

• 15V0102B1TECO •

# SINUS PENTA

MULTIFUNCTION AC DRIVE

## BASIC USER MANUAL

Issued on 18/05/2018  
R.09

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

**1 : EVERY START - UP**  
**2 : ONLY NOW**  
**3 : NEXT START - UP**  
**4 : NEVER**

If you select "EVERY START-UP", the wizard appears whenever the Penta drive is powered on;  
 if you select "ONLY NOW", you can scroll through the menu and the wizard is disabled as soon as you quit the menu;  
 if you select "NEXT START-UP", the menu is displayed only when the Penta drive is next started up;  
 if you select "NEVER", the Start-Up menu is disabled.

Parameters included in the Start-Up menu:

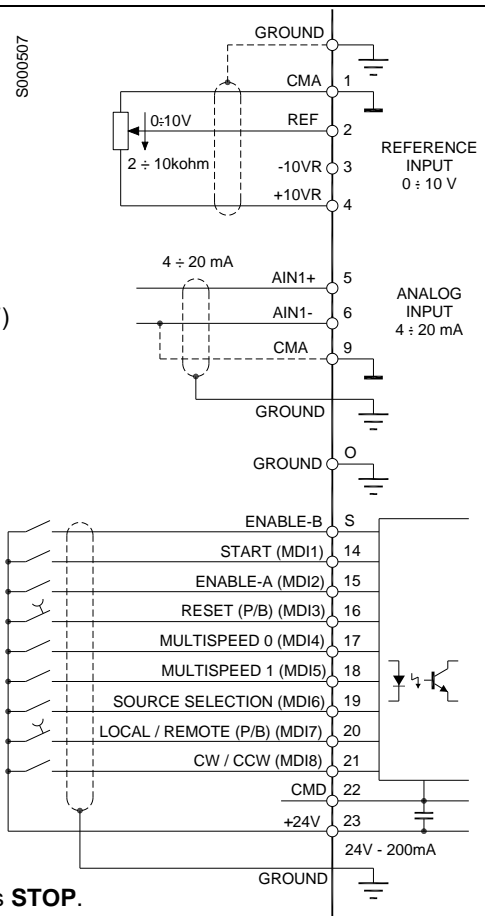
Parameter	Description	Visibility
C008	Rated mains voltage	
C010	Type of control algorithm	
C012	Speed feedback from encoder	[only if FOC is active]
C013	Type of V/f pattern	[only if IFD is active]
C015	Rated motor frequency	
C016	Rated motor rpm	
C017	Rated motor power	
C018	Rated motor current	
C019	Rated motor voltage	
C021	No-load current of the motor	[only if FOC is active]
C028	Min. motor speed	
C029	Max. motor speed	
C034	Voltage preboost	[only if IFD is active]
P009	Acceleration ramp time	
P010	Deceleration ramp time	
C043	Current limit while accelerating	[only if IFD is active]
C044	Current limit at constant rpm	[only if IFD is active]
C045	Current limit while decelerating	[only if IFD is active]
C048	Torque limit	[only if VTC/FOC are active]
C189	Encoder operating mode	[only if FOC is active]
C190	Encoder A pls/rev	[only if FOC is active]
C191	Encoder B pls/rev	[only if FOC is active]
I073	Autotuning selection	[only if VTC/FOC are active]
I074	Motor tuning selection	[only if VTC/FOC are active]
C265	Motor thermal protection	
C267	Motor thermal time constant	[only if protection is active]

After setting the last parameter and moving the cursor forward, the following page will appear:

**P r e s s   U P   A R R O W**  
**t o   q u i t**  
**D O W N   A R R O W**  
**t o   c o n t i n u e**

Press ▲ to quit the Start-up menu. The default page of the system will be displayed.

<p><b>5) Startup:</b></p>	<p><b>Control via terminal board:</b></p> <ul style="list-style-type: none"> <li>i) Activate the <b>ENABLE-A</b> (terminal 15) and <b>ENABLE-B</b> (terminal S) inputs.</li> <li>ii) Activate the <b>START</b> input (terminal 14).</li> <li>iii) Send speed reference to <b>REF</b>: 0-10V input (terminals 1, 2 &amp; 4)</li> <li>iv) The <b>RUN</b> LED and <b>REF</b> LED will come on and the motor will start. Make sure that the motor is rotating in the correct direction. If not, operate on terminal <b>MDI8</b> (terminal 21) (CW/CCW) to change the direction of rotation.</li> </ul> <p><b>Control via keypad:</b></p> <ul style="list-style-type: none"> <li>i) Activate the <b>ENABLE-A</b> (terminal 15) and <b>ENABLE-B</b> (terminal S) inputs.</li> <li>ii) Press the <b>LOC/REM</b> button on the keypad.</li> <li>iii) The L-CMD and L-REF LEDs will be lit.</li> <li>iv) Press the <b>START</b> button.</li> <li>v) Hold down the Up button to increase the speed reference.</li> <li>vi) The <b>RUN</b> LED and <b>REF</b> LED will come on and the motor will start. Make sure that the motor is rotating in the correct direction. If not, press the <b>FWD/REV</b> button to change the direction of rotation.</li> </ul> <p>If not, press the <b>FWD/REV</b> button to change the direction of rotation.</p> <p>In order to define a direction of rotation different from FWD/REV:</p> <ol style="list-style-type: none"> <li>1. Open <b>ENABLE-A</b>, <b>ENABLE-B</b> and <b>START</b>, and press <b>STOP</b>.</li> <li>2. Remove voltage from the inverter and swap two of the motor phases after at least 20 minutes.</li> </ol> <p><b>NOTE:</b> <b>ENABLE-A</b> and <b>ENABLE-B</b> inputs are allocated to the STO function. The control mode and the control circuit of these signals must be accomplished according to the instructions given in the <b>Safe Torque Off Function – Application Manual</b>. That manual also includes a detailed validation procedure for the STO control configuration to be performed upon first start up of the equipment and also every 12 months.</p>
<p><b>6) Possible failures:</b></p>	<p>If no failure occurred, go to the next step. Otherwise, check the drive connections paying particular attention to supply voltages, DC link and input reference.</p> <p>Also check if alarm messages are displayed. In the MEASURES MENU, check values in the Fault List for the reference speed (<b>M000</b>), the supply voltage to the drive (<b>M030</b>), the DC link voltage (<b>M029</b>), and the condition of control terminals (<b>M033</b>). Check to see if these readouts match with the measured values.</p>
<p><b>7) Additional parameter alterations:</b></p>	<p>In <b>BASIC</b> user level, adjustments can be made to a limited number of parameters. The SINUS PENTA has a wide range of functions; to access these function, set the user level to <b>ADVANCED</b> or <b>ENGINEERING</b> by adjusting parameter <b>P001</b> accordingly (refer to the <b>Programming Guide</b>).</p>
<p><b>8) Reset:</b></p>	<p>If an alarm trips, find the cause responsible for the alarm and reset the equipment. Enable the <b>RESET</b> input (terminal 16) or press the <b>RESET</b> key on the keypad.</p>



**NOTE** If the Safe Torque Off function is used, re-validation of the full functionality of the STO whenever the inverter application configuration is changed is required. Please consult the application notes given in the **Safe Torque Off Function – Application Manual**.

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## 1.4. How to Use this Manual

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### 1.4.1. Overview

This User Manual (Basic User Manual) provides information required to setup and monitor the drives of the Sinus Penta series manufactured by Elettronica Santerno when used in the Basic mode.

The section concerning the hardware description and installation covers basic wiring only. Refer to the **Installation Guide** to configure analogue/digital inputs and outputs. Refer to the **Motor Drives Accessories – User Manual** to install additional options. If the STO function is to be used within applications requiring high functional safety level, carefully follow the statements given in the **Safe Torque Off Function – Application Manual**.

The Sinus Penta is delivered in Basic mode, which provides a cut down parameter set and preset I/O settings. If additional adjustment is required, this may be achieved by setting the drive to Advanced or Engineering using parameter **P001** (see the PASSWORD AND USER LEVEL MENU in the **Programming Guide**).

Setup/monitoring may be obtained using one or both of the following options:

- 1) Display/keypad unit;
- 2) Serial link through RS485 standard port or ES822 optional board.

For the instructions on how to use and remote the display/keypad unit, please refer to the **Motor Drives Accessories – User Manual**.



Any information sent to/from the drive through the display/keypad unit may be obtained also via serial link using the RemoteDrive software application provided by Elettronica Santerno.

The 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 calculator, scan function for the automatic detection of the connected drives (up to 247 drives may be connected).

When used in Advanced or Engineering mode, many additional functions are available. These include the following:

- Customisation of Keypad navigation.
- Customisation of standard monitoring values.
- Selection of up to 4 acceleration and deceleration ramps.
- Customisation and scaling of analog input signals.
- Selection of up to 15 preset speeds.
- Configuration of 3 prohibit speeds.
- Utilisation of a speed variation function.
- Tuning of VTC and FOC algorithms.
- Customisation of analog output signals.
- Allocation of internal timer functions to digital I/O.
- PID activation and tuning.
- Configuration of Digital output comparator and logic functions.
- Master/slave operation with torque control.
- Adjustment of current and torque limits.
- Customisation of digital inputs.
- Setting of control source for start and speed commands.
- Configuration of a connected encoder.
- DC braking.
- Dynamic braking.
- Speed Search function.
- Autoreset.
- Motor thermal modelling and thermistor allocation.
- Crane control functions.
- Serial and Fieldbus communication.

If any of the above functions is required, use parameter **P001** to access the Advanced or Engineering settings.

## 2. HARDWARE DESCRIPTION AND INSTALLATION

### 2.1. Caution Statements

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#### 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

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



#### DANGER

1. ALWAYS PROVIDE PROPER GROUNDING OF THE MOTOR CASING AND THE DRIVE FRAME.
2. If a differential relay against electric shocks is intended to be used, this must be a "B-type" differential relay.
3. The inverter (depending on the models) may generate an output frequency up to 1000 Hz (on demand); this may cause a motor rotation speed up to 20 (twenty) times the rated motor speed (for 50 Hz motors): never use the motor at a higher speed than the max. allowable speed stated on the motor nameplate.
4. ELECTRICAL SHOCK HAZARD – Never touch the drive electrical parts when the drive is on; always wait at least 20 minutes after switching off the drive before operating on the drive.
5. Never perform any operation on the motor when the drive is on.
6. Do not perform electrical connections on the motor or the drive if the drive is on. Electrical shock hazard exists on output terminals (U, V, W) and resistive braking module terminals (+, -, B) even when the drive is disabled. Wait at least 20 minutes after switching off the drive before operating on the electrical connection of the motor or the drive.
7. MECHANICAL MOTION – The drive determines mechanical motion. It is the operator's responsibility to ensure that this does not give rise to any dangerous situation. The STO function may be used to avoid mechanical motion under certain operating conditions. It is the operator's responsibility to assess the machinery safety level and properly apply this function without exposing operators to mechanical hazard.
8. EXPLOSION AND FIRE – Explosion and fire hazard exists if the equipment is installed in presence of flammable fumes. Do not install the drive in places exposed to explosion and fire hazard, even if the motor is installed there.





**CAUTION**

1. Do not connect supply voltages exceeding the equipment rated voltage to avoid damaging the internal circuits.
2. If the drive is installed in environments exposed to flammable and/or explosive substances (AD zones according to IEC 64-2 standards), please refer to IEC 64-2, EN 60079-10 and related standards.
3. Do not connect the equipment power supply to the output terminals (U, V, W), to the resistive braking module terminals (+, -, B) or to the control terminals. The equipment power supply must be connected to input terminals only (R, S, T).
4. Do not short-circuit terminals (+) and (-) and terminals (+) and (B); do not connect any braking resistors with lower ratings than the required ratings given in the **Motor Drives Accessories – User Manual**.
5. Do not start or stop the connected motor using a contactor over the inverter power supply.
6. Do not install any contactor between the inverter and the motor. Do not connect any power factor correction capacitor to the motor.
7. Operate the inverter only if a proper grounding is provided.
8. If an alarm trips, a comprehensive review of the ALARMS AND WARNINGS section is recommended; restart the equipment only after removing the cause responsible for the alarm trip.
9. Do not perform any insulation test between the power terminals or the control terminals.
10. Make sure that the fastening screws of the control terminal board and the power terminal board are properly tightened.
11. Do not connect single-phase motors.
12. Always use a motor thermal protection (use the inverter motor thermal model or a thermoswitch installed in the motor).
13. Respect the environmental requirements for the equipment installation.
14. The bearing surface of the drive must be capable of withstanding high temperatures (up to 90°C).
15. The drive electronic boards contain components which may be affected by electrostatic discharges. Do not touch them unless it is strictly necessary. Always be very careful such as to prevent any damage caused by electrostatic discharges.

	<p><b>ATTENTION</b> Static Sensitive Devices. Handle Only at Static Safe Work Stations.</p>	<p><b>ATTENTION</b> Circuits sensibles à l'électricité statique. Manipulation uniquement autorisée sur un poste de travail protégé.</p>	<p><b>ACHTUNG</b> Elektrostatisch gefährdete Bauelemente. Handhabung daher nur an geschützten Arbeitsplätzen erlaubt.</p>
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16. Before programming and starting the inverter, make sure that the connected motor and all the controlled devices can be used for the whole speed range allowed by the converter. The inverter may be programmed to control the motor at higher or lower rpm in respect to the speed obtained by connecting the motor directly to the power supply line.
17. To exploit the Safe Torque Off (STO) function, it is necessary to ensure the correct application and integration of the Penta drive into the safety chain of the system. Carefully follow the instructions given in the **Safe Torque Off Function – Application Manual**.

**ADDITIONAL SAFETY STATEMENTS CONCERNING SINUS PENTA DRIVES USED WITH PERMANENT MAGNET MOTORS:**

Do not operate on the converter when the permanent magnet motor is rotating. Even if the power supply is cut out and the inverter is stopped, the permanent magnet motor, when rotating, powers the DC-link of the converter, and voltage is applied to the power supply links.

Do the following prior to install and service the inverter:

1. Stop the motor.
2. Make sure that the motor cannot rotate when operating on the equipment.
3. Make sure that no voltage is applied to the power terminals in the converter.

**DANGER**

Do not exceed the motor rated rpm. Exceeding the motor rpm may cause overvoltage leading to damage or explosion of the converter DC-Link.

The permanent magnet motor control is made possible only by using the application firmware "PS" of the Sinus Penta for permanent magnet synchronous motors.

## 2.2. Avertissements importants de sécurité à l'attention des clients canadiens

### LÉGENDE :



**DANGER**

Ce symbole indique des procédures qui pourraient entraîner un risque de blessures graves ou de mort par électrocution si elles ne sont pas exécutées de la façon correcte.



**ATTENTION**

Ce symbole indique des procédures qui pourraient entraîner de graves dommages aux appareillages si elles ne sont pas exécutées de la façon correcte.



**REMARQUE**

Ce symbole indique des informations importantes concernant l'emploi de l'équipement.

### RECOMMANDATIONS RELATIVES A LA SECURITE A RESPECTER PENDANT L'INSTALLATION ET L'EMPLOI DE L'APPAREILLAGE :



**REMARQUE**

1. Toujours lire ce manuel d'instructions en entier avant de toute mise en service de l'équipement.
2. La connexion à la terre du châssis du moteur doit suivre un routage séparé, afin d'éviter d'éventuelles perturbations.



**DANGER**

1. TOUJOURS EXÉCUTER LA MISE À LA TERRE DU MOTEUR ET DU VARIATEUR.
2. Si on utilise un relais différentiel pour la protection contre les chocs électriques, ceci doit être de type B.
3. Le variateur (selon le modèle) peut générer une fréquence de sortie jusqu'à 1000 Hz (sur demande) ; cela peut provoquer une vitesse de rotation du moteur jusqu'à 20 (vingt) fois la valeur nominale (pour un moteur à 50 Hz) ; ne jamais utiliser le moteur en excédant la vitesse maximale indiquée par le fabricant.
4. RISQUE DE CHOC ÉLECTRIQUE – Ne pas toucher les composants électriques du variateur lorsque ceci est sous tension ; toujours attendre au moins 20 minutes après avoir coupé l'alimentation avant d'effectuer des travaux sur les composants électriques, car le variateur accumule de l'énergie électrique à l'intérieur.
5. Ne pas effectuer des opérations sur le moteur lorsque le variateur est sous tension.
6. Ne pas effectuer des branchements électriques sur le variateur ou sur le moteur lorsque le variateur est sous tension. Même lorsque le variateur est désactivé, il existe un risque de choc électrique sur les bornes de sortie (U, V, W) et sur les bornes pour la connexion des dispositifs de freinage résistif (+, -, B). Après avoir coupé l'alimentation au variateur, attendre au moins 20 minutes avant d'opérer sur les branchements électriques du variateur et du moteur.
7. MOUVEMENT MÉCANIQUE – Le variateur cause un mouvement mécanique. Il est de la responsabilité de l'utilisateur de faire en sorte que cela ne cause pas de conditions dangereuses. La fonction de sécurité STO du variateur peut être utilisée pour empêcher le mouvement mécanique dans certaines conditions de fonctionnement. Il est de la responsabilité de l'utilisateur d'évaluer le niveau de sécurité et d'appliquer correctement cette fonction sans exposer les opérateurs à des risques mécaniques.
8. EXPLOSION ET INCENDIE – Des risques d'explosion et d'incendie peuvent exister si l'équipement est installé dans des endroits où des vapeurs inflammables sont présents. Toujours installer l'équipement à l'extérieur des zones à risque d'explosion et d'incendie, même si le moteur y est installé.

**ATTENTION**

1. Ne pas connecter des tensions d'alimentation supérieures à la valeur nominale. Au cas où une tension supérieure à la tension nominale serait appliquée, les circuits internes pourraient être endommagés.
2. En cas d'application dans des environnements avec la présence potentielle de substances combustibles et/ou explosives (zones AD selon la norme CEI 64-2), se référer aux normes CEI 64-2, EN 60079-10 et aux normes connexes.
3. Ne pas brancher l'alimentation aux bornes de sortie (U, V, W), aux bornes pour le branchement de dispositifs de freinage résistif (+, -, B) et aux bornes de commande. Ne brancher l'alimentation qu'aux bornes d'entrée (R, S, T).
4. Ne pas court-circuiter les bornes (+) et (-), et (+) et (B) ; ne pas connecter des résistances de freinage ayant des valeurs inférieures à celles spécifiées dans **Motor Drives Accessories – User Manual**.
5. Ne pas démarrer et arrêter le moteur en utilisant un contacteur installé sur le variateur.
6. Si un contacteur est installé entre le variateur et le moteur, ne le commuter qu'après avoir désactivé le variateur. Ne pas connecter des condensateurs de correction de facteur de puissance sur le moteur.
7. Ne pas utiliser le variateur sans connexion de mise à la terre.
8. En cas d'alarme, se référer au chapitre ALARMS AND WARNINGS et ne redémarrer l'équipement qu'après avoir identifié et éliminé le problème.
9. Ne pas effectuer des essais d'isolement entre les bornes de puissance ou les bornes de commande.
10. S'assurer que les vis des boîtes à bornes de commande et de puissance sont bien serrées.
11. Ne pas brancher à des moteurs monophasés.
12. Toujours utiliser une protection thermique du moteur (en utilisant la protection interne au variateur, ou bien un thermocontact installé dans le moteur).
13. Respecter les conditions d'installation environnementales.
14. La surface sur laquelle le variateur est installé doit être capable de résister à des températures allant jusqu'à 90°C.
15. Les cartes de circuits imprimés contiennent des composants sensibles aux charges électrostatiques. Éviter de les toucher, sauf si absolument nécessaire. Dans ce cas, prendre des précautions pour la prévention des dommages causés par les décharges électrostatiques.

	<p><b>ATTENTION</b> Static Sensitive Devices. Handle Only at Static Safe Work Stations.</p>	<p><b>ATTENTION</b> Circuits sensibles à l'électricité statique. Manipulation uniquement autorisée sur un poste de travail protégé.</p>	<p><b>ACHTUNG</b> Elektrostatisch gefährdete Bauelemente. Handhabung daher nur an geschützten Arbeitsplätzen erlaubt.</p>
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16. Avant de programmer le variateur et de le mettre en service s'assurer que le moteur et tous les équipements contrôlés sont adaptés pour une utilisation dans toute la plage de vitesse admise par le variateur. Le variateur peut être programmé pour faire fonctionner le moteur à des vitesses supérieures ou inférieures à la vitesse obtenue en connectant le moteur directement au réseau électrique.
17. Si on souhaite exploiter la fonction Safe Torque Off (STO) il faut vérifier l'utilisation correcte et l'intégration correcte du variateur dans la chaîne de sécurité de l'application. Pour cela, toutes les notes d'application dans le manuel **Safe Torque Off Function – Application Manual** doivent être observées rigoureusement.

### AUTRES RECOMMANDATIONS RELATIVES AUX VARIATEURS SINUS PENTA UTILISES AVEC DES MOTEURS A AIMANTS PERMANENTS :



#### **DANGER**

Ne pas effectuer des interventions sur le convertisseur lorsque le moteur à aimants permanents est en rotation. Même si l'alimentation est coupée et le variateur est à l'arrêt, le moteur à aimants permanents en rotation alimente le circuit intermédiaire du convertisseur et, par conséquent, les connexions d'alimentation sont sous tension.

Avant d'installer et d'effectuer toute intervention sur l'équipement :

1. Arrêter le moteur.
2. S'assurer que le moteur ne peut pas tourner pendant l'opération.
3. S'assurer qu'il n'y a pas de tension sur les bornes de puissance du convertisseur.

Ne pas dépasser la vitesse nominale du moteur. Une vitesse excessive du moteur peut provoquer des surtensions, en causant des dommages ou l'explosion des condensateurs dans le circuit intermédiaire du convertisseur.

Le contrôle d'un moteur à aimants permanents n'est autorisé que si on utilise le micrologiciel d'application PS de Sinus Penta pour les moteurs synchrones à aimants permanents.

### 2.3. Delivery Check

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 drive front part. The drive 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 the Installing the Equipment section. The equipment guarantee covers any manufacturing defect. The manufacturer has no responsibility for possible damages occurred when shipping or unpacking the drive. 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 drive operation at values exceeding the drive 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.

Product ID:

SINUS	PENTA	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	PENTA control
3	Inverter Model
4	Supply voltage 2 = Power supply 200÷240VAC; 280÷340VDC 4 = Power supply 380÷500VAC; 530÷705VDC 5 = Power supply 500÷600VAC; 705÷845VDC 6 = Power supply 575÷690VAC; 845÷970VDC
5	Type of power supply T = three-phase C = direct current
6	Braking module X = no internal braking chopper B = built-in braking chopper
7	Type of EMC filter: B = no filter provided; A1 = integrated filter, EN 61800-3 issue 2 FIRST ENVIRONMENT Category C2, EN55011 gr.1 cl. A for industrial and domestic users. A2 = integrated filter, EN 61800-3 issue 2 SECOND ENVIRONMENT Category C3 for <400A current values, category C4 for ≥400A current values, EN55011 gr.2 cl. A for industrial users. I = no filter
8	Control panel X = w/out control panel (display/keypad) K = w/ control panel and back-lit, 16x4 character LCD display provided.
9	Degree of protection for stand-alone drives: 0 = IP00 (Sizes greater than S32) 2 = IP20 (up to Size S32) 5 = IP54 (possible up to Size S32)

### 2.3.1. Nameplate

Typical nameplate for 4T SINUS PENTA Drives:

<b>ZZ0124022 34003 SINUS PENTA 0016 4T BA2K2 S12</b>		
<b>Max. Applicable Motor Power</b> : up to 11 kW / 15 HP (400 V) up to 15 kW / 20 HP (500 V)		
	<b>INPUT</b>	<b>OUTPUT</b>
Voltage	AC 3PH 380 ..500 V +10/-15%	AC 3PH 0 .. Vin
Frequency	50/60 Hz ± 20%	0.. 599 Hz
Current	27 A	Inom 27 A      Imax 30 A
Power		Pnom 23.4 kVA
Dynamic Brake Unit Max Current 25 A, Max Duty Cycle 50 %		
Protection degree IP20 – UL Open Type / IP21 – UL Type 1 with NEMA 1 Glandkit ZZ0124812		
FOR FURTHER DETAILS SEE USER MANUAL		
Elettronica Santerno S.p.A Via della Concia n° 7 40023 Castel Guelfo (BO) – Italy <b>santerno.com</b>		MADE IN ITALY 

S001010

Figure 1: Nameplate of the SINUS PENTA Drive

## 2.4. Installing the Equipment

The inverters of the SINUS PENTA series are Open Type Equipment – degree of protection IP00 and IP20 – that can be installed inside another enclosure. Only models with degree of protection IP54 may be wall-mounted.

The drives must be installed vertically.

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



**CAUTION**

Install the drive in an upright position.  
Do not install the drive horizontally or upside-down.  
Install the inverter closed, without removing its covers; grab its side handles where fitted.



**CAUTION**

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



**CAUTION**

The drive rear wall may reach high temperatures; make sure that the drive bearing surface is not heat-sensitive.



**CAUTION**

The inverter must be installed on a stiff surface.

### 2.4.1. Environmental Requirements for the Equipment Installation, Storage and Transport

Any electronic board installed in the inverters manufactured by Elettronica Santerno is tropicalised. This enhances electrical insulation between the tracks having different voltage ratings and ensures longer life of the components. It is however recommended that the prescriptions below be strictly followed:

Maximum surrounding air temperature	-10 to +55°C Based on the inverter model, it may be necessary to apply 2% derating of the rated current per degree beyond the given temperatures (see OPERATING TEMPERATURES BASED ON APPLICATION CLASSES in the <b>Installation Guide</b> ).
Ambient temperatures for storage and transport	-25°C to 70°C
Installation environment	Pollution degree 2 or better (according to IEC 61800-5-1 and for UL508C Open Type Equipment). Do not install in direct sunlight and in places exposed to conductive dust, corrosive gases, vibrations, water sprinkling or dripping (except for IP54 models); do not install in salty environments.
Altitude	Max. altitude for installation 2000 m a.s.l. For installation above 2000 m and up to 4000 m, please contact Elettronica Santerno. Above 1000 m, derate the rated current by 1% every 100 m.
Operating ambient humidity	From 5% to 95%, from 1g/m <sup>3</sup> to 29g/m <sup>3</sup> , non-condensing and non-freezing (extension to 95%, thus exceeding 85% required by class 3K3 according to EN 61800-5-1).
Storage ambient humidity	From 5% to 95%, from 1g/m <sup>3</sup> to 29g/m <sup>3</sup> , non-condensing and non-freezing (class 1K3 according to EN 61800-5-1).
Ambient humidity during transport	Max. 95%, up to 60g/m <sup>3</sup> ; condensation may appear when the equipment is not running (class 2K3 according to EN 61800-5-1).
Storage and operating atmospheric pressure	From 86 to 106 kPa (classes 3K3 and 1K4 according to EN 61800-5-1).
Atmospheric pressure during transport	From 70 to 106 kPa (class 2K3 according to EN 61800-5-1).

**CAUTION**

As ambient conditions strongly affect the drive life, do not install the equipment in places that do not have the above-mentioned ambient conditions.

**CAUTION**

Always transport the equipment within its original package.



## 2.4.2. Dimensions, Weight and Dissipated Power for Stand-alone Models

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

Size	SINUS PENTA MODEL	W	H	D	Weight	Power dissipated at Inom	Noise level
		mm	mm	mm	kg	W	db(A)
S05	0007	170	340	175	7	160	46
	0008				7	170	
	0010				7	220	
	0013				7	220	
	0015				7	230	
	0016				7	290	
	0020				7	320	
S12	0023	215	401	225	11	390	57
	0033				12	500	
	0037				12	560	
S15	0040	225	466	331	22.5	820	48
	0049				22.5	950	
S20	0060	279	610	332	33.2	950	58
	0067				33.2	1250	
	0074				36	1350	
	0086				36	1550	
S30	0113	302	748	421	51	2150	61
	0129				51	2300	
	0150				51	2450	66
	0162				51	2700	
S41	0180	500	882	409	117	2550	64
	0202				117	3200	
	0217				121	3450	
	0260				121	4050	
S51	0313	578	882	409	141	4400	65
	0367				141	4900	
	0402				141	6300	
S60	0457	890	1310	530	260	7400	61
	0524				260	8400	



P000042-B



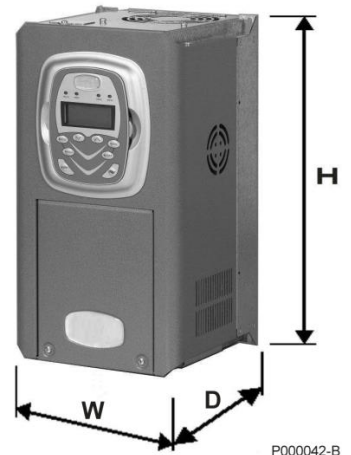
**NOTE** Degree of protection IP20 up to Size S30; IP00 for greater Sizes.



**NOTE** Please refer to the **Installation Guide** for IP54 stand-alone models, box and cabinet models.

2.4.2.2. IP20 AND IP00 STAND-ALONE MODELS (S05-S60P) 4T CLASS

Size	SINUS PENTA MODEL	W	H	D	Weight	Power Dissipated at Inom	Noise level
		mm	mm	mm	kg	W	db(A)
S05	0005	170	340	175	7	215	46
	0007				7	240	
	0009				7	315	
	0011				7	315	
	0014				7	315	
S12	0016	215	401	225	10.5	430	42
	0017				10.5	490	
	0020				10.5	490	
	0025				11.5	520	
	0030				11.5	550	53
	0034				12.5	680	
	0036				12.5	710	
S15	0040	225	466	331	22.5	820	48
	0049				22.5	950	
S20	0060	279	610	332	33.2	950	57
	0067				33.2	1250	
	0074				36	1350	
	0086				36	1550	
S30	0113	302	748	421	51	2150	61
	0129				51	2300	
	0150				51	2450	66
	0162				51	2700	
S41	0180	500	882	409	117	2550	63
	0202				117	3200	
	0217				121	3450	
	0260				121	4050	
S51	0313	578	882	409	141	4400	65
	0367				141	4900	
	0402				141	6300	
S60	0457	890	1310	530	260	7400	61
	0524				260	8400	
S60P	0598P	890	1310	530	255	6950	83



P000042-B



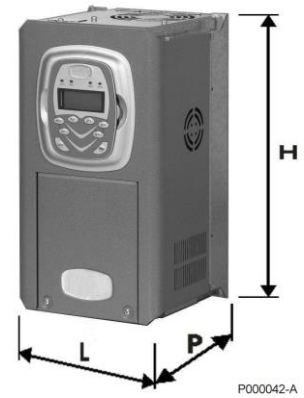
**NOTE** Degree of protection IP20 up to Size S30; IP00 for greater Sizes.



**NOTE** Please refer to the **Installation Guide** for IP54 stand-alone models, box and cabinet models.

2.4.2.3. IP20 AND IP00 STAND-ALONE MODELS (S12-S52) 5T AND 6T CLASS

Size	SINUS PENTA MODEL	W	H	W	Weight	Power dissipated at Inom	Noise Level
		mm	mm	mm	kg	W	db(A)
S12 5T	0003	215	401	225	10	160	50
	0004				10	180	
	0006				10.5	205	
	0012				10.5	230	
	0018				10.5	270	
S14	0003	270	527	240	17.5	170	49
	0004				17.5	190	
	0006				17.5	210	
	0012				17.5	240	
	0018				17.5	280	
	0019				17.5	320	
	0021				17.5	370	
	0022				18	470	
	0024				18	550	
	0032				18.5	670	
S22	0042	283	833	353	51	750	68
	0051				51	950	
	0062				54	1000	
	0069				54	1200	
S32	0076	367	880	400	80	1400	63
	0088				80	1700	
	0131				84	2100	
	0164				84	2500	
S42	0181	500	968	409	128	3450	63
	0201				128	3900	
	0218				136	4550	
	0259				136	4950	
S52	0290	578	968	409	160	5950	69
	0314				160	6400	
	0368				160	7000	
	0401				160	7650	



P000042-A



**NOTE** Degree of protection IP20 up to Size S32; IP00 for greater Sizes.



**NOTE** Please refer to the **Installation Guide** for IP54 stand-alone models, box and cabinet models.

### 2.4.2.4. MODULAR IP00 STAND-ALONE MODELS (S64-S90)

To obtain high-power inverters, the following individual modules are matched together:

- Control unit, containing the control board and ES842 board
- Power supply unit 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.

Four types of modules are available:

- Basic version
- Version with integrated control unit
- Version with integrated auxiliary supply unit (to be used for those models which are not equipped with the power supply module, Size S64, S74, and S84)
- Version with integrated splitter unit (to be used for the Penta sizes where parallel-connected inverter modules are installed - Size S74, S75, S80, S84, S90).

Match the modules above to obtain the proper inverter dimensioning for your application:

		Number of power supply modules			
		0	1	2	3
Number of IGBT modules	3	S64	S65	S70	–
	6	S74	–	S75	S80
	9	S84	–	–	S90



**CAUTION**

The busbars connecting the different modules are not supplied by Elettronica Santerno.



**CAUTION**

Properly configure ES842 control board 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 stated when ordering the inverter). Dimensions of the control unit (separate from the inverter).

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



**NOTE**

In the standard configuration, the control unit is installed on an inverter module.

## b) Inverter modules and supply modules

Configuration: power supply delivered from the mains

Models where no parallel-connected inverter modules are installed (S65 and S70)

Size	Sinus Penta Model	Voltage class	Modules		Overall Dimensions	Overall Weight	Overall Power dissipated at Inom	Noise Level
			Power Supply Modules	Inverter Modules	WxHxD	kg	kW	db(A)
S65	0598	4T	1	3	980x1400x560	440	9.75	71
	0748	4T	1	3			10.75	
	0831	4T	1	3			12.90	
	0457	5T-6T	1	3			9.15	
	0524	5T-6T	1	3			9.80	
	0598	5T-6T	1	3			11.25	
	0748	5T-6T	1	3			12.45	
S70	0831	5T-6T	2	3	1230x1400x560	550	14.90	72

Models including parallel-connected inverter modules (S75, S80 and S90)

Size	Sinus Penta Model	Voltage Class	Voltage class		Modules	Overall Dimensions	Overall Weight	Noise Level
			Power Supply Modules	Inverter Modules (*)				
S75	0964	4T	2	6	1980x1400x560	880	17.20	73
	1130	4T	2	6			18.90	
	1296	4T	2	6			21.10	
	0964	5T-6T	2	6			18.40	
	1130	5T-6T	2	6			22.80	
S80	1296	5T-6T	3	6	2230x1400x560	990	24.90	74
S90	1800	4T	3	9	2980x1400x560	1320	29.25	75
	2076	4T	3	9			32.25	
	1800	5T-6T	3	9			33.75	
	2076	5T-6T	3	9			37.35	

(\*): Three inverter modules are to be provided with an integrated splitter unit.

**c) Inverter modules only**

Configuration:

- inverter powered directly from a DC power supply source;
- inverter used as a regenerative power supply unit (for more details, please refer to the technical documentation relating to the Regenerative Penta Drive)

Models where no parallel-connected inverter modules are installed (S64)

Size	Sinus Penta Model	Voltage Class	Modules		Overall Dimensions	Overall Weight	Overall Power dissipated at Inom	Noise Level
			Inverter Modules with Aux. Power Supply Unit	Inverter modules (*)				
S64	0598	4C	1	2	730x1400x560	338	7.50	69
	0748	4C	1	2			8.25	
	0831	4C	1	2			9.90	
	0457	5C-6C	1	2			7.20	
	0524	5C-6C	1	2			7.80	
	0598	5C-6C	1	2			8.85	
	0748	5C-6C	1	2			9.75	
	0831	5C-6C	1	2			11.70	

(\*): One inverter module must be provided with an integrated auxiliary power supply unit.

Models including parallel-connected inverter modules (S74 and S84)

Size	Sinus Penta Model	Voltage Class	Modules		Overall Dimensions	Overall Weight	Overall Power dissipated at Inom	Noise Level
			Inverter Modules with Aux. Power Supply Unit	Inverter modules (*)				
S74	0964	4C	2	4	1480x1400x560	676	13.20	72
	1130	4C	2	4			14.40	
	1296	4C	2	4			15.60	
	0964	5C-6C	2	4			14.40	
	1130	5C-6C	2	4			18.00	
	1296	5C-6C	2	4			19.20	
S84	1800	4C	3	6	2230x1400x560	1014	22.50	74
	2076	4C	3	6			24.75	
	1800	5C-6C	3	6			26.55	
	2076	5C-6C	3	6			29.25	

(\*): Three inverter modules are to be provided with an integrated splitter unit.

### 2.4.3. Power Terminals / Bars

DESCRIPTION	
<b>41/R – 42/S – 43/T</b>	Inputs for three-phase supply (the phase sequence is not important).
<b>44/U – 45/V – 46/W</b>	Three-phase motor outputs.
<b>47/+</b>	Link to the DC voltage positive pole. It can be used for - DC voltage supply; - DC inductors; - the external braking resistor and the external braking unit (for the drive models which are NOT provided with terminal <b>50/+</b> dedicated to the external braking resistor) - the external braking unit.
<b>47/D</b>	When fitted, link to the positive pole of the continuous AC rectified voltage. It can be used for the inductor—if no DC inductor is used, terminal <b>47/D</b> must be short-circuited to terminal <b>47/+</b> using a cable/bar having the same cross-section as the cables used for power supply; factory setting).
<b>48/B</b>	When available, it can be used to connect the IGBT brake for braking resistors.
<b>49/-</b>	Link to the negative pole of the DC voltage. It can be used for - DC voltage power supply; - the external braking unit
<b>50/+</b>	When available, it can be used to - connect the positive pole of the DC voltage to be used for the external braking resistor only.

**S05 (4T)-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/-
------	------	------	------	------	------	------	------	------	------



**CAUTION**

Connection bars **47D** and **47+** are short-circuited as a factory setting. The DC choke, if any, shall be linked between bars **47D** and **47+** after removing the short-circuit.



**CAUTION**

If DC supply is required and if an external braking resistor is to be installed, remove the short-circuit between **47/D** and **47/+** and use terminal **47/+**.



**CAUTION**

Use terminals **47/+** and **48/B** if an external braking resistor is to be installed.

**S12 Terminal board (2T-4T)-S14:**

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



**CAUTION**

Connection bars **47/D** and **47/+** are short-circuited as a factory setting. The DC choke, if any, shall be linked between bars **47/D** and **47/+** after removing the short-circuit.



**CAUTION**

If DC supply is required and if an external braking resistor is to be installed, remove the short-circuit between **47/D** and **47/+** and use terminal **47/+**.



**CAUTION**

Use terminals **47/+** and **48/B** if an external braking resistor is to be installed.

**S12 Terminal board (5T):**

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

**S22-32 Terminal board:**

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



**CAUTION**

Connection bars **47/D** and **47/+** are short-circuited as a factory setting. The DC choke, if any, shall be linked between bars **47/D** and **47/+** after removing the short-circuit.



**CAUTION**

If DC supply is required and if an external braking resistor is to be installed, remove the short-circuit between **47/D** and **47/+** and use terminal **47/+**.



**CAUTION**

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

**Bloc de bornes S30 :**

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

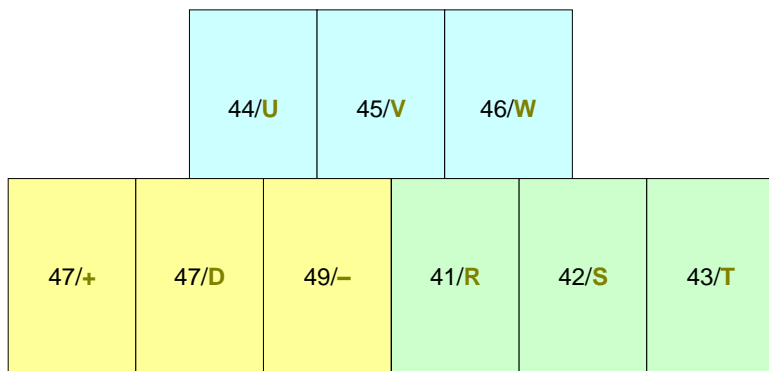


**CAUTION**

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



Connection bars for S41-S42-S51-S52:



**CAUTION**

Connection bars **47/D** and **47/+** are short-circuited as a factory setting. The DC choke, if any, shall be linked between bars **47/D** and **47/+** after removing the short-circuit.



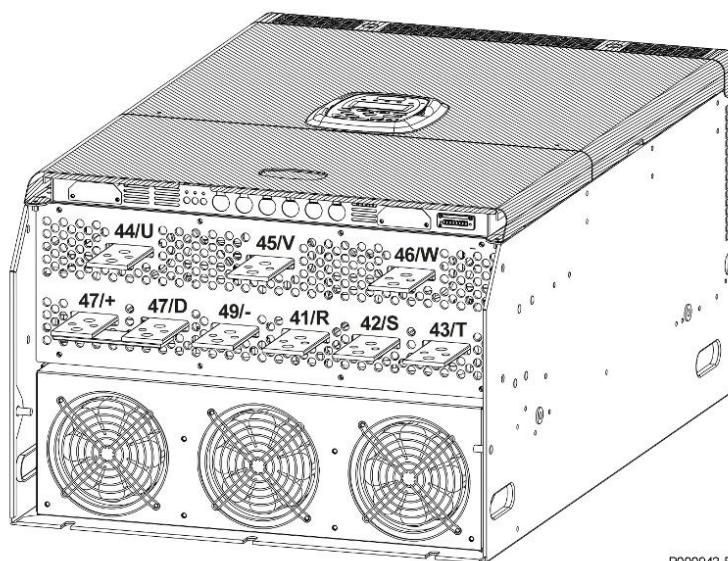
**CAUTION**

Please contact Elettronica Santerno if DC supply is to be applied to SINUS PENTA S41, S42, S51, S52.



**CAUTION**

Use terminals **47/+** and **49/-** if the external braking unit is to be installed.

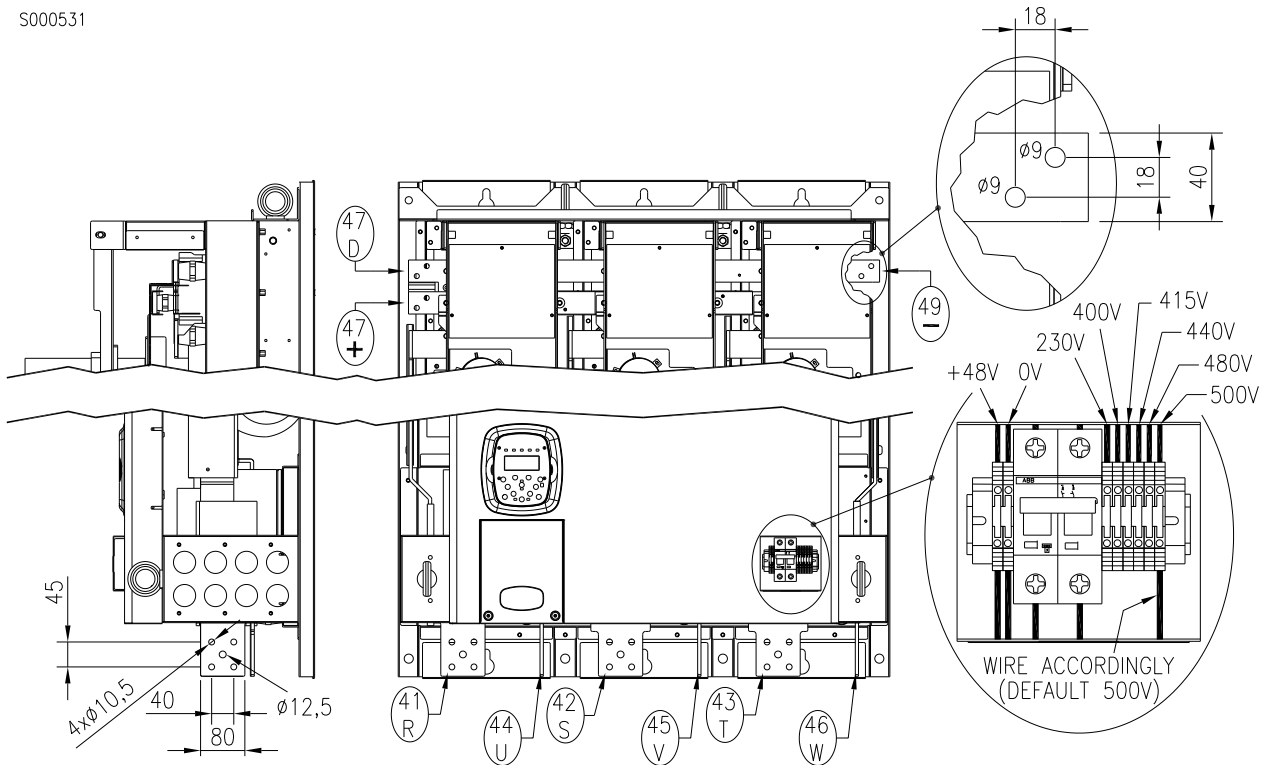


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Figure 2: Connection bars in S41-S42-S51-S52

### 2.4.4. Connection Bars for S60 and S60P Drives

S000531



**Figure 3: Connection bars S60 and S60P**

The figure shows the location and dimension of the bars connecting S60 and S60P SINUS PENTA 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 transformer must be wired based on the rated supply voltage being used.



**CAUTION**

Connection bars **47/D** and **47/+** are short-circuited as a factory setting. The DC choke, if any, shall be linked between bars **47/D** and **47/+** after removing the short-circuit.



**CAUTION**

Please contact Elettronica Santerno if DC supply is to be applied to SINUS PENTA S60 and S60P.



**CAUTION**

48Vdc 16A auxiliary power supply is required for S60P size only (see **Errore. L'origine riferimento non è stata trovata.**).

### 2.4.5. Connection Bars for Modular Inverters S64-S70

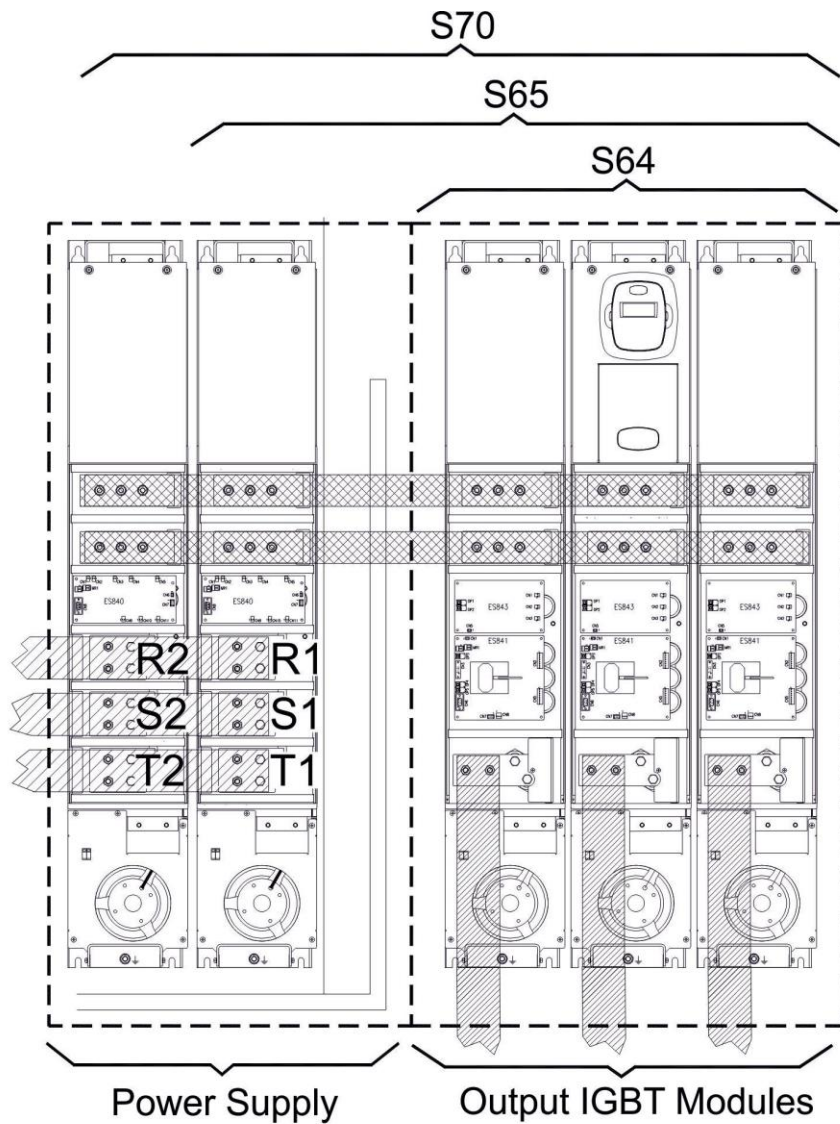


Figure 4: Connection bars for S64-S70



**CAUTION**

When a DC inductor is required for Sinus Penta S65 and S70, this must be specified when ordering the equipment.



**CAUTION**

When a DC inductor is to be installed, special-purpose bars are required.

### 2.4.6. Connection Bars for Modular Inverters S74-S80

S000265

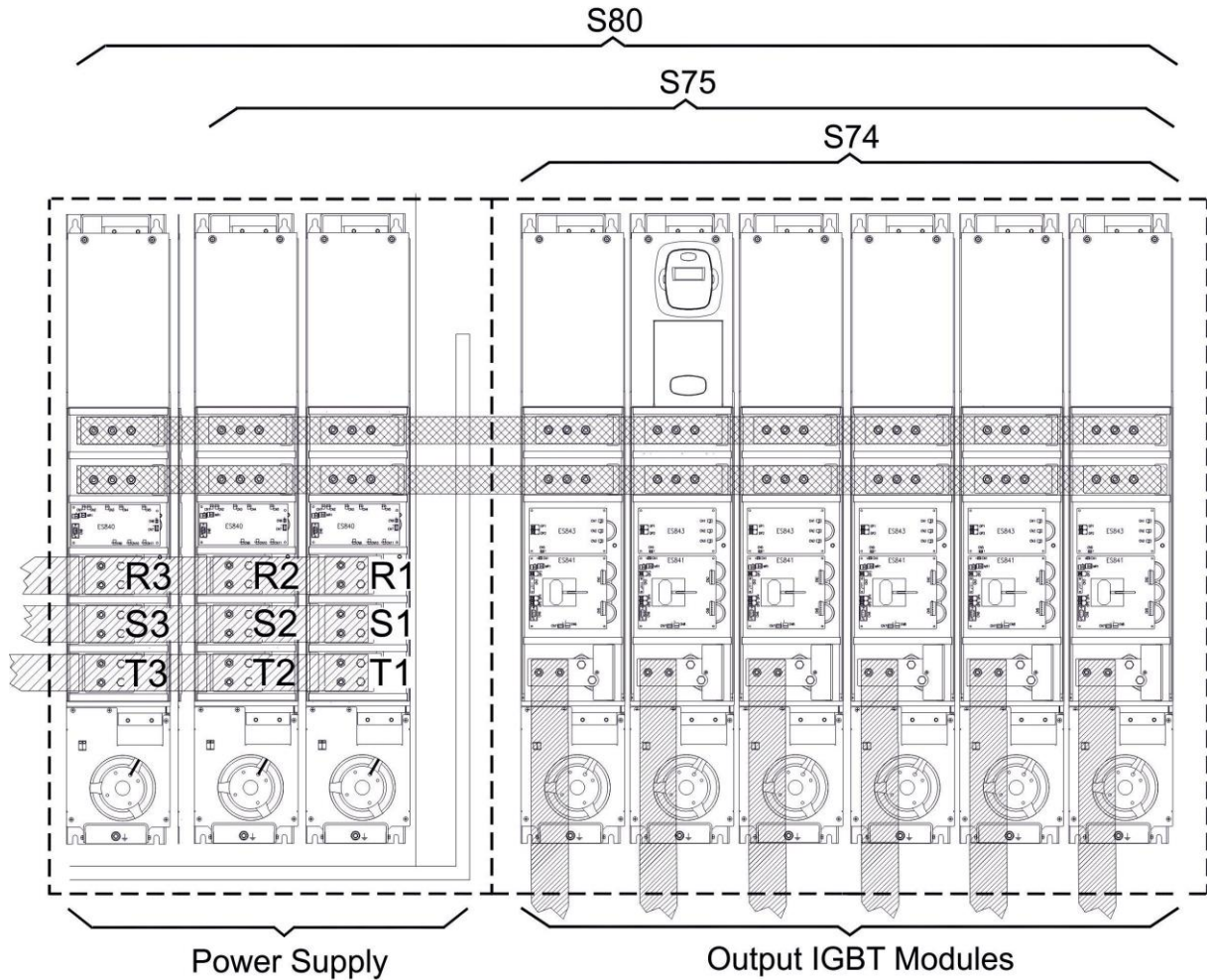


Figure 5: Connection bars for S74-S80



**CAUTION**

When a DC inductor is required for Sinus Penta S75 and S80, this must be specified when ordering the equipment.



**CAUTION**

When a DC inductor is to be installed, special-purpose bars are required.

### 2.4.7. Connection Bars for Modular Inverters S84-S90

S000266

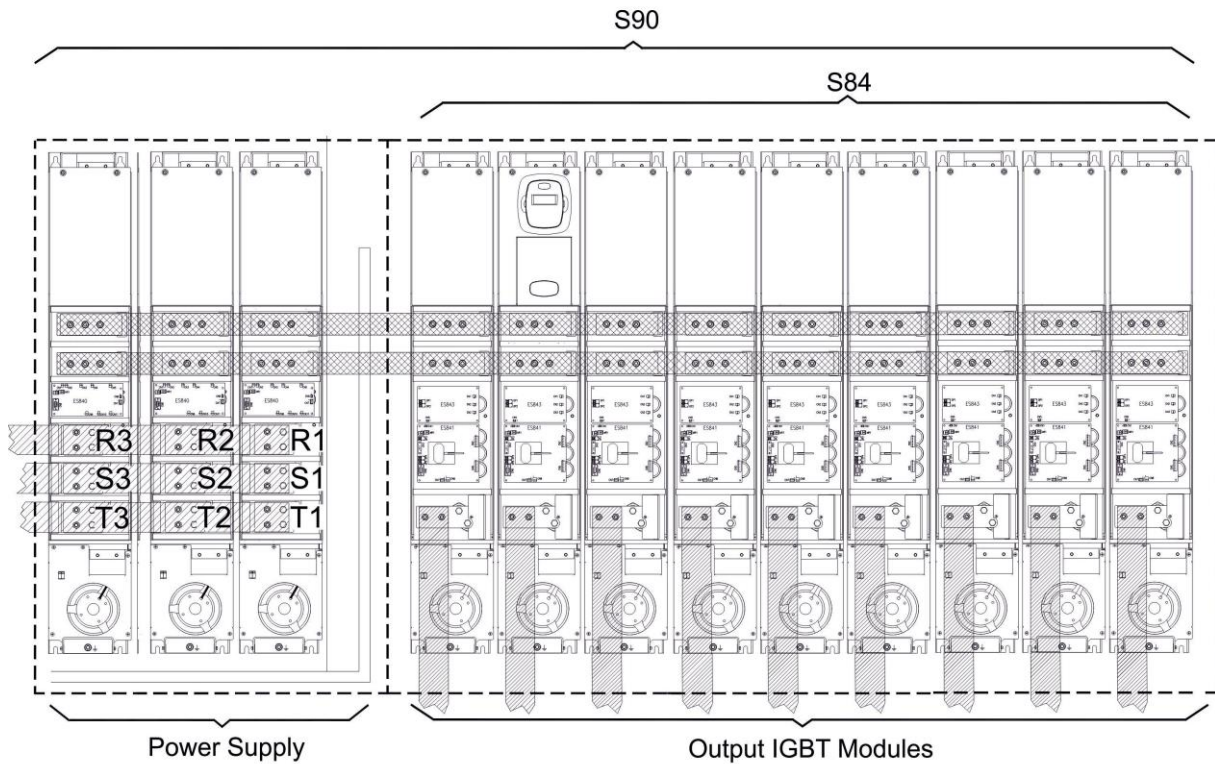


Figura 6: Connection bars for S84-S90



**CAUTION** When a DC inductor is required for Sinus Penta S90, this must be specified when ordering the equipment.



**CAUTION** When a DC inductor is to be installed, special-purpose bars are required.



**CAUTION** Please contact Elettronica Santerno if DC supply is to be applied to Sinus Penta S64 to S84 (the precharge circuit of DC-bus capacitors is not present).



**CAUTION** The mounting layout in the figures above may vary based on the accessories being used (input and output inductors, sinusoidal filters, harmonic filters).

### 2.4.8. Lay-out of the Auxiliary Power Supply Terminals

The auxiliary power supply terminals are provided in the Penta models requiring auxiliary power supply links to be used to power air-cooling systems.

Inverter	Terminal	Description	Ratings
S65-S64-S70-S74-S75-S80-S84-S90	61-62	Inputs for fan power supply	230Vac/2A

### 2.4.9. UL-approved Surge Protective Devices (SPDs) - 2T Voltage Class

For the S05 2T and S12 2T series, Overvoltage Protection shall be externally provided in the end-use application by R/C Surge Protective Devices - Component (VZCA2/VZCA8), as detailed in the **Installation Guide**.

### 2.4.10. Cross-sections of the Power Cables and Sizes of the Protective Devices

The minimum requirements of the inverter cables and the protective devices needed to protect the system against short-circuits are given in the tables below. It is however recommended that the applicable regulations in force be observed; also check if voltage drops occur for cable links longer than 100m.

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 150mm<sup>2</sup> parallel conductors are required for each phase. Multiple conductors shall have the same length and must run parallel to each other, 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 Penta drive must have the same lengths and must follow the same paths. Use 3-phase cables where possible.

2.4.10.1. 2T VOLTAGE CLASS

Size	SINUS PENTA Model	Inverter Rated Current	Cable Cross-section Fitting the Terminal	Cable Stripping	Tightening Torque	Cable Cross-section to Mains and Motor Side	Fast Fuses (700V) + Disc. Switch	Magnetic Circuit Breaker	AC1 Contactor
		A	mm <sup>2</sup> (AWG/kcmils)	mm	Nm	mm <sup>2</sup> (AWG/kcmils)	A	A	A
S05	0007	12.5	0.5÷10 (20÷6AWG)	10	1.2-1.5	2.5 (12AWG)	16	16	25
	0008	15		10	1.2-1.5		16	16	25
	0010	17		10	1.2-1.5	4 (10AWG)	20	25	25
	0013	19		10	1.2-1.5		20	25	25
	0015	23		10	1.2-1.5		25	25	25
	0016	27		10	1.2-1.5	8 (8AWG)	32	32	45
	0020	30		10	1.2-1.5		50	50	45
S12	0023	38	0.5÷25 (20÷4AWG)	18	2.5	10 (6AWG)	63	63	60
	0033	51		18	2.5	16 (5AWG)	80	80	80
	0037	65		18	2.5	25 (4AWG)	80	80	80
S15	0040	72	4÷25 (12÷4AWG)	15	2.5		100	100	100
	0049	80		15	2.5	125	100	100	
S20	0060	88	25÷70 (3÷2/0AWG)	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 (2AWG÷ 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
S41	0180	300	Bus bar	-	30	185 (400kcmils)	350	400	400
	0202	345	Bus bar	-	30	240 (500kcmils)	500	400	450
	0217	375	Bus bar	-	30	2x120 (2x4/0AWG)	550	630	450
	0260	425	Bus bar	-	30	2x120 (2x250kcmils)	630	630	500
S51	0313	480	Bus bar	-	50	2x150 (2x300kcmils)	700	630	550
	0367	550	Bus bar	-	50	2x185 (2x350kcmils)	800	800	600
	0402	680	Bus bar	-	50	2x240 (2x500kcmils)	1000	800	700
S60	0457	720	Bus bar	-	50	3x150 (3x300kcmils)	1000	800	800
	0524	800	Bus bar	-	50	3x185 (3x350kcmils)	1000	1000	1000



**CAUTION**

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

2.4.10.2. 4T VOLTAGE CLASS

Size	SINUS PENTA Model	Inverter Rated Current	Cable Cross-section Fitting the Terminal	Cable Stripping	Tightening Torque	Cable Cross-section to Mains and Motor Side	Fast Fuses (700V) + Disc. Switch	Magnetic Circuit Breaker	AC1 Contactor
		A	mm <sup>2</sup> (AWG/kcmils)	mm	Nm	mm <sup>2</sup> (AWG/kcmils)	A	A	A
S05	0005	10.5	0.5÷10 (20÷6AWG)	10	1.2-1.5	2.5 (12AWG)	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
S12	0016	27	0.5÷10 (20÷6AWG)	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÷4AWG)	18	2.5	16 (5AWG)	100	100	100
	0036	60		18	2.5	25 (4AWG)	100	100	100
S15	0040	72	0.5÷25 (20÷4AWG)	15	2.5	25 (4AWG)	100	100	100
	0049	80	4÷25 (12÷4AWG)	15	2.5		125	100	100
S20	0060	88	25÷70 (3÷2/0 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 (2AWG÷ 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		350	400	275

(continued)



(continued)

Size	SINUS PENTA Model	Inverter Rated Current	Cable Cross-section Fitting the Terminal	Cable Stripping	Tightening Torque	Cable Cross-section to Mains and Motor Side	Fast Fuses (700V) + Disc. Switch	Magnetic Circuit Breaker	AC1 Contactor
		A	mm <sup>2</sup> (AWG/kcmils)	mm	Nm	mm <sup>2</sup> (AWG/kcmils)	A	A	A
S41	0180	300	Bus bar	-	30	185 (400kcmils)	400	400	400
	0202	345	Bus bar	-	30	240 (500kcmils)	500	400	450
	0217	375	Bus bar	-	30	2x120 (2x4/0AWG)	550	630	450
	0260	425	Bus bar	-	30	2x120 (2x250kcmils)	630	630	500
S51	0313	480	Bus bar	-	50	2x150 (2x300kcmils)	700	630	550
	0367	550	Bus bar	-	50	2x185 (2x350kcmils)	800	800	600
	0402	680	Bus bar	-	50	2x240 (2x500kcmils)	1000	800	700
S60	0457	720	Bus bar	-	50	3x150 (3x300kcmils)	1000	800	800
	0524	800	Bus bar	-	50	3x185 (3x350kcmils)	1000	1000	1000
S60P	0598P	900	Bus bar	-	M10: 50 M12: 110	3x240 (3x500kcmils)	1250	1250	1000
S65	0598	900	Bus bar	-	M10: 50 M12: 110	3x240 (3x500kcmils)	1250	1250	1000
	0748	1000	Bus bar	-	M10: 50 M12: 110	3x240 (3x500kcmils)	1250	1250	1200
	0831	1200	Bus bar	-	M10: 50 M12: 110	4x240 (4x500kcmils)	1600	1600	1600
S75	0964	1480	Bus bar	-	M10: 50 M12: 110	6x150 (6x300kcmils)	2x1000	2000	2x1000
	1130	1700	Bus bar	-	M10: 50 M12: 110	6x185 (6x350kcmils)	2x1250	2000	2x1200
	1296	2100	Bus bar	-	M10: 50 M12: 110	6x240 (6x500kcmils)	2x1250	2500	2x1200
S90	1800	2600	Bus bar	-	M10: 50 M12: 110	9x240 (3x500kcmils)	3x1250	4000	3x1000
	2076	3000	Bus bar	-	M10: 50 M12: 110	9x240 (3x500kcmils)	3x1250	4000	3x1200



**CAUTION**

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

Size	SINUS PENTA Model	Rated Output Current	Rated Input Current	Cable Cross-section Fitting the Terminal	Tightening Torque	Motor Cable Cross-section
		A	Adc	mm <sup>2</sup> (AWG/kcmils)	Nm	mm <sup>2</sup> (AWG/kcmils)
S64	0598	900	1000	Bus bar	M10: 50 M12: 110	3x240 (3x500kcmils)
	0748	1000	1100	Bus bar	M10: 50 M12: 110	3x240 (3x500kcmils)
	0831	1200	1400	Bus bar	M10: 50 M12: 110	4x240 (4x500kcmils)
S74	0964	1480	1750	Bus bar	M10: 50 M12: 110	6x150 (6x300kcmils)
	1130	1700	2000	Bus bar	M10: 50 M12: 110	6x185 (6x350kcmils)
	1296	2100	2280	Bus bar	M10: 50 M12: 110	6x240 (6x500kcmils)
S84	1800	2600	2860	Bus bar	M10: 50 M12: 110	9x240 (9x500kcmils)
	2076	3000	3300	Bus bar	M10: 50 M12: 110	9x240 (9x500kcmils)



**CAUTION**

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

2.4.10.3. 5T AND 6T VOLTAGE CLASSES

Size	SINUS PENTA	Inverter Rated Current	Terminal Cross-section	Cable Stripping	Tightening Torque	Cable Cross-section to Mains and Motor Side	Fast Fuses (700V) + Disc. Switch	Magnetic Circuit Breaker	AC1 Contactor
		A	mm <sup>2</sup> (AWG or kcmils)	mm	Nm	mm <sup>2</sup> (AWG or kcmils)	A	A	A
S12 5T S14 6T	0003	7	0.5÷16 (20÷5AWG)	10	1.2-1.5	2.5 (12AWG)	16	16	25
	0004	9		10	1.2-1.5		16	16	25
	0006	11		10	1.2-1.5	4 (10AWG)	32	32	30
	0012	13		10	1.2-1.5		32	32	30
	0018	17		10	1.2-1.5		32	32	30
S14	0019	21	0.5÷25 (20÷4 AWG)	18	2.5-4.5	10 (6AWG)	40	40	45
	0021	25		18	2.5-4.5		40	40	45
	0022	33		18	2.5-4.5		63	63	60
	0024	40		18	2.5-4.5		63	63	60
	0032	52		18	2.5-4.5	16 (5AWG)	100	100	100
S22	0042	60	25÷50 (4÷1/0 AWG)	20	2.5-5	35 (2 AWG)	100	100	100
	0051	80		20	2.5-5		100	100	100
	0062	85		20	2.5-5	50 (1/0AWG)	125	125	125
	0069	100		20	2.5-5		125	125	125
S32	0076	125	25÷95 (4÷4/0AWG)	30	15-20	70 (2/0AWG)	200	200	250
	0088	150		30	15-20		200	200	250
	0131	190	35÷150 (2/0AWG÷ 300kcmils)	30	15-20	120 (250kcmils)	315	400	275
	0164	230		30	15-20		315	400	275
	0172	265		30	15-20		400	400	400
S42	0181	305	Bus bar	-	30	240 (500kcmils)	400	400	400
	0201	330	Bus bar	-	30		450	400	450
	0218	360	Bus bar	-	30	2x120 (2x250kcmils)	500	400	450
	0259	400	Bus bar	-	30		630	630	500
S52	0290	450	Bus bar	-	50	2x150 (2x300kcmils)	630	630	550
	0314	500	Bus bar	-	50		700	630	550
	0368	560	Bus bar	-	50	2x185 (2x350kcmils)	800	800	600
	0401	640	Bus bar	-	50	2x240 (2x500kcmils)	900	800	700
S65	0457	720	Bus bar	-	M10: 50 M12: 110	3x150 (3x300kcmils)	900	800	800
	0524	800	Bus bar	-	M10: 50 M12: 110	3x185 (3x350kcmils)	1000	1000	1000
	0598	900	Bus bar	-	M10: 50 M12: 110	3x240 (3x500kcmils)	1250	1250	1000
	0748	1000	Bus bar	-	M10: 50 M12: 110		1400	1250	1200
S70	0831	1200	Bus bar	-	M10: 50 M12: 110	4x240 (4x500kcmils)	2x800	1600	2x800
S75	0964	1480	Bus bar	-	M10: 50 M12: 110	6x150 (6x300kcmils)	2x1000	2000	2x1000
	1130	1700	Bus bar	-	M10: 50 M12: 110	6x185 (6x400kcmils)	2x1250	2000	2x1000
S80	1296	2100	Bus bar	-	M10: 50 M12: 110	6x240 (6x500kcmils)	3x1000	2500	3x1000
S90	1800	2600	Bus bar	-	M10: 50 M12: 110	9x240 (9x500kcmils)	3x1000	4000	3x1000
	2076	3000	Bus bar	-	M10: 50 M12: 110	9x240 (9x500kcmils)	3x1250	4000	3x1000



**CAUTION**

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



**NOTE**

In modular sizes S65-S90, each supply arm shall be protected by a separate fuse (see table above).

Size	SINUS PENTA Model	Rated Output Current	Rated Input Current	Cable Cross-section Fitting the Terminal	Tightening Torque	Motor Cable Cross-section
		A	Adc	mm <sup>2</sup> (AWG or kcmils)	Nm	mm <sup>2</sup> (AWG or kcmils)
S64	0457	720	750	Bus bar	M10: 50 M12: 110	3x150 (3x300kcmils)
	0524	800	840	Bus bar	M10: 50 M12: 110	3x185 (3x350kcmils)
	0598	900	950	Bus bar	M10: 50 M12: 110	3x240 (3x500kcmils)
	0748	1000	1070	Bus bar	M10: 50 M12: 110	3x240 (3x500kcmils)
	0831	1200	1190	Bus bar	M10: 50 M12: 110	4x240 (4x500kcmils)
S74	0964	1480	1500	Bus bar	M10: 50 M12: 110	6x150 (6x300kcmils)
	1130	1700	1730	Bus bar	M10: 50 M12: 110	6x185 (6x400kcmils)
	1296	2100	1980	Bus bar	M10: 50 M12: 110	6x240 (6x500kcmils)
S84	1800	2600	2860	Bus bar	M10: 50 M12: 110	9x240 (9x500kcmils)
	2076	3000	3300	Bus bar	M10: 50 M12: 110	9x240 (9x500kcmils)



**CAUTION**

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

2.4.10.4. UL-APPROVED EXTERNAL SEMICONDUCTOR PROTECTION FUSES

External (Recommended) Semiconductor Protection Fuses - R/C Special Purpose Fuses (JFHR2/JFHR8), Type Semiconductor Fuse, as detailed in the **Installation Guide**.

### 2.4.11. Inverter and Motor Earth Connection

A bolted screw for the earthing of the inverter enclosure is located close to the power wiring terminals. The screw can be located by the symbol below:



Always earth the inverter to state-of-the-art mains. To reduce disturbance and radiated interference to a minimum, connect the motor earthing conductor directly to the inverter following a parallel path to the motor supply cables.



**DANGER**

Always connect the inverter earthing terminal to the grid earthing using a conductor complying with the safety regulations in force (see table below).

Always connect the motor casing to the inverter earth to avoid dangerous voltage peaks and electrical shock hazard.

Always provide proper earthing of the inverter frame and the motor casing.



**NOTE**

To meet 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 earthing system. Use a loop lug fitting the earth screw and having the same cross-section as the earth cable being used.

**Protective earthing conductor cross-section (refer to EN 61800-5-1):**

Cross-sectional area of phase conductors of the inverter (mm <sup>2</sup> )	Minimum cross-sectional area of the corresponding protective earthing conductor (mm <sup>2</sup> )
$S \leq 10$	10 (*)
$10 < S \leq 16$	S (*)
$16 < S \leq 35$	16
$35 < S$	S/2



**NOTE**

The values in the table above are valid only if the protective earthing conductor is made of the same metal as the phase conductors.

If this is not so, the cross-sectional area of the protective earthing conductor shall be determined in a manner which produces a conductance equivalent to that which results from the application of the table above.



**NOTE (\*)**

In any case a cross-section of the protective earthing conductor of at least 10 mm<sup>2</sup> Cu or 16 mm<sup>2</sup> Al is required to maintain safety in case of damage to or disconnection of the protective earthing conductor (refer to EN 61800-5-1 about Touch current).

### 3. USING THE DISPLAY/KEYPAD

#### 3.1. Overview

This section covers navigation in the display/keypad.

For details about particular settings of the keypad (contrast, backlight, etc.), please refer to the section concerning the display/keypad in the Sinus Penta's **Installation Guide**, whilst for details regarding custom navigation for the root page, the measures in the Keypad page and the Root page and the PID custom unit of measure, please refer to the DISPLAY/KEYPAD MENU in the Sinus Penta's **Programming Guide**.

#### 3.2. Menu Tree

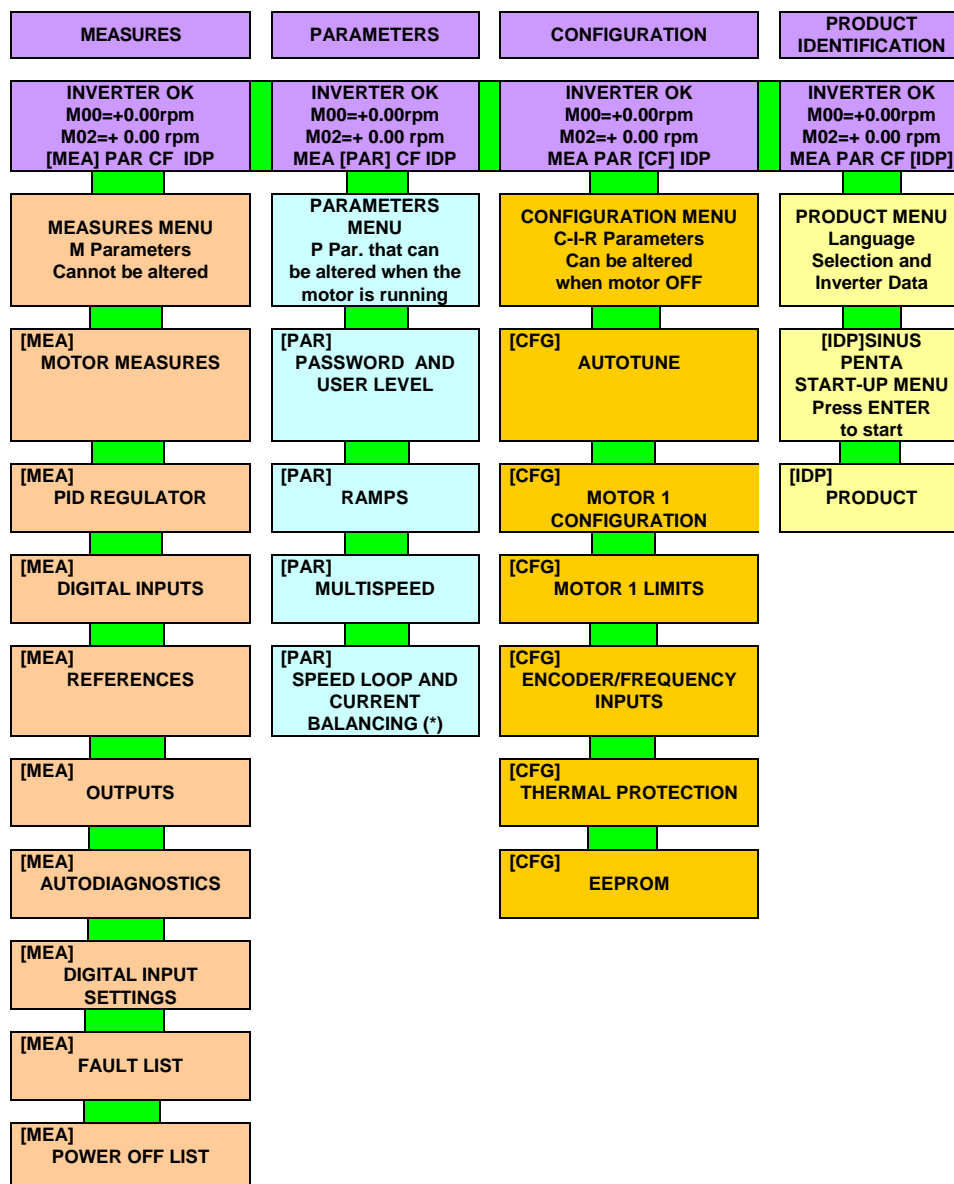
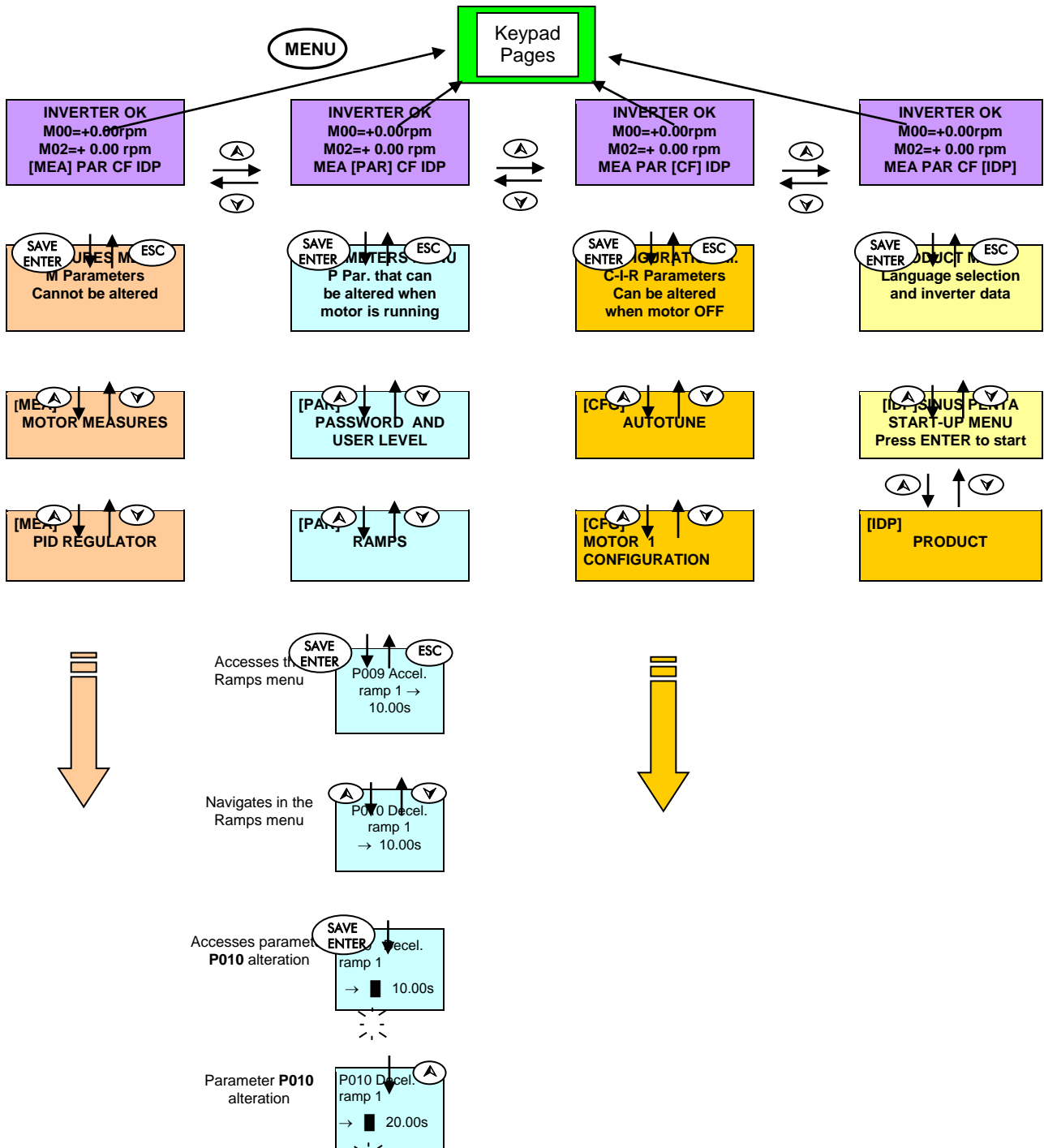


Figure 7: Menu Tree

(\*) Available for VTC and FOC controls only.

### 3.3. Navigation



If the **ESC** key is pressed to quit, the new parameter value will be acknowledged but not saved to non-volatile memory, and will therefore be lost at power off. Press **SAVE/ENTER** to confirm parameter alteration.

Figure 8: Navigation example

### 3.4. Function Keys














Press the **SAVE/ENTER** key for parameter alteration; when a flashing cursor appears, press **▲** and **▼** to change the parameter value. Do one of the following to quit the editing mode:

**Press ESC** → the parameter value that has been changed is used by the drive but is not stored to memory. It is lost when the drive is shut off.

**Press SAVE/ENTER** → the parameter value is stored to non-volatile memory and is not deleted when the drive is shut off.

Input values (**lxxx**) cannot be saved to non-volatile memory; inputs are automatically set to their default values.

**Rxxx** parameters become active only when the drive is next switched on or when the control board is reset by holding down the **RESET** key for a few seconds.

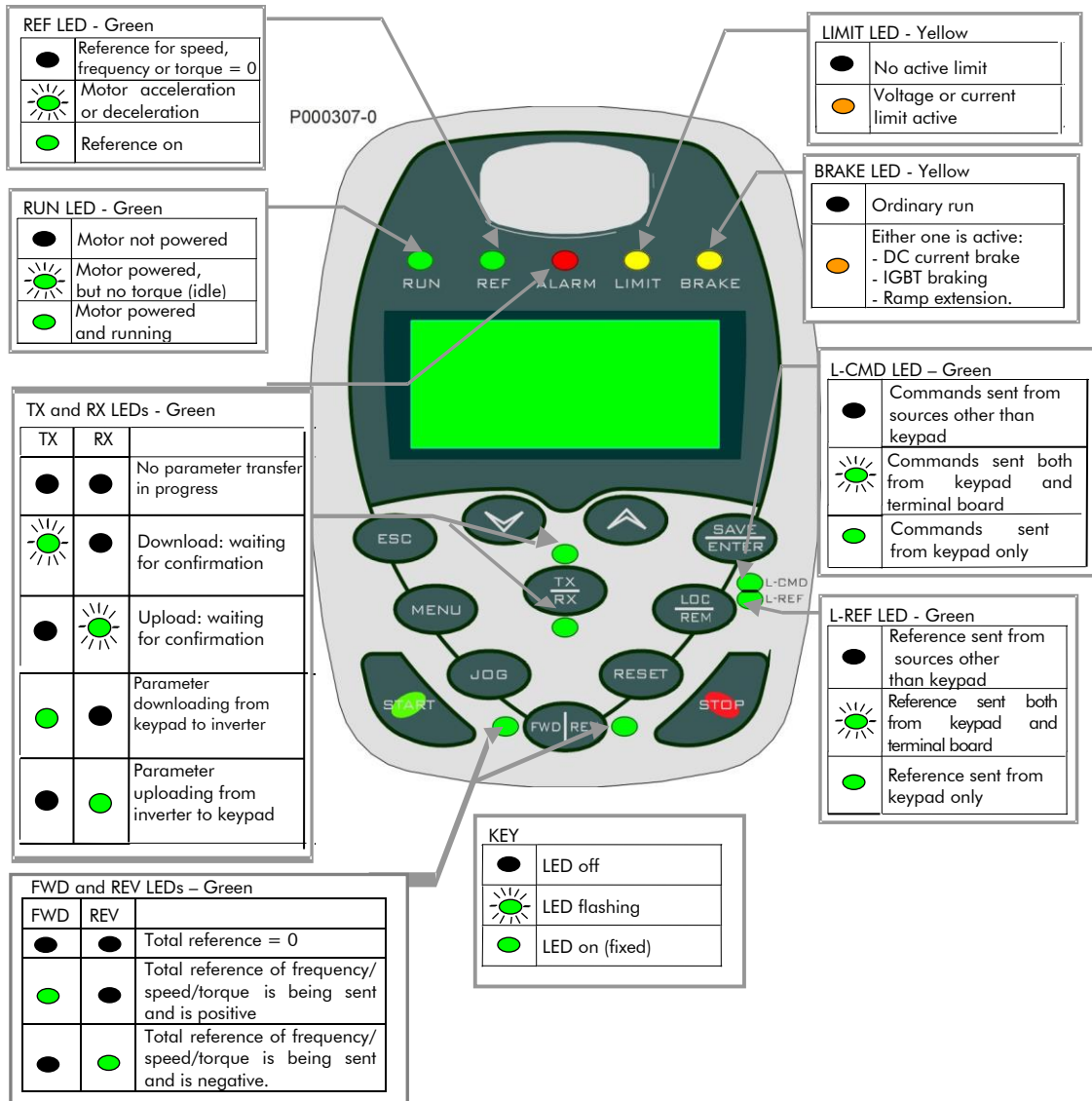
Key	Functions
	Quits menus and sub-menus and confirms a new parameter value (when the editing mode is activated, the cursor starts flashing), which is not saved to non-volatile memory (the value is lost when the inverter is turned off). If the Operator mode is set up and the keypad is locked on the Keypad page, press ESC for at least 5 s to restart navigation.
	Down arrow; scrolls through the menus and submenus, the pages in a submenu or the parameters in descending order. While programming, it decrements the parameter value. Hold it down along with the increment key  to access the next menu.
	Up arrow; scrolls through the menus and submenus, the pages in a submenu or the parameters in ascending order. While programming, it increments the parameter value.
	Accesses menus and submenus. In programming mode (cursor flashing) 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. If pressed when the Keypad page is displayed, the SAVE/ENTER key allows displaying the “Keypad Help” page, where the variables viewed in the previous page are detailed.
	If pressed more than once, it scrolls through the menus: start page → access page for parameter alteration → ID SW page → keypad → start page, and so on.
	Enters the pages for the parameter DOWNLOAD from the keypad to the inverter (TX) or allows parameter UPLOAD from the inverter to the keypad (RX); if pressed more than once, the <b>TX RX</b> key allows selecting either operating mode. The active selection is highlighted by the page displayed; the relevant TX or RX LED starts flashing. To confirm Upload/Download, press the Save/Enter key when the wanted selection is active.
	If pressed once, reference and commands are forced via keypad; press it again to return to the prior configuration or to change the active reference in the Keypad page depending on the preset type of Keypad page (see the Display menu in the Sinus Penta’s <b>Programming Guide</b> ).
	Resets the alarm tripped once the cause responsible for the alarm has disappeared. Press it for 8 seconds to reset the control board, thus allowing the microprocessors to be reinitialized and to activate R parameters with no need to shut off the inverter.
	If enabled, it starts the motor (at least one of the command sources is represented by the keypad).
	If enabled, it stops the motor (at least one of the command sources is represented by the keypad).
	The Jog key is active only when at least one of the command sources is represented by the keypad; if depressed, it enters the Jog reference set in the relevant parameter.
	If enabled (at least one of the command sources is represented by the keypad), it reverses the sign of the overall reference. Press this key again to change the reference sign.



### 3.5. Indicator LEDs in the Display/Keypad

Eleven LEDs are located on the keypad, along with a 4-line, 16-character LCD display, a buzzer and 12 function keys. The display shows parameter values, diagnostic messages and the variables processed by the Penta drive.

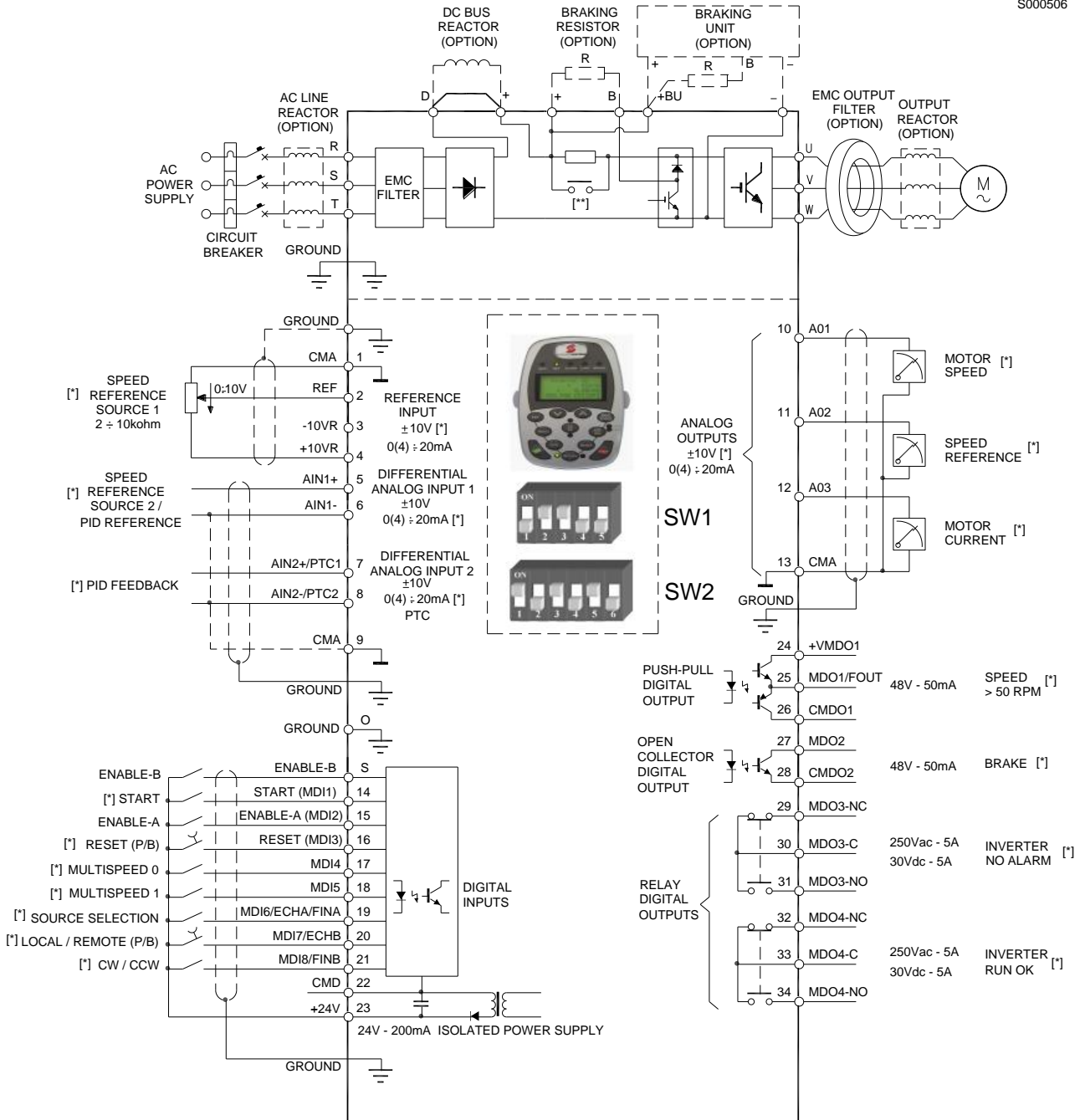
The figure below shows the location of the signal LEDs and their functionality.



## 4. WIRING

### 4.1. Wiring Diagram

S000506



[\*] FACTORY DEFAULTS

[\*\*] PRECHARGE CIRCUIT (SEE BELOW)

Figure 9: Wiring Diagram



**CAUTION**

In case of fuse line protection, always install the fuse failure detection device, that disables the drive, to avoid single-phase operation of the equipment.



**NOTE**

The wiring diagram relates to factory-setting. Please refer to the Power Terminals / Bars.



**NOTE**

Please refer to the **Motor Drives Accessories – User Manual** for the selection of the input and output inductors.



**NOTE**

**ENABLE-A** and **ENABLE-B** inputs are allocated to the STO function. The control mode and the control circuit of these signals must be accomplished according to the instructions given in the **Safe Torque Off Function – Application Manual**. That manual also includes a detailed validation procedure for the STO control configuration to be performed upon first start up of the equipment and also every 12 months.



**CAUTION**

Sizes S15, S20 and S30 and modular drives S65 to S90 require altering the hardware structure in order to apply DC inductors. Specify if the hardware structure is to be altered when ordering the equipment.



**NOTE [\*]**

Factory settings can be changed by changing the configuration of the DIP switches and/or by changing the parameters pertaining to the terminals concerned (see the Sinus Penta's **Programming Guide**).



**CAUTION**

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



**CAUTION [\*\*]**

Please contact Elettronica Santerno if DC current is to be supplied to Sinus Penta S41, S42, S51, S52, S60, S60P, S64, S74, S84, as no precharge circuit in the DC-bus capacitors is provided.



**CAUTION**

For S60 and S60P inverters only: if the supply voltage is other than 500Vac, the wiring of the internal auxiliary transformer must be changed accordingly.



**CAUTION**

48Vdc auxiliary power supply is required for S60P drives only.

## 5. ALARMS AND WARNINGS



### CAUTION

If a protection trips or the drive enters the emergency mode, the drive is locked and the motor idles!

### 5.1. What Happens when a Protective Device Trips



### NOTE

Before operating the drive in emergency conditions, carefully read this section and the following section, **What To Do When an Alarm Trips**.

The drive alarms are detailed below.

When a protection / alarm trips:

- 1) the **ALARM LED** on the keypad comes on;
- 2) the page displayed on the keypad is the root page of the **FAULT LIST**;
- 3) the **FAULT LIST** is refreshed;

In factory-setting, when the drive is switched on after an alarm has tripped—which has not been reset—it is kept in emergency condition.

**If the drive is in emergency mode when switched on, this could be due to an alarm tripped before the drive was reset.**

To avoid storing the alarms tripped before the drive is switched off, set parameter **C257** in the **Autoreset Menu**.

The drive stores the moment when an alarm trips to the **FAULT LIST** (supply time and operation time). The drive status when the alarm tripped and some measures sampled when the alarm tripped are also stored to the Fault List.

The readout and storage of the fault list can be very useful to detect the cause responsible for the alarm and its possible solution (see also the Fault List Menu/Power Off List Menu in the Sinus Penta's **Programming Guide**).



### NOTE

Alarms **A001** to **A039** relate to the main microcontroller (DSP Motorola) of the control board, which detected a fault on the control board itself. No fault list is available for Alarms **A001** to **A039** and no Reset command can be sent via serial link; alarms can be reset through the **RESET** terminal on the terminal board or the **RESET** key on the keypad. No software for the keypad interface is available; the drive parameters and measures cannot be accessed via serial link.

Avoid resetting alarms **A033** and **A039**, as they trip when the flash memory is not provided with its correct software. Alarms **A033** and **A039** can be reset only when proper software is downloaded for the drive flash memory.



### CAUTION

Before resetting any alarm, open the **ENABLE-A** and **ENABLE-B** terminals to disable the drive and prevent the connected motor from running at uncontrolled speed.

## 5.2. What To Do when an Alarm Trips

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### CAUTION

Before resetting any alarm, open the **ENABLE-A** and **ENABLE-B** terminals to disable the drive and to prevent the connected motor from running at uncontrolled speed.

#### Proceed as follows:

1. Open the **ENABLE-A** and **ENABLE-B** terminals to disable the drive and to lock the motor, unless parameter **C181=1** (the Safety Start function is active): after resetting an alarm or after supplying the drive, this will start only if the **ENABLE-A** and **ENABLE-B** terminals are opened and closed again.
2. If the motor is idling, wait until it stops.

Check the **FAULT LIST** carefully for any information about the alarm tripped, in order to find the cause responsible for the alarm and its possible solutions.

**Any information stored to the FAULT LIST is also required when contacting Elettronica Santerno's Customer Service.**

3. In the following sections, find the alarm code and follow the instructions given.
4. Solve any external problems that may have been responsible for the protection trip.
5. If the alarm tripped due to the entry of wrong parameter values, set new correct values and save them.
6. Reset the alarm.
7. If the alarm condition persists, please contact Elettronica Santerno's Customer Service.

A **RESET** command must be sent to reset the alarms tripped. Do one of the following:

- Enable the **RESET** signal in **MDI3** terminal in the hardware terminal board;
- Press the **RESET** key on the keypad.

### 5.3. Alarm Code List

Alarm	Alarm Message	Description	What to do
A001 ÷ A032 A034 ÷ A038	...	Control board failure	<ol style="list-style-type: none"> <li>Reset the Penta drive.</li> <li>Contact Elettronica Santerno's Customer Service.</li> </ol>
A033	TEXAS VER KO	Incompatible Texas Software Version	<ol style="list-style-type: none"> <li>Download the correct DSP Texas software version.</li> <li>Contact Elettronica Santerno's Customer Service.</li> </ol>
A039	FLASH KO	Texas Flash not programmed	
A040	User Fault	Alarm caused by the user	Reset the Penta drive.
A041	PWMA Fault	General hardware fault from IGBT	<ol style="list-style-type: none"> <li>Reset the Penta drive.</li> <li>Contact Elettronica Santerno's Customer Service.</li> </ol>
A042	Illegal XMDI in DGI	Illegal configuration of XMDI in the Digital Inputs menu	<ol style="list-style-type: none"> <li>Check setting in <b>R023</b>.</li> <li>Check settings in the Digital Inputs menu.</li> </ol>
A043	...	Control board failure	<ol style="list-style-type: none"> <li>Reset the Penta drive.</li> <li>Contact Elettronica Santerno's Customer Service.</li> </ol>
A044	SW OverCurrent	Software overcurrent	<ol style="list-style-type: none"> <li>Check drive and motor ratings.</li> <li>Check output short circuit.</li> <li>Check for disturbance in control signal.</li> <li>Set a longer acceleration time.</li> <li>Set a longer deceleration time.</li> <li>Disconnect motor and change <b>C010</b> to 0:IFD.</li> </ol>
A045	Bypass Circuit Fault	Precharge By-Pass fault	<ol style="list-style-type: none"> <li>Reset the Penta drive.</li> <li>Contact Elettronica Santerno's Customer Service.</li> </ol>
A046	Bypass Connector Fault	Precharge By-Pass connector fault	
A047	UnderVoltage	DC bus voltage lower than Vdc_min	<ol style="list-style-type: none"> <li>Check supply voltage on terminals R, S, T.</li> <li>Check <b>M030</b> (Supply voltage) and <b>M029</b> (DC bus voltage).</li> <li>Check <b>M030</b> and <b>M029</b> in the Fault List.</li> <li>Contact Elettronica Santerno's Customer Service.</li> </ol>
A048	OverVoltage	DC bus voltage exceeding Vdc_max	<ol style="list-style-type: none"> <li>Check supply voltage on terminals R, S, T.</li> <li>Check <b>M030</b> (Supply voltage) and <b>M029</b> (DC bus voltage).</li> <li>Check <b>M030</b> and <b>M029</b> in the Fault List.</li> <li>Set a longer deceleration time.</li> <li>Add dynamic brake resistor.</li> <li>Contact Elettronica Santerno's Customer Service.</li> </ol>
A049	...	Control board failure	<ol style="list-style-type: none"> <li>Reset the Penta drive.</li> <li>Contact Elettronica Santerno's Customer Service.</li> </ol>
A050	PWMA0 Fault	Hardware Fault from IGBT converter	<ol style="list-style-type: none"> <li>Reset the Penta drive.</li> <li>Contact Elettronica Santerno's Customer Service.</li> </ol>
A051	PWMA1 Fault	Hardware overcurrent	<ol style="list-style-type: none"> <li>Check drive and motor ratings.</li> <li>Check output short circuit.</li> <li>Check disturbance in control signal.</li> <li>Set a longer acceleration time.</li> <li>Set a longer deceleration time.</li> <li>Disconnect motor and change <b>C010</b> to 0:IFD.</li> </ol>
A052	Illegal XMDI in DGO	Illegal configuration of XMDI in the Digital Outputs menu	<ol style="list-style-type: none"> <li>Check setting in <b>R023</b>.</li> <li>Check settings in the Digital Outputs menu.</li> </ol>

Alarm	Alarm Message	Description	What to do
A053	PWMA Not ON	Hardware failure, IGBT power on impossible	<ol style="list-style-type: none"> <li>1. Reset the Penta drive.</li> <li>2. Contact Elettronica Santerno's Customer Service.</li> </ol>
A054	Option Board not in	Failure in detecting preset option I/O board	<ol style="list-style-type: none"> <li>1. Check consistency of parameter <b>R023</b>.</li> <li>2. Contact Elettronica Santerno's Customer Service.</li> </ol>
A055	PTC Alarm	External PTC tripped	<ol style="list-style-type: none"> <li>1. Allow motor to cool.</li> <li>2. Ensure that PTC is correctly connected to AIN2.</li> <li>3. Ensure that SW1 is correctly set up in the control board.</li> </ol>
A056	PTC Short Circuit	External PTC in short circuit	<ol style="list-style-type: none"> <li>1. Make sure that the PTC is correctly connected to AIN2.</li> <li>2. Ensure that SW1 is correctly set up in the control board.</li> </ol>
A057	Illegal XMDI in MPL	Illegal configuration of XMDI in the Virtual Digital Outputs menu	<ol style="list-style-type: none"> <li>1. Check setting in <b>R023</b>.</li> <li>2. Check setting in the MPL menu.</li> </ol>
A059	Encoder Fault	Error of motor speed measure	<ol style="list-style-type: none"> <li>1. Check if encoder parameters are correct.</li> <li>2. Check if encoders are properly connected and mounted.</li> <li>3. Check if encoder signals are correct.</li> </ol>
A060	NoCurrent Fault	Current is zero in FOC control	<ol style="list-style-type: none"> <li>1. Check motor connections U, V, W.</li> <li>2. Check FOC regulator menu setting (<b>Engineering</b> user level required).</li> <li>3. Perform a new current regulator autotune.</li> <li>4. Contact Elettronica Santerno's Customer Service.</li> </ol>
A061	Ser WatchDog	Watchdog tripped in serial link 0 (9-pole D connector)	<ol style="list-style-type: none"> <li>1. Check serial link 0.</li> <li>2. Make sure that the master sends read/write queries with max. interval between queries lower than preset watchdog operation time.</li> <li>3. Set longer watchdog operation time (<b>R005</b>).</li> </ol>
A062	SR1 WatchDog	Watchdog tripped in serial link 1 (RJ45)	<ol style="list-style-type: none"> <li>1. Check serial link 1.</li> <li>2. Make sure that the master sends read/write queries with max. interval between queries lower than preset watchdog operation time.</li> <li>3. Set a longer watchdog operation time (<b>R012</b>).</li> </ol>
A063	...	<i>Control board failure</i>	<ol style="list-style-type: none"> <li>1. <i>Reset the Penta drive.</i></li> <li>2. <i>Contact Elettronica Santerno's Customer Service.</i></li> </ol>
A064	Mains Loss	No power is supplied from the mains	<ol style="list-style-type: none"> <li>1. Check supply voltage on terminals R, S, T.</li> <li>2. Check <b>M030</b> (Supply voltage).</li> <li>3. Check <b>M030</b> in the Fault List.</li> <li>4. Alarm may be disabled or delayed in Power down menu (<b>Engineering</b> user level required).</li> </ol>
A065	AutoTune Fault	Autotune failed	<ol style="list-style-type: none"> <li>1. Reset the Penta drive.</li> <li>2. Check parameters in Motor Control Menu and perform a new autotune.</li> <li>3. Contact Elettronica Santerno's Customer Service.</li> </ol>
A066	REF < 4mA	REF Current input (4÷20mA) lower than 4mA	<ol style="list-style-type: none"> <li>1. Check setting of SW1 in the control board.</li> <li>2. Check if signal cable is properly connected.</li> <li>3. Check the current signal source.</li> </ol>
A067	AIN1 < 4mA	AIN1 Current input (4÷20mA) lower than 4mA	
A068	AIN2 < 4mA	AIN2 Current input (4÷20mA) lower than 4mA	

Alarm	Alarm Message	Description	What to do
A069	XAIN5 < 4mA	XAIN5 Current input (4÷20mA) lower than 4mA	<ol style="list-style-type: none"> <li>1. Check if signal cable is properly connected.</li> <li>2. Check the current signal source.</li> </ol>
A070	Fbs WatchDog	Fieldbus Watchdog tripped	<ol style="list-style-type: none"> <li>1. Check fieldbus connection.</li> <li>2. Ensure master sends legal messages with max. time interval lower than preset watchdog time.</li> <li>3. Set longer watchdog times (<b>R016</b>)</li> </ol>
A071	...	<i>Control board failure</i>	<ol style="list-style-type: none"> <li>1. <i>Reset the Penta drive.</i></li> <li>2. <i>Contact Elettronica Santerno's Customer Service.</i></li> </ol>
A072	Parm Lost Chk	Parameter download/upload error	<ol style="list-style-type: none"> <li>1. Check keypad connection.</li> <li>2. Reset the alarm and repeat Upload/Download.</li> </ol>
A073	Parm Lost 1 COM	Parameter download/upload error	
A074	Inverter Overheated	Drive thermal protection tripped	<ol style="list-style-type: none"> <li>1. Check drive output current (<b>M026</b>) during normal operation.</li> <li>2. Check mechanical load of connected motor (locked shaft/overload).</li> </ol>
A075	Motor Overheated	Motor thermal protection tripped	<ol style="list-style-type: none"> <li>1. Check mechanical conditions and load.</li> <li>2. Check parameters <b>C265</b> and <b>C267</b>.</li> </ol>
A076	Speed Alarm	Motor speed too high	<ol style="list-style-type: none"> <li>1. Check if <b>C031</b> is compatible with the connected motor.</li> <li>2. Check the torque reference in Slave mode (<b>Advanced</b> user level required).</li> </ol>
A078	...	<i>Control board failure</i>	<ol style="list-style-type: none"> <li>1. <i>Reset the Penta drive.</i></li> <li>2. <i>Contact Elettronica Santerno's Customer Service.</i></li> </ol>
A079	FOC No Encoder	Encoder not properly configured	Set correct encoder parameters for FOC control.
A080	Tracking Error	Encoder speed tracking error	<ol style="list-style-type: none"> <li>1. Set param. <b>C192</b>, <b>C193</b> correctly.</li> <li>2. Check torque limit value.</li> <li>3. Check mechanical load.</li> <li>4. Check encoder operation (<b>Engineering</b> user level required).</li> </ol>
A081	KeyPad WatchDog	Communication watchdog via keypad	<ol style="list-style-type: none"> <li>1. Check keypad connection.</li> <li>2. Check settings for RJ45 serial link.</li> </ol>
A082	Illegal Encoder Cfg	Functions programmed for MDI6 and MDI7 or Encoder B selected but no encoder board detected	<ol style="list-style-type: none"> <li>1. Check setting of <b>C189</b>.</li> <li>2. Check settings for MDI6 and MDI7.</li> <li>3. Check encoder board, if used (<b>Advanced</b> user level required).</li> </ol>
A083	External Alarm 1	External alarm 1	Check external signal in allocated MDI.
A084	External Alarm 2	External alarm 2	
A085	External Alarm 3	External alarm 3	
A086	XAIN5 > 20mA	XAIN5 Current input (4÷20mA or 0÷20mA) greater than 20mA	<ol style="list-style-type: none"> <li>1. Check if signal cable is properly connected.</li> <li>2. Check the current signal source.</li> </ol>
A087	±15V LOSS	Loss of ±15V	<ol style="list-style-type: none"> <li>1. Reset the Penta drive.</li> <li>2. Contact Elettronica Santerno's Customer Service.</li> </ol>
A088	...	<i>Control board failure</i>	<ol style="list-style-type: none"> <li>1. <i>Reset the Penta drive.</i></li> <li>2. <i>Contact Elettronica Santerno's Customer Service.</i></li> </ol>
A089	Parm Lost 2 COM	Parameter download/upload error	<ol style="list-style-type: none"> <li>1. Check keypad connection.</li> <li>2. Reset the alarm and repeat Upload/Download.</li> </ol>
A090	Parm Lost 3 COM	Parameter download/upload error	



Alarm	Alarm Message	Description	What to do
A091	Braking Resistor Overload	Overvoltage with braking resistance enabled due to continuous operation longer than the time set in <b>C211</b>	<ol style="list-style-type: none"> <li>1. Resest the Penta drive.</li> <li>2. Increase resistor rating and settings for <b>C211-C212</b> (<b>Engineering</b> user level required).</li> </ol>
A092	...	Control board failure	<ol style="list-style-type: none"> <li>1. Reset the Penta drive.</li> <li>2. Contact Elettronica Santerno's Customer Service.</li> </ol>
A093	Bypass Circuit Open	By-Pass relay open	<ol style="list-style-type: none"> <li>1. Reset the Penta drive.</li> <li>2. Contact Elettronica Santerno's Customer Service.</li> </ol>
A094	Heatsink Overheated	IGBT heatsink temperature too high	<ol style="list-style-type: none"> <li>1. Check ambient temperature.</li> <li>2. Check motor current.</li> <li>3. Decrease carrier frequency (<b>C001-C002</b>). (<b>Engineering</b> user level required).</li> </ol>
A095	Illegal Drive Profile Board	Incorrect configuration of Drive Profile board	<ol style="list-style-type: none"> <li>1. Make sure that the Drive Profile board is correctly configured for the Sinus Penta drive.</li> <li>2. Replace the Drive Profile board.</li> </ol>
A096	Fan Fault	Fault of the cooling fans	Replace the fans.
A097	Motor Not Connected	Motor not wired	<ol style="list-style-type: none"> <li>1. Check connections to U, V, W.</li> <li>2. Check motor parameters &amp; perform new autotune for VTC &amp; FOC.</li> </ol>
A098	Illegal Motor Selected	Illegal motor selected via MDI	<ol style="list-style-type: none"> <li>1. Check setting in <b>C009</b>.</li> <li>2. Check <b>C173-C174</b> and MDI status (<b>Engineering</b> level required).</li> </ol>
A099	2nd Sensor Fault	Fault of fan sensor 2	<ol style="list-style-type: none"> <li>1. Reset the Penta drive.</li> <li>2. Contact Elettronica Santerno's Customer Service.</li> </ol>
A100	MDI6 Illegal Configuration	Function programmed for MDI6 along with frequency input A	Check configuration of <b>MDI6</b> and setting in <b>C189</b> .
A101	MDI8 Illegal Configuration	Function programmed for MDI8 along with frequency input B	
A102	REF>20mA	REF Current input (4÷20mA or 0÷20mA) greater than 20mA	<ol style="list-style-type: none"> <li>1. Check setting of SW1 in the control board.</li> <li>2. Check the current signal source.</li> </ol>
A103	AIN1>20mA	AIN1 Current input (4÷20mA or 0÷20mA) greater than 20mA	
A104	AIN2>20mA	AIN2 Current input (4÷20mA or 0÷20mA) greater than 20mA	
A105	PT100 Channel 1 Fault	Hardware address out of measure range of the drive	<ol style="list-style-type: none"> <li>1. Check setting of SW1 in ES847 (optional board).</li> <li>2. Check the current signal source.</li> </ol>
A106	PT100 Channel 2 Fault	Hardware address out of measure range of the drive	
A107	PT100 Channel 3 Fault	Hardware address out of measure range of the drive	
A108	PT100 Channel 4 Fault	Hardware address out of measure range of the drive	
A109	Amb.Overtemp.	Ambient overtemperature	<ol style="list-style-type: none"> <li>1. Open the cabinet and check its conditions. Also check measure <b>M062</b>.</li> <li>2. Reset the Penta drive.</li> <li>3. Contact Elettronica Santerno's Customer Service.</li> </ol>

Alarm	Alarm Message	Description	What to do
A110	Fieldbus Board Fault	Fault occurring in the Fieldbus board	<ol style="list-style-type: none"> <li>1. Reset the Penta drive.</li> <li>2. Establish a connection to the fieldbus, making sure that the Fieldbus Master configuration is correct.</li> <li>3. If the alarm persists, please contact ELETTRONICA SANTERNO's Customer Service.</li> </ol>
A111 ÷ A127	...	<i>Control board failure</i>	<ol style="list-style-type: none"> <li>1. <i>Reset the Penta drive.</i></li> <li>2. <i>Contact Elettronica Santerno's Customer Service.</i></li> </ol>
A129	No Output Phase	Output phase disconnection	<ol style="list-style-type: none"> <li>1. Check circuitry continuity between the drive and the motor.</li> <li>2. Contact Elettronica Santerno's Customer Service.</li> </ol>
A140	Torque Off not Safe	Malfunctioning of ENABLE-A and ENABLE-B inputs for STO	<ol style="list-style-type: none"> <li>1. Reset the inverter.</li> <li>2. Contact Elettronica Santerno.</li> </ol> <p>NOTE: If alarm A140 persists, this means that the STO function is faulty. In order to restore the application safety level, replace the drive or at least the control board. Consult the <b>Safe Torque Off Function – Application Manual</b> for the check and restoration procedures to follow.</p>
A141	Illegal Hardware	SW version incompatible with the drive hardware	<ol style="list-style-type: none"> <li>1. Download the correct release of the PD software.</li> <li>2. Contact ELETTRONICA SANTERNO's Customer Service.</li> </ol>

Table 1: Alarm Code List


## 5.4. Warnings

**Warning** messages are displayed on the display/keypad. They are flashing messages that usually appear in line 1 or 2 on the display.



**NOTE**

Warnings are neither protections nor alarms and are not stored to the Fault list.

Warning	Message	Description
W03	SEARCHING...	The user interface is searching the data of the next page to display.
W04	DATA READ KO	Software warnings concerning data <b>reading</b> .
W06	HOME SAVED	The page displayed has been saved as the home page displayed at power on.
W07	DOWNLOADING	The keypad is <b>writing</b> to the drive the WORK zone parameters saved to its own flash memory.
W08	UPLOADING	The keypad is <b>reading</b> from the drive the WORK zone parameters that will be saved to its own flash memory.
W09	DOWNLOAD OK	Parameters were successfully downloaded ( <b>written</b> ) from the keypad to the drive.
W11	UPLOAD OK	Parameters were successfully uploaded ( <b>read</b> ) from the drive to the keypad.
W12	UPLOAD KO	The keypad interrupted parameter upload to the drive. Parameter <b>reading</b> has failed.
W13	NO DOWNLOAD	A Download procedure was queried, but no parameter is saved to the flash memory.
W16	PLEASE WAIT...	Wait until the system completes the operation required.
W17	SAVE IMPOSSIBLE	Parameter save is not allowed.
W18	PARAMETERS LOST	The keypad interrupted parameter download to the drive. Parameter <b>writing</b> has failed. As a result, not all parameters have been updated (parameter inconsistency).
W19	NO PARAMETERS LOAD	UPLOAD impossible.
W20	NOT NOW	The required function is not available at the moment.
W21	CONTROL ON	The required function is inhibited because the drive is running.
W23	DOWNLOAD VER. KO	Download failed because parameters saved to keypad memory relate to a SW version or product ID incompatible with the drive SW version or product ID.
W24	VERIFY DATA	Download preliminary operation underway, the system is checking the integrity and compatibility of the parameters saved in the keypad memory.
W28	OPEN START	Open and close the <b>START</b> input to start the drive.
W31	ENCODER OK	Encoder tuning procedure finished: the encoder is correctly connected.
W32	OPEN ENABLE	Open and close the <b>ENABLE-A</b> and <b>ENABLE-B</b> inputs.
W33	WRITE IMPOSSIBLE	<b>Writing</b> procedure impossible.
W34	ILLEGAL DATA	Illegal value entered, operation failed.
W35	NO WRITE CONTROL	<b>Writing</b> procedure impossible because Control is active and the drive is running.
W36	ILLEGAL ADDRESS	Illegal address entered, operation failed.
W37	ENABLE LOCKED	The drive is disabled and does not acknowledge the <b>ENABLE-A</b> and <b>ENABLE-B</b> inputs because it is writing a <b>Cxxx</b> parameter.  <b>CAUTION</b> The drive will start up as soon as writing is over!!!
W38	LOCKED	Editing mode cannot be accessed because parameter modification is disabled: <b>P000</b> is different from <b>P002</b> .

Warning	Message	Description
W39	KEYPAD DISABLED	The editing mode cannot be accessed because the keypad is disabled.
W40	FAN FAULT	Fan locked or disconnected or faulty.
W41	SW VERSION KO	Download impossible because of different SW Versions.
W42	IDP KO	Download impossible because of different IDPs (Identification Products).
W43	PIN KO	Download impossible because of different PINs (Part Identification Numbers).
W44	CURRENT CLASS KO	Download impossible because of different current classes.
W45	VOLTAGE CLASS KO	Download impossible because of different voltage classes.
W46	DOWNLOAD KO	Download impossible (generic cause).
W48	OT Time over	The preset threshold for the drive Operation Time has been exceeded.
W49	ST Time over	The preset threshold for the drive Supply Time has been exceeded.
W50	NTC Fault	NTC sensor for heatsink temperature disconnected or faulty

Table 2: Warning list

## 5.5. State List

Number	State	Description
0	ALARM!!!	Alarm tripped
1	START UP	The drive is starting up
2	MAINS LOSS	Mains loss
3	TUNING	The drive is tuning
4	SPEED SEARCHING	Searching for motor speed
5	DCB at START	DC Braking at start
6	DCB at STOP	DC Braking at stop
7	DCB HOLDING	DC current for Hold function
8	DCB MANUAL	Manual DC Braking
9	LIMIT IN ACCEL.	Current/torque limit while accelerating
10	LIMIT IN DECEL.	Current/torque limit while decelerating
11	LIMIT IN CONSTANT RPM	Current/torque limit at constant rpm
12	BRAKING	Braking module startup or deceleration ramp extension
13	CONSTANT RUN	Drive running at speed set point
14	IN ACCELERATION	Drive running with motor in acceleration stage
15	IN DECELERATION	Drive running with motor in deceleration stage
16	INVERTER OK	Drive on Stand-by with no alarms tripped
17	FLUXING	Motor fluxing stage
18	MOTOR FLUXED	Motor fluxed
19	FIRE MODE RUN	Constant rpm in Fire Mode
20	FIRE MODE ACCEL.	Acceleration in Fire Mode
21	FIRE MODE DECEL.	Deceleration in Fire Mode
22	INVERTER OK*	Drive on Stand-by with no alarms tripped, but void warranty due to alarm trip in Fire Mode
25	SPARE	Board in Spare mode
27	WAIT NO ENABLE	Waiting for <b>ENABLE-A</b> and <b>ENABLE-B</b> inputs opening
28	WAIT NO START	Waiting for <b>START</b> input opening
29	PIDOUT min DISAB	Drive disabled due to PID output < Min.
30	REF min DISAB.	Drive disabled due to REF < Min.
31	IFD WAIT REF.	Drive enabled with IFD control waiting for reference in order to start
32	IFD WAIT START	Drive enabled with IFD control waiting for START in order to start
33	DISABLE NO START	When fluxing, the RUN command was not given within the max. time set in <b>C183</b> . The drive is kept disabled until the RUN command is given.

Table 3: State List