

• 15R0124B1 •

# SINUS PENTA

## S41 S42 S51 S52

MULTIFUNCTION AC DRIVE

# EXTENDED DIAGNOSTICS

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R.00

Software Ver. 1.04x

**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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## 1. OVERVIEW

The Sinus Penta S41, S42, S51, S52 inverters feature extended diagnostics functions.

Additional measures—if compared to the measures available in the display/keypad—are displayed when connecting the Sinus Penta to ES890 driver board via serial interface. In case of failure, the fault list in the driver board can be accessed. The fault list provides detailed information on events and trips, including the date and time the trips/events happened.

Elettronica Santerno provides the RemoteDrive software for the remote control of the Penta drives via serial link.

The RemoteDrive allows the following functions: image acquisition, keypad simulation, oscilloscope and multifunction tester functions, data logger, table compiler including history data, parameter setup and data reception/transmission/storage from and to a laptop, scan function for the automatic detection of the connected drives and devices (up to 247 drives and devices may be connected).

Details on the comms protocol are given in the **Sinus Penta's Programming Instructions manual**.



**NOTE** Please refer to the **Sinus Penta's Programming Instructions manual** for the hardware description of the serial links and their connecting modes.



**NOTE** The driver board serial link is available only via the SUB-D 9-pole connector in the bottom part of the equipment, close to the terminal board.



**NOTE** Please refer to the **User Manual of the RemoteDrive** software for the description on how to access the data acquired from the driver board.



**NOTE** In the **RemoteDrive** software, the driver board is called a **FB** (Firing Board) device.



**NOTE** Scan shall start from address 200 (see the description in parameter **R001 Driver Board MODBUS Address Offset**) below.

## 2. CONNECTION REQUIREMENTS

### 2.1. Hardware

- Microprocessor: Pentium 1GHz or higher
- RAM: ≥ 256Mb for Windows 2000, 512 Mb for Windows XP and 1Gb for Vista
- CD-ROM Player
- Modem or network card (only if a remote connection is to be established)
- At least 1 serial port or 1 USB port
- Video card and monitor capable of supporting a resolution display of at least 800x600

## 2.2. Software

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- Operating system: Windows™ NT4, 2000, XP, Vista
- If Windows NT4 is used, Internet Explorer 5.00 or greater is also required

## 2.3. Options Required

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RemoteDrive 2.30 or greater with configuration file "FB104X.csv".



### NOTE

The FB104X.csv file is not automatically installed when launching the RemoteDrive 2.30, but is to be manually added later.  
The FB104X.csv file is contained in the \Upgrades\devices folder in the CD-ROM for the RemoteDrive installation. It can also be downloaded from [santerno.com](http://santerno.com).

If no RS485 serial port is available, a connection kit is required based on the port being used:

1. RS232–RS485 Adaptor box, including an external 230VAC power supply unit, and its standard RS232 cable;
2. USB–RS485 Adaptor and its standard USB cable.

### 3. MEASURES

#### 3.1. General Measures Menu

Measure	FUNCTION	User Level	MODBUS Address
M200	Inverter RMS Output Current	BASIC	1650
M201	RMS Current Supply	BASIC	1737
M202	DC-Bus Voltage	BASIC	1652
M203	Vrs RMS Voltage	BASIC	1653
M204	Vst RMS Voltage	BASIC	1654
M209	Board Configuration	BASIC	1658
M210	Alarm Code/Warning Code	BASIC	1761
M211	Phase Loss Fault	BASIC	1661
M212	OC and IGBT Command Status Register	BASIC	1662
M216	Status Register of Overtemperature Faults	BASIC	1666
M217	Current Unbalance Status Register	BASIC	1667
M218	Precharge Signal Status Register	BASIC	1762

Table 1: General Measures

##### M200 Inverter RMS Output Current

<b>M200</b>	Range	0 ÷ 2000	0 ÷ 2000 A
	Active	Always active	
	Level	BASIC	
	Address	1650	
	Function	RMS output current of the inverter measured by the driver board.	

##### M201 RMS Current Supply

<b>M201</b>	Range	0 ÷ 2000	0 ÷ 2000 A
	Active	Active only if the reading transformer is connected to the inverter input.	
	Level	BASIC	
	Address	1737	
	Function	RMS input current of the inverter if the reading transformer is connected to the inverter input.	

### M202 DC-bus Voltage

<b>M202</b>	<b>Range</b>	0 ÷ 1500	0 ÷ 1500 V
	<b>Active</b>	Always active	
	<b>Level</b>	BASIC	
	<b>Address</b>	1652	
	<b>Function</b>	DC-bus voltage measured from the driver board.	

### M203 Vrs RMS Voltage

<b>M203</b>	<b>Range</b>	0 ÷ 1500	0 ÷ 1500 V
	<b>Active</b>	Always active	
	<b>Level</b>	BASIC	
	<b>Address</b>	1653	
	<b>Function</b>	Measure of the RMS voltage between supply phases R and S.	

### M204 Vst RMS Voltage

<b>M204</b>	<b>Range</b>	0 ÷ 1500	0 ÷ 1500 V
	<b>Active</b>	Always active	
	<b>Level</b>	BASIC	
	<b>Address</b>	1654	
	<b>Function</b>	Measure of the RMS voltage between supply phases S and T.	

### M209 Board Configuration

<b>M209</b>	<b>Range</b>	0 ÷ 3	0 ÷ 3
	<b>Active</b>	Always active	
	<b>Level</b>	BASIC	
	<b>Address</b>	1658	
	<b>Function</b>	Board configuration: 0: SINGLE "Single inverter" 1: MASTER "Master inverter" when two/three inverters are parallel-connected 2: SLAVE1 "Slave1 inverter" when two/three inverters are parallel-connected 3: SLAVE2 "Slave2 inverter" when three inverters are parallel-connected	

### M210 Alarm Code/Warning Code

<b>M210</b>	<b>Range</b>	1 ÷ 22	See Table 14 and Table 15
	<b>Active</b>	Always active	
	<b>Level</b>	BASIC	
	<b>Address</b>	1761	
	<b>Function</b>	Displays the code of the alarm tripped or the event fired in the driver board: - 1 to 19 for alarms A001 to A019 respectively; - 20 to 22 for warnings W001 to W003 respectively.	

**M211 Phase Loss Fault**

<b>M211</b>	<b>Range</b>	Bit-controlled	See Table 2
	<b>Active</b>	Active only in case of operation in parallel or when the optional 12-Phase Power Supply unit is available.	
	<b>Level</b>	BASIC	
	<b>Address</b>	1661	
	<b>Function</b>	Indicates the phase concerned by alarm "A006 Phase Loss Fault" (operation in parallel) or by alarm A007 (12-Phase Loss).	

Bit	Description	Notes
0	Phase R fault	Only during operation in parallel; phase loss ON
1	Phase S fault	Only during operation in parallel; phase loss ON
2	Phase T fault	Only during operation in parallel; phase loss ON
3	12Ph Phase R fault	Only if 12-Phase Power Supply is available; phase loss ON
4	12Ph Phase S fault	Only if 12-Phase Power Supply is available; phase loss ON
5	12Ph Phase T fault	Only if 12-Phase Power Supply is available; phase loss ON

**Table 2: VNE Fault Status Register****M212 OC and IGBT Command Status Register**

In the instant when the driver board generates an overcurrent trip, the status of the following digital variables is stored:

- The gate commands of the 6 IGBTs of the inverter and the external braking IGBT (if any);
- The overcurrent signals produced by the IGBT drivers;
- The overcurrent signals produced by the current sensors (they are active only when operating in parallel).

This register contains the information about a latch, that conveys information on these variables during normal operation; when overcurrent occurs, the latch keeps the bit values until the fault is reset.

<b>M212</b>	<b>Range</b>	Bit-controlled	See Table 3
	<b>Active</b>	Always active	
	<b>Level</b>	BASIC	
	<b>Address</b>	1662	
	<b>Function</b>	Indicates the status of the IGBT firing signals, the status of the overcurrent faults generated by the IGBT drivers and the status of the output current protective device.	

Bit	Description	Notes
0	Phase U IGBT High (PG_UH)	ON: IGBT conducting
1	Phase U IGBT Low (PG_UL)	
2	Phase V IGBT High (PG_VH)	
3	Phase V IGBT Low (PG_VL)	
4	Phase W IGBT High (PG_WH)	
5	Phase W IGBT Low (PG_WL)	
6	IGBT Braking Unit (PG_BR)	ON: No fault occurred
7	Phase U Overcurrent High (\OCL_U)	
8	Phase U Overcurrent Low (\CL_UN)	
9	Phase V Overcurrent High (\OCL_V)	
10	Phase V Overcurrent Low (\OCL_VN)	
11	Phase W Overcurrent High (\OCL_W)	
12	Phase W Overcurrent Low (\OCL_WN)	ON: A fault occurred
13	Phase Iu Overcurrent (F_IU)	
14	Phase Iv Overcurrent (F_IV)	
15	Phase Iw Overcurrent (F_IW)	

Table 3: FLT Fault Status Register

M216 Status Register of Overtemperature Faults

M216	Range	Bit-controlled	See Table 4
	Active	Always active	
	Level	BASIC	
	Address	1666	
	Function	Indicates the inverter arm where the overtemperature sensor has tripped.	

Bit	Description	Notes
0	12Ph Fault	Overtemperature sensor on the 12-Phase Power Supply tripped
1	PTU Fault	Phase U, IGBT overtemperature sensor fault
2	PTV Fault	Phase V, IGBT overtemperature sensor fault
3	PTW Fault	Phase W, IGBT overtemperature sensor fault

Table 4: PT Fault Status Register

M217 Current Unbalance Status Register

In case of operation in parallel, the current sharing among the phases is constantly checked. In the event of current unbalance, faultA A050 trips. Measure M217 indicates which phase caused the fault trip.

M217	Range	Bit-controlled	See Table 5
	Active	Active only in Master board during operation in parallel.	
	Level	BASIC	
	Address	1667	
	Function	Indicates the arm and the inverter where current unbalance occurred.	



Bit	Description	Notes
0	Iu_M Unbalance	ON: A fault occurred
1	Iu_S1 Unbalance	
2	Iu_S2 Unbalance	
3	Iv_M Unbalance	
4	Iv_S1 Unbalance	
5	Iv_S2 Unbalance	
6	Iw_M Unbalance	
7	Iw_S1 Unbalance	
8	Iw_S2 Unbalance	

**Table 5: MNC Fault Status Register**

**M218 Precharge Signal Status Register**

At power on, the inverter performs a controlled precharge of the electrolytic capacitor bank. This measure detects precharge failures (if any).

<b>M218</b>	<b>Range</b>	Bit-controlled	See Table 6
	<b>Active</b>	Always active	
	<b>Level</b>	BASIC	
	<b>Address</b>	1762	
	<b>Function</b>	It instantaneously displays the status of the significant signals pertaining to the precharge of the electrolytic capacitors. NBYPASS: The precharge stage is complete; the control board signals that the precharge stage is complete. VBOK: The precharge voltage has been reached. The control board signals to the driver board that the electrolytic capacitor bank has completed the precharge stage. RUN: inverter running; the driver board detects that the inverter is running. PTPREC: Status of the precharge resistors; the driver board detects whether the precharge resistors are overheated.	

Bit	Description	Notes
11	NBypass: Precharge complete	OFF: Precharge complete
12	VBOK Signal: Precharge voltage reached	ON: Precharge voltage reached
13	Inverter RUNNING	ON: Inverter RUNNING
15	PTPREC: Status of the precharge resistors	ON: Precharge resistors OK

**Table 6: Precharge Status encoding**

### 3.2. Diagnostics Measures Menu

Measure	FUNCTION	User Level	MODBUS Address
M240	Supply Time M054-55	BASIC	1757-1758
M241	Operation Time M052-53	BASIC	1759-1760
M243	NTC1 Heatsink Temperature	BASIC	1772
M244	Max. NTC1 Heatsink Temperature	BASIC	1773
M245	Min. NTC1 Heatsink Temperature	BASIC	1774
M246	Hours of NTC1 Heatsink Temperature above 75°C	BASIC	1775
M247	Board Temperature	BASIC	1776
M248	Max. Board Temperature	BASIC	1777
M249	Min. Board Temperature	BASIC	1778
M250	Hours of Board Temperature above 60°C	BASIC	1779
M251	NTC2 Heatsink Temperature	BASIC	1781
M255	DSP Temperature	BASIC	1780

Table 7: Diagnostics Measures Menu

#### M240 Supply Time

<b>M240</b>	<b>Range</b>	0 ÷ 4294967295	0 ÷ 858993459 s
	<b>Active</b>	Always active	
	<b>Level</b>	BASIC	
	<b>Address</b>	1757-1758 (LSW-MSW)	
	<b>Function</b>	Supply Time of the inverter (time when voltage is applied to the inverter)	

#### M241 Operation Time

<b>M241</b>	<b>Range</b>	0 ÷ 4294967295	0 ÷ 858993459 s
	<b>Active</b>	Always active	
	<b>Level</b>	BASIC	
	<b>Address</b>	1759-1760 (LSW-MSW)	
	<b>Function</b>	Operation time of the inverter (time when IGBTs are enabled).	

#### M243 NTC1 Heatsink Temperature

<b>M243</b>	<b>Range</b>	-200 ÷ 1250	-20.0 ÷ 125.0°C
	<b>Active</b>	Always active	
	<b>Level</b>	BASIC	
	<b>Address</b>	1772	
	<b>Function</b>	Temperature of the heatsink.	

**M244 Max. NTC1 Heatsink Temperature**

<b>M244</b>	<b>Range</b>	-200 ÷ 1250	-20.0 ÷ 125.0°C
	<b>Active</b>	Always active	
	<b>Level</b>	BASIC	
	<b>Address</b>	1773	
	<b>Function</b>	Maximum heatsink temperature measured when the equipment is running.	

**M245 Min. NTC1 Heatsink Temperature**

<b>M245</b>	<b>Range</b>	-200 ÷ 1250	-20.0 ÷ 125.0°C
	<b>Active</b>	Always active	
	<b>Level</b>	BASIC	
	<b>Address</b>	1774	
	<b>Function</b>	Minimum heatsink temperature measured when the equipment is running.	

**M246 Hours of NTC1 Heatsink Temperature above 75°C**

<b>M246</b>	<b>Range</b>	0 ÷ 65535	0 ÷ 65535 h
	<b>Active</b>	Always active	
	<b>Level</b>	BASIC	
	<b>Address</b>	1775	
	<b>Function</b>	Hours when the heatsink temperature is above 75°C.	

**M247 Board Temperature**

<b>M247</b>	<b>Range</b>	-200 ÷ 1250	-20.0 ÷ 125.0°C
	<b>Active</b>	Always active	
	<b>Level</b>	BASIC	
	<b>Address</b>	1776	
	<b>Function</b>	Temperature of the driver board.	

**M248 Max. Board Temperature**

<b>M248</b>	<b>Range</b>	-200 ÷ 1250	-20.0 ÷ 125.0°C
	<b>Active</b>	Always active	
	<b>Level</b>	BASIC	
	<b>Address</b>	1777	
	<b>Function</b>	Maximum temperature of the driver board measured when the equipment is running.	

**M249 Min. Board Temperature**

<b>M249</b>	<b>Range</b>	-200 ÷ 1250	-20.0 ÷ 125.0°C
	<b>Active</b>	Always active	
	<b>Level</b>	BASIC	
	<b>Address</b>	1778	
	<b>Function</b>	Minimum temperature of the driver board measured when the equipment is running.	

**M250 Hours of Board Temperature above 60°C**

<b>M250</b>	<b>Range</b>	0 ÷ 65535	0 ÷ 65535 h
	<b>Active</b>	Always active	
	<b>Level</b>	BASIC	
	<b>Address</b>	1779	
	<b>Function</b>	Hours when the board temperature is above 60°C.	

**M251 NTC2 Heatsink Temperature**

<b>M251</b>	<b>Range</b>	-200 ÷ 1250	-20.0 ÷ 125.0°C
	<b>Active</b>	NOT ACTIVE	
	<b>Level</b>	BASIC	
	<b>Address</b>	1781	
	<b>Function</b>	Temperature detected by NTC2 sensor.	

**M255 DSP Temperature**

<b>M255</b>	<b>Range</b>	-200 ÷ 1450	-20.0 ÷ 160.0°C
	<b>Active</b>	Always active	
	<b>Level</b>	BASIC	
	<b>Address</b>	1780	
	<b>Function</b>	Temperature of the DSP microcontroller.	

### 3.3. 12-Phase Measures Menu

These measures are active only when the optional 12-Phase Power Supply unit is installed.

Measure	FUNCTION	User Level	MODBUS Address
M260	12-Phase Vrs RMS Voltage	ADVANCED	1700
M261	12-Phase Vst RMS Voltage	ADVANCED	1701
M262	12-Phase Heatsink Temperature	ADVANCED	1782

Table 8: 12-Phase Measures

#### M260 12-Phase Vrs RMS Voltage

M260	Range	0 ÷ 1500	0 ÷ 1500 V
	Active	Active only when the 12-Phase Power Supply optional unit is installed	
	Level	ADVANCED	
	Address	1700	
	Function	Measure of the RMS Voltage between phases R and S for the optional 12-Phase Power Supply unit.	

#### M261 12-Phase Vst RMS Voltage

M261	Range	0 ÷ 1500	0 ÷ 1500 V
	Active	Active only when the 12-Phase Power Supply optional unit is installed	
	Level	ADVANCED	
	Address	1701	
	Function	Measure of the RMS Voltage between phases S and T for the optional 12-Phase Power Supply unit.	

#### M262 12-Phase Heatsink Temperature

M262	Range	-200 ÷ 1250	-20.0 ÷ 125.0°C
	Active	Active only when the 12-Phase Power Supply optional unit is installed	
	Level	ADVANCED	
	Address	1782	
	Function	Temperature of the heatsink in the optional 12-Phase Power Supply unit.	

### 3.4. Air-cooling Measures Menu

Six fans are used for the air-cooling of the internal components of the inverter and the power heatsink. Four fans are used for sizes S41 and S42. Each fan is constantly monitored.

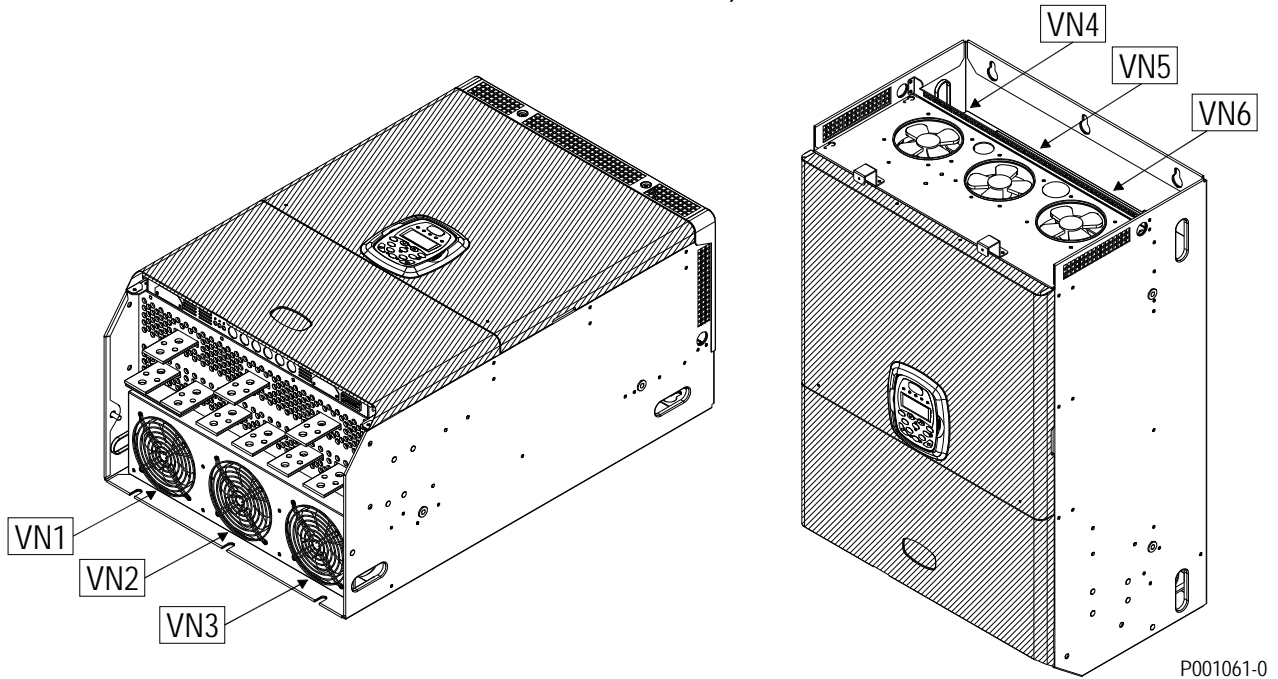


Figure 1: Location of the fans in Sinus Penta S51 and S52

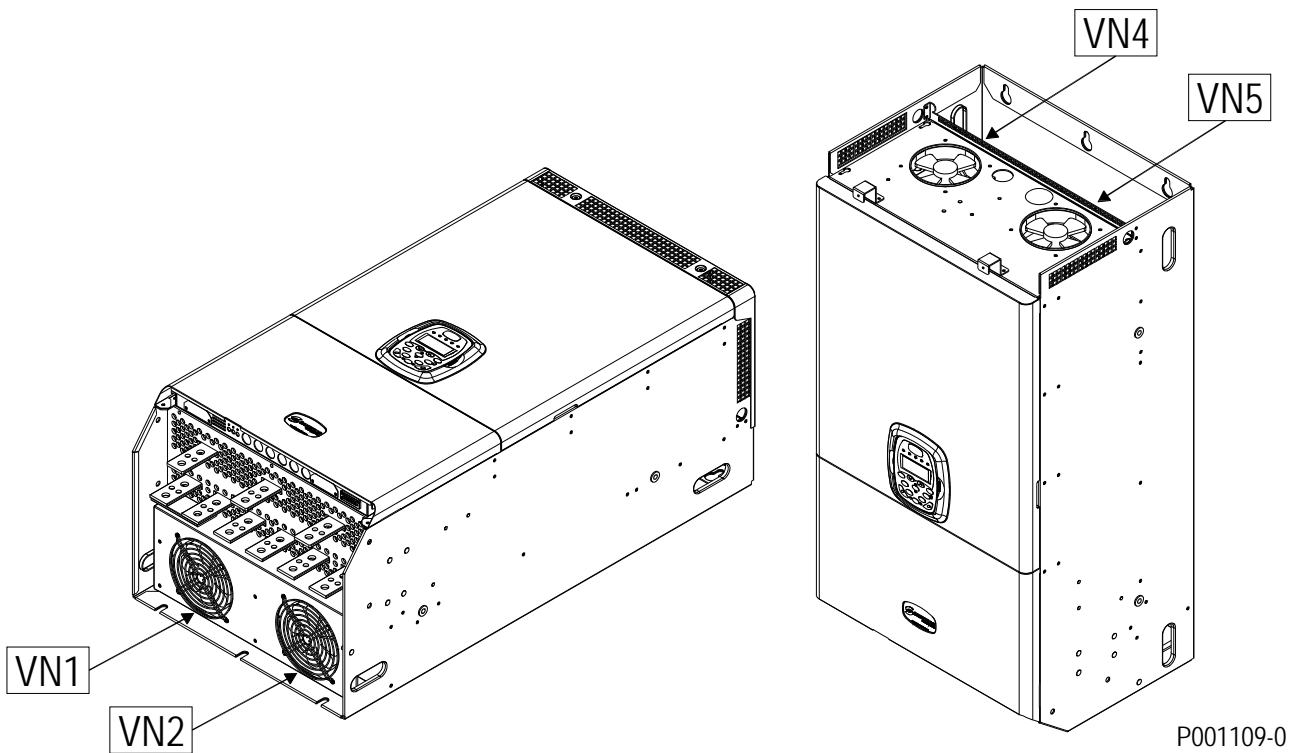


Figure 2: Location of the fans in Sinus Penta S41 and S42

Measure	FUNCTION	User Level	MODBUS Address
M270	Status of Fans 1, 2, 3	BASIC	1732
M270	Status of Fans 4, 5, 6	BASIC	1733
M271	Speed of Fan 1	BASIC	1783
M272	Speed of Fan 2	BASIC	1784
M273	Speed of Fan 3	BASIC	1785
M274	Speed of Fan 4	BASIC	1786
M275	Speed of Fan 5	BASIC	1787
M276	Speed of Fan 6	BASIC	1788
M277	Supply Time of Fan 1	BASIC	1720-1721
M278	Supply Time of Fan 2	BASIC	1722-1723
M279	Supply Time of Fan 3	BASIC	1724-1725
M280	Supply Time of Fan 4	BASIC	1726-1727
M281	Supply Time of Fan 5	BASIC	1728-1729
M282	Supply Time of Fan 6	BASIC	1730-1731

Table 9: Measures in the Air-Cooling menu

M270 Status of Fans 1, 2, 3

<b>M270</b>	<b>Range</b>	Bit-controlled	See Table 10
	<b>Active</b>	Always active	
	<b>Level</b>	BASIC	
	<b>Address</b>	1732	
	<b>Function</b>	Indicates the status of fans 1, 2 and 3.	

Bit	Description	Notes
0	Fan 1 Short circuit	Protective device tripped due to fan supply circuit overcurrent (Fan 3 is available only on S51 and S52)
1	Fan 2 Short circuit	
2	Fan 3 Short circuit	
3	Fan 1 Open Load	No fan has been detected (Fan 3 is available only on S51 and S52)
4	Fan 2 Open Load	
5	Fan 3 Open Load	
6	Fan 1 Underperformance	The fan is operating under its minimum allowable rate (Fan 3 is available only on S51 and S52) (*)
7	Fan 2 Underperformance	
8	Fan 3 Underperformance	
9	Fan 1 Failure	A fan failure occurred (Fan 3 is available only on S51 and S52)
10	Fan 2 Failure	
11	Fan 3 Failure	
12	Fan 1 Detection	Fan 1 is always fitted in S41-S42-S51-S52
13	Fan 2 Detection	Fan 2 is always fitted in S41-S42-S51-S52
14	Fan 3 Detection	Fan 3 is fitted only in S51 and S52

Table 10: Encoding of the Status of Fans 1, 2, 3

(\*) The rated speed of fans 1, 2, 3 is as follows:

SIZE	Rated Speed	Min. Speed
S41, S42, S51	3500	3000
S52	4300	4000

**M270 Status of Fans 4, 5, 6**

<b>M270</b>	<b>Range</b>	Bit-controlled	See Table 11
	<b>Active</b>	Always active	
	<b>Level</b>	BASIC	
	<b>Address</b>	1733	
	<b>Function</b>	Indicates the status of fans 4, 5, 6.	

Bit	Description	Notes
0	Fan 4 Short circuit	Protective device tripped due to fan supply circuit overcurrent (Fan 6 is available only on S51 and S52)
1	Fan 5 Short circuit	
2	Fan 6 Short circuit	
3	Fan 4 Open Load	No fan has been detected (Fan 6 is available only on S51 and S52)
4	Fan 5 Open Load	
5	Fan 6 Open Load	
6	Fan 4 Underperformance	The fan is operating under its minimum allowable rate (Fan 6 is available only on S51 and S52) (*)
7	Fan 5 Underperformance	
8	Fan 6 Underperformance	
9	Fan 4 Failure	A fan failure occurred (Fan 6 is available only on S51 and S52)
10	Fan 5 Failure	
11	Fan 6 Failure	
12	Fan 4 Detection	Fan 4 is always fitted in S41-S42-S51-S52
13	Fan 5 Detection	Fan 5 is always fitted in S41-S42-S51-S52
14	Fan 6 Detection	Fan 6 is fitted only in S51 and S52

**Table 11: Encoding of the Status of Fans 4, 5, 6**

(\*)The rated speed of fans 4, 5, 6 is as follows:

SIZE	Rated speed	Min. speed
S41, S42, S51, S52	2700	2500

**M271 Speed of Fan 1**

<b>M271</b>	<b>Range</b>	0 ÷ 5000	0 ÷ 5000 rpm
	<b>Active</b>	Always active	
	<b>Level</b>	BASIC	
	<b>Address</b>	1783	
	<b>Function</b>	Speed of fan 1. The fan is operating when the activation signal coming from the control board is present.	



**M272 Speed of Fan 2**

<b>M272</b>	<b>Range</b>	0 ÷ 5000	0 ÷ 5000 rpm
	<b>Active</b>	Always active	
	<b>Level</b>	BASIC	
	<b>Address</b>	1784	
	<b>Function</b>	Speed of fan 2. The fan is operating when the activation signal coming from the control board is present.	

**M273 Speed of Fan 3**

<b>M273</b>	<b>Range</b>	0 ÷ 5000	0 ÷ 5000 rpm
	<b>Active</b>	Only for S51 and S52	
	<b>Level</b>	BASIC	
	<b>Address</b>	1785	
	<b>Function</b>	Speed of fan 3. The fan is operating when the activation signal coming from the control board is present.	

**M274 Speed of Fan 4**

<b>M274</b>	<b>Range</b>	0 ÷ 5000	0 ÷ 5000 rpm
	<b>Active</b>	Always active	
	<b>Level</b>	BASIC	
	<b>Address</b>	1786	
	<b>Function</b>	Speed of fan 4. The fan is operating when the activation signal coming from the control board is present.	

**M275 Speed of Fan 5**

<b>M275</b>	<b>Range</b>	0 ÷ 5000	0 ÷ 5000 rpm
	<b>Active</b>	Always active	
	<b>Level</b>	BASIC	
	<b>Address</b>	1787	
	<b>Function</b>	Speed of fan 5. The fan is operating when the activation signal coming from the control board is present.	

**M276 Speed of Fan 6**

<b>M276</b>	<b>Range</b>	0 ÷ 5000	0 ÷ 5000 rpm
	<b>Active</b>	Only for S51 and S52	
	<b>Level</b>	BASIC	
	<b>Address</b>	1788	
	<b>Function</b>	Speed of fan 6. The fan is operating when the activation signal coming from the control board is present.	

**M277 Supply Time of Fan 1**

<b>M277</b>	<b>Range</b>	0 ÷ 4294967295	0 ÷ 858993459 s
	<b>Active</b>	Always active	
	<b>Level</b>	BASIC	
	<b>Address</b>	1720-1721 (LSW-MSW)	
	<b>Function</b>	Supply time of fan 1.	

**M278 Supply Time of Fan 2**

<b>M278</b>	<b>Range</b>	0 ÷ 4294967295	0 ÷ 858993459 s
	<b>Active</b>	Always active	
	<b>Level</b>	BASIC	
	<b>Address</b>	1722-1723 (LSW-MSW)	
	<b>Function</b>	Supply time of fan 2.	

**M279 Supply Time of Fan 3**

<b>M279</b>	<b>Range</b>	0 ÷ 4294967295	0 ÷ 858993459 s
	<b>Active</b>	Only for S51 and S52	
	<b>Level</b>	BASIC	
	<b>Address</b>	1724-1725 (LSW-MSW)	
	<b>Function</b>	Supply time of fan 3.	

**M280 Supply Time of Fan 4**

<b>M280</b>	<b>Range</b>	0 ÷ 4294967295	0 ÷ 858993459 s
	<b>Active</b>	Always active	
	<b>Level</b>	BASIC	
	<b>Address</b>	1726-1727 (LSW-MSW)	
	<b>Function</b>	Supply time of fan 4.	

**M281 Supply Time of Fan 5**

<b>M281</b>	<b>Range</b>	0 ÷ 4294967295	0 ÷ 858993459 s
	<b>Active</b>	Always active	
	<b>Level</b>	BASIC	
	<b>Address</b>	1728-1729 (LSW-MSW)	
	<b>Function</b>	Supply time of fan 5.	

**M282 Supply Time of Fan 6**

<b>M282</b>	<b>Range</b>	0 ÷ 4294967295	0 ÷ 858993459 s
	<b>Active</b>	Only for S51 and S52	
	<b>Level</b>	BASIC	
	<b>Address</b>	1730-1731 (LSW-MSW)	
	<b>Function</b>	Supply time of fan 6.	

### 3.5. Fault List and Power Off List

Whenever an alarm trips, a measure list is automatically stored to provide a snapshot of the system status when the alarm tripped. The driver board can save four Fault Lists pertaining to the last four alarms tripped. Four Power Off lists are also saved, pertaining to the same measures in the Fault List whenever the system is powered off.

The measures stored are detailed below:

Fault List 1			
Measure	FUNCTION	User Level	MODBUS Address
M240	Supply Time	BASIC	7711
M241	Operation Time	BASIC	7713
M210	Alarm Tripped	BASIC	7715
M218	Precharge Status	BASIC	7716
M270	Fan Status	BASIC	7716
M216	Thermoswitch Alarm	BASIC	7716
M211	Phase Loss Fault	BASIC	7717
M217	Unbalanced Current Alarm	BASIC	7717
M200	RMS Iout Current at Fault	BASIC	7718
M205	Instantaneous Iu Current at Fault	BASIC	7719
M206	Instantaneous Iv Current at Fault	BASIC	7720
M207	Instantaneous Iw Current at Fault	BASIC	7721
M202	DC-bus Voltage	BASIC	7722
M203	Vrs RMS Voltage	BASIC	7723
M204	Vst RMS Voltage	BASIC	7724
M212	HW Signals at Fault	BASIC	7725
M243	NTC1 Heatsink Temperature at Fault	BASIC	7726
M244	Max. NTC1 Heatsink Temperature at Fault	BASIC	7727
M245	Min. NTC1 Heatsink Temperature at Fault	BASIC	7728
M246	Hours of NTC1 Heatsink Temp. above 75°C at Fault	BASIC	7729
M247	Board Temperature at Fault	BASIC	7730
M248	Max. Board Temperature at Fault	BASIC	7731
M249	Min. Board Temperature at Fault	BASIC	7732
M250	Hours of Board Temp. above 60°C at Fault	BASIC	7733
M255	Die Temperature at Fault	BASIC	7734
M251	NTC2 Temperature at Fault	BASIC	7735
M262	NTC_D Temperature at Fault	BASIC	7736
M271	Fan 1 Speed at Fault	BASIC	7737
M272	Fan 2 Speed at Fault	BASIC	7738
M273	Fan 3 Speed at Fault	BASIC	7739
M274	Fan 4 Speed at Fault	BASIC	7740
M275	Fan 5 Speed at Fault	BASIC	7741
M276	Fan 6 Speed at Fault	BASIC	7742

Fault List 2			
Measure	FUNCTION	User Level	MODBUS Address
M240	Supply Time	BASIC	7775
M241	Operation Time	BASIC	7777
M210	Alarm Tripped	BASIC	7779
M218	Precharge Status	BASIC	7780
M270	Fan Status	BASIC	7780
M216	Thermoswitch Alarm	BASIC	7780
M211	Phase Loss Fault	BASIC	7781
M217	Unbalanced Current Alarm	BASIC	7781
M200	RMS Iout Current at Fault	BASIC	7782
M205	Instantaneous Iu Current at Fault	BASIC	7783
M206	Instantaneous Iv Current at Fault	BASIC	7784
M207	Instantaneous Iw Current at Fault	BASIC	7785
M202	DC-bus Voltage	BASIC	7786
M203	Vrs RMS Voltage	BASIC	7787
M204	Vst RMS Voltage	BASIC	7788
M212	HW Signals at Fault	BASIC	7789
M243	NTC1 Heatsink Temperature at Fault	BASIC	7790
M244	Max. NTC1 Heatsink Temperature at Fault	BASIC	7791
M245	Min. NTC1 Heatsink Temperature at Fault	BASIC	7792
M246	Hours of NTC1 Heatsink Temp. above 75°C at Fault	BASIC	7793
M247	Board Temperature at Fault	BASIC	7794
M248	Max. Board Temperature at Fault	BASIC	7795
M249	Min. Board Temperature at Fault	BASIC	7796
M250	Hours of Board Temp. above 60°C at Fault	BASIC	7797
M255	Die Temperature at Fault	BASIC	7798
M251	NTC2 Temperature at Fault	BASIC	7799
M262	NTC_D Temperature at Fault	BASIC	7800
M271	Fan 1 Speed at Fault	BASIC	7801
M272	Fan 2 Speed at Fault	BASIC	7802
M273	Fan 3 Speed at Fault	BASIC	7803
M274	Fan 4 Speed at Fault	BASIC	7804
M275	Fan 5 Speed at Fault	BASIC	7805
M276	Fan 6 Speed at Fault	BASIC	7806

Fault List 3			
Measure	FUNCTION	User Level	MODBUS Address
M240	Supply Time	BASIC	7839
M241	Operation Time	BASIC	7841
M210	Alarm Tripped	BASIC	7843
M218	Precharge Status	BASIC	7844
M270	Fan Status	BASIC	7844
M216	Thermoswitch Alarm	BASIC	7844
M211	Phase Loss Fault	BASIC	7845
M217	Unbalanced Current Alarm	BASIC	7845
M200	RMS Iout Current at Fault	BASIC	7846
M205	Instantaneous Iu Current at Fault	BASIC	7847
M206	Instantaneous Iv Current at Fault	BASIC	7848
M207	Instantaneous Iw Current at Fault	BASIC	7849
M202	DC-bus Voltage	BASIC	7850
M203	Vrs RMS Voltage	BASIC	7851
M204	Vst RMS Voltage	BASIC	7852
M212	HW Signals at Fault	BASIC	7853
M243	NTC1 Heatsink Temperature at Fault	BASIC	7854
M244	Max. NTC1 Heatsink Temperature at Fault	BASIC	7855
M245	Min. NTC1 Heatsink Temperature at Fault	BASIC	7856
M246	Hours of NTC1 Heatsink Temp. above 75°C at Fault	BASIC	7857
M247	Board Temperature at Fault	BASIC	7858
M248	Max. Board Temperature at Fault	BASIC	7859
M249	Min. Board Temperature at Fault	BASIC	7860
M250	Hours of Board Temp. above 60°C at Fault	BASIC	7861
M255	Die Temperature at Fault	BASIC	7862
M251	NTC2 Temperature at Fault	BASIC	7863
M262	NTC_D Temperature at Fault	BASIC	7864
M271	Fan 1 Speed at Fault	BASIC	7865
M272	Fan 2 Speed at Fault	BASIC	7866
M273	Fan 3 Speed at Fault	BASIC	7867
M274	Fan 4 Speed at Fault	BASIC	7868
M275	Fan 5 Speed at Fault	BASIC	7869
M276	Fan 6 Speed at Fault	BASIC	7870

Fault List 4			
Measure	FUNCTION	User Level	MODBUS Address
M240	Supply Time	BASIC	7903
M241	Operation Time	BASIC	7905
M210	Alarm Tripped	BASIC	7907
M218	Precharge Status	BASIC	7908
M270	Fan Status	BASIC	7908
M216	Thermoswitch Alarm	BASIC	7908
M211	Phase Loss Fault	BASIC	7909
M217	Unbalanced Current Alarm	BASIC	7909
M200	RMS Iout Current at Fault	BASIC	7910
M205	Instantaneous Iu Current at Fault	BASIC	7911
M206	Instantaneous Iv Current at Fault	BASIC	7912
M207	Instantaneous Iw Current at Fault	BASIC	7913
M202	DC-bus Voltage	BASIC	7914
M203	Vrs RMS Voltage	BASIC	7915
M204	Vst RMS Voltage	BASIC	7916
M212	HW Signals at Fault	BASIC	7917
M243	NTC1 Heatsink Temperature at Fault	BASIC	7918
M244	Max. NTC1 Heatsink Temperature at Fault	BASIC	7919
M245	Min. NTC1 Heatsink Temperature at Fault	BASIC	7920
M246	Hours of NTC1 Heatsink Temp. above 75°C at Fault	BASIC	7921
M247	Board Temperature at Fault	BASIC	7922
M248	Max. Board Temperature at Fault	BASIC	7923
M249	Min. Board Temperature at Fault	BASIC	7924
M250	Hours of Board Temp. above 60°C at Fault	BASIC	7925
M255	Die Temperature at Fault	BASIC	7926
M251	NTC2 Temperature at Fault	BASIC	7927
M262	NTC_D Temperature at Fault	BASIC	7928
M271	Fan 1 Speed at Fault	BASIC	7929
M272	Fan 2 Speed at Fault	BASIC	7930
M273	Fan 3 Speed at Fault	BASIC	7931
M274	Fan 4 Speed at Fault	BASIC	7932
M275	Fan 5 Speed at Fault	BASIC	7933
M276	Fan 6 Speed at Fault	BASIC	7934

Power Off List 1			
Measure	FUNCTION	User Level	MODBUS Address
M240	Supply Time	BASIC	5043
M241	Operation Time	BASIC	5045
M210	Alarm Tripped	BASIC	5047
M218	Precharge Status	BASIC	5048
M270	Fan Status	BASIC	5048
M216	Thermoswitch Alarm	BASIC	5048
M211	Phase Loss Fault	BASIC	5049
M217	Unbalanced Current Alarm	BASIC	5049
M200	RMS Iout Current at Power Off	BASIC	5050
M205	Instantaneous Iu Current at Power Off	BASIC	5051
M206	Instantaneous Iv Current at Power Off	BASIC	5052
M207	Instantaneous Iw Current at Power Off	BASIC	5053
M202	DC-bus Voltage	BASIC	5054
M203	Vrs RMS Voltage	BASIC	5055
M204	Vst RMS Voltage	BASIC	5056
M212	HW Signals at Power Off	BASIC	5057
M243	NTC1 Heatsink Temperature at Power Off	BASIC	5058
M244	Max. NTC1 Heatsink Temperature at Power Off	BASIC	5059
M245	Min. NTC1 Heatsink Temperature at Power Off	BASIC	5060
M246	Hours of NTC1 Heatsink Temp. above 75°C at Power Off	BASIC	5061
M247	Board Temperature at Power Off	BASIC	5062
M248	Max. Board Temperature at Power Off	BASIC	5063
M249	Min. Board Temperature at Power Off	BASIC	5064
M250	Hours of Board Temp. above 60°C at Power Off	BASIC	5065
M255	Die Temperature at Power Off	BASIC	5066
M251	NTC2 Temperature at Power Off	BASIC	5067
M262	NTC_D Temperature at Power Off	BASIC	5068
M271	Fan 1 Speed at Power Off	BASIC	5069
M272	Fan 2 Speed at Power Off	BASIC	5070
M273	Fan 3 Speed at Power Off	BASIC	5071
M274	Fan 4 Speed at Power Off	BASIC	5072
M275	Fan 5 Speed at Power Off	BASIC	5073
M276	Fan 6 Speed at Power Off	BASIC	5074



Power Off List 2			
Measure	FUNCTION	User Level	MODBUS Address
M240	Supply Time	BASIC	5107
M241	Operation Time	BASIC	5109
M210	Alarm Tripped	BASIC	5111
M218	Precharge Status	BASIC	5112
M270	Fan Status	BASIC	5112
M216	Thermoswitch Alarm	BASIC	5112
M211	Phase Loss Fault	BASIC	5113
M217	Unbalanced Current Alarm	BASIC	5113
M200	RMS Iout Current at Power Off	BASIC	5114
M205	Instantaneous Iu Current at Power Off	BASIC	5115
M206	Instantaneous Iv Current at Power Off	BASIC	5116
M207	Instantaneous Iw Current at Power Off	BASIC	5117
M202	DC-bus Voltage	BASIC	5118
M203	Vrs RMS Voltage	BASIC	5119
M204	Vst RMS Voltage	BASIC	5120
M212	HW Signals at Power Off	BASIC	5121
M243	NTC1 Heatsink Temperature at Power Off	BASIC	5122
M244	Max. NTC1 Heatsink Temperature at Power Off	BASIC	5123
M245	Min. NTC1 Heatsink Temperature at Power Off	BASIC	5124
M246	Hours of NTC1 Heatsink Temp. above 75°C at Power Off	BASIC	5125
M247	Board Temperature at Power Off	BASIC	5126
M248	Max. Board Temperature at Power Off	BASIC	5127
M249	Min. Board Temperature at Power Off	BASIC	5128
M250	Hours of Board Temp. above 60°C at Power Off	BASIC	5129
M255	Die Temperature at Power Off	BASIC	5130
M251	NTC2 Temperature at Power Off	BASIC	5131
M262	NTC_D Temperature at Power Off	BASIC	5132
M271	Fan 1 Speed at Power Off	BASIC	5133
M272	Fan 2 Speed at Power Off	BASIC	5134
M273	Fan 3 Speed at Power Off	BASIC	5135
M274	Fan 4 Speed at Power Off	BASIC	5136
M275	Fan 5 Speed at Power Off	BASIC	5137
M276	Fan 6 Speed at Power Off	BASIC	5138

Power Off List 3			
Measure	FUNCTION	User Level	MODBUS Address
M240	Supply Time	BASIC	5171
M241	Operation Time	BASIC	5173
M210	Alarm Tripped	BASIC	5175
M218	Precharge Status	BASIC	5176
M270	Fan Status	BASIC	5176
M216	Thermoswitch Alarm	BASIC	5176
M211	Phase Loss Fault	BASIC	5177
M217	Unbalanced Current Alarm	BASIC	5177
M200	RMS Iout Current at Power Off	BASIC	5178
M205	Instantaneous Iu Current at Power Off	BASIC	5179
M206	Instantaneous Iv Current at Power Off	BASIC	5180
M207	Instantaneous Iw Current at Power Off	BASIC	5181
M202	DC-bus Voltage	BASIC	5182
M203	Vrs RMS Voltage	BASIC	5183
M204	Vst RMS Voltage	BASIC	5184
M212	HW Signals at Power Off	BASIC	5185
M243	NTC1 Heatsink Temperature at Power Off	BASIC	5186
M244	Max. NTC1 Heatsink Temperature at Power Off	BASIC	5187
M245	Min. NTC1 Heatsink Temperature at Power Off	BASIC	5188
M246	Hours of NTC1 Heatsink Temp. above 75°C at Power Off	BASIC	5189
M247	Board Temperature at Power Off	BASIC	5190
M248	Max. Board Temperature at Power Off	BASIC	5191
M249	Min. Board Temperature at Power Off	BASIC	5192
M250	Hours of Board Temp. above 60°C at Power Off	BASIC	5193
M255	Die Temperature at Power Off	BASIC	5194
M251	NTC2 Temperature at Power Off	BASIC	5195
M262	NTC_D Temperature at Power Off	BASIC	5196
M271	Fan 1 Speed at Power Off	BASIC	5197
M272	Fan 2 Speed at Power Off	BASIC	5198
M273	Fan 3 Speed at Power Off	BASIC	5199
M274	Fan 4 Speed at Power Off	BASIC	5200
M275	Fan 5 Speed at Power Off	BASIC	5201
M276	Fan 6 Speed at Power Off	BASIC	5202

Power Off List 4			
Measure	FUNCTION	User Level	MODBUS Address
M240	Supply Time	BASIC	5235
M241	Operation Time	BASIC	5237
M210	Alarm Tripped	BASIC	5239
M218	Precharge Status	BASIC	5240
M270	Fan Status	BASIC	5240
M216	Thermoswitch Alarm	BASIC	5240
M211	Phase Loss Fault	BASIC	5241
M217	Unbalanced Current Alarm	BASIC	5241
M200	RMS Iout Current at Power Off	BASIC	5242
M205	Instantaneous Iu Current at Power Off	BASIC	5243
M206	Instantaneous Iv Current at Power Off	BASIC	5244
M207	Instantaneous Iw Current at Power Off	BASIC	5245
M202	DC-bus Voltage	BASIC	5246
M203	Vrs RMS Voltage	BASIC	5247
M204	Vst RMS Voltage	BASIC	5248
M212	HW Signals at Power Off	BASIC	5249
M243	NTC1 Heatsink Temperature at Power Off	BASIC	5250
M244	Max. NTC1 Heatsink Temperature at Power Off	BASIC	5251
M245	Min. NTC1 Heatsink Temperature at Power Off	BASIC	5252
M246	Hours of NTC1 Heatsink Temp. above 75°C at Power Off	BASIC	5253
M247	Board Temperature at Power Off	BASIC	5254
M248	Max. Board Temperature at Power Off	BASIC	5255
M249	Min. Board Temperature at Power Off	BASIC	5256
M250	Hours of Board Temp. above 60°C at Power Off	BASIC	5257
M255	Die Temperature at Power Off	BASIC	5258
M251	NTC2 Temperature at Power Off	BASIC	5259
M262	NTC_D Temperature at Power Off	BASIC	5260
M271	Fan 1 Speed at Power Off	BASIC	5261
M272	Fan 2 Speed at Power Off	BASIC	5262
M273	Fan 3 Speed at Power Off	BASIC	5263
M274	Fan 4 Speed at Power Off	BASIC	5264
M275	Fan 5 Speed at Power Off	BASIC	5265
M276	Fan 6 Speed at Power Off	BASIC	5266

### 3.6. P Parameters Menu

Parameter	FUNCTION	User Level	MODBUS Address
P000	User Level	BASIC	312
P001	BU Detection	BASIC	291

Table 12: P Parameters

#### P000 User Level

P000	Range	0÷2	0: BASIC 1: ADVANCED 2: ENGINEERING
	Default Level	0	0 : BASIC
	Address	312	
	Function	The inverter programming parameters are grouped by access levels based on their functions (more or less complex functions). Some menus, or some parts of menus, are not displayed when a given access level is selected. When the BASIC access level is selected, navigation is easier, as only frequently accessed parameters are displayed. The User Level is stated for each parameter.	

#### P001 BU Detection

P000	Range	0÷1	0: No BU detected 1: BU detected
	Default Level	0	0 : No BU detected
	Address	291	
	Function	When the Braking Unit is installed, Parameter P001 is to be set to 1 in order to detect any BU failure.	

### 3.7. R Parameters Menu

Parameter	FUNCTION	User Level	MODBUS
R001	ModBus Address	ENGINEERING	588
R002	Serial Link Response Delay	ENGINEERING	589
R003	Serial Link Baudrate	ENGINEERING	590
R004	Time Added to Serial Link 4ByteTime	ENGINEERING	591
R006	Serial Link Parity Bit	ENGINEERING	593
R007	Control Board CAN ID	ENGINEERING	290

Table 13: R Parameters

#### R001 ModBus Address

<b>R001</b>	Range	200 ÷ 247	200 ÷ 247
	Default	200	200
	Level	ENGINEERING	
	Address	588	
	Function	Defines the ModBus address of the driver board. The ModBus address takes the value defined by <b>R001</b> +1 (for single inverter or Master inverter), <b>R001</b> +2 for slave inverter 1, <b>R001</b> +3 for slave inverter 2.	

#### R002 Serial Link Response Delay

<b>R002</b>	Range	1 ÷ 1000	1 ÷ 1000 ms
	Default	5	5 ms
	Level	ENGINEERING	
	Address	589	
	Function	Response delay after a Master query sent via RS485 serial link.	

#### R003 Serial Link Baudrate

<b>R003</b>	Range	1 ÷ 7	1: 1200 bps 2: 2400 bps 3: 4800 bps 4: 9600 bps 5: 19200 bps 6: 38400 bps 7: 57600 bps
	Default	6	6: 38400bps
	Level	ENGINEERING	
	Address	590	
	Function	Baudrate in bits per second of the driver board.	

**R004 Time Added to Serial Link 4ByteTime**

<b>R004</b>	<b>Range</b>	1 ÷ 10000	1 ÷ 10000 ms
	<b>Default</b>	2	2 ms
	<b>Level</b>	ENGINEERING	
	<b>Address</b>	591	
	<b>Function</b>	This parameter sets the limit time when no character is received from the serial link and the message sent from the master to the drive is considered as complete.	

**R006 Serial Link Parity Bit**

<b>R006</b>	<b>Range</b>	0 ÷ 3	0: Disabled 1 Stop bit 1: Disabled 2 Stop bits 2: Even (1 Stop bit) 3: Odd (1 Stop bit)
	<b>Default</b>	1	1: Disabled 2 Stop bits
	<b>Level</b>	ENGINEERING	
	<b>Address</b>	593	
	<b>Function</b>	This parameter determines whether the parity bit is used or not when creating the MODBUS message from the driver board.	

**R007 Control Board CAN ID**

<b>R007</b>	<b>Range</b>	1 ÷ 14	1 ÷ 14
	<b>Default</b>	1	1
	<b>Level</b>	ENGINEERING	
	<b>Address</b>	588	
	<b>Function</b>	CAN address of the control board. Starting from that value, the driver board assigns itself a CAN address based on the status of the configuration pins.	

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## 4. FAULT LIST

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

The driver board faults are detailed below.

The faults generated by the driver board are sent to the control board, that produces some general faults. The driver board stores the details about the event that generated the alarm. When fan faults occur, the driver board sends a warning signal to the control board.

The alarm and warning indications concerning the driver board may be the following:

- **A050** IGBT Fault A
- **A094** Heatsink Overtemperature or **A096** Fan Fault or **A099** 2nd Fan Sensor Fault
- **A093** Bypass failure
- Warning **W040** Fan Fault

**NOTE**

See Table 14 and Table 15 for any detail concerning the alarm indication and warning indication displayed on the Sinus Penta.

When a fault trips, the driver board stores the trip details to the **FAULT LIST**, including the date and time when the trip happened (supply-time and operation-time), the status of the board when the trip happened and the value of some measures sampled when the trip happened.

The readout and storage of the fault list can be very useful to detect the cause responsible for the alarm and its possible solution.

The faults generated from the driver board are automatically reset 1 second after their cause is removed.

No warning list exists. Warnings are only indications about minor events.

## 4.2. Alarm Codes

Alarm	Name	Description	Alarm Indication on the Penta	STATUS
A001	USER FAULT	Alarm intentionally caused by the user	A050	Always active
A002	CHECKSUM FAULT	The memory checksum containing the parameters is corrupted	A050	Always active
A003	SW OVERCURRENT	The current delivered by the Penta has been exceeding its rated value for too long (mean value)	A050	Active when operating in parallel
A004	HW OVERCURRENT	Overcurrent detected by IGBT drivers	A050	Always active
A005	IOOUT OVERCURRENT	The current delivered by the Penta has reached an excessive value (instant value)	A050	Active when operating in parallel
A006	PHASE LOSS	Mains voltage threshold	A050	Active when operating in parallel
A007	12-PHASE LOSS	12-Phase Power Supply voltage threshold	A050	Active when optional 12-Phase Power Supply unit is installed
A008	PRECHARGE FAULT	Failure in the resistive precharge circuit	A093	Always active
A009	HEATSINK OVERTEMPERATURE	Thermal protective device on the power semiconductor heatsink tripped	A094/96/99	Always active
A010	12-PHASE HEATSINK OVERTEMPERATURE	Thermal protective device on the power semiconductor heatsink of the 12-Phase Power Supply tripped	A094/96/99	Active when optional 12-Phase Power Supply unit is installed
A011	DRIVER BOARD OVERTEMPERATURE	Overtemperature of the driver board	A094/96/99	Always active
A012	DSP OVERTEMPERATURE	Overtemperature of the microprocessor	A094/96/99	Always active
A013	AUX. SENS. OVERTEMPERATURE	Overtemperature of the aux temperature sensor	A094/96/99	Inactive
A014	MAX. PRECHARGE CURRENT	Current threshold during precharge	A050	Inactive
A015	PRECHARGE TIMEOUT	Precharge timeout	A050	Inactive
A016	CURRENT SYMMETRY	Unbalanced current alarm	A050	Active when operating in parallel
A017	BRAKING UNIT FAULT	Failure in the braking unit	A050	Active when the braking unit is operating
A018	GROUND FAULT	Ground leakage	A050	Always active
A019	WATCHDOG FAULT	Microprocessor failure	A093	Always active

Table 14: Alarm codes



**A001 User Fault**

<b>A001</b>	<b>Description</b>	Alarm intentionally caused by the user.
	<b>Active</b>	Always active
	<b>Event</b>	The user has caused an alarm via the ModBus interface for testing purposes.
	<b>Possible causes</b>	The value "1" has been written to ModBus 1400 register.

**A002 Checksum Fault**

<b>A002</b>	<b>Description</b>	The memory checksum containing the parameters is corrupted.
	<b>Active</b>	Always active
	<b>Event</b>	Incorrect parameter values have been detected at power on.
	<b>Possible causes</b>	<ul style="list-style-type: none"> <li>• The flash memory is corrupted.</li> <li>• The flash memory does not contain legal parameters.</li> </ul>
	<b>Solutions</b>	If the alarm persists, please contact ELETTRONICA SANTERNO's SERVICE DEPARTMENT.

**A003 Software Overcurrent**

<b>A003</b>	<b>Description</b>	The software system has detected excessive current levels.
	<b>Active</b>	Only when operating in parallel
	<b>Event</b>	Overload exceeding the allowable limits has been detected.
	<b>Possible causes</b>	Abrupt load transient: excessive current demand from the connected motor.
	<b>Solutions</b>	Check the mechanical load; set longer acceleration/deceleration ramps. If required, adjust the V/f pattern if overload occurs when the system is operating at given RPM.

**A004 Hardware Overcurrent**

<b>A004</b>	<b>Description</b>	HW Overcurrent detected by one of the IGBT drivers.
	<b>Active</b>	Always active
	<b>Event</b>	OC signal generated by the protective devices installed on each IGBT.
	<b>Possible causes</b>	<ul style="list-style-type: none"> <li>• Short-circuit between two phases or in the ground connection.</li> <li>• IGBT current exceeding the max. allowable value.</li> </ul>
	<b>Solutions</b>	Check the mechanical load; set longer acceleration/deceleration ramps. If required, adjust the V/f pattern if overload occurs when the system is operating at given RPM. Check isolation between motor/output cables. If the alarm persists, please contact ELETTRONICA SANTERNO's SERVICE DEPARTMENT.

A005 IOUT Overcurrent

<b>A005</b>	<b>Description</b>	HW overcurrent detected by the current sensors.
	<b>Active</b>	Only when operating in parallel / see also <b>M218a</b> .
	<b>Event</b>	Current peak detected on one of the output phases.
	<b>Possible causes</b>	<ul style="list-style-type: none"> <li>• Short-circuit between two phases or in the ground connection.</li> <li>• Iout exceeding the max. allowable value.</li> </ul>
	<b>Solutions</b>	<p>Check the mechanical load; set longer acceleration/deceleration ramps. If need be, adjust the V/f pattern if overload occurs when the system is operating at given RPM. Check isolation between motor/output cables.</p> <p>If the alarm persists, please contact ELETTRONICA SANTERNO's SERVICE DEPARTMENT.</p>

A006 Phase Loss

<b>A006</b>	<b>Description</b>	Phase loss
	<b>Active</b>	Only when operating in parallel
	<b>Event</b>	The RMS voltage value in one phase is below the minimum allowable value for a time longer than the one set in the relevant parameter.
	<b>Possible causes</b>	Phase loss.
	<b>Solutions</b>	<p>Check the supply voltages.</p> <p>If the alarm persists, please contact ELETTRONICA SANTERNO's SERVICE DEPARTMENT.</p>

A007 12-Phase Loss

<b>A007</b>	<b>Description</b>	Phase loss in the optional 12-Phase Power Supply unit.
	<b>Active</b>	Only when optional 12-Phase Power Supply unit is installed
	<b>Event</b>	The RMS voltage value in one phase of the optional 12-Phase Power Supply unit is below the minimum allowable value for a time longer than the time set in the relevant parameter.
	<b>Possible causes</b>	Phase loss in the optional 12-Phase Power Supply unit.
	<b>Solutions</b>	<p>Check the supply voltages.</p> <p>If the alarm persists, please contact ELETTRONICA SANTERNO's SERVICE DEPARTMENT.</p>

**A008 Precharge Fault**

<b>A008</b>	<b>Description</b>	The thermoswitch in the precharge resistor has tripped.
	<b>Active</b>	Always active
	<b>Event</b>	Failure in the precharge circuit of the DC-link capacitors; it can happen when the equipment is starting up but also when the equipment is already running.
	<b>Possible causes</b>	The inverter has been repeatedly powered on/off via a contactor installed on the supply line.
	<b>Solutions</b>	If the alarm persists, please contact ELETTRONICA SANTERNO's SERVICE DEPARTMENT.

**A009 Heatsink Overtemperature**

<b>A009</b>	<b>Description</b>	Thermal protective device on the power semiconductor heatsink tripped.
	<b>Active</b>	Always active
	<b>Event</b>	The thermal protective device in the power components has tripped.
	<b>Possible causes</b>	Ambient temperature over 40°C.
	<b>Solutions</b>	Check the ambient temperature of the place where the inverter is installed. If the alarm persists, please contact ELETTRONICA SANTERNO's SERVICE DEPARTMENT.

**A010 12-Phase Heatsink Overtemperature**

<b>A010</b>	<b>Description</b>	The thermoswitch protecting the optional 12-Phase Power Supply unit has tripped.
	<b>Active</b>	Only when optional 12-Phase Power Supply unit is installed
	<b>Event</b>	The thermal protective device in the optional 12-Phase Power Supply unit has tripped.
	<b>Possible causes</b>	Ambient temperature over 40°C.
	<b>Solutions</b>	Check the ambient temperature of the place where the optional 12-Phase Power Supply unit is installed. If the alarm persists, please contact ELETTRONICA SANTERNO's SERVICE DEPARTMENT.

**A011 Driver Board Overtemperature**

<b>A011</b>	<b>Description</b>	The temperature detected by the driver board is too high.
	<b>Active</b>	Always active
	<b>Event</b>	The temperature detected on the driver board is over the max. allowable temperature (60°C).
	<b>Possible causes</b>	Ambient temperature over 40°C.
	<b>Solutions</b>	Check the ambient temperature of the place where the inverter is installed. If the alarm persists, please contact ELETTRONICA SANTERNO's SERVICE DEPARTMENT.

**A012 DSP Overtemperature**

<b>A012</b>	<b>Description</b>	Overtemperature of the aux temperature sensor.
	<b>Active</b>	Always active
	<b>Event</b>	The temperature of the microcontroller core is over the max. temperature threshold (125°C).
	<b>Possible causes</b>	Ambient temperature over 40°C.
	<b>Solutions</b>	Check the ambient temperature of the place where the inverter is installed. If the alarm persists, please contact ELETTRONICA SANTERNO's SERVICE DEPARTMENT.

**A013 Aux. Sens. Overtemperature**

<b>A013</b>	<b>Description</b>	Overtemperature detected by an auxiliary temperature sensor.
	<b>Active</b>	Inactive
	<b>Event</b>	The temperature detected by the auxiliary temperature sensor is over the max. temperature threshold.
	<b>Possible causes</b>	Ambient temperature over 40°C
	<b>Solutions</b>	Check the ambient temperature of the place where the inverter is installed. If the alarm persists, please contact ELETTRONICA SANTERNO's SERVICE DEPARTMENT.

**A014 Max. Precharge Current**

<b>A014</b>	<b>Description</b>	The precharge current has exceeded the allowable threshold.
	<b>Active</b>	Inactive
	<b>Event</b>	Excessive current absorbed from the mains during the precharge stage.
	<b>Possible causes</b>	Short-circuit in the DC-bus.
	<b>Solutions</b>	Check external connections (if any) in bars + and -. If the alarm persists, please contact ELETTRONICA SANTERNO's SERVICE DEPARTMENT.

**A015 Precharge Timeout Fault**

<b>A015</b>	<b>Description</b>	The precharge stage has not been completed.
	<b>Active</b>	Inactive
	<b>Event</b>	The DC-bus capacitors have not been charged within the precharge timeout period.
	<b>Possible causes</b>	DC-bus overloaded.
	<b>Solutions</b>	Check external connections (if any) in bars + and -. If the alarm persists, please contact ELETTRONICA SANTERNO's SERVICE DEPARTMENT.

**A016 Current Symmetry**

<b>A016</b>	<b>Description</b>	Current unbalance between two parallel-connected output phases.
	<b>Active</b>	Only when operating in parallel
	<b>Event</b>	The output current between two parallel-connected phases is unbalanced (current unbalance over 10%).
	<b>Possible causes</b>	Asymmetric output connections.
	<b>Solutions</b>	If the alarm persists, please contact ELETTRONICA SANTERNO's SERVICE DEPARTMENT.

**A017 Braking Unit Fault**

<b>A017</b>	<b>Description</b>	Braking unit fault.
	<b>Active</b>	Only when the braking unit is installed
	<b>Event</b>	The braking module is locked.
	<b>Possible causes</b>	<ul style="list-style-type: none"> <li>• Braking resistor isolation loss.</li> <li>• Braking unit overheated.</li> </ul> More details are given in the <b>Sinus Penta's Installation Instructions manual</b> .
	<b>Solutions</b>	See the <b>Sinus Penta's Installation Instructions manual</b> .

**A018 Ground Fault**

<b>A018</b>	<b>Description</b>	Ground fault detected.
	<b>Active</b>	Always active
	<b>Event</b>	The output current is not zero.
	<b>Possible causes</b>	Ground leakage.
	<b>Solutions</b>	Check isolation; check the motor conditions; check the connection cables between the motor and the inverter. If the alarm persists, please contact ELETTRONICA SANTERNO's SERVICE DEPARTMENT.

**A019 Watchdog Fault**

<b>A019</b>	<b>Description</b>	Fault in the microcontroller of the driver board.
	<b>Active</b>	Always active
	<b>Event</b>	Fault in the microcontroller of the driver board.
	<b>Possible causes</b>	Fault in the digital section of the driver board.
	<b>Solutions</b>	If the alarm persists, please contact ELETTRONICA SANTERNO's SERVICE DEPARTMENT.

### 4.3. Warning List

Warnings are messages that do not lock the equipment, but indicate that maintenance is required.

Warning	Name	Description	Warning indication on the Penta	STATUS
W001	FAN UNDERPERFORMANCE	A fan is rotating	W40	Active
W002	FAN OPEN LOOP	Fan not detected	W40	Active
W003	FAN SHORT CIRCUIT	Fan short-circuit	W40	Active

Table 15: Warning list

#### W001 Fan Underperformance

W001	Description	At least one fan is rotating at a speed that is under the minimum threshold.
	Active	Always active
	Event	At least one fan has been rotating at a speed under the minimum threshold for over 5s.
	Possible causes	<ul style="list-style-type: none"> <li>Mechanical failure in a fan (such as fan locked)</li> <li>Fan faulty</li> </ul>
	Solutions	Check the fan status (see "Possible causes" above). If the warning persists, please contact ELETTRONICA SANTERNO's SERVICE DEPARTMENT.

#### W002 Fan Open Loop

W002	Description	One fan is disconnected. The warning status is not critical and is handled by the control board.
	Active	Always active
	Event	HW signal indicating that a fan is not detected
	Possible causes	<ul style="list-style-type: none"> <li>At least one fan is not detected</li> <li>Failure in the fan supply or the fan logic.</li> </ul>
	Solutions	Check the fan status (see "Possible causes" above). If the warning persists, please contact ELETTRONICA SANTERNO's SERVICE DEPARTMENT.

#### W003 Fan Short Circuit

W003	Description	At least one fan is not operating. The warning status is not critical and is handled by the control board.
	Active	Always active
	Event	HW signal indicating that a fan is not operating.
	Possible causes	<ul style="list-style-type: none"> <li>Failure in the fan supply or the fan logic.</li> <li>Mechanical failure in a fan (such as fan locked).</li> </ul>
	Solutions	Check the fan status (see "Possible causes" above). If the warning persists, please contact ELETTRONICA SANTERNO's SERVICE DEPARTMENT.