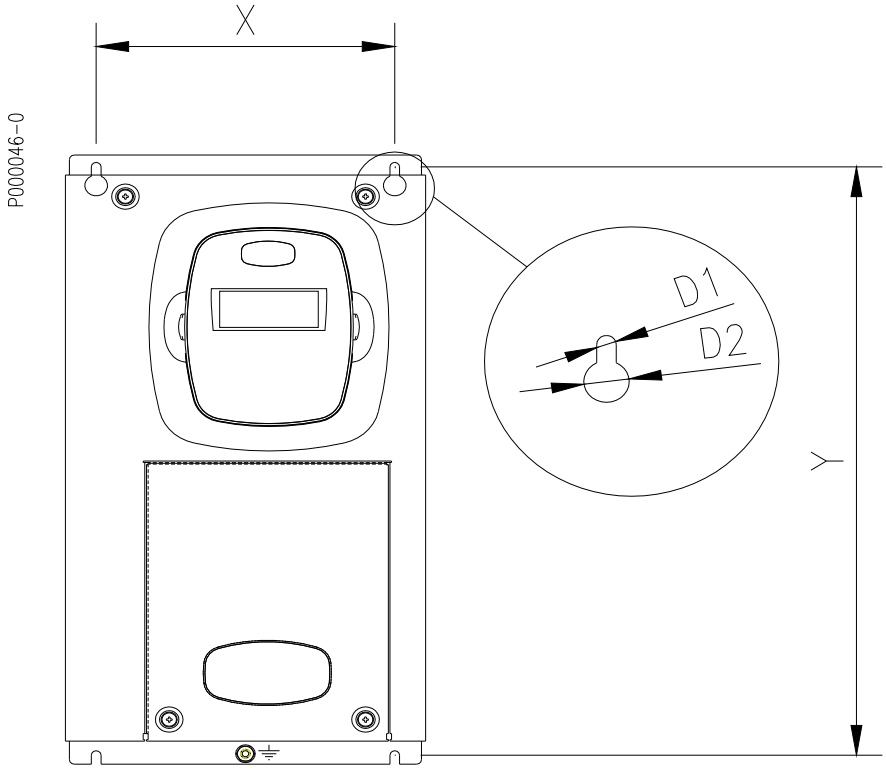


Figure 7: Fixing points for stand-alone control unit.

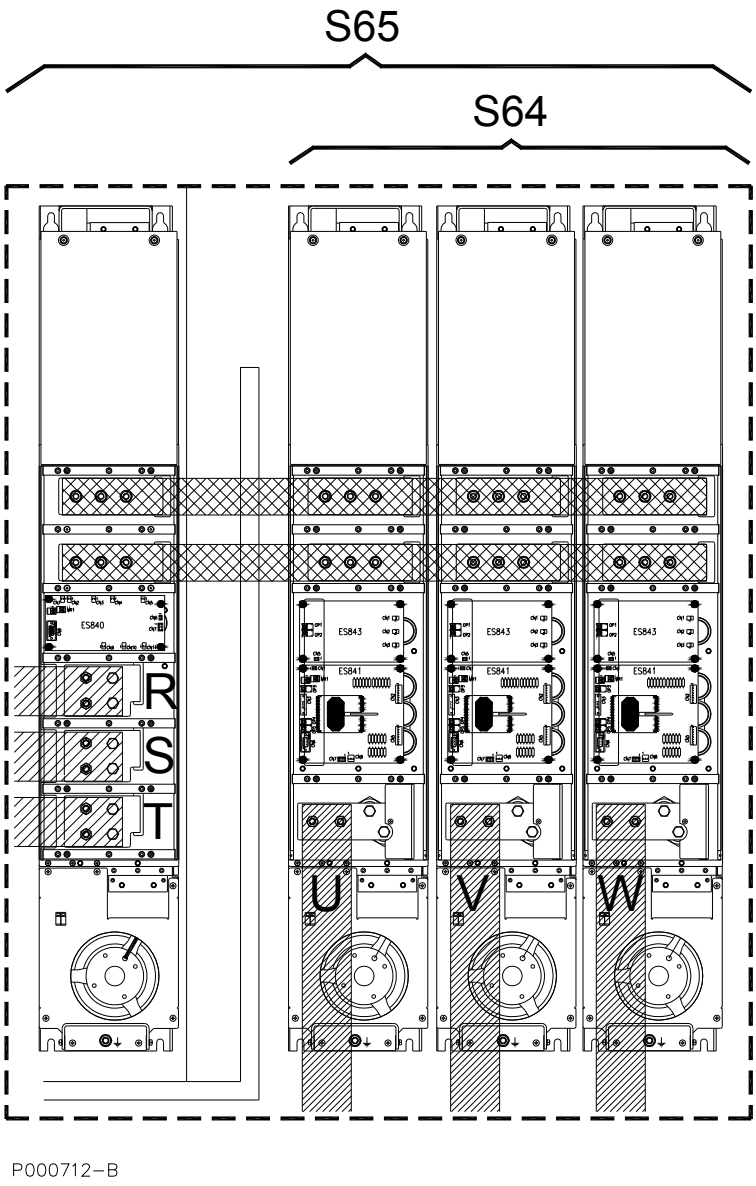


Figure 8: Installation Example of a SINUS K S64 – S65.

7.5.1. INSTALLATION AND WIRING OF A MODULAR INVERTER (S65)

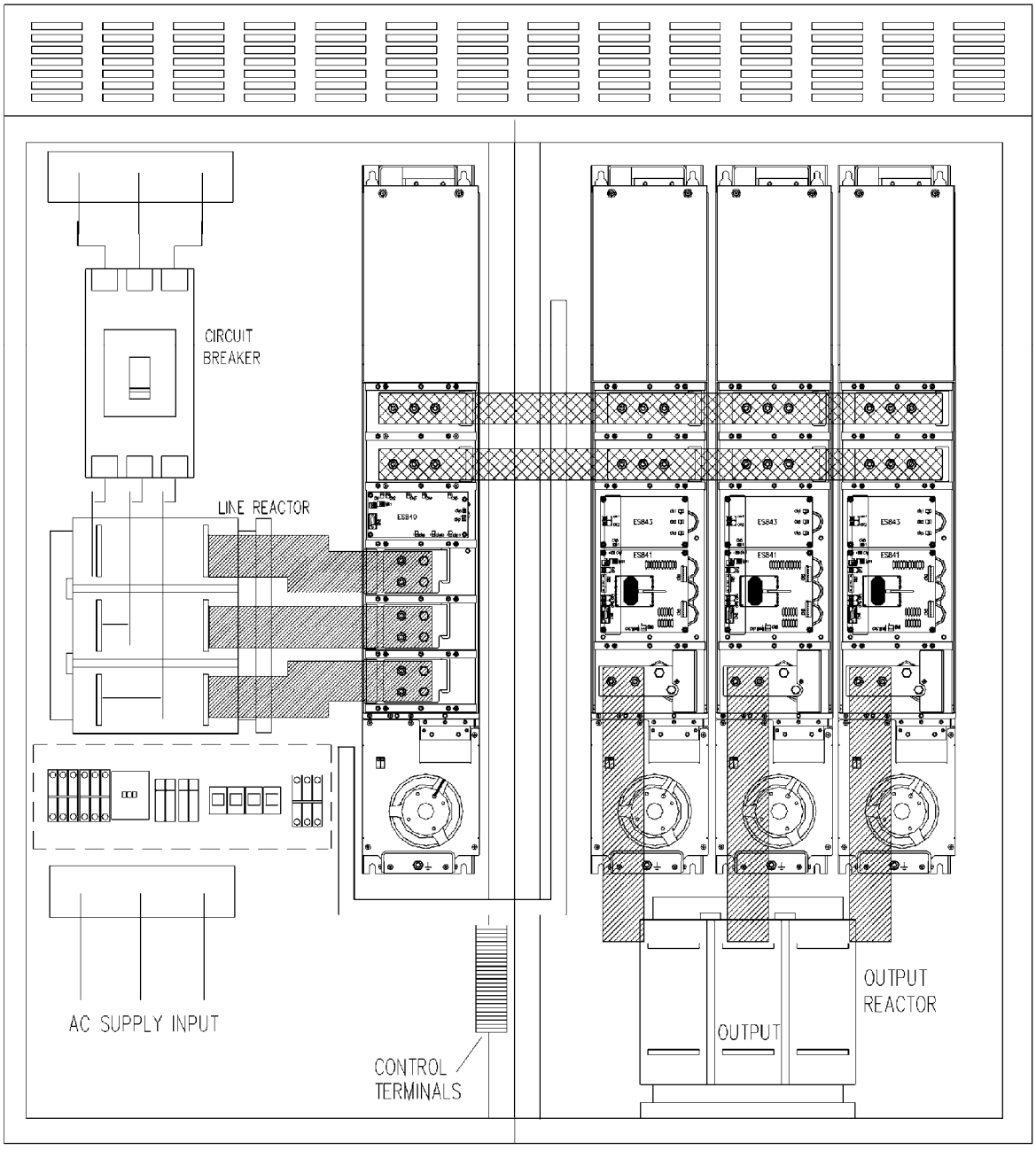


Figure 9: S65 inverter installed inside an enclosure.

7.6. Standard Mounting and Fixing Points for IP54 Stand-Alone Models (S05-S30)

SINUS K (IP54)	Fixing Points (mm) (Standard Mounting)				
	X	Y	D1	D2	Fastening Screws
S05	177	558	7	15	M6
S10/S12	213	602.5	7	15	M6
S15	223	695	10	20	M8
S20	274	821	10	20	M8
S30	296	987	10	20	M8

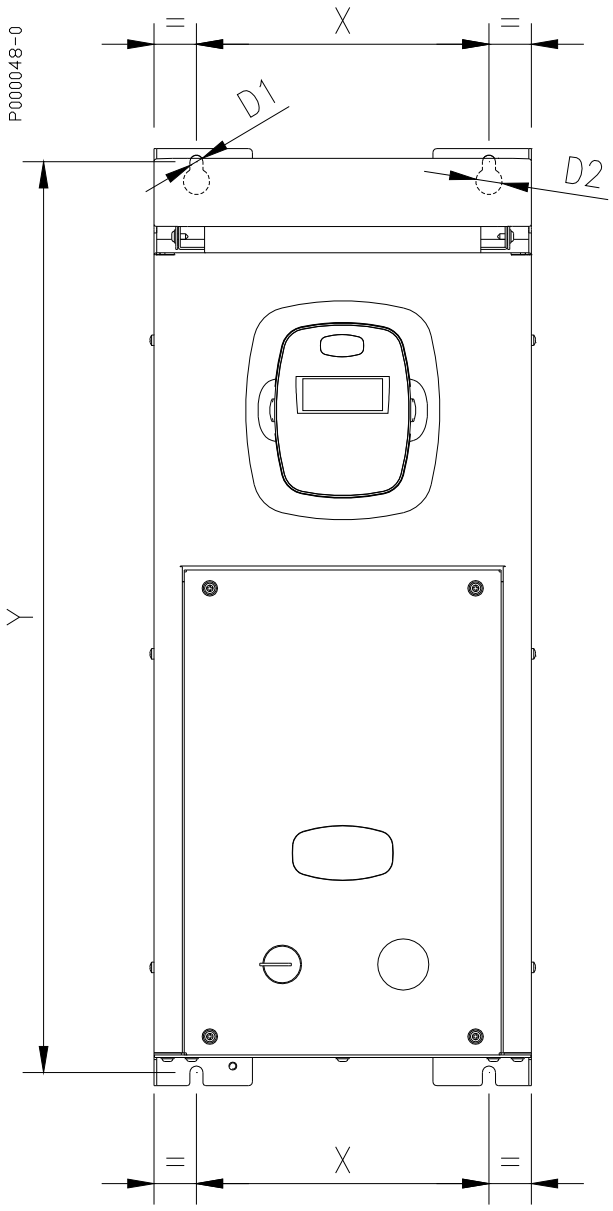


Figure 10: Fixing points for IP54 SINUS K.

7.7. Through-panel Assembly and Fixing Points (Stand-Alone Models S05-S50)

The through-panel assembly allows segregating the air flow cooling the power section in order to avoid dissipating power due to inverter loss inside the inverter case. The inverters available for through-panel assembly are from size S05 to S50, both IP20 and IP00. As a result, unless other features are included, IP44 rating becomes IP40.

7.7.1. 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 11).

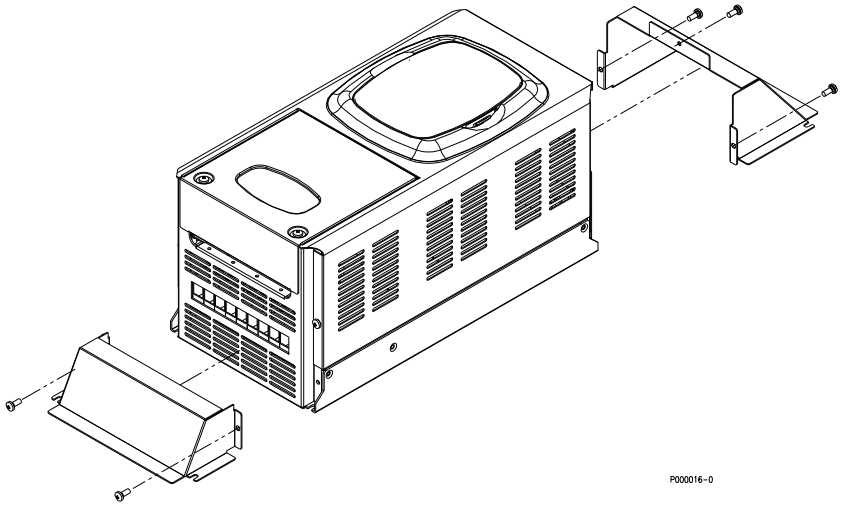


Figure 11: Mounting the accessories for the through-panel assembly of SINUS K S05.

The equipment height becomes 488 mm with the two additional components (see Figure 12)The figure 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.

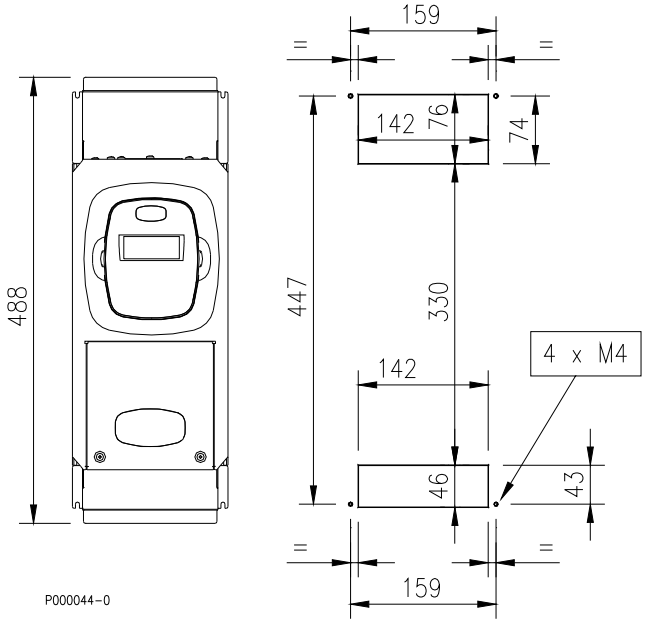


Figure 12: Fixing points of the mounting panel for the through-panel assembly of SINUS K S05.

7.7.2. SINUS K S10

Through-panel assembly is possible for this inverter size. A special kit is to be assembled on the inverter (see Figure 13). self-forming screws are used for this type of assembly.

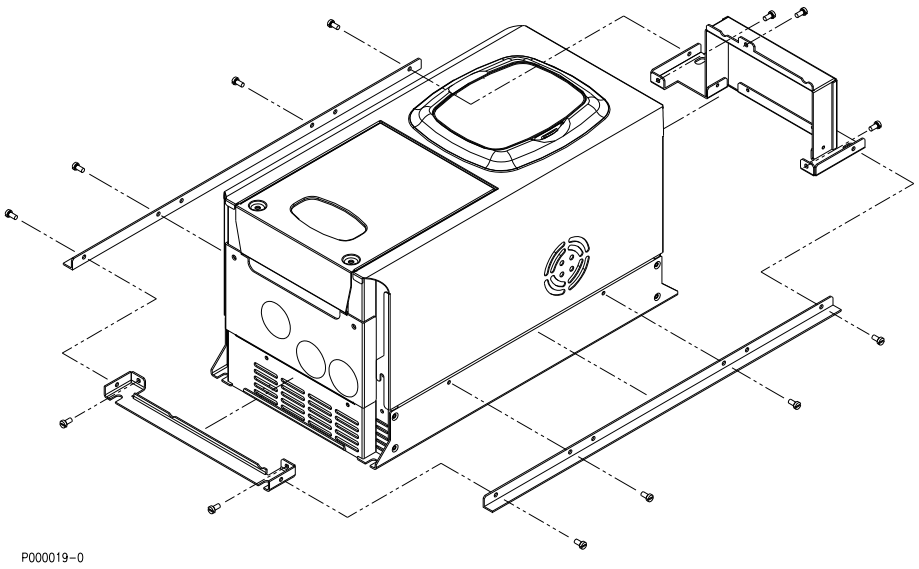


Figure 13: Mounting the accessories for the through-panel assembly of SINUS K S10.

The overall dimensions of the equipment including the through-panel assembly kit are 452 x 238 mm (see Figure 14). The figure shows the piercing template of the mounting panel, including four M5 holes and a rectangular slot (218 x 420 mm) as well as the equipment side view with two air flows (air flow "A" for the control section and air flow "B" for the power section).

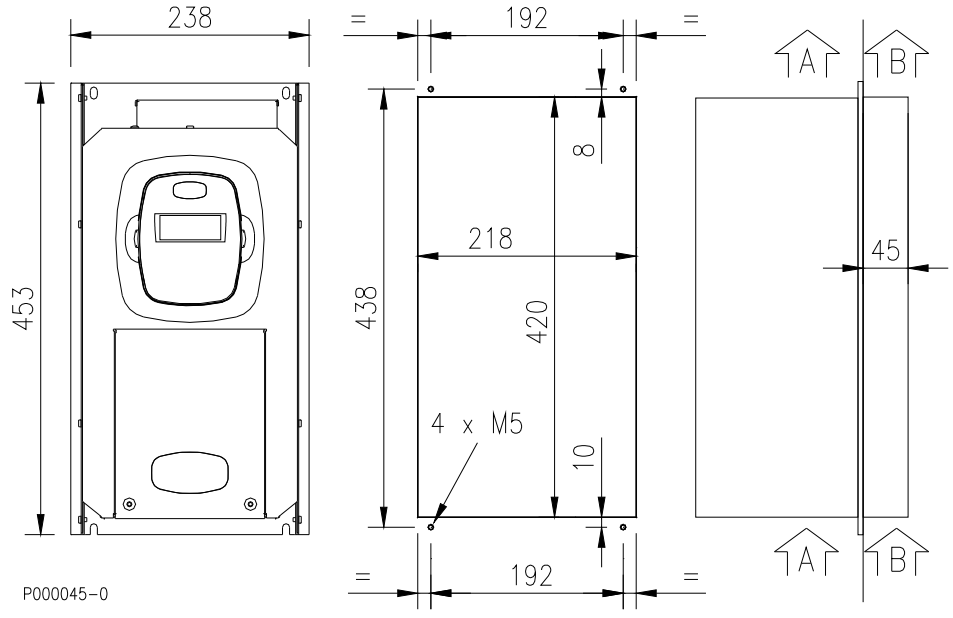


Figure 14: Fixing points of the mounting panel for the through-panel assembly of SINUS K S10.

7.7.3. SINUS K S12

For this inverter size, no actual through-panel assembly is used, but the air flow of the power section is segregated from the air flow of the control section by installing two optional mechanical parts to be assembled with five (5) M4 self-forming screws (see Figure 15: Fittings for the through-panel assembly for SINUS K S12.).

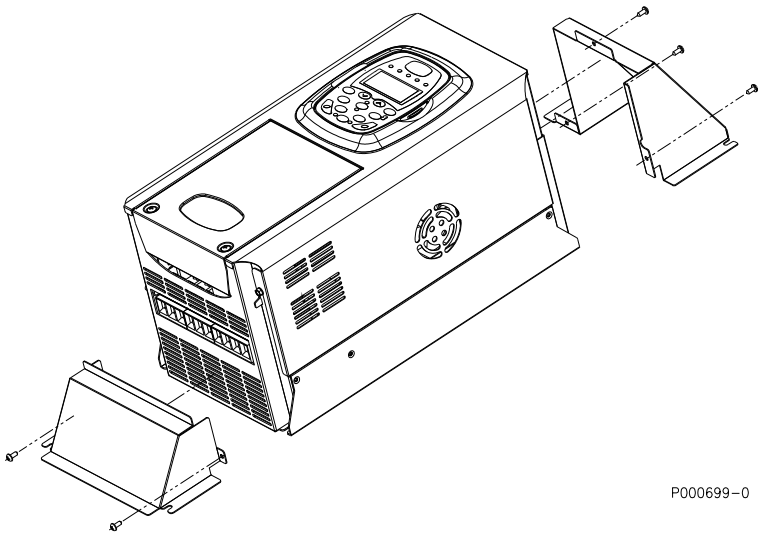


Figure 15: Fittings for the through-panel assembly for SINUS K S12.

The equipment height becomes 583 mm with the two additional components (see Figure 16). The same figure below also shows the piercing template of the mounting panel, including four M4 holes for the inverter mounting and two slots (175 x 77 mm and 175 x 61 mm) for the air-cooling of the power section.

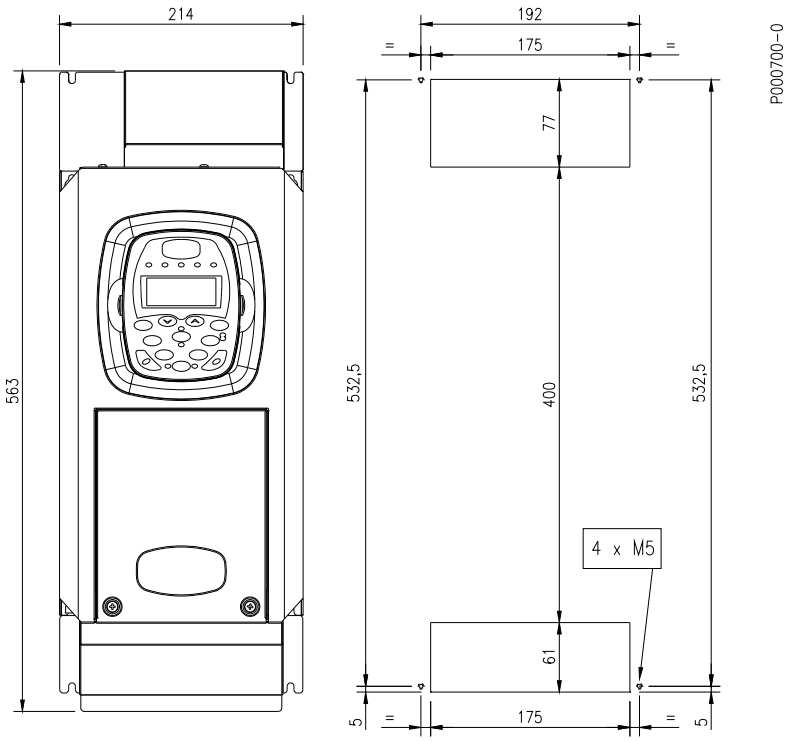


Figure 16: Piercing template for the through-panel assembly for SINUS K S12.

7.7.4. 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).

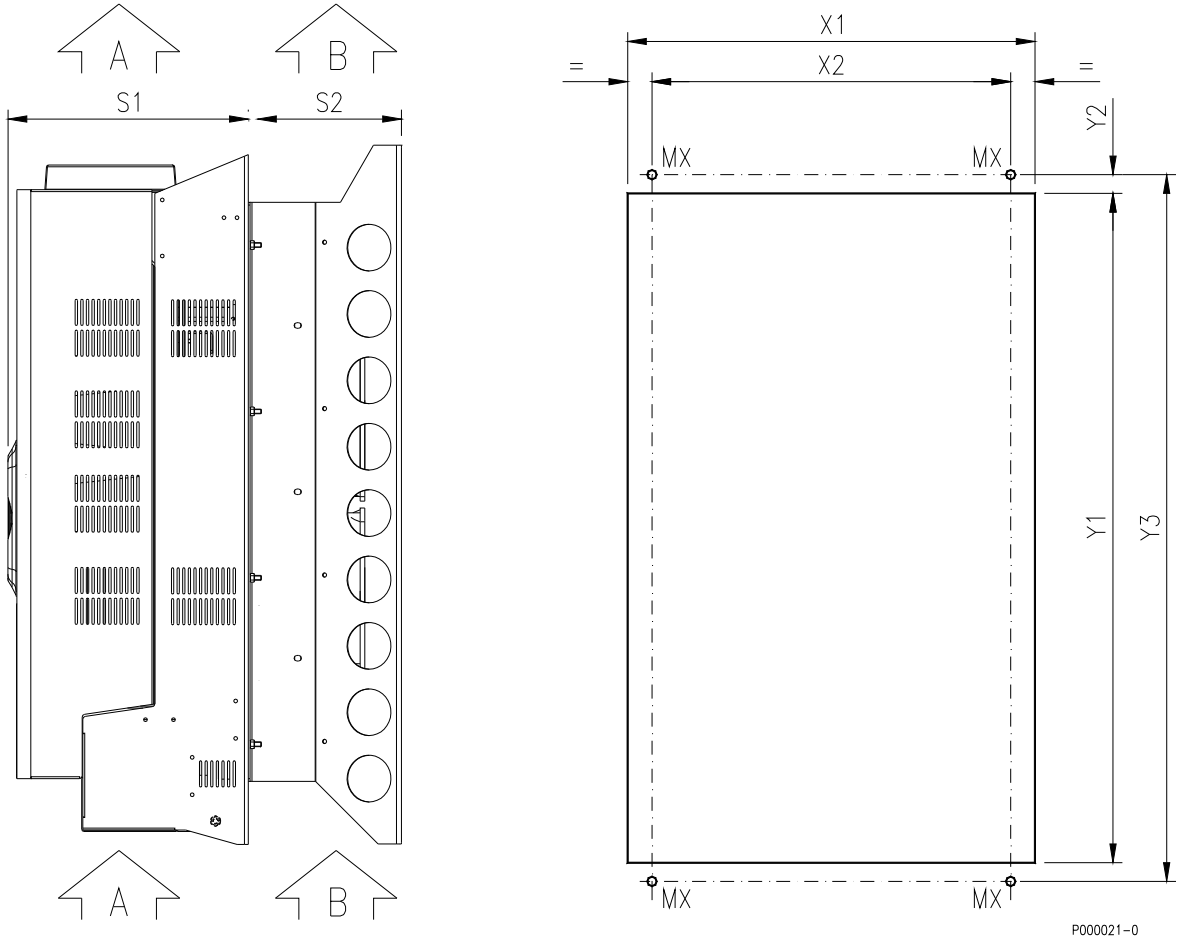
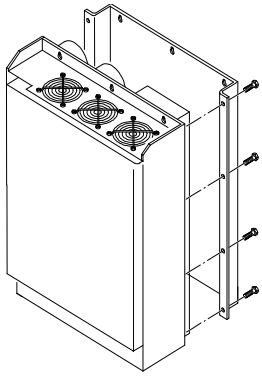


Figure 17: Through-panel assembly and fixing points for SINUS K S15, S20, S30.

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

7.7.5. 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 14 shows 4 screws on one side of the inverter).

Figure 18: Removing the mounting plate from SINUS K S40 for the through-panel assembly.

The piercing template shown in the figure below 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).

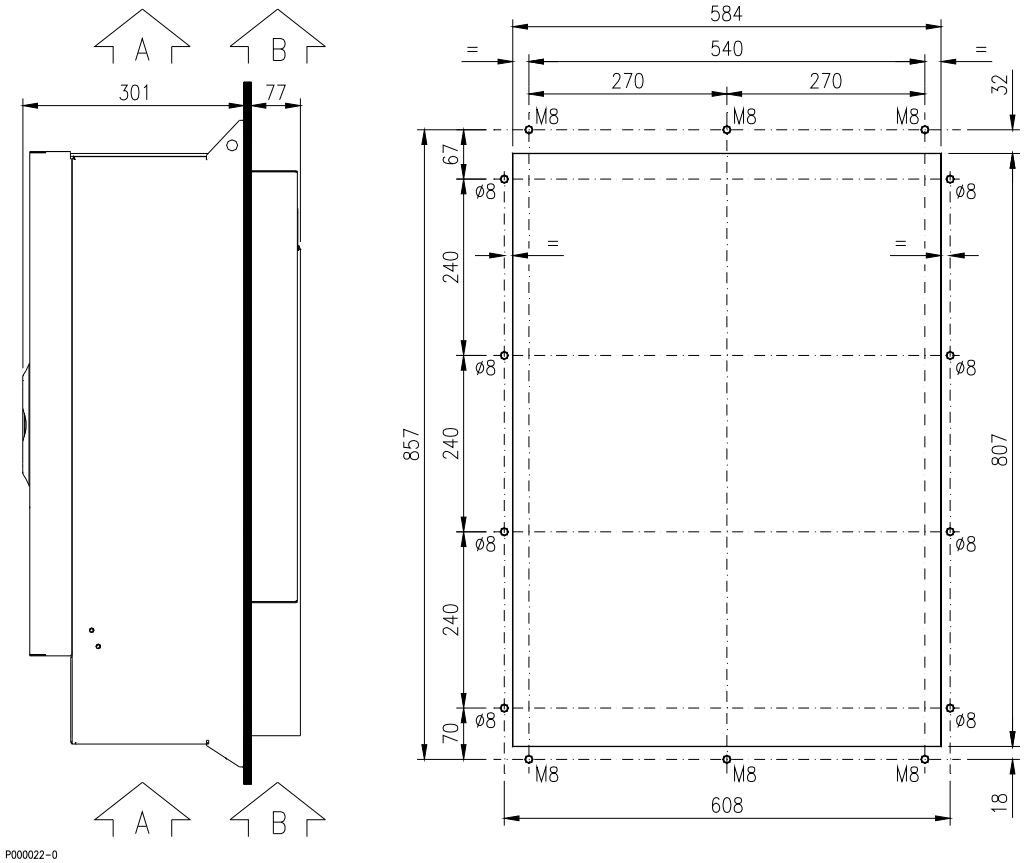
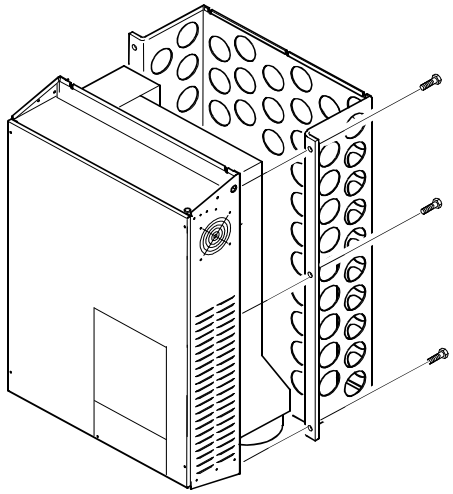


Figure 19: Through-panel assembly and fixing points for SINUS K S40.

7.7.6. SINUS K S50

To obtain the through-panel assembly of this inverter size, the bottom mounting plate must be removed. The figure below shows how to disassemble the mounting plate.



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

Figure 20: Removing the mounting plate from SINUS K S50 for the through-panel assembly.

The piercing template shown in the figure below (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).

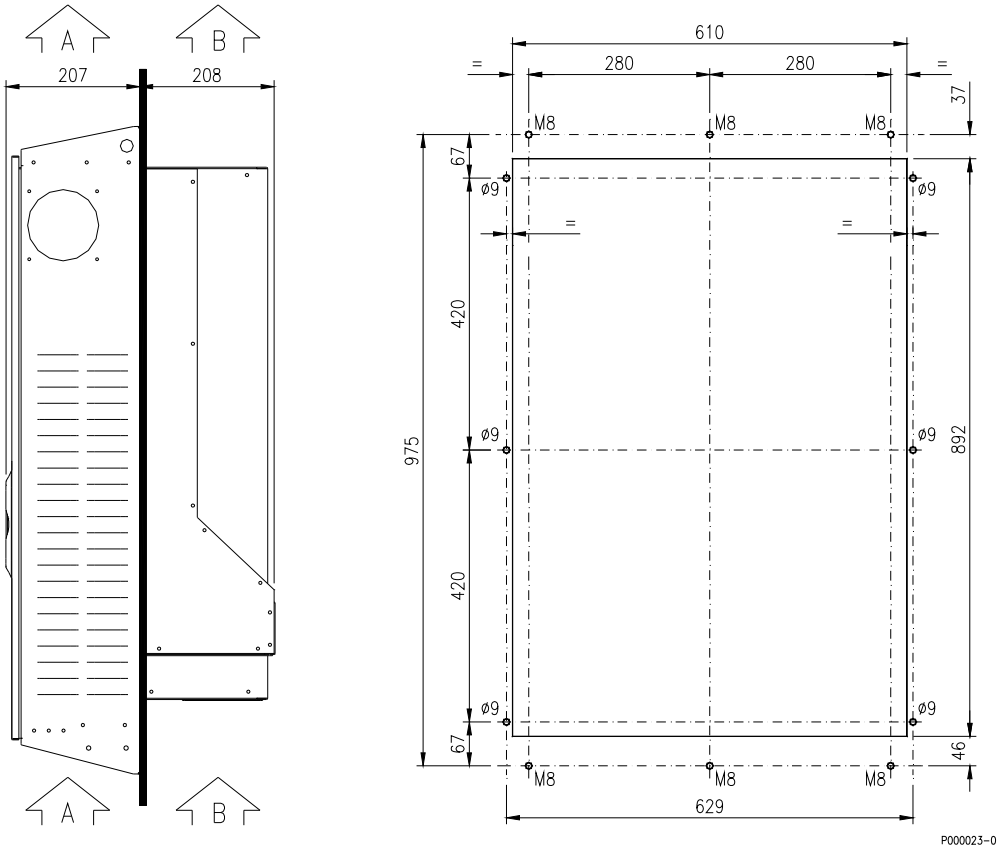


Figure 21: Through-panel assembly and fixing points for SINUS K S50.

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

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

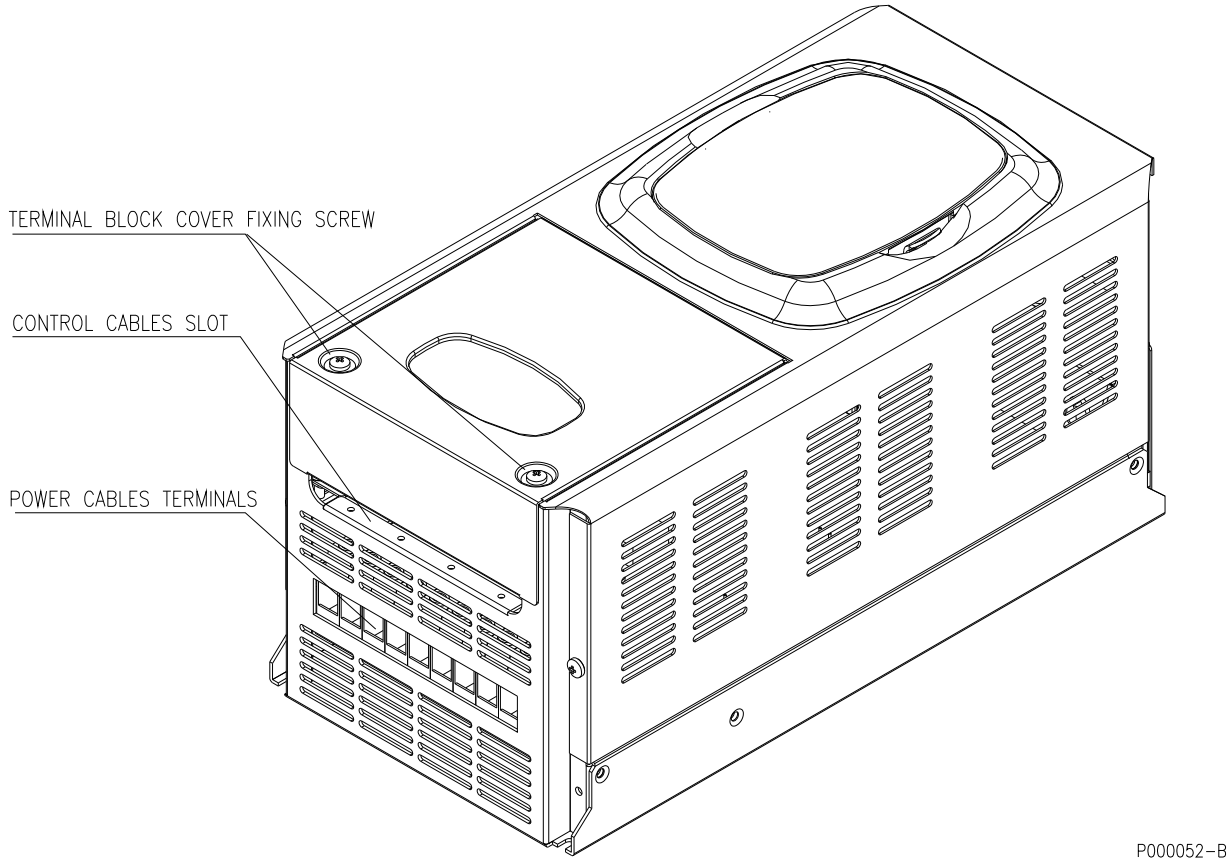


Figure 22: Access to the control terminals and power terminals.

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

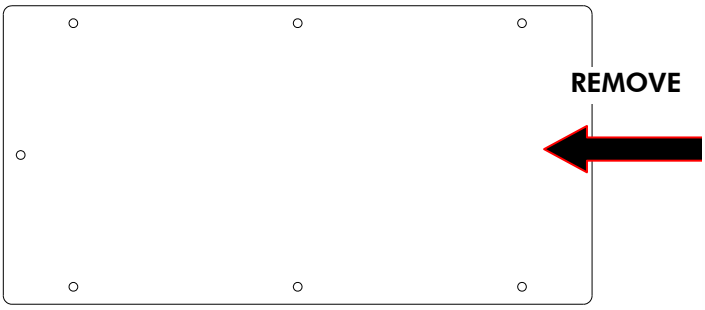
DANGER Before operating on the control/power terminals, remove voltage from the inverter at wait at least 5 minutes. Electrical shock hazard exists even when the inverter is disabled (wait for the complete discharge of the internal capacitors).

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

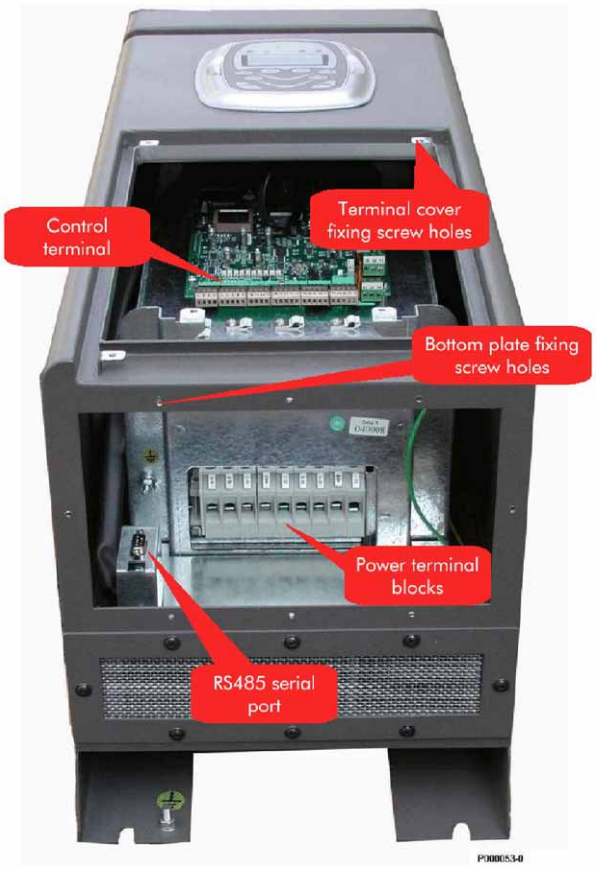
7.9. Connections to Control Terminals and Power Terminals (IP54 Models)

To reach the control terminals and power terminals, remove the front panel by removing its fastening screws. The following can be accessed:
- control terminals,
- power terminals,
- serial interface connector.

For input/output cables, drill the inverter bottom plate. To remove the inverter terminal cover, remove its fastening screws.



P000145-0



CAUTION For ingoing/outgoing cables through the inverter bottom plate, the following safety measures are required to maintain IP54 rating: use cable-glands or similar with a degree of protection not lower than IP54.

CAUTION Always remove the inverter front plate before piercing the holes for ingoing/outgoing cables, thus preventing metals chips from entering the equipment.

8. WIRING

DANGER

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

Use only B-type differential circuit breakers.

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

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

Always connect the ground terminal to avoid electrical shock hazard and to limit disturbance.
The user has the responsibility to provide a grounding system in compliance with the regulations in force.

After connecting the equipment, check the following:

CAUTION

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

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

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

Do not apply single-phase voltage.

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

At power on, if the inverter commands "ENABLE " (terminal 6) and "START" (terminal 7) are active, the motor will immediately start when the main reference is other than zero. This may be very dangerous. To avoid accidental starting of the connected motor, set parameter C61 (IFD SW) or C53 (VTC SW) to [NO]. In that case, the motor will start only after opening and closing the command contact on terminal 6.

8.1. Wiring Diagram (S05-S60)

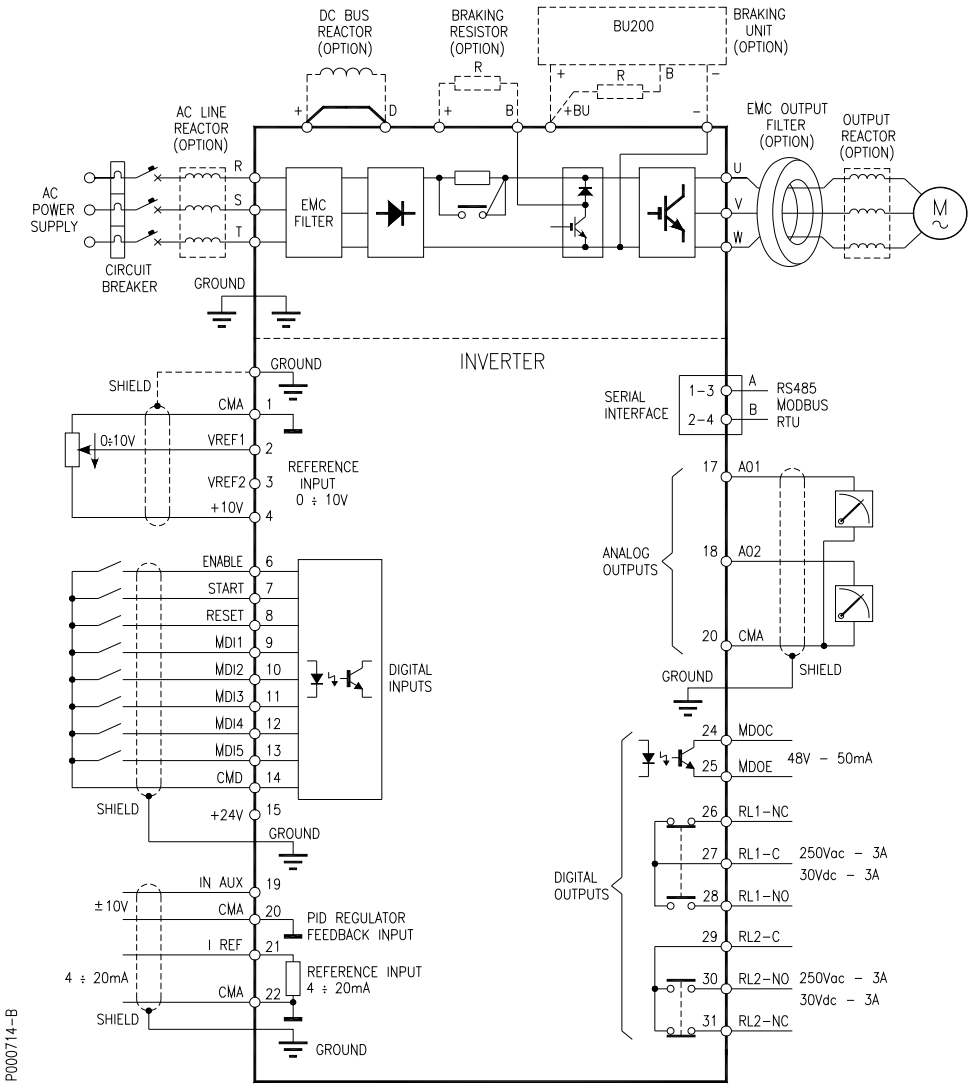


Figure 23: Wiring diagram for S05-S60.

CAUTION In case of fuse line protection, always install the fuse failure detection device, which must disable the inverter to avoid single-phase operation of the equipment.

NOTE Please refer to the OPTIONAL INPUT-OUTPUT REACTORS section for the applicable input and output reactors. When ordering Sinus K drives ranging from S20 to S60, please state if reactors are to be installed on the equipment..

NOTE The wiring diagram relates to factory-setting. Please refer to the Power Terminal Lay-out section for the ID numbers of the wiring terminals.

NOTE When no DC reactor is used, terminals 47D and 47+ must be short-circuited (factory setting).

CAUTION For S60 inverters only: if the supply voltage is not 400Vac rated, the connections of the internal auxiliary transformer must be changed accordingly. (See Figure 38)

8.2. Wiring Diagram for Modular Models (S65)

8.2.1. Connection of Modular Inverters

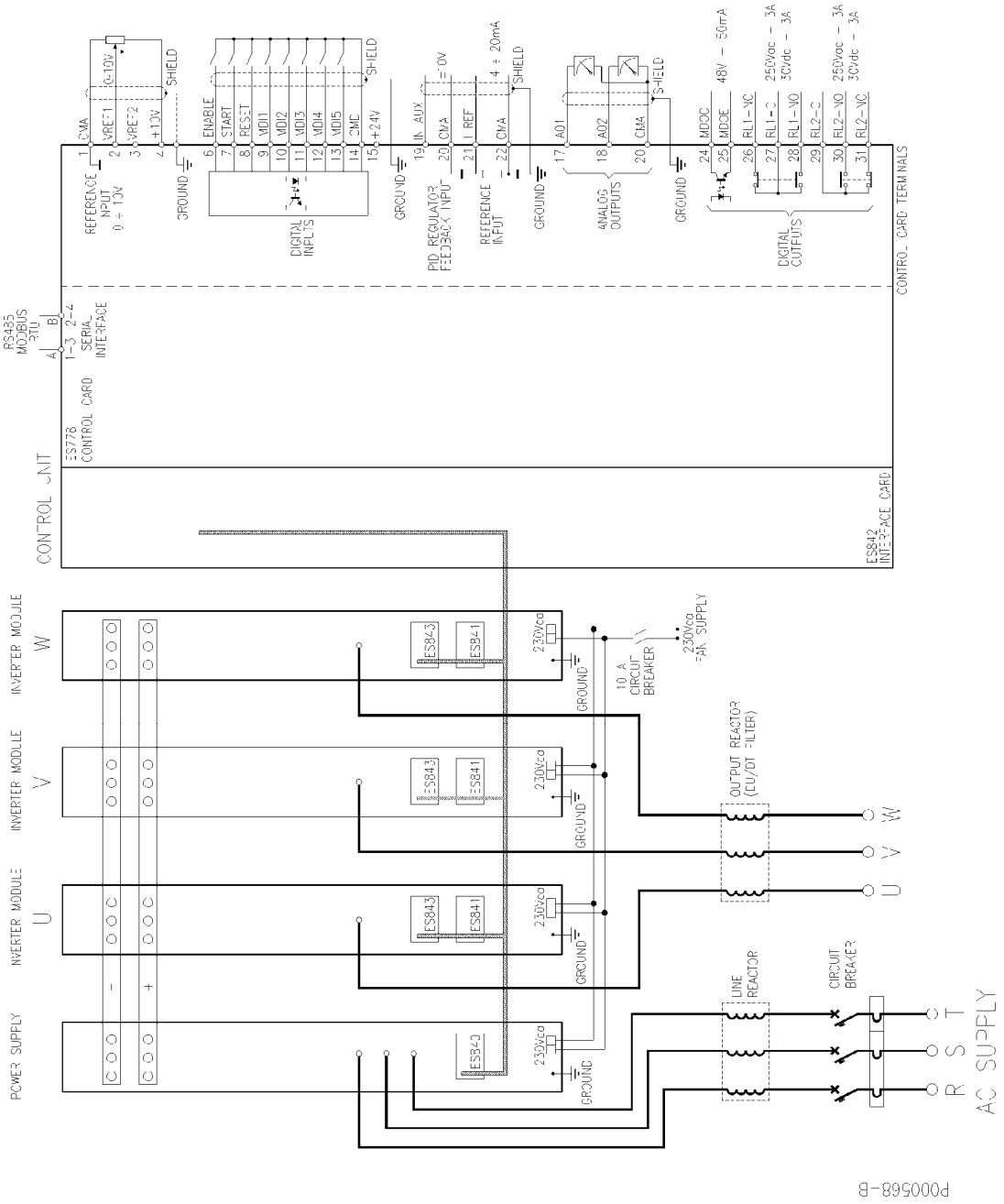


Figure 24: External connections for modular inverters.

CAUTION In case of fuse line protection, always install the fuse failure detection device, which must disable the inverter to avoid single-phase operation of the equipment.

NOTE Refer to the section relating to the inverter reactors.

8.2.2. EXTERNAL CONNECTIONS FOR S64 MODULAR INVERTERS

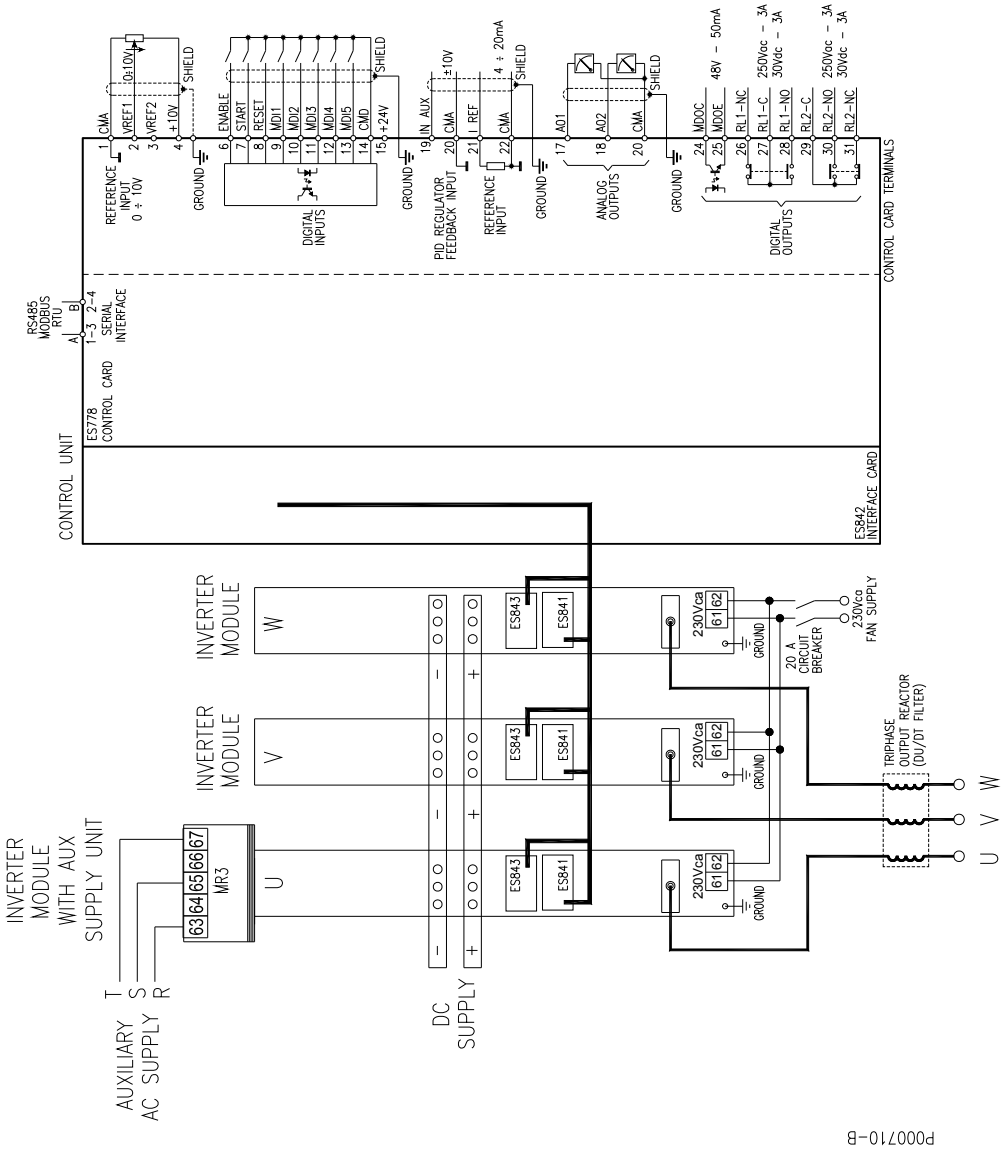


Figure 25: External connections for S64 modular inverters.

CAUTION The capacitors inside the DC power supply unit must always be precharged. Failure to do so will damage the inverter as well as its power supply unit.

NOTE Please refer to the REACTORS section.

8.2.3. 12-PHASE CONNECTION FOR MODULAR INVERTERS

A 12-phase connection allows reducing current harmonics in the inverter supply line.
The basic wiring diagram of a 12-phase connection is shown below.

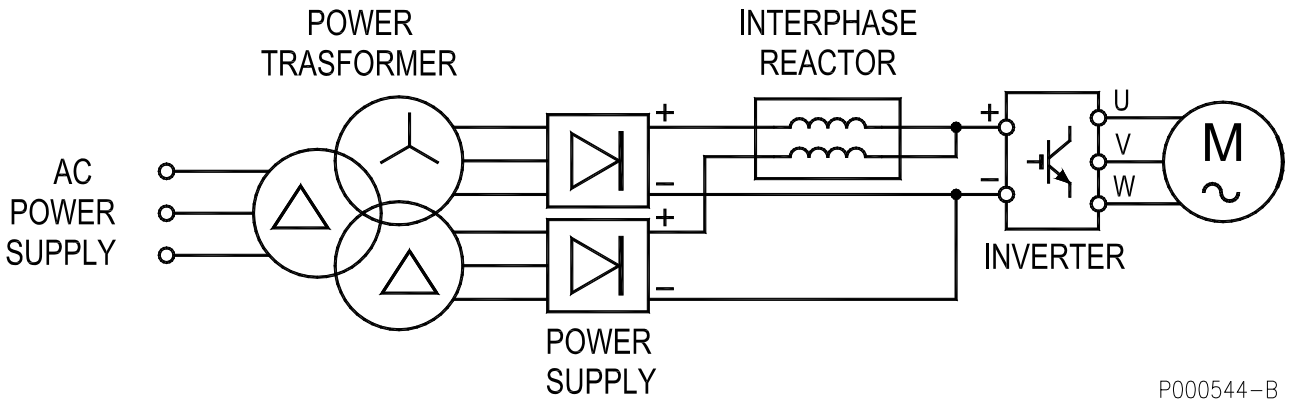


Figure 26: Lay-out of a 12-phase connection.

For more details, please refer to the Reactors section.

8.2.4. INTERNAL CONNECTIONS FOR MODULAR INVERTERS (S65)

The following connections are needed:
N. 2 power connections to 60*10mm copper bar between supply and inverter modules.
N. 4 connections with 9-pole screened cable (S65).
Type of cable:
screened cable
n. of wires: 9
diameter of each wire: AWG20÷24 (0.6÷0.22mm^2)
connectors: female SUB-D connectors;
Connections inside the cable:

Connector	Female SUB-D connector	Female SUB-D connector
pin	1→	1
pin	2→	2
pin	3→	3
pin	4→	4
pin	5→	5
pin	6→	6
pin	7→	7
pin	8→	8
pin	9→	9

The following connections are required:
- From control unit to supply module 1 (supply module 1 control signals)
- From control unit to inverter arm U (phase U control signals)
- From control unit to inverter arm V (phase V control signals)
- From control unit to inverter arm W (phase W control signals)

N° 4 connections with unipolar cable pairs, type AWG17-18 (1 mm^2)
- from supply module 1 to control unit (power supply +24V control unit)
- from supply module 1 to driver boards of each power module (the supply line can run from the supply to one driver board—e.g. arm U—to arm V, then to arm W) (24 V supply for IGBT driver boards)

N° 4 optical fibre connections, 1 mm, standard single plastic material (typical attenuation: 0.22dB/m) with Agilent HFBR-4503/4513 connectors.

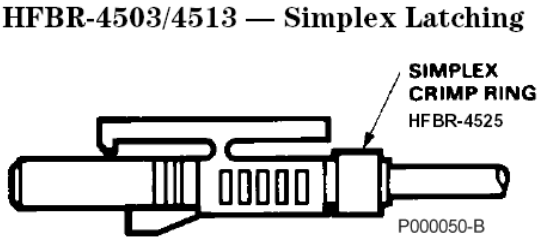


Figure 27: Single optical fibre connector.

Connections required:
- from control unit to arm U driver board (fault U signal)
- from control unit to arm V driver board (fault V signal)
- from control unit to arm W driver board (fault W signal)
- from control unit to bus voltage readout board assembled on inverter arm U (VB signal)

N° 4 optical fibre connections, 1 mm, standard double plastic material (typical attenuation: 0.22dB/m) with Agilent HFBR-4516 connectors.

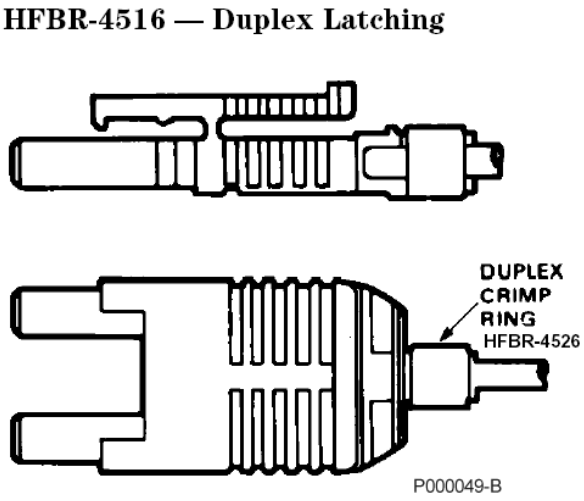


Figure 28: Double optical fibre connector.

Connections required:

- from control unit to arm U driver board (IGBT top and bottom control signals)
- from control unit to arm V driver board (IGBT top and bottom control signals)
- from control unit to arm W driver board (IGBT top and bottom control signals)

INTERNAL CONNECTIONS FOR S65

Signal	Type of connection	Cable marking	Component	Board	Connector	Component	Board	Connector
Control signals, supply module 1	9-pole screened cable	C-PS1	Control unit	ES842	CN4	Supply module 1	ES840	CN8
Control signals, supply module 2 (*)	9-pole screened cable	C-PS2	Control unit	ES842	CN3	Supply module 2	ES840	CN8
Control signals, Inverter module U	9-pole screened cable	C-U	Control unit	ES842	CN14	Inverter module U	ES841	CN3
Control signals, Inverter module V	9-pole screened cable	C-V	Control unit	ES842	CN11	Inverter module V	ES841	CN3
Control signals, Inverter module W	9-pole screened cable	C-W	Control unit	ES842	CN8	Inverter module W	ES841	CN3
+24V Power supply, control unit	Unipolar cable, 1mm^2	24V-CU	Supply module 1	ES840	MR1-1	Control unit	ES842	MR1-1
0V Power supply, control unit	Unipolar cable, 1mm^2		Supply module 1	ES840	MR1-2	Control unit	ES842	MR1-2
+24VD Power supply, driver boards ES841	Unipolar cable, 1mm^2	24V-GU	Supply module 1	ES840	MR1-3	Inverter module U	ES841	MR1-1
0VD Power supply, driver boards ES841	Unipolar cable, 1mm^2		Supply module 1	ES840	MR1-4	Inverter module U	ES841	MR1-2
+24VD power supply, driver boards ES841	Unipolar cable, 1mm^2	24V-GV	Inverter module U	ES841	MR1-3	Inverter module V	ES841	MR1-1
0VD power supply, driver boards ES841	Unipolar cable, 1mm^2		Inverter module U	ES841	MR1-4	Inverter module V	ES841	MR1-2
+24VD power supply, driver boards ES841	Unipolar cable, 1mm^2	24V-GW	Inverter module V	ES841	MR1-3	Inverter module W	ES841	MR1-1
0VD power supply, driver boards ES841	Unipolar cable, 1mm^2		Inverter module V	ES841	MR1-4	Inverter module W	ES841	MR1-2
IGBT command, Inverter module U	Double optical fibre	G-U	Control unit	ES842	OP19-OP20	Inverter module U	ES841	OP4-OP5
IGBT command, Inverter module V	Double optical fibre	G-V	Control unit	ES842	OP13-OP14	Inverter module V	ES841	OP4-OP5
IGBT command, Inverter module W	Double optical fibre	G-W	Control unit	ES842	OP8-OP9	Inverter module W	ES841	OP4-OP5
IGBT fault, Inverter module U	Single optical fibre	FA-U	Control unit	ES842	OP15	Inverter module U	ES841	OP3
IGBT fault, Inverter module U	Single optical fibre	FA-V	Control unit	ES842	OP10	Inverter module V	ES841	OP3
IGBT fault, Inverter module U	Single optical fibre	FA-W	Control unit	ES842	OP5	Inverter module W	ES841	OP3
Bus bar voltage reading	Single optical fibre	VB	Control unit	ES842	OP2	One Inverter module	ES843	OP2
IGBT status, Inverter module U	Single optical fibre	ST-U	Control unit	ES842	OP16	Inverter module U	ES843	OP1
IGBT status, Inverter module V	Single optical fibre	ST-V	Control unit	ES842	OP11	Inverter module V	ES843	OP1
IGBT status, Inverter module W	Single optical fibre	ST-W	Control unit	ES842	OP6	Inverter module W	ES843	OP1

CAUTION Carefully check that connections are correct. Wrong connections can adversely affect the equipment operation.

CAUTION NEVER supply the equipment if optical fibre connectors are disconnected.

The diagram below illustrates the connections required for the components of modular inverters.

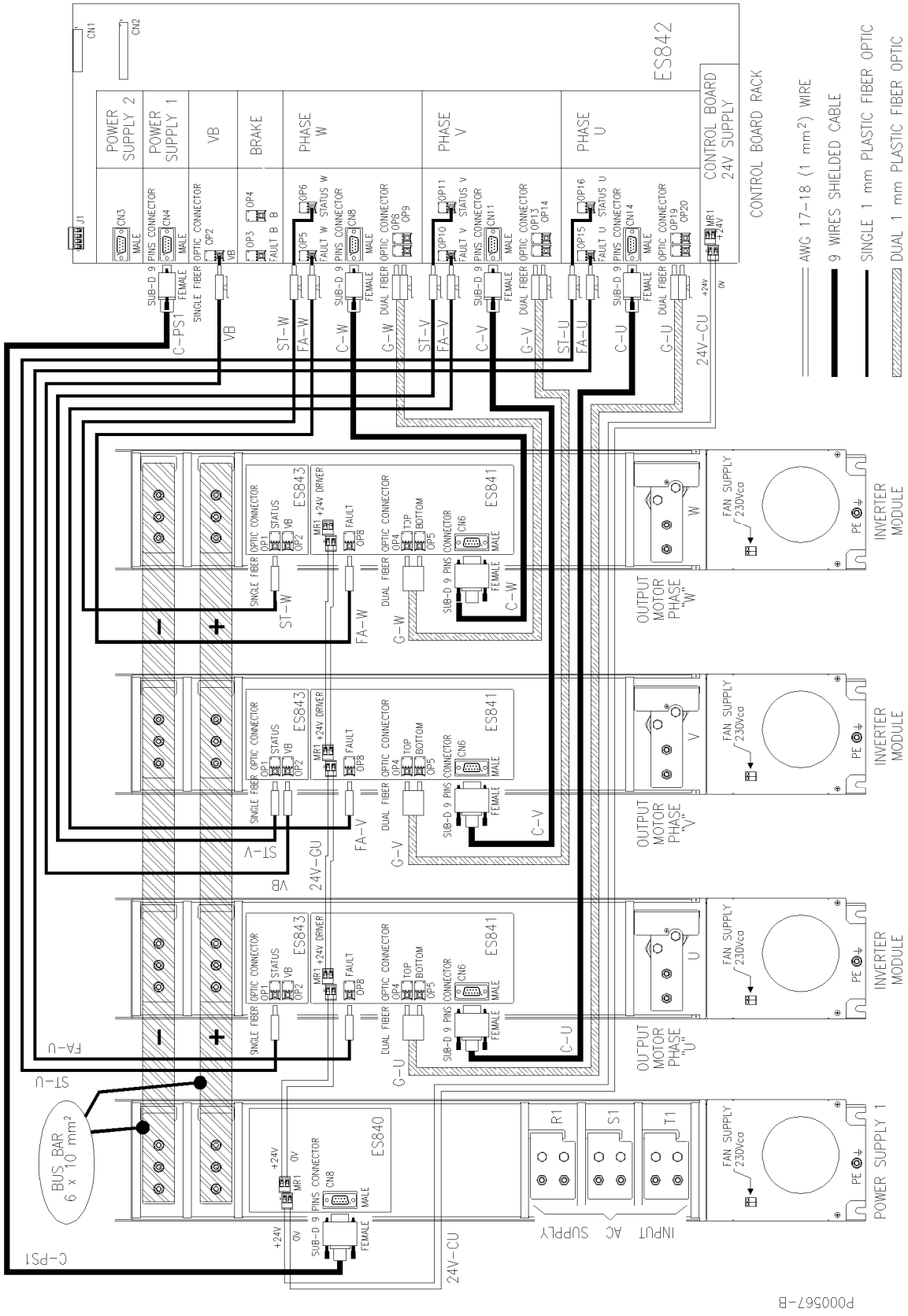


Figure 29: Internal connections for SINUS K S65.

Do the following to obtain the internal connections:

1) Gain access to boards ES840, ES841 and ES843. Board ES840 is located on the front part of the supply module; boards ES81 and ES843 are located on the front part of each inverter module. Remove the front covers made of Lexan by loosening the cover fastening screws;

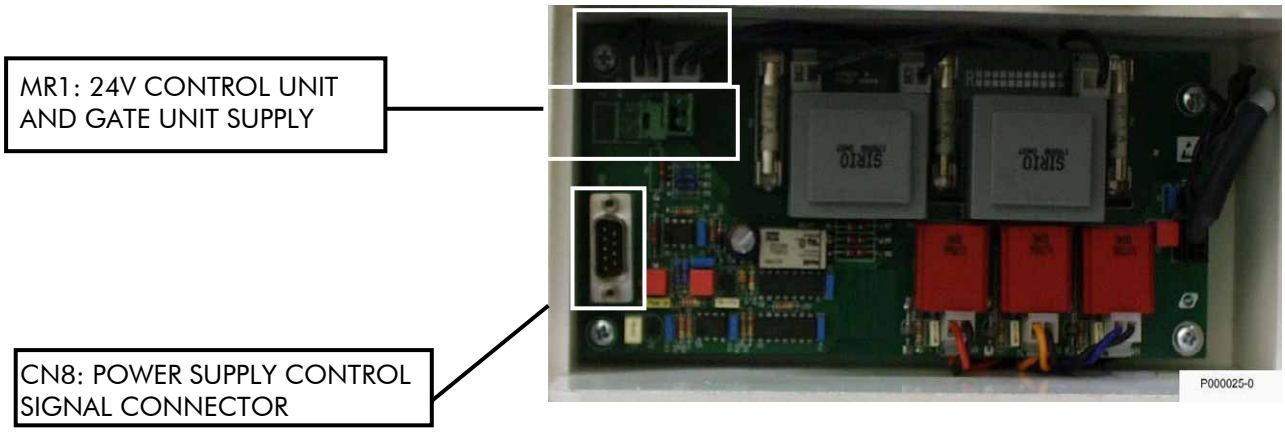


Figure 30: ES840 supply control board.

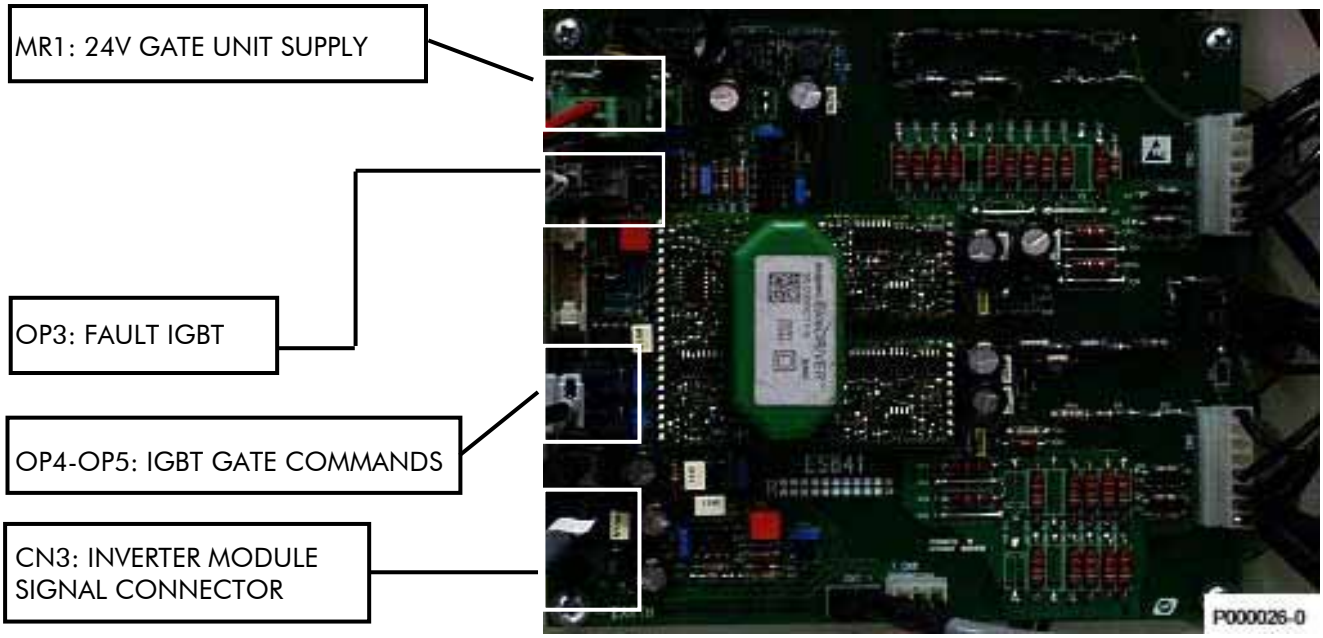


Figure 31: ES841 inverter module gate unit board.

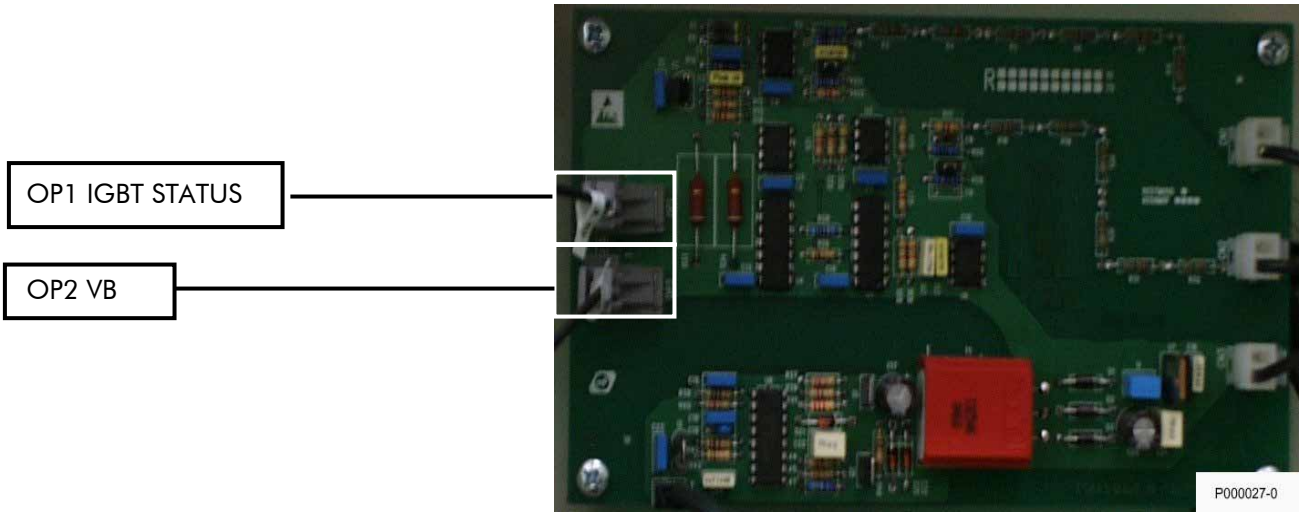
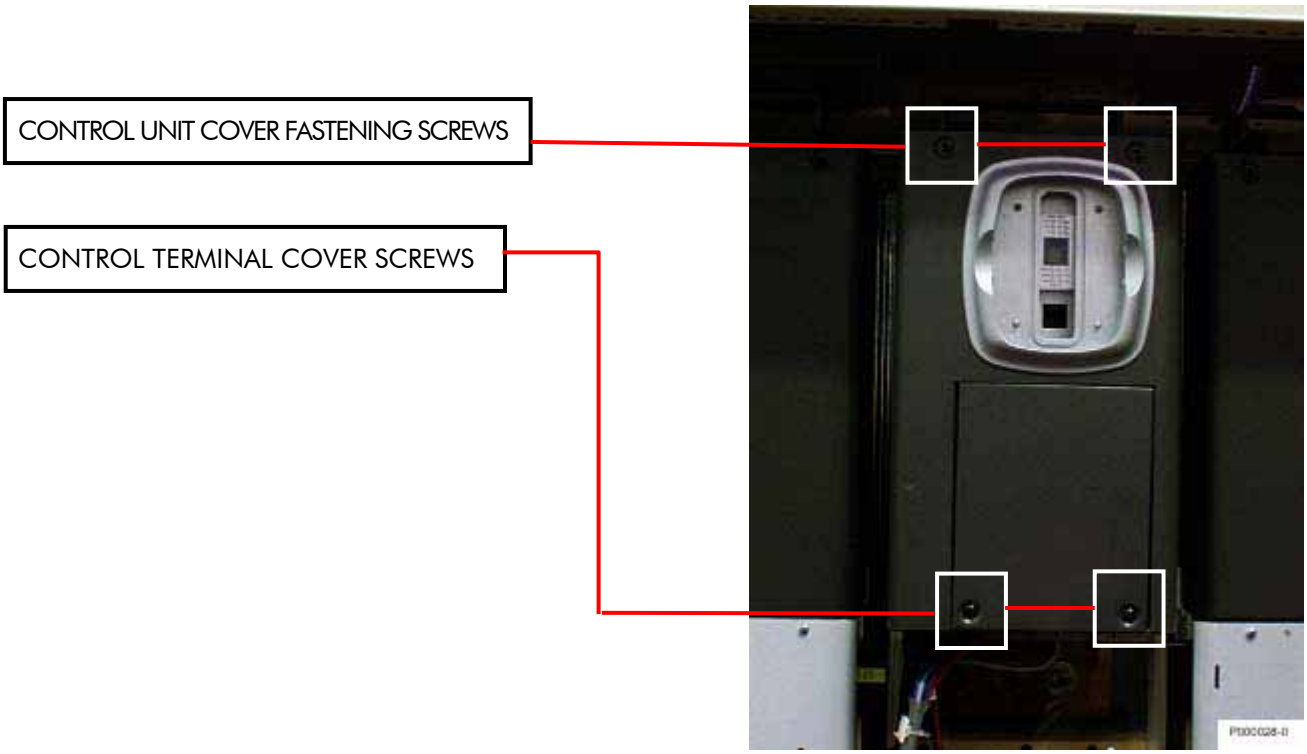


Figure 32: ES843 inverter module.

2) Gain access to ES842 located on the control unit; do the following:
   a) Remove the keypad (if fitted) (see the Remoting the Keypad section)
   b) Remove the cover of the terminal board after removing its fastening screws
   c) Remove the cover of the control unit after removing its fastening screws



3) You can then access to the connectors in ES842 control board.

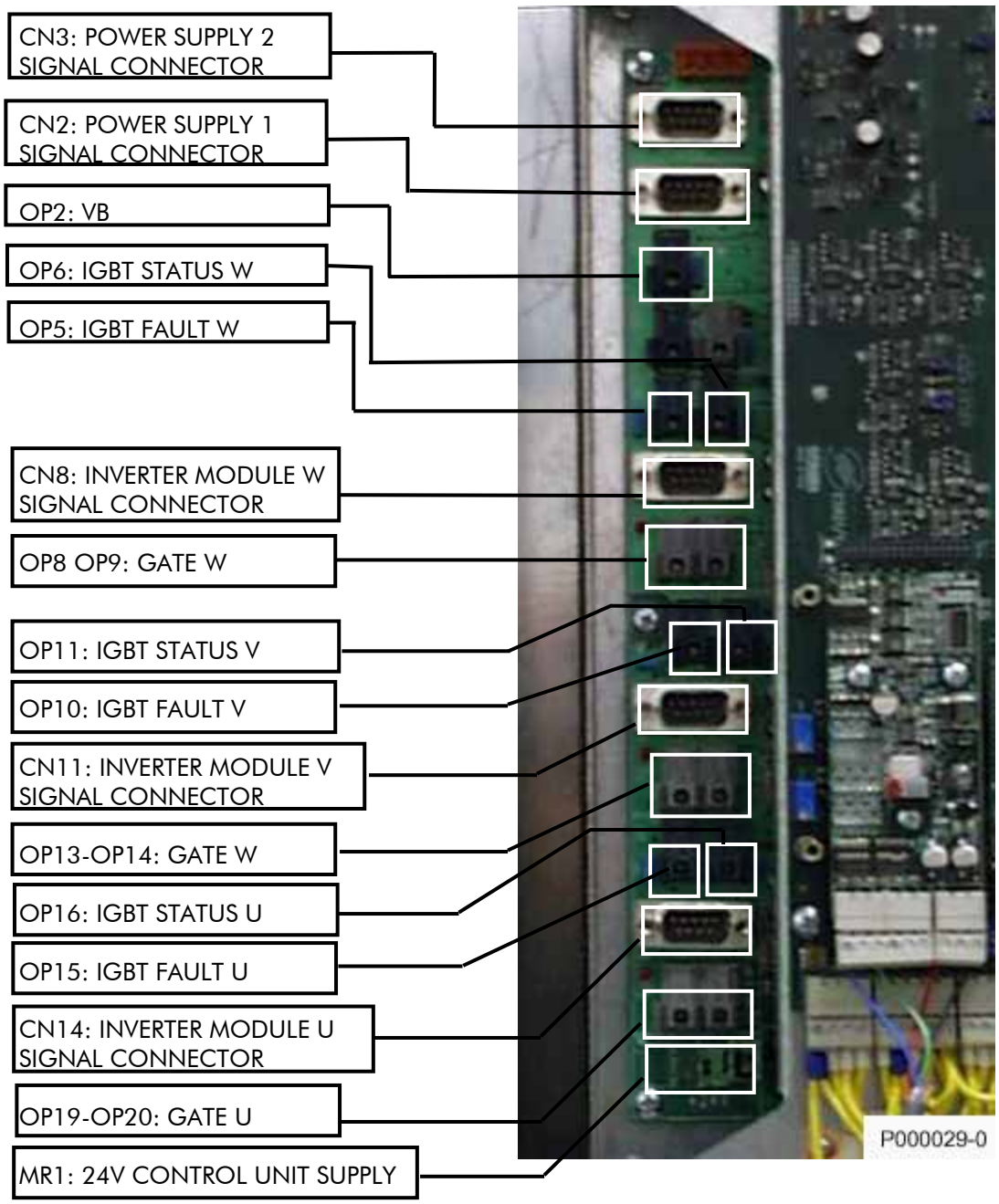


Figure 33: ES842 control unit.

4) Use the connection cable kit to connect the inverter components to each other. Make sure that the tab of the optical fibre connectors is turned outwards to the connector fixed in the control board.

5) Reassemble the covers made of Lexan and the covering of the control unit, making sure not to flatten any cable/optical fibre.

8.2.5. INTERNAL CONNECTIONS FOR S64 MODULAR INVERTERS

The following links are required:

N. 2 power connections with 60*10mm copper bar between the inverter arms in order to deliver DC voltage.
N. 4 connections with a 9-pole shielded cable.
Type of cable: shielded cable
N. of conductors: 9
Diameter of each conductor: AWG20÷24 (0.6÷0.22sqmm)
Connectors: 9-pole SUB-D female connectors
Connections within the cable:

Connector	SUB-D female connector	SUB-D female connector
pin	1→	1
pin	2→	2
pin	3→	3
pin	4→	4
pin	5→	5
pin	6→	6
pin	7→	7
pin	8→	8
pin	9→	9

The following links are required:

- from control unit to inverter arm with auxiliary power supply unit (control signals for auxiliary power supply)
- from control unit to inverter arm U (phase U control signals)
- from control unit to inverter arm V (phase V control signals)
- from control unit to inverter arm W (phase W control signals)

N. 4 connections with AWG17-18 (1sqmm) unipolar cable pairs delivering low-voltage DC power supply.
- from inverter arm with auxiliary power supply unit to control unit (control unit +24V voltage supply)
- from inverter arm with auxiliary power supply unit to driver boards of each power arm of the inverter (the power supply can be transferred from the supply unit to a driver board, in arm U for instance, then to arm V, finally to arm W). (IGBT driver board 24V power supply.)

N. 4 optical-fibre connections, 1mm, single standard plastics (0.22dB/m typical attenuation) with Agilent HFBR-4503/4513 connectors.

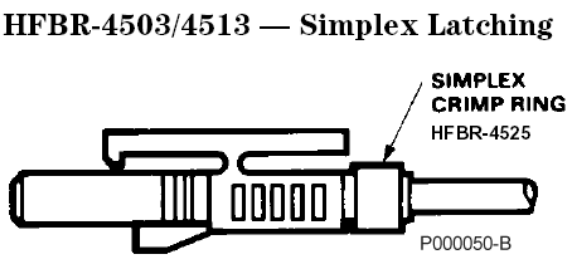


Figure 34: Single optical-fibre connector.

The following links are required:

- from control unit to driver board in inverter arm U (U fault signal)
- from control unit to driver board in inverter arm V (V fault signal)
- from control unit to driver board in inverter arm W (W fault signal)
- from control unit to bus voltage detecting board installed on inverter arm U (VB signal)

N. 4 optical-fibre connections, 1mm, double standard plastics (0.22dB/m typical attenuation) with Agilent HFBR-4516 connectors.

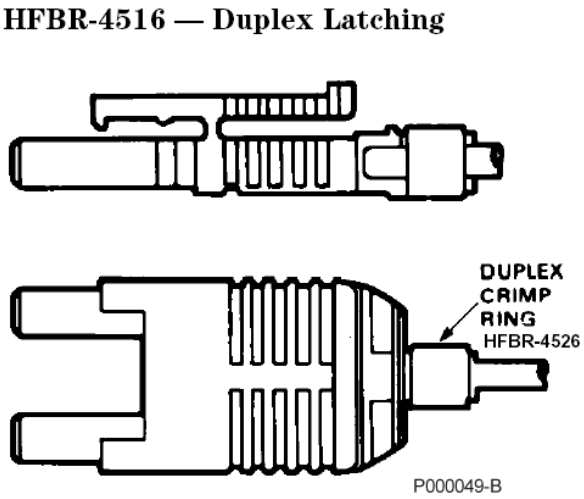


Figure 35: Double optical-fibre connector.

The following links are required:

- from control unit to driver board in inverter arm U (top and bottom IGBT control signals)
- from control unit to driver board in inverter arm V (top and bottom IGBT control signals)
- from control unit to driver board in inverter arm W (top and bottom IGBT control signals)

INTERNAL CONNECTIONS FOR S64

Signal	Type of Connection	Cable Marking	Component	Board	Connector	Component	Board	Connector
control signals for auxiliary power supply	9-pole shielded cable	CPS-1	control unit	ES842	CN4	inverter arm with auxiliary power supply unit	auxiliary power supply unit	CN3
control signals for phase U	9-pole shielded cable	C-U	control unit	ES842	CN14	phase U	ES841	CN3
control signals for phase V	9-pole shielded cable	C-V	control unit	ES842	CN11	phase V	ES841	CN3
control signals for phase W	9-pole shielded cable	C-W	control unit	ES842	CN8	phase W	ES841	CN3
+24V control unit power supply	1 sqmm unipolar cable	24V-CU	inverter arm with auxiliary power supply unit	auxiliary power supply unit	MR1-1	control unit	ES842	MR1-1
0V control unit power supply	1 sqmm unipolar cable		inverter arm with auxiliary power supply unit	auxiliary power supply unit	MR1-2	control unit	ES842	MR1-2
ES841 driver board +24VD power supply	1 sqmm unipolar cable (*)	24V-GU	inverter arm with auxiliary power supply unit	auxiliary power supply unit	MR2-1	phase U	ES841	MR1-1
ES841 driver board +0VD power supply	1 sqmm unipolar cable (*)		inverter arm with auxiliary power supply unit	auxiliary power supply unit	MR2-1	phase U	ES841	MR1-2
ES841 driver board +24VD power supply	1 sqmm unipolar cable	24V-GV	phase U	ES841	MR1-3	phase V	ES841	MR1-1
ES841 driver board +0VD power supply	1 sqmm unipolar cable		phase U	ES841	MR1-4	phase V	ES841	MR1-2
ES841 driver board +24VD power supply	1 sqmm unipolar cable	24V-GW	phase V	ES841	MR1-3	phase W	ES841	MR1-1
ES841 driver board +0VD power supply	1 sqmm unipolar cable		phase V	ES841	MR1-4	phase W	ES841	MR1-2
IGBT command, phase U	double optical fibre	G-U	control unit	ES842	OP19-OP20	phase U	ES841	OP4-OP5
IGBT command, phase V	double optical fibre	G-V	control unit	ES842	OP13-OP14	phase V	ES841	OP4-OP5
IGBT command, phase W	double optical fibre	G-W	control unit	ES842	OP8-OP9	phase W	ES841	OP4-OP5
IGBT fault, phase U	single optical fibre	FA-U	control unit	ES842	OP15	phase U	ES841	OP3
IGBT fault, phase V	single optical fibre	FA-V	control unit	ES842	OP10	phase V	ES841	OP3
IGBT fault, phase W	single optical fibre	FA-W	control unit	ES842	OP5	phase W	ES841	OP3
Vbus readout	single optical fibre	VB	control unit	ES842	OP2	one phase	ES843	OP2
IGBT status, phase U	single optical fibre	ST-U	control unit	ES842	OP16	phase U	ES843	OP1
IGBT status, phase V	single optical fibre	ST-V	control unit	ES842	OP11	phase V	ES843	OP1
IGBT status, phase W	single optical fibre	ST-W	control unit	ES842	OP6	phase W	ES843	OP1

(*) Factory-set connection provided in the inverter

CAUTION Make sure that links are correct, as incorrect links cause the inverter malfunctioning.

CAUTION NEVER power the inverter when the optical-fibre connectors are not connected.

The figure below shows the links required for the components of the modular inverter.

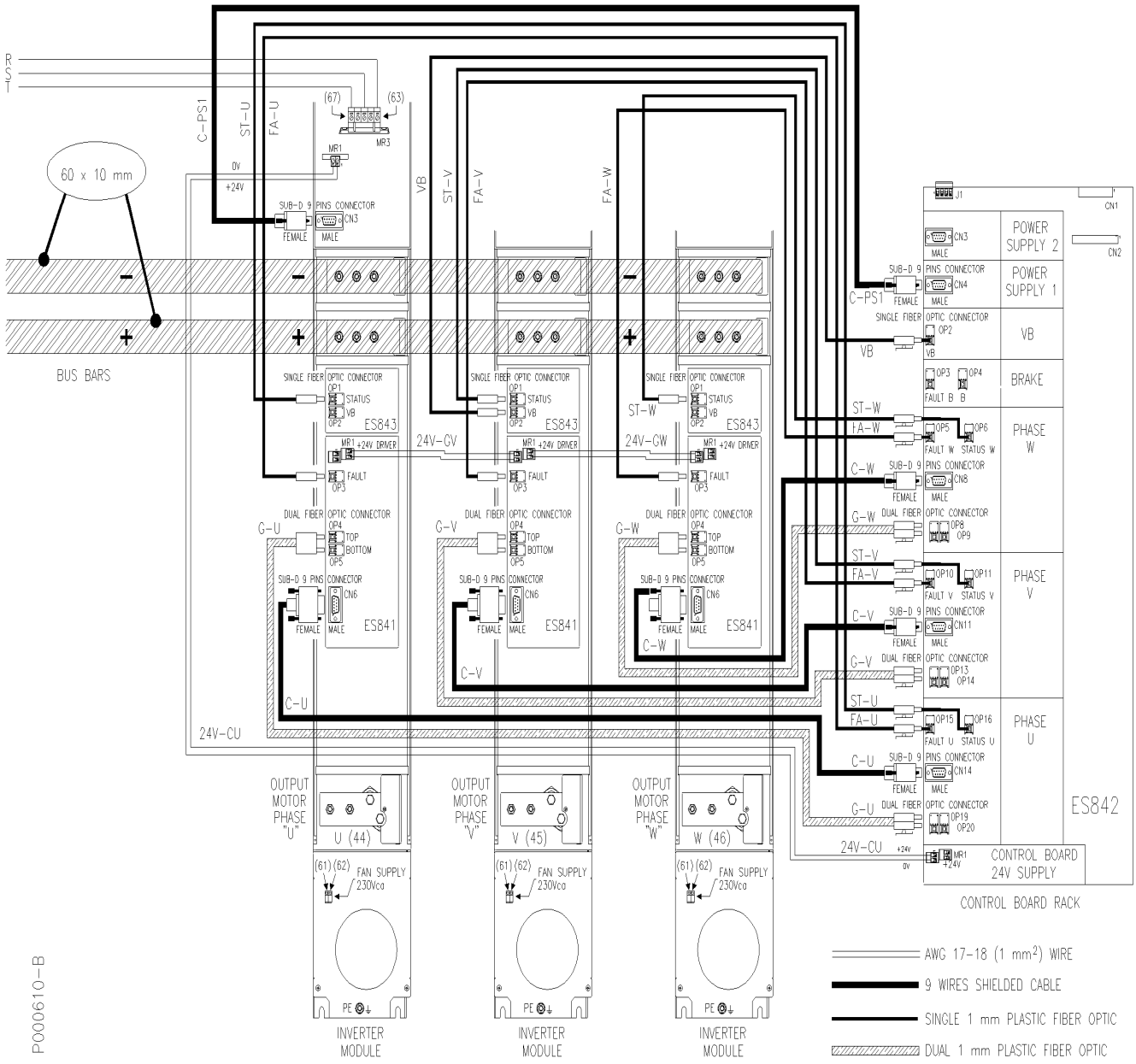


Figure 36: Internal wiring for S64 inverters.

8.3. Control Terminals

Term.	Name	Description	I/O Features	Jumpers	IFD parameters	VTC Parameters
1	CMA	0V for main reference.	Control board zero volt			
2	VREF1	Input for voltage Vref1 main reference.	Vmax: ±10V, Rin: 40kΩ Resolution: 10 bits	J14 (+/±)	P16, P17, P18, C29, C30, C22	P16, P17, P18, C15, C16, C23, C24
3	VREF2	Input for voltage Vref2 main reference.				
4	+10V	Supply for external potentiometer.	+10V Imax: 10mA			
6	ENABLE	Active input: inverter running with IFD control. Fluxed motor with VTC control. Inactive input: in neutral regardless of the control mode.	Optoisolated digital input	J10 (NPN/ PNP)	C61	C51, C53
7	START	Active input: inverter running. Inactive input: main ref. is reset and the motor stops following a deceleration ramp.	Optoisolated digital input	J10 (NPN/ PNP)	C21	C14
8	RESET	Active input: the inverter operation is reset after an emergency stop.	Optoisolated digital input	J10 (NPN/ PNP)	C50, C51, C52 C53, P25	C45, C46, C47, C48, C52
9	MDI1	Multifunction digital input 1.	Optoisolated digital input	J10 (NPN/ PNP)	C23: (factory setting: Multifrequency 1)	C17: (factory setting: Multispeed 1)
10	MDI2	Multifunction digital input 2.	Optoisolated digital input	J10 (NPN/ PNP)	C24: (factory setting: Multifrequency 2)	C18: (factory setting: Multispeed 2)
11	MDI3	Multifunction digital input 3.	Optoisolated digital input	J10 (NPN/ PNP)	C25: (factory setting: Multifrequency 3)	C19: (factory setting: Multispeed 3)
12	MDI4	Multifunction digital input 4.	Optoisolated digital input	J10 (NPN/ PNP)	C26: (factory setting: CW/CCW)	C20: (factory setting: CW/CCW)
13	MDI5	Multifunction digital input 5.	Optoisolated digital input, PTC with respect to BS4999 Pt.111 (DIN44081/ DIN44082)	J9 (PTC), J10 (NPN/ PNP)	C27: (factory setting: DCB)	C21: (factory setting: DCB)
14	CMD	0V optoisolated, multifunction digital inputs.	Optoisolated digital input zero volt			
15	+24V	Auxiliary supply for optoisolated, multifunction digital inputs	+24V Imax: 100mA			
17	AO1	Multifunction analog output 1.	0~10V Imax: 4mA, 4-20mA or 0-20mA Resolution: 8 bits	J5, J7, J8 (voltage/current)	P30: (factory setting: Fout), P32, P33, P34, P35, P36, P37.	P28: (factory setting: nout), P29, P32, P33, P34, P35, P36, P37.
18	AO2	Multifunction analog output 2.	0÷10V Imax: 4mA, 4-20mA o 0-20mA Resolution: 8 bits	J3, J4, J6 (voltage/current)	P31: (factory setting: Iout), P32, P33, P34, P35, P36, P37.	P30: (factory setting: Iout), P31, P32, P33, P34, P35, P36, P37.
19	INAUX	Auxiliary analog input.	Vmax: ±10V Rin: 20kΩ Resolution: 10 bits		P21, P22, C29, C30: (factory setting: PID regulator feedback).	P21, P22, C23, C24: (factory setting: PID regulator feedback), C43.

20	CMA	0V for auxiliary analog input.	Control board zero volt.			
21	IREF	Input for main current reference (0 20mA, 4÷20mA).	Rin: 100Ω Resolution: 10 bits		P19, P20, C29, C30: (factory setting: not used).	P19, P20, C23, C24: (factory setting: not used).
22	CMA	0V for main current reference.	Control board zero volt			
24	MDOC	Open collector digital output (collector terminal).	Open collector NPN/PNP Vmax: 48V Imax: 50mA		P60: (factory setting: FREQ. LEVEL), P63, P64, P69, P70.	P60: (factory setting: SPEED LEVEL), P63, P64, P69, P70, P75, P76, P77.
25	MDOE	Open collector digital output (emitter terminal).				
26	RL1-NC	Multifunction digital relay output 1 (NC contact).	250 VAC, 3A 30 VDC, 3A		P61: (factory setting: INV O.K. ON), P65, P66, P71, P72.	P61: (factory setting: INV O.K. ON), P65, P66, P71, P72, P75, P76, P77.
27	RL1-C	Multifunction digital relay output 1 (common).				
28	RL1-NO	Multifunction digital relay output (NO contact).				
29	RL2-C	Multifunction digital relay output 2 (common).	250 VAC, 3A 30 VDC, 3A		P62: (factory setting: FREQ. LEVEL), P67, P68, P73, P74.	P62: (factory setting: SPEED LEVEL), P67, P68, P73, P74, P75, P76, P77.
30	RL2-NO	Multifunction digital relay output 2 (NO contact).				
31	RL2-NC	Multifunction digital relay output 2 (NC contact).				

8.3.1. GROUNDING THE SHIELD OF SIGNAL SCREENED CABLES

All inverters of the SINUS K series are provided with a cable support bar including cable-glands connected to the inverter grounding. The cable support bar is located next to the control terminals. The cable-glands fasten the cables preventing them from disconnecting from the terminals; they also connect the shield of the signal screened cables to the grounding system. The figure below shows how to tighten a signal screened cable.

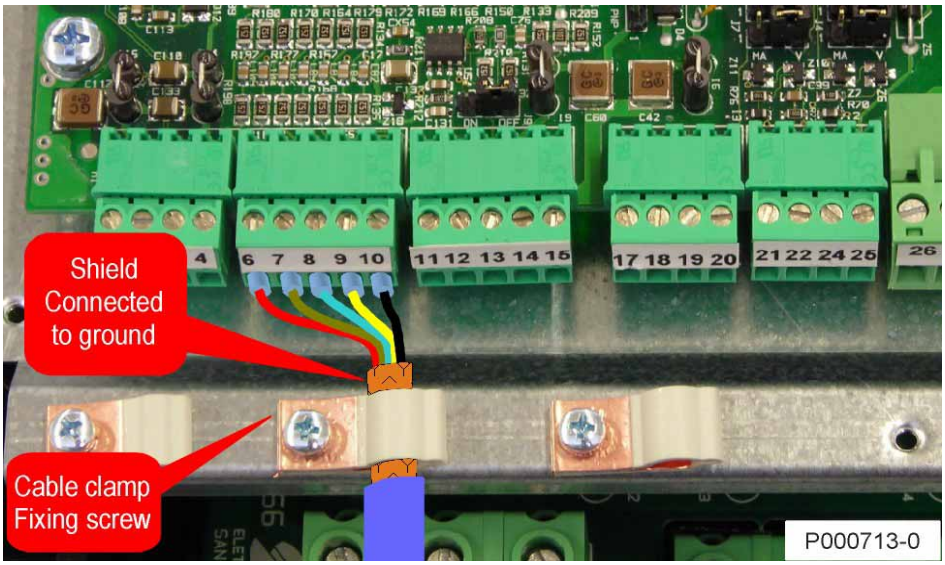


Figure 37: Tightening a signal screened cable.

CAUTION If control cables are not grounded or if wiring is not properly carried out, the inverter will be exposed to disturbance. In the worst cases, disturbance may cause the unwanted start-up of the motor.

8.4. POWER TERMINALS

8.4.1. LAY-OUT OF THE POWER TERMINALS FOR S05 – S50

SYMBOLS	
41/R – 42/S – 43/T	Inputs for three-phase supply (the phase sequence is not important)
44/U – 45/V – 46/W	Three-phase motor outputs
47/+	Link to the DC voltage positive pole. It can be used for DC voltage supply, the DC reactor, the external braking resistor and the external braking unit (for the inverter models where it is not built-in).
47/D	Link to the positive pole of the continuous AC rectified voltage. It can be used for the DC reactor—if no DC reactor is used, terminal 47/D must be short-circuited to terminal 47/+ using a cable having the same cross-section as the cables used for power supply; factory setting).
48/B	When available, it can be used to connect the IGBT brake for braking resistors.
49/-	Link to the negative pole of the DC voltage. It can be used for DC power supply and the external braking resistor.
50/+	When available, it can be used to connect the positive pole of the DC voltage to be used for the external braking resistor only.
51/+	When available, it can be used to connect the positive pole of the DC voltage to be used for the external braking unit only.
52/-	When available, it can be used to connect the negative pole of the DC voltage to be used for the external braking unit only.

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

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

S05 (2T) Terminal board:

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

S12 Terminal board:

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

S30 Terminal board:

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

NOTE

Connect the external braking unit to terminals **50/+** and **48/B**.
Avoid using terminals 48 and 50 for DC power supply.

S40 Terminal board:

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

NOTE

Connect the external braking unit to terminals **51/+** and **52/-**.
Avoid using terminals 51 and 52 for DC power supply.

S50 Connecting bars:

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

8.4.2. CONNECTING BARS FOR S60 – S65

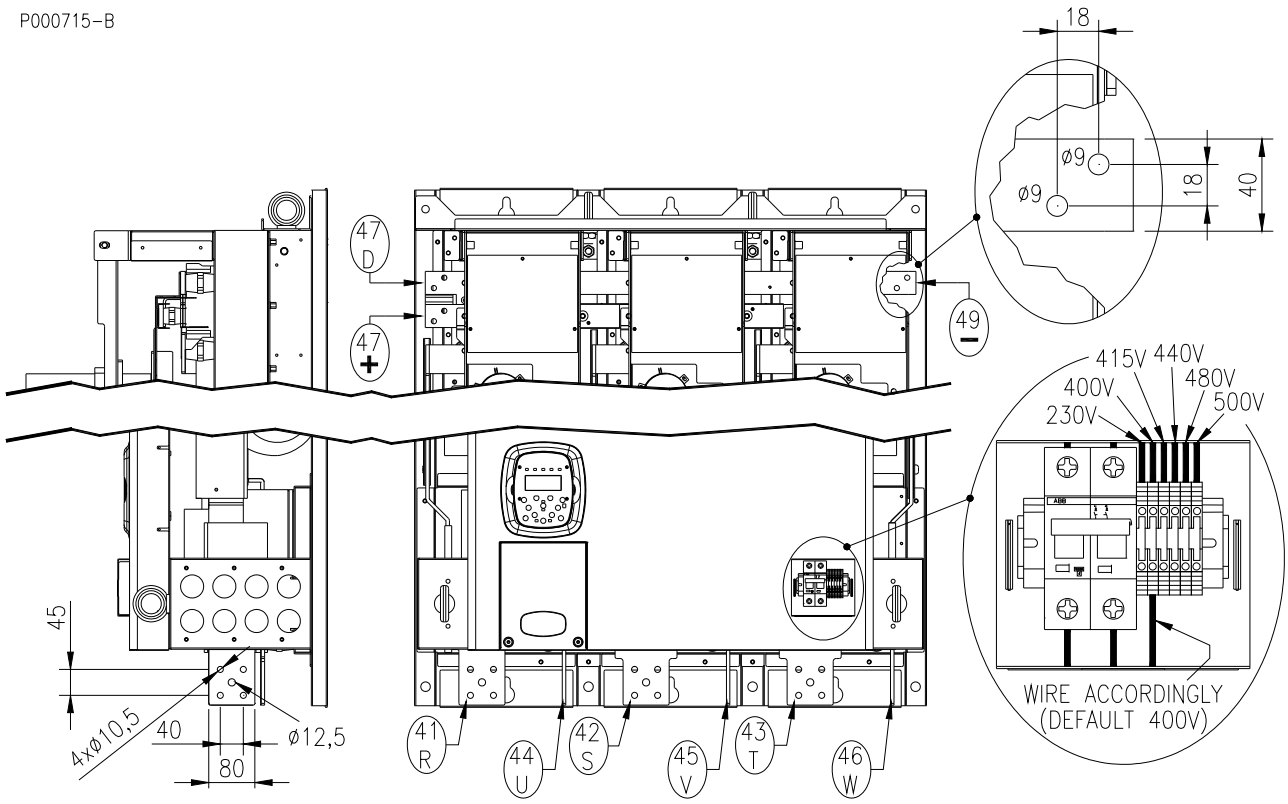


Figure 38: Connecting bars for S60.

Figure 38 shows the location and dimension of the bars connecting S60 SINUS K drives to the mains and the motor. The figure also shows the position and the wiring instructions for the built-in power supply transformer. The trasformer must be wired based on the rated supply voltage being used.

CAUTION

Bars 47/D and 47/+ are short-circuited (factory-setting). The DC inductance if any must be connected between bars 47D and 47+ after removing the short-circuit.

Lay-out of the auxiliary power supply terminals

The auxiliary power supply terminals are provided in the Sinus K models requiring auxiliary power supply links to be used to power air-cooling systems or to power internal circuits.

	NAME		
Inverter	Terminal	Description	Ratings
S64	63/Raux – 65/Saux – 67/Taux	Inputs for auxiliary 3-phase power supply	380-500Vac 100mA for 4T inverters
S65-S64	61-62	Inputs for fan power supply	230Vac/2A

Connecting bars for S64 – S65:

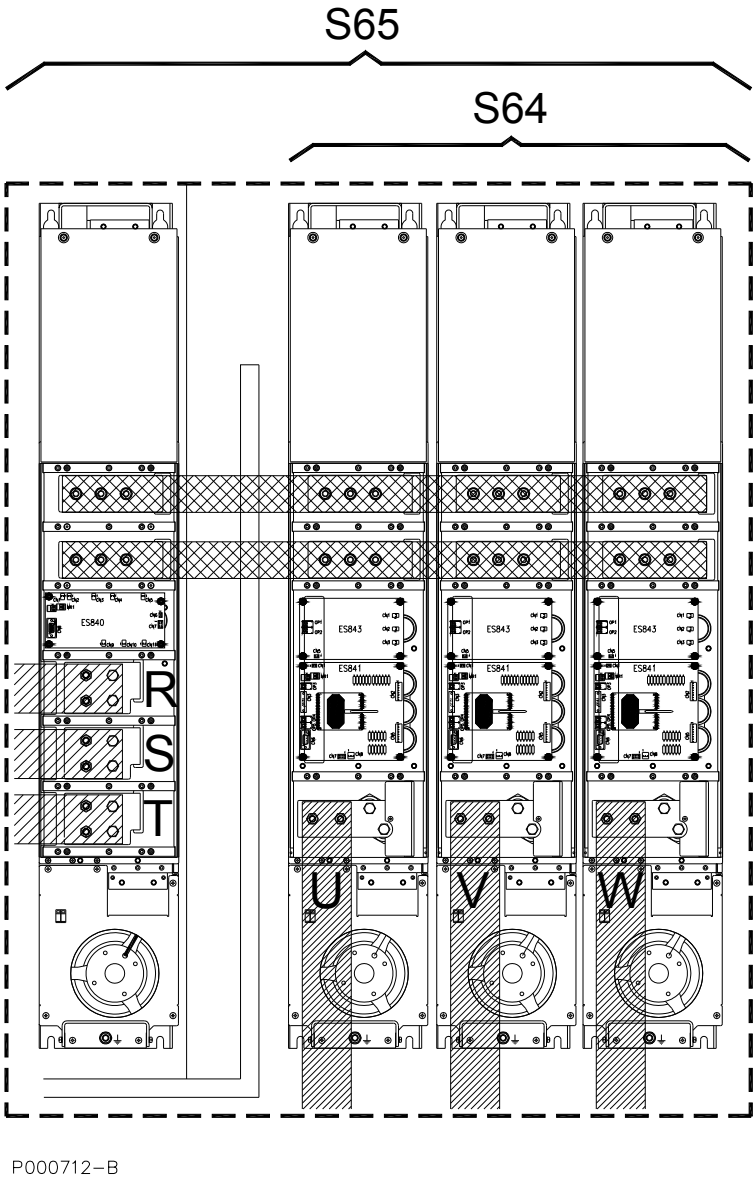


Figure 39: Connecting bars for S64 – S65.

8.4.3. GROUNDING THE INVERTER AND THE MOTOR

A screw nut for the grounding of the inverter frame is located next to the power terminals. The grounding screw is marked with the symbol below:

Connect the inverter to a grounding system in compliance with the regulations in force. To limit disturbance and radiated interference produced by the inverter, connect the motor ground wire directly to the inverter ground. The path of the motor ground wire should run parallel to the motor supply cables.

DANGER

Connect the inverter ground terminal to the mains grounding using a wire having a cross-section equal to or larger than the cross-section of the supply wires, in compliance with the regulations in force; otherwise, the inverter frame and the motor casing are exposed to dangerous voltage and electrical shock hazard. The user has the responsibility to provide a grounding system in compliance with the safety regulations in force.

NOTE

To fulfil UL conformity requirements of the system where the inverter is installed, use a "UL R/C" or "UL Listed" lug to connect the inverter to the grounding system. Use a loop lug fitting the ground screw and having the same cross-section as the ground cable being used.

9. CROSS SECTIONS OF POWER CONNECTION WIRE AND SIZE OF PROTECTION DEVICES

The tables below state the features of the inverter cables and the protecting devices required to protect the system against short-circuits. For the largest inverter sizes, special links with multiple conductors are provided for each phase. For example, 2x150 in the column relating to the cable cross-section means that two 150sqmm parallel conductors are required for each phase.
Multiple conductors shall have the same length and must run parallel to each others, thus ensuring even current delivery at any frequency value. Paths having the same length but a different shape deliver uneven current at high frequency.
Also, do not exceed the tightening torque for the terminals to the bar connections. For connections to bars, the tightening torque relates to the bolt tightening the cable lug to the copper bar. The cross-section values given in the tables below apply to copper cables.
The links between the motor and the Sinus K must have the same lengths and must follow the same paths. Use 3-phase cables where possible.

9.1. VOLTAGE CLASS: 2T

Size	SINUS K Model	Inverter Rated Current	Terminal Cross-section	Cable Stripping	Tightening Torque	Wire Cross-section, Mains Side and Motor Side	Fast Fuses (700V)+ Disc. Switches	Magnetic Switch	AC1 Contactor
		A	mm² (AWG/kcmils)	mm	Nm	mm² (AWG/kcmils)	A	A	A
S05	0007	12.5	0.5÷10 (20÷6AWG)	10	1.2-1.5	2.5 (13AWG)	16	16	25
	0008	15		10	1.2-1.5		16	16	25
	0010	17		10	1.2-1.5	4 (10AWG)	25	25	25
	0013	19		10	1.2-1.5		32	32	30
	0015	23		10	1.2-1.5		32	32	30
	0016	27		10	1.2-1.5	10 (6AWG)	40	40	45
	0020	30		10	1.2-1.5		40	40	45
S10	0016	26	0.5÷10 (20÷6 AWG)	10	1.2-1.5	10 (6AWG)	40	40	45
	0017	30		10	1.2-1.5		40	40	45
	0020	30		10	1.2-1.5		40	40	45
	0025	41		10	1.2-1.5		63	63	55
	0030	41		10	1.2-1.5		63	63	60
	0035	41		10	1.2-1.5		100	100	100
S12	0023	38	.5÷25 (20÷4 AWG	18	2.5	10 (6AWG)	63	63	60
	0033	51		18	2.5	16 (5WG)	100	100	100
	0037	65		18	2.5	25 (4AWG	100	100	100
S15	0038	65	0.5÷25 (20÷4 AWG)	15	2.5	25 (4AWG)	100	100	100
	0040	72		15	2.5		100	100	100
	0049	80	4÷25 (12÷4 AWG)	15	2.5	25 (4AWG)	125	100	100
S20	0060	88	25÷50 (6÷1/0 AWG	24	6-8	35 (2AWG)	125	125	125
	0067	103		24	6-8	50 (1/0AWG)	125	125	125
	0074	120		24	6-8		160	160	145
	0086	135		24	6-8		200	160	160
S30	0113	180	35÷185 (2/0AWG÷ 350kcmils)	30	10	95 (4/0AWG)	250	200	250
	0129	195		30	10	120 (250kcmils)	250	250	250
	0150	215		30	10		315	400	275
	0162	240		30	10		400	400	275

(continued)

(continued)

Size	SINUS K Model	Inverter Rated Current	Terminal Cross-section	Cable Stripping	Tightening Torque	Wire Cross-section, Mains Side and Motor Side	Fast Fuses (700V)+ Disc. Switches	Magnetic Switch	AC1 Contactor
		A	mm^2 (AWG/kcmils)	mm	Nm	mm^2 (AWG/kcmils)	A	A	A
S40	0179	300	70÷240 (2/0AWG÷ 500kcmils)	40	25-30	185 (400kcmils)	400	400	400
	0200	345		40	25-30	210 (400kcmils)	500	400	450
	0216	375		40	25-30	240 (500kcmils)	500	630	450
	0250	390		40	25-30		630	630	500
S50	0312	480	Bar	-	30	2x150 (2x300kcmils)	800	630	550
	0366	550	Bar	-	30	2x210 (2x400kcmils)	800	800	600
	0399	630	Bar	-	30	2x240 (2x500kcmils)	800	800	700
S60	0457	720	Bar	-	30	2x240 (2x500kcmils)	1000	800	800
	0524	800	Bar	-	35	3x210 (3x400kcmils)	1000	1000	1000
S65	0598	900	Bar	-	35	3x210 (3x400kcmils)	1250	1250	1000
	0748	1000	Bar	-	35	3x240 (3x500kcmils)	1250	1250	1200
	0831	1200	Bar	-	35		1600	1600	1600

CAUTION

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

9.2. VOLTAGE CLASS: 4T

Size	SINUS K Model	Inverter Rated Current	Terminal Cross-section	Cable Stripping	Tightening Torque	Wire Cross-section, Mains Side and Motor Side	Fast Fuses (700V)+ Disc. Switches	Magnetic Switch	AC1 Contactor
		A	mm² (AWG/kcmils)	mm	Nm	mm² (AWG/kcmils)	A	A	A
S05	0005	10.5	0.5÷10 (20÷6AWG)	10	1.2-1.5	2.5 (13AWG)	16	16	25
	0007	12.5		10	1.2-1.5		16	16	25
	0009	16.5		10	1.2-1.5	4 (10AWG)	25	25	25
	0011	16.5		10	1.2-1.5		25	25	25
	0014	16.5		10	1.2-1.5		32	32	30
S10	0016	26	0.5÷10 (20÷6 AWG)	10	1.2-1.5	10 (6AWG)	40	40	45
	0017	30		10	1.2-1.5		40	40	45
	0020	30		10	1.2-1.5		40	40	45
	0025	41		10	1.2-1.5		63	63	55
	0030	41		10	1.2-1.5		63	63	60
	0035	41		10	1.2-1.5		100	100	100
S12	0016	26	0.5÷10 (20÷6 AWG	10	1.2-1.5	10 (6AWG)	40	40	45
	0017	30		10	1.2-1.5		40	40	45
	0020	30		10	1.2-1.5		40	40	45
	0025	41		10	1.2-1.5		63	63	55
	0030	41		10	1.2-1.5		63	63	60
	0034	57	0.5÷25 (20÷4 AWG	18	2.5	16 (5AWG)	100	100	100
	0036	60		18	2.5	25 (4AWG)	100	100	100
S15	0038	65	0.5÷25 (20÷4 AWG)	15	2.5	25 (4AWG)	100	100	100
	0040	72		15	2.5		100	100	100
	0049	80	4÷25 (12÷4 AWG)	15	2.5	25 (4AWG)	125	100	100
S20	0060	88	25÷50 (6÷1/0 AWG	24	6-8	35 (2AWG)	125	125	125
	0067	103		24	6-8	50 (1/0AWG)	125	125	125
	0074	120		24	6-8		160	160	145
	0086	135		24	6-8		200	160	160
S30	0113	180	35÷185 (2/0AWG÷ 350kcmils)	30	10	95 (4/0AWG)	250	200	250
	0129	195		30	10	120 (250kcmils)	250	250	250
	0150	215		30	10		315	400	275
	0162	240		30	10		400	400	275

(continued)

(continued)

Size	SINUS K Model	Inverter Rated Current	Terminal Cross-section	Cable Stripping	Tightening Torque	Wire Cross-section, Mains Side and Motor Side	Fast Fuses (700V)+ Disc. Switches	Magnetic Switch	AC1 Contactor
		A	mm² (AWG/kcmils)	mm	Nm	mm² (AWG/kcmils)	A	A	A
S40	0179	300	70÷240 (2/0AWG÷ 500kcmils)	40	25-30	185 (400kcmils)	400	400	400
	0200	345		40	25-30	210 (400kcmils)	500	400	450
	0216	375		40	25-30	240 (500kcmils)	500	630	450
	0250	390		40	25-30		630	630	500
S50	0312	480	Bar	-	30	2x150 (2x300kcmils)	800	630	550
	0366	550	Bar	-	30	2x210 (2x400kcmils)	800	800	600
	0399	630	Bar	-	30	2x240 (2x500kcmils)	800	800	700
S60	0457	720	Bar	-	30	2x240 (2x500kcmils)	1000	800	800
	0524	800	Bar	-	35	3x210 (3x400kcmils)	1000	1000	1000
S65	0598	900	Bar	-	35	3x210 (3x400kcmils)	1250	1250	1000
	0748	1000	Bar	-	35	3x240 (3x500kcmils)	1250	1250	1200
	0831	1200	Bar	-	35		1600	1600	1600

CAUTION

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

Size	SINUS K Model	Rated Output Current	Rated Input Current	Terminal Cross-section	Tightening Torque	Motor Cable Cross-section
		A	Adc	mm² (AWG/kcmils)	Nm	mm² (AWG/kcmils)
S64	0598	900	1000	Bar	35	3x210 (3x400kcmils)
	0748	1000	1100	Bar	35	3x240 (3x500kcmils)
	0831	1200	1400	Bar	35	3x240 (3x500kcmils)

CAUTION

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

9.3. UL-APPROVED FUSES – 2T VOLTAGE CLASS

The **UL-marked fuses** for the protection of semiconductors to be used with SINUS K inverters are listed in the table below. In multiple-cable installations, just insert one fuse per phase (not one fuse per conductor). Fuses for the protection of semiconductors manufactured by other manufacturers may be used, provided that the system ratings are not exceeded and that fuses are marked as "UL R/C Special Purpose Fuses (JFHR2)".

Size	SINUS K Model	UL-approved Fuses Manufactured by:							
		SIBA Sicherungen-Bau GmbH (200 kA_{RMS} Symmetrical A.I.C.)				Bussmann Div Cooper (UK) Ltd (100/200 kA_{RMS} Symmetrical A.I.C.)			
		Mod. No.	Ratings			Mod. No.	Ratings		
			Current A_{RMS}	I^2t (500V) A^2sec	Vac		Current A_{RMS}	I^2t (500V) A^2sec	Vac
S05	0007	20 412 04 16	16	49	700	FWP-15B	15	48	700
	0008	20 412 04 25	25	140		FWP-20B	20	116	
	0010								
	0013								
	0015	20 412 20 40	40	350		FWP-40B	40	236	
	0016								
	0020								
S10	0016	20 412 20 40	40	350		FWP-40B	40	236	
	0017								
	0020								
	0025	20 412 20 63	63	980		FWP-60B	60	685	
	0030								
	0035	20 412 20 100	100	2800		FWP-100B	100	2290	
S12	0023	20 412 20 63	63	980		20 282 20	63	980	
	0033	20 412 20 100	100	2800		FWP-100B	100	2290	
	0037								
S15	0038	20 412 20 100	100	2800		FWP-100B	100	2290	
	0040								
	0049								
S20	0060	20 412 20 125	125	5040		FWP-100B	100	2290	
	0067					FWP-125A	125	5655	
	0074	20 412 20 160	160	10780		FWP-150A	150	11675	
	0086	20 412 20 200	200	19250		FWP-175A	175	16725	
S30	0113	20 412 20 250	250	32760		FWP-225A	225	31175	
	0129								
	0150	20 412 20 315	315	60200		FWP-250A	250	42375	
	0162	20 412 20 400	400	109200		FWP-350A	350	95400	
S40	0179	20 412 20 400	400	109200		FWP-350A	350	95400	
	0200								
	0216	20 622 32 500	550	136500		FWP-450A	450	139150	
	0250	20 622 32 700	700	287000		FWP-700A	700	189000	
S50	0312	20 622 32 800	800	406000		FWP-800A	800	280500	
	0366								
	0399								
S60	0457	20 632 32 1000	1000	602000		FWP-1000A	1000	390000	
	0524	20 632 32 1250	1250	1225000		FWP-1200A	1200	690000	
S65	0598	20 632 32 1400	1400	1540000		170M6067	1400	1700000	
	0748					170M6067	1400	1700000	
	0831	20 688 32 1600	1600	1344000		170M6069	1600	2700000	

NOTE In modular sizes S65–S75, each supply arm shall be protected by a separate fuse (see table above).

9.4. UL-APPROVED FUSES – 4T VOLTAGE CLASS

The **UL-marked fuses** for the protection of semiconductors to be used with SINUS K inverters are listed in the table below. In multiple-cable installations, just insert one fuse per phase (not one fuse per conductor). Fuses for the protection of semiconductors manufactured by other manufacturers may be used, provided that the system ratings are not exceeded and that fuses are marked as "UL R/C Special Purpose Fuses (JFHR2)".

Size	SINUS K Model	UL-approved Fuses Manufactured by:							
		SIBA Sicherungen-Bau GmbH (200 kA_{RMS} Symmetrical A.I.C.)				Bussmann Div Cooper (UK) Ltd (100/200 kA_{RMS} Symmetrical A.I.C.)			
		Mod. No.	Ratings			Mod. No.	Ratings		
			Current A_{RMS}	I^2t (500V) A^2sec	Vac		Current A_{RMS}	I^2t (500V) A^2sec	Vac
S05	0005	20 412 04 16	16	49		FWP-15B	15	48	
	0007								
	0009	20 412 04 25	25	140		FWP-20B	20	116	
	0011								
	0014	20 412 20 40	40	350		FWP-40B	40	236	
S10	0016	20 412 20 40	40	350		FWP-40B	40	236	
	0017								
	0020								
	0025	20 412 20 63	63	980		FWP-60B	60	685	
	0030								
	0035	20 412 20 100	100	2800		FWP-100B	100	2290	
S12	0016	20 412 20 40	40	350		FWP-40B	40	236	
	0017								
	0020								
	0025	20 412 20 63	63	980		FWP-60B	60	685	
	0030								
	0034	20 412 20 100	100	2800		FWP-100B	100	2290	
	0036								
S15	0038	20 412 20 100	100	2800	700	FWP-100B	100	2290	700
	0040								
	0049								
S20	0060	20 412 20 125	125	5040		FWP-100B	100	2290	
	0067					FWP-125A	125	5655	
	0074	20 412 20 160	160	10780		FWP-150A	150	11675	
	0086	20 412 20 200	200	19250		FWP-175A	175	16725	
S30	0113	20 412 20 250	250	32760		FWP-225A	225	31175	
	0129								
	0150	20 412 20 315	315	60200		FWP-250A	250	42375	
	0162	20 412 20 400	400	109200		FWP-350A	350	95400	
S40	0179	20 412 20 400	400	109200		FWP-350A	350	95400	
	0200								
	0216	20 622 32 550	550	136500		FWP-450A	450	139150	
	0250	20 622 32 700	700	287000		FWP-700A	700	189000	
S50	0312	20 622 32 800	800	406000		FWP-800A	800	280500	
	0366								
	0399								
S60	0457	20 622 32 1000	1000	602000		FWP-1000A	1000	390000	
	0524	20 622 32 1250	1250	1225000		FWP-1200A	1200	690000	
S65	0598	20 632 32 1400	1400	1540000		170M6067	1400	1700000	
	0748					170M6067	1400	1700000	
	0831	20 688 32 1600	1600	1344000		170M6069	1600	2700000	

NOTE In modular sizes S65–S75, each supply arm shall be protected by a separate fuse (see table above).

10. INPUT - OUTPUT FEATURES

10.1. Digital Input Features (Terminals 6 to 13)

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

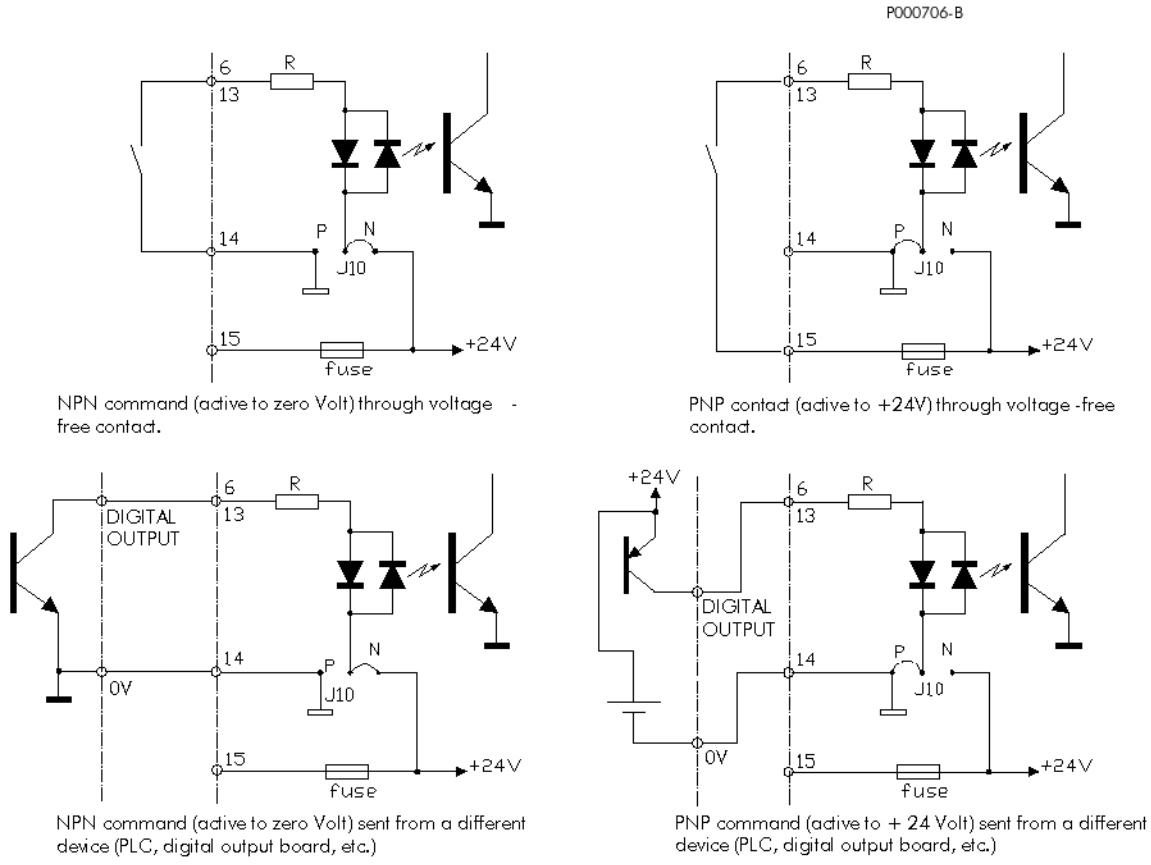


Figure 40: Control modes for the digital inputs.

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

The operating condition of the digital inputs is indicated by parameter M08 (IFD SW) or parameter M11 (VTC SW) in the Measure submenu. Digital inputs (except form terminal 6 and terminal 8) are disabled if parameter C21 (IFD SW) or C14 (VTC SW) is set to REM. In that case, the command is sent through serial communication. If parameter C21 (IFD SW) or C14 (VTC SW) is programmed to Kpd, input 7 command is sent via keypad (START key).

10.1.1. ENABLE (TERMINAL 6)

The ENABLE input must always be activated to enable the inverter operation regardless of the control mode.
If the 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 C61 (IFD SW) or C53 (VTC SW). The ENABLE command also unlocks PID regulator - if used regardless of the inverter operation - whether neither MDI3 nor MDI4 are set as A/M (Automatic/Manual).

NOTE

When the ENABLE command is active, alarms A11 (Bypass Failure), A25 (Mains Loss) (IFD SW only), A30 (DC OverVoltage) and A31 (DC UnderVoltage) are enabled as well.

10.1.2. START (TERMINAL 7)

To enable the Start input, set the control modes via terminal board (factory setting). When the START input is active, the main reference is enabled; otherwise, the main reference is set to zero. The output frequency (IFD SW) or the speed motor (VTC SW) drops to zero with respect to the preset deceleration ramp. If C21 (IFD SW) or C14 (VTC SW) is set to Kpd (command sent via keypad), the START input is disabled and its functionality is performed by the inverter remotable keypad (see the COMMANDS MENU in Sinus K's Programming Instructions Manual). If the REV function ("reverse rotation") is active, the START input may be used only when the REV input is inactive; if START and REV are enabled at a time, the main reference is set to zero.

10.1.3. 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 8 "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 C61 (IFD SW) or C53 (VTC SW) is set to [YES], the inverter is reset *and* restarts. The reset terminal also allows resetting the UP/DOWN commands; to do so, set parameter P25 "U/D RESET" to [YES].

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 (IFD SW) or C48 (VTC SW) to [YES]

CAUTION

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

DANGER

Electrical 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).

10.1.4. MDI-MULTIFUNCTION DIGITAL INPUTS (TERMINALS 9 TO 13)

The programmable digital input functionality is detailed in the SINUS K's Programming Manual.

10.1.5. MOTOR THERMAL PROTECTION (PTC TYPE) INPUT (TERMINAL 13)

The inverter manages the signal sent from a thermistor (PTC) incorporated in the motor windings to obtain a hardware thermal protection of the motor. The thermistor ratings must comply with BS4999 Pt.111 (DIN44081/DIN44082):

Resistor corresponding to trip value:	1000 ohm (typical rating)
Resistor at Tr–5°C:	< 550 ohm
Resistor at Tr+5°C:	> 1330 ohm

Do the following to use the thermistor:
1) Set jumper J9 to position 1-2,
2) Connect thermistor between terminals 13 and 14 in the control board,
3) Set MDI5 as auxiliary trip (Ext A).

In that way, the inverter will stop and indicate "auxiliary trip" as soon as the motor temperature exceeds threshold value Tr.

10.2. Analog Input Features (Terminals 2,3,15 and 21)

Inputs Vref1 and Vref2 (terminals 2 and 3) acknowledge both unipolar signals (0÷10V, factory setting) and bipolar signals (±10V) based on jumper J14 position.
Signals sent to terminals 2 and 3 are summed up.
Auxiliary power supply (+10V, terminal 4) is available to power an external potentiometer (2.5÷10 kΩ).
Do the following to use a bipolar signal (± 10 V) at the inverter input:
- set jumper J14 to position 1-2 (+/-)
- set parameter P18 (Vref J14 Pos.) as "+/-"
- set parameter P15 (Minimum Ref) as "+/-"

The motor direction of rotation changes when the main reference sign becomes opposite.

Bipolar voltage (±10V) may be sent to input Inaux (terminal 19). The motor direction of rotation changes when negative signals are sent.
Analog input Iref (terminal 21) acknowledges a current value ranging from 0 to 20mA as an input signal (factory setting: 4÷20 mA).

CAUTION Do not apply signals exceeding ±10V to terminals 2 and 3. Do not send current values exceeding 20mA to terminal 21.

Parameters P16 (Vref Bias), P17 (Vref Gain), P19 (Inmax), and P20 (Iref Gain) allow changing the relationship between the signals sent to terminals 2, 3 and 21 and the main reference.
It is possible to change the relationship between the signal sent to terminal 19 (Inaux) and the value acquired through parameters P21 and P22. Programming and functionality of the parameters managing analog inputs are detailed in the Programming Manual.

10.3. Digital Output Features

An OPEN COLLECTOR output is available on terminals 24 (collector) and 25 (common terminal). The OC output is galvanically insulated 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:
frequency/speed threshold: the transistor activates when the output frequency (IFD SW) or the motor speed (VTC SW) attains the level set through the "Digital Output" menu (parameters P69 "MDO level", P70 "MDO Hyst.").
The following figure show an example of a relay connected to the OPEN COLLECTOR output.

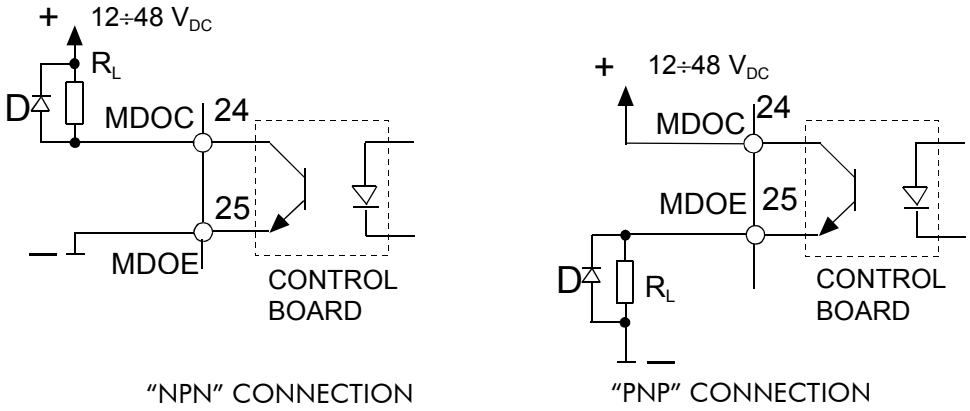


Figure 41: Connecting a relay to the OPEN COLLECTOR output.

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 isolated 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.

10.3.1. RELAY OUTPUTS (TERMINALS 24 TO 31)

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 and 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 and 31); energizes when the output frequency (IFD SW) or the motor speed (VTC SW) attains the level set through the "Digital Output" menu (parameters P73 "RL2 level", P74 "RL2 Hyst.").

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.

10.4. 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 selecting the type of output signal (0-10V, 4-20mA or 0-20mA).

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

X=any position

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 for IFS SW). 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.

11. SIGNALS AND PROGRAMMING FOR ES778 CONTROL BOARD

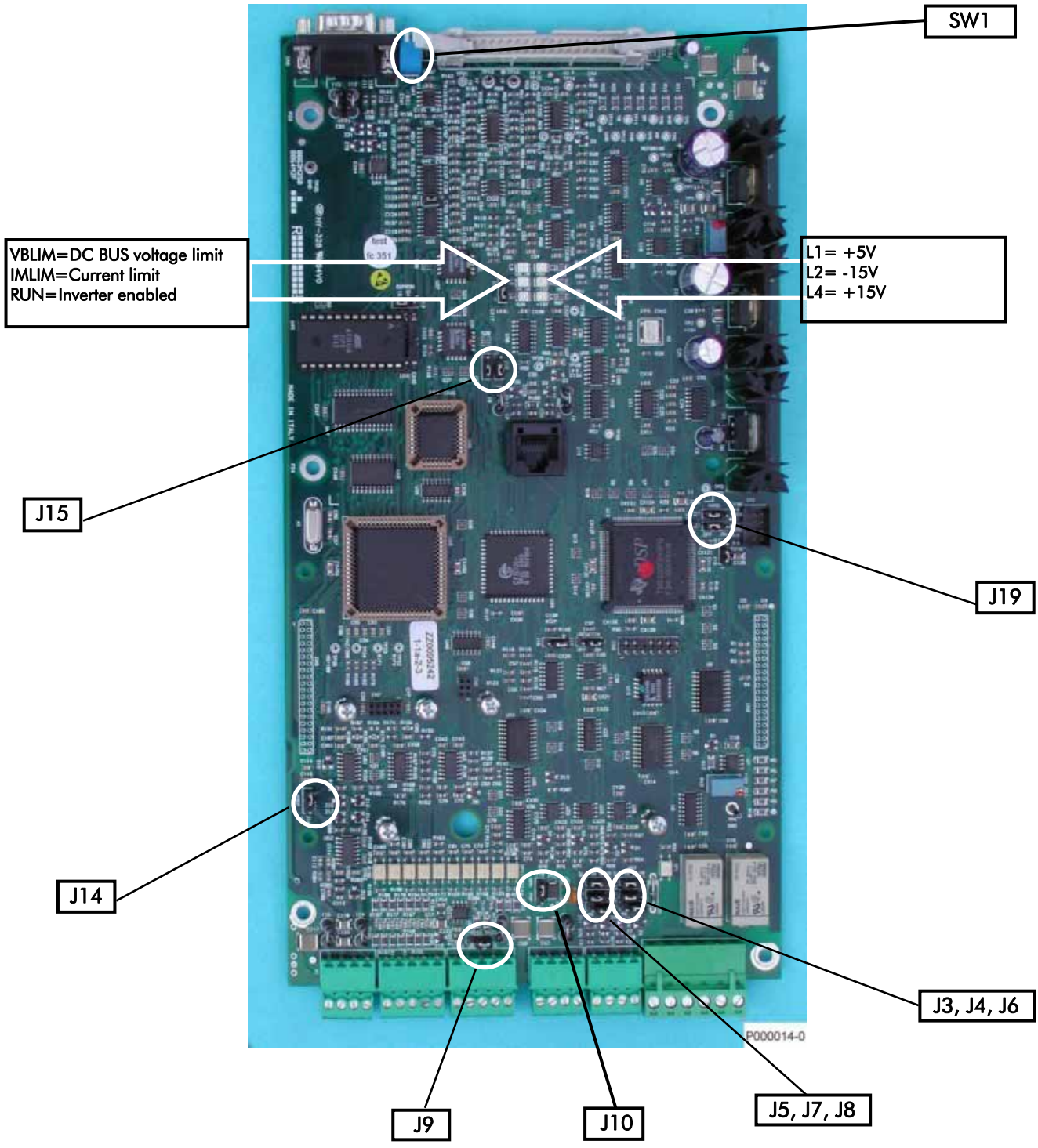


Figure 42: Location of the jumpers on ES778 control board.

11.1. Indicator Leds

L3 LED, red (VBLIM): voltage limiting activation during deceleration; "on" when VDC within the equipment exceeds by 20% the rated value during dynamic braking.
L5 LED, 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 (IFD SW) respectively. This Led is on even when the torque needed exceeds the value set in C42, Limits submenu (VTC SW).
L6 LED, green (RUN): Inverter enabled; "on" when the inverter is running or is enabled only (VTC SW only) (fluxed motor).
L1 LED, green (+5V): control board **+5V** power supply on.
L2 LED, green (-15V): control board **-15V** power supply on.
L4 LED, green (+15V): control board **+15V** power supply on.

11.2. Jumpers and Dip-Switches

J3	**(1-2)** 4-20mA in AO2
	(2-3) 0-20mA in AO2
J4	**(2-3)** V in AO2
	(1-2) mA in AO2
J5	**(1-2)** 4-20mA in AO1
	(2-3) 0-20mA in AO1
J6	**(1-2)** 4-20mA in AO2
	(2-3) 0-20mA in AO2
J7	**(2-3)** V in AO1
	(1-2) mA in AO1
J8	**(1-2)** 4-20mA in AO1
	(2-3) 0-20mA in AO1
J9	**(2-3)** PTC OFF
	(1-2) PTC ON
J10	**(1-2)** PNP inputs
	(2-3) NPN inputs
J14	**(2-3)** VREF + reference
	(1-2) VREF ± reference
J15	**(2-3)** IFD SW
	(1-2) VTC SW
J19	**(2-3)** VTC SW
	(1-2) IFD SW

CAUTION The position of J15 must be consistent with the position of J19 (both IFD SW or VTC SW).
When switching from one position to the other, make sure that the inverter is OFF.

SW1	**(on)** bias resistors and termination on RS485 connected
	(off) bias resistors and termination on RS485 disconnected

To gain access to SW1 dip-switch, remove the cap protecting RS485connector.
Size S05 to S20: SW1 dip-switch is installed in the control board next to RS485 interface connector. It can be reached from the cover on top of the inverter.

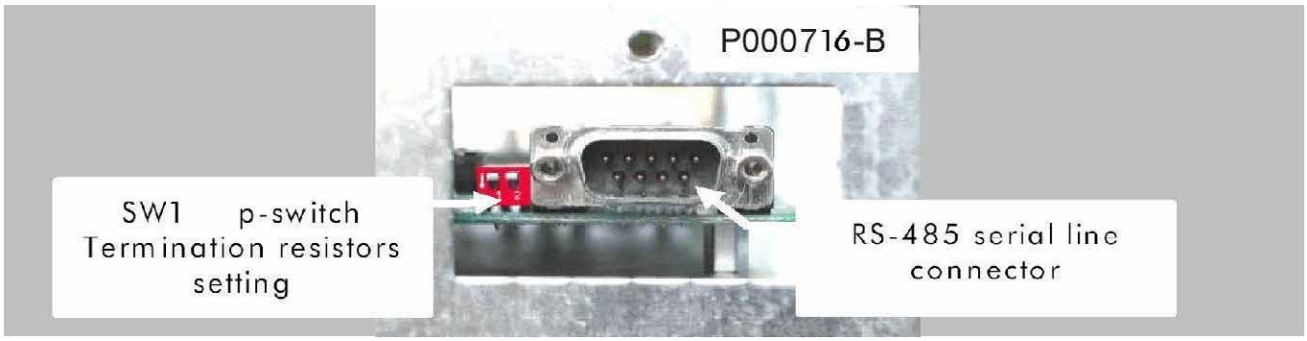


Figure 43: Location of SW1 dip-switch and RS485 connector for Sinus K S05 to S20.

Sizes S30 to S60: RS485 interface connector and SW1 dip-switch are located on the inverter bottom next to the front cover of the control terminals.
Size S65: to reach SW1 dip-switch, remove the cover located on the rear part of the control board frame.

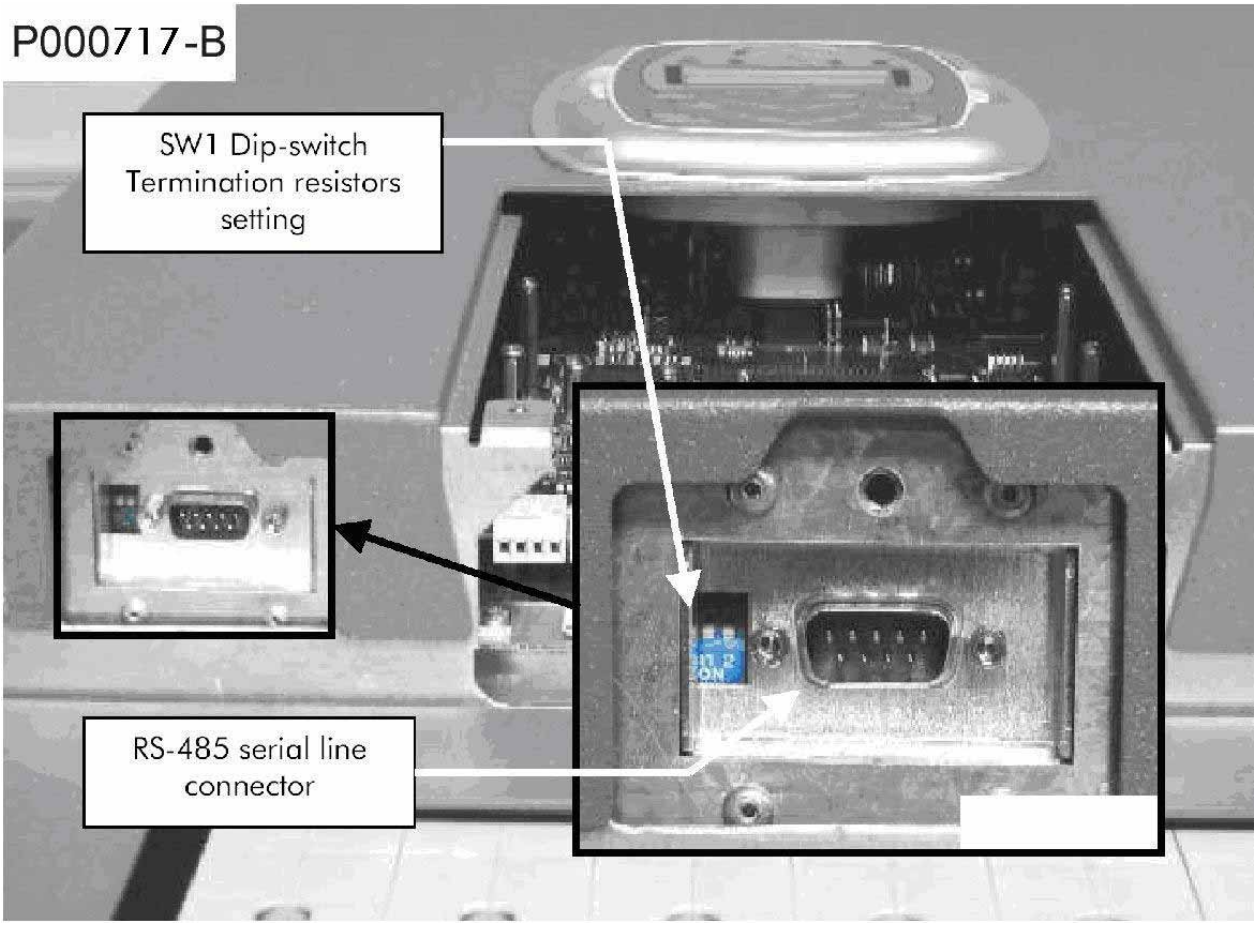


Figure 44: Location of SW1 dip-switch and RS485 connector for Sinus K S30 to S60.

IP54 inverters: RS485 serial link connector and SW1 dip-switch can be reached from the inside of the wiring front cover.

12. SERIAL COMMUNICATIONS

12.1. 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/keypad. 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 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).

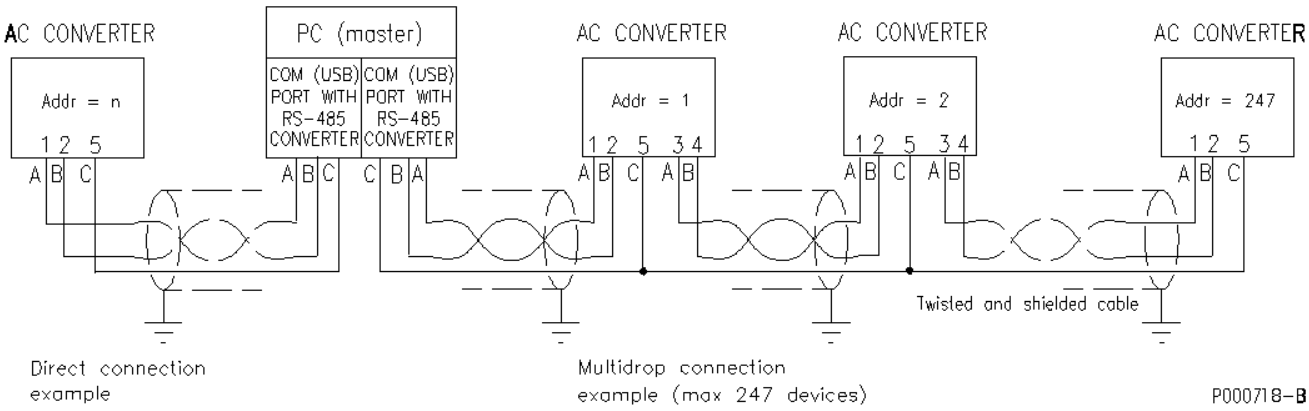


Figure 45: Example of multidrop and direct connection.

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

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

12.1.1. 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 (vice versa for logic "0" , normally called a SPACE).

12.1.2. MULTIDROP NETWORK CONNECTION

SINUS K inverters 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 identification number, which can be set in the "Serial network" submenu as a unique code in the network connected to the PC.

12.1.2.1. CONNECTION

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

PIN	FUNCTION
1 – 3	(TX/RX A) Differential input/output A (bidirectional) according to standard RS485. Positive polarity with respect to pins 2 – 4 for one MARK. Signal D1 according to MODBUS-IDA association.
2 – 4	(TX/RX B) Differential input/output B (bidirectional) according to standard RS485. Negative polarity with respect to pins 1 – 3 for one MARK. Signal D1 according to MODBUS-IDA association.
5	(GND) control board zero volt. Common according to MODBUS-IDA association.
6	(VTEST) Test supply input – (see section below)
7 – 8	not connected
9	+ 5 V, max 100 mA for power supply of optional converter RS485/RS232

The D-connector metal frame is connected to the grounding. Wire duplex cable braiding to the metal frame of the female connector to be connected to the inverter. To avoid obtaining a too high common voltage for driver RS485 of the master or the multidrop-connected devices, connect together terminals GND (if any) for all devices. This ensures equipotentiality for all signal circuits, thus providing the best operating conditions for drivers RS485; however, if devices are connected to each others with analog interfaces, this can create ground loops. If disturbance occurs when communication interfaces and analog interface operate at a time, use optional, galvanically isolated RS485 communications interface.

The basic wiring recommended from MODBUS-IDA association for the connection of 2-wire devices is as follows:

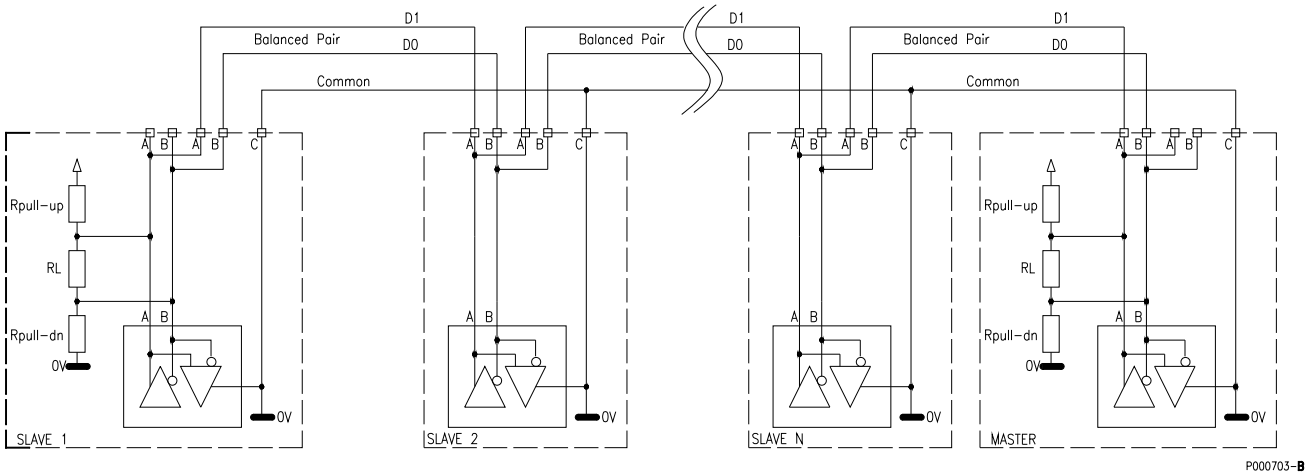


Figure 46: Recommended wiring diagram for "2-wire" MODBUS wiring.

Note that the network composed of the termination resistor and the polarization resistors is integrated into the inverter and can be activated via appropriate dip-switches. Figure 46 shows the termination network in the devices at both ends of the chain. The terminator must be activated in those devices only.

NOTE

Four-pair data transfer cables of Category 5 are normally used for serial links. Although their usage is not recommended, cables of Category 5 can be used for short cable paths. Note that the colours of such cables are different from the colours defined by MODBUS-IDA association. One pair is used for D1/D0 signals, one pair is used as a "Common" conductor, while the remaining two pairs must not be connected to any other device, or must be connected to the "Common".

NOTE

All devices connected to the communication multidrop network should be grounded to the same conductor to minimize any difference of ground potentials between devices that can affect communication.

NOTE

The common terminal for the supply of the inverter control board is isolated from grounding. If one or multiple inverters are connected to a communication device with a grounded common (typically a computer), a low-impedance path between control boards and grounding occurs. High-frequency disturbance could come from the inverter power components and interfere with the communication device operation.
If this happens, provide the communication device with a galvanically isolated interface, type RS485/RS232.

12.1.2.2. LINE TERMINATORS

Provide a linear wiring (not a star wiring) for multidrop line RS485. To do so, two pins for each line signal are provided on the inverter connector. The incoming line may be connected to pins 1 and 2, whereas the outgoing line may be connected to pins 3 and 4.
The first device in the multidtrop connection will have only one outgoing line, while the last device will have only one incoming line. Line terminator is to be installed on the first device and the last device. In serial link 0, the terminator is selected through dip-switch SW1 for SINUS K inverters (see the Jumpers and Dip-Switches section).
The line master (computer) is typically placed at the beginning or at the end of a multidrop connection; in that case, the line terminator of the farthest inverter from the master computer (or the only inverter in case of direct connection to the master computer) shall be enabled: dip-switch SW1 in position ON.
The line terminator of the other inverters in intermediate positions shall be disabled: dip-switch SW1, in position OFF.

NOTE

Communication does not take place or is adversely affected if multidrop terminators are not properly set, especially in case of a high baud rate. If more than two terminators are fitted, some drivers can enter the protection mode due to thermal overload, thus stopping dialoguing with some of the connected devices.

12.1.3. ES822 ISOLATED BOARD (OPTIONAL)

ES822 Optional board can be used to connect the equipment to RS485 or RS232 serial link. ES822 isolated board is to be installed inside the inverter to connect it either to a computer via serial link RS232 (with no need to use additional devices) or to RS485 serial link. ES822 Optional board also ensures galvanic isolation between the serial link and the inverter control board grounding, thus avoiding unwanted loops and improving immunity to serial link disturbance. For more details, see ES822/1 ISOLATED SERIAL BOARD in the ACCESSORIES section of this manual.
The activation of ES822 results in the automatic commutation of serial link 0, which is electrically suppressed from the standard serial connector of the inverter.

12.2. 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.
The terminal board inputs may be controlled by the field or the serial link, depending on programming of parameters C21 and C22 for IFD SW, C14 and C16 for VTC SW.
If parameters C21 or C14 are set to REM, commands relating to START digital inputs and to multifunction inputs are to be sent via serial link. Their condition in the terminal board has no effect.
If parameters C22 or C16 are set to REM, the main reference is to be sent via serial link. Signals applied to terminals 2, 3 and 21 (Vref1, Vref2 and Iref) have no effect.
However, the ENABLE command is always to be sent via terminal board regardless of the inverter programming mode.

12.3. Communication Ratings

		IFD SW Parameters	VTC SW Parameters
Electrical standard:	RS485		
Protocol:	MODBUS RTU		
Supported functions:	03h (Read Holding Registers) 10h (Preset Multiple Registers)		
Device address:	configurable between 1 and 247 (default address: 1)	C90	C80
Inverter response delay:	configurable between 0 and 500 ms (default delay time: 0 ms)	C91	C81
End of message timeout:	configurable between 0 and 2000 ms (default timeout: 0 ms)	C93	C83
Baud rate:	configurable between 1200..9600 bps (default baud rate: 9600 bps)	C94	C84
Data format:	8 bits		
Start bit:	1		
Parity/ Stop bit	Configurable among: NO/2 stop bit (default value) Even/ 1 stop bit NO/ 1 stop bit	C95	C85

13. ACCESSORIES

13.1. Braking Resistors

13.1.1. APPLICATION TABLES

From size S05 to size S30, SINUS K inverters are supplied with a built-in braking unit. The braking resistor is to be incorporated in the inverter and connected to terminal B and terminal + (see the WIRING section). For IFD SW only, the braking unit is enabled through programming parameter C57, Special Functions submenu. An external braking unit is used for greater sizes (BU200,BU720,BU1440). When choosing the braking resistor, consider its Ohm value and rated power. The Ohm value determines the instant power dissipated in the braking resistor and is relating to the motor power; the rated power determines the mean power to be dissipated in the braking resistor and is relating to the duty cycle of the equipment, i.e. to the resistor activation time with respect to the duty cycle full time (the duty cycle of the resistor is equal to the motor braking time divided by the equipment duty cycle).
It is not possible to connect resistors with an Ohm value lower than the min. value acknowledged by the inverter.
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 unit, please refer to the Braking Unit BU200 section.

13.1.1.1. BRAKING RESISTORS FOR APPLICATIONS WITH A BRAKING DUTY CYCLE OF 10% AND 380-500VAC SUPPLY VOLTAGE

Size	SINUS K Model 4T Class	Braking Unit	Min. Resistor to be Applied to the BU	BRAKING RESISTOR WITH 10% DUTY CYCLE		
			Ω	Type	IP Rating	ID
S05	0005	internal	50	75Ω-550W	IP33	RE3063750
	0007	internal	50	75Ω-550W	IP33	RE3063750
	0009	internal	50	50Ω-1100W	IP55	RE3083500
	0011	internal	50	50Ω-1100W	IP55	RE3083500
	0014	internal	50	50Ω-1100W	IP55	RE3083500
S10	0016	internal	50	50Ω-1500W	IP54	RE3093500
	0017	internal	50	50Ω-1500W	IP54	RE3093500
	0020	internal	50	50Ω-1500W	IP54	RE3093500
	0025	internal	20	25Ω-1800W	IP54	RE3103250
	0030	internal	20	25Ω-1800W	IP54	RE3103250
	0035	internal	20	25Ω-1800W	IP54	RE3103250
S12	0016	internal	40	50Ω-1500W	IP54	RE3093500
	0017	internal	40	50Ω-1500W	IP54	RE3093500
	0020	internal	40	50Ω-1500W	IP54	RE3093500
	0025	internal	20	25Ω-1800W	IP54	RE3103250
	0030	internal	20	25Ω-1800W	IP54	RE3103250
	0034	internal	20	20Ω-4000W	IP20	RE3483200
	0036	internal	20	20Ω-4000W	IP20	RE3483200
S15	0038	internal	15	15Ω-4000W	IP20	RE3483150
	0040	internal	15	15Ω-4000W	IP20	RE3483150
	0049	internal	10	15Ω-4000W	IP20	RE3483150
S20	0060	internal	10	10Ω-8000W	IP20	RE3763100
	0067	internal	10	10Ω-8000W	IP20	RE3763100
	0074	internal	8.5	10Ω-8000W	IP20	RE3763100
	0086	internal	8.5	10Ω-8000W	IP20	RE3763100
S30	0113	internal	6	6.6Ω-12000W	IP20	RE4022660
	0129	internal	6	6.6Ω-12000W	IP20	RE4022660
	0150	internal	5	6.6Ω-12000W	IP20	RE4022660
	0162	internal	5	6.6Ω-12000W	IP20	RE4022660
S40	0179	2*BU200	5	2*10Ω-8000W (*)	IP20	2*RE3763100
	0200	2*BU200	5	2*6.6Ω-12000W (*)	IP20	2*RE4022660
	0216	2*BU200	5	2*6.6Ω-12000W (*)	IP20	2*RE4022660
	0250	2*BU200	5	2*6.6Ω-12000W (*)	IP20	2*RE4022660
S50	0312	3*BU200	5	3*6.6Ω-12000W (*)	IP20	3*RE4022660
	0366	3*BU200	5	3*6.6Ω-12000W (*)	IP20	3*RE4022660
	0399	3*BU200	5	3*6.6Ω-12000W (*)	IP20	3*RE4022660
S60	0457	3*BU200	5	3*6.6Ω-12000W (*)	IP20	3*RE4022660
	0524	4*BU200	5	4*6.6Ω-12000W (*)	IP20	4*RE4022660

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S65	**0598**	BU1440 2T-4T	0.48	1.2Ohm/64000W**(*)**	IP23	RE4562120
	0748	BU1440 2T-4T	0.48	1.2Ohm/64000W**(*)**	IP23	RE4562120
	0831	BU1440 2T-4T	0.48	2*1.6Ohm/48000W**(*)**	IP23	2*RE4462160

(*): For the connection of BU200 and the braking resistor, please refer to the relevant section in this manual.

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

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

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

13.1.1.2. BRAKING RESISTORS FOR APPLICATIONS WITH A BRAKING DUTY CYCLE OF 20% AND 380-500VAC SUPPLY VOLTAGE

Size	SINUS K Model 4T Class	Braking Unit	Min. Resistor to be Applied to the BU	BRAKING RESISTOR WITH 20% DUTY CYCLE		
			Ω	Type	IP Rating	ID
S05	0005	internal	50	50Ω-1100W	IP55	RE3083500
	0007	internal	50	50Ω-1100W	IP55	RE3083500
	0009	internal	50	50Ω-1100W	IP55	RE3083500
	0011	internal	50	50Ω-1500W	IP54	RE3093500
	0014	internal	50	50Ω-1500W	IP54	RE3093500
S10	0016	internal	50	50Ω-2200W	IP54	RE3113500
	0017	internal	50	50Ω-2200W	IP54	RE3113500
	0020	internal	50	50Ω-4000W	IP20	RE3483500
	0025	internal	20	25Ω-4000W	IP20	RE3483250
	0030	internal	20	25Ω-4000W	IP20	RE3483250
	0035	internal	20	25Ω-4000W	IP20	RE3483250
S12	0016	internal	40	50Ω-2200W	IP54	RE3113500
	0017	internal	40	50Ω-2200W	IP54	RE3113500
	0020	internal	40	50Ω-4000W	IP20	RE3483500
	0025	internal	20	25Ω-4000W	IP20	RE3483250
	0030	internal	20	25Ω-4000W	IP20	RE3483250
	0034	internal	20	20Ω-4000W	IP20	RE3483200
	0036	internal	20	20Ω-4000W	IP20	RE3483200
S15	0038	internal	15	15Ω-4000W	IP20	RE3483150
	0040	internal	15	15Ω-4000W	IP20	RE3483150
	0049	internal	10	10Ω-8000W	IP20	RE3763100
S20	0060	internal	10	10Ω-8000W	IP20	RE3763100
	0067	internal	10	10Ω-12000W	IP20	RE4023100
	0074	internal	8.5	10Ω-12000W	IP20	RE4023100
	0086	internal	8.5	10Ω-12000W	IP20	RE4023100
S30	0113	internal	6	2*3.3Ω-8000W (*)	IP20	2*RE3762330
	0129	internal	6	2*3.3Ω-8000W (*)	IP20	2*RE3762330
	0150	internal	5	2*10Ω-12000W (**)	IP20	2*RE4023100
	0162	internal	5	2*10Ω-12000W (**)	IP20	2*RE4023100
S40	0179	2* BU200	6.6	2*6.6Ω-12000W (***)	IP20	2*RE4022660
	0200	2* BU200	6.6	2*6.6Ω-12000W (***)	IP20	2*RE4022660
	0216	3* BU200	6.6	3*6.6Ω-12000W (***)	IP20	3*RE4022660
	0250	3* BU200	6.6	3*6.6Ω-12000W (***)	IP20	3*RE4022660
S50	0312	4* BU200	6.6	4*6.6Ω-12000W (***)	IP20	4*RE4022660
	0366	4* BU200	6.6	4*6.6Ω-12000W (***)	IP20	4*RE4022660
	0399	4* BU200	6.6	4*6.6Ω-12000W (***)	IP20	4*RE4022660
S60	0457	5*BU200	6.6	5*10Ω-12000W (***)	IP20	5*RE4023100
	0524	5*BU200	6.6	5*10Ω-12000W (***)	IP20	5*RE4023100

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S65	0598	BU1440 2T-4T	0.48	2*2.4Ω-64000W(***)	IP23	2*RE4562240
	0748	BU1440 2T-4T	0.48	2*2.4Ω-64000W(***)	IP23	2*RE4562240
	0831	BU1440 2T-4T	0.48	2*1.6Ω-64000W(***)	IP23	2*RE4562160

(*): Two series-connected resistors, 3.3Ohm/8000W
(**): Two parallel-connected resistors, 10Ohm/12000W
(***): For the connection of BU200 and the braking resistor, please refer to the relevant section in this manual.

13.1.1.3. BRAKING RESISTORS FOR APPLICATIONS WITH A BRAKING DUTY CYCLE OF 50% AND 380-500VAC SUPPLY VOLTAGE

Size	SINUS K Model 4T Class	Braking Unit	Min. Resistor to be Applied to the BU	BRAKING RESISTOR WITH 50% DUTY CYCLE		
			Ω	Type	IP Rating	ID
S05	0005	internal	50	50Ω-4000W	IP23	RE3503500
	0007	internal	50	50Ω-4000W	IP23	RE3503500
	0009	internal	50	50Ω-4000W	IP23	RE3503500
	0011	internal	50	50Ω-4000W	IP23	RE3503500
	0014	internal	50	50Ω-4000W	IP23	RE3503500
S10	0016	internal	50	50Ω-8000W	IP23	RE3783500
	0017	internal	50	50Ω-8000W	IP23	RE3783500
	0020	internal	50	50Ω-8000W	IP23	RE3783500
	0025	internal	20	20Ω-12000W	IP23	RE4053200
	0030	internal	20	20Ω-12000W	IP23	RE4053200
	0035	internal	20	20Ω-12000W	IP23	RE4053200
S12	0016	internal	40	50Ω-8000W	IP23	RE3783500
	0017	internal	40	50Ω-8000W	IP23	RE3783500
	0020	internal	40	50Ω-8000W	IP23	RE3783500
	0025	internal	20	20Ω-12000W	IP23	RE4053200
	0030	internal	20	20Ω-12000W	IP23	RE4053200
	0034	internal	20	20Ω-12000W	IP23	RE4053200
	0036	internal	20	20Ω-12000W	IP23	RE4053200
S15	0038	internal	15	15Ω-16000W	IP23	RE4163150
	0040	internal	15	15Ω-16000W	IP23	RE4163150
	0049	internal	10	15Ω-16000W	IP23	RE4163150
S20	0060	internal	10	10Ω-24000W	IP23	RE4293100
	0067	internal	10	10Ω-24000W	IP23	RE4293100
	0074	internal	8.5	10Ω-24000W	IP23	RE4293100
	0086	internal	8.5	10Ω-24000W	IP23	RE4293100
S30	0113	internal	6	6Ω-48000W	IP23	RE4462600
	0129	internal	6	6Ω-48000W	IP23	RE4462600
	0150	internal	5	5Ω-64000W	IP23	RE4552500
	0162	internal	5	5Ω-64000W	IP23	RE4552500
S40	0179	3 * BU200	10	3*10Ω-24000W (*)	IP23	3*RE4293100
	0200	3 * BU200	10	3*10Ω-24000W (*)	IP23	3*RE4293100
	0216	3 * BU200	10	3*10Ω-24000W (*)	IP23	3*RE4293100
	0250	4 * BU200	10	4*10Ω-24000W (*)	IP23	4*RE4293100
S50	0312	4 * BU200	10	4*10Ω-24000W (*)	IP23	4*RE4293100
	0366	6 * BU200	10	6*10Ω-24000W (*)	IP23	6*RE4293100
	0399	6 * BU200	10	6*10Ω-24000W (*)	IP23	6*RE4293100
S60	0457	8 * BU200	10	8*10Ω-24000W (*)	IP23	8*RE4293100
	0524	10 * BU200	10	10*10Ω-24000W (*)	IP23	10*RE4293100

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S65	0598	BU1440 2T-4T	0.48	4*1.2Ω-64000W(*)	IP23	4*RE4562120
	0748	BU1440 2T-4T	0.48	4*1.2Ω-64000W(*)	IP23	4*RE4562120
	0831	BU1440 2T-4T	0.48	4*0.8Ω-64000W(*)	IP23	4*RE4561800

(*): For the connection of BU200 and the braking resistor, please refer to the relevant section in this manual.

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

CAUTION Power dissipated by braking resistors may be equal to approx. 50% of the rated power of the connected motor. Use a proper air-cooling system. Do not install braking resistors near heat-sensitive equipment or objects.

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

13.1.1.4. BRAKING RESISTORS FOR APPLICATIONS WITH A BRAKING DUTY CYCLE OF 10% AND 200-240VAC SUPPLY VOLTAGE

Size	SINUS K Model 2T Class	Braking Unit	Min. Resistor to be Applied to the BU	BRAKING RESISTOR WITH 10% DUTY CYCLE		
			Ω	Type	IP Rating	ID
S05	0007	internal	25.0	56Ω-350W	IP55	RE2643560
	0008	internal	25.0	2*56Ω-350W (*)	IP55	2*RE2643560
	0010	internal	25.0	2*56Ω-350W (*)	IP55	2*RE2643560
	0013	internal	20.0	2*56Ω-350W (*)	IP55	2*RE2643560
	0015	internal	20.0	2*56Ω-350W (*)	IP55	2*RE2643560
	0016	internal	20.0	2*56Ω-350W (*)	IP55	2*RE2643560
	0020	internal	20.0	2*56Ω-350W (*)	IP55	2*RE2643560
S10	0016	internal	25.0	2*56Ω-350W (*)	IP55	2*RE2643560
	0017	internal	25.0	2*56Ω-350W (*)	IP55	2*RE2643560
	0020	internal	25.0	2*56Ω-350W (*)	IP55	2*RE2643560
	0025	internal	10.0	15Ω-1100W	IP55	RE3083150
	0030	internal	10.0	15Ω-1100W	IP55	RE3083150
	0035	internal	10.0	15Ω-1100W	IP55	RE3083150
S12	0023	internal	15.0	15Ω-1100W	IP55	RE3083150
	0033	internal	10.0	10Ω-1500W	IP55	RE3093100
	0037	internal	10.0	10Ω-1500W	IP55	RE3093100
S15	0038	internal	7.5	2*15Ω-1100W (*)	IP55	2*RE3083150
	0040	internal	7.5	2*15Ω-1100W (*)	IP55	2*RE3083150
	0049	internal	5.0	5Ω-4000W	IP20	RE3482500
S20	0060	internal	5.0	5Ω-4000W	IP20	RE3482500
	0067	internal	5.0	5Ω-4000W	IP20	RE3482500
	0074	internal	4.2	5Ω-4000W	IP20	RE3482500
	0086	internal	4.2	5Ω-4000W	IP20	RE3482500
S30	0113	internal	3.0	3.3Ω-8000W	IP20	RE3762330
	0129	internal	3.0	3.3Ω-8000W	IP20	RE3762330
	0150	internal	2.5	3.3Ω-8000W	IP20	RE3762330
	0162	internal	2.5	3.3Ω-8000W	IP20	RE3762330
S40	0179	2 * BU200	2.5	2*3.3Ω-8000W (**)	IP20	2*RE3762330
	0200	2 * BU200	2.5	2*3.3Ω-8000W (**)	IP20	2*RE3762330
	0216	2 * BU200	2.5	2*3.3Ω-8000W (**)	IP20	2*RE3762330
	0250	2 * BU200	2.5	2*3.3Ω-8000W (**)	IP20	2*RE3762330
S50	0312	3 * BU200	2.5	3*3.3Ω-8000W (**)	IP20	3*RE3762330
	0366	3 * BU200	2.5	3*3.3Ω-8000W (**)	IP20	3*RE3762330
	0399	3 * BU200	2.5	3*3.3Ω-8000W (**)	IP20	3*RE3762330
S60	0457	3 * BU200	2.5	3*3.3Ω-8000W (**)	IP20	3*RE3762330
	0524	4 * BU200	2.5	4*3.3Ω-8000W (**)	IP20	4*RE3762330
S65	0598	BU1440 2T-4T	0.24	0.45Ω-48000W (**)	IP23	RE4461450
	0748	BU1440 2T-4T	0.24	0.45Ω-48000W (**)	IP23	RE4461450
	0831	BU1440 2T-4T	0.24	0.3Ω-64000W (**)	IP23	RE4561300

(*): Parallel-connection is required.
(**): For the connection of BU200 and the braking resistor, please refer to the relevant section in this manual.

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

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

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

13.1.1.5. BRAKING RESISTORS FOR APPLICATIONS WITH A BRAKING DUTY CYCLE OF 20% AND 200-240VAC SUPPLY VOLTAGE

Size	SINUS K Model 2T Class	Braking Unit	Min. Resistor to be Applied to the BU	BRAKING RESISTOR WITH 20% DUTY CYCLE		
			Ω	Type	IP Rating	ID
S05	0007	internal	25.0	2*100Ω-350W (*)	IP55	2*RE2644100
	0008	internal	25.0	2*56Ω-350W(*)	IP55	2*RE2635560
	0010	internal	25.0	2*56Ω-350W(*)	IP55	2*RE2635560
	0013	internal	20.0	4*100Ω-350W (*)	IP55	4*RE2644100
	0015	internal	20.0	4*100Ω-350W (*)	IP55	4*RE2644100
	0016	internal	20.0	4*100Ω-350W(*)	IP55	4*RE2644100
	0020	internal	20.0	25Ω-1800	IP54	RE3103250
S10	0016	internal	25.0	4*100Ω-350W (*)	IP55	4*RE2644100
	0017	internal	25.0	4*100Ω-350W(*)	IP55	4*RE2644100
	0020	internal	25.0	25Ω-1800	IP54	RE3103250
	0025	internal	10.0	6*75Ω-550W (*)	IP33	6*RE3063750
	0030	internal	10.0	6*75Ω-550W (*)	IP33	6*RE3063750
	0035	internal	10.0	6*75Ω-550W (*)	IP33	6*RE3063750
S12	0023	internal	15.0	5*75Ω-550W (*)	IP33	5*RE3063750
	0033	internal	10.0	2*25Ω-1800W (*)	IP54	2*RE3103250
	0037	internal	10.0	2*25Ω-1800W (*)	IP54	2*RE3103250
S15	0038	internal	8.0	2*25Ω-1800W (*)	IP54	2*RE3103250
	0040	internal	8.	2*25Ω-1800W (*)	IP54	2*RE3103250
	0049	internal	5	5Ω-4000W	IP20	RE3482500
S20	0060	internal	5.0	5Ω-8000W	IP20	RE3762500
	0067	internal	5.0	5Ω-8000W	IP20	RE3762500
	0074	internal	4.2	5Ω-8000W	IP20	RE3762500
	0086	internal	4.2	5Ω-8000W	IP20	RE3762500
S30	0113	internal	3.0	3.3Ω-12000W	IP20	RE4022330
	0129	internal	3.0	3.3Ω-12000W	IP20	RE4022330
	0150	internal	2.5	3.3Ω-12000W	IP20	RE4022330
	0162	internal	2.5	3.3Ω-12000W	IP20	RE4022330
S40	0179	2 * BU200	3.3	2*3.3Ω-8000W (**)	IP20	2*RE3762330
	0200	2 * BU200	3.3	2*3.3Ω-8000W (**)	IP20	2*RE3762330
	0216	2 * BU200	3.3	2*3.3Ω-12000W (**)	IP20	2*RE4022330
	0250	2 * BU200	3.3	2*3.3Ω-12000W (**)	IP20	2*RE4022330
S50	0312	3 * BU200	3.3	3*3.3Ω-12000W (**)	IP20	3*RE4022330
	0366	3 * BU200	3.3	3*3.3Ω-12000W (**)	IP20	3*RE4022330
	0399	3 * BU200	3.3	3*3.3Ω-12000W (**)	IP20	3*RE4022330
S60	0457	3 * BU200	3.3	3*3.3Ω-12000W (**)	IP20	3*RE4022330
	0524	4 * BU200	3.3	4*3.3Ω-12000W (**)	IP20	4*RE4022330
S65	0598	BU1440 2T-4T	0.24	0.45-64000W (**)	IP23	RE4561450
	0748	BU1440 2T-4T	0.24	0.45-64000W (**)	IP23	RE4561450
	0831	BU1440 2T-4T	0.24	2*0.6-48000W (**)	IP23	2*RE4461600

(*): Parallel-connection is required.

(**): For the connection of the modules and their braking resistors please refer to the relevant section in this manual.

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 application tables.

13.1.1.6. BRAKING RESISTORS FOR APPLICATIONS WITH A BRAKING DUTY CYCLE OF 50% AND 200-240VAC SUPPLY VOLTAGE

Size	SINUS K Model 2T Class	Braking Unit	Min. Resistor to be Applied to the BU	BRAKING RESISTOR WITH 50% DUTY CYCLE		
			Ω	Type	IP Rating	ID
S05	0007	internal	25.0	50Ω-1100W	IP55	RE3083500
	0008	internal	25.0	25Ω-1800W	IP54	RE3103250
	0010	internal	25.0	25Ω-1800W	IP54	RE3103250
	0013	internal	20.0	25Ω-4000W	IP20	RE3483250
	0015	internal	20.0	25Ω-4000W	IP20	RE3483250
	0016	internal	20.0	25Ω-4000W	IP20	RE3483250
	0020	internal	20.0	20Ω-4000W	IP20	RE3483200
S10	0016	internal	25.0	25Ω-4000W	IP20	RE3483250
	0017	internal	25.0	25Ω-4000W	IP20	RE3483250
	0020	internal	25.0	25Ω-4000W	IP20	RE3483250
	0025	internal	10.0	10Ω-8000W	IP20	RE3763100
	0030	internal	10.0	10Ω-8000W	IP20	RE3763100
	0035	internal	10.0	10Ω-8000W	IP20	RE3763100
S12	0023	internal	15.0	20Ω-4000W	IP20	RE3483200
	0033	internal	10.0	10Ω-8000W	IP20	RE3763100
	0037	internal	10.0	10Ω-8000W	IP20	RE3763100
S15	0038	internal	7.5	10Ω-8000W	IP20	RE3763100
	0040	internal	7.5	10Ω-8000W	IP20	RE3763100
	0049	internal	5.0	6.6Ω-12000W	IP20	RE4022660
S20	0060	internal	5.0	6.6Ω-12000W	IP20	RE4022660
	0067	internal	5.0	2*10Ω-8000W (*)	IP20	2*RE3762500
	0074	internal	4.2	2*10Ω-8000W (*)	IP20	2*RE3763100
	0086	internal	4.2	2*10Ω-8000W (*)	IP20	2*RE3763100
S30	0113	internal	3.0	2*6.6Ω-12000W (*)	IP20	2*RE4022660
	0129	internal	3.0	2*6.6Ω-12000W (*)	IP20	2*RE4022660
	0150	internal	2.5	3*10Ω-12000W (*)	IP20	RE4023100
	0162	internal	2.5	3*10Ω-12000W (*)	IP20	RE4023100
S40	0179	3*BU200	5.0	3*6.6Ω-12000W (**)	IP20	3*RE4022660
	0200	4*BU200	5.0	4*6.6Ω-12000W (**)	IP20	4*RE4022660
	0216	4*BU200	5.0	4*6.6Ω-12000W (**)	IP20	4*RE4022660
	0250	5*BU200	5.0	5*6.6Ω-12000W (**)	IP20	5*RE4022660
S50	0312	6*BU200	5.0	6*6.6Ω-12000W (**)	IP20	6*RE4022660
	0366	6*BU200	5.0	6*6.6Ω-12000W (**)	IP20	6*RE4022660
	0399	7*BU200	5.0	7*6.6Ω-12000W (**)	IP20	7*RE4022660
S60	0457	8*BU200	5.0	8*6.6Ω-12000W (**)	IP20	8*RE4022660
	0524	10*BU200	5.0	10*6.6Ω-12000W (**)	IP20	10*RE4022660
S65	0598	BU1440 2T-4T	0.24	4*0.45/48000W (**)	IP23	4*RE4461450
	0748	BU1440 2T-4T	0.24	4*0.45/48000W (**)	IP23	4*RE4461450
	0831	BU1440 2T-4T	0.24	4*0.3/64000W (**)	IP23	4*RE4561300

(*): Parallel-connection is required.

(**): For the connection of the modules and their braking resistors please refer to the relevant section in this manual.

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

CAUTION Power dissipated by braking resistors may be equal to approx. 50% 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 application tables.

13.1.2. AVAILABLE MODELS

The specifications given for each resistor model also include the mean power to be dissipated and the max. operating time, depending on the inverter voltage class.
Based on these values, parameters C67 and C68 (IFD SW) OR C59 and C60 (VTC SW) (concerning braking features) in the Resistor Braking menu can be set up. (See relevant section in the Programming Manual).
The max. operating time set in C68 (IFD SW) or C60 (VTC SW) is factory-set in order not to exceed the allowable time for each resistor model (see section below).
Parameters C67 (IFD SW) or C59 (VTC SW) represent the max. duty-cycle of the resistor and must be set to a value lower than or equal to the value stated in the dimensioning table (see sections above).

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

CAUTION For parameters C67, C68 (IFD SW) or C60 (VTC SW), do not set values exceeding the max. allowable values stated in the tables above. Failure to do so will cause irreparable damage to the braking resistors; also, fire hazard exists.

CAUTION Braking resistors may dissipate up to 50% of the rated power of the connected motor; use a proper air-cooling system. Do not install braking resistors near heat-sensitive equipment or objects.

13.1.2.1. 56-100 OHM/350W MODEL

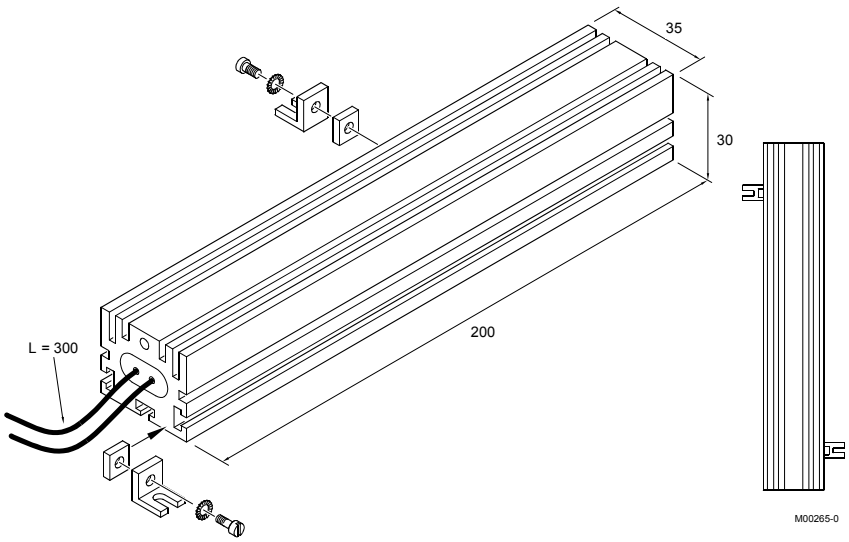


Figure 47: Overall dimensions for 56-100Ω/350W resistor.

Type	Wgt (g)	Degree of Protection	Mean Power that can be Dissipated (W)	Max. Duration of Continuous Operation at 200-240VAC (s)*
56 Ohm/350W RE2643560	400	IP55	350	3.5
100 Ohm/350W RE2644100	400	IP55	350	3.5

(*) max. value to be set for the Brake Enable parameter (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 unit.

13.1.2.2. 75 OHM/1300W MODEL

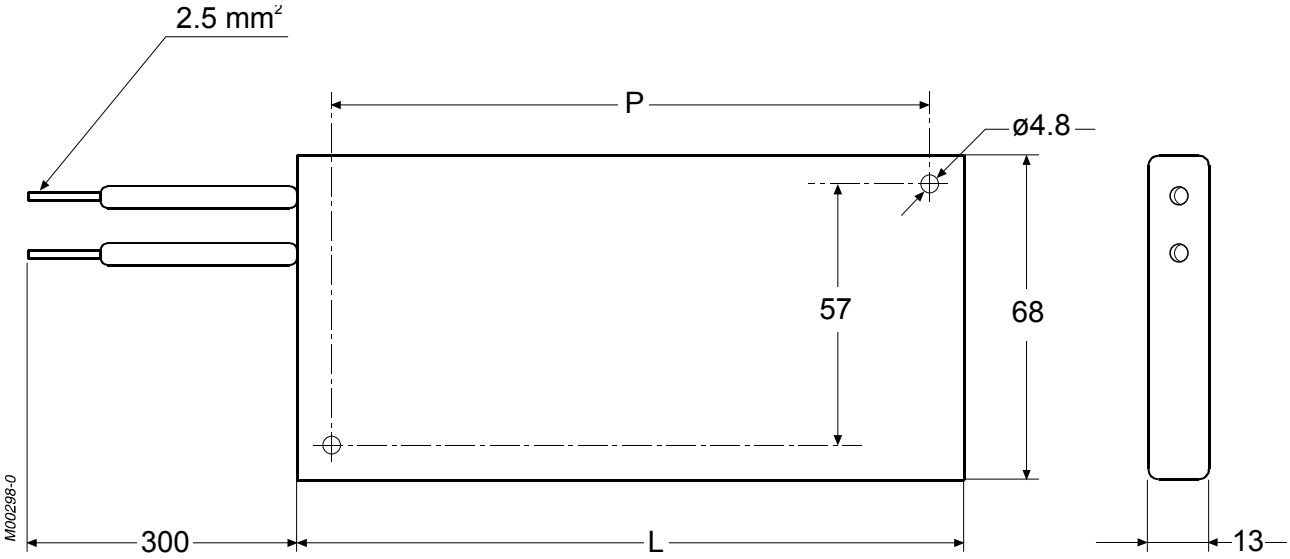


Figure 48: Overall dimensions and ratings for 75Ω/1300W braking resistor.

Type	L (mm)	D (mm)	Wgt (g)	Degree of Protection	Mean Power that can be Dissipated (W)	Max. Duration of Continuous Operation at 380-500VCA (s)*
75 Ohm/750W RE3063750	195	174	500	IP33	550	2.25

(*) max. value to be set for the Brake Enable parameter (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 unit.

13.1.2.3. MODELS FROM 1100W TO 2200W

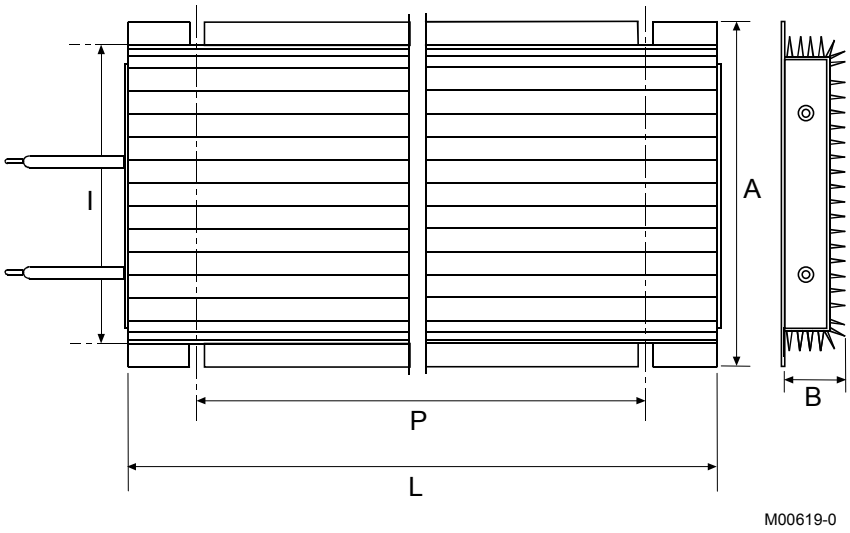


Figure 49: Overall dimensions and mechanical features for braking resistors from 1100W to 2200W.

Type	A (mm)	B (mm)	L (mm)	I (mm)	D (mm)	Wgt (g)	Degree of Protection	Mean Power that can be Dissipated (W)	Max. Duration of Continuous Operation	
									380-500Vac (s)*	380-500Vac (s)*
15 Ohm/1100W **RE3083150**	95	30	320	80-84	240	1250	IP55	950	not applic.	6
20 Ohm/1100W **RE3083200**									not applic.	8
50 Ohm/1100W **RE3083500**									5	20
10 Ohm/1500W **RE3093100**	120	40	320	107-112	240	2750	IP54	1100	not applic.	4,5
39 Ohm/1500W **RE3093390**									4.5	18
50 Ohm/1500W **RE3093500**										
25 Ohm/1800W **RE310250**	120	40	380	107-112	300	3000	IP54	1300	3	12
50 Ohm/2200W **RE3113500**	190	67	380	177-182	300	7000	IP54	2000	8	not limited
75 Ohm/2200W **RE3113750**									11	
Wire standard length: 300mm										

(*) max. value to be set for the Brake Enable parameter (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 unit.

13.1.2.4. 4KW-8KW-12KW MODELS

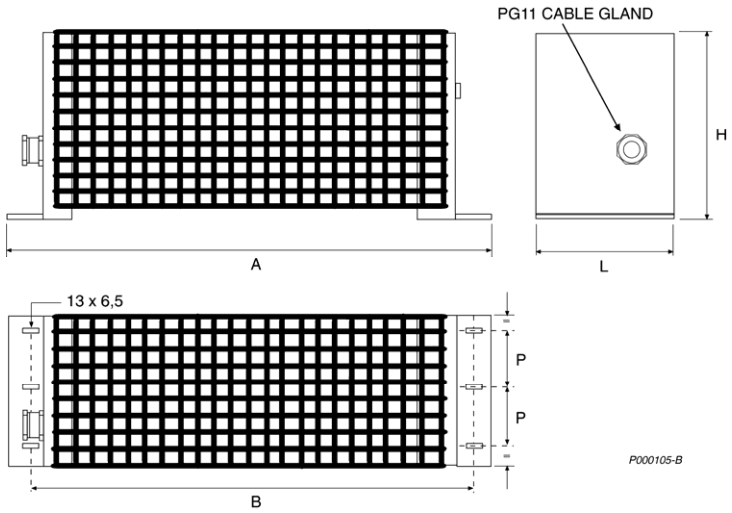


Figure 50: Overall dimensions for 4kW, 8kW, 12kW braking resistors.

RESISTOR	A (mm)	B (mm)	L (mm)	H (mm)	P (mm)	Wgt (Kg)	Degree of Protection	Mean Power that can be Dissipated (W)	Max. Duration of Continuous Operation		Wire Cross-section (mm^2)**
									380-500Vac (s)*	380-500Vac (s)*	
5Ω4KW **RE3482500**	620	600	100	250	40	5.5	IP20	4000	not applic.	10	10
15Ω4KW **RE3483150**									5	100	6
25Ω4kW **RE3483250**									20	not limited	6
39Ω4kW **RE3483390**									60		6
50Ω4kW **RE3483500**									90		4
3.3Ω/8kW **RE3762330**	620	600	160	250	60	10.6	IP20	8000	not applic.	5	16
5Ω/8kW **RE3762500**									not applic.	40	10
10Ω/8kW **RE3763100**									2	100	10
3.3 Ω/12kW **RE4022330**	620	600	200	250	80	13.7	IP20	12000	not applic.	70	25
6.6Ω/12kW **RE4022660**									5	200	16
10Ω/12kW **RE4023100**									12	not limited	10

(*) max. value to be set in the Brake Enable parameter (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 unit.
(**) cross sections refer to the applications covered in this manual

13.1.2.5. MODELS OF IP23 BOX RESISTORS, 4KW-64KW

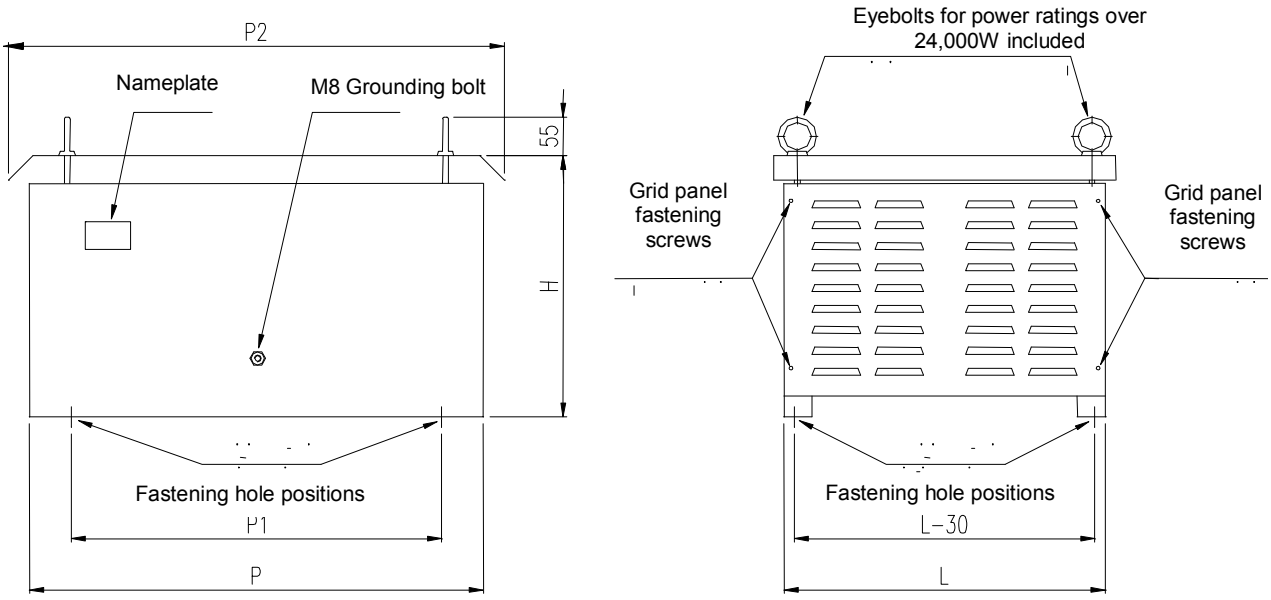


Figure 51: Overall dimensions for IP23 box resistors.

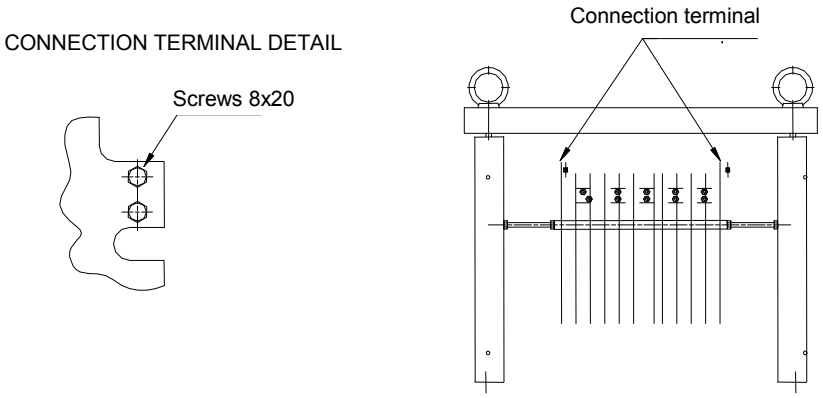


Figure 52: Position of the electrical connections in box resistors.

Remove the grids to gain access to the wiring terminals.
Important: the figure above shows 20 Ohm/12kW resistor. In certain models, remove both panels to gain access to the wiring terminals.

RESISTOR	D (mm)	D1 (mm)	D2 (mm)	L (mm)	H (mm)	Wgt (Kg)	IP Rating	Mean Power that can be Dissipated (W)	Max. Duration of Continuous Operation (s)(*)				Wire Cross-section (mm^2)**
									Operation at 200-240Vac	Operation at 380-500Vac	Operation at 500-575Vac	Operation at a 660-690Vac	
50Ω/4KW **RE3503500**	650	530	710	320	375	20	IP23	4000	not limited	30	not applicable	not applicable	4
50Ω/8KW **RE3783500**	650	530	710	380	375	23	IP23	8000	not limited	50	not applicable	not applicable	4
20Ω/12KW **RE4053200**	650	530	710	460	375	34	IP23	12000	not limited	50	not applicable	not applicable	6
15Ω/16KW **RE4163150**	650	530	710	550	375	40	IP23	16000	not limited	58	not applicable	not applicable	10
10Ω /24kW **RE4293100**	650	530	710	750	375	54	IP23	24000	not limited	62	not applicable	not applicable	16
6.6Ω/32kW **RE4362660**	650	530	710	990	375	68	IP23	32000	not limited	62	not applicable	not applicable	25
6Ω/48kW **RE4462600**	650	530	710	750	730	101	IP23	48000	not limited	90	65	44	35
6Ω/64kW **RE4562600**	650	530	710	990	730	128	IP23	64000	not limited	120	90	60	50
5Ω/48kW **RE4462500**	650	530	710	750	730	101	IP23	48000	not limited	75	55	35	35
5Ω/64kW **RE4552500**	650	530	710	990	730	128	IP23	64000	not limited	106	75	50	50
2.4Ω/48kW **RE4462240**	650	530	710	750	730	101	IP23	48000	150	37	35	24	70
2.4Ω/64kW **RE4562240**	650	530	710	990	730	128	IP23	64000	not limited	50	25	18	90
1.6Ω/48kW **RE4462160**	650	530	710	750	730	101	IP23	48000	100	25	17	12	90
1.6Ω/64kW **RE4562160**	650	530	710	990	730	128	IP23	64000	130	35	24	16	120
1.2Ω/48kW **RE4462120**	650	530	710	750	730	101	IP23	48000	75	18	12	9	120
1.2Ω/64kW **RE4562120**	650	530	710	990	730	128	IP23	64000	100	25	18	12	120
0.8Ω/48kW **RE4461800**	650	530	710	750	730	101	IP23	48000	50	12	8	6	120
0.8Ω/64kW **RE4561800**	650	530	710	990	730	128	IP23	64000	70	18	12	8	185
0.6Ω/48kW **RE4461600**	650	530	710	750	730	101	IP23	48000	36	9	6	not applicable	120
0.6Ω/64kW **RE4561600**	650	530	710	990	730	128	IP23	64000	50	12	9	not applicable	185
0.45Ω/48W **RE4461450**	650	530	710	750	730	101	IP23	48000	48	not applicable	not applicable	not applicable	120
0.45Ω/64W **RE4561450**	650	530	710	990	730	128	IP23	64000	38	not applicable	not applicable	not applicable	210
0.3Ω/64kW **RE4561300**	650	530	710	990	730	128	IP23	64000	25	not applicable	not applicable	not applicable	240

(*): Max. value to be set in the Brake Enable parameter (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 unit.
(**): Cross sections refer to the applications covered in this manual.

13.2. Braking Unit BU200

A braking module is available to be connected to terminals + and – (see the WIRING section) of the inverter for sizes S40 to S65. 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).
The braking power required to brake a rotating object is proportional to the total moment of inertia of the rotating object, to speed variations, and to absolute speed, while it inversely proportional to the deceleration time required.
This braking power is dissipated on a resistor (external to the braking unit) with an Ohm value depending on the inverter size and the mean power to be dissipated.

13.2.1. Inspection upon Receipt of the Goods

Make sure that the equipment is not damaged and it complies with the equipment you ordered by referring to the nameplate located on the inverter front part (see figure 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.
If the equipment is stored before being started, make sure that temperatures range from -20 °C to +60 °C and that relative humidity is <95% (non-condensing).
The equipment guarantee covers any manufacturing defect. The manufacturer has no responsibility for possible damages due to the equipment 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 equipment operation at values exceeding the equipment ratings and is not responsible for consequential and accidental damages.
The braking unit BU200 is covered by a one-year guarantee starting from the date of delivery.

13.2.1.1. NAMEPLATE OF BU200

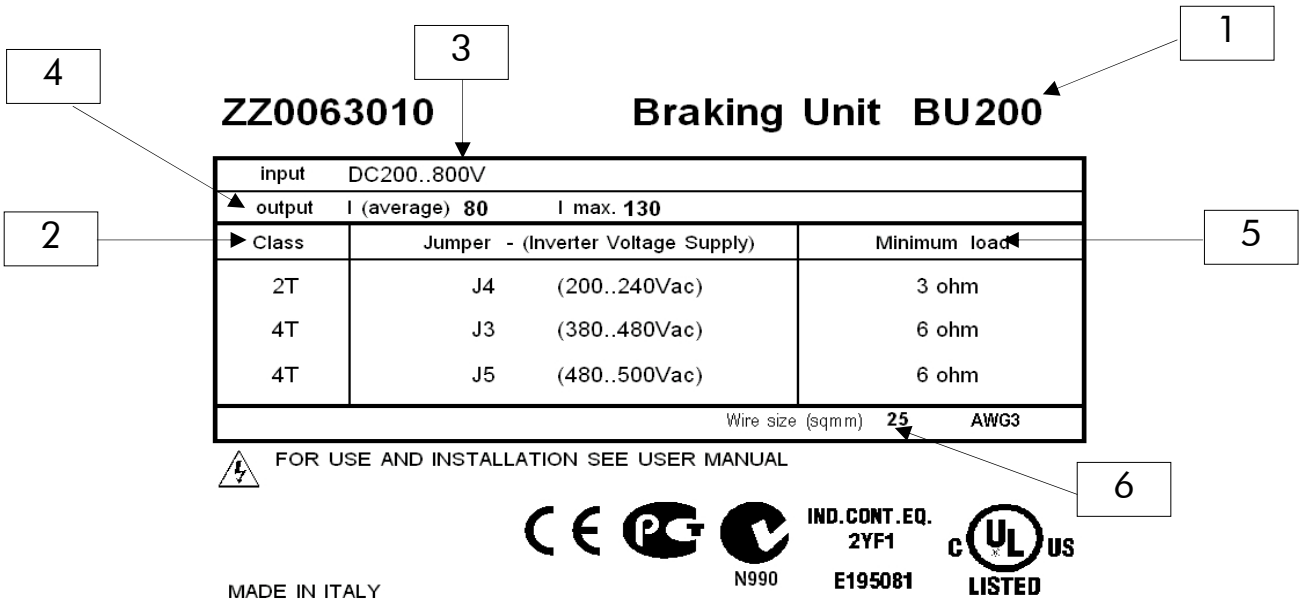


Figure 53: Nameplate of BU200.

Numbered items in the figure above:

1. Model:	BU200-braking unit
2. Voltage class:	List of applicable voltage classes
3. Supply ratings	200÷800 VDC (DC supply voltage produced by the inverter terminals)
4. Output current:	80A (average): mean current in output cables 130A (Peak): peak current in output cables
5. Min. load:	Minimum value of the resistor to be connected to the output terminals (see application tables)
6. Cable cross-section:	Dimensioning of the power cables.

13.2.2. OPERATION

The basic size of the braking unit can be used with a braking resistor avoiding exceeding a max. instant current of 130 A, corresponding to a peak braking power of approx. 97.5 kW (4T class) and to an average power of 60 kW (4T class). For applications requiring higher braking power values, multiple braking units can be parallel-connected in order to obtain a greater braking power based on the number of braking units.
To ensure that the overall braking power is evenly distributed to all braking units, configure one braking unit in MASTER mode and the remaining braking units in SLAVE mode, and connect the output signal of the MASTER unit (terminal 8 in connector M1) to the forcing input for all SLAVE braking units (terminal 4 in connector M1).

13.2.2.1. CONFIGURATION JUMPERS

The jumpers located on ES839 board are used for the configuration of the braking unit.
Their positions and functions are as follows:

Jumper	Function
J1	If on, it configures the SLAVE operating mode.
J2	If on, it configures the MASTER operating mode.

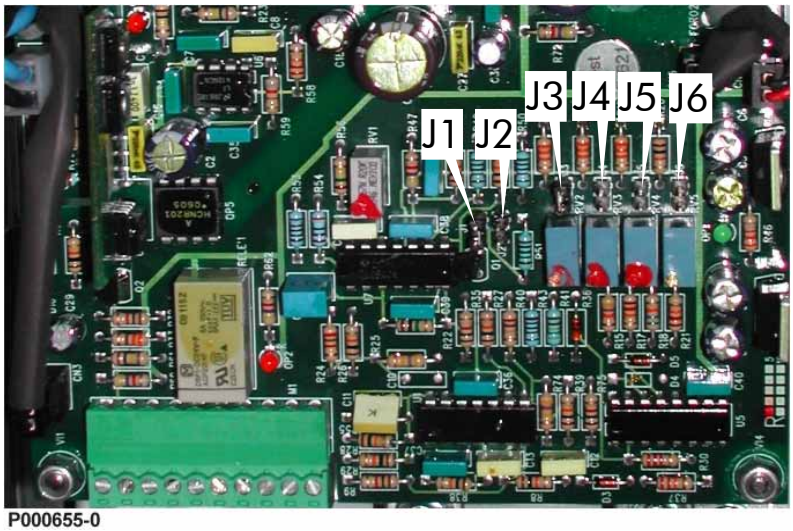
NOTE

Either one of the two jumpers must always be “on”. Avoid enabling both jumpers at a time.

Jumper	Function
J3	To be activated for 4T class inverters and mains voltage ranging from 380 Vac to 480 Vac
J4	To be activated for 2T class inverters and mains voltage ranging from 200 Vac to 240 Vac
J5	To be activated for 4T class inverters and mains voltage ranging from 481 Vac to 500 Vac
J6	To be activated for special adjustment requirements

NOTE

One of the four jumpers must always be “on”. Avoid enabling two or more jumpers at a time.



P000655-0

Figure 54: Position of the jumpers on ES839 BU200 control board.

DANGER Before changing jumper positions, remove voltage from the equipment and wait at least 5 minutes.

CAUTION **Never** set jumpers to a voltage value lower than the inverter supply voltage, to avoid continuous activation of the braking unit.

13.2.2.2. ADJUSTING TRIMMERS

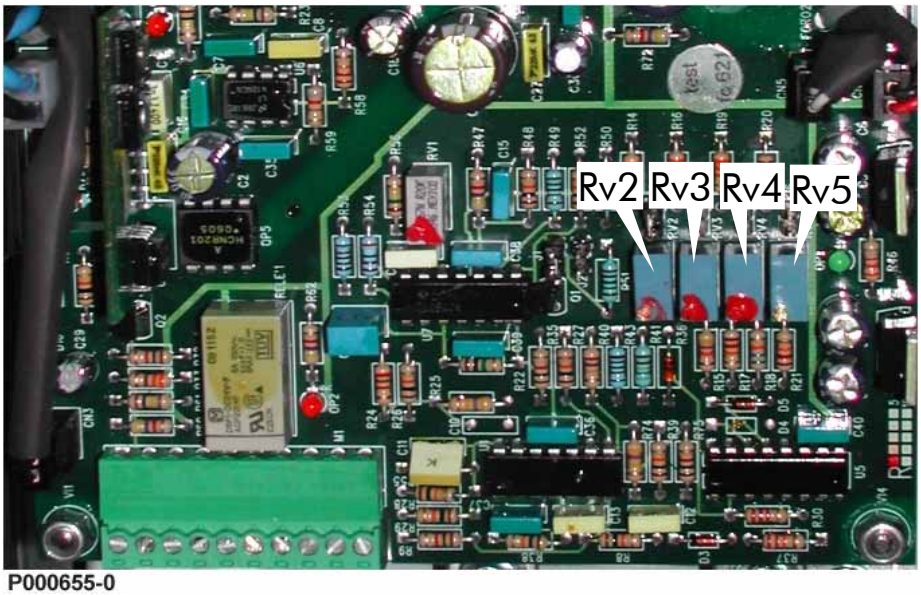
Depending on the jumper configuration, each trimmer allows the fine-tuning of the braking unit voltage threshold trip.
Jumper-trimmer matching is as follows:

Jumper	Function
J3	Fine-tuning of pick-up voltage through trimmer RV2
J4	Fine-tuning of pick-up voltage through trimmer RV3
J5	Fine-tuning of pick-up voltage through trimmer RV4
J6	Fine-tuning of pick-up voltage through trimmer RV5

The rated voltage for the braking unit activation and its range to be set with the 4 trimmers is stated in the table below:

Mains voltage [Vac]	Jumper	Trimmer	Minimum braking voltage [Vdc]	Rated braking voltage [Vdc]	Maximum braking voltage [Vdc]
200÷240 (2T)	J4	RV2	339	364	426
380÷480 (4T)	J3	RV3	700	764	826
481÷500 (4T)	J5	RV4	730	783	861
230-500	J6	RV5	464	650	810

CAUTION!! Max. values in the table above are theoretical values for special applications only; their use must be authorized by Elettronica Santerno. For standard applications, never change the factory-set rated value.



P000655-0

Figure 55: Positions of BU200 adjusting trimmers.

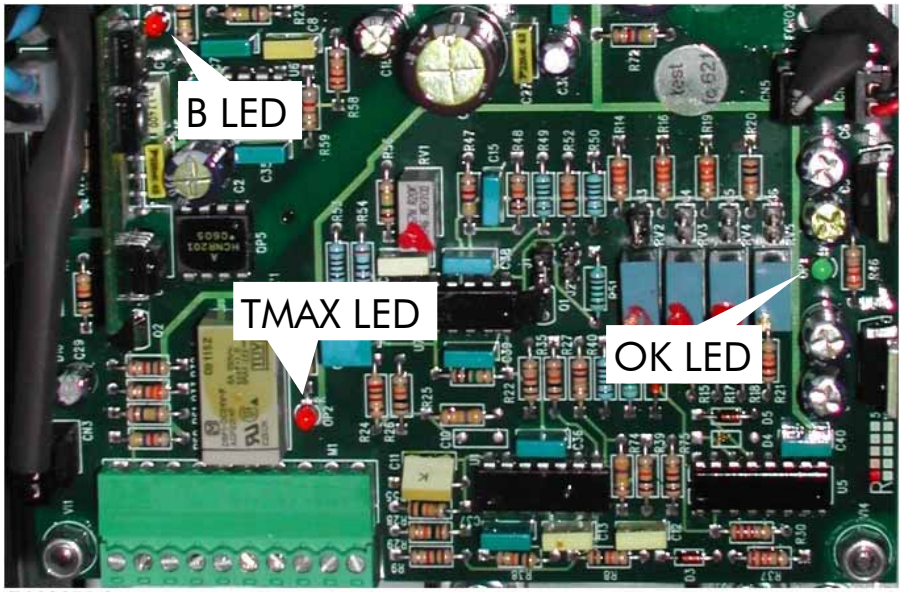
13.2.2.3. INDICATOR LEDS

The indicator LEDs below are located on the front part of the braking units:

OK LED Normally "on"; the equipment is running smoothly.
This LED turns off due to overcurrent or power circuit failure.

B LED Normally off"; this LED turns on when the braking unit activates.

TMAX LED Normally "off"; this LED turns on when the thermoswitch located on the heatsink of the braking unit trips; if overtemperature protection trips, the equipment is locked until temperature drops below the alarm threshold.



P000655-0

Figure 56: Position of the indicator LEDs.

13.2.3. RATINGS

SIZE	Max. Braking Current (A)	Average Braking Current (A)	INVERTER SUPPLY VOLTAGE and JUMPER POSITIONS		
			200-240Vac (2T class)	380-480Vac (4T class)	480-500Vac (4T class)
			J4	J3	J5
			MIN. BRAKING RESISTOR (Ohm)	MIN. BRAKING RESISTOR (Ohm)	MIN. BRAKING RESISTOR (Ohm)
BU200	130	80	3	6	6

13.2.4. INSTALLATION

13.2.4.1. MOUNTING

- Install vertically;
- Make sure to allow a min. clearance of 5 cm on both sides and 10 cm on top and bottom;
- use cable-glands to maintain degree of protection IP20.

ENVIRONMENTAL REQUIREMENTS FOR THE BRAKING UNIT INSTALLATION, STORAGE AND TRANSPORT

Operating ambient temperatures	0-40°C with no derating from 40°C to 50°C with a 2% derating of the rated current for each degree beyond 40°C
Ambient temperatures for storage and transport	- 25°C - +70°C
Installation environment	Pollution degree 2 or higher. Do not install in direct sunlight and in places exposed to conductive dust, corrosive gases, vibrations, water sprinkling or dripping; do not install in salty environments.
Altitude	Up to 1000 m above sea level. For higher altitudes, derate the output current of 1% every 100m above 1000m (max. 4000m).
Operating ambient humidity	From 5% to 95%, from 1g/m^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)

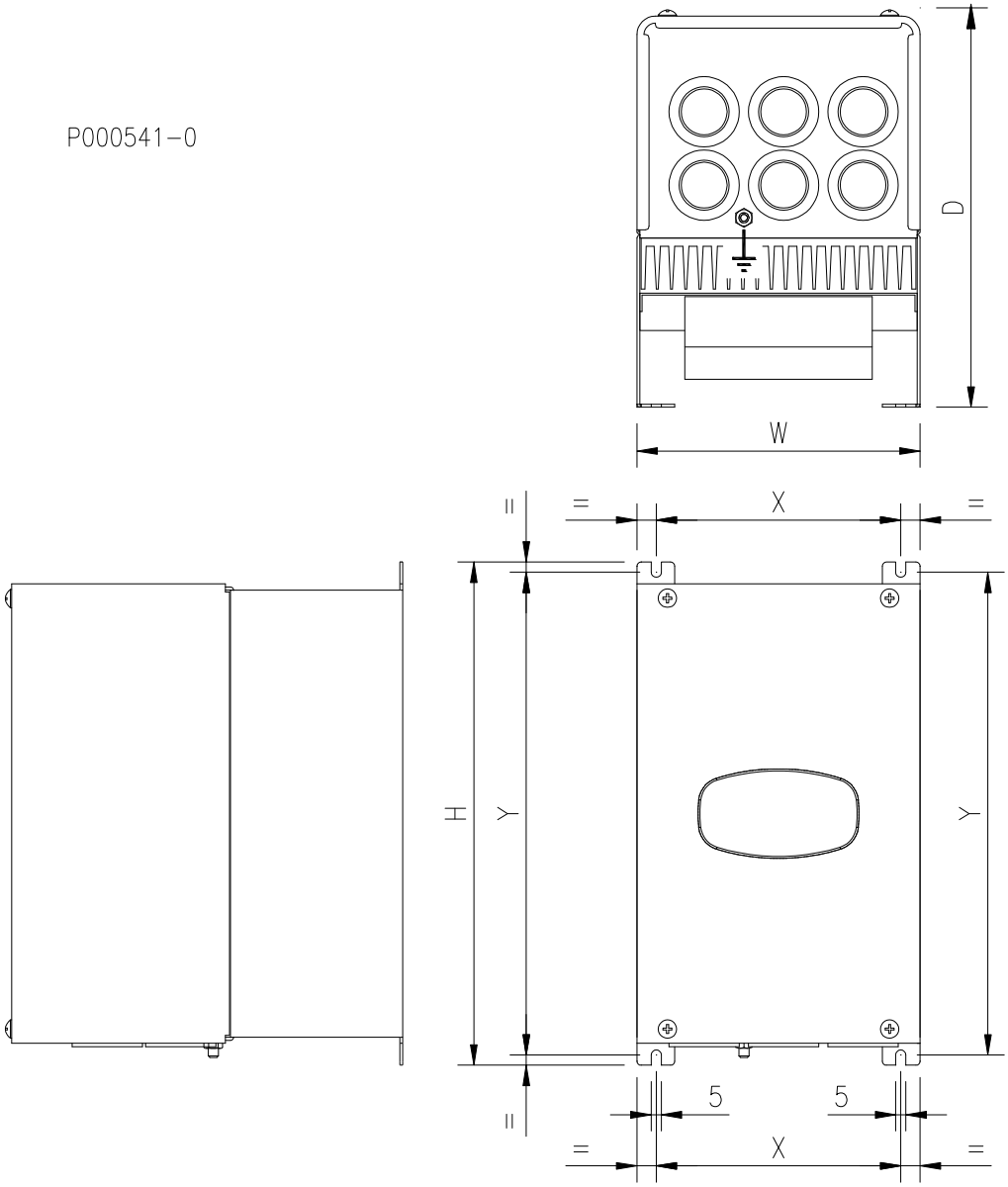
CAUTION Ambient conditions strongly affect the inverter life. Do not install the equipment in places that do not have the above-mentioned ambient conditions.

COOLING SYSTEM AND DISSIPATED POWER

The braking unit is provided with a heatsink reaching a max. temperature of 80 °C.
Make sure that the bearing surface for the braking unit is capable of withstanding high temperatures. Max. dissipated power is approx. 150 W and depends on the braking cycle required for the operating conditions of the load connected to the motor.
The max. temperature alarm for the braking unit shall be used as a digital signal to control the inverter stop.

STANDARD MOUNTING

The braking unit BU200 must be installed in an upright position inside a cabinet. Fix the BU200 with four M4 screws.



Dimensions (mm)			Distance between Fixing Points (mm)		Type of Screws	Weight (Kg)
W	H	D	X	Y	M4	4
139	247	196	120	237		

Figure 57: Dimensions and fixing points of BU200.

NOTE Elettronica Santerno reserves the right to make any technical changes to this manual and to the device without prior notice.

13.2.4.2. WIRING

WIRING DIAGRAM

The braking unit must be connected to the inverter and the braking resistor.
The braking unit is connected directly to the inverter terminals (or copper bars for sizes greater than S40) of the DC output, while the braking resistor must be connected to the inverter on one side and to the braking unit on the other side.
The wiring diagram is shown in the figure below:

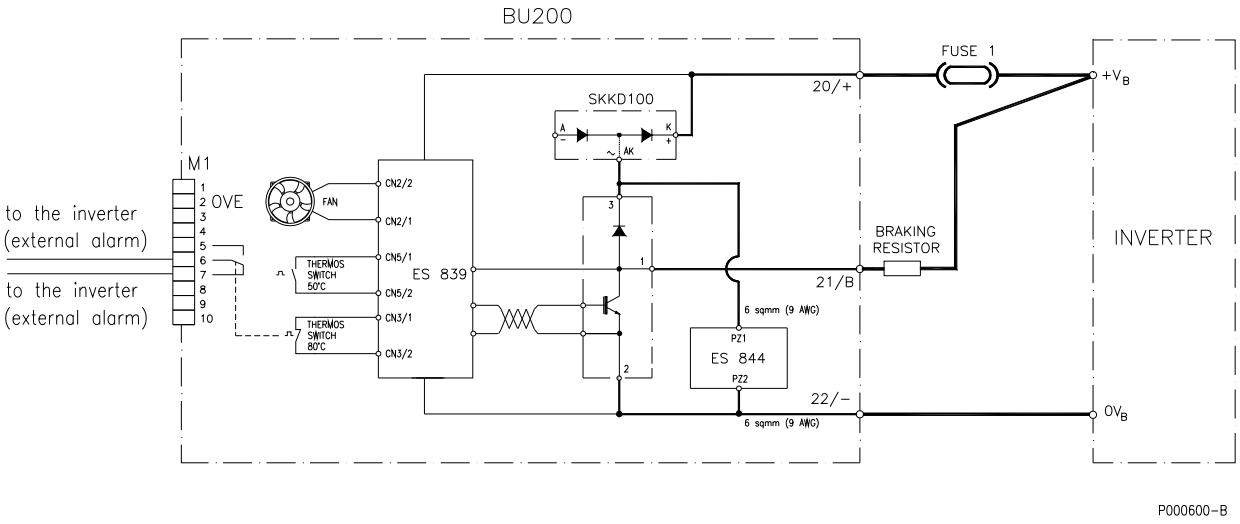


Figure 58: Connecting one BU200 to the inverter.

NOTE!! The braking resistor must be connected between terminal **B** of BU200 and terminal + of the inverter. In that way, no sudden variation in braking current occurs in the supply line between the inverter and BU200. In order to minimize electromagnetic radiated emissions when BU200 is operating, the loop obtained from the wiring connecting terminal + of the inverter, the braking resistor, terminals **B** and **-** of BU200 and terminal **-** of the inverter should be as short as possible.

NOTE Install a 50A fuse with a DC current of at least 700 Vdc (type URDC SIBA series, NH1 fuse) provided with a safety contact.

CAUTION Link the safety contact of the fuse being used with the external alarm of BU200.

MASTER – SLAVE CONNECTION

The Master-Slave connection must be used when multiple braking units are connected to the same inverter. An additional connection must be done between the Master output signal (terminal 8 in M1) and the Slave input signal (terminal 4 in M1); zero volt of the signal connector in the Master module (terminal 2 in M1) must be connected to zero volt of the signal connector in the Slave module (terminal 2 in M1).
The connection of more than two modules must always be done by configuring one module like a master and the other modules like slaves. Use configuration jumpers accordingly.
The max. temperature alarm of the braking unit must be used as a digital signal to control the inverter stop. All contacts (voltage-free contacts) in all braking modules may be series-connected as shown in the diagram below:

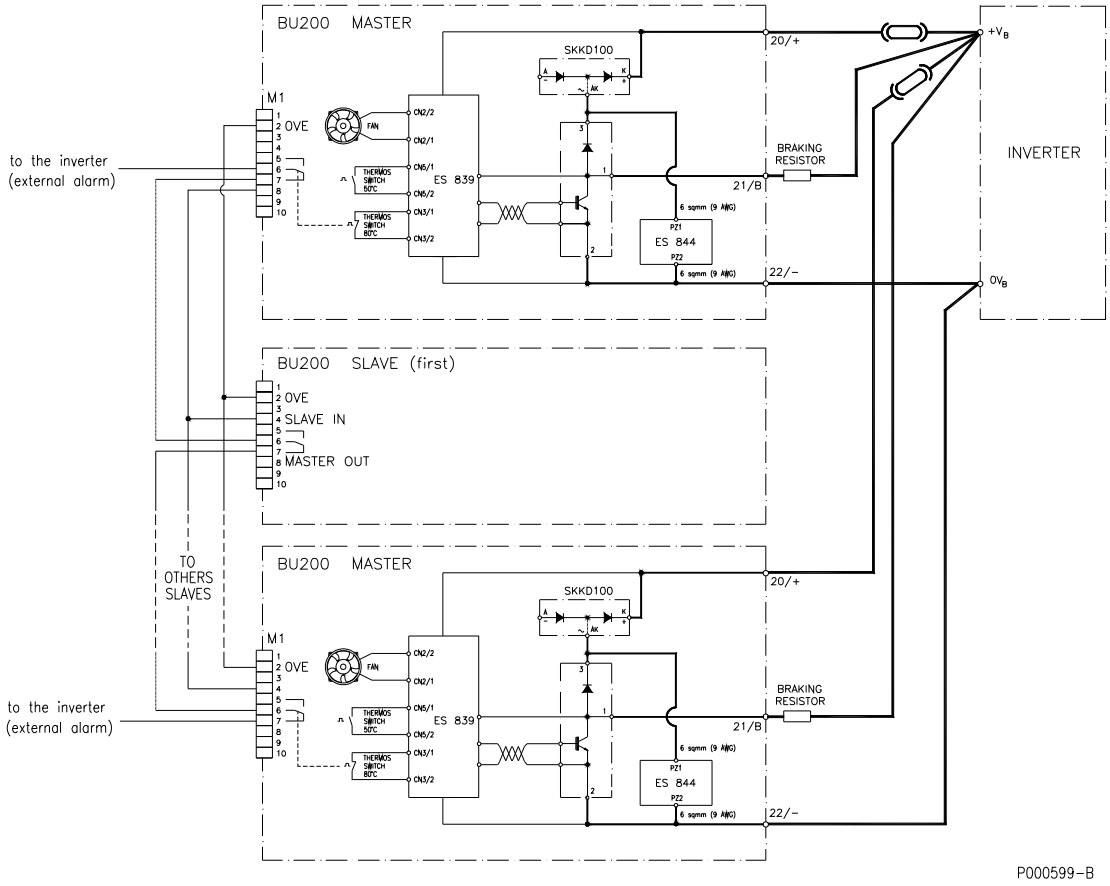


Figure 59: Master – Slave multiple connection.

	**NOTE**	NEVER connect signal zero volt (terminal 2 in M1) to zero volt of the inverter power supply voltage (-).
	**NOTE**	Install a 50A fuse with a DC current of at least 700 Vdc (type URDC SIBA series, NH1 fuse) provided with a safety contact.
	**CAUTION**	Link the safety contact of the fuse being used with the external alarm of BU200.

LAY-OUT OF POWER TERMINALS AND SIGNAL TERMINALS

Remove the cover of the braking unit to gain access to its terminal blocks. Just loosen the four fixing screws of the cover located on the front side and on the bottom side of the braking unit.
Loosen the fastening screws to slide off the cover from above.
Power terminals consist of copper bars, that can be reached through the three front holes.

Terminal	N.	Type of terminal	Connection
+	20	Copper bar	Inverter DC side connected to terminal +
B	21	Copper bar	Connection to braking resistor
-	22	Copper bar	Inverter DC side connected to terminal -

Signal terminal block M1 can be accessed through its hole (see figure below).

Terminal block M1:

N°	Name	Description	Notes	Features
M1 : 1		Not used		
M1 : 2	0VE	Signal zero volt		Control board zero volt
M1 : 3	Vin	Modulation input (0÷10 V)	To be used for special applications	Rin=10kOhm
M1 : 4	Sin	Logic input for signal sent from Master	The SLAVE brakes if a signal > 6 V is sent	Max. 30V
M1 : 5	RL-NO	NO contact of "thermoswitch on" relay	The relay energizes when an overtemperature alarm trips for BU200	250Vac,3A 30Vdc,3A
M1 : 6	RL-C	Common of the contact of "thermoswitch on" relay		
M1 : 7	RL-NC	NC contact of "thermoswitch on" relay		
M1 : 8	Mout	Digital output for Slave command signal	High level output when the Master is braking	PNP output (0-15V)
M1 : 9		Not used		
M1 :10		Not used		

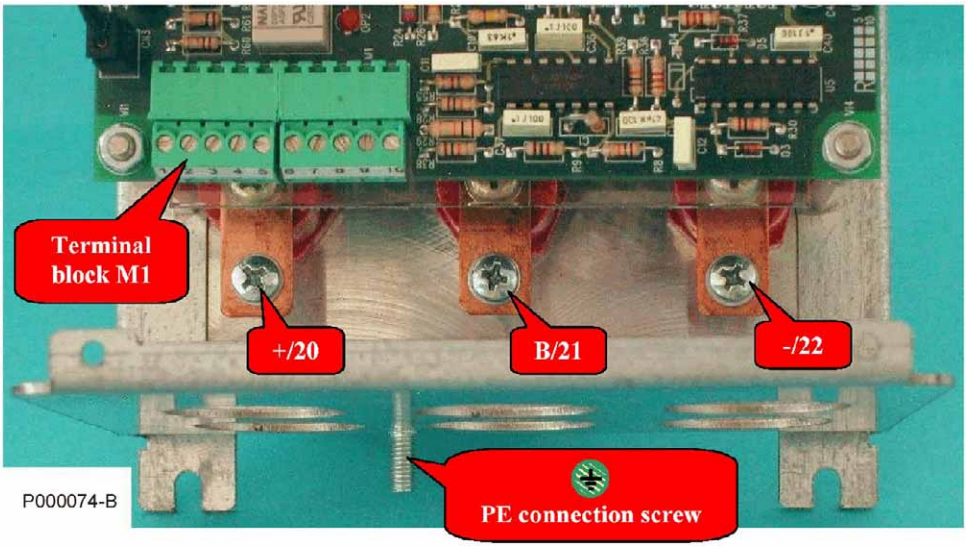


Figure 60: Terminals in BU200.

WIRE CROSS-SECTIONS

Use 25 sqmm wires for power connection wirings and 0.5 or 1sqmm wires for signal wiring.
When connecting the conductor to the braking resistor, consider that the latter can reach a temperature of 200 °C.

RESISTORS THAT CAN BE CONNECTED TO THE BRAKING UNIT

The min. rating of the resistor to be connected to the braking unit depends on the inverter rated voltage (Ratings). The max. braking time (Ton) is limited from the max. allowable temperature and from the allowable dissipated power. As a result, the Duty-cycle δ parameter is defined based on the braking resistor rating and time Ton (braking time) and is expressed as the ratio between time Ton and the entire duty-cycle (Ton+Toff). Duty-cycle represents a whole braking cycle.
Figure 61shows the max. allowable duty-cycle (depending on Ton) for the connected braking resistor.

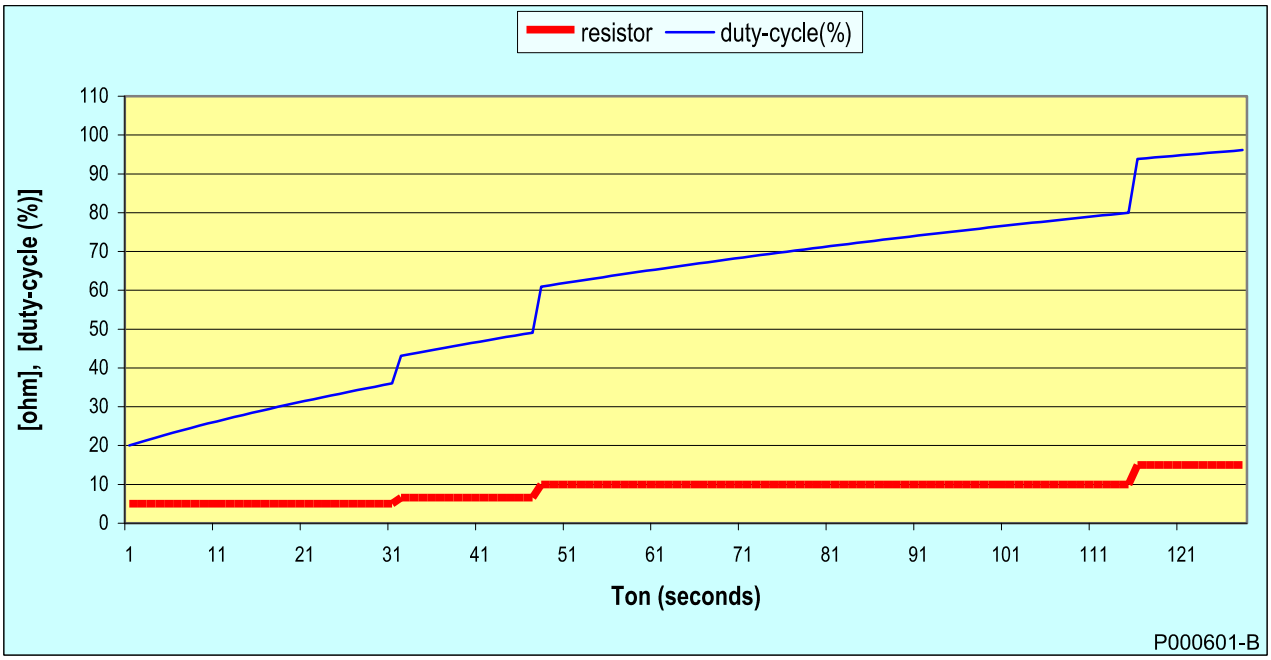


Figure 61: Max. allowable duty-cycle (depending on Ton) for the connected braking resistor.

The figure below shows the value of the peak power and the average power dissipated to the braking resistor depending on the actual braking time.
The selection of the resistor power depends both on the average dissipated power and on the peak power the resistor shall be capable of withstanding.

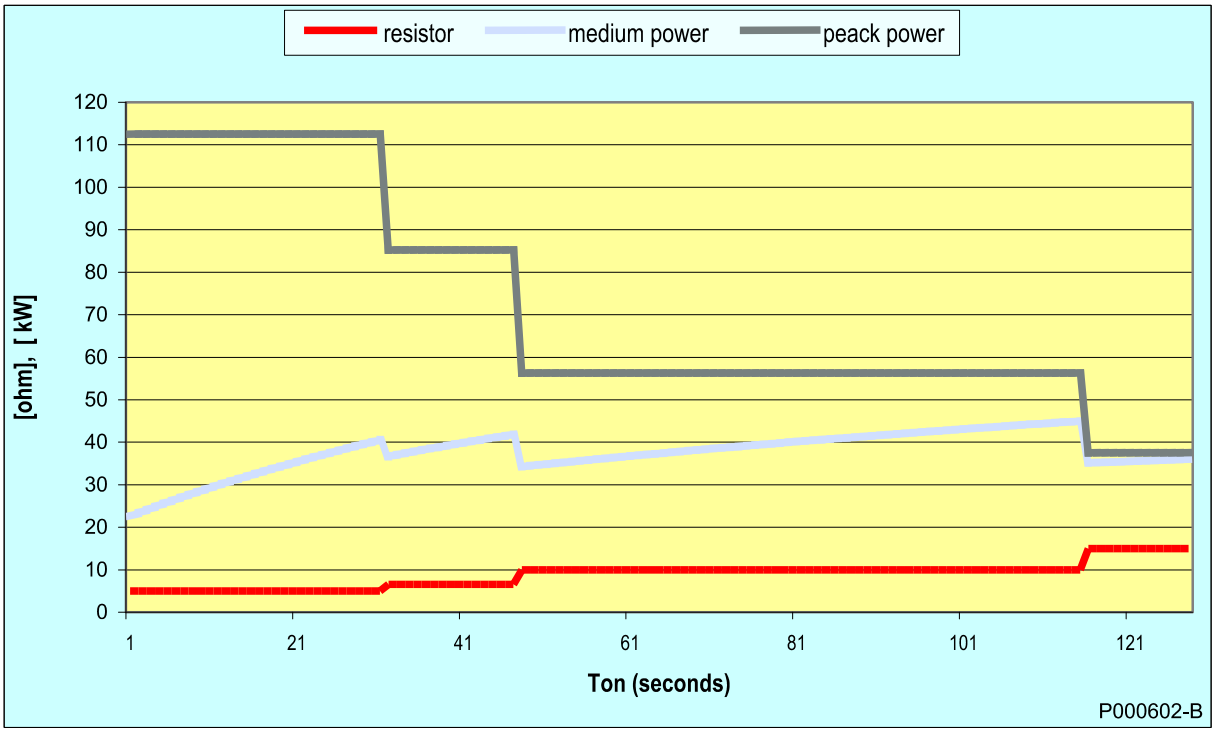


Figure 62: Peak power and average power (depending on Ton) dissipated to the braking resistor.

2T CLASS	DUTY-CYCLE			
RESISTORS (Ohm)	0-10%	10%-20%	20%-50%	50%-100%
2.8	240 s	240 s	240 s	Not applicable
3.3	400 s	400 s	400 s	Not applicable
4.5	Not limited	Not limited	Not limited	Not limited

Table 1: Max. braking time depending on the duty-cycle and the connected braking resistor.

4T CLASS	DUTY-CYCLE			
RESISTORS (Ohm)	0-10%	10%-20%	20%-50%	50%-100%
6	240 s	240 s	240 s	Not applicable
6.6	300 s	300 s	300 s	Not applicable
10	Not limited	Not limited	Not limited	Not limited

Table 2: Max. braking time depending on the duty-cycle and the connected braking resistor.

13.3. Braking Unit for Modular Inverters (BU720-BU1440)

A braking unit to be applied to modular inverters only is available. The inverter size must be equal to S65.

13.3.1. Inspection upon Receipt of the Goods

Make sure that the equipment is not damaged and that it complies with the equipment you ordered by referring to the nameplate located on the inverter front part (see figure 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.
If the equipment is stored before being started, make sure that temperatures range from -20 °C to +60 °C and that relative humidity is <95% (non-condensing).
The equipment guarantee covers any manufacturing defect. The manufacturer has no responsibility for possible damages occurred while shipping or unpacking the equipment. 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 equipment operation at values exceeding the equipment ratings. The manufacturer is not responsible for consequential and accidental damages.
The braking unit is covered by a 12-month guarantee starting from the date of delivery.

13.3.1.1. Nameplate for BU720-960-1440

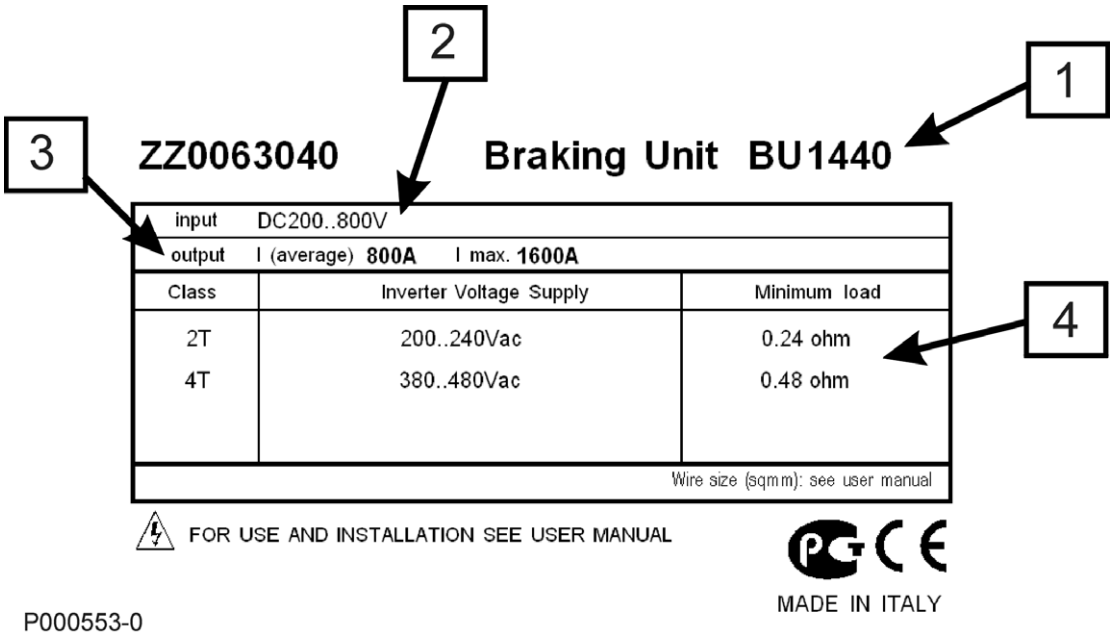


Figure 63: Nameplate of BU720-1440.

1. Model (BU1440 – braking unit);
2. Supply ratings: 200 to 800 VDC for BU 720-1440 2-4T (DC supply voltage produced by the inverter terminals);
3. Output current: 800A (average): mean current in output cables, 1600A (Peak): peak current in output cables;
4. Minimum value of the resistor to be connected to the output terminals (see application table).

13.3.2. OPERATION

Each size of the braking unit can be used with a braking resistor avoiding exceeding the max. instant current stated in its specifications.
The braking unit is controlled directly by the control unit. Braking units cannot be parallel-connected when applied to modular inverters.

13.3.3. RATINGS

SIZE	Max. Braking Current (A)	Mean Braking Current (A)	Inverter Supply Voltage	Min. Braking Resistor (Ohm)	Dissipated Power (at Mean Braking Current) (W)
BU1440 2-4T	1600	800	200-240Vac/	0.24	1700
BU1440 2-4T	1600	800	380-500Vac/	0.48	1800

13.3.4. INSTALLATION

13.3.4.1. MOUNTING

- Install vertically;
- Make sure to allow a min. clearance of 2 cm on both sides and 10 cm on top and bottom;
- Use Lexan cable-glands to maintain degree of protection IP20.

ENVIRONMENTAL REQUIREMENTS FOR THE BRAKING UNIT INSTALLATION, STORAGE AND TRANSPORT

Operating ambient temperatures	0-40 °C with no derating from 40 °C to 50 °C with a 2% derating of the rated current for each degree beyond 40 °C
Ambient temperatures for storage and transport	- 25 °C - +70 °C
Installation environment	Pollution degree 2 or higher. Do not install in direct sunlight and in places exposed to conductive dust, corrosive gases, vibrations, water sprinkling or dripping; do not install in salty environments.
Altitude	Up to 1000 m above sea level. For higher altitudes, derate the output current of 1% every 100m above 1000m (max. 4000m).
Operating ambient humidity	From 5% to 95%, from 1g/m^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.

13.3.4.2. STANDARD MOUNTING

Install braking unit BU720-1440 for modular inverters in an upright position inside a cabinet, next to the other inverter modules. Its overall dimensions are the same as those of an inverter arm.

Dimensions (mm)			Fixing Points (mm)				Screws	Weight (Kg)
W	H	D	X	Y	D1	D2	M10	110'
230	1400	480	120	237	11	25		

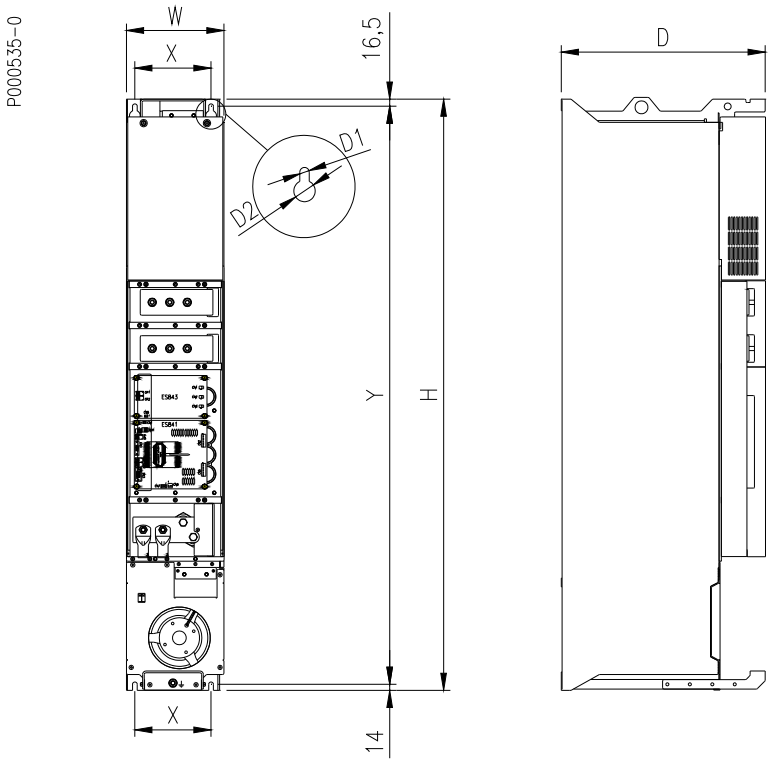


Figure 64: Dimensions and fixing points of BU720-1440.

NOTE

Elettronica Santerno reserves the right to make any technical changes to this manual and to the device described herein without prior notice.

13.3.4.3. WIRING

WIRING DIAGRAM

a) Power unit

The braking unit must be connected to the inverter and the braking resistor.
The connection to the inverter is direct through 60*10mm copper plates connecting the different inverter modules. The braking resistor is connected to the + bar and to the braking unit.
Also connect the single-phase 250Vac supply of the cooling fan.

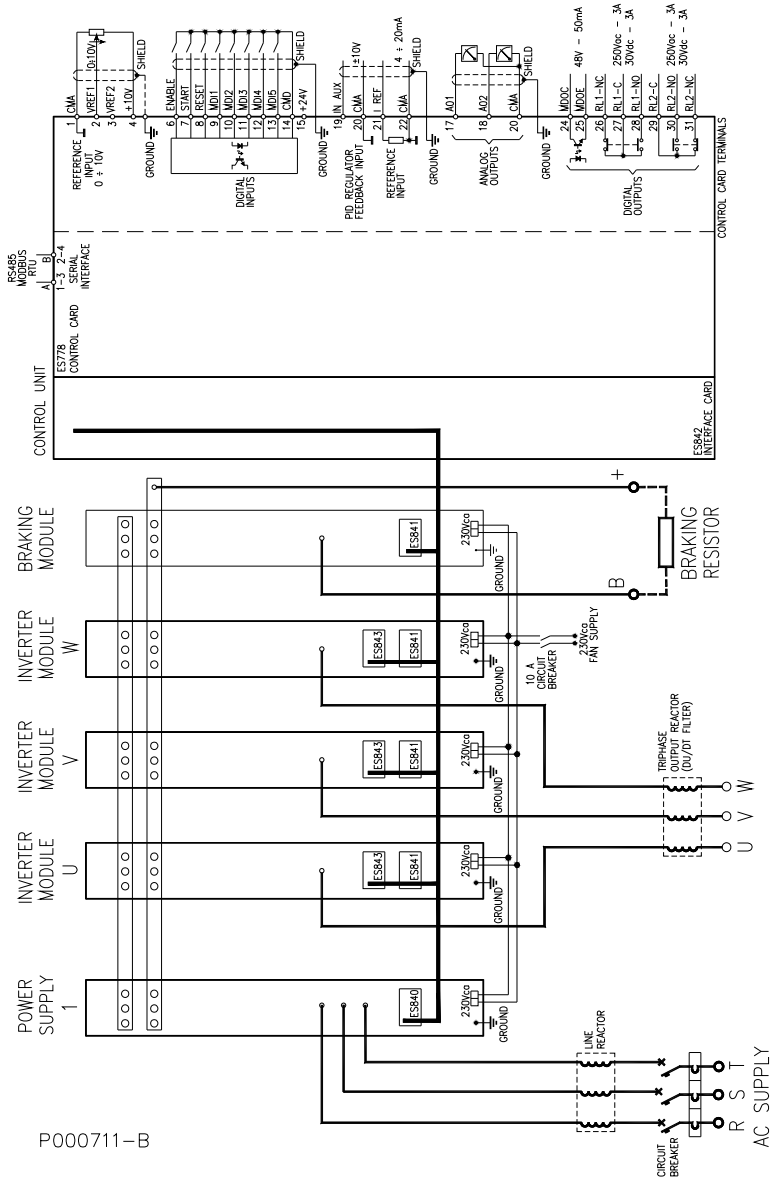


Figure 65: External power connections for S65 modular inverters provided with BU770-1440.

Wire braking resistors as stated in the tables below.

Voltage class: 2T

Applications with a braking duty cycle of 10%

Inverter Size	Braking Unit	Braking Resistors			
		Quantity	Recommended Rating (Ohm)	Power (W)	Wire Cross-Section Mm² (Kcmils)
0598	BU1440 2T-4T	1	0.45	48000	120 (250)
0748	BU1440 2T-4T	1	0.45	48000	120 (250)
0831	BU1440 2T-4T	1	0.3	64000	210(400)

Applications with a braking duty cycle of 20%

Inverter Size	Braking Unit	Braking Resistors					
		Applicable Resistors			Resistor Wiring	Resultant Rating (Ohm)	Wire Cross-Section Mm² (Kcmils)
		Quantity	Recommended Rating (Ohm)	Power (W)			
0598	BU1440 2T-4T	1	0.8	100000	--	0.4	210(400)
0748	BU1440 2T-4T	1	0.8	100000	--	0.4	210(400)
0831	BU1440 2T-4T	2	0.6	100000	parallel-connected	0.3	2*120 (250)

Applications with a braking duty cycle of 50%

Inverter Size	Braking Unit	Braking Resistors					
		Applicable Resistors			Resistor Wiring	Resultant Rating (Ohm)	Wire Cross-Section Mm² (Kcmils)
		Quantity	Recommended rating (Ohm)	Power (W)			
0598	BU1440 2T-4T	4	0.45	48000	series/parallel-connected	0.45	2*120 (250)
0748	BU1440 2T-4T	4	0.45	48000	series/parallel-connected	0.45	2*185(400)
0831	BU1440 2T-4T	4	0.3	64000	series/parallel-connected	0.3	2*240(400)

Voltage class: 4T

Applications with a braking duty cycle of 10%

Inverter Size	Braking Unit	Braking Resistors				
		Quantity	Recommended Rating (Ohm)	Power(W)	Resistor Wiring	Wire Cross-Section Mm² (Kcmils)
0598	BU1440 2T-4T	1	1.2Ohm	64000	-	120 (250)
0748	BU1440 2T-4T	1	1.2Ohm	64000	-	120 (250)
0831	BU1440 2T-4T	1	0.8Ohm	100000	Parallel connected	120 (250)

Applications with a braking duty cycle of 20%

Inverter Size	Braking Unit	Braking Resistors					
		Applicable Resistors			Resistor Wiring	Resultant Rating (Ohm)	Wire Cross-Section Mm² (Kcmils)
		Quantity	Recommended Rating (Ohm)	Power (W)			
0598	BU1440 2T-4T	2	2.4	64000	parallel-connected	1.2	2*95(400)
0748	BU1440 2T-4T	2	2.4	64000	parallel-connected	1.2	2*95(400)
0831	BU1440 2T-4T	2	1.6	100000	parallel-connected	0.8	2*120(500)

Applications with a braking duty cycle of 50%

Inverter Size	Braking Unit	Braking Resistors					
		Applicable Resistors			Resistor Wiring	Resultant Rating (Ohm)	Wire Cross-Section Mm² (Kcmils)
		Quantity	Recommended Rating (Ohm)	Power (W)			
0598	BU1440 2T-4T	4	1.2	64000	series/parallel-connected	1.2	2*120 (250)
0748	BU1440 2T-4T	4	1.2	64000	series/parallel-connected	1.2	2*120 (250)
0831	BU1440 2T-4T	4	0.8	100000	series/parallel-connected	0.8	2*185(400)

b) Signal wiring

CAUTION!! Make sure that the control device is properly set-up when using the braking arm. When ordering the inverter, always state the inverter configuration you want to obtain.

Because the braking arm is controlled directly by the control device, the following links are required:

- connect +24V supply of gate unit ES841 of the braking unit through a pair of unipolar wires (AWG17-18 - 1 mm^2)
- connect braking IGBT to the fault IGBT signal through 2 optical fibres (diameter: 1mm) made of plastic (typical attenuation coefficient: 0.22dB/m) provided with Agilent HFBR-4503/4513 connectors.

The wiring diagram is as follows:

Signal	Type of Wiring	Wire Marking	Component	Board	Connector	Component	Board	Connector
+24VD Driver board ES841 power supply	Unipolar wire 1mm^2	24V-GB	Phase W	ES841	MR1-3	Braking unit	ES841	MR1-1
0VD Driver board ES841 power supply	Unipolar wire 1mm^2		Phase W	ES841	MR1-4	Braking unit	ES841	MR1-2
Brake IGBT command	Single optical fibre	G-B	Control unit	ES842	OP-4	Braking unit	ES841	OP5
Brake IGBT fault	Single optical fibre	FA-B	Control unit	ES842	OP-3	Braking unit	ES841	OP3

CAUTION!! Do not remove the cap of connector OP4 in control board ES841 for the braking module.

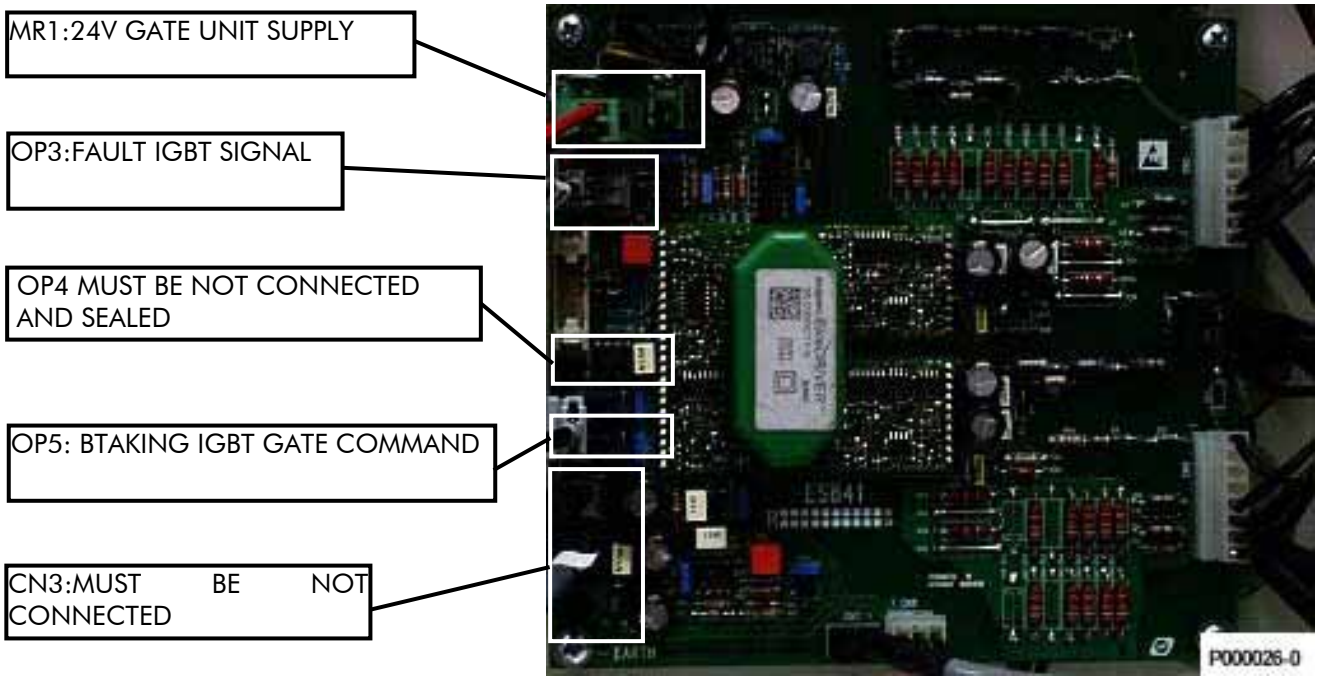


Figure 66: ES841 gate unit board for the braking unit.

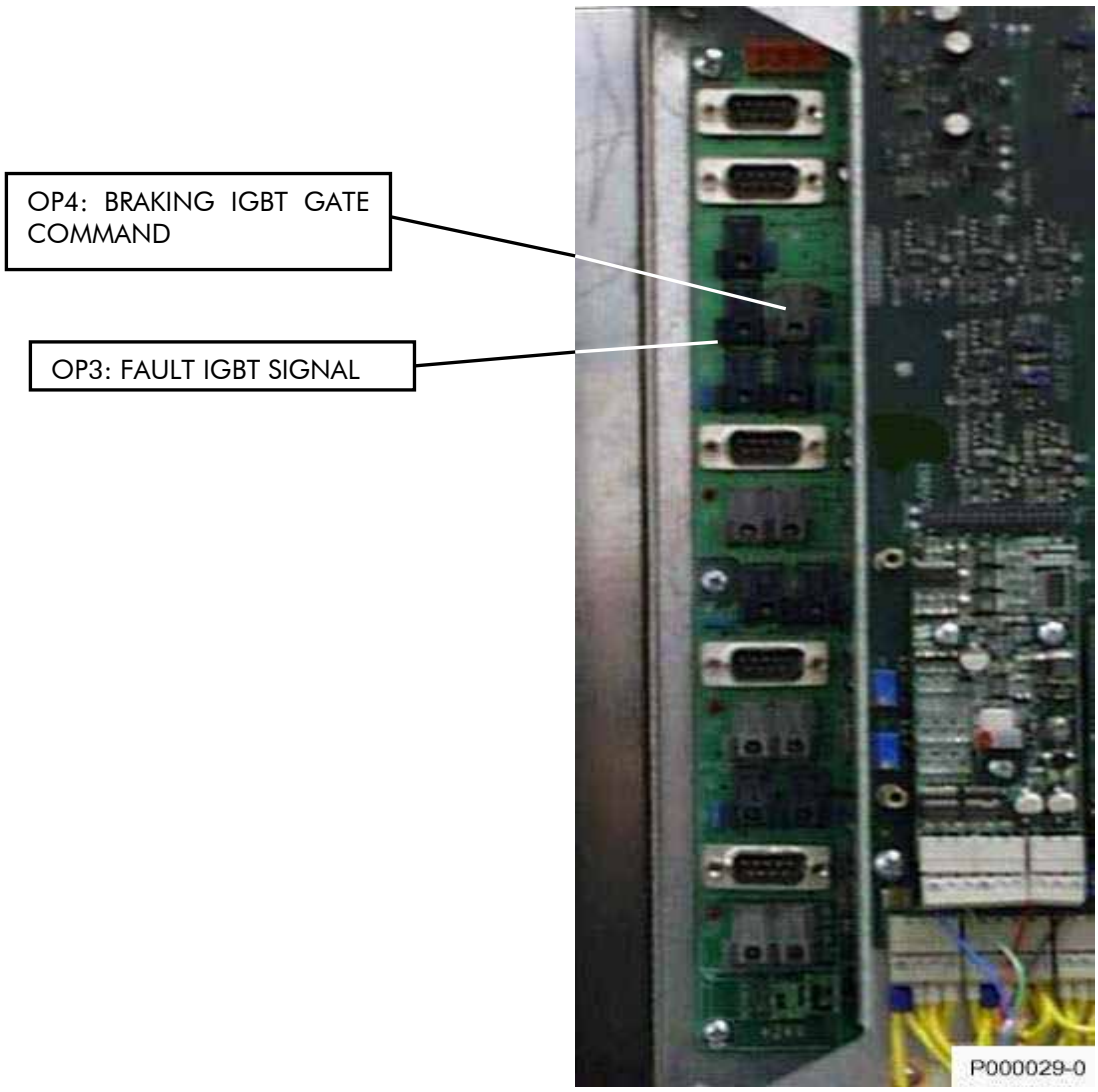


Figure 67: Wiring points of the optical fibres in ES482 control board.

The figure below shows the internal wiring of S65 inverters provided with an integrated braking unit.

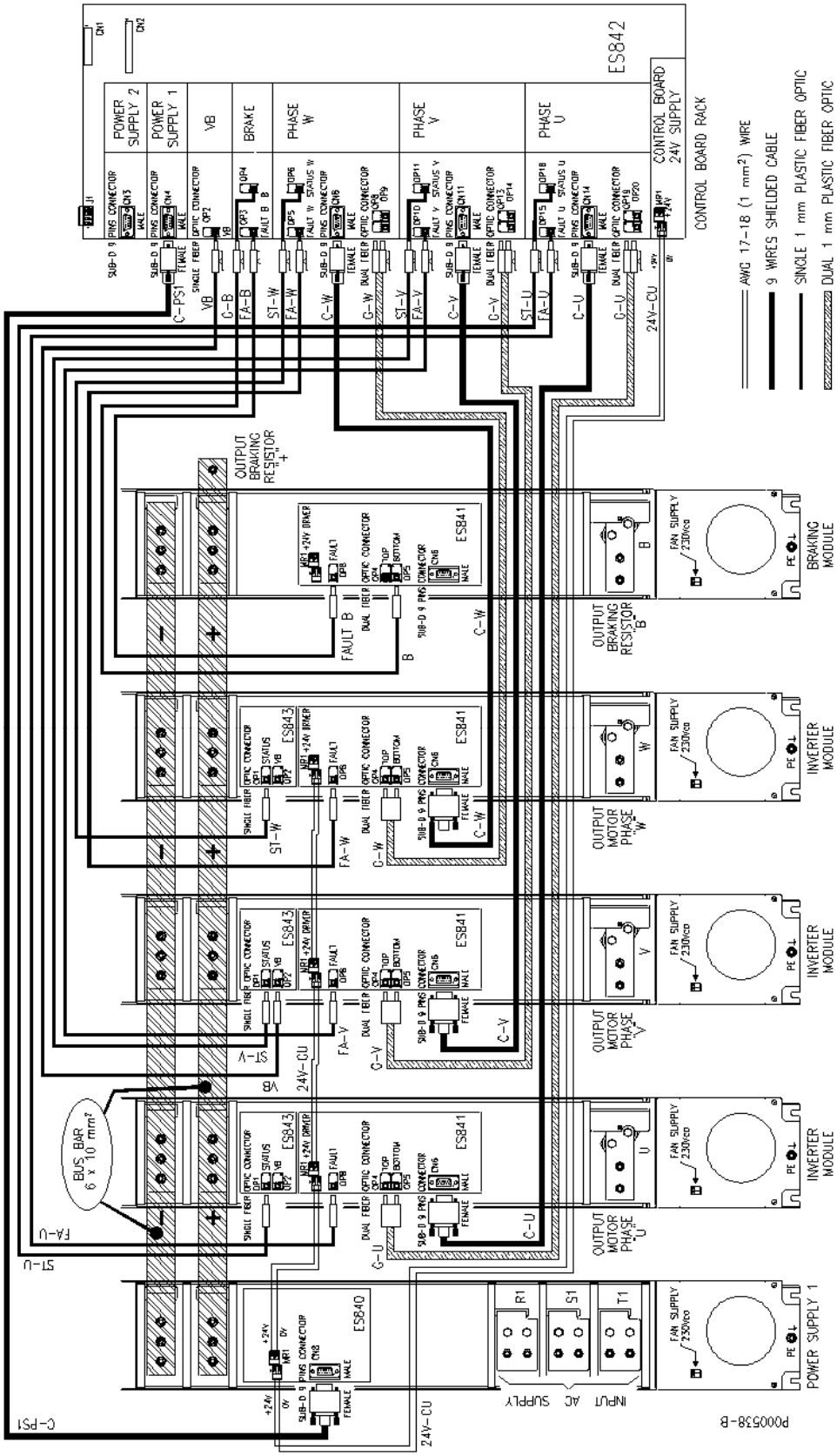


Figure 68: Internal wiring of S65 inverters provided with an integrated braking unit.

13.4. KEYPAD REMOTING KIT

13.4.1. REMOTING THE KEYPAD

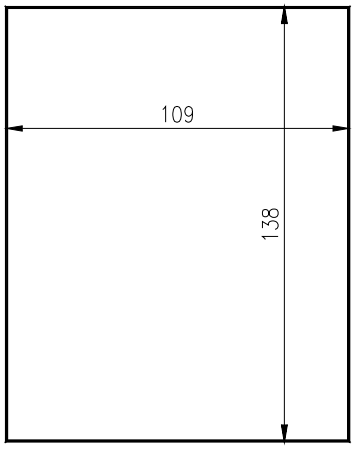
The REMOTING KIT is required to remote the keypad. The remoting kit includes:

- Plastic shell
- Keypad mounting plate
- Fastening brackets
- Remoting wire (length: 5 m)

NOTE

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

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



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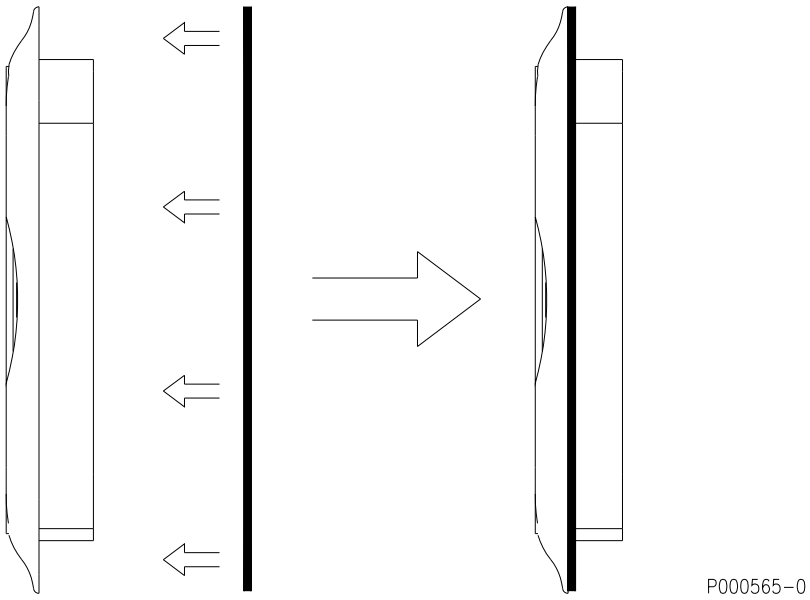
2 – Apply the self-adhesive mounting plate on the rear part of the plastic shell between the shell and the cabinet; make sure that holes coincide.



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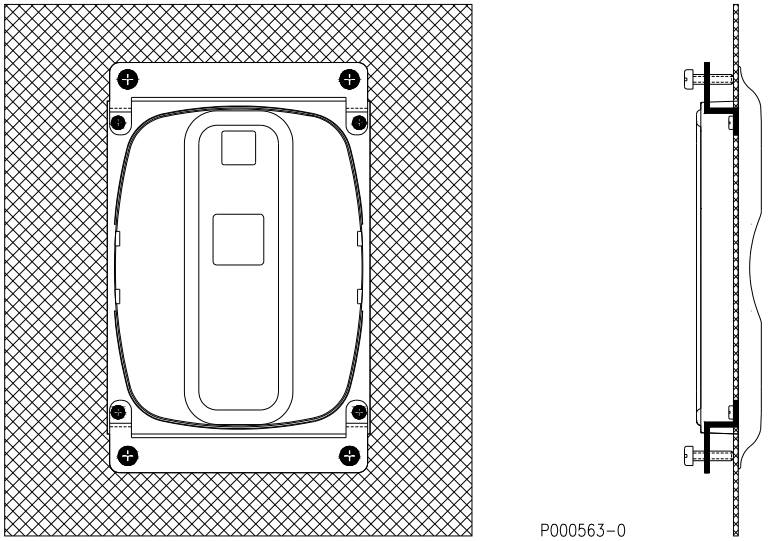
3 – Fit the plastic shell in the relevant slot.

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



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

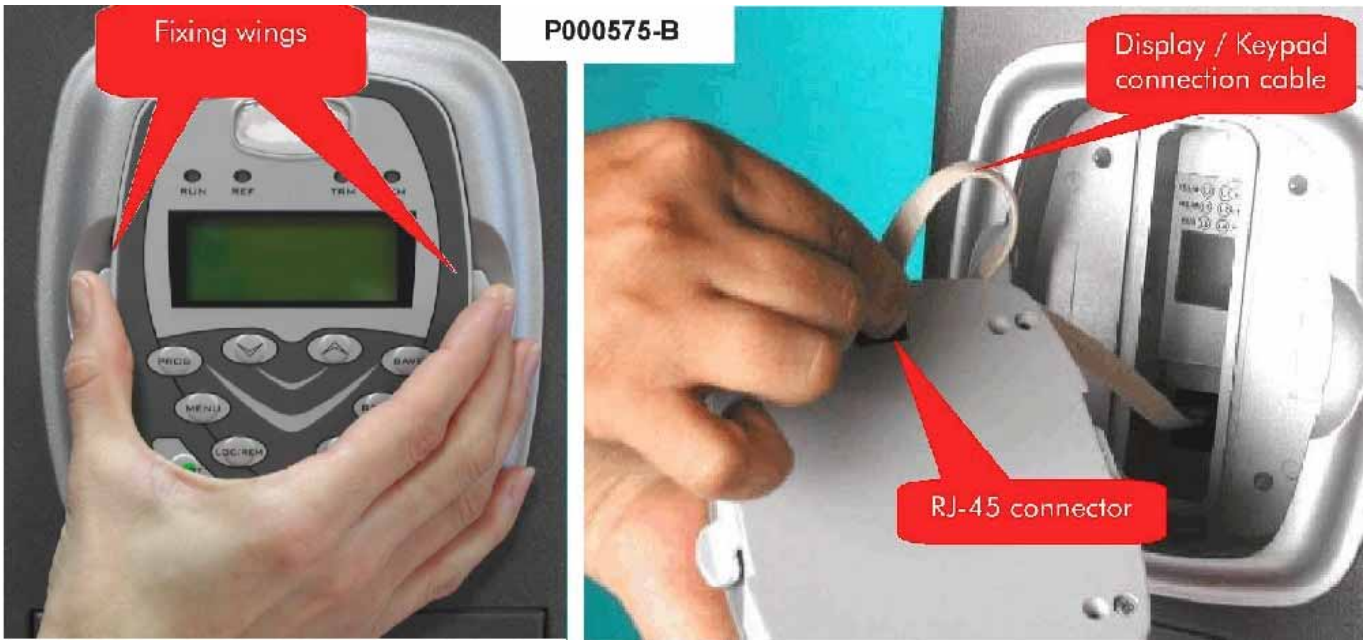


Figure 69: Removing the display/keypad.

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

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

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

Figure 70: Front view/rear view of the keypad.

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

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

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

13.5. OPTIONAL INPUT-OUTPUT REACTORS

13.5.1. INPUT REACTOR

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

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

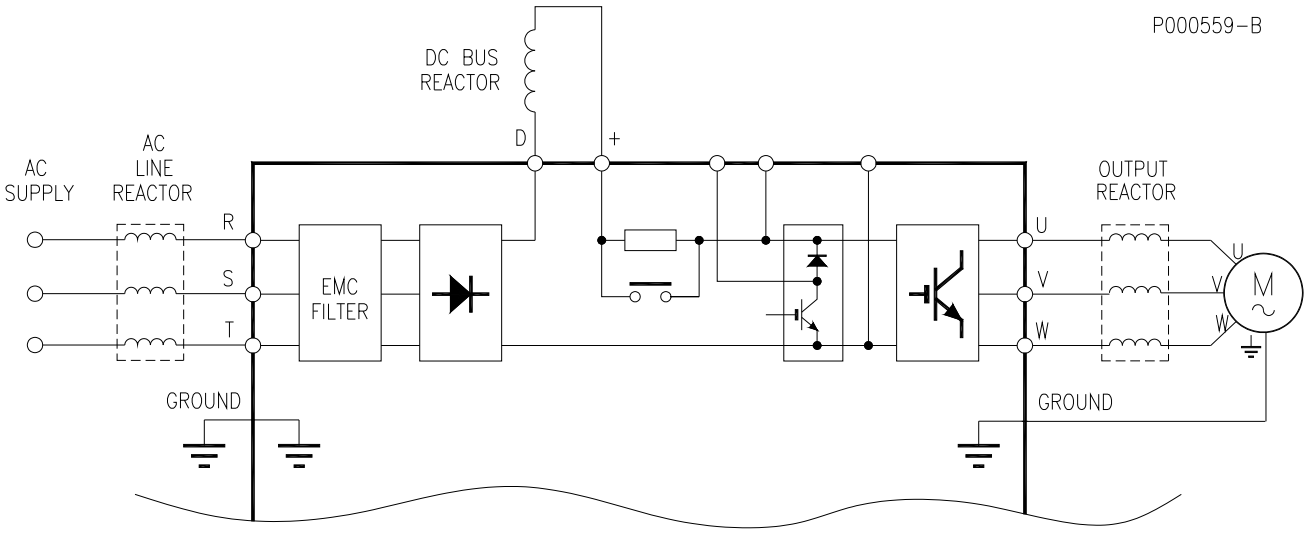


Figure 71: Wiring diagram for optional inductance.

Harmonic currents

The shapes of the different waves (current or voltage) may be expressed as the sum of the basic frequency (50 or 60Hz) and its multiples. In balanced, three-phase systems, only odd harmonic current exists, as even current is neutralized by symmetrical considerations.
Harmonic current is generated by non linear loads absorbing non-sinusoidal current. Typical sources of this type are bridge rectifiers (power electronics), switched mode power supply and fluorescent lamps. Three-phase rectifiers absorb line current with a harmonic content n=6K±1 with K=1,2,3,... (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 23rd, the 25th and so on, with their relevant low levels. The supply current shape is very similar to a sinusoid. A different solution to suppress this problem consists in powering the inverter with DC voltage supply using a regenerative inverter: current absorbed by the mains is perfectly sinusoidal, and the regenerative inverter recovers energy to the mains when the motor is regenerating.

NOTE

DC-side inductance can be connected only to inverters sizes from S15 on (to be stated when ordering the equipment).

NOTE

When a DC-side inductance is used, it is sometimes possible that no braking resistor or external braking unit can be connected to the inverter.

Harmonic currents

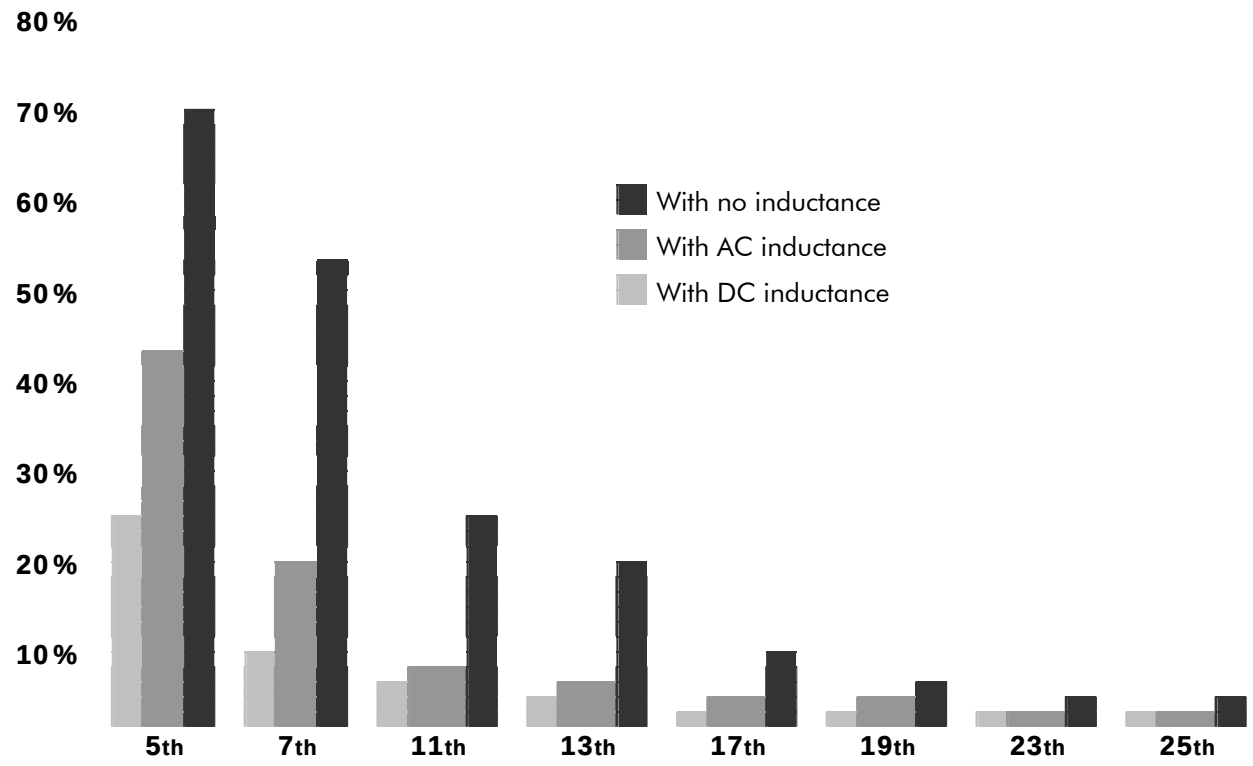


Figure 72: Amplitude of harmonic currents (approximate values)

NOTE

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

CAUTION

For inverter sizes lower than S40 included, always use an input inductance under the following circumstances: mains instability; converters installed for DC motors; loads generating strong voltage variations at startup; power factor correction systems; mains rated power exceeding 500 KVA.
Always activate a line inductance for inverter sizes higher than S50, unless the inverter is powered via a dedicated transformer.

The ratings of optional inductance recommended based on the inverter size are detailed in section 13.5.4.

13.5.2. 12-PHASE CONNECTION

For >500kW drives, a *12-pulse* rectifier is normally used. This suppresses the lowest harmonic current in the supply line.
A 12-pulse inductance suppresses 5th and 7th harmonics; harmonics left 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.

In that case, a dedicated transformer is needed, along with a specific interphase inductance for current balance and an additional diode bridge installed outside the inverter (two supply modules are needed for modular inverters).

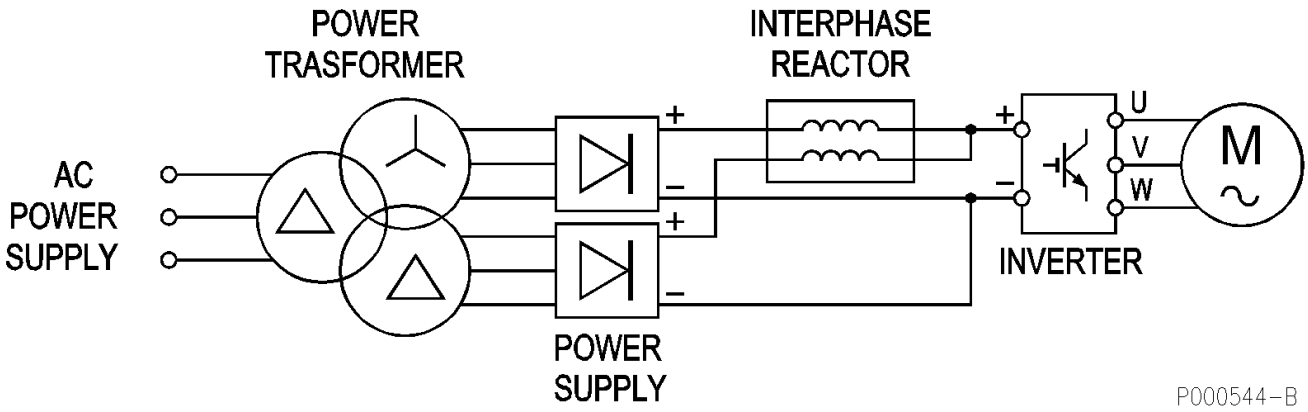


Figure 73: Lay-out of a 12-phase connection.

13.5.3. OUTPUT INDUCTANCE

Installations requiring a longer distance between the inverter and the motor may cause overcurrent protections to frequently trip. This is due to the wire parasite capacity generating current pulses at the inverter output. This current peak may be limited by an inductance installed on the inverter output. Screened cables even have a higher capacity and may have problems with a shorter length. The recommended output inductance is the same that can be installed at the inverter input (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 at the output of each inverter.

Motor wiring with unscreened cables

2-4-6-pole MOTORS

Size							
Up toS10							
Up toS30							
Up toS40							
FromS40							
Cable Length	30	60	90	120	150	> 150	**mt.**

8-10 pole MOTORS

Size						
Up toS10						
Up toS30						
Up toS40						
FromS40						
Cable Length	30	60	90	120	>120	**mt.**

No output inductance is required
Output inductance is required

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

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

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

Motor wiring with screened cables

2-4-6-pole MOTORS

Size					
Up toS10					
Up toS30					
Up toS40					
FromS40					
Cable Length	20	40	80	>80	**mt.**

8-10 pole MOTORS

Size						
Up toS10						
Up toS30						
Up toS40						
FromS40						
Cable Length	20	40	60	80	> 80	**mt.**

No output inductance is required
Output inductance is required

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

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

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

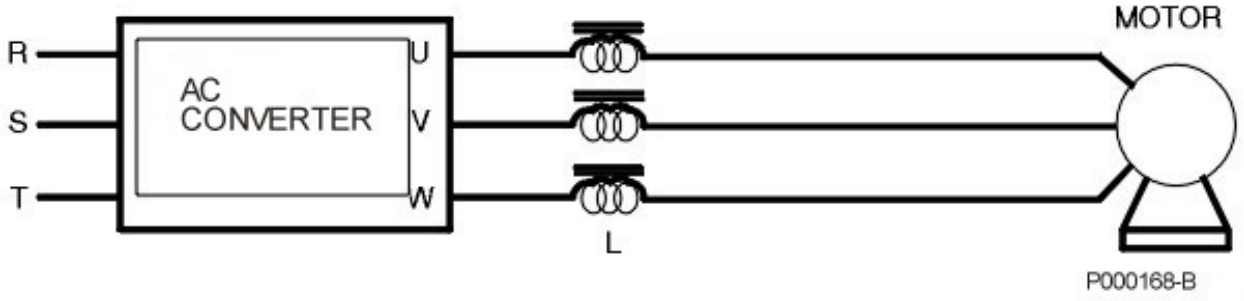


Figure 74: Connection of an output inductance.

13.5.4. APPLYING THE INDUCTANCE TO THE INVERTERS

13.5.4.1. 2T CLASS – AC / DC INDUCTANCE

INVERTER SIZE	INVERTER MODEL	INPUT AC 3-PHASE INDUCTANCE	DC SINGLE-PHASE INDUCTANCE	OUTPUT INDUCTANCE
S05	0007	IM0126004 2.0mH–11Arms	IM0140054 8mH-10.5Arms/12.8Apeak	IM0126004 2.0mH–11Arms (AC 3-phase)
	0008	IM0126044 1.27mH–17Arms	IM0140104 5.1mH-17Arms/21Apeak	IM0126044 1.27mH–17Arms (AC 3-phase)
	0010			
	0015	IM0126084 0.7mH–32Arms	IM0140154 2.8mH– 32.5Arms/40.5Apeak	IM0126084 0.7mH–32Arms (AC 3-phase)
	0016			
	0020			
S10	0016	IM0126084 0.7mH–32Arms	Not applicable	IM0126084 0.7mH–32Arms (AC 3-phase)
	0017			
	0020			
	0025	IM0126124 0.51mH – 43Arms	Not applicable	IM0126124 0.51mH–43Arms (AC 3-phase)
	0030			
	0035			
S12	0023	IM0126124 0.51mH – 43Arms	IM0140204 2.0mH–47Arms/58.5 Apeak	IM0126124 0.51mH–43Arms (AC 3-phase)
	0033	IM0126144 0.3mH–68Arms	IM0140254 1.2mH–69Arms/87Apeak	IM0126144 0.32mH–68Arms (AC 3-phase)
	0037			
S15	0038		Not applicable	
	0040	IM0126164 0.24mH–92Arms		IM0126164 0.24 mH–92Arms (AC 3-phase)
	0049			
S20	0060		IM0140304 0.64mH– 160Arms/195Apeak	
	0067	IM0126204 0.16mH–142Arms		IM0126204 0.16mH–142Arms (AC 3-phase)
	0074			
	0086			
S30	0113	IM0126244 0.09mH–252Arms	IM0140404 0.36mH–275Arms/345 Apeak	IM0126244 0.09mH–252Arms (AC 3-phase)
	0129			
	0150			
	0162			
S40	0179	IM0126284 0.061mH–362Arms	IM0140504 0.24mH– 420Arms/520Apeak	IM0126284 0.061mH–362Arms (AC 3-phase)
	0200			
	0216	IM0126324 0.054mH–410Arms	IM0140554 0.216mH– 460Arms/580Apeak	IM0126324 0.054mH–410Arms (AC 3-phase)
	0250			
S50	0312	IM0126364 0.033mH–662Arms	IM0140654 0.132mH– 740Arms/930Apeak	IM0126364 0.033mH–662Arms (AC 3-phase)
	0366			
	0399			
S60	0457	IM0126404 0.023mH–945Arms	IM0140754 0.092mH– 1040Arms1300/Apeak	IM0126404 0.023mH–945Arms (AC 3-phase)
	0525			
S65	0598			
	0748	IM0126444 0.018mH–1260 Arms	IM0140854 0.072mH– 1470Arms/1850Apeak	IM0126444 0.018mH–1260Arms (AC 3-phase)
	0831			

13.5.4.2. 4T CLASS – AC / DC INDUCTANCE

INVERTER SIZE	INVERTER MODEL	INPUT AC 3-PHASE INDUCTANCE	DC SINGLE-PHASE INDUCTANCE	OUTPUT INDUCTANCE
S05	0005	IM0126004 2.0mH–11Arms	Not applicable	IM0126004 2.0mH–11Arms (AC 3-phase)
	0007	IM0126044 1.27mH – 17Arms	Not applicable	IM0126044 1.27mH–17Arms (AC 3-phase)
	0009			
	0011			
	0014			
S10	0016	IM0126084 0.7mH–32Arms	Not applicable	IM0126084 0.7mH–32Arms (AC 3-phase)
	0017			
	0020			
	0025	IM0126124 0.51mH – 43Arms	Not applicable	IM0126124 0.51mH–43Arms (AC 3-phase)
	0030			
	0035			
S12	0016	IM0126084 0.7mH–32Arms	IM0140154 2.8mH– 32.5Arms/40.5Apeak	IM0126084 0.7mH–32Arms (AC 3-phase)
	0017			
	0020			
	0025	IM0126124 0.51mH – 43Arms	IM0140204 2.0mH–47Arms/58.5 Apeak	IM0126124 0.51mH–43Arms (AC 3-phase)
	0030			
	0034	IM0126144 0.3mH–68Arms	IM0140254 1.2mH–69Arms/87Apeak	IM0126144 0.32mH–68Arms (AC 3-phase)
	0036			
S15	0038		Not applicable	
	0040	IM0126164 0.24mH–92Arms		IM0126164 0.24 mH–92Arms (AC 3-phase)
	0049			
S20	0060		IM0140304 0.64mH– 160Arms/195Apeak	
	0067	IM0126204 0.16mH–142Arms		IM0126204 0.16mH–142Arms (AC 3-phase
	0074			
	0086			
S30	0113	IM0126244 0.09mH–252Arms	IM0140404 0.36mH–275Arms/345 Apeak	IM0126244 0.09mH–252Arms (AC 3-phase)
	0129			
	0150			
	0162			
S40	0179	IM0126284 0.061mH–362Arms	IM0140504 0.24mH– 420Arms/520Apeak	IM0126284 0.061mH–362Arms (AC 3-phase)
	0200			
	0216	IM0126324 0.054mH–410Arms	IM0140554 0.216mH– 460Arms/580Apeak	IM0126324 0.054mH–410Arms (AC 3-phase)
	0250			
S50	0312	IM0126364 0.033mH–662Arms	IM0140654 0.132mH– 740Arms/930Apeak	IM0126364 0.033mH–662Arms (AC 3-phase)
	0366			
	0399			
S60	0457	IM0126404 0.023mH–945Arms	IM0140754 0.092mH– 1040Arms1300/Apeak	IM0126404 0.023mH–945Arms (AC 3-phase)
	0525			
S65	0598			
	0748	IM0126444 0.018mH–1260 Arms	IM0140854 0.072mH– 1470Arms/1850Apeak	IM0126444 0.018mH–1260Arms (AC 3-phase)
	0831			

CAUTION

When installing S40 inverters or smaller, use L2 inductance under the following circumstances: mains instability; thyristor converters, loads generating strong voltage variations at startup; power factor correction systems; mains power exceeding 500 KVA.
When installing S50 size inverters or bigger, always install line inductance, unless they are powered through a dedicated transformer.
Always activate a line inductance for inverter sizes greater than S50, unless the inverter is powered via a dedicated transformer.

13.5.4.3. 2T-4T CLASS, INTERPHASE INDUCTANCE

SIZE	INVERTER MODEL	INTERPHASE INDUCTANCE MODEL	
S65	0598	1100A	IM0143504
	0748	1400A	IM0143604
	0831		

NOTE

Inductance designed for 12-phase connection.
Carefully follow the application diagram.

13.5.5. INDUCTANCE RATINGS

13.5.5.1. VOLTAGE CLASS: 2T – 4T

INDUCTANCE MODEL	INDUCTANCE TYPE	INDUCTANCE RATINGS		DIMENSIONS							HOLE	WGT	LEAKAGE
		mH	A	TYPE	L	H	P	M	E	G	mm	Kg	W
IM0126004	AC 3-PHASE	2.0	11	A	120	125	75	25	67	55	5	2.9	29
IM0126044	AC 3-PHASE	1.27	17	A	120	125	75	25	67	55	5	3	48
IM0126084	AC 3-PHASE	0.70	32	B	150	130	115	50	125	75	7x14	5.5	70
IM0126124	AC 3-PHASE	0.51	43	B	150	130	115	50	125	75	7x14	6	96
IM0126144	AC 3-PHASE	0.3	68	B	180	160	150	60	150	82	7x14	9	150
IM0126164	AC 3-PHASE	0.24	92	B	180	160	150	60	150	82	7x14	9.5	183
IM0126204	AC 3-PHASE	0.16	142	B	240	210	175	80	200	107	7x14	17	272
IM0126244	AC 3-PHASE	0.09	252	B	240	210	220	80	200	122	7x14	25	342
IM0126284	AC 3-PHASE	0.061	362	C	300	260	185	100	250	116	9x24	36	407
IM0126324	AC 3-PHASE	0.054	410	C	300	260	205	100	250	116	9x24	39.5	423
IM0126364	AC 3-PHASE	0.033	662	C	300	290	235	100	250	143	9x24	53	500
IM0126404	AC 3-PHASE	0.023	945	C	300	320	240	100	250	143	9x24	67	752
IM0126444	AC 3-PHASE	0.018	1260	C	360	375	280	100	250	200	12	82	1070

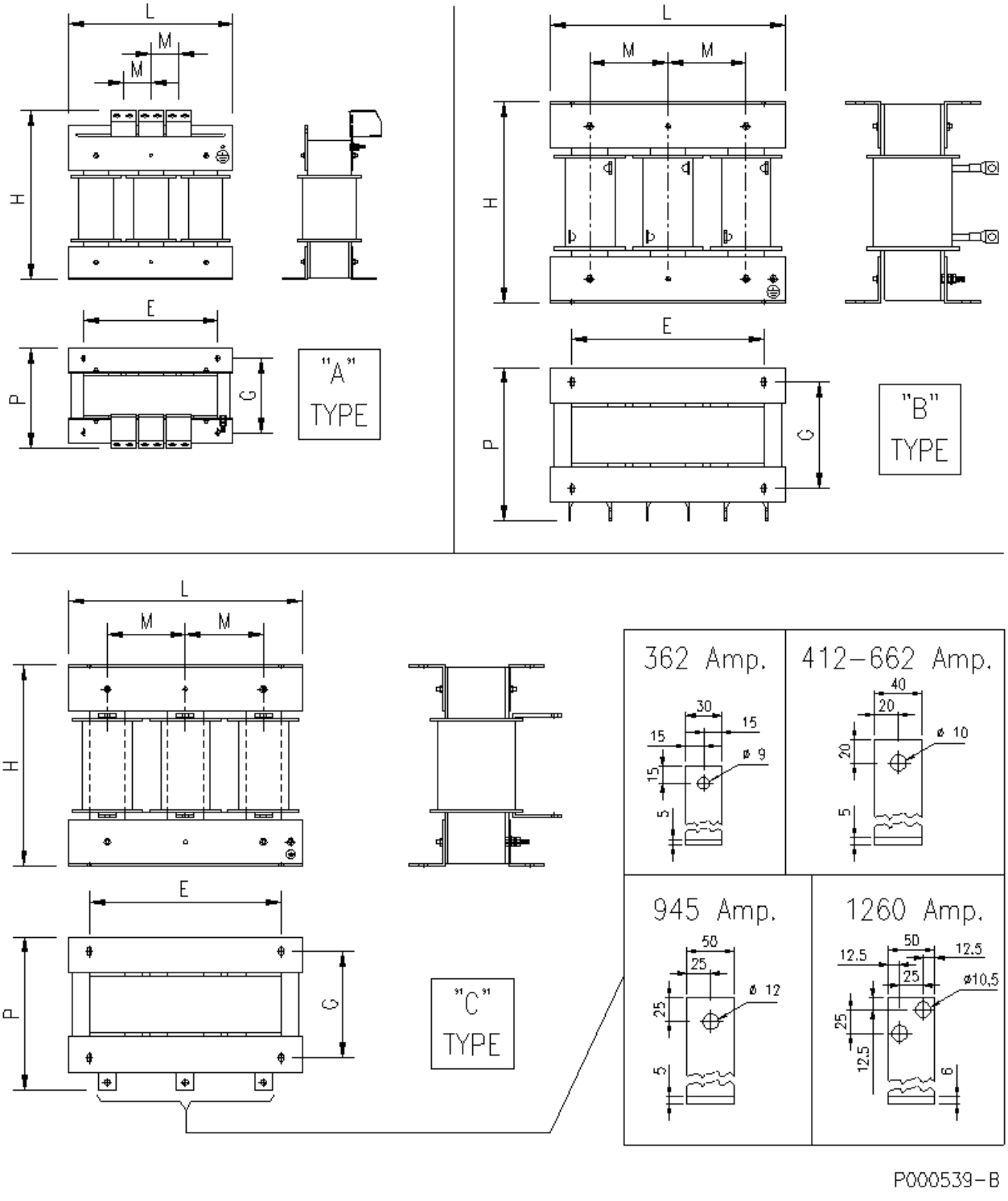


Figure 75: Mechanical features of an AC 3-phase inductance.

13.5.6. AC 3-PHASE INDUCTANCE, 2T AND 4T CLASS IN IP54 CABINET

INVERTER SIZE	INVERTER MODEL	INDUCTANCE MODEL	INDUCTANCE TYPE	MECHANICAL DIMENSIONS (see figure on next page)	WEIGHT	LEAKAGE
				TYPE	Kg	W
S05	0005	ZZ0112010	AC 3-PHASE	A	6.5	29
	0007	ZZ0112020	AC 3-PHASE	A	7	48
	0009					
	0011					
	0014					
S05-S10	0016	ZZ0112030	AC 3-PHASE	A	9.5	70
	0017					
	0020					
S10-S12	0023	ZZ0112040	AC 3-PHASE	A	10	96
	0025					
	0030					
	0035					
S12	0033	ZZ0112045	AC 3-PHASE	B	14	150
	0034					
	0036					
	0037					
S15	0038	ZZ0112050	AC 3-PHASE	B	14.5	183
	0040					
	0049					
S20	0060	ZZ0112060	AC 3-PHASE	C	26	272
	0067					
	0074					
	0086					
S30	0113	ZZ0112070	AC 3-PHASE	C	32.5	342
	0129					
	0150					
	0162					

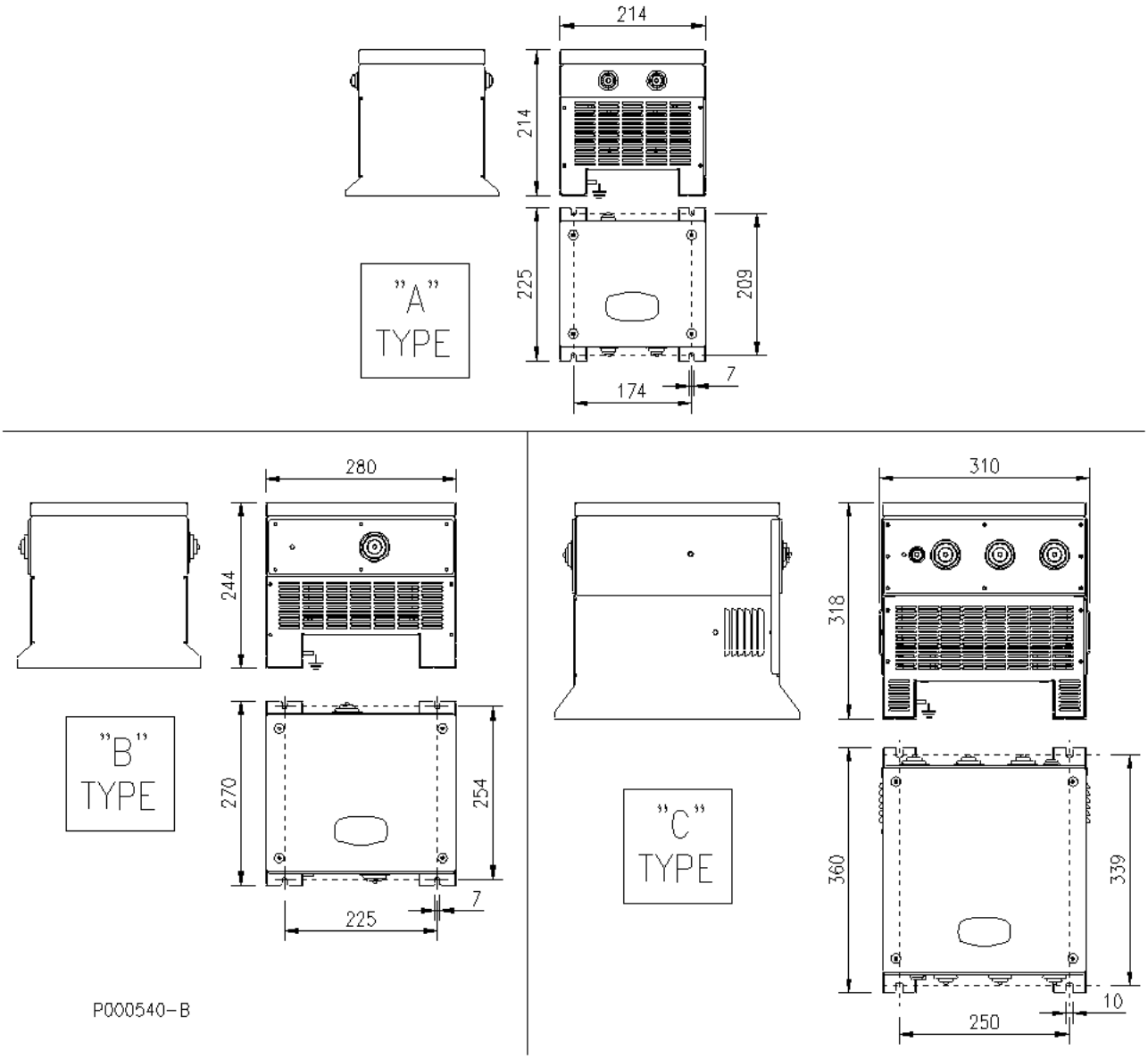


Figure 76: Mechanical features of an AC 3-phase inductance, 2T-4T Class in IP54 cabinet.

13.6. ES836/2 Encoder board

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

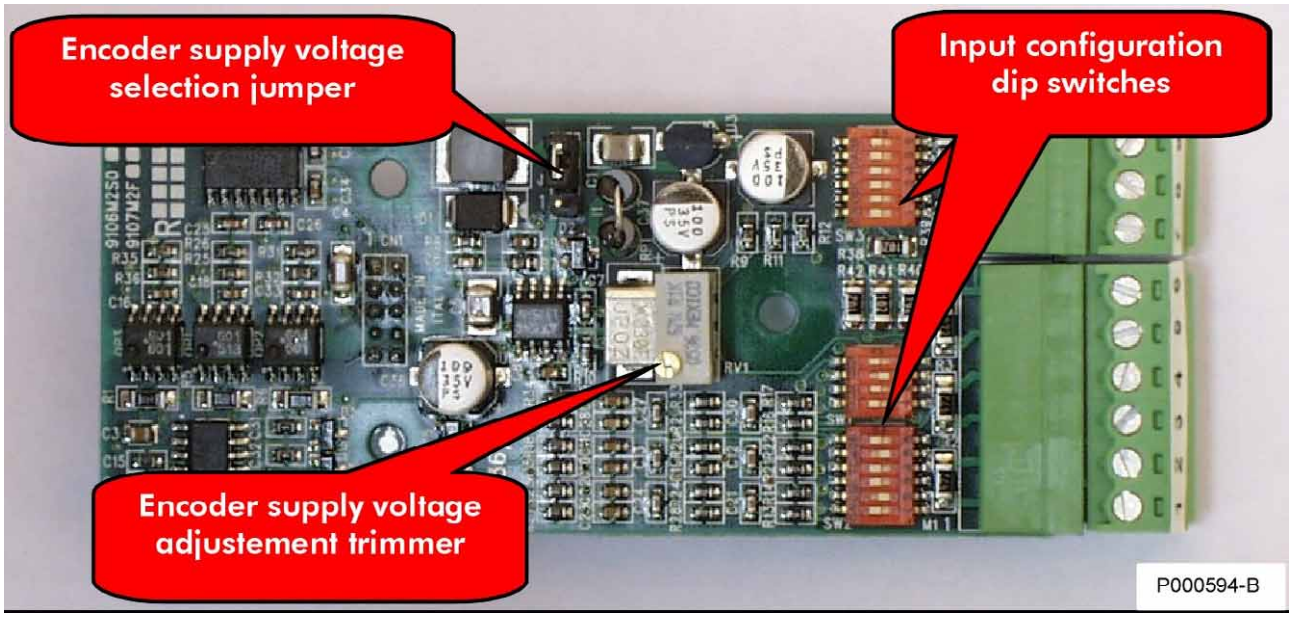


Figure 77: ES836/2 Encoder board.

DESCRIPTION	CODE	COMPATIBLE ENCODERS	
		POWER SUPPLY	OUTPUT
Encoder board ES836/2	ZZ0095834	5VDC to 15VDC, 24VDC	Complementary LINE DRIVER, NPN, PNP, PUSH-PULL outputs and single-ended NPN, PNP, PUSH-PULL outputs

13.6.1. 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.)

13.6.2. ELECTRIC SPECIFICATIONS

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

ISOLATION:

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

13.6.3. INSTALLING THE ENCODER BOARD ON THE INVERTER

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

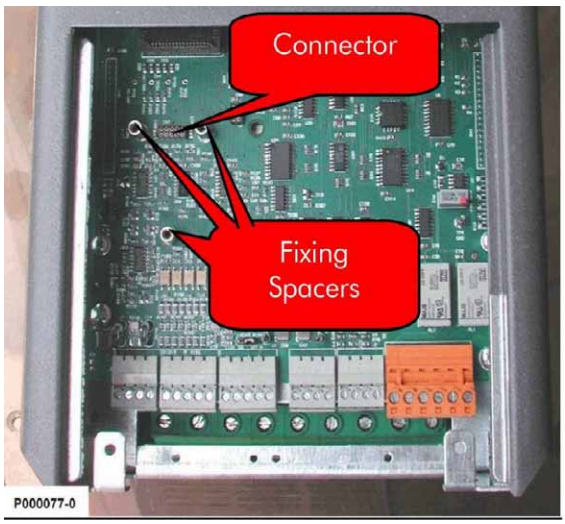


Figure 78: Position of the slot for the installation of the encoder board.

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

Figure 79: Encoder board fastened to its slot.

13.6.4. ENCODER BOARD TERMINALS

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	$\overline{\text{CHA}}$	Encoder input channel A inverse polarity
3	CHB	Encoder input channel B true polarity
4	$\overline{\text{CHB}}$	Encoder input channel B inverse polarity
5	CHZ	Encoder input channel Z (zero notch) true polarity
6	$\overline{\text{CHZ}}$	Encoder input channel Z (zero notch) inverse polarity
7	+VE	Encoder supply output 5V...15V or 24V
8	GNDE	Encoder supply ground
9	GNDE	Encoder supply ground

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

13.6.5. CONFIGURATION DIP-SWITCHES

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

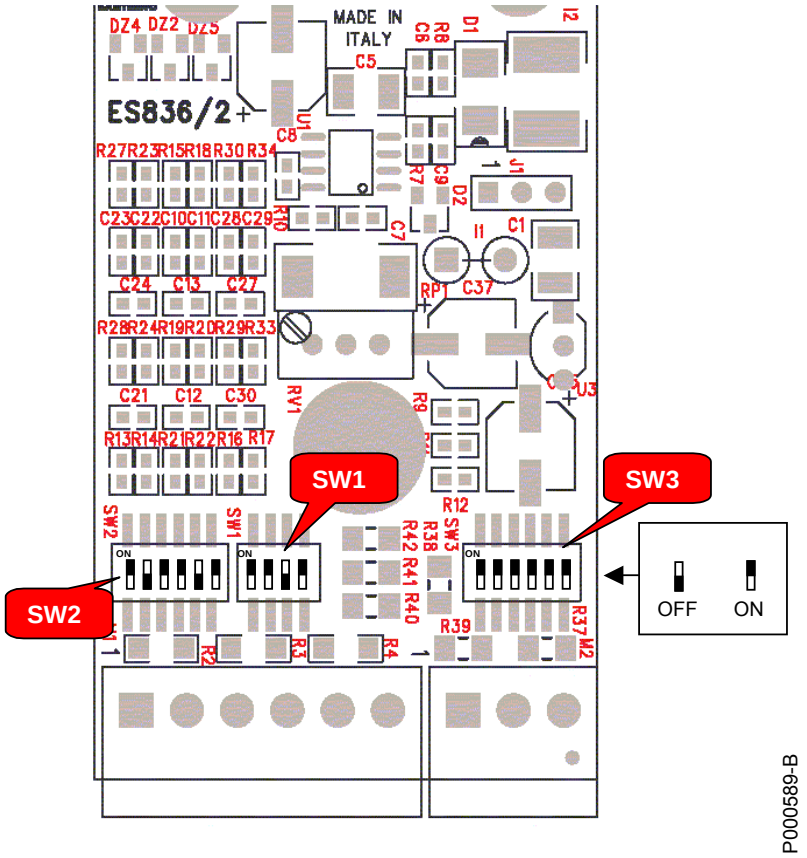


Figure 80: Positions and default settings of the configuration dip-switches.

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

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

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

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

13.6.6. JUMPER FOR ENCODER SUPPLY

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

13.6.7. TUNING TRIMMER

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

Adjustment procedure:

- put a tester on the encoder supply connector (encoder side of the connecting cable); make sure that the encoder is on.
- rotate the trimmer clockwise to increase supply voltage. Trimmer is factory-reset to obtain 5V and 12V voltage (depending on dip-switch setting) in supply terminals. 5V configuration: power supply can range from 4.4V to 7.3V; 12V configuration: power supply can range from 10.3V to17.3V.

NOTE

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

CAUTION

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

CAUTION

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

CAUTION

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

13.6.8. ENCODER WIRING AND CONFIGURATION EXAMPLES

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

CAUTION

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

NOTE

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

NOTE

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

NOTE

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

NOTE

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

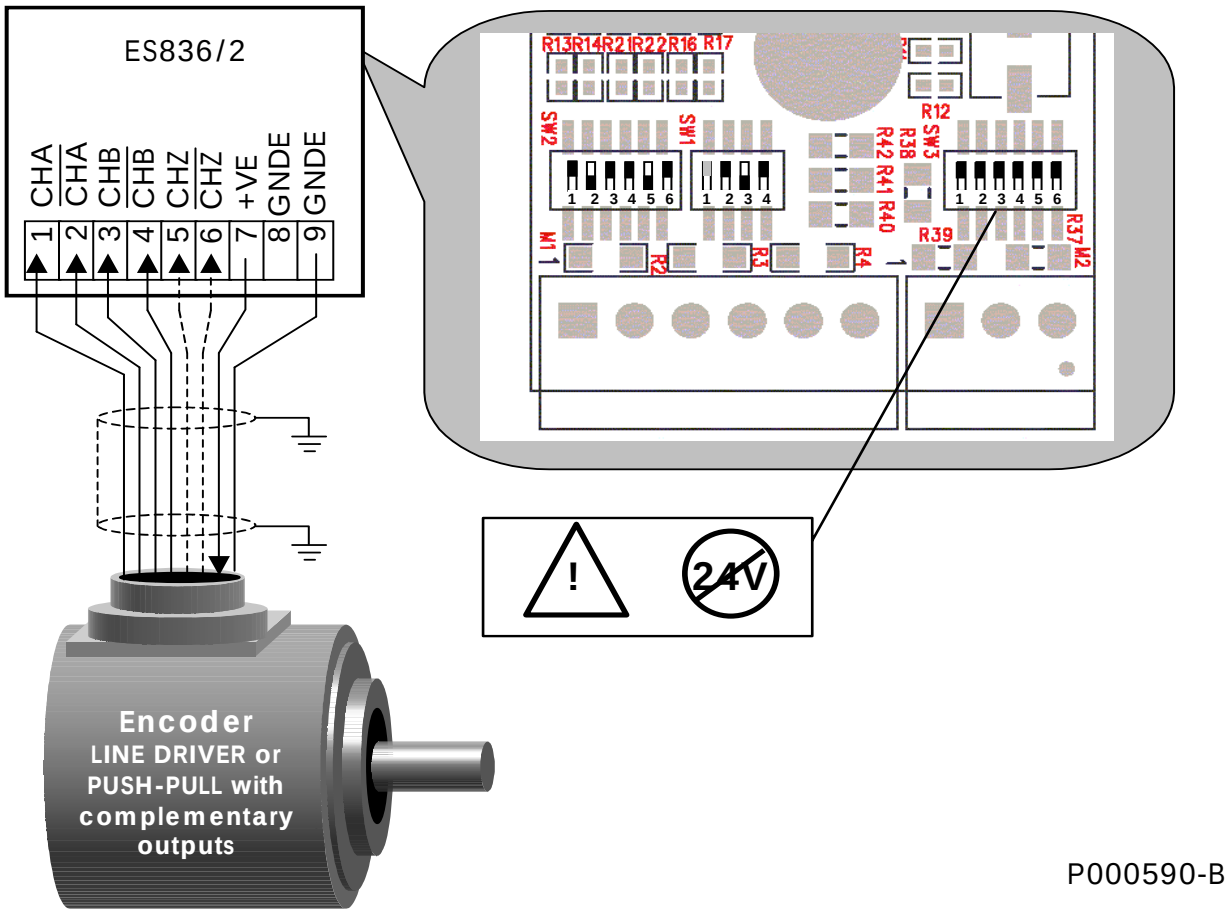


Figure 81: LINE DRIVER or PUSH-PULL encoder with complementary outputs.

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

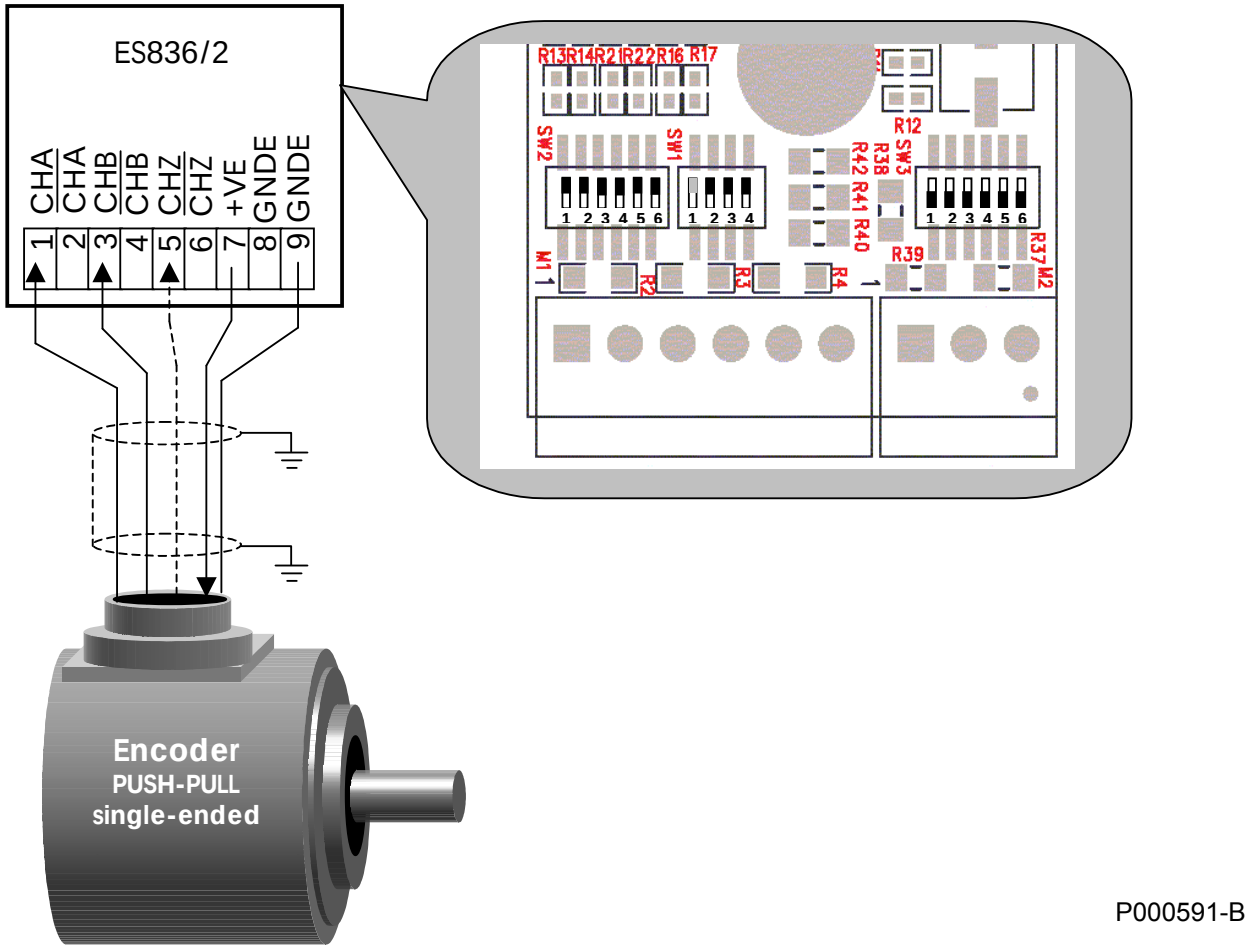


Figure 82: PUSH-PULL encoder with single-ended outputs.

CAUTION

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

NOTE

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

NOTE

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

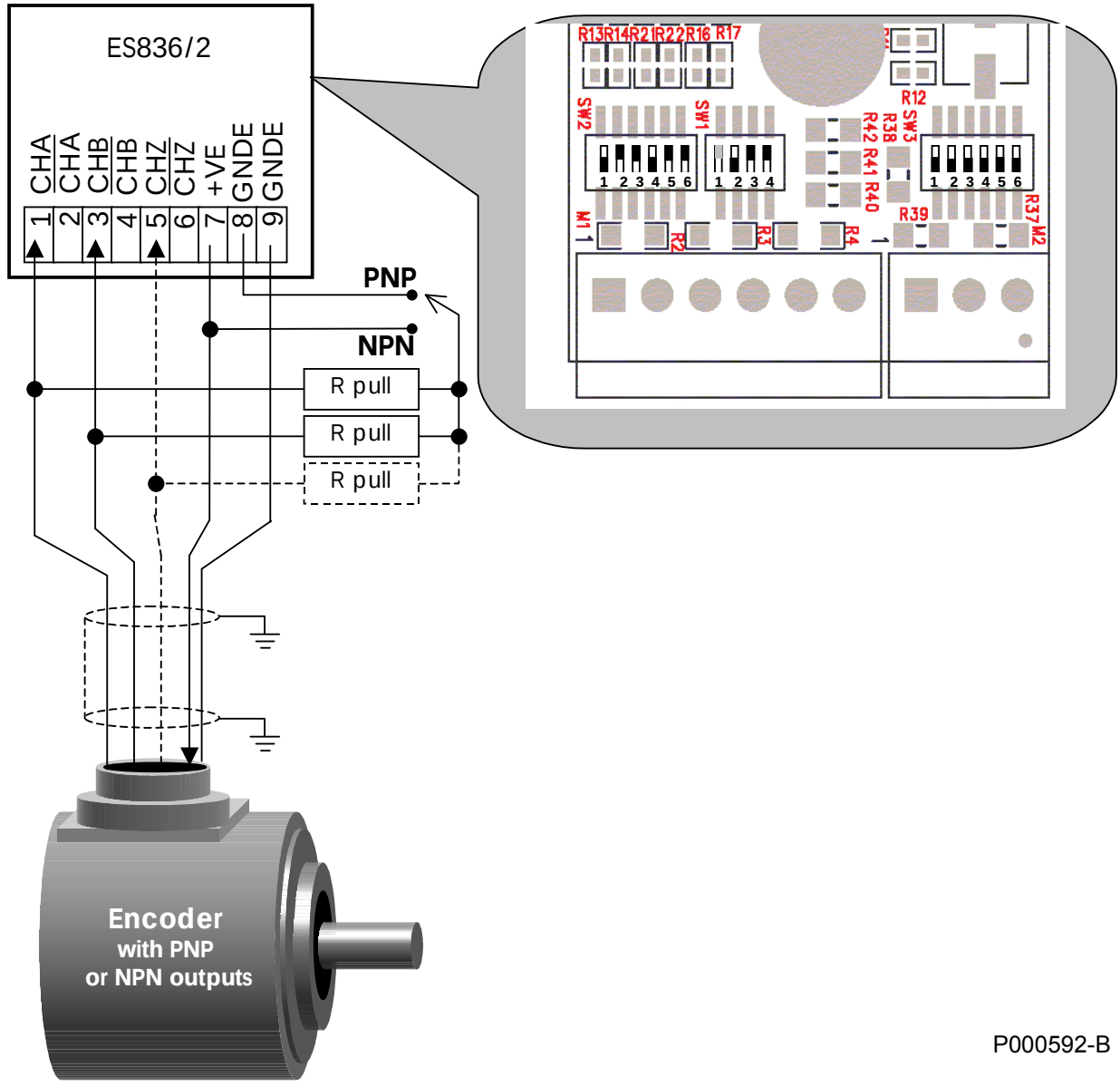


Figure 83: PNP or NPN encoder with single-ended outputs and load resistors with external wiring.

NOTE

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

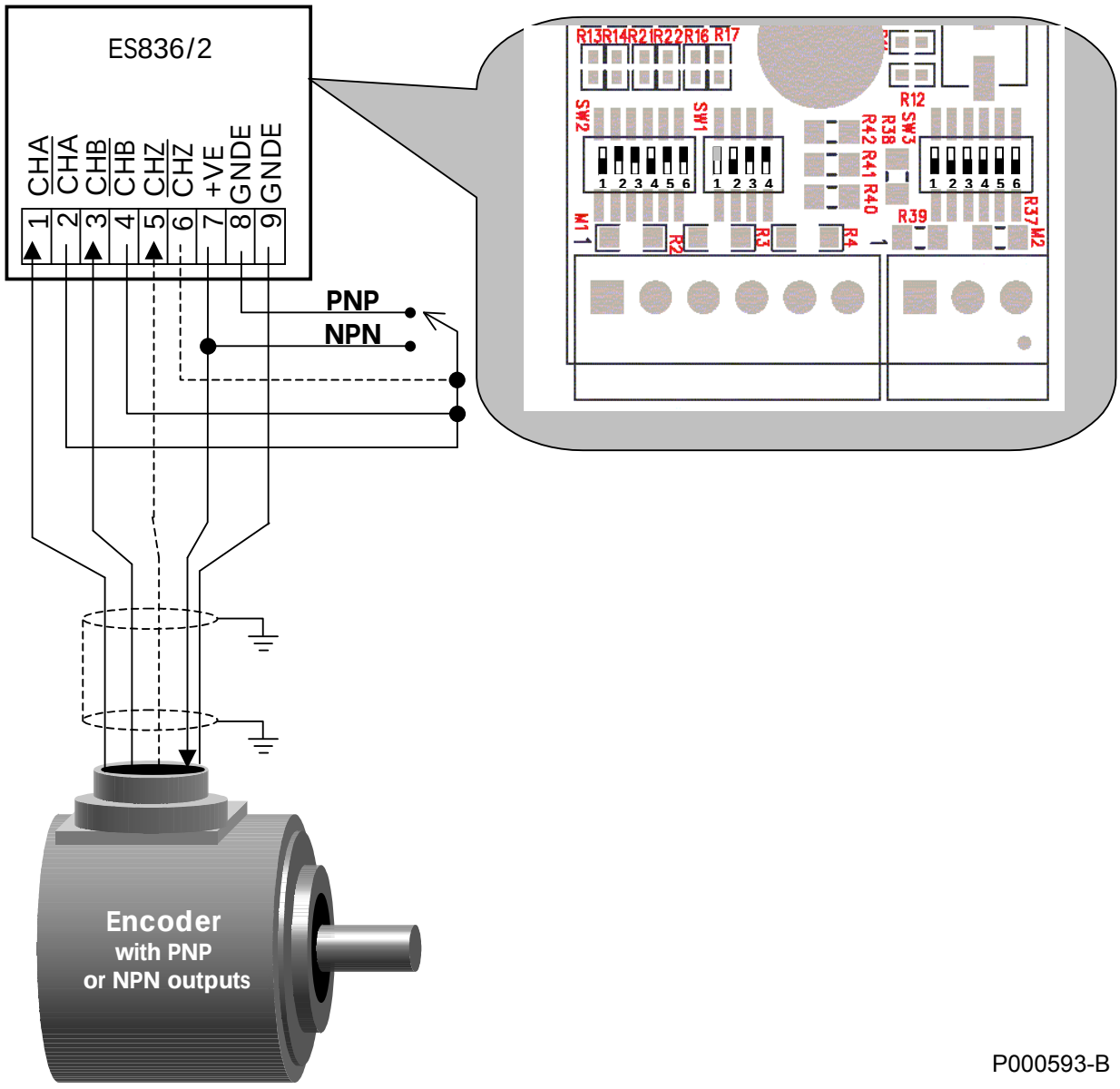


Figure 84: PNP or NPN encoder with single-ended outputs and internal load resistors.

NOTE

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

NOTE

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

13.6.9. WIRING THE ENCODER CABLE

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

Figure 85: Wiring the encoder cable.

Do not stretch the encoder wire along with the motor supply cable.
Connect the encoder directly to the inverter using a cable with no intermediate devices, such as terminals or return connectors.
Use a model of encoder suitable for your application (as for connection length and max. rev number).
Preferably use encoder models with complementary LINE-DRIVER or PUSH-PULL outputs. Non-complementary PUSH-PULL, PNP or NPN open-collector outputs offer a lower immunity to noise.
The encoder electrical noise occurs as difficult speed adjustment or uneven operation of the inverter; in the worst cases, it can lead to the inverter stop due to overcurrent conditions.

13.7. ES822/1 ISOLATED SERIAL BOARD

Isolated serial board RS232/485 controlling SINUS K inverters. It permits to connect a computer via RS232 interface or permits the multidrop connection of modbus devices via RS485 interface. Interface signals are galvanically isolated with respect to the control board ground and the common of the control board terminals.

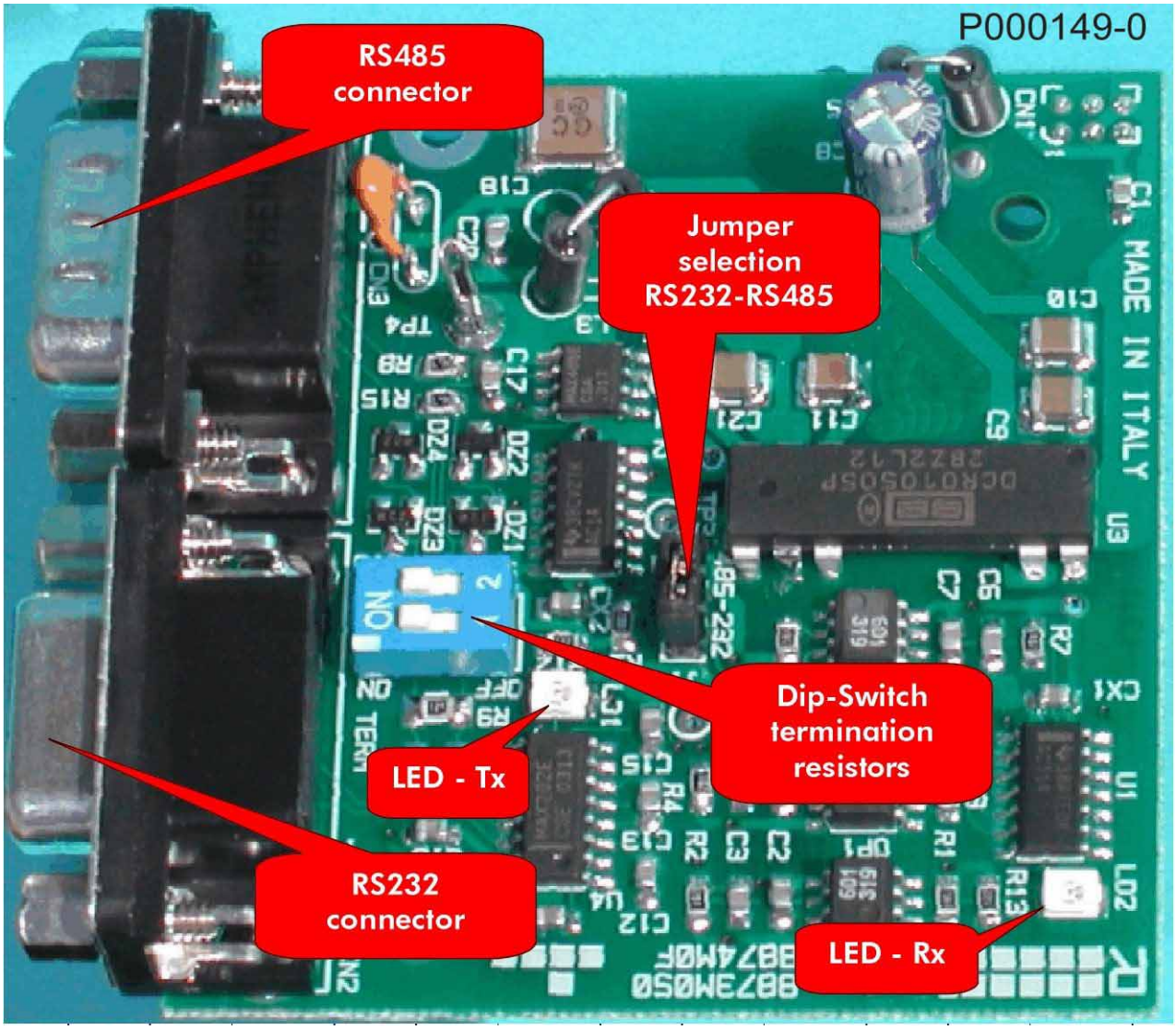


Figure 86: ES822 isolated board.

DESCRIPTION	CODE
Isolated serial board, RS232/485	ZZ0095850

13.7.1. ENVIRONMENTAL REQUIREMENTS

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

13.7.2. ELECTRICAL FEATURES

CONNECTION:
When board ES822 is fitted, RS485 connector automatically disables; 9-pole D connectors (male D connectors for RS485, or female D connectors for RS232-DTE located on board ES822) activate depending on the position of J1.

Contacts of 9-pole, male D connector CN3 (RS485):

PIN	FUNCTION
1 - 3	(TX/RX A) Differential input/output A (bidirectional) according to RS485standard. Positive polarity with respect to pins 2 – 4 for one MARK.
2 - 4	(TX/RX B) Differential input/output B (bidirectional) according to RS485 standard. Negative polarity with respect to pins 1 – 3 for one MARK.
5	(GND) control board zero volt.
6-7-8	Not connected.
9	+5 V, max 100mA for power supply of optional, external RS485/RS232 converter.

Contacts of 9-pole, female D connector CN2 (RS232-DCE):

PIN	FUNCTION
1-9	Not connected
2	(TX A) Output according to RS232 standard
3	(RX A) Input according to RS232 standard
5	(GND) zero volt
4-6	Connected together for DTR-DSR loopback
7-8	Connected together for RTS-CTS loopback

13.7.3. INSTALLING ES822 BOARD

1) Remove voltage from 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 right.

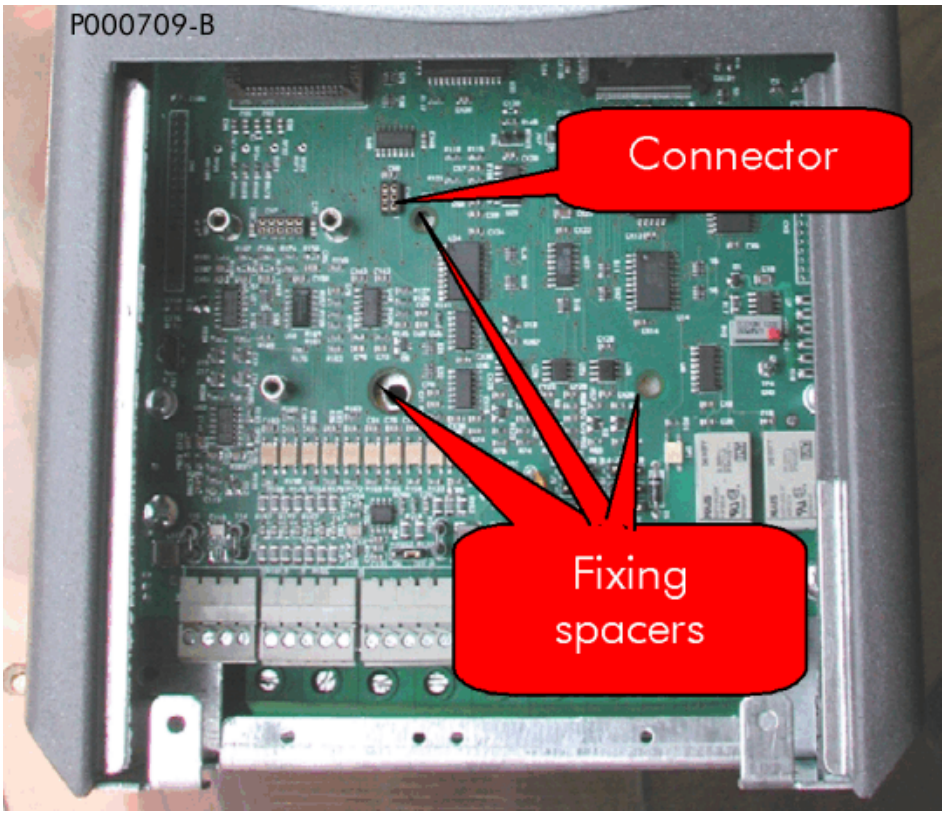


Figure 87: Position of the slot for the installation of the isolated serial board.

3) Fit the 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 the dip-switch and the jumper located on the board choosing the type of connection required.

13.7.4. CONFIGURING ES822 ISOLATED BOARD

13.7.4.1. JUMPER SELECTING RS232/RS485

Jumper J1 configures ES822 as RS485 or RS232 interface. Its positions are silk-screened on ES822 board.
Jumper between pin 1-2: CN3 is enabled (RS485)
Jumper between pin 2-3: CN2 is enabled (RS232)

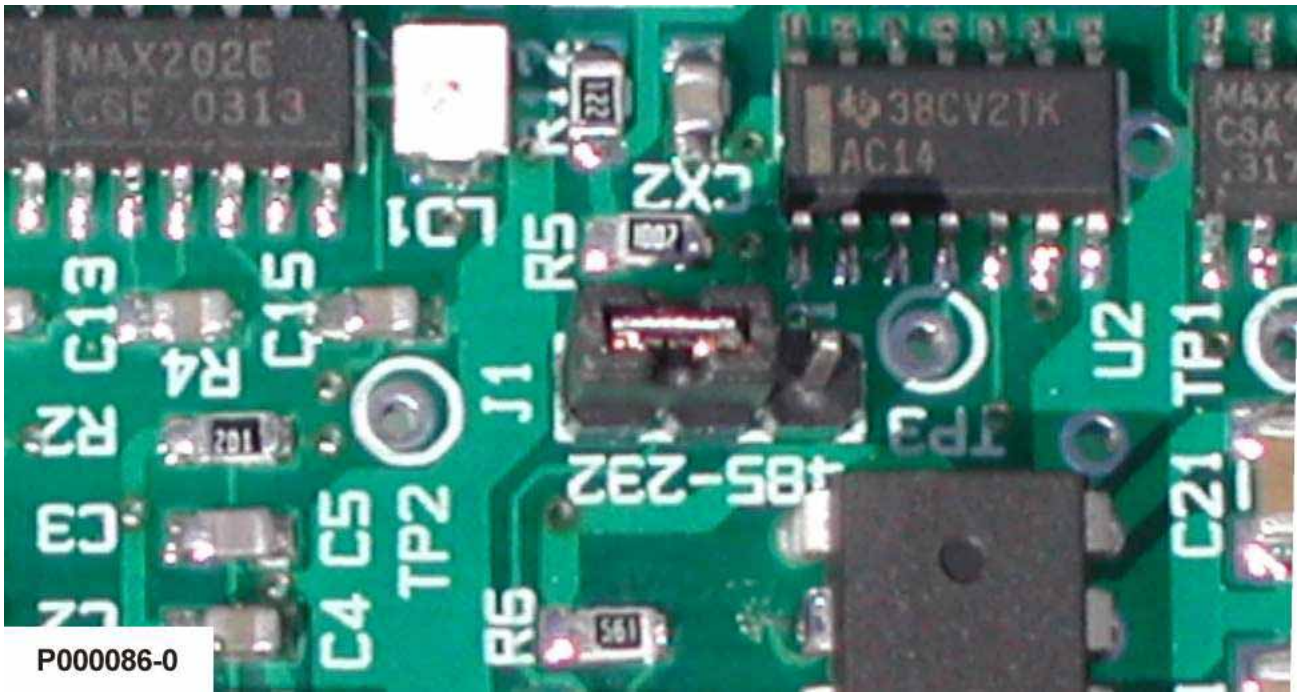


Figure 88: Configuration of the jumpers for RS232/RS485.

13.7.4.2. DIP-SWITCH ENABLING RS485 TERMINATOR

(See the SERIAL COMMUNICATIONS section):
For RS485 serial link in ES822 board, the terminator is selected with SW1 dip-switch as shown in the figure below.
The line terminator of the farthest inverter from the master computer (or the only inverter in case of direct connection to the master computer) shall be enabled: SW1 dip switch, selector switches 1 and 2 in position ON (default setting).
The line terminator of the other inverters in intermediate positions shall be disabled: dip switch SW1, selector switches 1 and 2 in position OFF (default setting).
RS232-DTE Serial link does not require any particular setup of d SW1 dip switch.

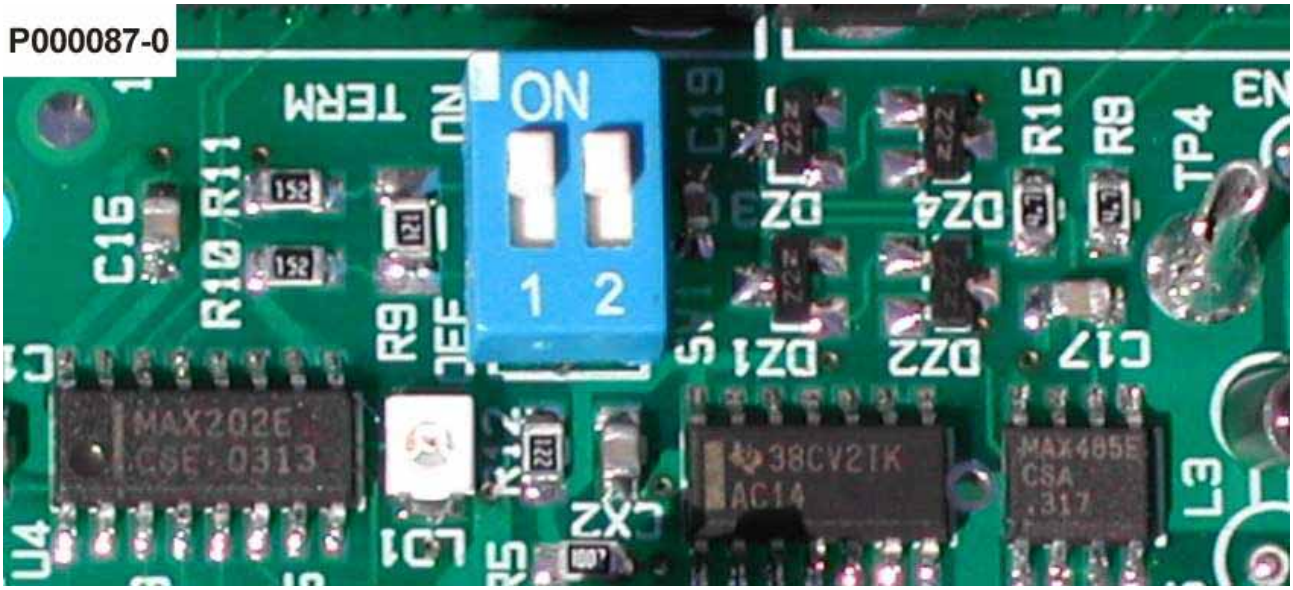


Figure 89: Configuring the dip-switch for RS485 terminator.

13.8. "LOC-0-REM" Key Selector Switch and Emergency Push-button for IP54 Models

Inverter with rating IP54 can be provided with a key selector switch and an emergency push-button (optional devices supplied by request).
Key-selector switch selects the following operating modes:

POSITION	OPERATING MODE	DESCRIPTION
LOC	INVERTER IN LOCAL MODE	The inverter operates in "Local" mode. The Start command and the frequency/speed reference are sent via keypad. Press the Start button to start the inverter: the Enable command (terminal 6) is sent from the selector switch if terminals 1 and 2 are connected together (factory-setting).
0	INVERTER DISABLED	Inverter disabled
REM	INVERTER IN REMOTE MODE	The control mode is defined by programming in parameters C21/22 (IFD SW) or C14/C16 (VTC SW). The Enable command (terminal 6) is sent from the selector switch if terminals 1 and 2 are connected together (factory-setting).

When pressed, the emergency push-button immediately stops the inverter.
An auxiliary terminal board with voltage-free contacts is provided for the selector switch status, the emergency push-button status and the Enable command.

TERMINALS	FEATURES	FUNCTION	DESCRIPTION
1	Optoisolated digital input	ENABLE	Connect terminal 1 to terminal 2 to enable the inverter (terminals 1 and 2 are connected together—factory-setting)
2	0V digital inputs	CMD	Digital input ground
3-4	Voltage-free contacts (220V-3A, 24V 2,5A)	STATUS OF LOC-0-REM SELECTOR SWITCH	Contacts closed: selector switch in position LOC; contacts open: selector switch in position 0 or REM
5-6	Voltage-free contacts (220V-3A, 24V 2,5A)	STATUS OF LOC-0-REM SELECTOR SWITCH	Contacts closed: selector switch in position REM; contacts open: selector switch in position 0 or LOC
7-8	Voltage-free contacts (220V-3A, 24V 2,5A)	STATUS OF EMERGENCY PUSH-BUTTON	Contacts closed: emergency push-button not depressed Contacts open: emergency push-button depressed

NOTE

When the key selector switch and the emergency push-button are installed, multifunction digital input MDI4 (terminal 12) cannot be used.
The ground of multifunction digital inputs is available also on terminal 2 in the auxiliary terminal board.
When the key selector switch and the emergency push-button are installed, digital inputs cannot be used with a "PNP" command. If "PNP" command must be used, please contact Elettronica Santerno Spa.

13.8.1. WIRING INVERTERS WITH "LOC-0-REM" KEY SELECTOR SWITCH AND EMERGENCY PUSH-BUTTON

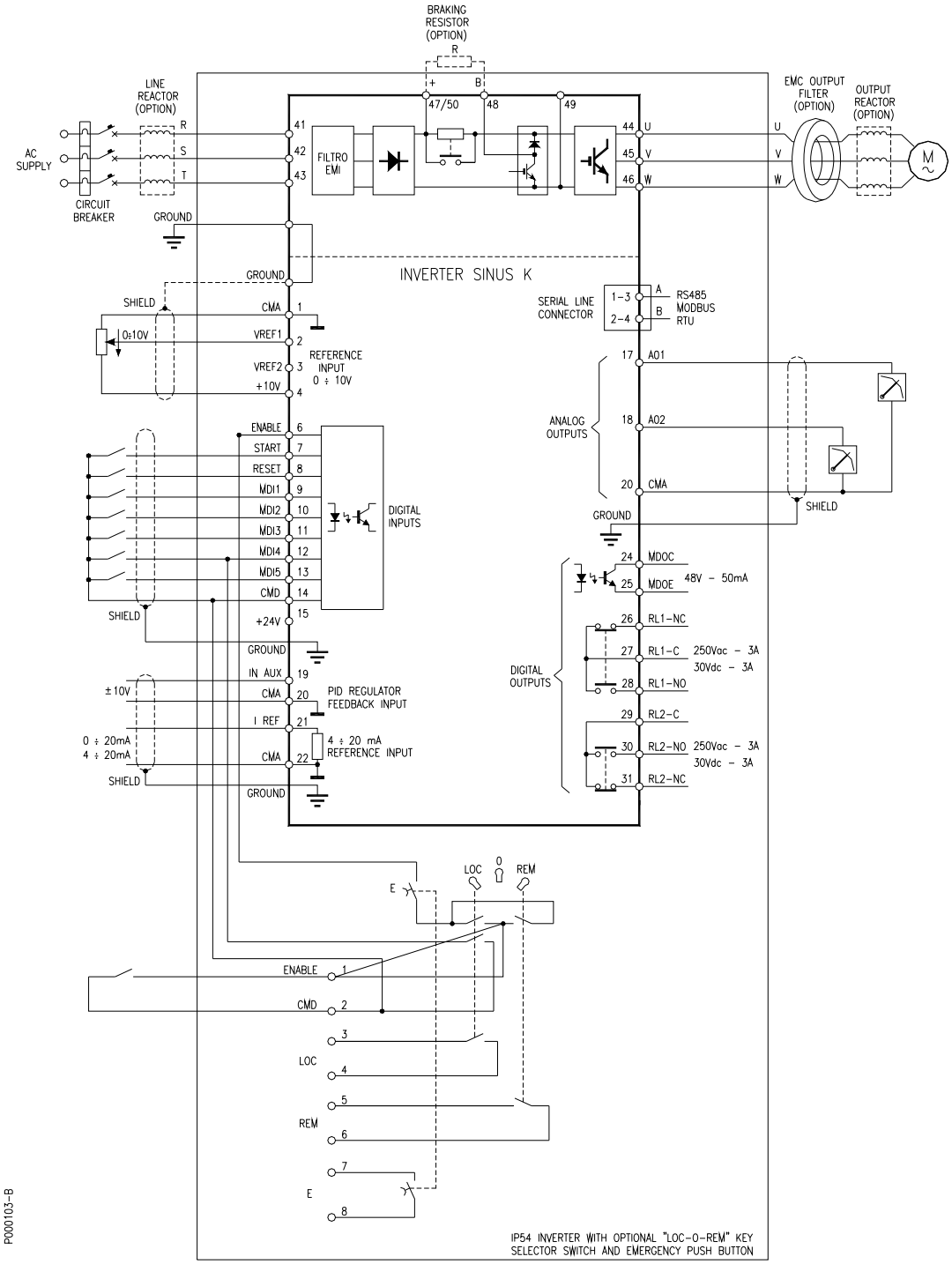


Figure 90: Wiring inverters with optional "LOC-0-REM" key selector switch and emergency push-button.

14. 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, captors, and so on, that are usually installed one next to the other, thus causing disturbance:
- Low frequency – harmonics.
- High frequency – electromagnetic interference (EMI)

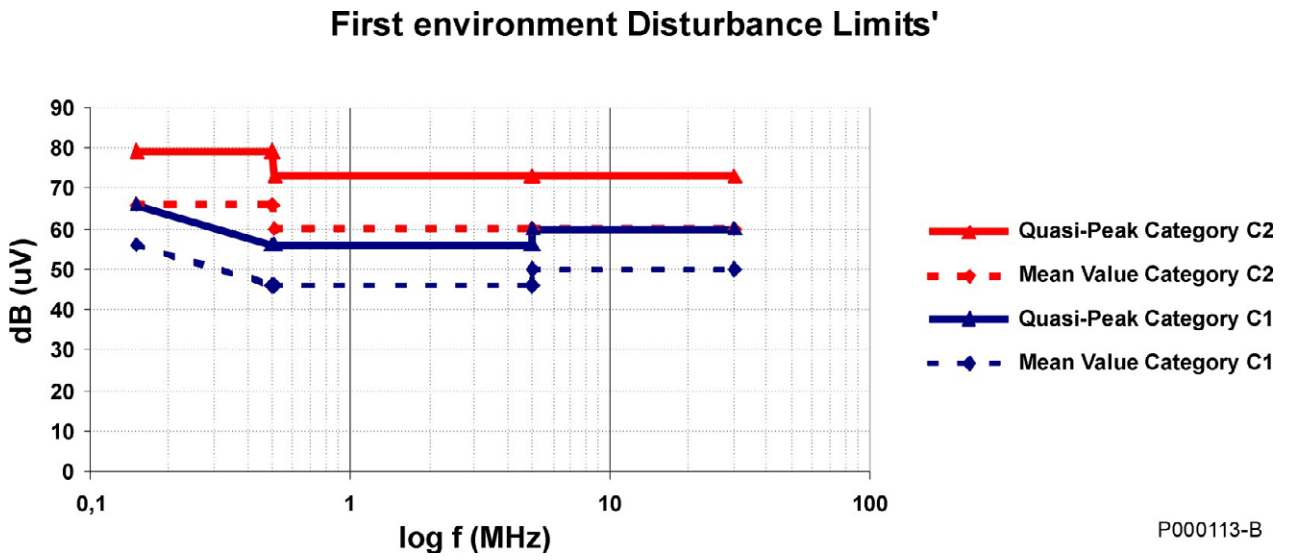
High frequency interference
High frequency interference is disturbance or radiated interference with >9kHz frequency. Critical values range from 150kHz to 1000MHz.
Interference is often caused by commutations to be found in any device, i.e. switched mode power supply and drive output modules. High frequency 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.

The table below defines PDS (Power Drive Systems) of EN 61800-3:2002 (which will become EN61800-3 issue 2).

FIRST ENVIRONMENT	Environment including domestic devices and industrial devices which are connected directly to a low-voltage mains (with no intermediate transformer) for domestic usage.
SECOND ENVIRONMENT	Environment including industrial connections different from “First Environment” connections.
PDS of Category C1	PDS with rated voltage lower than 1000 V to be used in the First Environment.
PDS of Category C2	PDS with rated voltage lower than 1000 V; if used in the First Environment, they are intended to be installed and commissioned by professional users only.
PDS of Category C3	PDS with rated voltage lower than 1000 V to be used in the Second Environment.
PDS of Category C4	PDS with rated voltage equal to or higher than 1000 V or with a current equal to or higher than 400A to be used in complex systems installed in the Second Environment.

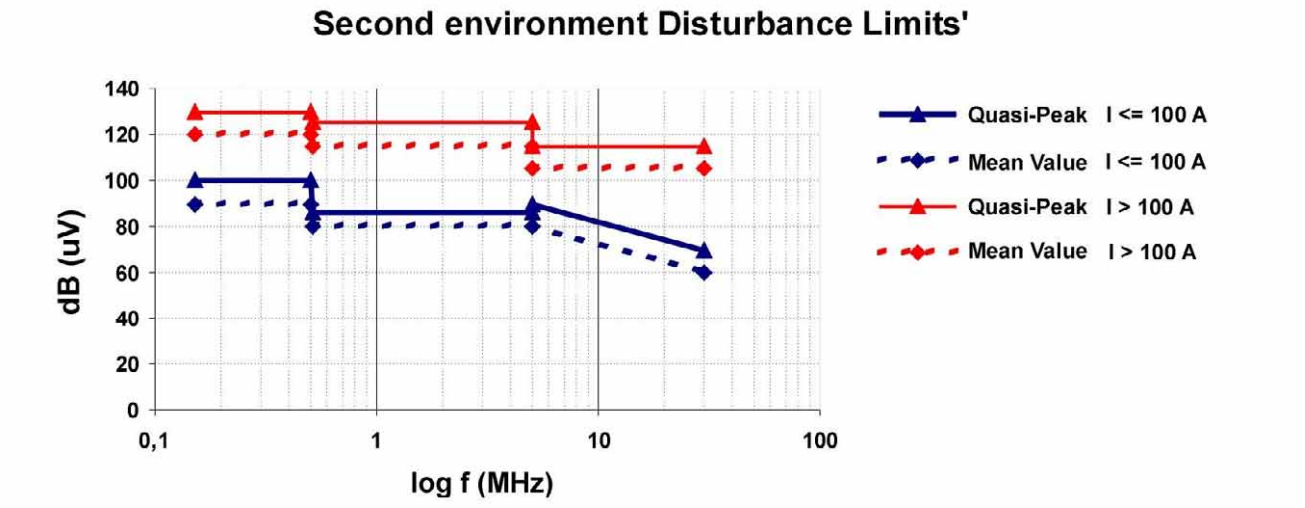
Emission Limits

The standards in force also define the allowable emission level for different environments.
The diagrams below show emission limits allowed by Pr CEI EN 61800-3 issue 2 (corresponding to EN61800-3/A11).



A1 = EN 61800-3 issue 2 FIRST ENVIROMENT, Category C2, EN55011 gr.1 cl. A, EN50081-2, EN61800-3/A11.

B = EN 61800-3 issue 2 FIRST ENVIROMENT, Category C1, EN55011 gr.1 cl. B, EN50081-1,-2, EN61800-3/A11.



A2 = EN 61800 - 3 issue 2 SECOND ENVIRONMENT Category C3, EN55011 gr.2 cl. A, EN61800 - 3/A11.

P000114-B

The inverters manufactured by ELETTRONICA SANTERNO allow choosing among four levels:
I no suppression of the emissions for users who use power drive systems in a non-vulnerable environment and who directly provide for the suppression of the emissions;
A1 emission suppression for PDS installed in the FIRST ENVIRONMENT, Category C2;
A2 emission suppression for PDS installed in the SECOND ENVIRONMENT, Category C3;
B emission suppression for PDS installed in the FIRST ENVIRONMENT, Category C1.
ELETTRONICA SANTERNO is the only manufacturer offering power drive systems with built-in A2-level filters up to 1200kW. All those classes are provided with the Declaration of European Conformity.
Additional external RFI filters may be installed to bring emissions of devices of level **I** or **A1** to level **B**.

As for lifts, 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.

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 standards EN61800-3:1996/A11:2000 and Pr EN61800-3:2002, 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 (reproduced on the last pages of this manual).

CAUTION	As for products with ID "I" in column 7 in the nameplate (see section 1.2): These devices are not provided with RFI filters. They can produce radio interference in domestic environments; additional measures should be taken to suppress radio interference
CAUTION	As for products with ID "A1" in column 7 in the nameplate (see section 1.2): These are category C2 devices according to EN61800-3. They can produce radio interference in domestic environments; additional measures should be taken to suppress radio interference
CAUTION	As for products with ID "A2" in column 7 in the nameplate (see section 1.2): These are category C3 devices according to EN61800-3. They can produce radio interference in domestic environments; additional measures should be taken to suppress radio interference.

Low Voltage Directive (73/23/CEE and following amendment 93/68/CEE)	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	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 (1997-10)	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 and to MACHINES DIRECTIVE, 89/392/CEE, 91368/CEE-93/44/CEE (reproduced on the last pages of this manual).

14.1. 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 (line cables, motor cables, signal cables).

The figure shows how disturbance takes place:

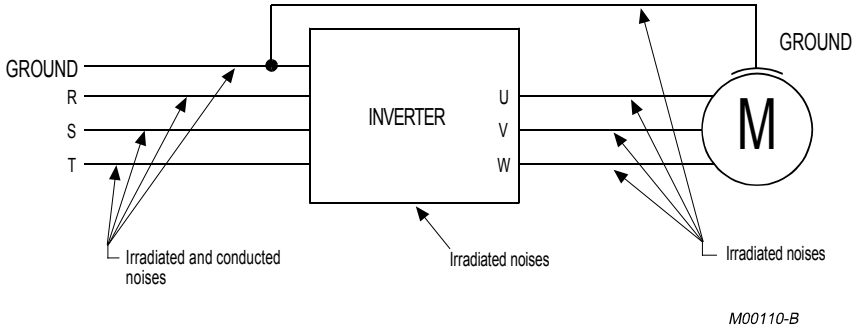


Figure 91: Disturbance sources in a power drive system equipped with an inverter.

The measures to be taken to suppress disturbance include: grounding enhancement; changes made to the cabinet structure; installation of mains filters on the line and installation of output toroid filters on the motor cables; optimization of the wiring and cable screening.
Always restrict as much as possible the area exposed to disturbance, so as to limit interferences with the other components 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.

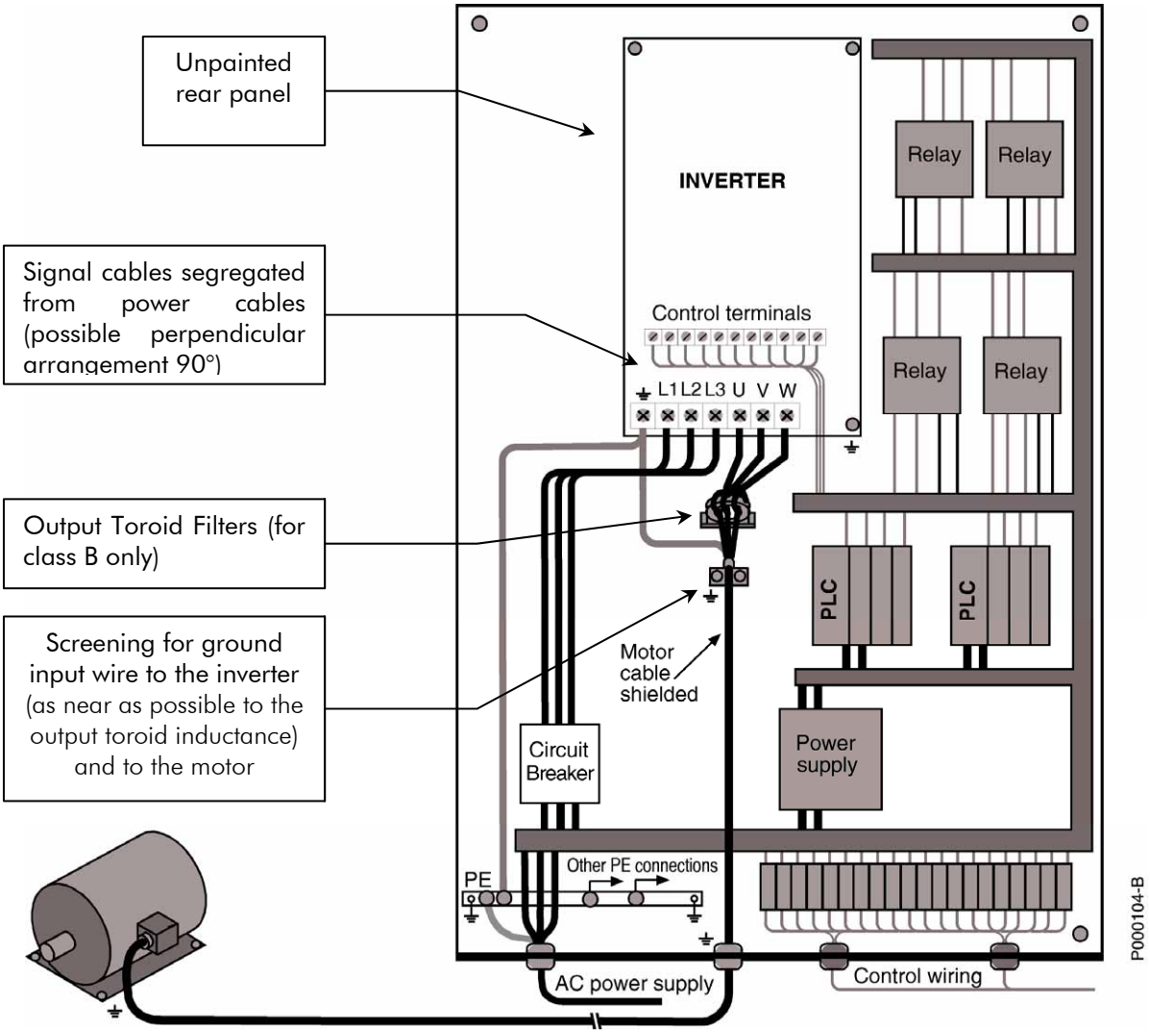
14.1.1. MAINS

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. Incorporated filters installed in the inverters are shown in section Input and Output Filters.



14.1.2. 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).

14.1.3. 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 low perturbation	- digital inputs and outputs: optoisolated commands, relay outputs - filtered AC supply - power circuits in general
high perturbation	- 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 helps running both signal sensitive cables and power cables in the same raceway. When using screened cables, 360° screening is obtained with collars directly bolted to the ground support.

14.1.4. 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 NORMATIVE REFERENCES).
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.

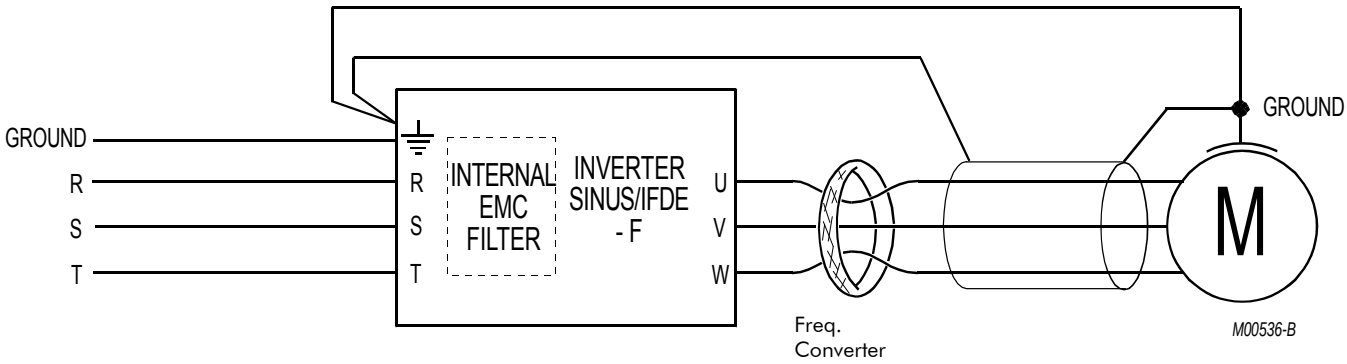


Figure 92: Toroid filter connection for Sinus K.

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 Mains).

NOTE

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

15. DECLARATIONS OF CONFORMITY

ELETTRONICA
SANTERNO

TÜV SÜD ISO 9001

EC DECLARATION OF CONFORMITY

Elettronica Santerno S.p.A.

Via G. Di Vittorio, 3 - 40020 Casalfiumanese (BO) - Italia

AS MANUFACTURER

DECLARE

UNDER OUR SOLE RESPONSABILITY

THAT THE DIGITAL THREE-PHASE AC INVERTER FROM

SINUS K LINE,

AND RELATED ACCESSORIES,

TO WHICH THIS DECLARATION RELATES,

APPLIED UNDER CONDITIONS SUPPLIED IN THE USER'S MANUAL,

ARE IN CONFORMITY TO WITH THE FOLLOWING STANDARDS:

CEI EN 61800-3 2ª ed. **(2005 - 04)**	Adjustable speed electrical power drive systems. Part 3: EMC requirements and specific test methods.

FOLLOWING THE PROVISIONS OF ELECTROMAGNETIC COMPATIBILITY
DIRECTIVE 2004/108/CE

PLACE AND DATE
Casalfiumanese, 03/04/2007

General Manager
BOMBARDA ING. GIORGIO

GRUPPO CARRARO

Elettronica Santerno Spa
Società soggetta all'attività di direzione e coordinamento di Carraro Spa

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R.E.A. PD 328951
Cod. Mecc. PD 054138
Cod. Ident. IVA Intracom.
IT03686440284

ELETTRONICA
SANTERNO

TÜV SÜD ISO 9001

MANUFACTURER'S DECLARATION

Elettronica Santerno S.p.A.

Via G. Di Vittorio, 3 - 40020 Casalfiumanese (BO) - Italia

AS MANUFACTURER

DECLARE

UNDER OUR SOLE RESPONSABILITY

THAT THE DIGITAL THREE-PHASE AC INVERTER FROM

SINUS K LINE,

TO WHICH THIS DECLARATION RELATES,

APPLIED UNDER CONDITIONS SUPPLIED IN THE USER'S MANUAL,

ARE IN CONFORMITY TO WITH THE FOLLOWING STANDARDS:

EN 60204-1 (1997)	Safety of machinery - Electrical equipment of machines – Part 1: General requirements
EN 60204-1 Amendment 1 (1988)	Electrical equipment of industrial machines. Part 2: Item designation and examples of drawings, diagrams, tables and instructions.

AND MUST NOT BE PUT INTO SERVICE UNTIL THE MACHINERY INTO WHICH IT IS TO BE 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 AND THEIR RIFUSION AS 2006/42/CE

PLACE AND DATE
Casalfiumanese, 03/04/2007

General Manager
BOMBARDA ING. GIORGIO

GRUPPO CARRARO

Elettronica Santerno Spa
Società soggetta all'attività di direzione e coordinamento di Carraro Spa

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R.E.A. PD 328951
Cod. Mecc. PD 054138
Cod. Ident. IVA Intracom.
IT03686440284

ELETTRONICA
SANTERNO

TÜV SÜD ISO 9001

EC DECLARATION OF CONFORMITY

Elettronica Santerno S.p.A.

Via G. Di Vittorio, 3 - 40020 Casalfiumanese (BO) - Italia

AS MANUFACTURER

DECLARE

UNDER OUR SOLE RESPONSABILITY

THAT THE DIGITAL THREE-PHASE AC INVERTER FROM **SINUS K** LINE,

AND RELATED ACCESSORIES, TO WHICH THIS DECLARATION RELATES,

APPLIED UNDER CONDITIONS SUPPLIED IN THE USER'S MANUAL,

ARE IN CONFORMITY TO WITH THE FOLLOWING STANDARDS:

CEI EN 61800-5-1: (2005)	Adjustable speed electrical power drive systems. Part 5-1: Safety requirements – Electrical, thermal and energy.
prEN 61800-5-2: (2006)	Adjustable speed electrical power drive systems. Part 5-2: Safety requirements – Functional.
EN 60146-1-1 (1995) + A1 (1998)	Semiconductor converters. General requirements and line commutated converters. Part 1-1: Specifications of basic requirements.
EN 60146-2 (2001)	Semiconductor converters. Part 2: Self-commutated semiconductor converters including direct d.c. converters.
CEI EN 61800-2 (1999)	Adjustable speed electrical power drive systems. Part 2: General requirements – Rating specifications for low voltage adjustable frequency a.c. power drive systems.
EN 60204-1 (2005 -10)	Safety of machinery – Electrical equipment of machines Part 1:General requirements
EN 60529 (1992) /EC(1993) / A1(2000)	Degrees of protection provided by enclosures (IP Code).
IEC 62103 (2003)	Electronic equipment for use in power installations
EN 50178 (1999)	Electronic equipment for use in power installations

FOLLOWING THE PROVISIONS OF LOW VOLTAGE DIRECTIVE 2006/95/CE

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

PLACE AND DATE
Casalfiumanese, 04/04/2007

General Manager
BOMBARDA ING. GIORGIO

GRUPPO CARRARO

Elettronica Santerno Spa
Società soggetta all'attività di direzione e coordinamento di Carraro Spa

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Cod. Ident. IVA Intracom.
IT03686440284

ELETTRONICA
SANTERNO

TÜV SÜD ISO 9001

EC DECLARATION OF CONFORMITY

Elettronica Santerno S.p.A.

Via G. Di Vittorio, 3 - 40020 Casalfiumanese (BO) - Italia

AS MANUFACTURER

DECLARE

UNDER OUR SOLE RESPONSABILITY

THAT THE DIGITAL THREE-PHASE AC INVERTER FROM THE LINES

SINUS K CABINET and, **SINUS K BOX**,

AND RELATED ACCESSORIES,

TO WHICH THIS DECLARATION RELATES,

APPLIED UNDER CONDITIONS SUPPLIED IN THE USER'S MANUAL,

ARE IN CONFORMITY TO WITH THE FOLLOWING STANDARDS:

CEI EN 61800-3 2ª ed. **(2005 - 04)**	Adjustable speed electrical power drive systems. Part 3: EMC requirements and specific test methods.

FOLLOWING THE PROVISIONS OF ELECTROMAGNETIC COMPATIBILITY DIRECTIVE 2004/108/CE

PLACE AND DATE
Casalfiumanese, 03/04/2007

General Manager
BOMBARDA ING. GIORGIO

GRUPPO CARRARO

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MANUFACTURER'S DECLARATION

Elettronica Santerno S.p.A.

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LINES, TO WHICH THIS DECLARATION RELATES,

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ARE IN CONFORMITY TO WITH THE FOLLOWING STANDARDS:

EN 60204-1 (1997)	Safety of machinery - Electrical equipment of machines – Part 1: General requirements
EN 60204-1 Amendment 1 (1988)	Electrical equipment of industrial machines. Part 2: Item designation and examples of drawings, diagrams, tables and instructions.

AND MUST NOT BE PUT INTO SERVICE UNTIL THE MACHINERY INTO WHICH IT IS TO BE 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 AND THEIR RIFUSION AS 2006/42/CE

PLACE AND DATE
Casalfiumanese, 03/04/2007

General Manager
BOMBARDA ING. GIORGIO

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APPLIED UNDER CONDITIONS SUPPLIED IN THE USER'S MANUAL,

ARE IN CONFORMITY TO WITH THE FOLLOWING STANDARDS:

CEI EN 61800-5-1: (2005)	Adjustable speed electrical power drive systems. Part 5-1: Safety requirements – Electrical, thermal and energy.
prEN 61800-5-2: (2006)	Adjustable speed electrical power drive systems. Part 5-2: Safety requirements – Functional.
EN 60146-1-1 (1995) + A1 (1998)	Semiconductor converters. General requirements and line commutated converters. Part 1-1: Specifications of basic requirements.
EN 60146-2 (2001)	Semiconductor converters. Part 2: Self-commutated semiconductor converters including direct d.c. converters.
CEI EN 61800-2 (1999)	Adjustable speed electrical power drive systems. Part 2: General requirements – Rating specifications for low voltage adjustable frequency a.c. power drive systems.
EN 60204-1 (2005 -10)	Safety of machinery – Electrical equipment of machines Part 1:General requirements
EN 60529 (1992) /EC(1993) / A1(2000)	Degrees of protection provided by enclosures (IP Code).
IEC 62103 (2003)	Electronic equipment for use in power installations
EN 50178 (1999)	Electronic equipment for use in power installations
EN 60439-1 (2000)	Low voltage switchgear and control-gear assemblies Part 1: Requirements for type-tested and partially type-tested assemblies.

FOLLOWING THE PROVISIONS OF LOW VOLTAGE DIRECTIVE 2006/95/CE

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