

• 15V0102B1 •

# SINUS PENTA

MULTIFUNCTION AC DRIVE

## BASIC USER MANUAL

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R. 02

SW Ver.1.66x

*English*

- This manual is integrant and essential to the product. Carefully read the instructions contained herein as they provide important hints for use and maintenance safety.
- This device is to be used only for the purposes it has been designed to. Other uses should be considered improper and dangerous. The manufacturer is not responsible for possible damages caused by improper, erroneous and irrational uses.
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- Elettronica Santerno assumes no responsibility for the consequences resulting by the use of non-original spare-parts.
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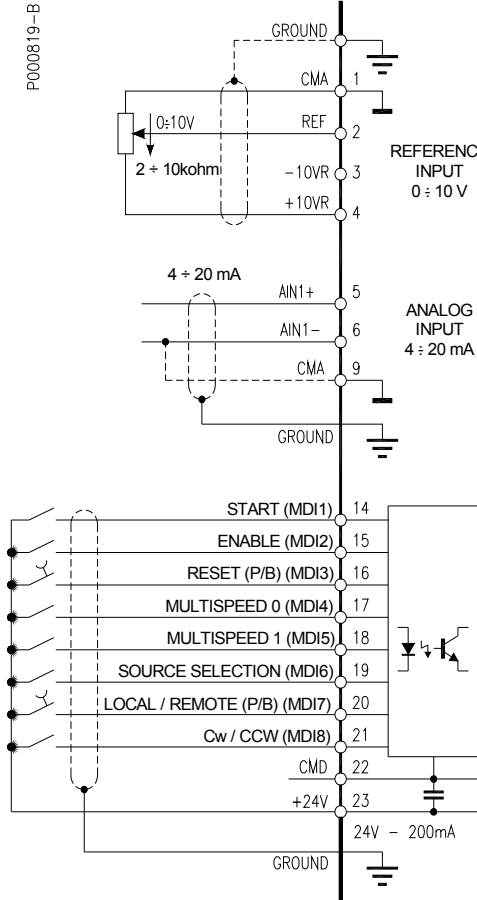
If you select "EVERY START-UP", the wizard appears whenever the Penta drive is powered on;  
 if you select "ONLY NOW", you can scroll through the menu and the wizard is disabled as soon as you quit the menu;  
 if you select "NEXT START-UP", the menu is displayed only when the Penta drive is next started 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 power	
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]
C291	PID operating mode	
C285	PID reference selection	[only if PID is active]
C288	PID feedback selection	[only if PID is active]
P267	Preset PID units of measure	[only if PID is active]
P257	PID measure scale factor	[only if PID is active]
P236	Max. value of PID output	[only if PID is active]
P237	Min. value of PID output	[only if PID is active]
P237a	PID wake up enable	[only if PID is active]
P237b	PID wake up level	[only if PID is active]

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

Press UP ARROW  
to quit  
DOWN ARROW  
to continue

<b>5) Startup:</b>	<p><b>Terminal Control:</b></p> <ul style="list-style-type: none"> <li>i) Activate the <b>ENABLE</b> input (terminal 15).</li> <li>ii) Activate the <b>START</b> input (terminal 14).</li> <li>iii) Send speed reference to REF: 0-10V (terminals 1, 2 &amp; 3) or Send speed reference to AIN1: 4-20mA (terminals 5 &amp; 6). This requires Source Selection input on MDI6 to be active (terminal 19).</li> </ul> <p>The RUN LED and REF LED will be lit and the motor will start. Make sure that the motor is rotating in the correct direction.</p> <p>If not, operate on terminal MDI5 (terminal 18) (CW/CCW) or open the <b>ENABLE</b> and <b>START</b> terminals. Shut off the drive, wait at least 5 minutes and reverse two of the motor phases.</p> <p><b>Keypad Control:</b></p> <ul style="list-style-type: none"> <li>i) Activate the <b>ENABLE</b> input (terminal 15).</li> <li>ii) Press the <b>LOCAL/REMOTE</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 the Up button to increase the speed reference.</li> </ul> <p>The RUN LED and REF LED will come on and the motor will start. Make sure that the motor is rotating in the correct direction.</p> <p>If not, press the <b>FWD/REV</b> button or press <b>STOP</b>. Shut off the drive, wait at least 5 minutes and reverse two of the motor phases.</p>	
<b>6) Possible failures:</b>	<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. 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>	
<b>7) Additional parameter alterations:</b>	<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. You can write down any custom parameters in the table given on the last page of this manual (<b>CUSTOM PARAMETERS</b>).</p>	
<b>8) Reset:</b>	<p>If an alarm trips, find the cause responsible for the alarm and reset the equipment. Enable MDI3 (terminal 16) or press the <b>RESET</b> key on the display/keypad.</p>	

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## 1.4. How to use this Manual

### 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 SpA when used in the basic mode.

The section concerning the hardware description and installation covers basic wiring only. Refer to the standard **Installation Instructions** manual to install additional options and/or to configure analog/digital inputs and outputs.

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 this case, please refer to the standard **Programming Instructions** manual.

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 standard **Installation Instructions** 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.

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## 2. HARDWARE DESCRIPTION AND INSTALLATION

### 2.1. Caution Statements

---

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. The drive may generate an output frequency up to 1000 Hz; this may cause a motor rotation speed up to 20 (twenty) times the motor rated speed: never use the motor at higher speed than the max. allowable speed stated on the motor nameplate.
3. ELECTRICAL SHOCK HAZARD – Never touch the drive electrical parts when the drive is on; always wait at least 5 minutes after switching off the drive before operating on the drive.
4. Never perform any operation on the motor when the drive is on.
5. 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 5 minutes after switching off the drive before operating on the electrical connection of the motor or the drive.
6. 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.
7. 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. Respect the environmental requirements for the equipment installation.
4. The bearing surface of the drive must be capable of withstanding high temperatures (up to 90°C).
5. 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 so as to prevent any damage caused by electrostatic discharges.



**ATTENTION**  
Static Sensitive  
Devices.  
Handle Only at  
Static Safe Work  
Stations.

**ATTENTION**  
Circuits sensibles à  
l'électricité statique.  
Manipulation uniquement  
autorisée sur un poste de  
travail protégé.

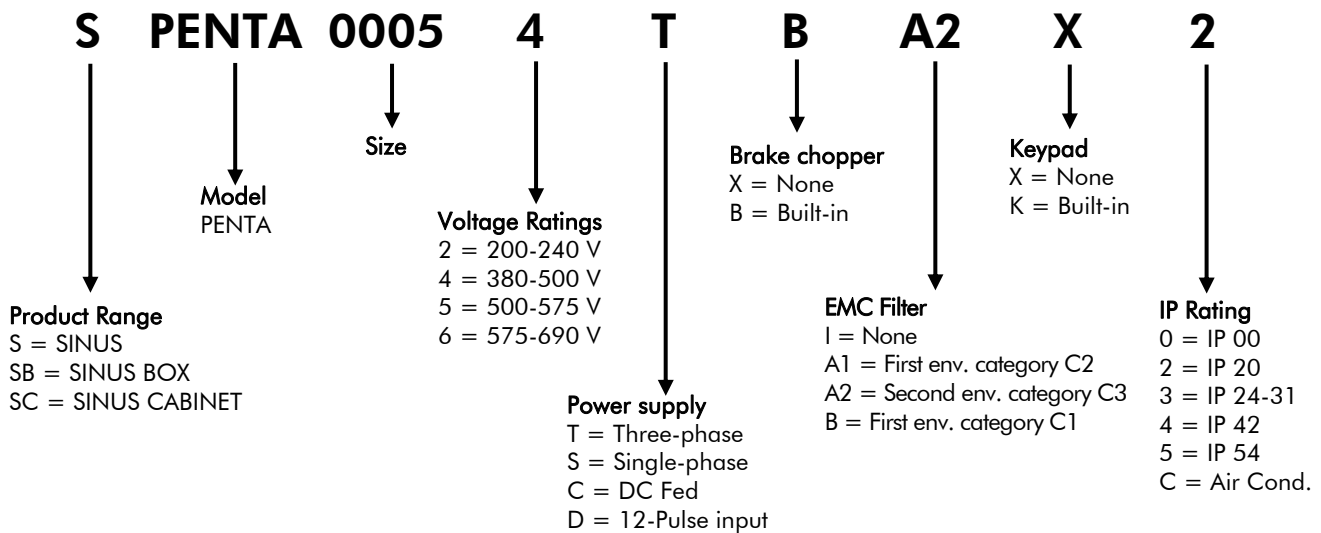
**ACHTUNG**  
Elektrostatisch gefährdete  
Bauelemente.  
Handhabung daher nur an  
geschützten Arbeitsplätzen  
erlaubt.

## 2.2. Inspection upon Receipt of the Goods

Make sure that the equipment is not damaged and that it complies with the equipment you ordered by referring to the nameplate located on the 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:



### 2.2.1. NAMEPLATE

Typical nameplate for 4T Penta Drives:




<b>ZZ0102025.34003</b>		<b>SINUS PENTA</b>		<b>0049 4T BA2K2</b>	
input AC3PH 380..500V +10/-15%	50/60Hz	80,0 A	size S20		
output AC3PH 0..500V 0..800Hz	I nom. (A)	80	I <sub>max</sub> (A) 96		
<b>UL ratings@500Vac</b>	69,0 kVA max (drive)	54,0 kW/ 72 Hp (motor)			
Short Circuit Rating: 10000 Arms@500Vac					
Aux. Contact Ratings: 5A@250Vac (resistive) 3A@250Vac 5A@30Vdc					
FOR FURTHER DETAILS SEE USER MANUAL					
Fuse (A)	100	Circ.breaker (A)	100	Cont. AC1 (A)	100
Wire size (sqmm)	25	AWG4			
application table $\frac{kW}{Hp}$				IND.CONT.EQ.	
motor voltage	light	standard	heavy	strong	2YF1
380-415V	45 60	37 50,0	30 40	25 35	E195081 MADE IN ITALY N990
440-460V	50 65,0	45 60	37 50	30 40	
480-500V	57 78,0	50 69,0	43 58,0	37 50,0	
				  	

Figure 1: Nameplate of the Penta Drive.

## 2.3. Installing the Equipment

The drives of the SINUS PENTA series (degree of protection IP20) 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**

This manual covers basic installation for Sinus Penta drives up to size S60. For more details, or for installation instructions as per sizes greater than S60, please refer to the standard **Sinus Penta's Installation Instructions** manual.



**CAUTION**

Do not install the drive horizontally or upside-down.



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

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

Operating ambient temperatures	0 – 40 °C with no derating from 40°C to 50°C with a 2% derating of the rated current for each degree beyond 40°C
Ambient temperatures for storage and transport	– 25 °C - + 70 °C
Installation environment	Pollution degree 2 or higher. Do not install in direct sunlight and in places exposed to conductive dust, corrosive gases, vibrations, water sprinkling or dripping (except for IP54 models); do not install in salty environments.
Altitude	Up to 1000 m above sea level. For higher altitudes, derate the output current of 1% every 100 m above 1,000 m (max. 4,000 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 (class 3k3 according to EN50178)
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 EN50178)
Ambient humidity during transport	Max. 95%, up to 60g/m <sup>3</sup> ; condensation may appear when the equipment is not running (class 2k3 according to EN50178)
Storage and operating atmospheric pressure	From 86 to 106 kPa (classes 3k3 and 1k4 according to EN50178)
Atmospheric pressure during transport	From 70 to 106 kPa (class 2k3 according to EN50178).



**CAUTION**

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

### 2.3.2. SIZE, WEIGHT AND DISSIPATED POWER – 2T CLASS

Size	MODEL	L	H	D	Weight	Power Dissipated at Inom
		mm	mm	mm	kg	W
S05	SINUS PENTA 0007	170	340	175	7	160
	SINUS PENTA 0008				7	170
	SINUS PENTA 0010				7	220
	SINUS PENTA 0013				7	220
	SINUS PENTA 0015				7	230
	SINUS PENTA 0016				7	290
	SINUS PENTA 0020				7	320
S10	SINUS PENTA 0016	215	391	218	10.5	350
	SINUS PENTA 0017				10.5	380
	SINUS PENTA 0020				10.5	420
	SINUS PENTA 0025				11.5	525
	SINUS PENTA 0030				11.5	525
	SINUS PENTA 0035				11.5	525
S12	SINUS PENTA 0023	215	401	225	11	390
	SINUS PENTA 0033				12	500
	SINUS PENTA 0037				12	560
S15	SINUS PENTA 0038	225	466	331	22.5	750
	SINUS PENTA 0040				22.5	820
	SINUS PENTA 0049				22.5	950
S20	SINUS PENTA 0060	279	610	332	33.2	950
	SINUS PENTA 0067				33.2	1250
	SINUS PENTA 0074				36	1350
	SINUS PENTA 0086				36	1500
S30	SINUS PENTA 0113	302	748	421	51	2150
	SINUS PENTA 0129				51	2300
	SINUS PENTA 0150				51	2450
	SINUS PENTA 0162				51	2700
S40	SINUS PENTA 0179	630	880	381	112	3200
	SINUS PENTA 0200				112	3650
	SINUS PENTA 0216				112	4100
	SINUS PENTA 0250				112	4250
S50	SINUS PENTA 0312	666	1000	421	148	4900
	SINUS PENTA 0366				148	5600
	SINUS PENTA 0399				148	6400
S60	SINUS PENTA 0457	890	1310	530	260	7400
	SINUS PENTA 0524				260	8400



### 2.3.3. SIZE, WEIGHT AND DISSIPATED POWER – 4T CLASS

Size	MODEL	L	H	D	Weight	Power Dissipated at Inom
		mm	mm	mm	kg	W
S05	SINUS PENTA 0005	170	340	175	7	215
	SINUS PENTA 0007				7	240
	SINUS PENTA 0009				7	315
	SINUS PENTA 0011				7	315
	SINUS PENTA 0014				7	315
S10	SINUS PENTA 0016	215	391	218	10.5	350
	SINUS PENTA 0017				10.5	380
	SINUS PENTA 0020				10.5	420
	SINUS PENTA 0025				11.5	525
	SINUS PENTA 0030				11.5	525
	SINUS PENTA 0035				11.5	525
S12	SINUS PENTA 0016	215	401	225	10.5	430
	SINUS PENTA 0017				10.5	490
	SINUS PENTA 0020				10.5	490
	SINUS PENTA 0025				11.5	520
	SINUS PENTA 0030				11.5	520
	SINUS PENTA 0034				12.5	680
	SINUS PENTA 0036				12.5	710
	S15				SINUS PENTA 0038	225
SINUS PENTA 0040		22.5	820			
SINUS PENTA 0049		22.5	950			
S20	SINUS PENTA 0060	279	610	332	33.2	950
	SINUS PENTA 0067				33.2	1250
	SINUS PENTA 0074				36	1350
	SINUS PENTA 0086				36	1500
S30	SINUS PENTA 0113	302	748	421	51	2150
	SINUS PENTA 0129				51	2300
	SINUS PENTA 0150				51	2450
	SINUS PENTA 0162				51	2700
S40	SINUS PENTA 0179	630	880	381	112	3200
	SINUS PENTA 0200				112	3650
	SINUS PENTA 0216				112	4100
	SINUS PENTA 0250				112	4250
S50	SINUS PENTA 0312	666	1000	421	148	4900
	SINUS PENTA 0366				148	5600
	SINUS PENTA 0399				148	6400
S60	SINUS PENTA 0457	890	1310	530	260	7400
	SINUS PENTA 0524				260	8400



### 2.3.4. POWER TERMINALS / BARS FOR S05 – S50

TERMINALS/BARS ALWAYS FITTED	
<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 positive pole of the DC-link. It can be used for: DC supply along with <b>49/-</b> ; link to the DC reactor along with <b>47/D</b> (when fitted); link to the external braking unit along with <b>48/B</b> (when fitted); link to external braking unit BU200 along with <b>49/-</b> (when the internal brake IGBT is NOT provided).
<b>49/-</b>	Link to the negative pole of the DC-link. It can be used for: DC supply along with <b>47/+</b> .

TERMINALS/BARS FITTED FOR SOME DRIVE SIZES	
<b>47/D</b>	Link to the positive pole of the DC-link. It can only be used for: link to the DC reactor along with <b>47/+</b> (if no DC reactor is used, terminal 47/D must be short-circuited to terminal 47/+ using a cable having the same cross-section as the cables used for power supply; factory connection).
<b>48/B</b>	When available, it can be used to connect the internal brake IGBT. It can only be used for: link to the external braking unit along with <b>47/+</b> or <b>50/+</b> .
<b>50/+</b>	When available, this is the link connecting the positive pole of the DC link. It can only be used for: link to the braking resistor along with <b>48/B</b> .
<b>51/+</b>	When available, this is the link connecting the positive pole of the DC link. It can only be used for: link to external braking unit BU200 along with <b>52/-</b> .
<b>52/-</b>	When available, this is the link connecting the positive pole of the DC link. It can only be used for: link to external braking unit BU200 along with <b>51/+</b> .



**NOTE** Also refer to Figure 5 (in the WIRING section).

## Terminals in S05 (4T)-S10-S15-S20:

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

## Terminals in S05 (2T):

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

**CAUTION**

Terminals **47D** and **47+** are short-circuited (factory setting). The DC choke (if any) shall be linked to terminals **47D** and **47+** after removing the short-circuit.

## Terminals in S12:

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

**CAUTION**

Terminals **47D** and **47+** are short-circuited (factory setting). The DC choke (if any) shall be linked to terminals **47D** and **47+** after removing the short-circuit.

## Terminals in S30:

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

**CAUTION**

Use terminals **48/B** and **50/+** only for the link to the external braking unit. Avoid using them for DC supply.

## Terminals in S40:

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

**CAUTION**

Use terminals **51/+** and **52/-** only for the link to external braking unit BU200. Avoid using them for DC supply.

## Connecting bars in S50:

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

## 2.3.5. CONNECTING BARS IN S60

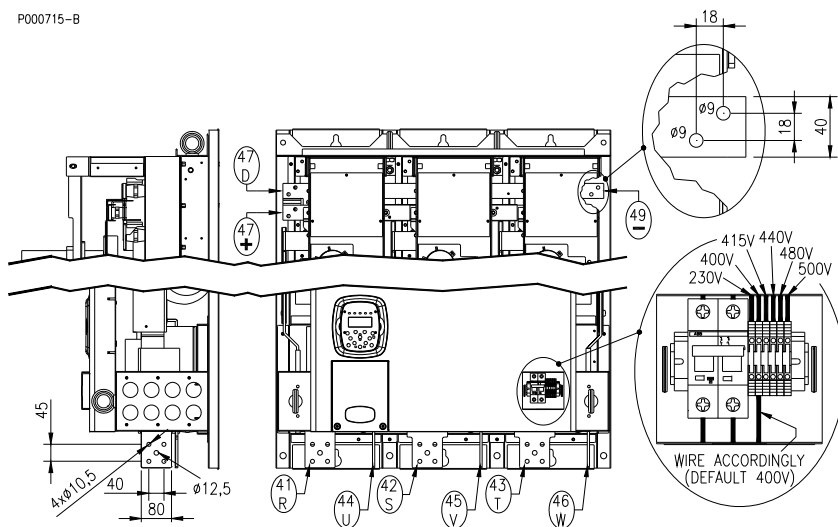


Figure 2: Connecting bars in S60.

Figure 2 shows the location and dimensions of the bars connecting S60 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.



**CAUTION**

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



### **2.3.6. CROSS-SECTIONS OF THE POWER CABLES AND SIZES OF THE SAFETY DEVICES**

The tables below state the features of the drive cables and the protecting devices required to protect the system against short-circuits.

For the largest drive sizes, special links with multiple conductors are provided for each phase. For example, 2x150 in the column relating to the cable cross-section means that two 150sqmm parallel conductors are required for each phase.

Multiple conductors shall have the same length and must run parallel to each others, thus ensuring even current delivery at any frequency value. Paths having the same length but a different shape deliver uneven current at high frequency.

Also, do not exceed the tightening torque for the terminals to the bar connections. For connections to bars, the tightening torque relates to the bolt tightening the cable lug to the copper bar. The cross-section values given in the tables below apply to copper cables.

The links between the motor and the Penta drive must have the same lengths and must follow the same paths. Use 3-phase cables where possible.

**VOLTAGE CLASS: 2T**

Size	SINUS PENTA Model	Drive 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 (13AWG)	16	16	25
	0008	15		10	1.2-1.5		16	16	25
	0010	17		10	1.2-1.5	4 (10AWG)	25	25	25
	0013	19		10	1.2-1.5		32	32	30
	0015	23		10	1.2-1.5		32	32	30
	0016	27		10	1.2-1.5	10 (6AWG)	40	40	45
	0020'	30		10	1.2-1.5		40	40	45
S10	0016	26	0.5÷10 (20÷6 AWG)	10	1.2-1.5	10 (6AWG)	40	40	45
	0017	30		10	1.2-1.5		40	40	45
	0020	30		10	1.2-1.5		40	40	45
	0025	41		10	1.2-1.5		63	63	55
	0030	41		10	1.2-1.5		63	63	60
	0035	41		10	1.2-1.5		100	100	100
S12	0023	38	.5÷25 (20÷4 AWG)	18	2.5	10 (6AWG)	63	63	60
	0033	51		18	2.5	16 (5WG)	100	100	100
	0037	65		18	2.5	25 (4AWG)	100	100	100
S15	0038	65	0.5÷25 (20÷4 AWG)	15	2.5	25 (4AWG)	100	100	100
	0040	72		15	2.5		100	100	100
	0049	80	4÷25 (12÷4 AWG)	15	2.5	25 (4AWG)	125	100	100
S20	0060	88	25÷50 (6÷1/0 AWG)	24	6-8	35 (2AWG)	125	125	125
	0067	103		24	6-8	50 (1/0AWG)	125	125	125
	0074	120		24	6-8		160	160	145
	0086	135		24	6-8	200	160	160	
S30	0113	180	35÷185 (2/0AWG÷ 350kcmils)	30	10	95 (4/0AWG)	250	200	250
	0129	195		30	10	120 (250kcmils)	250	250	250
	0150	215		30	10		315	400	275
	0162	240		30	10		400	400	275
S40	0179	300	70÷240 (2/0AWG÷ 500kcmils)	40	25-30	185 (400kcmils)	400	400	400
	0200	345		40	25-30	210 (400kcmils)	500	400	450
	0216	375		40	25-30	240 (500kcmils)	500	630	450
	0250	390		40	25-30		630	630	500
S50	0312	480	Bar	-	30	2x150 (2x300kcmils)	800	630	550
	0366	550	Bar	-	30	2x210 (2x400kcmils)	800	800	600
	0399	630	Bar	-	30	2x240 (2x500kcmils)	800	800	700
S60	0457	720	Bar	-	30	2x240 (2x500kcmils)	1000	800	800
	0524	800	Bar	-	35	3x210 (3x400kcmils)	1000	1000	1000



**CAUTION**

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

**VOLTAGE CLASS: 4T**

Size	SINUS PENTA Model	Drive 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 (13AWG)	16	16	25
	0007	12.5		10	1.2-1.5		16	16	25
	0009	16.5		10	1.2-1.5	4 (10AWG)	25	25	25
	0011	16.5		10	1.2-1.5		25	25	25
	0014	16.5		10	1.2-1.5		32	32	30
S10	0016	26	0.5÷10 (20÷6 AWG)	10	1.2-1.5	10 (6AWG)	40	40	45
	0017	30		10	1.2-1.5		40	40	45
	0020	30		10	1.2-1.5		40	40	45
	0025	41		10	1.2-1.5		63	63	55
	0030	41		10	1.2-1.5		63	63	60
	0035	41		10	1.2-1.5		100	100	100
S12	0016	26	0.5÷10 (20÷6 AWG)	10	1.2-1.5	10 (6AWG)	40	40	45
	0017	30		10	1.2-1.5		40	40	45
	0020	30		10	1.2-1.5		40	40	45
	0025	41		10	1.2-1.5		63	63	55
	0030	41		10	1.2-1.5		63	63	60
	0034	57	0.5÷25 (20÷4 AWG)	18	2.5	16 (5AWG)	100	100	100
	0036	60	18	2.5	25 (4AWG)	100	100	100	
S15	0038	65	0.5÷25 (20÷4 AWG)	15	2.5	25 (4AWG)	100	100	100
	0040	72	15	2.5	100		100	100	
	0049	80	4÷25 (12÷4 AWG)	15	2.5	25 (4AWG)	125	100	100
S20	0060	88	25÷50 (6÷1/0 AWG)	24	6-8	35 (2AWG)	125	125	125
	0067	103		24	6-8	50 (1/0AWG)	125	125	125
	0074	120		24	6-8		160	160	145
	0086	135		24	6-8		200	160	160
S30	0113	180	35÷185 (2/0AWG÷ 350kcmils)	30	10	95 (4/0AWG)	250	200	250
	0129	195		30	10	120 (250kcmils)	250	250	250
	0150	215		30	10		315	400	275
	0162	240		30	10		400	400	275
S40	0179	300	70÷240 (2/0AWG÷ 500kcmils)	40	25-30	185 (400kcmils)	400	400	400
	0200	345		40	25-30	210 (400kcmils)	500	400	450
	0216	375		40	25-30	240 (500kcmils)	500	630	450
	0250	390		40	25-30		630	630	500

(continued)

(continued)

S50	0312	480	Bar	-	30	2x150 (2x300kcmils)	800	630	550
	0366	550	Bar	-	30	2x210 (2x400kcmils)	800	800	600
	0399	630	Bar	-	30	2x240 (2x500kcmils)	800	800	700
S60	0457	720	Bar	-	30	2x240 (2x500kcmils)	1000	800	800
	0524	800	Bar	-	35	3x210 (3x400kcmils)	1000	1000	1000



**CAUTION**

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

### 3. USING THE DISPLAY/KEYPAD

#### 3.1. Overview

This paragraph covers navigation in the display/keypad.

This section contains several examples for navigation in the display/keypad unit and the UPLOAD and DOWNLOAD functions of the programming settings of the drive using the 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 Instructions** manual, 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 Instructions** manual.

#### 3.2. Menu Tree

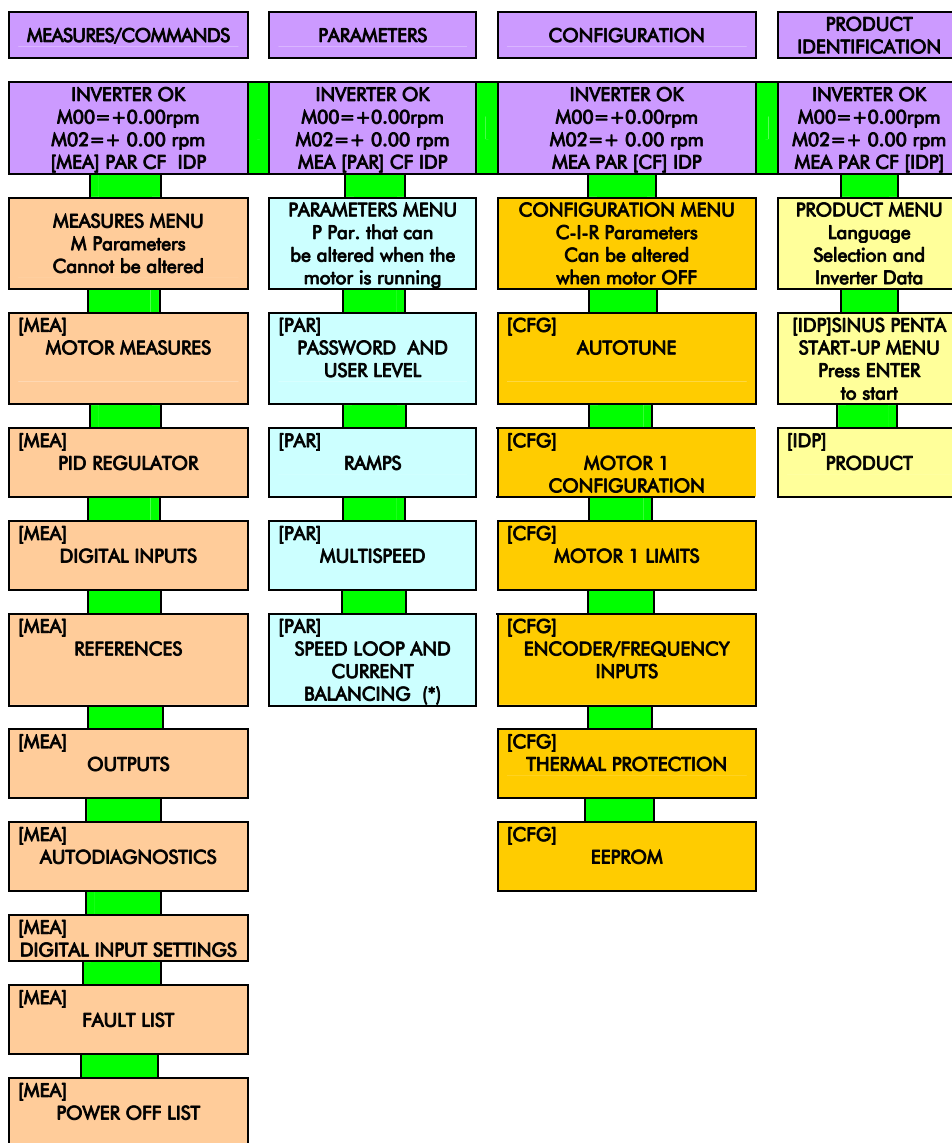
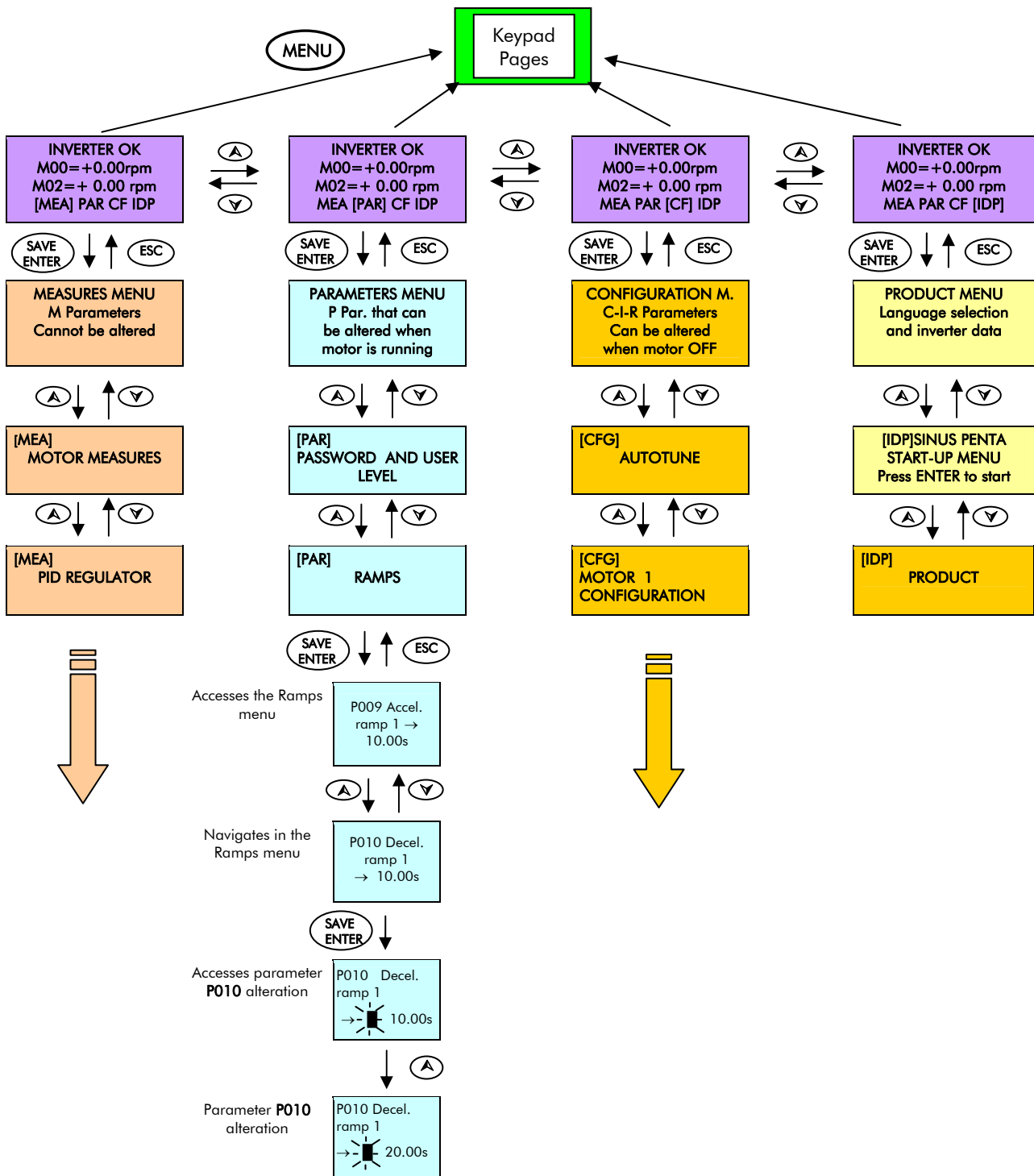


Figure 3: Menu Tree.

(\*) 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 4: Navigation example.









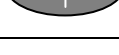



### 3.4. Function Keys

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 used by the drive is altered and is maintained until 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 (**loxx**) cannot be saved to non-volatile memory; inputs are automatically set to their default values.

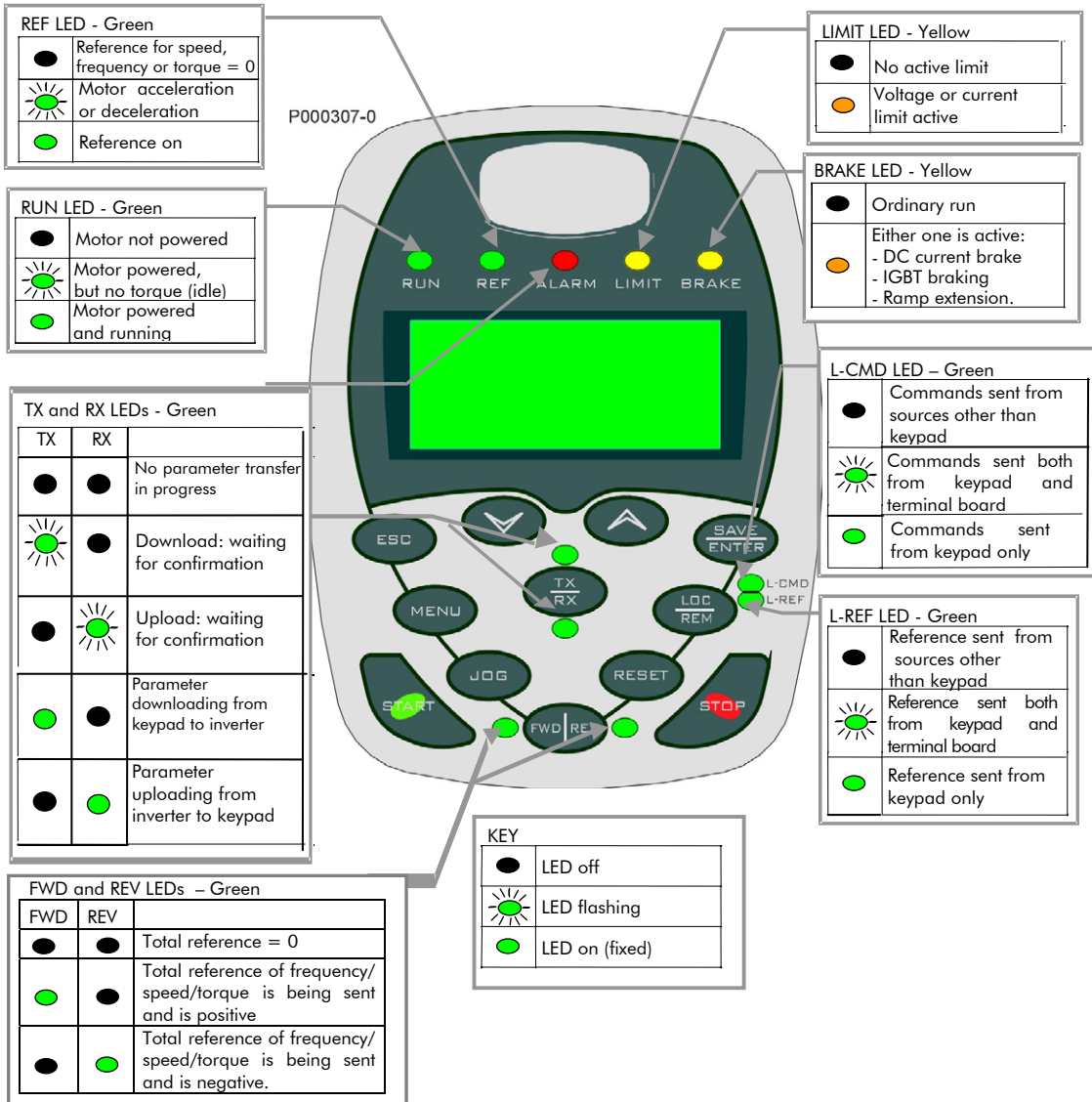
Key	Function
	In programming mode, it allows entering parameter groups and individual parameters. It is also used to accept parameter changes and write them to non-volatile memory.
	In programming mode, it steps back one level or confirms parameter changes that are not written to non-volatile memory.
	Up arrow; it scrolls through menus and submenus. It also allows parameter settings to be selected. When pressed together with the Down Arrow, it moves to the next menu.
	Down arrow; it scrolls through menus and submenus. It also allows parameter settings to be selected. When pressed together with the Up Arrow, it moves to the next menu.
	Cycles between the current parameter, the first parameter in the parameter group, the Root page, the Keypad page, the Root page again and returns to the starting page.
	Allows uploading and downloading parameter settings to and from the keypad.
	When pressed, commands and references are controlled via keypad. If pressed again, it returns to the previous configuration.
	If enabled (the command source must be selected from the keypad), it toggles between forward and reverse operation.
	If enabled (the command source must be selected from the keypad), it sets the reference speed to the preset Jog speed. It is disabled in Basic mode.
	Allows alarm trips to be reset once the cause of the alarm has been removed.
	If enabled (the command source must be selected from the keypad), it starts the motor.
	If enabled (the command source must be selected from the keypad), it stops the motor.

For a more detailed description of the function keys, please refer to the standard **Sinus Penta's Installation Instructions** manual.

### 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 drive.

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





## 4. WIRING

### 4.1. Wiring Diagram

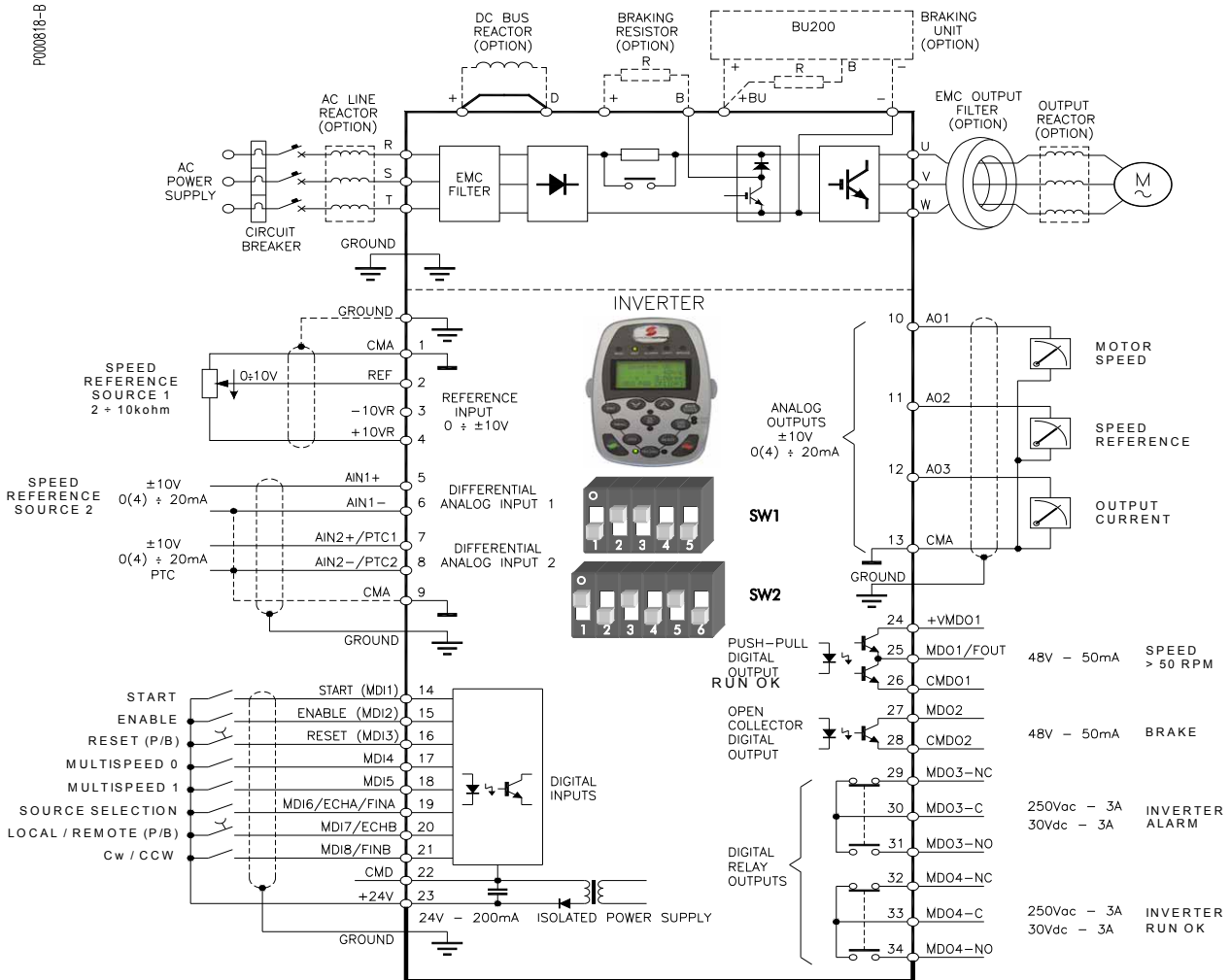


Figure 5: Wiring Diagram.



**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**

See the standard **Sinus Penta's Installation Instructions** manual for any information on accessories and optional reactors.



**NOTE**

The wiring diagram relates to factory-setting. Please refer to the Power Terminals / Bars for S05 – S50 and Connecting Bars in S60 sections for the ID numbers of the wiring terminals.



**NOTE**

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



**CAUTION**

For S60 drives only: if the power supply mains is not 400 Vac rated, the connection of the internal auxiliary transformer must be changed accordingly (see Figure 2).

## 5. MEASURES MENU

### 5.1. Overview

The Measures Menu contains the variables measured by the drive that can be used by the user. In the display/keypad, measures are divided into subgroups. The measure subgroups are the following:

No.	Measure Name	Units	Description
<b>Motor Measures Menu</b>			
M000	Speed Reference at Constant Rpm	rpm	Value of speed reference when at constant speed.
M002	Speed Ramp Output	rpm	Speed value with respect to the ramps.
M004	Motor Speed	rpm	Motor speed value.
M006	Drive Output Frequency	Hz	Frequency output to the motor.
M007	Torque Reference at Constant Speed	Nm	Value of torque reference when at constant speed.
M008	Torque Demand	Nm	Torque demand of speed regulator for VTC and FOC.
M009	Torque Generated by the Motor	Nm	Approximate torque generated for VTC and FOC.
M010	Torque Reference at Constant Rpm	%	Value of torque reference when at constant speed.
M011	Torque Demand	%	The amount of torque required for VTC and FOC.
M012	Torque Generated by the Motor	%	The value of the torque produced by the motor.
M013	Torque Limit Demand before Ramps	Nm	Torque limit value when at constant speed.
M014	Torque Limit Demand after Ramps	Nm	Torque limit value.
M013a	Speed Limit before Ramps	rpm	Speed limit value at constant speed.
M014a	Speed Limit after Ramps	rpm	Current speed limit value.
M015	Torque Limit Ref. before Ramps	%	Torque limit value at constant speed.
M016	Torque Limit Reference after Ramps	%	Torque limit value.
M017	Flux Reference	Wb	The flux required.
M026	Output Current	A	Value of the RMS output current.
M026a	Motor Thermal Capacity	%	Level of the motor heating.
M027	Output Voltage	V	Value of the RMS output voltage.
M028	Output Power	kW	Value of active power produced.
M028a	Energy Consumption	kWh	Counter of the drive energy consumption.
M029	DC-Bus Voltage	V	Value of voltage on the DC-bus.
M030	Supply Voltage	V	Value of supply voltage.

No.	Measure Name	Units	Description
<b><u>PID Regulator Menu</u></b>			
M018	PID Reference at Constant Rpm	%	Reference at constant speed for PID loop.
M019	PID Reference after Ramps	%	Reference for PID loop.
M020	PID Feedback	%	Feedback for PID loop.
M021	PID Error	%	Calculated error from PID loop.
M022	PID Output	%	Output of PID regulator.
M023	PID Reference after ramps	Custom	Reference for PID loop in custom units.
M024	PID Feedback	Custom	Feedback for PID loop in custom units.
<b><u>Digital Inputs Menu</u></b>			
M031	Delayed Digital Inputs		State of virtual control terminals after internal delay.
M032	Instantaneous Digital Inputs		Instantaneous state of virtual control terminals.
M033	Local Control Terminal Board		State of digital inputs from control terminal board.
M034	Control Terminals from Serial Link		State of virtual control terminals from serial link.
M035	Control Terminals from Field Bus		State of virtual control terminals from fieldbus.
M036	Auxiliary Digital Inputs in the Terminal Board		State of the auxiliary digital inputs in ES847 or ES870 terminal board.
M036a	M036a Auxiliary Digital Inputs via Serial Link		State of the auxiliary digital inputs via serial link.
M036b	Auxiliary Digital Inputs via PROFIdrive		State of the auxiliary digital inputs via PROFIdrive.
<b><u>References Menu</u></b>			
M037	External Analog Reference REF	V/mA	Value of analog input REF (term 1-2).
M038	External Analog Reference AIN1	V/mA	Value of analog input AIN1 (term 5-6).
M039	External Analog Reference AIN2	V/mA	Value of analog input AIN2 (term 7-8).
M039a	XAIN4 External Analog Reference	V	Voltage value of XAIN4 analog input in ES847.
M039b	XAIN5 External Analog Reference	mA	Current value of XAIN5 analog input in ES847.
M040	Speed Reference from Serial Link	rpm	Speed reference sent from serial link.
M042	Speed Reference from Field Bus	rpm	Speed reference sent from fieldbus.
M044	Torque Reference from Serial Link	%	Torque reference sent from serial link.
M045	Torque Reference from Field Bus	%	Torque reference sent from fieldbus.
M046	PID Reference from Serial Link	%	Reference for PID loop sent from serial link.
M047	PID Reference from Field Bus	%	Reference for PID loop sent sent from fieldbus.
M048	PID Feedback from Serial Link	%	Feedback for PID loop sent from serial link.
M049	PID Feedback from Field Bus	%	Feedback for PID loop sent from fieldbus.
M050	Encoder Reference	rpm	Reference provided by encoder input.
M051	Frequency Input Reference	Hz	Pulse frequency input used as a reference.

No.	Measure Name	Units	Description
<b>Outputs Menu</b>			
M056	Digital Outputs		Status of the Penta drive digital outputs.
M056a	Virtual Digital Outputs		Status of logic blocks MPL1÷4.
M057	Frequency Outputs	Hz	Value of the pulse frequency output of the Penta drive.
M058	AO1 Analog Output	%	Value of AO1 analog output of the Penta drive.
M059	AO2 Analog Output	%	Value of AO2 analog output of the Penta drive.
M060	AO3 Analog Output	%	Value of AO3 analog output of the Penta drive.
M061	Auxiliary Analog Outputs		State of the auxiliary digital outputs located on the expansion board.
<b>Temperature Measures from PT100 Menu</b>			
M069	PT100 Measure in Channel 1	°C	Temperature detected in analog channel 1 in ES847.
M070	PT100 Measure in Channel 2	°C	Temperature detected in analog channel 2 in ES847.
M071	PT100 Measure in Channel 3	°C	Temperature detected in analog channel 3 in ES847.
M072	PT100 Measure in Channel 4	°C	Temperature detected in analog channel 4 in ES847.
<b>Autodiagnosics Menu</b>			
M052/ M054	Functioning Times	sec	The ST ( Supply Time) and OT ( Operation Time) are displayed.
M062	Room Temperature Measure	°C	Temperature measured on the control board.
M064	IGBT Heatsink Temperature	°C	Temperature of IGBT/heatsink (not for all models)
M065	Operation Time Counter	h	Time elapsed after resetting the operation time counter.
M066	Supply Time Counter	h	Time elapsed after resetting the supply time counter.
M089	Drive State		Current condition of the drive.
M090	Active Alarm		Active alarm tripped.
<b>Data Logger Measures Menu</b>			
M100	Data Logger Status (Line 3)+ ES851 Fault (Line 4)		Status (interlocked or not interlocked) and alarm tripped for Data Logger ES851.
M101	Connection Status		Status of the connections supported by ES851 Data Logger board.
<b>Digital Input Settings Menu</b>			
	MDI1÷8		Status of the functions programmed for digital inputs MDI1÷8 in the Penta drive.
	MPL1÷4		Status of the functions programmed for logic blocks MPL1÷4.
	XMDI1÷8		Status of the functions programmed for auxiliary digital inputs XMDI1÷8 in ES847 or ES870 optional boards.

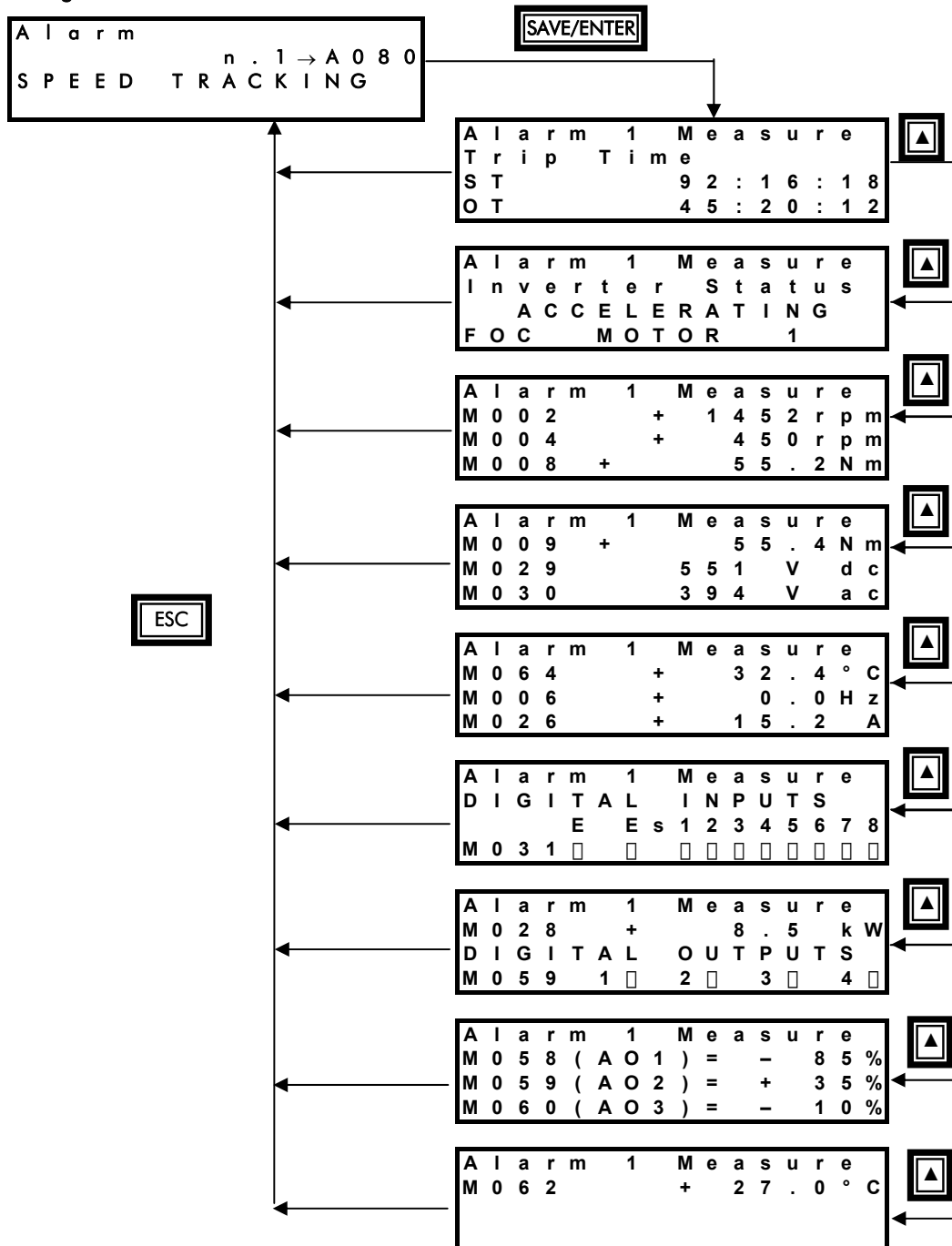
## 5.2. Fault List Menu/Power Off List Menu

Scroll the **Fault List Menu** or **Power Off List Menu** to display the codes of the last eight alarms tripped and the last eight poweroff conditions. These are listed in two separate submenus.

Press the **SAVE/ENTER** key to access the alarm submenu and navigate to each value measured by the drive when the alarm tripped or the drive was turned off.

The diagram below shows a navigation example for the **Fault List Menu** (relating to alarm n.1 in particular). Note that n.1 is the last alarm tripped and n.8 is the first alarm tripped. The Poweroff Menu shows similar information. The measures marked with **Mxxx** are the same measures used in this section.

Example of navigation in the Fault List Menu



## 6. PRODUCT MENU

### 6.1. Overview

The Product menu contains parameter **P263 Language** (allowing selecting the dialogue language), the Fire Mode Enable Password and the information related to the product (information is read-only):

Product Name and Type
SW Application
SW Versions
Serial Number
Manufacturer

### 6.2. Parameter P263 and Fire Mode Enable Password

Parameter	FUNCTION	User Level	DEFAULT VALUE
P263	Language	BASIC	1:ENGLISH
	Fire Mode Enable Password	BASIC	0

Table 1: Parameter P263 and Fire Mode enable Password.

#### P263 Language

<b>P263</b>	Range	0: ITALIANO 1: ENGLISH 2: ESPANOL 3: PORTUGUES 4: DEUTSCH
	Default Level	1: ENGLISH BASIC
	Address	863
	Function	The dialog language is factory set to English. Use parameter <b>P263</b> to choose a different language. The software implemented in the display/keypad is called MMI (Man/Machine Interface); its version is displayed in the SW screen of the Product Menu.



**NOTE**

By request, Elettronica Santerno can provide the extended version of the MMI software containing additional languages.

**Product Name and Type**

<b>Product Name and Type</b>	<b>Function</b>	This screen displays the product name and type.

**SW Application**

<b>SW Application</b>	<b>Function</b>	This screen displays the type of software application which is implemented in the drive (e.g. Multipump, Regenerative, etc...). See Elettronica Santerno's Catalogue about Software Accessories. For the application software downloading instructions see the Applications' Manuals.

**SW Versions**

<b>SW Versions</b>	<b>Function</b>	This screen displays the SW versions implemented in the drive.  Texas → SW version of the DSP Texas module MMI → SW version of the MMI implemented in the display/keypad Motorola → SW version of the Motorola microprocessor.

**Serial Number**

<b>Serial Number</b>	<b>Function</b>	This is the Serial Number of the drive. The serial number is required when contacting ELETTRONICA SANTERNO's CUSTOMER SERVICE in order to activate the Fire Mode.

**Fire Mode Enable Password**

<b>Fire Mode Enable Password</b>	<b>Function</b>	Do the following to get the password enabling Fire Mode: 1. Contact Elettronica Santerno's Customer Service; 2. Provide the Serial Number of your drive; 3. Enter the password given.



**CAUTION** The Fire Mode Enable Password is set to 0 when the Restore Default is performed.

**Manufacturer**

<b>Manufacturer</b>	<b>Function</b>	The name of Elettronica Santerno is displayed, followed by Elettronica Santerno's website ( <a href="http://www.elettronicasanterno.com">www.elettronicasanterno.com</a> ).

## 7. PASSWORD AND USER LEVEL MENU

### 7.1. Overview

The Password and User Level menu allows altering the programming parameters and sets their visibility.

### 7.2. List of Parameters P000 and P001

Parameter	FUNCTION	User Level	DEFAULT VALUE
P000	Write Enable	BASIC	00001
P001	Programming Level	BASIC	0:[Basic]

Table 2: List of parameters P000 and P001.

#### P000: Write Enable

Factory setting is **P000 = 1** (parameter write is enabled). To access parameter **P000** allowing parameter write, access the Password and User Level Menu from the Parameters Menu.

<b>P000</b>	Range	00000 ÷ 32767	00000: [No] ÷ 32767
	Default	1	1
	Level	BASIC	
	Address	Cannot be accessed via serial link. Parameter write via serial link is always enabled.	
Function	Set the correct value in <b>P000</b> to enable parameter write. The default password for <b>P000</b> is 00001. You can enter a custom password in <b>P002</b> .		

#### P001: User Level

<b>P001</b>	Range	0: Basic 1: Advanced 2: Engineering
	Default	0: Basic
Function	<p>The drive programming parameters are grouped by user levels based on their functions (more or less complex functions). Some menus, or some parts of menus, are not displayed when a given user level is selected. When the BASIC user level is selected when the drive parameterization is correct, navigation is easier, as only frequently accessed parameters are displayed. The User Level is stated for each parameter. <b>This manual covers Basic parameters only. For Advanced or Engineering parameters, please refer to the standard Sinus Penta's Programming Instructions manual.</b></p>	



## 8. RAMPS MENU

### 8.1. Overview

An acceleration/deceleration ramp is a function allowing a linear variation of the motor speed. The ramp time is the time the motor takes to reach its max. speed when it starts from zero speed (or the time the motor takes to reach 0 speed when decelerating).

### 8.2. List of Parameters P009 and P010

Parameter	FUNCTION	User Level	DEFAULT VALUE
P009	Speed Ramp 1: Acceleration Time	BASIC	See relevant table in the <b>Programming Instructions</b> manual
P010	Speed Ramp 1: Deceleration Time	BASIC	See relevant table in the <b>Programming Instructions</b> manual

Table 3: List of parameters P009 and P010.

#### P009 Speed Ramp 1: Acceleration Time

P009	Range	0 ÷ 327000 s
	Default	See relevant table in the <b>Programming Instructions</b> manual
	Function	Determines the time the reference takes to go from 0 rpm to the max. preset speed (considering the max. value between absolute values for max. speed and min. speed set for the selected motor). If S ramps are used, the actual time the reference takes to reach constant rpm exceeds the time set in <b>P009</b> for a percentage equal to $(P022 + P023)/2$ .

#### P010 Speed Ramp 1: Deceleration Time

P010	Range	0 ÷ 327000 s
	Default	See relevant table in the <b>Programming Instructions</b> manual
	Function	Determines the time the reference takes to go from the max. preset speed (considering the max. value between absolute values for max. speed and min. speed set for the selected motor) to zero rpm. If S ramps are used, the actual time the reference takes to reach 0 speed exceeds the time set in <b>P010</b> for a percentage equal to $(P024 + P025)/2$ .

## 9. MULTISPEED MENU

### 9.1. Overview

The Preset Speed menu sets the values for 3 **preset speeds** (or **multispeeds**) references set in parameters **P081** to **P085**. Their application method is set in **P080**.

The desired speed is selected through the digital inputs described in the **Digital Inputs Menu** (see the standard **Sinus Penta's Programming Instructions** manual).

### 9.2. List of Parameters P080 to P085

Parameter	FUNCTION	User Level	DEFAULT VALUE
P080	Multispeed Function	BASIC	0:Preset Speed
P081	Output Speed Mspd1	BASIC	0.00 rpm
P083	Output Speed Mspd2	BASIC	0.00 rpm
P085	Output Speed Mspd3	BASIC	0.00 rpm

Table 4: List of parameters P080 to P085.

#### P080 Multispeed Function

P080	Range	0: Preset Speed, 1: Sum Speed, 2: Exclusive Preset Speed
	Default	0: Preset Speed
	Function	<p>Defines the functionality of the multispeed values for the global speed reference. Three functions are available:</p> <ul style="list-style-type: none"> <li>0: [ Preset Speed ] → the selected <b>multispeed</b> is the actual rpm value (upon limit due to min. and max. speed parameters for the selected motor) of the motor speed reference. If no <b>multispeed</b> is selected (<i>no digital input programmed for multispeed selection is activated, or all digital inputs programmed for multispeed selection are deactivated</i>), the speed reference is the reference for the sources set in the <b>Control Method Menu</b> (see the standard <b>Sinus Penta's Programming Instructions</b> manual).</li> <li>1: [ Sum Speed ] → the reference relating to the selected multispeed is considered as the sum of the references for the other reference sources selected in the Control Method Menu (see the standard <b>Sinus Penta's Programming Instructions</b> manual).</li> <li>2: [ Exclusive Preset Speed ] → the selected multispeed is the actual rpm value (upon saturation due to min. and max. speed parameters for the selected motor) of the motor speed reference. Unlike function 0 [Preset Speed], if no multispeed is selected (<i>no digital input programmed for multispeed selection is activated, or all digital inputs programmed for multispeed selection are deactivated</i>) <b>the speed reference is zero</b>.</li> </ul>

#### P081+P085 Output Speed n.1 (n.2 / n.3)

P081+P085	Range	±32000 rpm
	Default	0.00 rpm
	Function	Determines the value of the output speed for the selection of multispeed performed with the relevant digital inputs. This multispeed reference selected via the digital inputs will be processed based on <b>P080</b> .

## 10. SPEED LOOP AND CURRENT BALANCING MENU (VTC & FOC ONLY)

### 10.1. Overview

The Speed Loop and Current Balancing Menu (VTC and FOC controls only) allows setting the parameter values of the speed regulators. The speed regulator for each motor has two parameterization functions: two integral terms, two proportional terms and two speed error thresholds (expressed as a percentage of the motor rated speed).

The response of the speed regulator can be dynamically linked with the speed error; in this way, the speed regulator will be more sensitive to remarkable speed errors and less sensitive to negligible speed errors.

Factory setting: because two identical error thresholds are set, only two parameters are used: **Max. Integral time** and **Min. Proportional Constant**.

### 10.2. List of Parameters P125 to P131

Parameter	FUNCTION	User Level	Default Value
P125	Minimum Integral Time	BASIC	500 ms
P126	Maximum Integral Time	BASIC	500 ms
P128	Minimum Proportional Coefficient	BASIC	10.00
P129	Maximum Proportional Coefficient	BASIC	10.00
P130	Minimum Error Threshold	BASIC	1.00%
P131	Maximum Error Threshold	BASIC	1.00%

Table 5: List of parameters P125 to P131.

#### P125 Minimum Integral Time

P125	Range	0.001 ÷ 32.000 [Disable] ms
	Default	500 ms
	Control	VTC and FOC
	Function	This parameter sets the min. integral time for the speed regulator. It may be accessed only if the min. and max. error thresholds are different (P130≠P131).

#### P126 Maximum Integral Time

P126	Range	0.001 ÷ 32.000 [Disable] ms
	Default	500 ms
	Control	VTC and FOC
	Function	This parameter sets the max. integral time for the speed regulator.

**P128 Minimum Proportional Coefficient**

<b>P128</b>	<b>Range</b>	0.00 ÷ 650.00
	<b>Default</b>	10.00
	<b>Control</b>	VTC and FOC
	<b>Function</b>	This parameter sets the min. proportional coefficient for the speed regulator. Default value (10): if a speed error of 1% occurs, the regulator will require 10% of the rated motor torque.

**P129 Maximum Proportional Coefficient**

<b>P129</b>	<b>Range</b>	0.00 ÷ 650.00
	<b>Default</b>	10.00
	<b>Control</b>	VTC and FOC
	<b>Function</b>	This parameter sets the max. proportional coefficient for the speed regulator. Default value (10): if a speed error of 1% occurs, the regulator will require 10% of the motor rated torque. This parameter may be accessed only if the min. and max. error thresholds are different ( <b>P130</b> ≠ <b>P131</b> ).

**P130 Minimum Error Threshold**

<b>P130</b>	<b>Range</b>	0.00 ÷ 320.00
	<b>Default</b>	1.00%
	<b>Control</b>	VTC and FOC
	<b>Function</b>	This parameter determines the min. error threshold. If <b>P130</b> = <b>P131</b> or in case of speed errors lower than or equal to the min. threshold, parameters <b>P126</b> and <b>P128</b> will be used.

**P131 Maximum Error Threshold**

<b>P131</b>	<b>Range</b>	0.00 ÷ 320.00
	<b>Default</b>	1.00%
	<b>Control</b>	VTC and FOC
	<b>Function</b>	This parameter sets the max. error threshold. If <b>P130</b> = <b>P131</b> or in case of speed errors greater than or equal to the max. threshold, parameters <b>P125</b> and <b>P129</b> will be used.

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## 11. AUTOTUNE MENU

### 11.1. Overview

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**NOTE** See the STARTUP section for tuning based on the control algorithm to be used.



**NOTE** At the end of the Autotune procedure, the system automatically saves the whole parameter set of the drive.



**NOTE** Autotune must be performed only after entering the motor ratings or the ratings of the encoder used as a speed feedback. Please refer to the MOTOR CONTROL MENU and the ENCODER/FREQUENCY INPUTS MENU.

The selected motor may be tuned in order to obtain the machine ratings or the parameterization required for the correct operation of the control algorithms. The user can also check the proper operation/wiring of the encoder used as a speed feedback.

The Autotune menu includes two programming inputs, **I073** and **I074**. Input **I073** allows enabling and selecting the type of autotune. Input **I074**—which can be programmed only if **I073** = Motor Tune— describes the type of autotune which is performed. Because the values set in **I073** or **I074** cannot be changed once for all and are automatically reset after autotuning, the **ENABLE** signal must be disabled and the **ESC** key must be pressed to accept the new value.

### 11.1.1. MOTOR AUTOTUNE AND ADJUSTING LOOPS

Set **I073** as Motor Tune to enable autotune functions that can be selected with **I074**.



**NOTE**

For the correct operation of the tuning algorithms, enter the motor ratings and the ratings of the encoder used as a speed feedback. Please refer to the MOTOR CONTROL MENU and the ENCODER/FREQUENCY INPUTS MENU.

I074 Setting	Motor Rotation	Type of Tune
0: All Ctrl No Rotation	No	<b>Automatic</b> estimation of the stator resistance and the leakage inductance. If no-load current (C018) is zero, no-load current values are computed based on the rated power of the connected motor. Tuning mode required for the correct operation of the control algorithms.
1: Foc Auto No Rotation	No	<b>Automatic</b> autotune of the current loop. Tuning mode required for the correct operation of FOC algorithm. If autotune of the current loop fails (Alarm <b>A065</b> Autotune KO trips), the current loop may be manually tuned (see 4: FOC Man Rotation (Current)). While autotuning, the system can monitor the reference current and the current obtained in analog outputs AO2 and AO1 respectively.
2: Foc Auto + Rotation	Yes	<b>Automatic</b> estimation of the rotor time constant. Tuning mode required for the correct operation of FOC algorithm. After entering the correct no-load current value (parameters <b>C021</b> ) and tuning the current loop, the system can measure the rotor time constant for no-load rotation of the connected motor up to 90% of its constant speed.
3: Vtc/Foc Man Rotation (Speed)	Yes	<b>Manual</b> tune of the current loop. Analog outputs AO1 and AO2 are displayed, showing the speed reference and the speed value obtained with the preset parameters of the speed regulator (see the SPEED LOOP AND CURRENT BALANCING MENU (VTC & FOC ONLY)). Set the current regulator's parameters in order to reduce to a minimum the difference between the two waveforms.
4: FOC Man No Rotation (Current)	No	<b>Manual</b> tune of the current loop. If automatic tuning 1: FOC Auto No Rotation fails, the current loop may be manually tuned. Display the values in analog outputs AO1 and AO2, showing the current reference value and the current value measured. Set the current regulator's parameters (see the standard <b>Sinus Penta's Programming Instructions</b> manual) in order to reduce to a minimum the difference between the two waveforms.
5: FOC Man No Rotation (Flux)	No	<b>Manual</b> tune of the flux loop. The correct parameters of the flux regulator are calculated whenever the rotor time constant value changes (see 2: FOC Auto Rotation). However, you can manually tune the flux loop. Display the values in analog outputs AO1 and AO2, showing the flux reference value and the flux value obtained. Set the current regulator's parameters in order to reduce to a minimum the difference between the two waveforms. See the standard <b>Sinus Penta's Programming Instructions</b> manual.

Table 6: Programmable "Motor Tune" functions.



**NOTE**

If a **manual tune** is selected, do the following to quit the function: disable the **ENABLE** command and set **I073** = [0: Disable].

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## 11.1.2. CHECKING THE ENCODER OPERATION

Set I073 as Encoder Tune to check the correct operation of the encoder selected as a speed feedback (see the ENCODER/FREQUENCY INPUTS MENU) and to automatically set the correct direction of rotation.

**NOTE**

Before checking the correct operation of the encoder used as a speed feedback, **enter the motor ratings and the encoder ratings.**

Please refer to the MOTOR CONTROL MENU and the ENCODER/FREQUENCY INPUTS MENU.

Once **I073** is set as Encoder Tune and the **ENABLE** and **START** commands are enabled, the connected motor attains a speed of rotation of approx. 150 rpm; its speed of rotation is detected by the encoder, then the drive is disabled. The following messages can be displayed on the display/keypad:

**A059 Encoder Fault**

**W31 Encoder OK**

Then the following message is always displayed:

**W32 OPEN ENABLE**

If alarm **A059 Encoder Fault** trips: in the encoder input, the value measured by the drive does not match with the real speed of rotation of the motor. Check that the encoder is properly set up (see the ENCODER/FREQUENCY INPUTS MENU) and wired; if the Encoder B input is used, check the Configuration of the dip-switches located on ES836 optional board (see the **Sinus Penta's Installation Instructions** manual).

If **W31 Encoder OK** appears: the speed feedback from encoder is correct.

The autotune function also sets the encoder signal as feedback with parameter **C199**.

## 11.2. List of Inputs I073 and I074

Input	FUNCTION	User Level
I073	Type of Autotune	BASIC
I074	Type of Motor Tune	BASIC

Table 7: List of Inputs I073 and I074.

### I073 Type of Autotune

I073	Range	0: Disable 1: Motor Tune 2: Encoder Tune
	Default	This is not a programming parameter: the input is set to zero whenever the drive is powered on and whenever the command is executed.
	Function	I073 selects the type of tune to perform. If you select [1: Motor Tune]: I074 sets different types of tune for current loops, flux loops and speed loops and for the estimation of the motor ratings (see the MULTISPEED MENU section). [If you select [2: Encoder Tune]: you can check the correct operation of the encoder used as a speed feedback (see the Checking the Encoder Operation section).

### I074 Type of Motor Tune

I074	Range	0: All Auto No Rotation 1: FOC Auto No Rotation 2: FOC Auto Rotation 3: VTC/FOC Man Rotation (Speed) 4: FOC Man Rotation (Current) 5: FOC Man Rotation (Flux)
	Default	This is not a programming parameter: the input is set to zero whenever the drive is powered on and whenever the command is executed.
	Function	I074 selects the type of autotune to perform if I073 = [1: Motor Tune].



NOTE

No changes can be made to I073 and I074 when the **ENABLE** signal is present. If you attempt to change these values when **ENABLE** is active, "W34 ILLEGAL DATA" warning appears. Remove the **ENABLE** signal to set these values and activate the **ENABLE** signal to begin the selected autotune process.



NOTE

If **SAVE/ENTER** is pressed to store the changes made to I073 and I074, "W17 SAVE IMPOSSIBLE" warning appears. Use the **ESC** key instead.



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## 12. MOTOR CONTROL MENU

### 12.1. Overview

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The Sinus Penta allows configuring three different types of motors and three different types of control algorithms at the same time.

The three types of control algorithms are identified with the acronyms

- ✓ **IFD** (Voltage/Frequency Control);
- ✓ **VTC** (Vector Torque Control);
- ✓ **FOC** (Field Oriented Control).

The **Voltage/Frequency Control** allows controlling the motor by producing voltage depending on frequency.

The **Vector Torque Control (sensorless)** processes the machine equations depending on the equivalent parameters of the asynchronous machine and allows separating torque control from flux control with no need to use a transducer.

The **Field Oriented Control** is a closed-chain control requiring a speed transducer to detect the position of the motor shaft instant by instant.

#### 12.1.1. ELECTRICAL SPECIFICATIONS OF THE CONNECTED MOTOR

This group of parameters can be divided into two subunits: the first subunit includes the motor ratings, the second subunit includes the parameters of the equivalent circuit of the asynchronous machine being used.

## 12.1.2. V/F PATTERN (IFD ONLY)

This group of parameters, which is included in the **Motor Control Menu**, defines the V/f pattern trend of the drive when it is used with the IFD control algorithm. When setting the type of V/f pattern (e.g. **C013**), the following patterns can be used:

- Constant torque
- Quadratic
- Free setting

The diagram below illustrates three types of programmable patterns compared to the theoretical V/f pattern. By setting **C013 = Constant Torque**, the voltage starting value is increased slightly to produce a greater torque at fewer revs with respect to the theoretical pattern.

By setting **C013 = Quadratic**, the drive will follow a V/f pattern with a parabolic trend to suit variable torque loads such as centrifugal pumps and fans.

By setting **C013 = Free Setting**, you can program the starting voltage, the increase in voltage to 1/20 of the rated frequency and the increase in voltage to the programmable frequency. The **Advanced** user level is required.

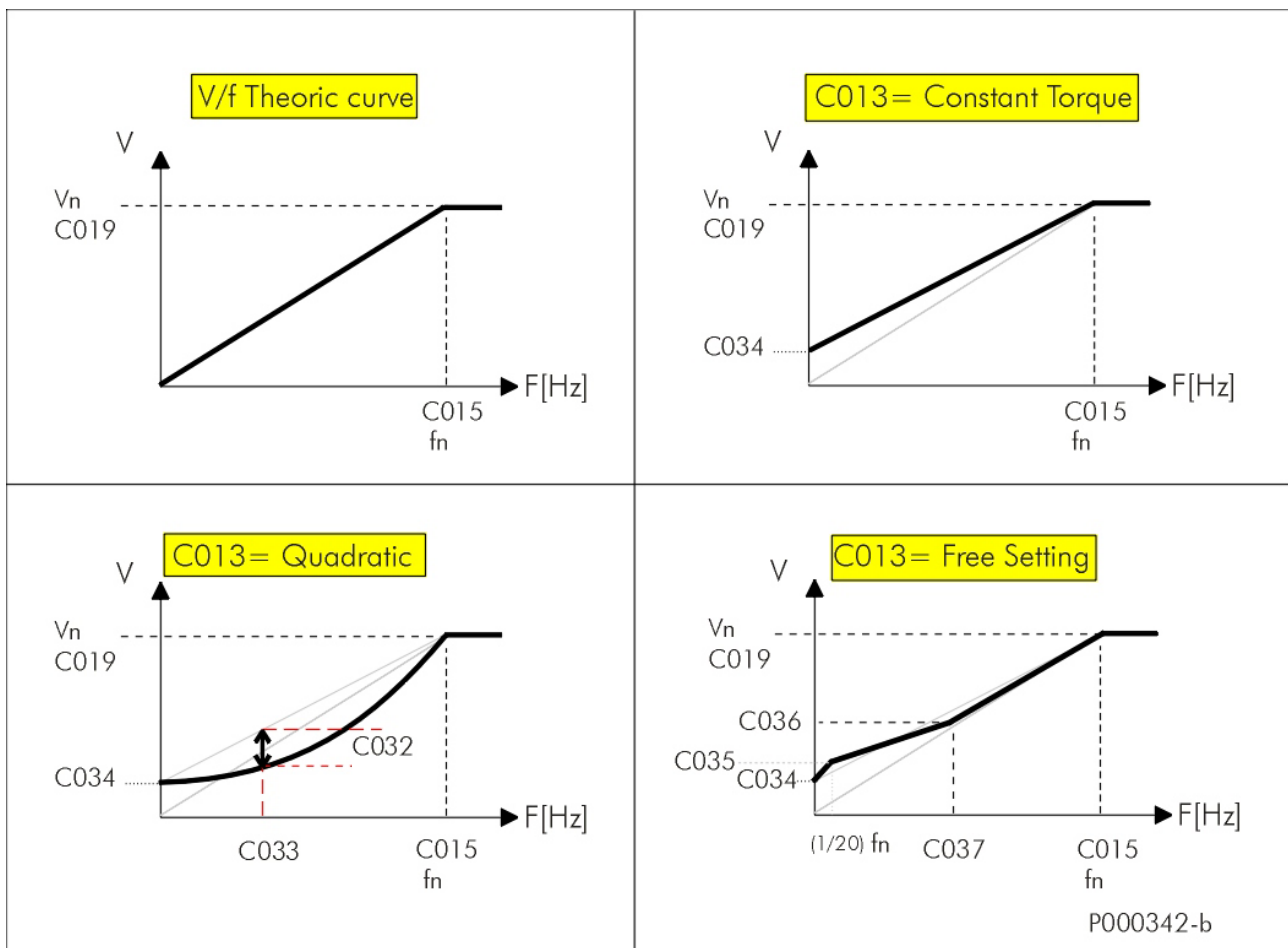


Figure 6: Types of programmable V/f patterns.

## 12.2. List of Parameters C008 to C034

Parameter	FUNCTION	User Level	DEFAULT VALUE
C008	Rated Mains Voltage	BASIC	2:[380÷480V]
C010	Type of Control Algorithm	BASIC	0: IFD
C012	Speed Feedback from Encoder	BASIC	0: No
C013	Type of V/f Pattern	BASIC	See relevant table in the Sinus Penta's <b>Programming Instructions</b> manual
C015	Rated Motor Frequency	BASIC	50.0 Hz
C016	Rated Motor Rpm	BASIC	1420 rpm
C017	Rated Motor Power	BASIC	See relevant table in the Sinus Penta's <b>Programming Instructions</b> manual
C018	Rated Motor Current	BASIC	See relevant table in the Sinus Penta's <b>Programming Instructions</b> manual
C019	Rated Motor Voltage	BASIC	Depending on the drive voltage class
C028	Min. Motor Speed	BASIC	0 rpm
C029	Max. Motor Speed	BASIC	1500 rpm
C034	Voltage Preboost	BASIC	See relevant table in the Sinus Penta's <b>Programming Instructions</b> manual

Table 8: List of parameters C008 to C034.

### C008 Rated Mains Voltage

C008	Range	0: [ 200 ÷ 240 ] V 1: 2T Regen. 2: [ 380 ÷ 480 ] V 3: [ 481 ÷ 500 ] V 4: 4T Regen. 5: [ 500 ÷ 575 ] V 6: 5T Regen. 7: [ 575 ÷ 690 ] V 8: 6T Regen.
	Default	2: [ 380 ÷ 480 ] V
	Function	This parameter defines the rated voltage of the mains powering the drive, thus allowing obtaining voltage ranges to be used for the drive operation. The setting of this parameter depends on the <b>drive voltage class</b> .



**NOTE**

Select xT Regen (where x relates to the voltage class of the drive) if the drive is DC-supplied through a regenerative Sinus Penta or a different drive used to stabilize the DC bus.

**C010 Type of Control Algorithm**

<b>C010</b>	Range	0: IFD 1: VTC 2: FOC
	Default	0: IFD
	Function	<p>This parameter sets the type of control algorithm to be used.</p> <p>Type of controls:                      0: IFD V/f control                      1: VTC Sensorless Vector Torque control                      2: FOC Field Oriented Control</p> <p><b>V/f control:</b> allows controlling the motor by producing voltage depending on frequency. It is possible to configure several types of V/f patterns (see the V/F Pattern (IFD Only) section).</p> <p><b>Sensorless Vector Control:</b> processes the machine equations depending on the equivalent parameters of the asynchronous machine, such as stator resistance (C022) and leakage inductance (C023) and allows separating torque control from flux control with no need to use a transducer. The drive can be then controlled with a torque reference instead of a speed reference.</p> <p><b>Field Oriented Control:</b> this is a closed-loop control requiring a speed transducer to detect the position of the motor shaft instant by instant. The machine equations depend on the following:  <b>magnetizing current</b>, obtained from no-load current C021;  <b>mutual inductance C024;</b>  <b>rotor time constant C025.</b></p> <p>The machine equations allow separating torque control from flux control with no need to use a transducer; the drive can be controlled with a torque reference instead of a speed reference.</p>



**NOTE** FOC control requires a speed transducer, such as an encoder feedback.

**C012 Speed Feedback from Encoder**

<b>C012</b>	Range	0: No 1: Yes
	Default	0 ÷ 1
	Control	VTC and FOC
	Function	<p>This parameter enables the encoder as a speed feedback.</p> <p>It defines the encoder characteristics and whether Encoder A (MDI6 and MDI7 in the terminal board) or Encoder B (with optional board) is used as a speed feedback (see the ENCODER/FREQUENCY INPUTS MENU).</p>

C013 Type of V/f Pattern

C013	Range	0: Constant Torque 1: Quadratic 2: Free Setting
	Default	See relevant table in the standard Sinus Penta's <b>Programming Instructions</b> manual.
	Control	IFD
	Function	<p>Allows selecting different types of V/f pattern.</p> <p>If <b>C013 = Constant torque</b>, voltage at zero frequency can be selected (Preboost, <b>C034</b>).</p> <p>If <b>C013 = Quadratic</b>, you can select voltage at zero frequency (Preboost, <b>C034</b>), max. voltage drop with respect to the theoretical V/f pattern, <b>C032</b>, and the frequency allowing implementing max. voltage drop, <b>C033</b>.</p> <p>If <b>C013 = Free Setting</b>, you can set voltage at zero frequency (Preboost, <b>C034</b>); voltage increase to 20% of the rated frequency (Boost0, <b>C035</b>); and voltage increase to a programmed frequency (Boost1, <b>C036</b>); frequency for Boost1, <b>C037</b>.</p>

C015 Rated Motor Frequency

C015	Range	1.0 Hz ÷ 1000.0 Hz
	Default	50.0 Hz
	Function	This parameter defines the rated motor frequency (nameplate rating).

C016 Rated Motor Rpm

C016	Range	1 ÷ 32000 rpm
	Default	1420 rpm
	Function	This parameter defines the rated motor rpm (nameplate rating).

C017 Rated Motor Power

C017	Range	0.1 ÷ 3200.0 kW See relevant table in the standard <b>Sinus Penta's Programming Instructions</b> manual.
	Default	See relevant table in the standard <b>Sinus Penta's Programming Instructions</b> manual.
	Function	This parameter defines the rated motor power (nameplate rating).

C018 Rated Motor Current

C018	Range	0.1 ÷ 3200.0 A See relevant table in the standard Sinus Penta's <b>Programming Instructions</b> manual.
	Default	See relevant table in the standard Sinus Penta's <b>Programming Instructions</b> manual.
	Function	This parameter defines the rated motor current (nameplate rating).

**C019 Rated Motor Voltage**

<b>C019</b>	<b>Range</b>	5.0 ÷ 1200.0 V
	<b>Default</b>	690.0V for 6T class drives 575.0V for 5T class drives 400.0V for 4T class drives 230.0V for 2T class drives
	<b>Function</b>	This parameter defines the rated motor voltage (nameplate rating).

**C028 Min. Motor Speed**

<b>C028</b>	<b>Range</b>	-32000 ÷ 32000 rpm (*)
	<b>Default</b>	0 rpm
	<b>Function</b>	This parameter defines the minimum speed of the connected motor. When references forming the global reference are at their min. relative value, the global reference equals the min. speed of the connected motor.



NOTE (\*)

The maximum allowable value (as an absolute value) for **C028** and **C029** (min. and max. motor speed) also depends on the preset **max. carrier frequency**. It can be max. 4 times the rated speed of the connected motor.



NOTE

The value set as the min. speed is used as the saturation of the global reference; the speed reference will never be lower than the value set as min. speed.



NOTE

The min. speed is not respected only when the REV command or the CW/CCW command are sent after setting a value for max. speed exceeding the min. value (**C029** > **C028** for motor 1) and with the max. reference to the drive. The motor rpm will be **-C029** < **C028**.

**C029 Max. Motor Speed**

<b>C029</b>	<b>Range</b>	0 ÷ 32000 rpm (*see note in parameter <b>C028</b> )
	<b>Default</b>	1500 rpm
	<b>Function</b>	This parameter defines the maximum speed of the connected motor. When references forming the global reference are at their max. relative value, the global reference equals the max. speed of the connected motor.

**C034 Voltage Preboost**

<b>C034</b>	<b>Range</b>	0.0 ÷ 5.0 %
	<b>Default</b>	See relevant table in the standard <b>Sinus Penta's Programming Instructions</b> manual.
	<b>Control</b>	IFD and VTC
	<b>Function</b>	Torque compensation at minimum frequency produced by the drive. IFD Control: sets the increase of the output voltage at 0Hz. VTC Control: sets the increase of the stator resistance <b>C022</b> at 0Hz.

## 13. LIMITS MENU

### 13.1. Overview

The **Limits Menu** defines the current/torque limits applied to the control functions (IFD, VTC or FOC controls) selected for the three connected motors.

For IFD control, current limits are used. Three limit current levels are available, which are expressed as a percentage of the motor rated current:

- 1) Current limit while accelerating;
- 2) Current limit at constant rpm;
- 3) Current limit while decelerating.

### 13.2. List of Parameters C043 to C045

Parameter	FUNCTION	User Level	DEFAULT VALUE
C043	Current Limit while Accelerating	BASIC	150%
C044	Current Limit at Constant Rpm	BASIC	150%
C045	Current Limit while Decelerating	BASIC	See relevant table in the standard <b>Sinus Penta's Programming Instructions</b> manual
C048	Maximum Torque	BASIC	120.0%

Table 9: List of parameters C043 to C045.

#### C043 Current Limit while Accelerating

C043	Range	0: Disabled 1.0% ÷ Min[ $I_{max\ inverter}/I_{nom\ mot}$ , 400.0%]
	Default	150%
	Control	IFD
	Function	This parameter defines the current limit while accelerating; it is expressed as a percentage of the rated current of the selected motor.

(\*) The maximum allowable value depends on the drive size.

#### C044 Current Limit at Constant Rpm

C044	Range	0: Disabled 1.0% ÷ Min[ $I_{max\ inverter}/I_{nom\ mot}$ , 400.0%]
	Default	150%
	Control	IFD
	Function	This parameter defines the current limit at constant rpm; it is expressed as a percentage of the rated current of the selected motor.

(\*) The maximum allowable value depends on the drive size.

#### C045 Current Limit while Decelerating

C045	Range	0: Disabled 1.0% ÷ Min[ $I_{max\ inverter}/I_{nom\ mot}$ , 400.0%]
	Default	See relevant table in the standard Sinus Penta's <b>Programming Instructions</b> manual
	Control	IFD
	Function	This parameter defines the current limit while decelerating; it is expressed as a percentage of the rated current of the selected motor.

(\*) The maximum allowable value depends on the drive size.

**C048 Max. Torque Limit**

<b>C048</b>	<b>Range</b>	-5000(*) ÷ 5000 (*)	-500.0% ÷ +500.0%
	<b>Default</b>	120%	
	<b>Control</b>	VTC and FOC	
	<b>Function</b>	This parameter sets the max. limit of the torque demand for the control being used. Torque is expressed as a percentage of the rated torque of the selected motor.	



## 14. ENCODER/FREQUENCY INPUTS MENU

### 14.1. Overview

Three quick acquisition digital inputs are available in the Sinus Penta control board:

- MDI6/ECHA/FINA;
- MDI7/ECHB;
- MDI8/FINB.

These inputs can be used as encoder reading (encoder A) or as frequency inputs. In addition, if ES836 optional board is used (see the standard **Sinus Penta's Installation Instructions** manual), an additional encoder reading (encoder B) is allowed.



**NOTE**

If **MDI6** and **MDI7** are used for encoder reading, only 24V Push–Pull encoders can be used.



**NOTE**

For the reversal of the encoder speed measure, properly set up parameter **C199**.

#### 14.1.1. WHEN ES836 IS NOT USED

• **Encoder reading:**

Digital inputs **MDI6** and **MDI7** are used for reading the two channels of a 24V push–pull encoder powered directly by the encoder board (see the standard **Sinus Penta's Installation Instructions** manual).

No function can be programmed for **MDI6** and **MDI7**; if you attempt to program **MDI6** and **MDI7**, alarm **A082** Illegal Encoder Configuration will trip when **ENABLE** closes.

• **Reading a Frequency Input:**

Digital inputs **MDI6** or **MDI8** can be used.

If **MDI6** is programmed as a frequency input (**FINA**) with **C189**, no other function can be programmed; otherwise, alarm **A100** MDI6 Illegal Configuration trips when **ENABLE** closes.

If **MDI8** is programmed as a frequency input (**FINB**) with **C189**, no other function can be allocated to MDI8, and ES836 optional board must not be applied to the power drive, otherwise, alarm **A101** MDI8 Illegal Configuration trips when **ENABLE** closes.

• **Reading a Frequency Input and an Encoder:**

**MDI6** and **MDI7** are used to read the push–pull encoder, and **MDI8** is used to read the frequency input. The following alarms may trip:

- **A082 Illegal Encoder Configuration**, if additional functions are allocated to **MDI6** or **MDI7**;
- **A101 MDI8 Illegal Configuration**, if additional functions are allocated to **MDI8** or if the power drive detects the presence of ES836 optional board.

## 14.2. List of Parameters C189 to C191

Parameter	FUNCTION	User Level	DEFAULT VALUES
C189	Encoder/Frequency Input Operating Mode	BASIC	0 [Not used, Not used]
C190	Number of Pls/Rev for Encoder A	BASIC	1024
C191	Number of Pls/Rev for Encoder B	BASIC	1024

Table 10: List of parameters C189 to C191.

### C189 Encoder/Frequency Input Operating Mode

C189	Range	See Table 11.
	Default	0 [Not used; Not used]
	Function	<p>This parameter determines the operating mode of quick acquisition digital inputs. If MDI8 is used as a frequency input, the optional board for encoder B is not required. MDI6 digital input may be used as a frequency input; if used along with MDI7, it can be used for encoder A reading.</p> <p>Reading both encoders A and B can be programmed; parameter C189 defines the encoder to be used as a reference source and the encoder to be used as a speed feedback.</p> <p>Configuration allowed for quick acquisition digital inputs is shown in Table 11. <b>If the encoder is used as a reference source, the detected speed value will be saturated and scaled based on the values set in P073 and P074 respectively (minimum and maximum value for the encoder rate).</b></p>

Value	When using Encoder A/FINA	When using Encoder B/FINB
0	Not used	Not used
1	EncA Feedback	Not used
2	EncA Reference	Not used
3	Not used	EncB Feedback
4	Not used	EncB Reference
5	EncA Feedback	EncB Reference
6	EncA Reference	EncB Feedback
7	EncA Reference and Feedback	Not used
8	Not used	EncB Reference and Feedback
9	MDI6 Frequency Input	Not used
10	Not used	MDI8 Frequency Input
11	MDI6 Frequency Input	EncB Reference
12	EncA Reference	MDI8 Frequency Input
13	MDI6 Frequency Input	EncB Feedback
14	EncA Feedback	MDI8 Frequency Input

Table 11: Codification of C189.

Values 7-8: the same encoder can be used both as a reference source and as a reference feedback. Value 7: encoder A can be used both as a speed feedback for the motor control and as a PID regulator reference.

**C190 Number of Pls/Rev for Encoder A**

<b>C190</b>	<b>Range</b>	256 ÷ 10000 pls/rev
	<b>Default</b>	1024
	<b>Function</b>	Defines the number of pls/rev for encoder A (encoder in the terminal board).

**C191 Number of Pls/Rev for Encoder B**

<b>C191</b>	<b>Range</b>	256 ÷ 10000 pls/rev
	<b>Default</b>	1024
	<b>Function</b>	Defines the number of pls/rev for encoder B (encoder that can be connected to ES836 optional board).

## 15. MOTOR THERMAL PROTECTION MENU

### 15.1. Overview

The Motor Thermal Protection function protects the motor against overloads. Some Sinus Penta models allow setting the heatsink temperature for the activation of the cooling fans.

For each programmable motor, thermal protection can be configured in 4 modes, which can be selected with parameter **C265** (or **C268** or **C271** for motor 2 and 3 respectively), depending on the cooling system being used (configuration modes 1, 2 and 3) or whether a PTC is used (configuration 4):

<b>0:NO</b>	<b>[NO]</b>	The Motor Thermal Protection function is disabled (factory-setting);
<b>1:YES</b>	<b>[No Derated]</b>	The Motor Thermal Protection function is active with pick-up current <b>I<sub>t</sub></b> independent of operating speed;
<b>2:YES A</b>	<b>[Forced Cooled]</b>	The Motor Thermal Protection function is active with pick-up current <b>I<sub>t</sub></b> depending on operating speed, with fan-cooled motor de-rating;
<b>3: YES B</b>	<b>[Self Cooled]</b>	The Motor Thermal Protection function is active; pick-up current <b>I<sub>t</sub></b> depends on operating speed and de-rating is suitable for motors having a fan keyed to the shaft.
<b>4: PTC</b>	<b>[PTC]</b>	Thermoswitch on AIN2 analog input (for PTC features, see the <b>Sinus Penta's Installation Instructions</b> manual).

When **C265**=1, 2 and 3, the motor thermal model is considered. The heating of a motor is proportional to the square of the current flowing ( $I_o^2$ ). The Motor overheated alarm (**A075**) will trip after the time "t" computed based on the motor thermal model is over.

The alarm can be reset only after a given time depending on the thermal constant (**C267**) of the motor, thus allowing for the correct cooling of the motor.

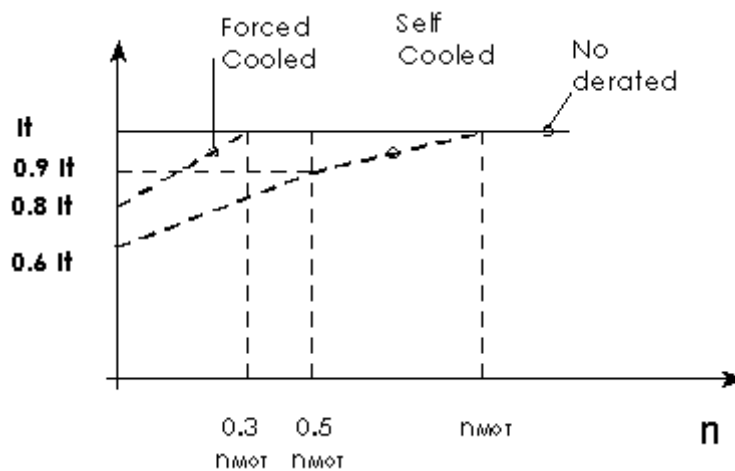


Figure 7: Trip current drop depending on speed values.

The graph above shows how trip current **I<sub>t</sub>** drops depending on the generated speed based on the value set in parameter **C265**.

**NOTE**

The motor heating can be monitored with measure **M026a**.  
This value is expressed as a percentage of the asymptotic value that can be attained.

When **C265=4**, the thermal protection function is implemented from a PTC sensor: the PTC alarm (**A055**) trips when voltage acquired by AIN2 used as a PTC signal input exceeds a preset threshold value when the characteristic temperature is attained. Alarm **A055** can be reset only if temperature decreases by 5% in respect to the trip temperature.

Please refer to the Programming Instructions manual for further information on calculating the correct value of the thermal time constant (**C267**).

## 15.2. List of Parameters C265 and C267

Parameter	FUNCTION	User Level	DEFAULT VALUE
<b>C265</b>	Thermal Protection Activation	BASIC	0:[Disabled]
<b>C267</b>	Thermal Time Constant	BASIC	360s (IEC Class 10)

Table 12: List of parameters C265 and C267.

### C265 Thermal Protection Activation

<b>C265</b>	Range	0 : [Disabled] 1 : [No Derating] 2 : [Fan Cooled] 3 : [Fan Keyed to Shaft] 4 : [PTC]
	Default	0 : [Disabled]
	Function	This parameter enables the Motor Thermal Protection function. It also selects the type of thermal protection among 3 different patterns and PTC mode (AIN2 analog input).

### C267 Thermal Time Constant

<b>C267</b>	Range	1 ÷ 10.800 s
	Default	360s (corresponding to IEC Class 10)
	Function	This parameter sets the thermal time constant of the connected motor. The thermal time constant is the time within which the calculated thermal stage has reached 63% of its final value. The motor attains its thermal time constant when it operates in constant load conditions for a time equal to approx. 5 times the constant set in this parameter.

## 16. EEPROM MENU

### 16.1. Overview

The drive has four different memory zones:

- **RAM** → Volatile memory containing the drive's current parameterization;
- **Default Zone** → Non-volatile memory that cannot be accessed by the user, containing the factory-setting of the drive parameters.
- **Work Zone** → Non-volatile memory where customized parameters are saved. Whenever the drive is reset, this parameterization is loaded to the RAM.
- **Back-up Zone** → Non-volatile memory storing a new drive parameterization. Back-up parameters are modified only when the user explicitly saves the back-up zone.

Any parameter can be changed by the user. The drive will immediately use the new parameter value.

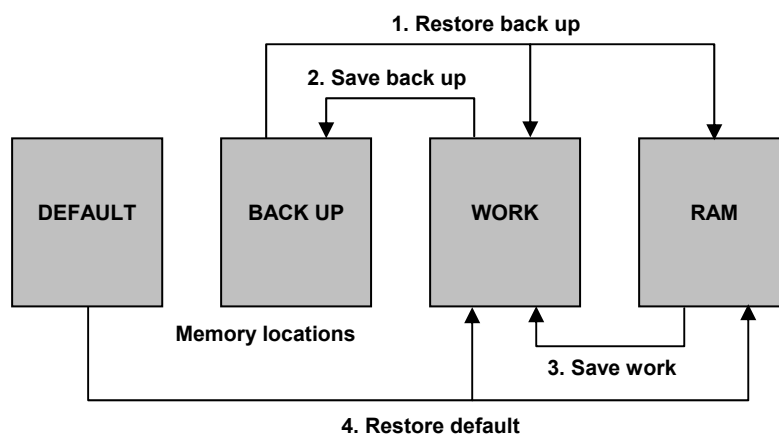
The user may save the parameter value in the Work zone. If no new value is saved for a given parameter, the drive will use the parameter value stored in the Work zone when next turned on.

- **"P"** parameters can be written at any moment.
- According to factory-setting, **"C"** parameters (see **P003** to modify them even when fluxing and when the motor is not running) can be written only if the drive is not running and the **ENABLE** command is disabled (terminal **MDI2** open).
- **"R"** parameters have the same features as **"C"** parameters, but the new parameter value, once written and saved, will be used only at next power on. To use the new parameter value immediately, turn the drive off and on or press the **RESET** key for at least 5 seconds.

The Work zone may be copied to the BACKUP zone through **I012** included in the Eeprom menu and described in the section below.

**I012** input also allows copying the Backup zone to the WORK zone in order to restore the parameter values stored in the WORK zone.

**I012** input also allows restoring the factory-setting values for all parameters in the WORK zone.



## 16.2. List of Inputs I009 to I012

Input	FUNCTION	User Level
I009	Parameter Save	BASIC
I012	EEPROM Control	BASIC

Table 13: List of programmable inputs I009 to I012.

### I009 Parameter Save

I009	Range	131 ÷ 2466
	Address	1396
	Function	Allows saving each parameter to EEPROM. The value to be saved must be the same as the value set in the Address field of the parameter concerned.

### I012 EEPROM Control

I012	Range	0: No Command 2: Restore Backup 4: Save Backup 5: Save Work 11: Restore Default
	Address	1399
	Function	<p>This parameter saves and restores the entire set of parameters that can be accessed by the user:</p> <p><b>2: Restore Backup:</b> the parameters stored in the Backup zone are copied and stored in the WORK zone. They represent the new RAM parameterization; the previous RAM parameters are cleared. <b>Backup → RAM → Work;</b></p> <p><b>4: Save Backup:</b> the parameters in the WORK zone are saved to a copy of the Backup zone. <b>Work → Backup;</b></p> <p><b>5: Save Work:</b> the current values of the parameters stored in the RAM zone are saved to non-volatile memory in the Work zone. All the parameters are saved with this command. <b>RAM → Work;</b></p> <p><b>11: Restore Default:</b> factory-setting values are restored for all parameters; each factory-setting value is stored to non-volatile memory in the Work zone. <b>Default → RAM → Work.</b></p>

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## 17. ALARMS AND WARNINGS



### CAUTION

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

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### 17.1. What Happens when a Protection Trips

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### 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).



### NOTE

Alarms **A001** to **A039** relate to the main microcontroller (DSP Motorola) of ES821 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, deactivate the **ENABLE** signal on terminal **MD12** to disable the drive and prevent the connected motor from running at uncontrolled speed.



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## 17.2. What To Do when an Alarm Trips

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**CAUTION**

If a protection trips or the drive is in emergency condition, the drive is locked and the motor starts idling!

**CAUTION**

Before resetting any alarm, disable the **ENABLE** signal on terminal **MDI2** to disable the drive and to prevent the connected motor from running at uncontrolled speed.

**Proceed as follows:**

1. Disable the **ENABLE** signal on terminal **MDI2** 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** contact is open and closed.
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.

## 17.3. Alarm Code List

Alarm	Alarm Message	Description	What to do
A001 ÷ A032	...	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, side A	<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 DGI 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	False Interrupt	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	RAM Fault	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, side A	<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, side A	<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 DGO 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>
A053	PWMA Not ON	Hardware failure, IGBT A power on impossible	<ol style="list-style-type: none"> <li>Reset the Penta drive.</li> <li>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>Check consistency of parameter <b>R023</b>.</li> <li>Contact Elettronica Santerno's Customer Service.</li> </ol>
A055	PTC Alarm	External PTC tripped	<ol style="list-style-type: none"> <li>Allow motor to cool.</li> <li>Ensure that PTC is correctly connected to AIN2.</li> <li>Ensure that SW1 is correctly set up in ES821.</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 <b>AIN2</b>.</li> <li>2. Ensure that SW1 is correctly set up in ES821.</li> </ol>
A057	Illegal XMDI in MPL	Illegal configuration of XMDI in the MPL 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	Generic Motorola	<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 ES821.</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	
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	1 ms Interrupt OverTime	<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	MMI Trouble	<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	FOC control but Encoder not enabled	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>
A088	ADC Not Tuned	<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	
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. Reset 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	SW Version KO	<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>
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 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> user level is 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 ES821.</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>
A108 ÷ A127	...	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>


Table 14: Alarm Code List.

## 17.4. 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> (MDI1) signal 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</b> (MDI2) signal to enable the drive.
W33	WRITE IMPOSSIBLE	Writing procedure impossible.
W34	ILLEGAL DATA	Illegal value entered, operation failed.
W35	NO WRITE CONTROL	Writing 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</b> command because it is writing a "C" parameter.  <b>CAUTION The drive will start up as soon as writing is over!!!</b>
W38	LOCKED	Editing mode cannot be accessed because parameter modification is disabled: <b>P000</b> is different from <b>P002</b> .

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

**Table 15: Warning list.**

## 17.5. 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	DC Braking at start
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</b> command opening
28	WAIT NO START	Waiting for <b>START</b> command 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 16: State List.



## 18. CUSTOM PARAMETERS

Use the list below to write down settings that are different from the default values.

PARAMETERS	Default Value	Custom Setting
<b><u>P00x User Level</u></b>		
P001 – User Level	0: Basic	
<b><u>Product</u></b>		
P263 – Language	1: ENGLISH	
<b><u>P00x–P03x Ramps</u></b>		
P009 – Ramp 1: Acceleration Time	[*]	
P010 – Ramp 1: Deceleration Time	[*]	
<b><u>P08x–P10x Multispeeds</u></b>		
P080 – Multispeed Function	0: Preset Speed	
P081 – Multispeed 1	0.00 rpm	
P083 – Multispeed 2	0.00 rpm	
P085 – Multispeed 3	0.00 rpm	
<b><u>P12x–P15x Speed Loop (VTC &amp; FOC ONLY)</u></b>		
P125 – Min. Integral Time	0.500 s	
P126 – Max. Integral Time	0.500 s	
P128 – Min. Proportional Coefficient	10.00	
P129 – Max. Proportional Coefficient	10.00	
P130 – Min. Error Threshold	1.00 %	
P131 – Max. Error Threshold	1.00 %	
<b><u>C00x–C04x Motor Control</u></b>		
C008 – Rated Mains Voltage	[**]	
C010 – Type of Control Algorithm	0: IFD	
C012 – Speed Feedback from Encoder (VTC & FOC ONLY)	0: No	
C013 – Type of V/f Pattern (IFD ONLY)	[*]	
C015 – Rated Motor Frequency	50.0 Hz	
C016 – Rated Motor RPM	1420 rpm	
C017 – Rated Motor Power	[*]	
C018 – Rated Motor Current	[*]	
C019 – Rated Motor Voltage	[**]	
C028 – Min. Motor Speed	0 rpm	
C029 – Max. Motor Speed	1500 rpm	
C038 – AutoBoost (IFD ONLY)	[*]	
<b><u>C04x Limits</u></b>		
C043 – Current Limit while Accelerating (IFD ONLY)	150%	
C044 – Current Limit at constant RPM (IFD ONLY)	150%	
C045 – Current Limit while decelerating (IFD ONLY)	[*]	
C048 – Torque Limit	120%	
<b><u>C18x–C19x Encoder/Frequency Input</u></b>		
C189 – UseEnc	0: A / B Not used	
C190 – PulsEncA	1024	
C191 – PulsEncB	1024	
<b><u>C26x–C27x Motor Thermal Protection</u></b>		
C265 – Thermal Protection Activation	0: Disabled	
C267 – Thermal Time Constant	360s (IEC Class 10)	

**Note:**

[\*] Parameter depending on current size.

[\*\*] Parameter depending on voltage class.