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SINUS PENTA

MULTIFUNCTION AC DRIVE

GUIDE TO THE REGENERATIVE APPLICATION

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English

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REVISION INDEX

The following subjects covered in this Guide to the Regenerative Application, R.06, have been added, changed or suppressed with respect to the previous revision R.05.

GENERAL

Manual heading changed into "Guide to the Regenerative Application".
Section “SCOPE OF THIS MANUAL” added.
List of the necessary additional components added to section 3.6.2.
Tables and sections covering UL-approved fuses modified based on the latest reviews from UL.
Column “Q.ty” added to tables covering UL-approved fuses for better understanding.

MODELS

New S84 4T/5T/6T models added along with their additional components (Lr and Lf reactors and interface kits).
New S12/S14/S22/S32 5T/6T models added together with their additional components (Lr and Lf reactors and interface kits).
Out-of-production S40/S50 4T models removed together with their additional components (Lr and Lf reactors and interface kits).
Some values changed in Light/Standard/Heavy/Strong Application Tables.
New columns added for current ratings in Light/Standard/Heavy/Strong Application Tables.
Some values changed in Regenerative Drive Ratings Tables.

ADDITIONAL COMPONENTS

MCC1 added to Figure 3 (wiring diagram).
Correspondence between AWG and mm^2 fixed in the tables covering the cross-sections of the power cables.
Note "(*) Alternative to MCC1." added to the tables covering the size of the safety components.

OPTIONAL BOARDS

Figure 8 (Energy Counter) fixed.
Optional board ES847: Fixed XAIN7 for DC Current with Energy Counter (optional).

MENUS, SETTINGS, PARAMETERS

Factory default for P500 (Vdc setpoint) fixed.
“Mains Monitor” menu updated based on mains default settings.
References to UL 1741, IEEE 1547 and CSA C22.2 added.

0. TABLE OF CONTENTS

0.1. Index of Figures

0.2. Index of Tables

1. SCOPE OF THIS MANUAL

Elettronica Santerno is committed to update its User Manuals available for download from santerno.com with the latest software version officially released. Please contact Elettronica Santerno if you require technical documents related to previous software versions.

2. OVERVIEW

Special software that can be used for particular applications is supplied with the drives of the Sinus Penta series. The menu tree, the programming mode and navigation mode of the Sinus Penta are used; parameters or menus will be added/(removed) whether required/(not required) for your application.
This manual covers the wiring diagrams and the parameters relating to the Regenerative application.
Accessory boards are covered in the Sinus Penta Installation Instructions manual.
The parameters shared with the standard Sinus Penta are covered in the Sinus Penta Programming Instructions manual.

The FIRMWARE UPGRADE section explains how to download the files for the Sinus Penta applications to the standard drive: this download procedure is to be performed only when a drive programmed with standard firmware, *not* with Regenerative firmware, needs to be updated.
The procedure above is not required if the drive is factory set with the Regenerative firmware.

2.1. THE REGENERATIVE APPLICATION

The Regenerative Penta drive allows exchanging ingoing-outgoing power with sinusoidal currents (weak current harmonics) and with a unitary power factor. The Regenerative application allows tuning the DC-bus voltage: when the Penta is used to power one or multiple inverters for motor control, this allows recovering the kinetic energy of the connected motor(s) during the braking stage, and delivering energy to the mains (thus avoiding using braking resistors, which also cause overheating). When the motor drive is powered by the DC-bus through the regenerative function, motors having greater voltage ratings than the mains voltage can be controlled by the Sinus Penta.

3. INSTALLATION INSTRUCTIONS

3.1. OVERVIEW

The drives of the SINUS PENTA series can be used as regenerative feeders.

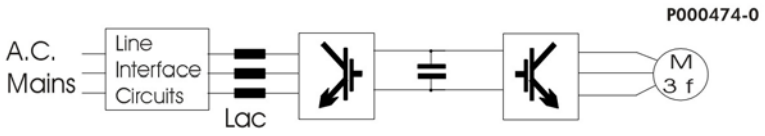
The Penta becomes a feeder absorbing or delivering sinusoidal current to the grid with a unitary power factor; it is called a regenerative feeder because a bidirectional power flow can be obtained. The regenerative feeder has a DC link output which is used for the power supply of one or more Elettronica Santerno inverters through the DC-bus terminals.

The following benefits can be obtained:
- Absorption from the current mains with weak harmonic currents and unitary power factor;
- Recovery of the kinetic energy of the connected motor(s) during the braking stage (thus avoiding using braking resistors, which also cause overheating);
- Possibility of controlling connected motors having greater voltage ratings than the mains voltage (see Motors Having a Different Supply Voltage than the Mains Supply Voltage).

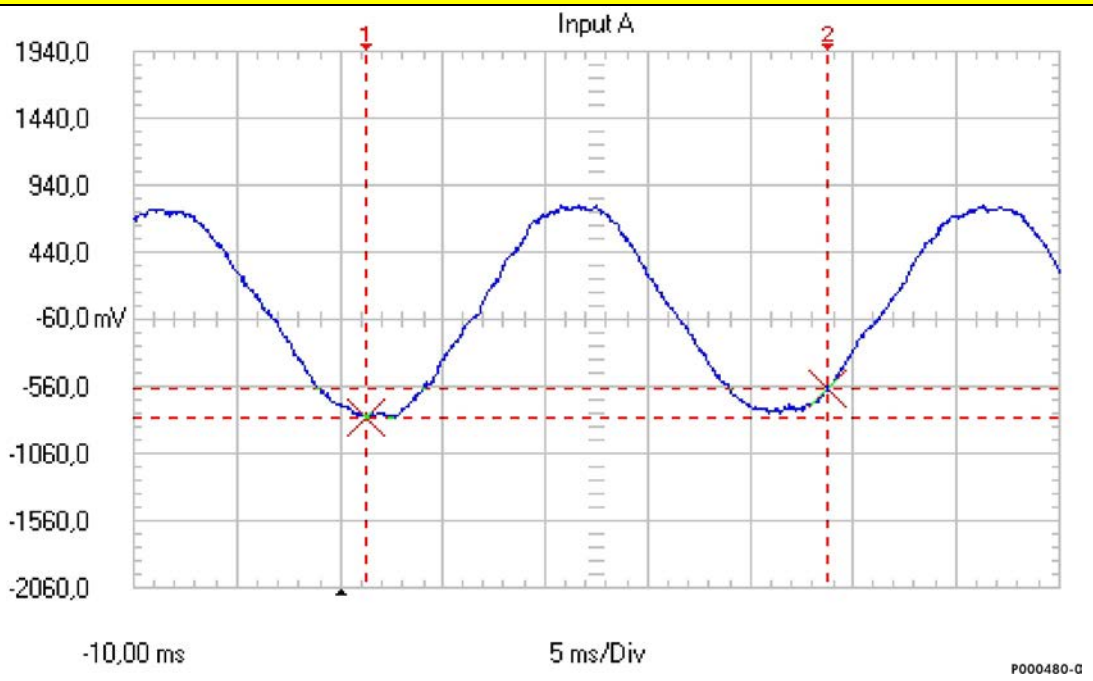
The following pages explain how drives can be connected to the mains; current waveforms and harmonic currents are also given. As you will see, the Penta used as a regenerative drive allows obtaining great benefits.

NOTE Current harmonics depend both on mains voltage distortion (the weaker the distortion, the weaker the current harmonics) and on drive power ratings (rated power ensures the best harmonic currents percentage).

TYPE OF INSTALLATION: Using a regenerative drive



MAINS-SIDE CURRENT: Drive operating at rated current



MAINS-SIDE CURRENT SPECTRUM

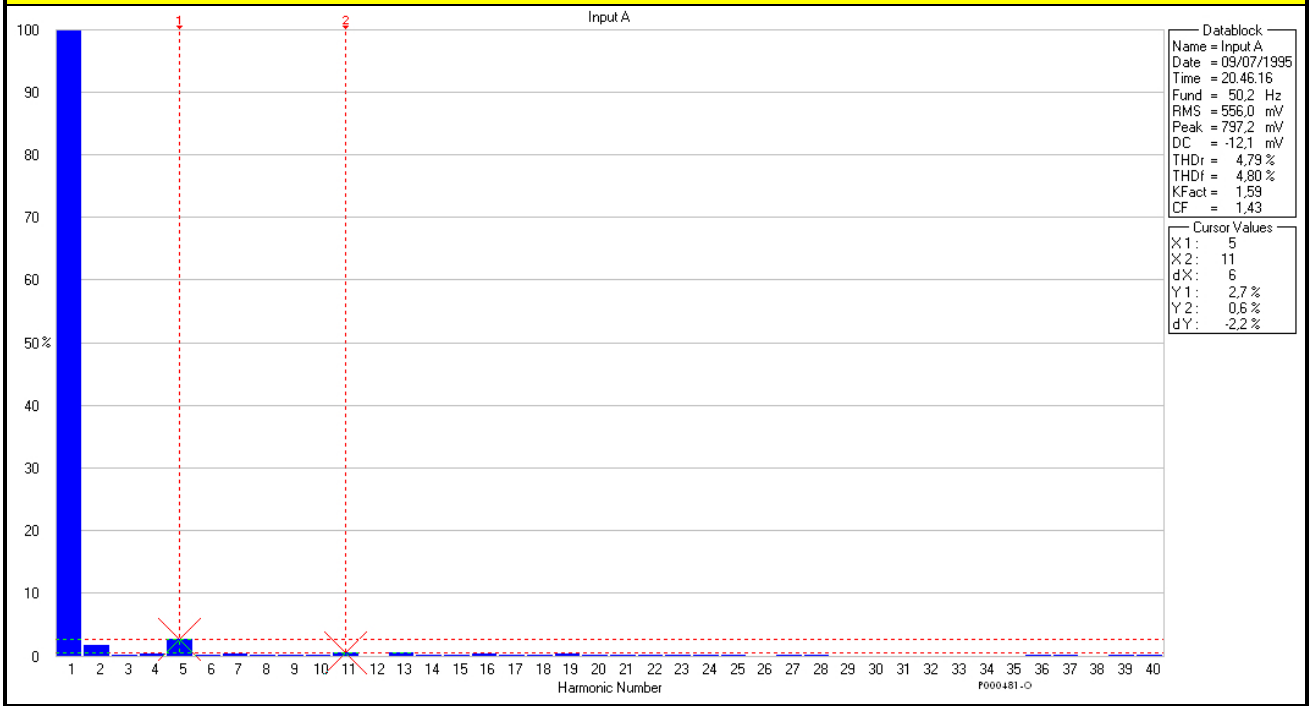


Figure 1: Mains-side current produced when a regenerative drive is used

Figure 2 shows the block-diagram for the connection of a SINUS PENTA used as a regenerative feeder powering a SINUS PENTA used as a motor controller.

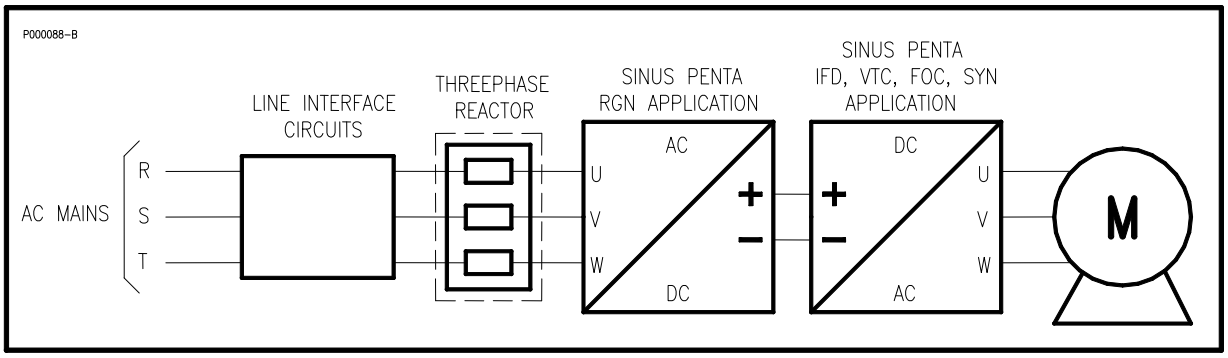


Figure 2: Block-diagram of the regenerative drive

A reactor filtering PWM voltage from the output terminals of the drive and transforming output current into sinusoidal current is to be installed between the regenerative drive and the mains.
Using the drive as a regenerative feeder is particularly useful when the motor connected to the drive frequently operates as a generator (e.g. lifting applications, test benches, etc.). Energy is then delivered to the mains under a sinusoidal waveform and with a unitary power factor, thus ensuring energy saving and avoiding using braking resistor units.

NOTE Output power is intended for the supply of one or more SINUS K inverters/PENTA drives. Any other applications must be authorized by Elettronica Santerno.

3.2. CHOOSING THE REGENERATIVE DRIVE

Basically, when choosing the regenerative drive, the power delivered from the drive used to control the motor is compared to the power that the drive can deliver when overloaded and when operating in continuous mode, also considering the efficiency of the two drives. In most cases, using two drives of the same model allows meeting this criterion.

CAUTION

Using two drives (feeder and motor drive) of the same model does not always meet the criterion above, because the continuous current delivered by the regenerative drive is sometimes lower than the current delivered by the equivalent motor drive, as the minimum current frequency for the regenerative drive is 4 kHz or 5kHz based on the drive model.
It is therefore recommended that the application tables given later in this section be carefully consulted.

The application tables below for light, standard, heavy, strong applications, contain the model of the drive that controls the motor and the model of the regenerative drive, depending both on the rated motor voltage and the mains voltage.

3.2.1. LIGHT APPLICATIONS (OVERLOAD UP TO 120%) – 2T VOLTAGE CLASS

Rated Motor Voltage: 200-240Vac					
MOTOR DRIVE				REGENERATIVE DRIVE	
Maximum Applicable Motor			Model of MOTOR SINUS PENTA	Model of REGENERATIVE SINUS PENTA with Supply Mains	
kW	HP	A		220±10%	230±10%
3	4	11.2	0007	0007	0007
3.7	5	13.2	0008	0008	0008
4	5.5	14.6	0010	0010	0010
4.5	6	15.7	0013	0013	0013
5.5	7.5	19.5	0015	0015	0015
7.5	10	25.7	0016	0016	0016
9.2	12.5	30	0020	0020	0020
11	15	36	0023	0023	0023
15	20	50	0033	0033	0033
18.5	25	61	0037	0037	0037
22	30	71	0040	0049	0040
25	35	80	0049	0060	0060
28	38	88	0060	0067	0060
30	40	96	0067	0067	0067
37	50	117	0074	0074	0074
45	60	135	0086	0113	0113
55	75	170	0113	0113	0113
65	90	195	0129	0129	0129
70	95	213	0150	0179	0150
75	100	231	0162	0179	0179
90	125	277	0180	0180	0180
110	150	332	0202	0202	0202
120	165	375	0217	0217	0217
132	180	390	0260	0260	0260
160	220	475	0313	0367	0313
185	250	550	0367	0402	0367
200	270	593	0402	0457	0402
250	340	732	0457	0524	0524
260	350	780	0524	0598	0524

3.2.2. STANDARD APPLICATIONS (OVERLOAD UP TO 140%) – 2T VOLTAGE CLASS

Rated Motor Voltage: 200-240Vac					
MOTOR DRIVE				REGENERATIVE DRIVE	
Maximum Applicable Motor			Model of MOTOR SINUS PENTA	Model of REGENERATIVE SINUS PENTA with Supply Mains	
kW	HP	A		220±10%	230±10%
2.2	3	8.5	0007	0007	0007
3	4	11.2	0008	0008	0008
3.7	5	13.2	0010	0010	0010
4	5.5	14.6	0013	0013	0013
4.5	6	15.7	0015	0015	0015
5.5	7.5	19.5	0016	0016	0016
7.5	10	25.7	0020	0020	0020
9.2	12.5	30	0023	0023	0023
11	15	36	0033	0033	0033
15	20	50	0037	0037	0037
18.5	25	61	0040	0040	0040
22	30	71	0049	0049	0049
25	35	80	0060	0060	0060
30	40	96	0067	0067	0067
37	50	117	0074	0074	0074
40	55	127	0086	0086	0086
45	60	135	0113	0113	0113
55	75	170	0129	0129	0129
65	90	195	0150	0179	0150
75	100	231	0162	0179	0179
80	110	250	0180	0180	0180
90	125	277	0202	0202	0202
110	150	332	0217	0217	0217
132	180	390	0260	0260	0260
150	200	458	0313	0313	0313
160	220	475	0367	0367	0367
185	250	550	0402	0457	0457
220	300	661	0457	0457	0457
260	350	780	0524	0524	0524

3.2.3. HEAVY APPLICATIONS (OVERLOAD UP TO 175%) – 2T VOLTAGE CLASS

Rated Motor Voltage: 200-240Vac					
MOTOR DRIVE				REGENERATIVE DRIVE	
Maximum Applicable Motor			Model of MOTOR SINUS PENTA	Model of REGENERATIVE SINUS PENTA with Supply Mains	
kW	HP	A		220±10%	230±10%
1.8	2.5	7.3	0007	0007	0007
2.2	3	8.5	0008	0008	0008
3	4	11.2	0010	0010	0010
3.7	5	13.2	0013	0013	0013
4	5.5	14.6	0015	0015	0015
4.5	6	15.7	0016	0016	0016
5.5	7.5	19.5	0020	0020	0020
7.5	10	25.7	0023	0023	0023
11	15	36	0033	0033	0033
15	20	50	0037	0037	0037
15	20	50	0040	0040	0040
18.5	25	61	0049	0049	0049
22	30	71	0060	0060	0060
25	35	80	0067	0067	0067
30	40	96	0074	0074	0074
32	45	103	0086	0086	0086
45	60	135	0113	0113	0113
50	70	150	0129	0129	0129
55	75	170	0150	0150	0150
65	90	195	0162	0179	0162
75	100	231	0180	0180	0180
80	110	250	0202	0202	0202
110	150	332	0217	0217	0217
110	150	332	0260	0260	0260
132	180	390	0313	0180	0180
150	200	458	0367	0202	0202
160	220	475	0402	0217	0217
200	270	593	0457	0457	0457
220	300	661	0524	0524	0524

3.2.4. STRONG APPLICATIONS (OVERLOAD UP TO 200%) – 2T VOLTAGE CLASS

Rated Motor Voltage: 200-240Vac					
MOTOR DRIVE				REGENERATIVE DRIVE	
Maximum Applicable Motor			Model of MOTOR SINUS PENTA	Model of REGENERATIVE SINUS PENTA with Supply Mains	
kW	HP	A		220±10%	230±10%
1.5	2	6.1	0007	0007	0007
1.8	2.5	7.3	0008	0008	0008
2.2	3	8.5	0010	0010	0010
3	4	11.2	0013	0013	0013
3.7	5	13.2	0015	0015	0015
4	5.5	14.6	0016	0016	0016
4.5	6	15.7	0020	0020	0020
5.5	7.5	19.5	0023	0023	0023
7.5	10	25.7	0033	0033	0033
11	15	36	0037	0037	0037
12.5	17	41	0040	0040	0040
15	20	50	0049	0049	0049
18.5	25	61	0060	0060	0060
20	27	66	0067	0067	0067
22	30	71	0074	0074	0074
25	35	80	0086	0086	0086
30	40	96	0113	0113	0113
37	50	117	0129	0129	0129
45	60	135	0150	0150	0150
55	75	170	0162	0162	0162
60	85	185	0180	0180	0180
65	90	195	0202	0202	0202
75	100	231	0217	0217	0217
90	125	277	0260	0260	0260
110	150	332	0313	0313	0313
120	165	375	0367	0367	0367
132	180	390	0402	0402	0402
160	220	475	0457	0457	0457
185	250	550	0524	0524	0524

3.2.5. LIGHT APPLICATIONS (OVERLOAD UP TO 120%) – 4T VOLTAGE CLASS

Rated Motor Voltage: 380-415Vac						Rated Motor Voltage: 440-460Vac					Rated Motor Voltage: 480-500Vac				
MOTOR DRIVE				RGN DRIVE		MOTOR DRIVE				RGN DRIVE	MOTOR DRIVE				RGN DRIVE
Maximum Applicable Motor			Model of MOTOR SINUS PENTA	Model of REGENERATIVE SINUS PENTA with Supply Mains		Maximum Applicable Motor			Model of MOTOR SINUS PENTA	Model of REGENERATIVE SINUS PENTA with Supply Mains	Maximum Applicable Motor			Model of MOTOR SINUS PENTA	Model of REGENERATIVE SINUS PENTA with Supply Mains
kW	HP	A		380 ±10%	400 ±10%	kW	HP	A		440 ±10%	kW	HP	A		480 ±10%
4.5	6	9.0	0005	0005	0005	5.5	7.5	9.7	0005	0005	6.5	9	10.2	0005	0007
5.5	7.5	11.2	0007	0007	0007	7.5	10	12.5	0007	0009	7.5	10	11.8	0007	0009
7.5	10	14.5	0009	0009	0009	9.2	12.5	16	0009	0009	9.2	12.5	14.3	0009	0009
7.5	10	14.8	0011	0011	0011	9.2	12.5	16	0011	0011	11	15	16.5	0011	0016
7.5	10	14.8	0014	0014	0014	9.2	12.5	16	0014	0014	11	15	16.5	0014	0016
11	15	21	0016	0016	0016	15	20	25	0016	0016	15	20	23.2	0016	0017
15	20	29	0017	0017	0017	18.5	25	30	0017	0025	18.5	25	28	0017	0017
15	20	29	0020	0020	0020	18.5	25	30	0020	0025	18.5	25	28	0020	0020
22	30	41	0025	0034	0025	22	30	36	0025	0025	22	30	33	0025	0025
22	30	41	0030	0034	0030	22	30	36	0030	0030	25	35	37	0030	0030
30	40	55	0034	0034	0034	30	40	48	0034	0034	37	50	53	0034	0034
30	40	55	0036	0036	0036	37	50	58	0036	0036	37	50	53	0036	0036
37	50	67	0040	0040	0040	45	60	70	0040	0040	50	70	70	0040	0040
45	60	80	0049	0060	0060	50	65	75	0049	0060	55	75	78	0049	0060
50	70	87	0060	0067	0060	55	75	85	0060	0060	65	90	88	0060	0067
55	75	98	0067	0067	0067	65	90	100	0067	0067	75	100	103	0067	0074
65	90	114	0074	0074	0074	75	100	116	0074	0074	85	115	120	0074	0074
75	100	133	0086	0086	0086	90	125	135	0086	0113	90	125	127	0086	0086
100	135	180	0113	0113	0113	110	150	166	0113	0113	132	180	180	0113	0129
110	150	191	0129	0150	0129	125	170	192	0129	0129	140	190	195	0129	0150
120	165	212	0150	0180	0162	132	180	198	0150	0162	150	200	211	0150	0162
132	180	228	0162	0180	0180	150	200	230	0162	0180	175	238	240	0162	0180
160	220	273	0180	0180	0180	200	270	297	0180	0180	220	300	300	0180	0180
200	270	341	0202	0217	0202	220	300	326	0202	0202	250	340	337	0202	0202
220	300	375	0217	0260	0217	250	340	366	0217	0260	260	350	359	0217	0217
250	340	421	0260	0313	0260	280	380	410	0260	0260	300	410	418	0260	0260
280	380	480	0313	0367	0313	315	430	459	0313	0313	355	480	471	0313	0367
315	430	528	0367	0367	0367	375	510	540	0367	0402	400	550	544	0367	0367
400	550	680	0402	0457	0402	450	610	665	0402	0402	500	680	673	0402	0402
400	550	680	0457	0457	0457	450	610	665	0457	0457	500	680	673	0457	0457
450	610	765	0524	0524	0524	500	680	731	0524	0524	560	760	751	0524	0524
500	680	841	0598	0598	0598	560	760	817	0598	0598	630	860	864	0598	0598
560	760	939	0748	0748	0748	630	860	939	0748	0748	710	970	960	0748	0748
710	970	1200	0831	0964	0831	800	1090	1160	0831	0831	900	1230	1184	0831	0964
900	1230	1480	0964	1130	0964	1000	1360	1431	0964	1130	1100	1500	1480	0964	1130
1000	1360	1646	1130	1296	1130	1170	1600	1700	1130	1296	1270	1730	1700	1130	1296
1200	1650	2050	1296	1296	1296	1400	1830	2000	1296	1296	1460	1990	2050	1296	1296
1500	2000	2500	1800	1800	1800	1750	2400	2500	1800	1800	1850	2500	2500	1800	1800
1750	2400	2900	2076	(*)	2076	2000	2720	2900	2076	2076	2100	2900	2900	2076	2076

(*) Please contact Elettronica Santerno.

3.2.6. STANDARD APPLICATIONS (OVERLOAD UP TO 140%) – 4T VOLTAGE CLASS

Rated Motor Voltage: 3804415Vac						Rated Motor Voltage: 4404460Vac					Rated Motor Voltage: 4804500Vac				
MOTOR DRIVE				RGN DRIVE		MOTOR DRIVE				RGN DRIVE	MOTOR DRIVE				RGN DRIVE
Maximum Applicable Motor			Model of MOTOR SINUS PENTA	Model of REGENERATIVE SINUS PENTA with Supply Mains		Maximum Applicable Motor			Model of MOTOR SINUS PENTA	Model of REGENERATIVE SINUS PENTA with Supply Mains	Maximum Applicable Motor			Model of MOTOR SINUS PENTA	Model of REGENERATIVE SINUS PENTA with Supply Mains
kW	HP	A		380 ±10%	400 ±10%	kW	HP	A		440 ±10%	kW	HP	A		480 ±10%
4	5.5	8.4	0005	0005	0005	4.5	6	7.8	0005	0005	5.5	7.5	9.0	0005	0005
4.5	6	9.0	0007	0007	0007	5.5	7.5	9.7	0007	0007	6.5	9	10.2	0007	0007
5.5	7.5	11.2	0009	0009	0009	7.5	10	12.5	0009	0009	7.5	10	11.8	0009	0009
7.5	10	14.8	0011	0011	0011	9.2	12.5	15.6	0011	0011	9.2	12.5	14.3	0011	0011
7.5	10	14.8	0014	0014	0014	9.2	12.5	15.6	0014	0014	11	15	16.5	0014	0016
9.2	12.5	17.9	0016	0016	0016	11	15	18.3	0016	0016	15	20	23.2	0016	0016
11	15	21	0017	0017	0017	11	15	18.3	0017	0025	15	20	23.2	0017	0017
15	20	29	0020	0020	0020	15	20	25	0020	0025	18.5	25	28	0020	0020
18.5	25	35	0025	0025	0025	18.5	25	30	0025	0025	22	30	33	0025	0025
22	30	41	0030	0034	0030	22	30	36	0030	0030	25	35	37	0030	0030
25	35	46	0034	0034	0034	30	40	48	0034	0034	30	40	44	0034	0034
30	40	55	0036	0036	0036	30	40	48	0036	0036	37	50	53	0036	0036
30	40	55	0040	0040	0040	37	50	58	0040	0040	40	55	58	0040	0040
37	50	67	0049	0049	0049	45	60	70	0049	0049	45	60	64	0049	0049
45	60	80	0060	0060	0060	55	75	85	0060	0060	55	75	78	0060	0060
55	75	98	0067	0067	0067	60	80	91	0067	0067	65	90	88	0067	0067
65	90	114	0074	0074	0074	70	95	107	0074	0074	75	100	103	0074	0074
75	100	133	0086	0086	0086	75	100	116	0086	0086	85	115	120	0086	0086
90	125	159	0113	0113	0113	90	125	135	0113	0113	90	125	127	0113	0113
100	135	180	0129	0129	0129	110	150	166	0129	0129	110	150	153	0129	0129
110	150	191	0150	0150	0150	132	180	198	0150	0162	150	200	211	0162	0162
132	180	228	0162	0180	0180	150	200	230	0162	0180	160	220	218	0180	0180
160	220	273	0180	0180	0180	185	250	279	0180	0180	200	270	300	0180	0180
200	270	341	0202	0202	0202	220	300	326	0202	0202	250	340	345	0202	0202
220	300	375	0217	0260	0217	250	340	375	0217	0260	260	350	375	0217	0217
250	340	421	0260	0313	0260	280	380	410	0260	0260	300	410	425	0260	0260
280	380	480	0313	0367	0313	315	430	459	0313	0313	355	480	480	0367	0367
315	430	528	0367	0367	0367	375	510	540	0367	0402	400	550	550	0367	0367
400	550	680	0402	0457	0402	450	610	665	0402	0402	500	680	680	0402	0402
400	550	680	0457	0457	0457	450	610	665	0457	0457	500	680	720	0457	0457
450	610	765	0524	0524	0524	500	680	731	0524	0524	560	770	800	0524	0524
500	680	841	0598	0598	0598	560	760	817	0598	0598	630	860	900	0598	0598
560	760	939	0748	0748	0748	630	860	939	0748	0748	710	970	1000	0748	0748
630	860	1080	0831	0831	0831	800	1090	1160	0831	0831	800	1090	1200	0831	0831
800	1090	1334	0964	0964	0964	900	1230	1287	0964	0964	1000	1360	1480	0964	0964
900	1230	1480	1130	1130	1130	1100	1500	1630	1130	1130	1170	1600	1700	1130	1130
1200	1650	2050	1296	1800	1800	1400	1830	2000	1296	1800	1460	1990	2050	1800	1800
1400	1910	2400	1800	1800	1800	1700	2300	2400	1800	1800	1750	2400	2400	1800	1800
1750	2400	2900	2076	(*)	2076	2000	2720	2900	2076	2076	2100	2900	2900	2076	2076

(*) Please contact Elettronica Santerno.

3.2.7. HEAVY APPLICATIONS (OVERLOAD UP TO 175%) – 4T VOLTAGE CLASS

Rated Motor Voltage: 3804415Vac						Rated Motor Voltage: 4404460Vac					Rated Motor Voltage: 4804500Vac				
MOTOR DRIVE				RGN DRIVE		MOTOR DRIVE				RGN DRIVE	MOTOR DRIVE				RGN DRIVE
Maximum Applicable Motor			Model of MOTOR SINUS PENTA	Model of REGENERATIVE SINUS PENTA with Supply Mains		Maximum Applicable Motor			Model of MOTOR SINUS PENTA	Model of REGENERATIVE SINUS PENTA with Supply Mains	Maximum Applicable Motor			Model of MOTOR SINUS PENTA	Model of REGENERATIVE SINUS PENTA with Supply Mains
kW	HP	A		380 ±10%	400 ±10%	kW	HP	A		440 ±10%	kW	HP	A		480 ±10%
3	4	6.4	0005	0005	0005	3.7	5	6.6	0005	0005	4.5	6	7.2	0005	0005
4	5.5	8.4	0007	0007	0007	4.5	6	7.8	0007	0007	5.5	7.5	9.0	0007	0007
4.5	6	9.0	0009	0009	0009	5.5	7.5	9.7	0009	0009	7.5	10	11.8	0009	0009
5.5	7.5	11.2	0011	0011	0011	7.5	10	12.5	0011	0011	9.2	12.5	14.3	0011	0011
7.5	10	14.8	0014	0014	0014	9.2	12.5	15.6	0014	0014	11	15	16.5	0014	0016
9.2	12.5	17.9	0016	0016	0016	11	15	18.3	0016	0016	12.5	17	18.9	0016	0016
9.2	12.5	17.9	0017	0017	0017	11	15	18.3	0017	0017	12.5	17	18.9	0017	0017
11	15	21	0020	0020	0020	15	20	25	0020	0020	15	20	23.2	0020	0020
15	20	29	0025	0025	0025	18.5	25	30	0025	0025	18.5	25	28	0025	0025
18.5	25	35	0030	0030	0030	22	30	36	0030	0030	22	30	33	0030	0030
22	30	41	0034	0034	0034	25	35	40	0034	0034	28	38	41	0034	0034
25	35	46	0036	0036	0036	30	40	48	0036	0036	30	40	44	0036	0036
25	35	46	0040	0040	0040	30	40	48	0040	0040	37	50	53	0040	0040
30	40	55	0049	0049	0049	37	50	58	0049	0049	45	60	64	0049	0049
37	50	67	0060	0060	0060	45	60	70	0060	0060	50	70	70	0060	0060
45	60	80	0067	0067	0067	50	70	75	0067	0067	55	75	78	0067	0067
50	70	87	0074	0074	0074	55	75	85	0074	0074	65	90	88	0074	0074
55	75	98	0086	0086	0086	65	90	100	0086	0086	75	100	103	0086	0086
75	100	133	0113	0113	0113	75	100	116	0113	0113	90	125	127	0113	0113
80	110	144	0129	0129	0129	90	125	135	0129	0129	110	150	153	0129	0129
90	125	159	0150	0150	0150	110	150	166	0150	0150	132	180	180	0150	0150
110	150	191	0162	0162	0162	132	180	198	0162	0162	140	190	191	0162	0162
132	180	228	0180	0180	0180	160	220	237	0180	0180	160	220	218	0180	0180
150	200	264	0202	0202	0202	185	250	279	0202	0202	200	270	273	0202	0202
185	250	321	0217	0217	0217	220	300	326	0217	0217	220	300	300	0217	0217
200	270	341	0260	0260	0260	260	350	390	0260	0260	280	380	393	0260	0260
220	300	375	0313	0313	0313	260	350	390	0313	0313	300	400	413	0313	0313
250	340	421	0367	0367	0367	315	430	459	0367	0367	355	480	471	0367	0367
315	430	528	0402	0402	0402	400	550	576	0402	0402	400	550	544	0402	0402
315	430	528	0457	0457	0457	375	510	540	0457	0457	450	610	612	0457	0457
355	480	589	0524	0524	0524	450	610	665	0524	0524	500	680	673	0524	0524
400	550	680	0598	0598	0598	500	680	731	0598	0598	560	760	751	0598	0598
500	680	841	0748	0748	0748	560	760	817	0748	0748	630	860	864	0748	0748
560	760	939	0831	0831	0831	630	860	939	0831	0831	710	970	960	0831	0831
710	970	1200	0964	0964	0964	800	1090	1160	0964	0964	900	1230	1184	0964	0964
800	1090	1334	1130	1130	1130	900	1230	1287	1130	1130	1000	1360	1317	1130	1130
1000	1360	1650	1296	1296	1296	1100	1500	1630	1296	1296	1170	1600	1560	1296	1296
1200	1650	2050	1800	1800	1800	1450	1970	2050	1800	1800	1500	2000	2050	1800	1800
1400	1910	2400	2076	2076	2076	1700	2300	2400	2076	2076	1750	2400	2400	2076	2076

3.2.8. STRONG APPLICATIONS (OVERLOAD UP TO 200%) – 4T VOLTAGE CLASS

Rated Motor Voltage: 3804415Vac						Rated Motor Voltage: 4404460Vac					Rated Motor Voltage: 4804500Vac				
MOTOR DRIVE				RGN DRIVE		MOTOR DRIVE				RGN DRIVE	MOTOR DRIVE				RGN DRIVE
Maximum Applicable Motor			Model of MOTOR SINUS PENTA	Model of REGENERATIVE SINUS PENTA with Supply Mains		Maximum Applicable Motor			Model of MOTOR SINUS PENTA	Model of REGENERATIVE SINUS PENTA with Supply Mains	Maximum Applicable Motor			Model of MOTOR SINUS PENTA	Model of REGENERATIVE SINUS PENTA with Supply Mains
kW	HP	A		380 ±10%	400 ±10%	kW	HP	A		440±10%	kW	HP	A		480±10%
2.2	3	4.9	0005	0005	0005	3	4	5.6	0005	0005	3.7	5	6.1	0005	0005
3	4	6.4	0007	0007	0007	3.7	5	6.6	0007	0007	4.5	6	7.2	0007	0007
4	5.5	8.4	0009	0009	0009	4.5	6	7.8	0009	0009	5.5	7.5	9.0	0009	0009
4.5	6	9.0	0011	0011	0011	5.5	7.5	9.7	0011	0011	7.5	10	11.8	0011	0011
5.5	7.5	11.2	0014	0014	0014	7.5	10	12.5	0014	0014	9.2	12.5	14.3	0014	0014
7.5	10	14.8	0016	0016	0016	9.2	12.5	15.6	0016	0016	11	15	16.5	0016	0016
7.5	10	14.8	0017	0017	0017	9.2	12.5	15.6	0017	0017	12.5	17	18.9	0017	0017
9.2	12.5	17.9	0020	0020	0020	11	15	18.3	0020	0020	12.5	17	18.9	0020	0020
11	15	21	0025	0025	0025	15	20	25	0025	0025	15	20	23.2	0025	0025
15	20	29	0030	0030	0030	18.5	25	30	0030	0030	18.5	25	28	0030	0030
18.5	25	35	0034	0034	0034	22	30	36	0034	0034	22	30	33	0034	0034
22	30	41	0036	0036	0036	25	35	40	0036	0036	28	38	41	0036	0036
22	30	41	0040	0040	0040	25	35	40	0040	0040	30	40	44	0040	0040
25	35	46	0049	0049	0049	30	40	48	0049	0049	37	50	53	0049	0049
30	40	55	0060	0060	0060	37	50	58	0060	0060	45	60	64	0060	0060
32	45	59	0067	0067	0067	40	55	63	0067	0067	50	70	70	0067	0067
37	50	67	0074	0074	0074	45	60	70	0074	0074	55	75	78	0074	0074
45	60	80	0086	0086	0086	55	75	85	0086	0086	65	90	88	0086	0086
55	75	98	0113	0113	0113	65	88	100	0113	0113	75	100	103	0113	0113
65	90	114	0129	0129	0129	75	100	116	0129	0129	85	115	120	0129	0129
75	100	133	0150	0150	0150	90	125	135	0150	0150	90	125	127	0150	0150
90	125	159	0162	0162	0162	110	150	166	0162	0162	110	150	153	0162	0162
110	150	191	0180	0180	0180	120	165	184	0180	0180	132	180	180	0180	0180
132	180	228	0202	0202	0202	150	200	230	0202	0202	160	220	218	0202	0202
150	200	260	0217	0217	0217	160	220	245	0217	0217	185	250	257	0217	0217
160	220	273	0260	0260	0260	200	270	307	0260	0260	200	270	273	0260	0260
185	250	321	0313	0313	0313	220	300	326	0313	0313	250	340	337	0313	0313
200	270	341	0367	0367	0367	250	340	366	0367	0367	260	350	359	0367	0367
280	380	480	0402	0402	0402	315	430	462	0402	0402	355	480	471	0402	0402
280	380	480	0457	0457	0457	330	450	493	0457	0457	375	510	497	0457	0457
315	430	528	0524	0524	0524	375	510	540	0524	0524	400	550	544	0524	0524
355	480	589	0598	0598	0598	400	550	591	0598	0598	450	610	612	0598	0598
400	550	680	0748	0748	0748	500	680	731	0748	0748	560	760	751	0748	0748
450	610	765	0831	0831	0831	560	760	817	0831	0831	630	860	864	0831	0831
560	770	939	0964	0964	0964	710	970	1043	0964	0964	800	1090	1067	0964	0964
710	970	1200	1130	1130	1130	800	1090	1160	1130	1130	900	1230	1184	1130	1130
800	1090	1334	1296	1296	1296	900	1230	1287	1296	1296	1000	1360	1317	1296	1296
1000	1360	1650	1800	1800	1800	1170	1600	1650	1800	1800	1200	1650	1650	1800	1800
1200	1650	2050	2076	2076	2076	1450	1970	2050	2076	2076	1500	2000	2050	2076	2076

3.2.9. LIGHT APPLICATIONS (OVERLOAD UP TO 120%) – 5T-6T VOLTAGE CLASS

Rated Motor Voltage: 600-690Vac						Rated Motor Voltage: 575Vac				
MOTOR DRIVE				REGENERATIVE DRIVE		MOTOR DRIVE				REGENERATIVE DRIVE
Maximum Applicable Motor			Model of MOTOR SINUS PENTA	Model of REGENERATIVE SINUS PENTA with Supply Mains		Maximum Applicable Motor			Model of MOTOR SINUS PENTA	Model of REGENERATIVE SINUS PENTA with Supply Mains
kW	HP	A		660±10%	690±10%	kW	HP	A		575±10%
5.5	7.5	6.3	0003	0003	0003	4	5.5	5.7	0003	0003
7.5	10	8.4	0004	0004	0004	5.5	7.5	7.6	0004	0004
9.2	12.5	10.2	0006	0006	0006	7.5	10	10	0006	0006
11	15	12.1	0012	0012	0012	9.2	12.5	12.5	0012	0012
15	20	16.8	0018	0018	0018	11	15	14	0018	0018
18.5	25	21	0019	0019	0019	15	20	20	0019	0019
22	30	23	0021	0021	0021	18.5	25	25	0021	0021
30	40	33	0022	0022	0022	22	30	28	0022	0022
37	50	39	0024	0024	0024	30	40	39	0024	0024
45	60	46	0032	0032	0032	37	50	47	0032	0032
55	75	56	0042	0042	0042	45	60	55	0042	0042
75	100	78	0051	0051	0051	55	75	70	0051	0051
75	100	78	0062	0062	0062	65	90	83	0062	0062
90	125	94	0069	0069	0069	75	100	95	0069	0069
110	150	113	0076	0076	0076	90	125	115	0076	0076
132	180	133	0088	0088	0088	110	150	138	0088	0088
160	220	158	0131	0131	0131	132	180	168	0131	0131
220	300	220	0164	0181	0181	160	220	198	0164	0164
250	340	250	0181	0201	0181	220	300	275	0181	0201
315	430	310	0201	0259	0259	250	340	300	0201	0218
355	485	350	0218	0290	0290	300	410	358	0218	0290
400	550	390	0259	0290	0290	330	450	395	0259	0290
450	610	440	0290	0290	0290	355	485	420	0290	0290
500	680	480	0314	0401	0368	400	550	480	0314	0314
560	770	544	0368	0457	0457	450	610	532	0368	0457
630	860	626	0401	0457	0457	560	770	630	0401	0457
710	970	696	0457	0457	0457	630	860	720	0457	0457
800	1090	773	0524	0524	0524	710	970	800	0524	0598
900	1230	858	0598	0598	0598	800	1090	900	0598	0748
1000	1360	954	0748	0831	0748	900	1230	1000	0748	0964
1240	1690	1200	0831	0964	0964	1000	1360	1145	0831	0964
1530	2090	1480	0964	1130	0964	1270	1730	1480	0964	0964
1750	2380	1700	1130	1296	1130	1460	1990	1700	1130	1130
2010	2860	2100	1296	1800	1296	1750	2380	2100	1296	1800
2400	3300	2400	1800	1800	1800	2000	2720	2400	1800	1800
3000	4000	3000	2076	(*)	2076	2500	3400	3000	2076	2076

(*) Please contact Elettronica Santerno.

3.2.10. STANDARD APPLICATIONS (OVERLOAD UP TO 140%) – 5T-6T VOLTAGE CLASS

Rated Motor Voltage: 600-690Vac						Rated Motor Voltage: 575Vac				
MOTOR DRIVE			REGENERATIVE DRIVE			MOTOR DRIVE			REGENERATIVE DRIVE	
Maximum Applicable Motor			Model of MOTOR SINUS PENTA	Model of REGENERATIVE SINUS PENTA with Supply Mains		Maximum Applicable Motor			Model of MOTOR SINUS PENTA	Model of REGENERATIVE SINUS PENTA with Supply Mains
kW	HP	A		660±10%	690±10%	kW	HP	A		575±10%
4	5.5	4.8	0003	0003	0003	4	5.5	5.7	0003	0003
5.5	7.5	6.3	0004	0004	0004	5.5	7.5	7.6	0004	0004
7.5	10	8.4	0006	0006	0006	7.5	10	10	0006	0006
9.2	12.5	10.2	0012	0012	0012	7.5	10	10	0012	0012
11	15	12.1	0018	0018	0018	11	15	14	0018	0018
15	20	16.8	0019	0019	0019	11	15	14	0019	0019
18.5	25	21	0021	0021	0021	15	20	20	0021	0021
22	30	23	0022	0022	0022	22	30	28	0022	0022
30	40	33	0024	0024	0024	25	35	32	0024	0024
37	50	39	0032	0032	0032	37	50	47	0032	0032
45	60	46	0042	0042	0042	45	60	55	0042	0042
55	75	56	0051	0051	0051	55	75	70	0051	0051
75	100	77	0062	0062	0062	65	90	83	0062	0062
90	125	95	0069	0069	0069	75	100	95	0069	0069
110	150	113	0076	0076	0076	90	125	115	0076	0076
132	180	133	0088	0088	0088	110	150	135	0088	0088
160	220	158	0131	0131	0131	132	180	168	0131	0131
200	270	198	0164	0181	0181	160	220	198	0164	0164
250	340	250	0181	0181	0181	220	300	275	0181	0181
315	430	310	0201	0218	0218	250	340	300	0201	0201
355	485	310	0218	0259	0259	300	410	358	0218	0259
400	550	390	0259	0290	0290	330	450	395	0259	0290
450	610	440	0290	0290	0290	355	485	420	0290	0290
450	610	440	0314	0314	0314	400	550	480	0314	0314
500	680	480	0368	0368	0368	450	610	532	0368	0368
630	860	626	0401	0457	0457	450	610	532	0401	0401
630	860	626	0457	0457	0457	560	770	630	0457	0457
710	970	696	0524	0524	0524	630	860	720	0524	0524
900	1230	858	0598	0598	0598	710	970	800	0598	0598
1000	1360	954	0748	0748	0748	900	1230	1000	0748	0748
1100	1500	1086	0831	0831	0831	1000	1360	1145	0831	0964
1410	1920	1369	0964	0964	0964	1180	1610	1369	0964	0964
1620	2210	1569	1130	1130	1130	1350	1840	1569	1130	1130
1850	2520	1800	1296	1296	1296	1750	2380	2100	1296	1296
2400	3300	2400	1800	1800	1800	2000	2720	2400	1800	1800
3000	4000	3000	2076	2076	2076	2500	3400	3000	2076	2076

3.2.11. HEAVY APPLICATIONS (OVERLOAD UP TO 175%) – 5T-6T VOLTAGE CLASS

Rated Motor Voltage: 600-690Vac						Rated Motor Voltage: 575Vac				
MOTOR DRIVE				REGENERATIVE DRIVE		MOTOR DRIVE				REGENERATIVE DRIVE
Maximum Applicable Motor			Model of MOTOR SINUS PENTA	Model of REGENERATIVE SINUS PENTA with Supply Mains		Maximum Applicable Motor			Model of MOTOR SINUS PENTA	Model of REGENERATIVE SINUS PENTA with Supply Mains
kW	HP	A		660±10%	690±10%	kW	HP	A		575±10%
4	5.5	4.8	0003	0003	0003	3	4	4.4	0003	0003
4	5.5	4.8	0004	0004	0004	4	5.5	5.7	0004	0004
7.5	10	8.4	0006	0006	0006	5.5	7.5	7.6	0006	0006
7.5	10	8.4	0012	0012	0012	7.5	10	10	0012	0012
11	15	12.1	0018	0018	0018	9.2	12.5	12.5	0018	0018
11	15	12.1	0019	0019	0019	11	15	14	0019	0019
15	20	16.8	0021	0021	0021	15	20	20	0021	0021
22	30	23	0022	0022	0022	18.5	25	25	0022	0022
22	30	23	0024	0024	0024	22	30	28	0024	0024
37	50	39	0032	0032	0032	30	40	39	0032	0032
37	50	39	0042	0042	0042	37	50	47	0042	0042
55	75	56	0051	0051	0051	45	60	55	0051	0051
55	75	56	0062	0062	0062	55	75	70	0062	0062
75	100	78	0069	0069	0069	55	75	70	0069	0069
90	125	94	0076	0076	0076	75	100	95	0076	0076
110	150	113	0088	0088	0088	110	150	135	0088	0088
160	220	158	0131	0131	0131	110	150	135	0131	0131
185	250	185	0164	0181	0181	132	180	168	0164	0164
220	300	220	0181	0181	0181	185	250	225	0181	0181
250	340	250	0201	0201	0201	200	270	240	0201	0201
315	430	310	0218	0259	0259	220	300	275	0201	0218
355	485	341	0259	0290	0290	280	380	336	0259	0290
400	550	390	0290	0290	0290	300	400	358	0290	0290
450	610	440	0314	0314	0314	330	450	395	0314	0314
500	680	480	0368	0401	0368	355	485	420	0368	0368
560	770	544	0401	0457	0457	400	550	473	0401	0401
560	770	544	0457	0457	0457	500	680	585	0457	0457
630	860	626	0524	0524	0524	560	770	630	0524	0524
710	970	696	0598	0598	0598	630	860	720	0598	0598
900	1230	858	0748	0748	0748	710	970	800	0748	0748
1000	1360	954	0831	0831	0831	800	1090	900	0831	0831
1220	1660	1187	0964	0964	0964	1000	1360	1145	0964	0964
1400	1910	1360	1130	1130	1130	1170	1600	1360	1130	1130
1610	2190	1560	1296	1296	1296	1340	1830	1560	1296	1296
2100	2860	2100	1800	1800	1800	1750	2400	2050	1800	1800
2400	3300	2400	2076	2076	2076	2000	2720	2400	2076	2076

3.2.12. STRONG APPLICATIONS (OVERLOAD UP TO 200%) – 5T-6T VOLTAGE CLASS

Rated Motor Voltage: 600-690Vac						Rated Motor Voltage: 575Vac				
MOTOR DRIVE				REGENERATIVE DRIVE		MOTOR DRIVE				REGENERATIVE DRIVE
Maximum Applicable Motor			Model of MOTOR SINUS PENTA	Model of REGENERATIVE SINUS PENTA with Supply Mains		Maximum Applicable Motor			Model of MOTOR SINUS PENTA	Model of REGENERATIVE SINUS PENTA with Supply Mains
kW	HP	A		660±10%	690±10%	kW	HP	A		575±10%
3	4	3.7	0003	0003	0003	3	4	4.4	0003	0003
4	5.5	4.8	0004	0004	0004	4	5.5	5.7	0004	0004
5.5	7.5	6.3	0006	0006	0006	4	5.5	5.7	0006	0006
7.5	10	8.4	0012	0012	0012	5.5	7.5	7.6	0012	0012
9.2	12.5	10.2	0018	0018	0018	7.5	10	10	0018	0018
9.2	12.5	12	0019	0019	0019	9.2	12.5	12.5	0019	0019
11	15	12	0021	0021	0021	11	15	14	0021	0021
18.5	25	21	0022	0022	0022	15	20	20	0022	0022
22	30	23	0024	0024	0024	18.5	25	25	0024	0024
30	40	33	0032	0032	0032	25	35	32	0032	0032
30	40	33	0042	0042	0042	30	40	39	0042	0042
45	60	46	0051	0051	0051	37	50	47	0051	0051
55	75	56	0062	0062	0062	45	60	55	0062	0062
55	75	56	0069	0069	0069	45	60	55	0069	0069
75	100	77	0076	0076	0076	55	75	70	0076	0076
90	125	95	0088	0088	0088	75	100	95	0088	0088
110	150	115	0131	0131	0131	90	125	115	0131	0131
132	180	140	0164	0181	0181	110	150	138	0164	0164
200	270	198	0181	0181	0181	160	220	198	0181	0181
220	300	220	0201	0201	0201	160	220	198	0201	0201
250	340	250	0218	0218	0218	200	270	240	0218	0218
315	430	310	0259	0259	0259	220	300	275	0259	0259
355	485	341	0290	0290	0290	250	340	300	0290	0290
375	510	360	0314	0314	0314	280	380	336	0314	0314
400	550	390	0368	0368	0368	315	430	367	0368	0368
500	680	480	0401	0401	0401	355	480	410	0401	0401
500	680	480	0457	0457	0457	400	550	480	0457	0457
560	770	544	0524	0524	0524	450	610	532	0524	0524
630	860	626	0598	0598	0598	560	770	630	0598	0598
800	1090	773	0748	0748	0748	630	860	720	0748	0748
900	1230	858	0831	0831	0831	710	970	800	0831	0831
1000	1360	954	0964	0964	0964	900	1230	1000	0964	0964
1100	1500	1086	1130	1130	1130	1000	1360	1145	1130	1130
1380	1880	1337	1296	1296	1296	1150	1570	1337	1296	1296
1750	2380	1700	1800	1800	1800	1460	1990	1700	1800	1800
2100	2860	2100	2076	2076	2076	1750	2400	2050	2076	2076

3.3. SPECIFICATIONS FOR THE REGENERATIVE DRIVE

3.3.1. REGENERATIVE DRIVE RATINGS – 2T VOLTAGE CLASS

SIZE	REGENERATIVE SINUS PENTA MODEL	REGENERATIVE DRIVE DELIVERABLE CURRENT		RATED POWER OF THE REGENERATIVE DRIVE		MAXIMUM POWER OF THE REGENERATIVE DRIVE		REGENERATIVE DRIVE LOSSES
		Inom	Imax	Power Supply (±10%)		Power Supply (±10%)		
				220Vac	230Vac	220Vac	230Vac	
		A	A	kW	kW	kW	kW	kW
S05	0007	12.5	13.5	4.1	4.3	4.5	4.7	0.16
	0008	15	16	5.0	5.2	5.3	5.6	0.17
	0010	17	19	5.6	5.9	6.3	6.6	0.18
	0013	19	21	6.3	6.6	7.0	7.3	0.19
	0015	23	25	7.7	8.1	8.4	8.8	0.21
	0016	27	30	9.0	9.4	10.1	10.5	0.23
	0020	30	36	10.0	10.5	12.1	12.6	0.25
S12	0023	38	42	12.7	13.3	14.1	14.7	0.39
	0033	51	56	17.0	17.8	18.7	19.6	0.51
	0037	60	72	20.0	20.9	24.1	25.2	0.60
S15	0040	72	80	24.0	25.1	25.1	26.2	0.64
	0049	75	96	24.9	26.1	32.1	33.6	0.75
S20	0060	88	112	29.3	30.7	37.5	39.3	0.83
	0067	103	118	34.3	35.9	39.4	41.3	0.99
	0074	120	144	40.1	41.9	48.3	50.5	1.05
	0086	135	155	45.1	47.2	51.9	54.3	1.16
S30	0113	180	200	60.0	62.8	66.8	69.9	1.70
	0129	195	215	65.0	68.0	71.8	75.2	1.81
	0150	200	270	66.6	69.7	90.5	94.7	1.95
	0162	210	290	69.8	73.0	97.2	101.7	2.18
S41	0180	300	340	102.8	107.5	114.6	119.9	1.86
	0202	345	420	118.2	123.6	141.6	148.1	2.30
	0217	375	460	128.5	134.3	155.1	162.3	2.43
	0260	425	560	145.6	152.2	189.1	197.8	2.75
S51	0313	480	600	161.3	168.7	202.4	211.7	3.15
	0367	550	680	184.9	193.5	229.5	240.0	3.47
	0402	680	850	228.5	239.1	286.8	300.0	4.40
S60	0457	720	880	241.0	252.2	295.8	309.5	5.60
	0524	800	960	267.6	280.1	322.4	337.4	6.40

Legend:
Inom = Continuous rated current of the regenerative drive.
Imax = Max. current that can be delivered by the drive for 120sec every 20min up to S30, and for 60sec every 10min for S41 and greater.

NOTE

Output power is intended for the power supply of one or more SINUS PENTA drives. Any other applications must be authorized by Elettronica Santerno.

3.3.2. REGENERATIVE DRIVE RATINGS – 4T VOLTAGE CLASS

SIZE	REGENERATIVE SINUS PENTA MODEL	REGENERATIVE DRIVE DELIVERABLE CURRENT		RATED POWER OF THE REGENERATIVE DRIVE				MAXIMUM POWER OF THE REGENERATIVE DRIVE				REGENERATIVE DRIVE LOSSES
		Inom	Imax	Power Supply (±10%)				Power Supply (±10%)				
				380Vac	400Vac	440Vac	480Vac	380Vac	400Vac	440Vac	480Vac	
		A	A	kW	kW	kW	kW	kW	kW	kW	kW	kW
S05	0005	10.5	11.5	6.0	6.4	7.0	7.7	6.6	7.0	7.7	8.4	0.19
	0007	12.5	13.5	7.2	7.6	8.4	9.1	7.8	8.2	9.0	9.9	0.21
	0009	16.5	17.5	9.5	10.0	11.0	12.1	10.1	10.6	11.7	12.8	0.27
	0011	16.5	21	9.5	10.0	11.0	12.1	12.2	12.8	14.1	15.4	0.27
	0014	16.5	25	9.5	10.0	11.0	12.1	14.5	15.3	16.9	18.4	0.27
S12	0016	27	30	15.6	16.5	18.1	19.8	17.4	18.3	20.2	22.1	0.27
	0017	30	32	17.4	18.3	20.2	22.1	18.6	19.6	21.6	23.6	0.35
	0020	30	36	17.4	18.3	20.2	22.1	21.0	22.1	24.3	26.6	0.35
	0025	41	48	23.8	25.1	27.7	30.2	28.0	29.5	32.5	35.5	0.43
	0030	41	56	23.8	25.1	27.7	30.2	32.7	34.5	37.9	41.4	0.43
	0034	57	63	33.2	35	38.5	42.1	36.7	38.7	42.6	46.5	0.54
	0036	60	72	34.9	36.8	40.5	44.3	42.0	44.3	48.8	53.2	0.58
S15	0040	72	80	42.0	44.2	48.7	53.2	43.7	46.1	50.7	55.4	0.64
	0049	75	96	43.6	45.9	50.6	55.3	56.0	59.0	65.0	71.0	0.77
S20	0060	88	112	51.2	54.0	59.5	64.9	65.4	68.9	75.9	82.9	0.83
	0067	103	118	59.9	63.2	69.6	76.0	68.8	72.5	79.8	87.2	0.99
	0074	120	144	69.9	73.7	81.2	88.6	84.1	88.6	97.6	106.6	1.05
	0086	135	155	78.7	82.9	91.3	99.7	90.5	95.4	105.0	114.7	1.16
S30	0113	180	200	104.8	110.5	121.7	132.9	116.7	122.9	135.4	147.8	1.50
	0129	195	215	113.7	119.8	131.9	144.1	125.6	132.3	145.6	159.0	1.61
	0150	210	270	116.7	122.9	135.4	147.8	158.1	166.5	183.3	200.1	1.65
	0162	210	290	122.6	129.1	142.2	155.3	169.9	179.0	197.0	215.1	1.65
S41	0180	300	340	175.6	185.0	203.7	222.3	201.2	211.8	232.9	254.1	1.86
	0202	345	420	201.8	212.6	234.1	255.5	248.5	261.6	287.8	313.9	2.30
	0217	375	460	219.4	231.1	254.5	277.8	272.2	286.5	315.2	343.8	2.43
	0260	425	560	248.7	261.9	288.4	314.9	331.4	348.8	383.7	418.5	2.75
S51	0313	480	600	280.8	295.8	325.7	355.6	351.8	370.5	407.9	445.3	3.15
	0367	550	680	321.9	339.1	373.3	407.6	398.9	420.0	462.4	504.7	3.47
	0402	680	850	397.9	419.1	461.5	503.8	498.5	525.0	577.9	630.9	4.40
S60	0457	720	880	422.0	444.4	489.3	534.1	516.7	544.1	598.9	653.7	5.60
	0524	800	960	468.8	493.7	543.5	593.3	563.4	593.3	653.1	712.9	6.40
S64	0598	900	1100	527.3	555.3	611.4	667.4	645.6	679.9	748.4	816.9	7.40
	0748	1000	1300	585.2	616.3	678.6	740.9	762.7	803.1	884.1	965.1	8.25
	0831	1200	1440	702.0	739.4	814.1	888.8	844.0	888.8	978.5	1068.2	9.90
S74	0964	1480	1780	863.5	909.5	1002	1094	1041	1096	1207	1318	12.20
	1130	1700	2040	991.4	1044	1150	1256	1193	1256	1383	1510	14.40
	1296	2100	2520	1226.9	1292.3	1423.1	1553.9	1475.4	1553.9	1710.8	1867.7	15.60
S84	1800	2600	3120	1515.8	1596.8	1758.7	1920.6	1823.5	1920.6	2114.9	2309.3	22.50
	2076	3000	3600	1750.2	1843.7	2030.5	2217.3	2105.2	2217.3	2441.5	2665.7	24.75

Legend:
Inom = Continuous rated current of the regenerative drive.
Imax = Max. current that can be delivered by the drive for 120sec every 20min up to S30, and for 60sec every 10min for S41 and greater.

NOTE Output power is intended for the power supply of one or more SINUS PENTA drives. Any other applications must be authorized by Elettronica Santerno.

3.3.3. REGENERATIVE DRIVE RATINGS – 5T-6T VOLTAGE CLASS

SIZE	REGENERATIVE SINUS PENTA MODEL	REGENERATIVE DRIVE DELIVERABLE CURRENT		RATED POWER OF THE REGENERATIVE DRIVE			MAXIMUM POWER OF THE REGENERATIVE DRIVE			REGENERATIVE DRIVE LOSSES	
		Inom	Imax	Power Supply (±10%)			Power Supply (±10%)			Power Supply (±10%)	
				575Vac	660Vac	690Vac	575Vac	660Vac	690Vac	575Vac	660-690Vac
		A	A	kW	kW	kW	kW	kW	kW	kW	kW
S12 5T	0003	7	8.5	6.1	7.1	7.4	7.5	8.6	9.0	0.14	0.14
	0004	9	11	7.9	9.1	9.5	9.7	11.1	11.7	0.16	0.17
	0006	11	13.5	9.7	11.1	11.6	11.9	13.7	14.3	0.18	0.20
S14 6T	0012	13	16	11.4	13.1	13.8	14.1	16.2	17.0	0.21	0.22
	0018	17	21	15.0	17.2	18.0	18.5	21.3	22.3	0.26	0.28
S14	0019	21	25	18.5	21.3	22.3	22.1	25.4	26.6	0.31	0.33
	0021	25	30	22.0	25.3	26.5	26.5	30.5	31.9	0.36	0.39
	0022	33	40	29.1	33.5	35.0	35.4	40.7	42.5	0.46	0.50
	0024	40	48	35.3	40.6	42.4	42.4	48.8	51.0	0.54	0.59
	0032	52	63	45.9	52.7	55.2	55.7	64.1	67.0	0.69	0.75
S22	0042	60	72	52.9	60.8	63.6	63.6	73.1	76.5	0.87	0.95
	0051	80	96	70.7	81.3	85.0	85.0	97.7	102.2	0.96	1.05
	0062	85	110	75.2	86.3	90.3	97.5	112.1	117.2	1.01	1.10
	0069	105	135	92.9	106.7	111.6	119.7	137.6	143.9	1.19	1.30
S32	0076	125	165	110.5	127.0	132.8	146.2	168.1	175.8	1.51	1.65
	0088	150	200	132.8	152.5	159.5	177.5	204.0	213.3	1.65	1.80
	0131	190	250	168.1	193.1	202.0	221.7	254.9	266.5	2.15	2.35
	0164	200	300	177.0	203.3	212.6	266.4	306.1	320.2	2.29	2.50
S42	0181	240	380	270.6	310.7	324.9	337.4	387.7	405.5	2.47	2.76
	0201	260	420	292.8	336.2	351.6	373.1	428.7	448.3	2.60	2.92
	0218	290	465	310.2	356.2	372.5	412.8	474.4	496.1	3.10	3.48
	0259	320	560	319.0	366.2	383.1	497.7	571.8	597.9	3.29	3.70
S52	0290	450	600	399.0	457.7	478.7	532.4	611.8	639.9	4.24	4.74
	0314	470	665	443.0	508.8	532.1	590.3	678.3	709.4	4.49	5.02
	0368	490	720	497.0	570.0	596.2	639.2	734.5	768.1	4.84	5.42
	0401	510	850	505.0	579.9	606.5	755.2	867.7	907.4	5.18	5.82
S64	0457	720	880	636.9	731.5	765.1	779.4	895.9	937.0	7.80	8.50
	0524	800	960	707.6	812.7	850.1	850.1	977.2	1022.0	8.60	9.40
	0598	900	1100	796.1	914.3	956.4	974.3	1119.9	1171.2	9.70	10.60
	0748	950	1300	840.3	965.1	1009.5	1152.7	1324.8	1385.5	10.20	11.20
	0831	1000	1440	884.6	1015.9	1062.6	1277.5	1468.1	1535.3	10.80	11.80
S74	0964	1480	1780	1311.8	1506.5	1575.6	1579.2	1814.8	1897.9	13.20	14.40
	1130	1700	2040	1505.5	1729.0	1808.4	1808.4	2078.3	2173.6	16.50	18.00
	1296	1900	2280	1701.0	1952.5	2041.2	2041.2	2343.0	2449.5	17.60	19.20
S84	1800	2600	3120	2327.7	2671.8	2793.2	2793.2	3206.1	3351.9	24.30	26.55
	2076	2800	3360	2506.7	2877.3	3008.1	3008.1	3452.8	3609.7	26.80	29.25

Legend:
Inom = Continuous rated current of the regenerative drive;
Imax = Max. current that can be delivered by the drive for 60 sec every 10 min.

NOTE

Output power is intended for the power supply of one or more SINUS PENTA drives. Any other applications must be authorized by Elettronica Santerno.

3.4. DIMENSIONING THE REGENERATIVE DRIVE

The correct match between the regenerative drive and the motor drive is given—in most cases—in the application tables in the previous sections. If a special application is not included in the tables, you need to check the regenerative drive dimensioning.
The same dimensioning must be worked out when the application comprises multiple motor drives.

Basically, the power exchanged with the mains—both in continuous operation and when the drive is overloaded—must be lower than or equal to the drive rated power and peak power respectively.

a) Continuous Operation

The power exchanged with the mains in continuous operation (Pconrgn) is as follows:

Pconrgn= Pmot + motor drive losses + regenerative drive losses.

- Pmot is the electric power absorbed by the motor;
- Loss values are given in the tables containing the drive specifications (the motor drive losses are supposed to be the same as the regenerative drive losses).

The electric power absorbed by the motor can be calculated as follows:

Pmot= Mechanical power/motor efficiency

or

Pmot=1.73*Vmot*Imot*power factor

where:

Vmot: rated motor voltage
Imot: rated motor current
power factor: rated motor power factor

b) Overload

The power obtained when the drive is overloaded (Polrgn) is as follows:

Polrgn= Polmot + overloaded motor drive losses + overloaded regenerative drive losses

The electric power required when the motor is overloaded is as follows:

Polmot=1.73*Vmot*Ilim*power factor

where Ilim is the limit current for the drive controlling the motor.

Loss values are given in the tables containing the drive specifications (the motor drive losses are supposed to be the same as the regenerative drive losses) and should be increased by the ratio between the overload current and the rated current (Ilim/Imot).

Normally, if multiple motor drives are connected, the continuous power and the overload power are considered as the sum of the power of each motor drive. The dimensioning of the regenerative drive can be reduced when ore or more drives operate only as motors or only as generators.

The regenerative drive power is as follows:

Preg=1.73*Vacmin* Imax

where Vacmin is the min. mains voltage

The power transferred when the regenerative drive is overloaded is the following:

Pmaxreg=1.73*Vacmin* Imax

These values are given in the specification tables above.

EXAMPLE:

Dimensioning the regenerative drive for a motor drive unit including a SINUS PENTA 0020 4T and a 15kW, 4-pole motor.

Motor features:

Type: 4-pole MJ 160L
Rated power (mechanical power): 15kW
Efficiency: 0.91
Rated voltage: 400V
Rated current: 28.1A
Power factor: 0.85

Drive:

SINUS PENTA 0020 4T
Rated current: Inom=30A
Peak current: Ilim=36A

Rated mains voltage: 400VAC

Pconrgn= Pmot + motor drive losses + regenerative drive losses

Pmot= Mechanical power/motor efficiency

or

Pmot=1.73*Vmot*Imot*power factor

Both methods result in → Pmot=16.5kW

Supposing that the same ratings as the motor drive apply to the regenerative drive being used, the loss of a 0020 4T drive is 0.35kW (see "4T Class Regenerative Drive" tables).
As a result, the continuous power of the regenerative drive should be the following:

Pconrgn= 16.5 + 0.35 + 0.35 =17.2kW

Polrgn= Polmot + overloaded motor drive losses + overloaded regenerative drive losses

Polmot=1.73*Vmot*Ilim* power factor → Polmot=20.7kW

The drive losses are to be compared to the overload current:

Polrgn=20.7+0.35* Ilim/Imot+0.35* Ilim/Imot=21.54kW

From the 4T Class Regenerative Drive tables, the continuous power and the overload power of a SINUS PENTA 0020 4T regenerative drive with 400VAC power supply is 18.3kW and 22.1kW respectively; as a result, the SINUS PENTA 0020 4T can be used.
The same result is given in the Light Applications (Overload up to 120%) table, where a 15kW motor with a rated voltage ranging from 380V to 415V connected to a SINUS PENTA 0020 4T is coupled to a regenerative SINUS PENTA 0020 4T.

3.5. APPLICATIONS OF THE REGENERATIVE DRIVE

3.5.1. MOTORS HAVING A DIFFERENT SUPPLY VOLTAGE THAN THE MAINS SUPPLY VOLTAGE

The regenerative drive produces a bus voltage higher than the rectified mains voltage; in the drive controlling the motor, which is powered by a DC voltage greater than the mains voltage, the output voltage can exceed the mains voltage (a drive is capable of generating a max. voltage equal to the bus voltage divided by 1.41).

As a result, motors having greater voltage ratings than the mains voltage can be controlled by the regenerative Penta. More precisely, a motor with the same rated voltage as the bus voltage divided by 1.41 can be used, or operation at constant torque can occur even when exceeding the rated motor frequency.

For example, if the regenerative drive is factory-set to generate 700VDC as the bus voltage, the output voltage of the motor drive can be 496VAC. Supposing that a standard 50Hz/400V motor is used, the parameters relating to the rated frequency and the rated voltage of the connected motor can be set to 60Hz and 480V respectively for the motor drive. In that way, the connected motor operates with a constant V/f pattern up to 60Hz, thus increasing power by 20%.

NOTE Make sure that no electric and/or mechanical trouble occurs when using the motor at different voltage/frequency ratings than its rated voltage/frequency. Please contact the motor manufacturer.

NOTE Make sure that the regenerative drive is properly dimensioned (see section above).

3.6. WIRING

3.6.1. POWER WIRING FOR THE REGENERATIVE DRIVE UP TO SIZE S64 INCLUDED

A special interface panel (supplied by Elettronica Santerno) as well as additional electromechanical components are required when connecting the regenerative drive to the mains. Those components allow matching output terminal commutated voltage to mains sinusoidal current; they also allow filtering the current component at the drive commutation frequency.

The following is a list of the additional components and the matching tables between those components and the regenerative drive:

- One regenerative reactor (see sections 3.7.8, 3.7.9, 3.7.10);
- One filter reactor (see sections 3.7.11, 3.7.12, 3.7.13);
- One interface panel (see sections 3.7.17, 3.7.18, 3.7.19);
- One bypass contactor.

The wiring diagram is shown below.

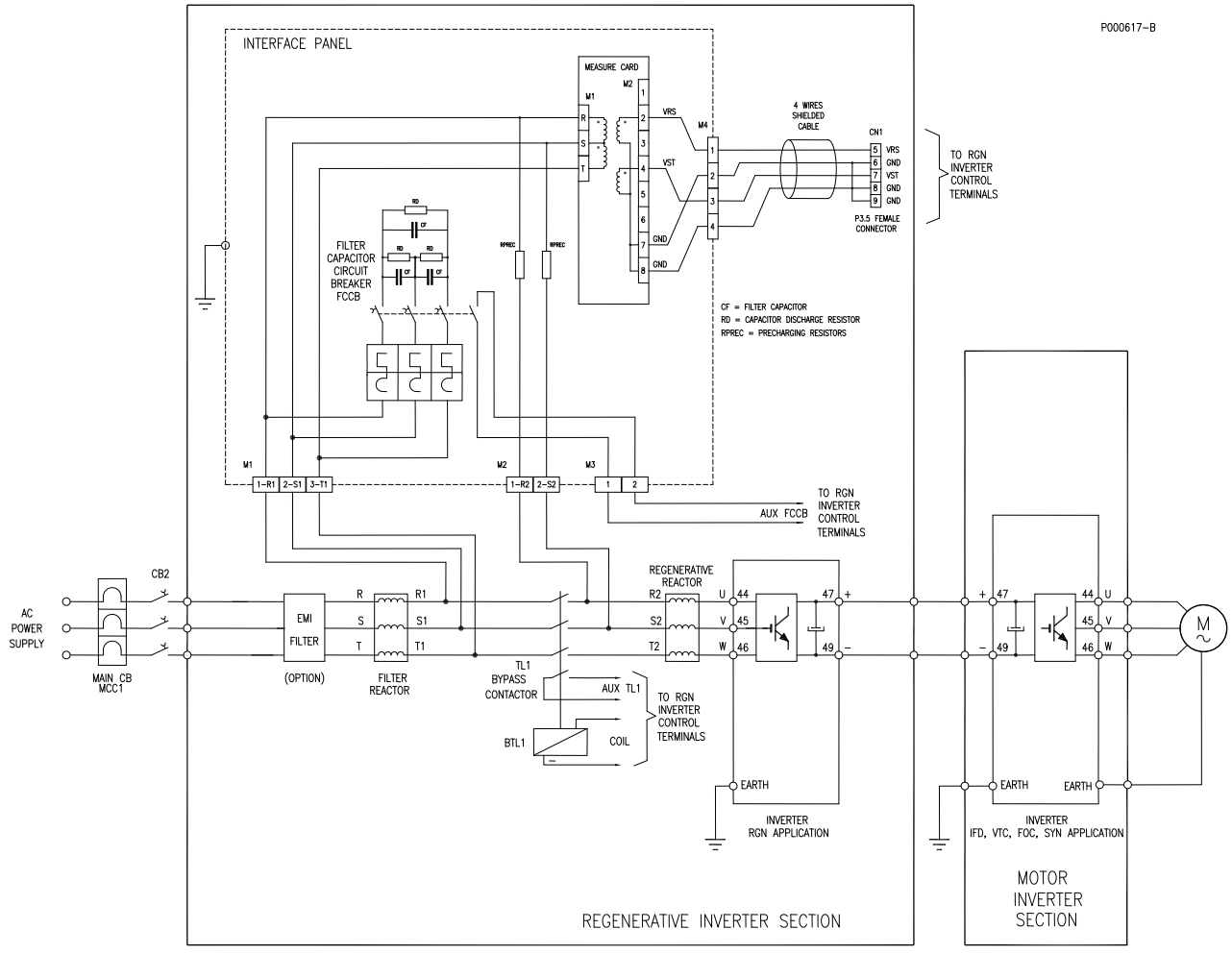


Figure 3: Wiring diagram for the electromechanical components up to Size S64 included

NOTE Do not alter wiring when connecting the drive components; the equipment automatically detects the mains phase sequence.

3.6.2. POWER WIRING FOR THE REGENERATIVE DRIVE - SIZE S74

Two drive arms per phase are required when connecting an "S74" regenerative drive.
The diagram below shows how to connect the interface panels (supplied by Elettronica Santerno). It also shows how to connect the electromechanical components allowing matching the output terminal commutated voltage with the mains sinusoidal voltage, and filtering the current component at the drive commutation frequency.

The following is a list of the additional components and the matching tables between those components and the regenerative drive:

- Two regenerative reactors (see sections 3.7.8, 3.7.9, 3.7.10);
- One filter reactor (see sections 3.7.11, 3.7.12, 3.7.13);
- Two interface panels (see sections 3.7.17, 3.7.18, 3.7.19);
- Two bypass contactors.

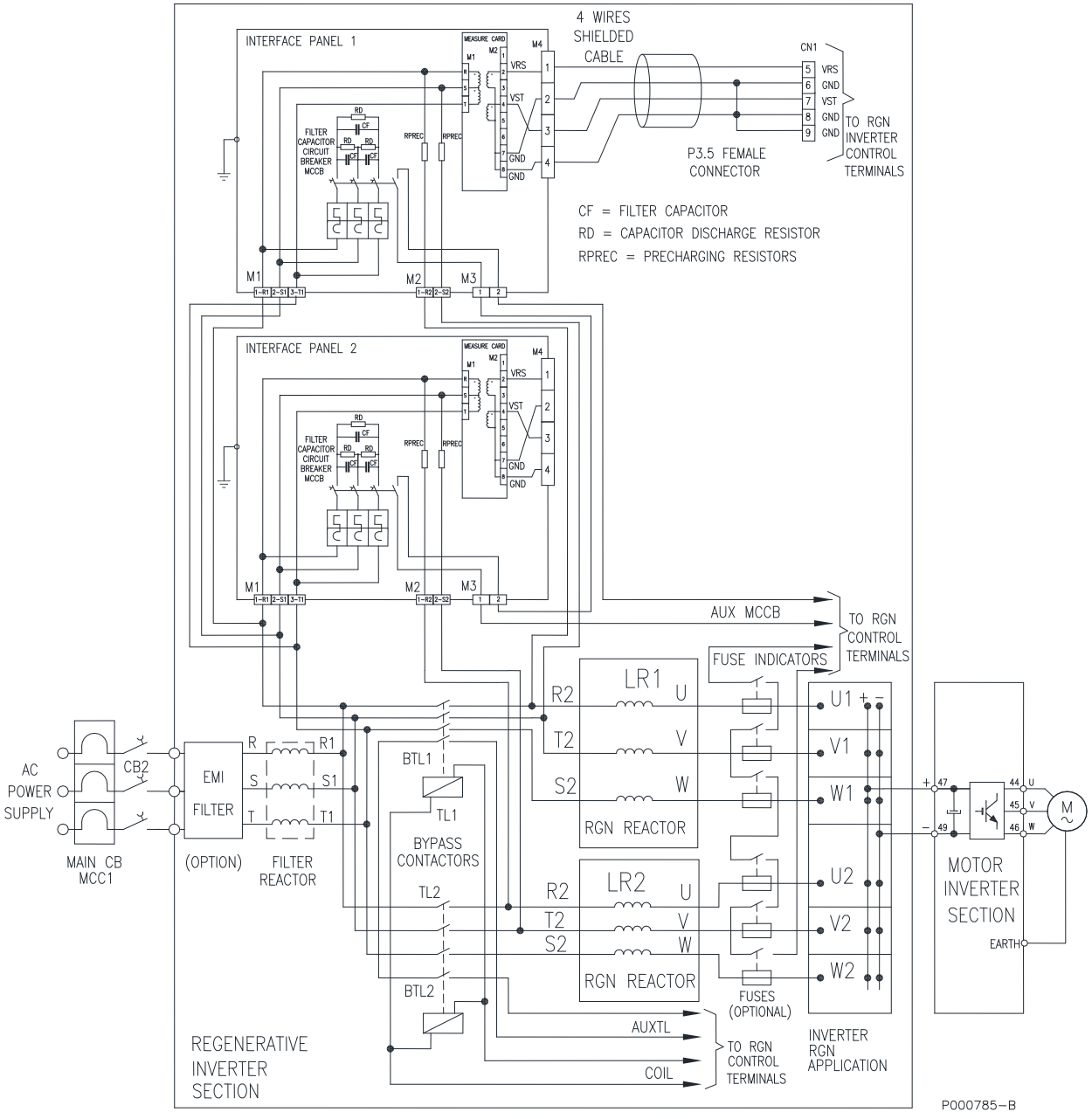


Figure 4: Wiring diagram for the electromechanical components, Size S74

NOTE

Do not alter wiring when connecting the drive components; the equipment automatically detects the mains phase sequence.

NOTE

If fuses are used, special microswitches capable of detecting when a fuse opens are required. Connect the fuse signal to the input for auxiliary alarms of the regenerative drive, and activate the respective alarm (see parameters **C164-C166**).

3.6.3. SIGNAL WIRING FOR THE REGENERATIVE DRIVE

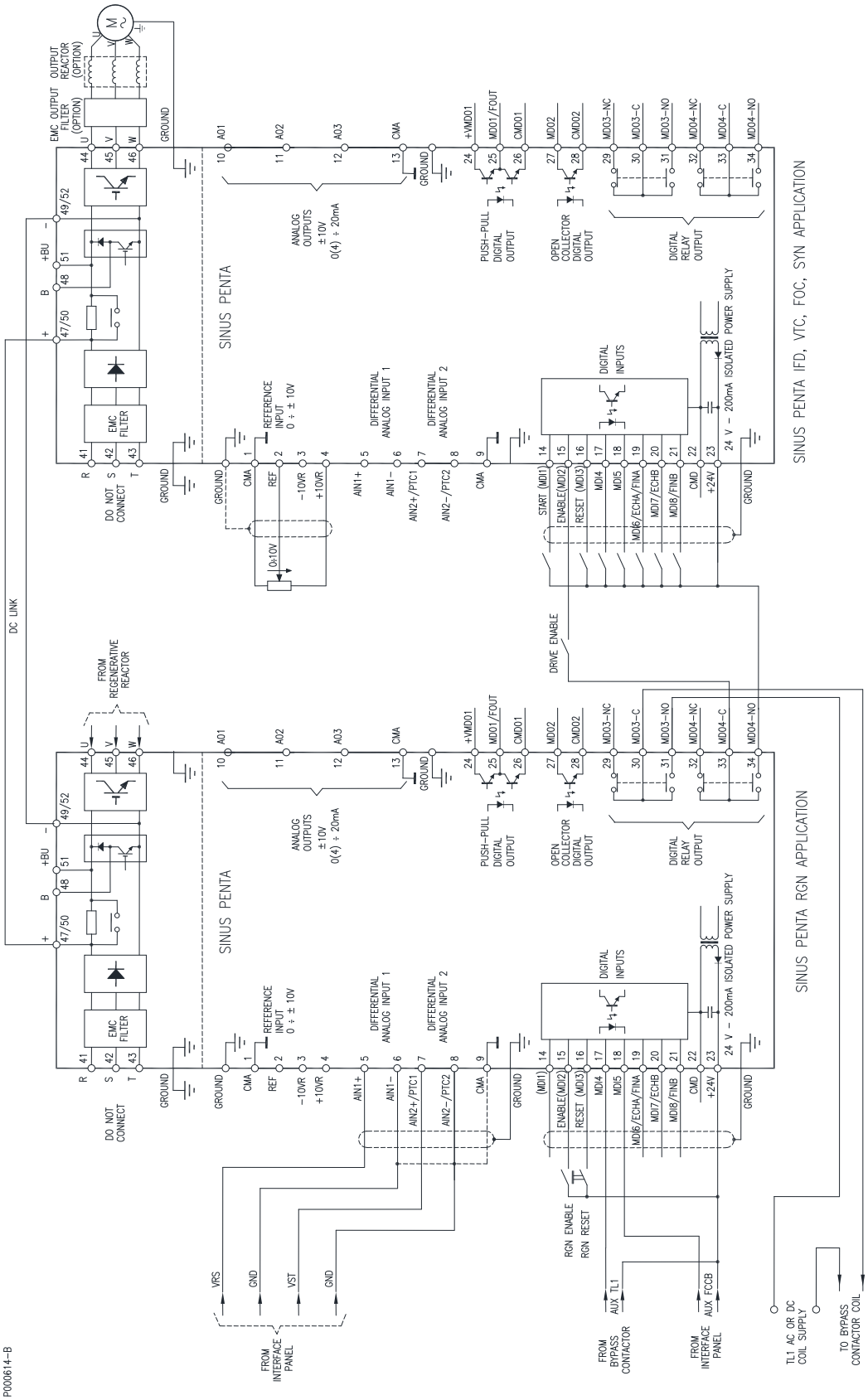


Figure 5: Signal wiring diagram

Wiring for the regenerative drive powering a SINUS PENTA drive is shown in the wiring diagram above.
For the RGN application, the following analog and digital inputs/outputs are required:

Terminal N.	Type of I/O	Function
5 – 6	AIN1	Analog input for Vrs line voltage measured through the interface panel
7 – 8	AIN2	Analog input for Vst line voltage measured through the interface panel
17	MDI4	Digital input for bypass contactor auxiliary contact closure AUX TL1
18	MDI5	Digital input for the state of the auxiliary contact in capacitor safety switch AUX FCCB
30 – 31	MDO3	NO relay output for bypass contactor coil command COIL
33 – 34	MDO4	NO relay output for regenerative drive "ON" to be series-connected to the motor-drive enable process

Activate the ENABLE input (MDI2) to enable the regenerative drive; if it locks due to a fault, activate the RESET input (MDI3) to reset the equipment.

CAUTION Make sure that voltage and current in the coil of TL1 do not exceed MDO3-NO contact ratings. If need be, install an additional external relay having greater current ratings.

CAUTION As shown in the wiring diagram, activate the MDO4-NO contact in the motor drive enabling chain to prevent this from starting when the regenerative drive is inactive.

3.7. EXTERNAL COMPONENTS

3.7.1. POWER CABLE CROSS-SECTIONS AND ELECTROMECHANICAL COMPONENTS OF THE POWER CIRCUIT

Specifications for the drive wires, safety devices and operating devices are given in the tables below.
For the greatest drive sizes, wiring with multiple conductors for the same phase is recommended. For example, "2x150" in the wire cross-section column means that two parallel-connected 150mm^2 conductors per phase are used.
Multiple conductors must have the same length and must follow parallel paths so that current is evenly delivered at any frequency level. Unparallel paths, even if their length is the same, result in uneven current distribution at high frequency. The cross-sections given in the tables below apply to copper wires.

3.7.2. CROSS-SECTION OF POWER CABLES AND SIZE OF SAFETY COMPONENTS FOR 2T CLASS DRIVES

Size	SINUS PENTA Model	Rated Current of the RGN Drive	Cable Cross-section Fitting the Terminals	Cable Stripping	Tightening Torque	Cable Cross-section for Mains-Drive Connection	Size of Fast Fuses (700V) + Disconnecting Switch for Supply Line (*)	Magnetic CB for Supply Line (MCC1)	AC1 Class Rated Current of TL1 Pre-charge Contactor
		(A)	mm² (AWG o kcmils)	mm	Nm	mm² (AWG o kcmils)	(A)	(A)	(A)
S05	0007	12.5	0.5÷10 (20÷6AWG)	10	1.2-1.5	2.5 (12AWG)	16	16	25
	0008	15					16	16	25
	0010	17				4 (10AWG)	25	25	25
	0013	19					32	32	30
	0015	23					32	32	30
	0016	27				10 (6AWG)	40	40	45
	0020	30					40	40	45
S12	0023	28	0.5÷25 (12÷4AWG)	18	2.5		63	63	60
	0033	51				16 (5AWG)	100	100	100
	0037	60				25 (4AWG)	100	100	100
S15	0040	72		15			100	100	100
	0049	75					125	100	100
S20	0060	88	25÷50 (4÷1/0AWG)	24	6-8	35 (2AWG)	125	125	115
	0067	103				50 (1/0AWG)	125	125	125
	0074	120					160	160	145
	0086	135					200	160	160
S30	0113	180	35÷185 (2AWG÷ 400kcmils)	30	10	95 (4/0AWG)	250	200	250
	0129	195				120 (250kcmils)	250	250	250
	0150	200					315	400	275
	0162	210					400	400	275
S41	0180	300	Bus bar	–	25-30	185 (400kcmils)	350	400	400
	0202	345				240 (500kcmils)	500	400	450
	0217	375				2x120 (2x250kcmils)	550	630	450
	0260	425					630	630	500
S51	0313	480			50	2x150 (2x300kcmils)	700	630	550
	0367	550				2x185 (2x400kcmils)	800	800	600
	0402	680				2x240 (2x500kcmils)	1000	800	700
S60	0457	720					1000	800	800
	0524	800				3x185 (3x400kcmils)	1250	1000	1000

(*) Alternative to MCC1.

CAUTION

Always use the correct cable cross-sections and enable the protecting 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.

NOTE

Make sure that the pre-charge contactor coil can be controlled by the relay installed on the drive (250VAC-5A/30VDC-5A); if this is not the case, use an additional external relay. Always use a noise filter parallel-connected to the contactor coil.

3.7.3. UL-APPROVED FUSES – CLASS 2T

UL-approved semiconductor fuses, which are recommended for the drives of the SINUS PENTA series, are listed in the table below.
In multiple cable installations, install one fuse per phase (NOT one fuse per conductor).
Fuses suitable for the protection of semiconductors produced by other manufacturers may be used, provided that they have the same or better ratings and

- are Nonrenewable UL Listed Cartridge Fuses, or UL Recognized External Semiconductor Fuses;
- are of the type specifically approved also with reference to the Canadian Standard.

Size	SINUS PENTA Model	UL-approved Fuses Manufactured by:									
		SIBA Sicherungen-Bau GmbH (200 kA_{RMS} Symmetrical A.I.C.)					Bussmann Div Cooper (UK) Ltd (200 kA_{RMS} Symmetrical A.I.C.)				
		Q.ty	Mod. N.	Ratings			Q.ty	Mod. N.	Ratings		
				Arms Current	I^2t (230V) A^2sec	Vac			Arms Current	I^2t (230V) A^2sec	Vac
S05	0007	1	60 033 05 16	16	48	600	1	170M1409	16	22	700
	0008										
	0010	1	60 033 05 20	20	80		1	170M1410	20	35	
	0013										
	0015	1	50 142 06 25	25	60	700	1	170M1411	25	58	
	0016	1	50 142 06 32	32	135		1	FWP-35B	35	40	
	0020	1	50 142 06 50	50	400		1	FWP-50B	50	150	
S12	0023										
	0033	1	20 412 20 80	80	1120		1	FWP-70B	70	500	
	0037						1	FWP-80B	80	600	
S15	0040	1	20 412 20 100	100	1720		1	FWP-100B	100	900	
	0049										
S20	0060	1	20 412 20 125	125	3100						
	0067						1	FWP-125A	125	3650	
	0074	1	20 412 20 160	160	6700		1	FWP-150A	150	5850	
	0086		20 412 20 200	200	12000		1	FWP-175A	175	8400	
S30	0113	1	20 412 20 250	250	20100		1	FWP-225A	225	15700	
	0129										
	0150	1	20 412 20 315	315	37000		1	FWP-250A	250	21300	
	0162	1	20 412 20 400	400	68000		1	FWP-350A	350	47800	
S41	0180	1	20 622 32 450	450	47300		1	FWP-450A	450	68500	
	0202	1	20 622 32 500	500	64500		1	FWP-500A	500	85000	
	0217	1	20 622 32 550	550	84000		1	FWP-600A	600	125000	
	0260	1	20 622 32 630	630	129000		1	FWP-700A	700	54000	
S51	0313	1	20 622 32 700	700	177000						
	0367	1	20 622 32 800	800	250000		1	FWP-800A	800	81000	
S60	0402	1	20 622 32 1000	1000	542000		1	FWP-1000A	1000	108000	
	0457										
	0524	1	20 632 32 1250	1250	924000		1	FWP-1200A	1200	198000	

3.7.4. CROSS-SECTION OF POWER CABLES AND SIZE OF SAFETY COMPONENTS FOR 4T CLASS DRIVES

Size	SINUS PENTA Model	Rated Current of the RGN Drive	Cable Cross-section Fitting the Terminals	Cable Stripping	Tightening Torque	Cable Cross-section for Mains-Drive Connection	Size of Fast Fuses (700V) + Disconnecting Switch for Supply Line (*)	Magnetic CB for Supply Line (MCC1)	AC1 Class Rated Current of TL1 Pre-charge Contactor
		(A)	mm² (AWG o kcmils)	mm	Nm	mm² (AWG or kcmils)	(A)	(A)	(A)
S05	0005	10.5	0.5÷10 (20÷6AWG)	10	1.2-1.5	2.5 (12AWG)	16	16	25
	0007	12.5					16	16	25
	0009	16.5				4 (10AWG)	25	25	25
	0011	16.5					25	25	25
	0014	16.5					32	32	30
S12	0016	27	0.5÷10 (20÷6AWG)			10 (6AWG)	40	40	45
	0017	30					40	40	45
	0020	30					40	40	45
	0025	41					63	63	55
	0030	41					63	63	60
S15	0034	57	0.5÷25 (12÷4AWG)	18	2.5	16 (5AWG)	100	100	100
	0036	60				25 (4AWG)	100	100	100
	0040	72		15			100	100	100
	0049	75					125	100	100
S20	0060	88	25÷50 (6÷1/0AWG)	24	6-8	35 (2AWG)	125	125	115
	0067	103				50 (1/0AWG)	125	125	125
	0074	120					160	160	145
	0086	135					200	160	160
S30	0113	180	35÷185 (2AWG÷ 400kcmils)	30	10	95 (4/0AWG)	250	200	250
	0129	195				120 (250kcmils)	250	250	250
	0150	210					315	400	275
	0162	210					400	400	275
S41	0180	300	Bus bar	–	25-30	185 (400kcmils)	350	400	400
	0202	345				240 (500kcmils)	500	400	450
	0217	375				2x120 (2x250kcmils)	550	630	450
	0260	425					630	630	500
S51	0313	480			50	2x150 (2x300kcmils)	800	630	550
	0367	550				2x185 (2x400kcmils)	800	800	600
	0402	680				2x240 (2x500kcmils)	1000	800	700

S60	0457	720	Bus bar	–	50	3x150 (3x300kcmils)	1000	800	800
	0524	800				3x185 (3x400kcmils)	1000	1000	1000
S64	0598	900			M10: 50 M12: 110	3x240 (3x500kcmils)	1250	1250	1000
	0748	1000				3x240 (3x500kcmils)	1250	1250	1200
	0831	1200				4x240 (4x500kcmils)	1600	1600	1350
S74	0964	1480				2x3x185 (2x3x400kcmils)	2x1000	2000	2x800
	1130	1700					2x1250	2000	2x1000
	1296	2100				2x3x240 (2x3x500kcmils)	2x1400	2500	2x1200
S84	1800	2600				3x3x240 (3x3x500kcmils)	3x1250	4000	3x1000
	2076	3000					3x1250	4000	3x1200

(*) Alternative to MCC1.

CAUTION

Always use the correct cable cross-sections and enable the protecting 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.

NOTE

Make sure that the pre-charge contactor coil can be controlled by the relay installed on the drive (250VAC-5A/30VDC-5A); if this is not the case, use an additional external relay. Always use a noise filter parallel-connected to the contactor coil.

3.7.5. UL-APPROVED FUSES – CLASS 4T

UL-approved semiconductor fuses, which are recommended for the drives of the SINUS PENTA series, are listed in the table below.
In multiple cable installations, install one fuse per phase (NOT one fuse per conductor).
Fuses suitable for the protection of semiconductors produced by other manufacturers may be used, provided that they have the same or better ratings and

- are Nonrenewable UL Listed Cartridge Fuses, or UL Recognized External Semiconductor Fuses;
- are of the type specifically approved also with reference to the Canadian Standard.

Size	SINUS PENTA Model	UL-approved Fuses Manufactured by:									
		SIBA Sicherungen-Bau GmbH (200 kA_{RMS} Symmetrical A.I.C.)					Bussmann Div Cooper (UK) Ltd (100/200 kA_{RMS} Symmetrical A.I.C.)				
				Ratings					Ratings		
		Q.ty	Mod. N.	A_{RMS} Current	I^2t (500V) A^2s	Vac	Q.ty	Mod. N.	A_{RMS} Current	I^2t (500V) A^2s	Vac
S05	0005	1	20 412 34 16	16	122	690	1	170M1409	16	36	700
	0007										
	0009	1	20 412 04 25	25	140	660	1	170M1410	20	58	
	0011										
	0014	1	20 412 04 40	40	490		1	FWP-40B	40	160	
S12	0016	1	50 142 06 40	40	430	700					
	0017										
	0020										
	0025	1	20 412 20 63	63	980		1	FWP-60B	60	475	
	0030										
	0034	1	20 412 20 80	80	1820		1	FWP-80B	80	1200	
	0036										
S15	0040	1	20 412 20 100	100	2800		1	FWP-100B	100	2290	
	0049										
S20	0060	1	20 412 20 125	125	5040		1	FWP-125A	125	5655	
	0067										
	0074	1	20 412 20 160	160	10780		1	FWP-150A	150	11675	
	0086	1	20 412 20 200	200	19250		1	FWP-175A	175	16725	
S30	0113	1	20 412 20 250	250	32760		1	FWP-225A	225	31175	
	0129										
	0150	1	20 412 20 315	315	60200		1	FWP-250A	250	32000	
	0162	1	20 412 20 400	400	109200		1	FWP-350A	350	70800	

Size	SINUS PENTA Model	UL-approved Fuses Manufactured by:									
		SIBA Sicherungen-Bau GmbH (200 kARMS Symmetrical A.I.C.)					Bussmann Div Cooper (UK) Ltd (100/200 kA_{RMS} Symmetrical A.I.C.)				
				Ratings					Ratings		
		Q.ty	Mod. No.	A_{RMS} Current	I^2t (500V) A^2s	Vac	Q.ty	Mod. No.	A_{RMS} Current	I^2t (500V) A^2s	Vac
S41	0180	1	20 622 32 450	450	77000	700	1	FWP-450A	450	101400	700
	0202	1	20 622 32 500	500	105000		1	FWP-500A	500	125800	
	0217	1	20 622 32 550	550	136500		1	FWP-600A	600	185000	
	0260	1	20 622 32 630	630	210000						
S51	0313						1	FWP-700A	700	129000	
	0367	1	20 622 32 700	700	287000						
	0402	1	20 622 32 900	900	665000		1	FWP-900A	900	228000	
S60	0457	1	20 622 32 1000	1000	882000		1	FWP-1000A	1000	258000	
	0524	1	20 632 32 1250	1250	1225000		1	FWP-1200A	1200	473000	
S64	0598	1	20 632 32 1400	1400	1540000		1	170M6067	1400	1700000	
	0748										
	0831	2	20 622 32 800	800	406000		1	170M6069	1600	2700000	
S74	0964	2	20 622 32 1000	1000	882000		2	FWP-1000A	1000	258000	
	1130	2	20 632 32 1250	1250	1225000		2	FWP-1200A	1200	473000	
	1296	2	20 632 32 1400	1400	1540000		2	170M6067	1400	1700000	
S84	1800	3	20 632 32 1400	1400	1540000		3	170M6067	1400	1700000	
	2076										

3.7.6. CROSS-SECTION OF POWER CABLES AND SIZE OF SAFETY COMPONENTS FOR 5T-6T CLASS DRIVES

Size	SINUS PENTA Model	Rated Current of the RGN Drive	Cable Cross-section Fitting the Terminals	Cable Stripping	Tightening Torque	Cable Cross-section for Mains-Drive Connection	Size of Fast Fuses (700V) + Disconnecting Switch for Supply Line (*)	Magnetic CB for Supply Line (MCC1)	AC1 Class Rated Current of TL1 Pre-charge Contactor
		A	mm² (AWG or kcmils)	mm	Nm	mm² (AWG or kcmils)	A	A	A
S12 5T S14 6T	0003	7	0.5÷16 (20÷5AWG)	10	1.2-1.5	2.5 (12AWG)	16	16	25
	0004	9					16	16	25
	0006	11					16	16	25
	0012	13					16	16	25
	0018	17				4 (10AWG)	20	20	25
S14	0019	21	0.5÷25 (20÷4 AWG)	18	2.5-4.5		32	32	27
	0021	25				6 (8AWG)	32	32	30
	0022	33				10 (8AWG)	50	50	45
	0024	40					50	50	55
	0032	52				16 (5AWG)	63	63	60
S22	0042	60	25÷50 (4÷1/0 AWG)	20	2.5-5	25 (4AWG)	80	80	100
	0051	80				35 (2AWG)	100	100	100
	0062	85					100	100	100
	0069	105				50 (1/0AWG)	125	125	125
S32	0076	125	25÷95 (4÷4/0AWG)	30	15-20	70 (3/0AWG)	160	160	160
	0088	150				95 (4/0AWG)	200	200	250
	0131	190	35÷150 (2AWG÷ 300kcmils)			120 (250kcmils)	250	250	250
	0164	230				185 (400kcmils)	315	400	275
S42	0181	305	Bus bar	–	25-30	240 (500kcmils)	400	400	400
	0201	330					450	400	450
	0218	350				2x120 (2x250kcmils)	500	400	450
	0259	360					630	630	500
S52	0290	450			50	2x150 (2x300kcmils)	630	630	550
	0314	500					700	630	550
	0368	560				2x185 (2x400kcmils)	800	800	600
	0401	570				2x240 (2x500kcmils)	800	800	600

S64	0457	720	Bus bar	–	M10: 50 M12: 110	3x185 (3x400kcmils)	900	800	800
	0524	800					1000	1000	1000
	0598	900				3x240 (3x500kcmils)	1250	1250	1000
	0748	950					1250	1250	1000
	0831	1000					1600	1600	1200
S74	0964	1480				2x3x185 (2x3x400kcmils)	2x1000	2000	2x800
	1130	1700					2x1250	2000	2x1000
	1296	1900				2x3x240 (2x3x500kcmils)	2x1400	2500	2x1200
S84	1800	2600				3x3x240 (3x3x500kcmils)	3x1250	4000	3x1000
	2076	2800					3x1250	4000	3x1200

(*) Alternative to MCC1.

CAUTION

Always use the correct cable cross-sections and enable the protecting 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.

NOTE

Make sure that the pre-charge contactor coil can be controlled by the relay installed on the drive (250VAC-5A/30VDC-5A); if this is not the case, use an additional external relay. Always use a noise filter parallel-connected to the contactor coil.

3.7.7. UL-APPROVED FUSES – CLASS 5T-6T

UL-approved semiconductor fuses, which are recommended for the drives of the SINUS PENTA series, are listed in the table below.
In multiple cable installations, install one fuse per phase (NOT one fuse per conductor).
Fuses suitable for the protection of semiconductors produced by other manufacturers may be used, provided that they have the same or better ratings and

- are UL Listed Cartridge Fuses, Nonrenewable or UL Recognized External Semiconductor Fuses;
- are of the type specifically approved also with reference to the Canadian Standard.

Size	SINUS PENTA Model	UL-approved Fuses Manufactured by:									
		SIBA Sicherungen-Bau GmbH (200 kA_{RMS} Symmetrical A.I.C.)					Bussmann Div Cooper (UK) Ltd (100/200 kA_{RMS} Symmetrical A.I.C.)				
				Ratings					Ratings		
		Q.ty	Mod. No.	A_{RMS} Current	I^2t (690V) kA^2s	Vac	Q.ty	Mod. No.	A_{RMS} Current	I^2t (690V) kA^2s	Vac
S12 5T	0003	1	20 412 34 16	16	0.18 (0.14@575V)	690	1	170M1409	16	0.05 (0.04@575V)	700
	0004										
	0006										
S14 6T	0012						1	170M1410	20	0.08 (0.06@575V)	
	0018	1	20 412 04 25	25	0.22 (0.16@575V)	700	1	170M1411	25	0.14 (0.11@575V)	
S14	0019	1	20 412 04 25	25	0.22		1	170M1411	25	0.14	
	0021	1	20 412 04 32	32	1.50		1	170M1412	32	0.29	
	0022	1	20 412 20 40	40	0.55		1	FWP-40B	40	0.32	
	0024	1	20 412 20 50	50	0.85		1	FWP-50B	50	0.60	
	0032	1	20 412 20 63	63	1.54		1	FWP-60B	60	0.95	
S22	0042	1	20 412 20 80	80	2.8		1	FWP-80B	80	2.4	
	0051	1	20 412 20 100	100	4.4		1	FWP-100B	100	3.5	
	0062										
	0069	1	20 412 20 125	125	7.9		1	FWP-125A	125	7.3	
S32	0076	1	20 412 20 160	160	16.9		1	FWP-150A	150	11.7	
	0088	1	20 412 20 200	200	30.3		1	FWP-175A	175	16.7	
	0131	1	20 412 20 250	250	51.5		1	FWP-225A	225	31.3	
	0164	1	20 412 20 315	315	94.6		1	FWP-300A	300	71.2	
S42	0181						1	FWP-400A	400	125	
	0201	1	20 622 32 450	450	113		1	FWP-450A	450	137	
	0218	1	20 622 32 500	500	155		1	FWP-500A	500	170	
	0259	1	20 622 32 630	630	309		1	FWP-600A	600	250	
S52	0290										
	0314	1	20 622 32 700	700	422		1	FWP-700A	700	300	
	0368	1	20 622 32 800	800	598		1	FWP-800A	800	450	
	0401	1	20 622 32 900	900	979		1	FWP-900A	900	530	

Size	SINUS PENTA Model	UL-approved Fuses Manufactured by:									
		SIBA Sicherungen-Bau GmbH (200 kA_{RMS} Symmetrical A.I.C.)					Bussmann Div Cooper (UK) Ltd (100/200 kA_{RMS} Symmetrical A.I.C.)				
		Q.ty	Mod. No.	Ratings			Q.ty	Mod. No.	Ratings		
				A_{RMS} Current	I^2t (690V) kA^2s	Vac			A_{RMS} Current	I^2t (690V) kA^2s	Vac
S64	0457	1	20 622 32 900	900	979	700	1	FWP-900A	900	530	700
	0524	1	20 622 32 1000	1000	1298		1	FWP-1000A	1000	600	
	0598	1	20 632 32 1250	1250	1802		1	FWP-1200A	1200	1100	
	0748	1	20 632 32 1400	1400	2266		2	FWP-700A	700	300	
	0831	2	20 622 32 800	800	598		2	FWP-800A	800	450	
S74	0964	2	20 622 32 1000	1000	1298		2	FWP-1000A	1000	600	
	1130	2	20 632 32 1250	1250	1802		2	FWP-1200A	1200	1100	
	1296	3	20 622 32 1000	1000	1298		3	FWP-1000A	1000	600	
S84	1800	3	20 632 32 1250	1250	1802		3	FWP-1200A	1200	1100	
	2076	3	20 632 32 1400	1400	2266		6	FWP-800A	800	450	

3.7.8. REGENERATIVE REACTORS FOR 2T VOLTAGE CLASS

SIZE	SINUS PENTA MODEL	REACTOR Part Number	Reactance Ratings	Reactance Current
			(mH)	(A)
S05	0007	IM0128004	5.2	12.5
	0008			
	0010	IM0128044	3.9	16.5
	0013			
	0015			
	0016	IM0128084	2.2	30
	0020			
S12	0023	IM0128124	1.8	41
	0033	IM0128144	1.2	60
	0037			
S15	0040	IM0128164	0.90	80
	0049			
S20	0060	IM0128204	0.70	103
	0067			
	0074	IM0128244	0.50	135
	0086			
S30	0113	IM0128284	0.35	200
	0129			
	0150			
	0162			
S41	0180	IM0128324	0.27	320
	0202	IM0128334	0.20	440
	0217			
	0260			
S51	0313	IM0128364	0.15	565
	0367			
	0402	IM0128374	0.12	700
S60	0457	IM0128404	0.11	900
	0524			

3.7.9. REGENERATIVE REACTORS FOR 4T VOLTAGE CLASS

SIZE	SINUS PENTA MODEL	REACTOR Part Number	Reactance Ratings (mH)	Reactance Current (A)
S05	0005	IM0128004	5.2	12.5
	0007			
	0009	IM0128044	3.9	16.5
	0011			
	0014			
S12	0016	IM0128084	2.2	30
	0017			
	0020			
	0025	IM0128124	1.8	41
	0030			
	0034	IM0128144	1.2	60
	0036			
S15	0040	IM0128164	0.90	80
	0049			
S20	0060	IM0128204	0.70	103
	0067			
	0074	IM0128244	0.50	135
	0086			
S30	0113	IM0128284	0.35	200
	0129			
	0150			
	0162			
S41	0180	IM0128324	0.27	320
	0202	IM0128334	0.20	440
	0217			
	0260			
S51	0313	IM0128364	0.15	565
	0367			
	0402	IM0128374	0.12	700
S60	0457	IM0128404	0.11	900
	0524			
S64	0598			
	0748	IM0128444	0.08	1200
	0831			
S74	0964	2xIM0128404	0.11/2	2x900
	1130			
	1296	2xIM0128444	0.08/2	2x1200
S84	1800	3xIM0128444	0.08/3	3x1200
	2076			

3.7.10. REGENERATIVE REACTORS FOR 5T-6T VOLTAGE CLASS

SIZE	SINUS PENTA MODEL	REACTOR Part Number	Reactance Ratings (mH)	Reactance Current (A)
S12 5T S14 6T	0003	IM0129194	16	9
	0004			
	0006	IM0129204	12	13
	0012			
	0018	IM0129214	8.2	18
S14	0019	IM0129224	6	26
	0021			
	0022	IM0129234	3.8	42
	0024			
	0032	IM0129244	2.5	63
S22	0042			
	0051	IM0129254	1.7	90
	0062			
	0069	IM0129264	1.4	110
S32	0076	IM0129274	0.95	155
	0088			
	0131	IM0129284	0.60	240
	0164			
S42	0181	IM0129294	0.39	385
	0201			
	0218			
	0259			
S52	0290	IM0129304	0.29	480
	0314	IM0129334	0.24	600
	0368			
	0401			
S64	0457	IM0129344	0.20	720
	0524	IM0129384	0.15	1000
	0598			
	0748			
	0831			
S74	0964	2xIM0129384	0.15/2	2x1000
	1130			
	1296			
S84	1800	3xIM0129384	0.15/3	3x1000
	2076			

3.7.11. FILTER REACTORS FOR 2T VOLTAGE CLASS

SIZE	SINUS PENTA MODEL	REACTOR Part Number	Reactance Ratings (mH)	Reactance Current (A)
S05	0007	IM0128604	2.6	12.5
	0008			
	0010	IM0128644	2.0	16.5
	0013			
	0015			
	0016	IM0128684	1.1	30
	0020			
S12	0023	IM0128724	0.90	41
	0033	IM0128744	0.60	60
	0037			
S15	0040	IM0128764	0.45	80
	0049			
S20	0060	IM0128804	0.35	103
	0067			
	0074	IM0128844	0.25	135
	0086			
S30	0113	IM0128884	0.175	200
	0129			
	0150			
	0162			
S41	0180	IM0128924	0.135	320
	0202	IM0128934	0.100	440
	0217			
	0260			
S51	0313	IM0128964	0.080	550
	0367			
	0402	IM0128965	0.060	700
S60	0457	IM0128974	0.060	900
	0524			

3.7.12. FILTER REACTORS FOR 4T VOLTAGE CLASS

SIZE	SINUS PENTA MODEL	REACTOR Part Number	Reactance Ratings (mH)	Reactance Current (A)
S05	0005	IM0128604	2.6	12.5
	0007			
	0009	IM0128644	2.0	16.5
	0011			
	0014			
S12	0016	IM0128684	1.1	30
	0017			
	0020			
	0025	IM0128724	0.90	41
	0030			
	0034	IM0128744	0.60	60
	0036			
S15	0040	IM0128764	0.45	80
	0049			
S20	0060	IM0128804	0.35	103
	0067			
	0074	IM0128844	0.25	135
	0086			
S30	0113	IM0128884	0.175	200
	0129			
	0150			
	0162			
S41	0180	IM0128924	0.135	320
	0202	IM0128934	0.100	440
	0217			
	0260			
S51	0313	IM0128964	0.080	550
	0367			
	0402	IM0128965	0.060	700
S60	0457	IM0128974	0.060	900
	0524			
S64	0598			
	0748	IM0128984	0.040	1200
	0831			
S74	0964	IM0128988	0.028	1700
	1130			
	1296	IM0128994	0.020	1950
S84	1800	3xIM0128984	0.040/3	3x1200
	2076			

3.7.13. FILTER REACTORS FOR 5T-6T VOLTAGE CLASS

SIZE	SINUS PENTA MODEL	REACTOR Part Number	Reactance Ratings	Reactance Current
			(mH)	(A)
S12 5T S14 6T	0003	IM0129494	8.0	9
	0004			
	0006	IM0129504	6.0	13
	0012			
	0018	IM0129514	4.1	18
S14	0019	IM0129524	3.0	26
	0021			
	0022	IM0129534	1.9	42
	0024			
	0032	IM0129544	2.3	63
S22	0042			
	0051	IM0129554	0.85	90
	0062			
	0069	IM0129564	0.70	110
S32	0076	IM0129574	0.50	155
	0088			
	0131	IM0129584	0.30	240
	0164			
S42	0181	IM0129594	0.20	385
	0201			
	0218			
	0259			
S52	0290	IM0129604	0.145	480
	0314			
	0368	IM0129634	0.120	600
	0401			
S64	0457	IM0129644	0.100	720
	0524	IM0129684	0.075	1000
	0598			
	0748			
	0831			
S74	0964	IM0129724	0.038	1950
	1130			
	1296			
S84	1800	3xIM0129684	0.075/3	3x1000
	2076			

3.7.14. REGENERATIVE REACTOR RATINGS

3.7.14.1. CLASS 2T AND 4T

ES Part Number	Reactance (mH)	Rated Current (A rms)	Losses when operating at Rated Current (W)	Length (mm max)	Width (mm max)	Height (mm max)	Weight (kg max)
IM0128004	5.2	12.5	70	240	140	245	16
IM0128044	3.9	16.5	90	240	150	245	17
IM0128084	2.2	30	150	240	170	250	22
IM0128124	1.8	41	215	240	200	250	29
IM0128144	1.2	60	285	240	200	250	31
IM0128164	0.90	80	335	300	200	320	40
IM0128204	0.70	103	515	360	200	345	53
IM0128244	0.50	135	580	360	240	350	64
IM0128284	0.35	200	810	360	250	405	94
IM0128324	0.27	320	1080	420	300	500	157
IM0128334	0.20	440	1950	480	320	510	203
IM0128364	0.15	565	1650	540	340	550	237
IM0128374	0.12	700	2870	595	360	660	332
IM0128404	0.11	900	2500	590	400	690	440
IM0128444	0.08	1200	3100	675	440	735	605

3.7.14.2. CLASS 5T AND 6T

ES Part Number	Reactance (mH)	Rated Current (A rms)	Losses when operating at Rated Current (W)	Length (mm max)	Width (mm max)	Height (mm max)	Weight (kg max)
IM0129194	16	9	Please contact Elettronica Santerno				
IM0129204	12	13					
IM0129214	8.2	18					
IM0129224	6.0	26					
IM0129234	3.8	42					
IM0129244	2.5	63					
IM0129254	1.7	90					
IM0129264	1.4	110	980	360	280	385	98
IM0129274	0.95	155	1420	420	310	440	136
IM0129284	0.60	240	1660	510	330	490	206
IM0129294	0.39	385	2560	595	370	580	333
IM0129304	0.29	480	1800	600	380	535	335
IM0129334	0.24	600	3600	610	370	660	415
IM0129344	0.20	720	2650	615	430	700	515
IM0129384	0.15	1000	3250	705	450	740	663

3.7.15. FILTER REACTOR RATINGS

3.7.15.1. CLASS 2T AND 4T

ES Part Number	Reactance (mH)	Rated Current (A rms)	Losses when operating at Rated Current (W)	Length (mm max)	Width (mm max)	Height (mm max)	Weight (kg max)
IM0128604	2.6	12.5	25	150	120	170	7
IM0128644	2.0	16.5	35	180	110	195	8
IM0128684	1.1	30	50	180	130	195	11
IM0128724	0.90	41	90	240	150	245	15
IM0128744	0.60	60	110	240	150	245	16
IM0128764	0.45	80	120	240	160	245	18
IM0128804	0.35	103	135	240	180	245	24
IM0128844	0.25	135	160	240	190	245	26
IM0128884	0.175	200	220	300	210	325	43
IM0128924	0.135	320	310	360	220	350	64
IM0128934	0.100	440	810	360	250	330	70
IM0128964	0.080	550	540	360	290	350	85
IM0128965	0.060	700	1270	420	290	410	120
IM0128974	0.060	900	730	420	320	415	136
IM0128984	0.040	1200	940	450	320	525	182
IM0128988	0.028	1700	2080	510	400	610	281
IM0128994	0.020	1950	1980	510	400	610	260

3.7.15.2. CLASS 5T AND 6T

ES Part Number	Reactance (mH)	Rated Current (A rms)	Losses when operating at Rated Current (W)	Length (mm max)	Width (mm max)	Height (mm max)	Weight (kg max)
IM0129494	8.0	9	Please contact Elettronica Santerno				
IM0129504	6.0	13					
IM0129514	4.1	18					
IM0129524	3.0	26					
IM0129534	2.3	42					
IM0129544	1.9	63					
IM0129554	0.85	90					
IM0129564	0.70	110	310	300	200	300	45
IM0129574	0.50	155	450	300	220	320	52
IM0129584	0.30	240	570	360	250	360	75
IM0129594	0.20	385	1050	420	290	400	121
IM0129604	0.145	480	665	420	275	390	123
IM0129634	0.120	600	1400	450	300	465	153
IM0129644	0.100	720	800	450	300	505	175
IM0129684	0.075	1000	1060	480	360	530	240
IM0129724	0.038	1950	2870	610	450	660	463

3.7.16. TECHNICAL FEATURES OF THE INTERFACE PANEL

The interface panel must be used based on the model of the regenerative drive.
The interface panel includes the following: resistors of pre-charge capacitors installed on the DC-bus inside the drive; capacitors of the component filter at the commutation frequency and the relevant safety switch; measure circuits of the mains voltage.
Figure 6 shows the block-diagram of the interface panel.

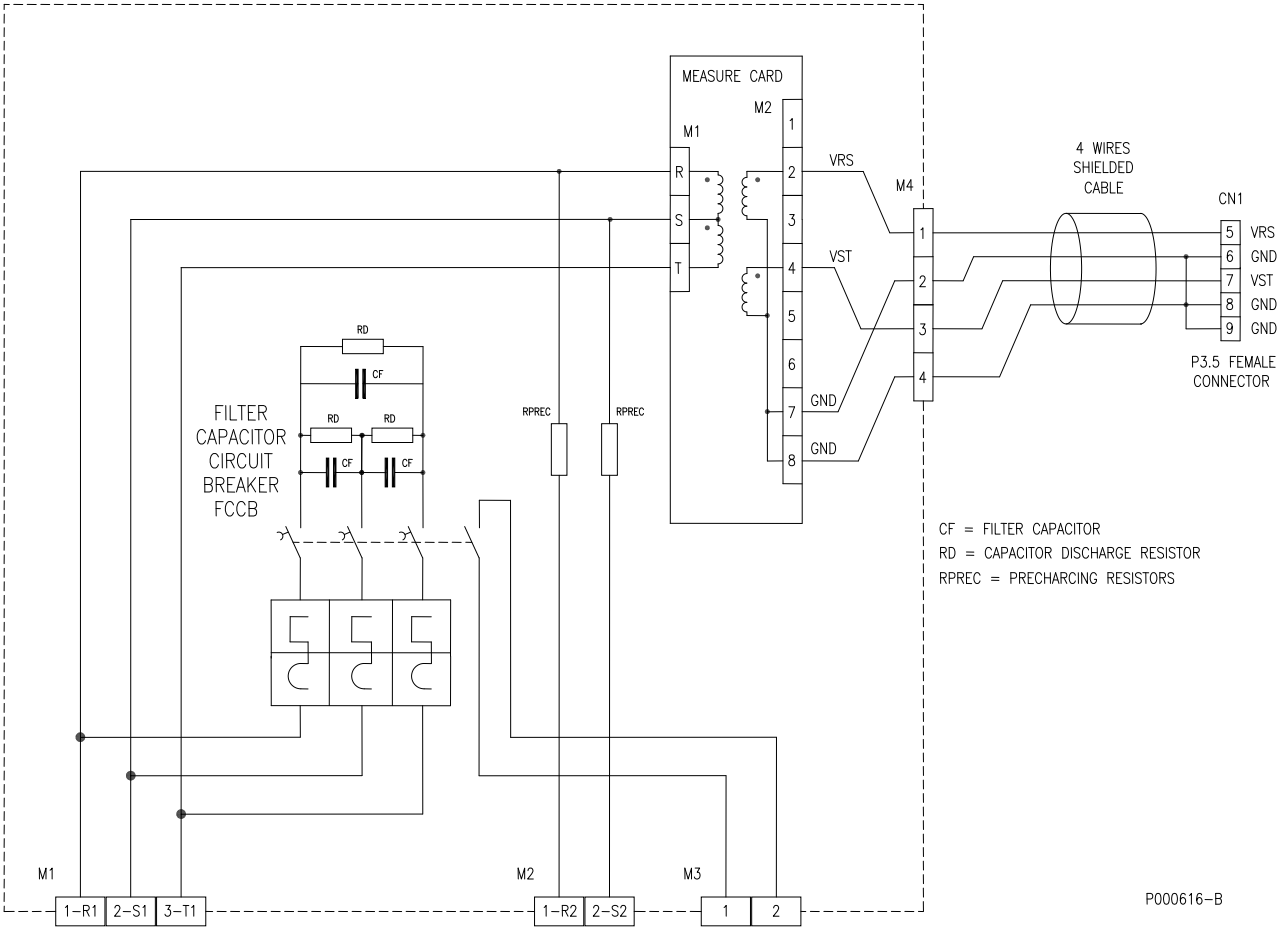


Figure 6: Block-diagram of the interface panel

NOTE

Based on the drive model, the interface panel can contain up to 5 filter capacitor units. Each capacitor unit is provided with a safety switch.

3.7.16.1. Dimensions, Weights and Dissipated Power 2T-4T

Size	MODEL	ES PART NUMBER	L	H	P	X	Y	D	Weight	Power dissipated at Inom
			mm	mm	mm	mm	mm	mm	kg	W
P010	0014 2T-4T	ZZ0120010	170	386	261.5	150	366.5	7	9	5
	0035 2T-4T	ZZ0120015							9	5
	0049 2T-4T	ZZ0120020							9	5
	0067 2T-4T	ZZ0120025							9	5
	0086 2T-4T	ZZ0120030							9	5
P020	0162 2T-4T	ZZ0120035	220	471	344	190	457	7	23	10
	0250 2T-4T	ZZ0120040							25	10
P030	0260 2T-4T	ZZ0120042	234	997	428	178	970	11	37	20
	0399 2T-4T	ZZ0120045							40	30
	0598 2T-4T	ZZ0120050							43	40
	0831 2T-4T	ZZ0120055							46	50

3.7.16.2. Dimensions, Weights and Dissipated Power 5T-6T

Size	MODEL	ES PART NUMBER	L	H	P	X	Y	D	Weight	Power dissipated at Inom
			mm	mm	mm	mm	mm	mm	kg	W
P010	0012 5T-6T	ZZ0120078	170	386	261.5	150	366.5	7	9	5
	0021 5T-6T	ZZ0120080							9	5
	0024 5T-6T	ZZ0120082							9	5
	0042 5T-6T	ZZ0120084							9	5
	0069 5T-6T	ZZ0120085							9	5
P020	0172 5T-6T	ZZ0120086	220	471	344	190	457	7	25	10
P030	0259 5T-6T	ZZ0120058	234	997	428	178	970	11	41	20
	0312 5T-6T	ZZ0120060							44	30
	0457 5T-6T	ZZ0120065							47	40
	0831 5T-6T	ZZ0120070							50	50

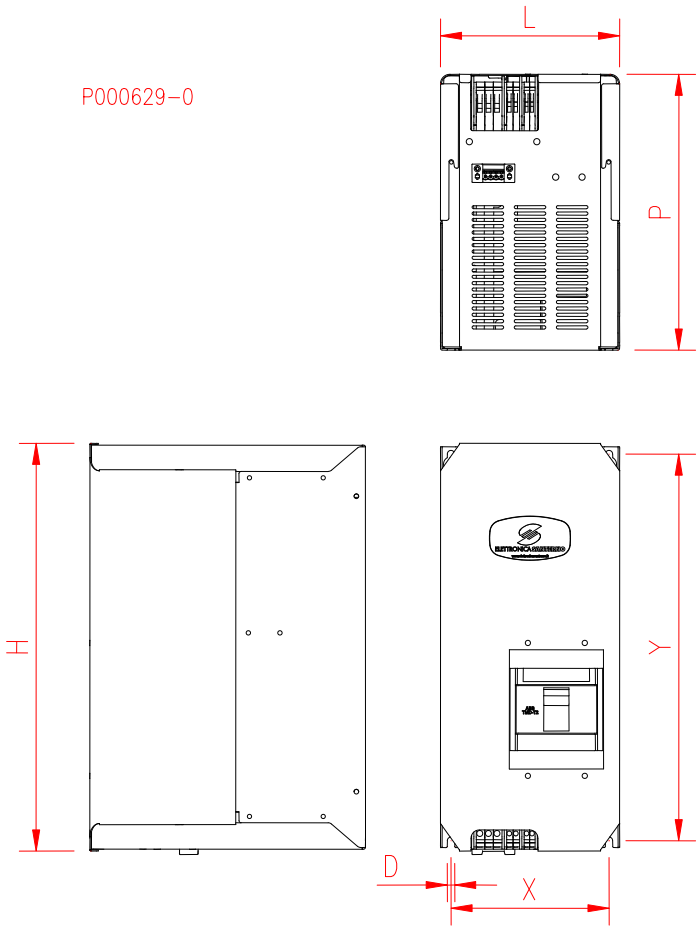


Figure 7: Dimensions and fixing holes of the interface panel

NOTE Install the interface panel vertically as shown in the figure; make sure to allow a min. clearance of 50 mm on both sides and 10 mm on top and bottom for air circulation.

NOTE The maximum allowable ambient temperature for the interface panel is 50 °C.

3.7.16.3. TERMINALS IN THE INTERFACE PANEL

When connecting the interface panel, three terminal boards are needed for the power signals; a special cable is also needed for the measure signals, which is ready to be connected to the control board terminals of the regenerative drive.

Terminal Board	Terminal N.	Signal	Description	NOTES
M1	1	R1	Filter capacitor connection also used for the mains voltage measuring circuit.	Connect to R1 phase in the filter reactor. DO NOT CHANGE THE PHASE SEQUENCE.
	2	S1		Connect to S1 phase in the filter reactor. DO NOT CHANGE THE PHASE SEQUENCE.
	3	T1		Connect to T1 phase in the filter reactor. DO NOT CHANGE THE PHASE SEQUENCE.
M2	1	R2	Pre-charge resistor connection.	Connect to R2 phase in the regenerative reactor.
	2	S2		Connect to S2 phase in the regenerative reactor.
M3	1	1	Connection of NO auxiliary contact of the filter capacitor safety switch.	Connect to terminals 23 and 18 in the control board of the regenerative drive. The Rgn drive starts only when this contact closes; alarm A059 trips when this contact is open.
	2	2		
M4	1	Vrs	Supply mains Vrs voltage measure.	Connect to the terminal board in the control board of the regenerative drive through the cable supplied with the interface panel. Ground the cable braiding through the cable glands located in the regenerative drive.
	2	GND	Ground.	
	3	Vst	Supply mains Vst voltage measure.	
	4	GND	Ground.	

NOTE If multiple filter capacitor units are installed, close all switches located on the interface panel to close the contact on terminals 1 and 2 in M3 and to allow the regenerative drive to start.

3.7.17. INTERFACE PANEL – 2T VOLTAGE CLASS

SIZE	SINUS PENTA MODEL	INTERFACE PANEL SIZE	INTERFACE PANEL MODEL	M1 Terminal Board (filter capacitor connection)					M2 Terminal Board (pre-charge resistor connection)				M3 Terminal Board (connection of auxiliary contact of filter capacitor safety switch)			
				Cable Cross-section fitting the Terminal	Cable Stripping	Tightening Torque	Filter Capacitor Connection Current	Recommended Cross-section	Cable Cross-section fitting the Terminal	Cable Stripping	Tightening Torque	Recommended Cross-section	Cable Cross-section fitting the Terminal	Cable Stripping	Tightening Torque	Recommended Cross-section
				mm² (AWG)	mm	Nm	(A)	mm² (AWG)	mm² (AWG)	mm	Nm	mm² (AWG)	mm² (AWG)	mm	Nm	mm² (AWG)
S05	0007	P010	0014-4T	0.5-10 (20-8)	10	1.5-1.8	2.5	2.5 (14)	0.14-4 (26-12)	9	0.6-0.8	1.5 (16)	0.14-2.5 (26-14)	9	0.6-0.8	1 (18)
	0008															
	0010		0035-4T				4									
	0013															
	0015															
	0016															
	0020															
S12	0023		0035-4T				4	2.5 (14)				1.5 (16)				
	0033		0049-4T				8	2.5 (14)				2.5 (14)				
	0037															
S15	0040															
	0049															
S20	0060		0067-4T				12	2.5 (14)				4 (12)				
	0067															
	0074		0086-4T				20	4 (12)								
	0086															
S30	0113	P020	0162-4T	1.5-35 (16-2)	16	3.2-3.7	25	6 (10)	0.2-6 (24-10)	10	1.5-1.8	4 (12)				
	0129															
	0150															
	0162															

SIZE	SINUS PENTA MODEL	INTERFACE PANEL SIZE	INTERFACE PANEL MODEL	M1 Terminal Board (filter capacitor connection)					M2 Terminal Board (pre-charge resistor connection)				M3 Terminal Board (connection of auxiliary contact of filter capacitor safety switch)			
				Cable Cross-section fitting the Terminal	Cable Stripping	Tightening Torque	Filter Capacitor Connection Current	Recommended Cross-section	Cable Cross-section fitting the Terminal	Cable Stripping	Tightening Torque	Recommended cross-section	Cable Cross-section fitting the Terminal	Cable Stripping	Tightening Torque	Recommended Cross-section
				mm² (AWG)	mm	Nm	(A)	mm² (AWG)	mm² (AWG)	mm	Nm	mm² (AWG)	mm² (AWG)	mm	Nm	mm² (AWG)
S41	0180	P020	0250-4T	1.5-35 (16-2)	16	3.2-3.7	40	10 (8)	0.2-6 (24-10)	10	1.5-1.8	6 (10)	0.14-2.5 (26-14)	9	0.6-0.8	1 (18)
	0202	P030	0260-4T	25-95 (3-4/0)	33	15-20	60	25 (3)	0.5-10 (20-8)			6 (10)				
	0217															
	0260															
S51	0313		0399-4T				80	35 (2)	0.5-10 (20-8)			6 (10)				
	0367															
	0402		0598-4T				100	0 (1								
S60	0457		0598-4T				100	50 (14)	0.5-10 (20-8)			10 (8)				
	0524															

3.7.18. INTERFACE PANEL – 4T VOLTAGE CLASS

SIZE	SINUS PENTA MODEL	INTERFACE PANEL SIZE	INTERFACE PANEL MODEL	M1 Terminal Board (filter capacitor connection)					M2 Terminal Board (pre-charge resistor connection)				M3 Terminal Board (connection of auxiliary contact of filter capacitor safety switch)			
				Cable Cross-section fitting the Terminal	Cable Stripping	Tightening Torque	Filter Capacitor Connection Current	Recommended Cross-section	Cable Cross-section fitting the Terminal	Cable Stripping	Tightening Torque	Recommended Cross-section	Cable Cross-section fitting the Terminal	Cable Stripping	Tightening Torque	Recommended Cross-section
				mm² (AWG)	mm	Nm	(A)	mm² (AWG)	mm² (AWG)	mm	Nm	mm² (AWG)	mm² (AWG)	mm	Nm	mm² (AWG)
S05	0005	P010	0014-4T	0.5-10 (20-8)	10	1.5-1.8	5	2.5 (14)	0.14-4 (26-10)	9	0.6-0.8	1.5 (16)	0.14-2.5 (26-14)	9	0.6-0.8	1 (18)
	0007															
	0009															
	0011															
	0014															
S12	0016		0035-4T				8									
	0017															
	0020															
	0025															
	0030															
	0034		0049-4T				16	4 (12)				2.5 (14)				
	0036															
S15	0040															
	0049															
S20	0060		0067-4T				24	6 (10)				4 (12)				
	0067															
	0074		0086-4T				40	10 (8)								
	0086															
S30	0113	P020	0162-4T	1.5-35 (16-2)	16	3.2-3.7	48	16 (6)	0.2-6 (24-8)	10	1.5-1.8					
	0129															
	0150															
	0162															

SIZE	SINUS PENTA MODEL	INTERFACE PANEL SIZE	INTERFACE PANEL MODEL	M1 Terminal Board (filter capacitor connection)					M2 Terminal Board (pre-charge resistor connection)				M3 Terminal Board (connection of auxiliary contact of filter capacitor safety switch)			
				Cable Cross-section fitting the Terminal	Cable Stripping	Tightening Torque	Filter Capacitor Connection Current	Recommended Cross-section	Cable Cross-section fitting the Terminal	Cable Stripping	Tightening Torque	Recommended Cross-section	Cable Cross-section fitting the Terminal	Cable Stripping	Tightening Torque	Recommended Cross-section
				mm² (AWG)	mm	Nm	(A)	mm² (AWG)	mm² (AWG)	mm	Nm	mm² (AWG)	mm² (AWG)	mm	Nm	mm² (AWG)
S41	0180	P020	0250-4T	1.5-35 (16-2)	16	3.2-3.7	80	25 (3)	0.2-6 (24-10)	10	1.5-1.8	6 (10)	0.14-2.5 (26-14)	9	0.6-0.8	1 (18)
S41	0202	P030	0260-4T	25-95 (3-4/0)	33	15-20	110	50 (1/0)	0.5-10 (20-8)							
	0217															
	0260															
S51	0313		0399-4T				145	70 (2/0)								
S51	0367															
	0402		0598 - 4T				190	95 (4/0)				10 (8)				
S60	0457															
S60	0524															
S64	0598															
S64	0748		0831-4T													
S64	0831															
S74	0964	2x P030	0831-4T				2x 190									
S74	1130															
S74	1296															
S84	1800	3x P030	0831-4T				3x 190									
S84	2076															

3.7.19. INTERFACE PANEL – 5T-6T VOLTAGE CLASS

SIZE	SINUS PENTA MODEL	INTERFACE PANEL SIZE	INTERFACE PANEL MODEL	M1 Terminal Board (filter capacitor connection)					M2 Terminal Board (pre-charge resistor connection)				M3 Terminal Board (connection of auxiliary contact of filter capacitor safety switch)			
				Cable Cross-section fitting the Terminal	Cable Stripping	Tightening Torque	Filter Capacitor Connection Current	Recommended Cross-section	Cable Cross-section fitting the Terminal	Cable Stripping	Tightening Torque	Recommended Cross-section	Cable Cross-section fitting the Terminal	Cable Stripping	Tightening Torque	Recommended Cross-section
				mm² (AWG)	mm	Nm	(A)	mm² (AWG)	mm² (AWG)	mm	Nm	mm² (AWG)	mm² (AWG)	mm	Nm	mm² (AWG)
S12 5T S14 6T	0003 0004 0006 0012 0018	P010-6T	0012-6T 0021-6T	0.5-10 (20-8)	10	1.5-1.8	5 7	2.5 (14)	0.14-4 (26-10)	9	0.6-0.8	1.5 (16)	0.14-2.5 (26-14)	9	0.6-0.8	1 (18)
S14	0019 0021 0022 0024 0032		0024-6T 0042-6T				10 17	4 (12)				2.5 (14)				
S22	0042 0051 0062 0069		0069-6T				35	10 (3)				4 (12)				
S32	0076 0088 0131 0164	P020-6T	0172-6T	1.5-35 (16-2)	16	3.2-3.7	70	25	0.2-6 (24-10)	10	1.5-1.8					
S42	0181 0201 0218 0259	P030-6T	0259-6T	25-95 (4-4/0)	33	15-20	105	50 (1/0)	0.5-10 (20-8)			6 (10)				
S52	0290 0314 0368 0401		0312-6T 0457-6T				140	70 (2/0)								
S64	0457 0524 0598 0748 0831		0831-6T				175	95 (4/0)				10 (8)				
S74	0964 1130 1296	2x P030-6T	0831-6T				2x 175									
S84	1800 2076	3x P030-6T	0831-6T				3x 175									

3.8. ADDITIONAL COMPONENTS FOR THE "ENERGY COUNTER" APPLICATION

ES847 option board allows measuring the amount of regenerated energy through the ADE integrated circuit. The following variables can be measured:

- Instantaneous power;
- Energy;
- Current in each phase;
- Voltage in each phase.

How to install ES847 board is detailed in the Sinus Penta's Installation Instructions manual.

In addition to ES847 option board, three AC CTs – one per phase – shall be connected, along with ES917 board for the measurement of the voltage values in each phase (see ES917 Board). The diagram below shows the wiring required for the correct detection of the regenerated energy.

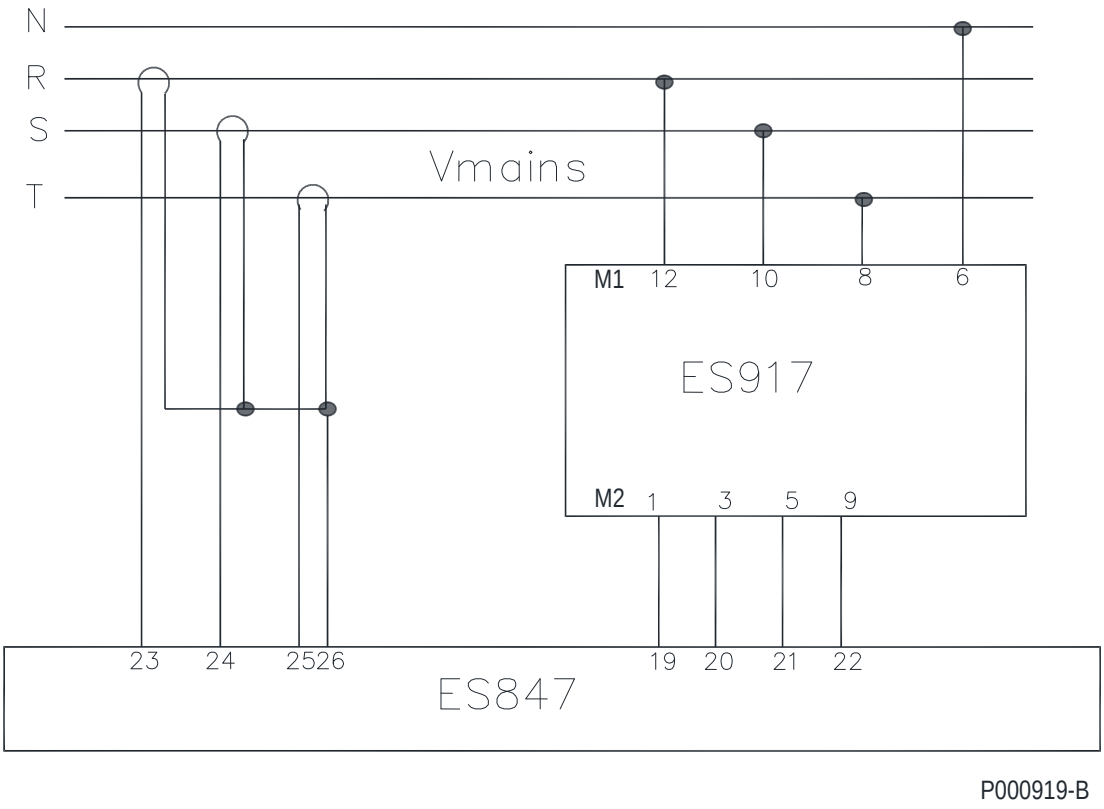


Figure 8: Wiring diagram for the Energy Counter application

NOTE

Before using the Energy Counter application, measures shall be adjusted using the dedicated parameters (see the ADE REGISTERS SETTINGS MENU). Measurement devices (such as a power meter, a current meter and a voltmeter) are required to check if the values measured through ES847 board are correct (see Menu n.2 – ADE Measures).

SIZE	MODEL	CT SIZE	ES PART NUMBER	Coil Ratio
S05	0005	20/0.1A	TA1010010	200
	0007			
	0008			
	0009			
	0010			
	0011	50/0.1A	TA1010011	500
	0013			
	0014			
	0015			
	0016			
	0020			
S12	0016			
	0017			
	0020			
	0023			
	0025			
	0030	80/0.1A	TA1210010	800
	0033			
	0034			
	0036			
	0037			
S15	0040			
	0049	150/0.1A	XXTA00038	1500
S20	0060			
	0067			
	0074			
	0086	250/0.1A	TA1310010	2500
S30	0113			
	0129			
	0150	400/0.1A	TA1310011	4000
	0162			
S41	0180			
	0202	600/0.1A	TA1310012	6000
	0217			
	0260			
S51	0313			
	0367	1000/0.1A	TA1410010	10000
	0402			
S60	0457	1000/0.1A	TA1410010	10000
	0524			
S64	0598			
	0748	1500/0.1A	TA1410011	15000
	0831			
S74	0964	2000/0.1A	TA1510010	20000
	1130			
	1296	Not applicable		
S84	1800	Not applicable		
	2076	Not applicable		

Table 1: Recommended values for the CTs based on the Penta model (Class 2T and 4T)

SIZE	MODEL	CT SIZE	ES PART NUMBER	Coil Ratio
S12 5T S14 6T	0003	20/0.1A	TA1010010	200
	0004			
	0006			
	0012			
	0018	50/0.1A	TA1010011	500
S14	0019			
	0021			
	0022			
	0024			
	0032	80/0.1A	TA1210010	800
S22	0042			
	0051	150/0.1A	XXTA00038	1500
	0062			
	0069			
S32	0076	250/0.1A	TA1310010	2500
	0088			
	0131			
	0164	400/0.1A	TA1310011	4000
S42	0181			
	0201	600/0.1A	TA1310012	6000
	0218			
	0259			
S52	0290			
	0314	1000/0.1A	TA1410010	10000
	0368			
	0401			
S64	0457			
	0524			
	0598	1500/0.1A	TA1410011	15000
	0748			
	0831			
S74	0964	2000/0.1A	TA1510010	20000
	1130			
	1296	Not applicable		
S84	1800			
	2076			

Table 2: Recommended values for the CTs based on the Penta model (Class 5T and 6T)

3.8.1. ES847 ID

Description	*Part Number*
ES847/1 for Signal Conditioning	ZZ0101814

3.8.2. TERMINALS IN ES847 BOARD

Screwable terminal board including 12 sections (each section can be individually removed) for 0.08÷1.5mm^2 (AWG 28-16) cables.

N.	Name	Description	I/O Features	DIP-switch/Notes
1-2	XAIN1+ XAIN1–	"Fast" differential auxiliary analog input, ±10V f.s. number 1	Vfs = ±10V, Rin= 10kΩ; Resolution: 12 bits	n.u.
3	CMA	0V for analog inputs (common to control 0V)	Control board zero Volt	n.u.
4-5	+15VM –15VM	Stabilized, bipolar output protected from short-circuits for auxiliary circuits.	+15V, –15V; Iout max: 100mA	
6	CMA	0V for analog inputs (common to control 0V)	Control board zero Volt	
7-8	XAIN2+ XAIN2–	"Fast" differential auxiliary analog input, ±10V f.s. number 2	Vfs = ±10V, Rin= 10k Ω; Resolution: 12 bits	n.u.
9-10	XAIN3+ XAIN3–	"Fast" differential auxiliary analog input, ±10V f.s. number 3	Vfs = ±10V, Rin= 10k Ω; Resolution: 12 bits	n.u.
11-12	XAIN4+ XAIN4–	"Fast" differential auxiliary analog input, ±10V f.s. number 4	Vfs = ±10V, Rin= 10k Ω; Resolution: 12 bits	n.u.
13	XAIN5	"Fast" auxiliary analog input (current input), number 5	Ifs = ±20mA, Rin= 200 Ω; Resolution: 12 bits	n.u.
14	CMA	0V for analog inputs for XAIN5 return	Control board zero Volt	n.u.
15	XAIN6	"Fast" auxiliary analog input (current input), number 6	Ifs = ±20mA, Rin= 200 Ω; Resolution: 12 bits	n.u.
17	XAIN7	"Fast" differential auxiliary analog input, number 7 (Energy Counter option)	Ifs = ±160mA, Rin= 33Ω; Resolution: 12 bits	[*]
18	CMA	0V for analog inputs (common to control 0V)	Control board zero Volt	[*]
19	VAP	Voltage analog input from ES917 – phase R (Energy Counter option)	Vfs = ±10V, Rin= 50kΩ; Resolution: 12 bits	
20	VBP	Voltage analog input from ES917 – phase S (Energy Counter option)	Vfs = ±10V, Rin= 50kΩ; Resolution: 12 bits	
21	VCP	Voltage analog input from ES917 – phase T (Energy Counter option)	Vfs = ±10V, Rin= 50kΩ; Resolution: 12 bits	
22	CMA	0V for analog inputs (common to control 0V)	Control board zero Volt	
23	IAP	Current analog input from CT – Phase R (Energy Counter option)	Ifs = ±150mA, Rin= 33Ω; Resolution: 12 bits	
24	IBP	Current analog input from CT – Phase S (Energy Counter option)	Ifs = ±150mA, Rin= 33Ω; Resolution: 12 bits	
25	ICP	Current analog input from CT – Phase T (Energy Counter option)	Ifs = ±150mA, Rin= 33Ω; Resolution: 12 bits	
26	CMA	0V for analog inputs (common to control 0V)	Control board zero Volt	

NOTE

The signals for the Energy Counter application are marked as [*]

NOTE

[*] By adding a LEM current transducer to the DC bus (DC current), you can calculate the performance of the plant. This transducer is to be connected to auxiliary analog input XAIN7 (see DC MEASURES SETTINGS MENU).
Please contact Elettronica Santerno to choose the most appropriate component.

N.	Name	Description	I/O Features	DIP-switch/Notes
27	XAIN8/T1+	"Slow" configurable auxiliary analog input, number 8	Vfs = 10V, Rin = 30kΩ	SW1.3 = ON SW1.1-2-4 = OFF
			Vfs = 100mV, Rin = 1MΩ	SW1.4 = ON SW1.1-2-3 = OFF
			Ifs = 20mA, Rin = 124,5Ω	SW1.2 = ON SW1.1-3-4 = OFF
		Thermistor temperature measure, number 1	Temperature measure with PT100. Compliant with IEC 60751 or DIN 43735.	SW1.1-4 = ON SW1.2-3 = OFF (default)
28	CMA/T1–	0V for analog inputs for XAIN8 return	Control board zero Volt	
29	XAIN9/T2+	"Slow" configurable auxiliary analog input, number 9	Vfs = 10V, Rin = 30kΩ	SW1.7 = ON SW1.5-6-8 = OFF
			Vfs = 100mV, Rin = 1MΩ	SW1.8 = ON SW1.5-6-7 = OFF
			Ifs = 20mA, Rin = 124,5Ω	SW1.6 = ON SW1.5-7-8 = OFF
		Thermistor temperature measure, number 2	Temperature measure with PT100. Compliant with IEC 60751 or DIN 43735.	SW1.5-8 = ON SW1.6-7 = OFF (default)
30	CMA/T2–	0V for analog inputs for XAIN9 return	Control board zero Volt	
31	XAIN10/T3+	"Slow" configurable auxiliary analog input, number 10	Vfs = 10V, Rin = 30kΩ	SW2.3 = ON SW2.1-2-4 = OFF
			Vfs = 100mV, Rin = 1MΩ	SW2.4 = ON SW2.1-2-3 = OFF
			Ifs = 20mA, Rin = 124,5Ω	SW2.2 = ON SW2.1-3-4 = OFF
		Thermistor temperature measure, number 3	Temperature measure with PT100. Compliant with IEC 60751 or DIN 43735.	SW2.1-4 = ON SW2.2-3 = OFF (default)
32	CMA/T3–	0V for analog inputs for XAIN10 return	Control board zero Volt	
33	XAIN11/T4+	"Slow" configurable auxiliary analog input, number 11	Vfs = 10V, Rin = 30kΩ	SW2.7 = ON SW2.5-6-8 = OFF
			Vfs = 100mV, Rin = 1MΩ	SW2.8 = ON SW2.5-6-7 = OFF
			Ifs = 20mA, Rin = 124,5Ω	SW2.6 = ON SW2.5-7-8 = OFF
		Thermistor temperature measure, number 4	Temperature measure with PT100. Compliant with IEC 60751 or DIN 43735.	SW2.5-8 = ON SW2.6-7 = OFF (default)
34	CMA/T4–	0V for analog inputs for XAIN11 return	Control board zero Volt	
35	XAIN12	"Slow" auxiliary analog input, 10V f.s., number 12	Fs = 10V; Rin= 30kΩ	**n.u.**
36	CMA	0V for analog inputs for XAIN12 return	Control board zero Volt	**n.u.**
37	XAIN13	"Slow" auxiliary analog input, 10V f.s., number 13	Fs = 10V; Rin= 30kΩ	**n.u.**
38	CMA	0V for analog inputs for XAIN13 return	Control board zero Volt	**n.u.**

N.	Name	Description	I/O Features	DIP-switch/Notes
39	XMDI1	Multifunction auxiliary digital input 1	24Vdc Optoisolated digital inputs; positive logic (PNP): active with high level signal with respect to CMD (terminals 43 and 50). In compliance with EN 61131-2 as type 1 digital inputs (24Vdc rated voltage).	Maximum response time to processor: 500µs
40	XMDI2	Multifunction auxiliary digital input 2		
41	XMDI3	Multifunction auxiliary digital input 3		
42	XMDI4	Multifunction auxiliary digital input 4		
43	CMD	0V digital input isolated to control 0V		
44	+24V	Auxiliary supply output for optoisolated multifunction digital inputs		
45	XMDI5	Multifunction digital input 5		
46	XMDI6	Auxiliary multifunction digital input 6 / Single-ended, push-pull 24V encoder input, phase A / Frequency input A		
47	XMDI7	Auxiliary multifunction digital input 7 / Single-ended, push-pull 24V encoder input, phase B		
48	XMDI8	Auxiliary multifunction digital input 8 / Frequency input B		
49	+24V	Auxiliary supply output for optoisolated multifunction digital inputs	+24V±15% ; Imax: 200mA Protected by resettable fuse	
50	CMD	0V digital input isolated to control 0V	Optoisolated digital input zero volt	
51	XMDO1	Multifunction auxiliary digital output 1 (collector)	Open collector isolated digital outputs, Vomax = 48V; Iomax = 50mA	
52	CMDO1	Multifunction auxiliary digital output 1 (emitter)		
53	XMDO2	Multifunction auxiliary digital output 2 (collector)		
54	CMDO2	Multifunction auxiliary digital output 2 (emitter)		
55	XMDO3	Multifunction auxiliary digital output 3 (collector)		
56	CMDO3	Multifunction auxiliary digital output 3 (emitter)		
57	XMDO4	Multifunction auxiliary digital output 4 (collector)		
58	CMDO4	Multifunction auxiliary digital output 4 (emitter)		
59	XMDO5	Multifunction auxiliary digital output 5 (collector)		
60	CMDO5	Multifunction auxiliary digital output 5 (emitter)		
61	XMDO6	Multifunction auxiliary digital output 6 (collector)		
62	CMDO6	Multifunction auxiliary digital output 6 (emitter)		

3.8.3. ES917 BOARD

ES917 board measures the mains voltage. It detects the three line voltages and it outputs three voltage signals proportional to the inputs. These outputs may be proportional to phase to phase voltages (in that case, they must not be used) or they may be proportional to each voltage phase to neutral (in that case, they are allocated to the Energy Counter).

CAUTION Exclusively use the ES917 board fitting the rated voltage of the grid it is to be connected to (see below).

3.8.4. ES917 ID

Description	*Part Number*
ES917 for mains voltage measure, class 2T-4T	ZZ4091706
ES917 for mains voltage measure, class 5T-6T	ZZ4091707

3.8.5. ES917 TERMINALS

M1, screwable terminal board suitable for cable cross-sections 0.2÷2.5mm² (AWG 24-14)

N.	Name	Description	I/O Features	Notes
6	N	Neutral	Three-phase reference	Input
8	T	Phase T with respect to Neutral	460Vac max, Irms<500µA	Input
10	S	Phase S with respect to Neutral		Input
12	R	Phase R with respect to Neutral		Input

M2, screwable terminal board suitable for cable cross-sections 0.2÷2.5mm² (AWG 24-14)

N.	Name	Description	I/O Features	Notes
1	VRN	Phase R to N scaled voltage	836V Input ⇒ 10V Output for ZZ4091706 1518V Input ⇒ 10V Output for ZZ4091707	Output
2	VRS	Phase R to phase S scaled voltage		n.u.
3	VSN	Phase S to N scaled voltage		Output
4	VST	Phase S to phase T scaled voltage		n.u.
5	VTN	Phase T to N scaled voltage		Output
6	VTR	Phase T to phase R scaled voltage		n.u.
7	N0	Low Voltage signal reference	0V	n.u.
8	N0	Low Voltage signal reference	0V	n.u.
9	N0	Low Voltage signal reference	0V	
16	0V EXT	-	-	Not mounted
17	+24V EXT	-	-	Not mounted
18	NO	-	-	Not mounted
19	COM	-	-	Not mounted
20	NC	-	-	Not mounted
21	AL–	-	-	Not mounted
22	AL+	-	-	Not mounted

NOTE The signals dedicated to the Energy Counter application are marked as

NOTE The terminals that are not mentioned are intended as n.c. (not connected).

3.9. ELECTROMAGNETIC COMPATIBILITY

Electromagnetic Compatibility 89/336/CEE and following amendments 92/31/CEE, 93/68/CEE, and 93/97/CEE.
In most systems, the processing control also requires additional devices, such as computers, captors, and so on, that are usually installed one next to the other, thus causing disturbance:

- Low frequency – harmonics.

- High frequency – electromagnetic interference (EMI).

High frequency interference is disturbance or radiated interference with >9kHz frequency. Critical values range from 150kHz to 1000MHz.
Interference is often caused by commutations to be found in any device, i.e. switching feeders and drive output modules. High frequency disturbance may interfere with the correct operation of the other devices. High frequency noise produced by a device may cause malfunctions in measurement systems and communication systems, so that radio receivers only receive electrical noise. This may cause unexpected faults.
Standards EN55011 and 50082, as well as standard EN61800-3, define immunity and emission levels required for devices designed to operate in different environments. The drives manufactured by ELETTRONICA SANTERNO are designed to operate under the most different conditions, so they all ensure high immunity against RFI and high reliability in any environment.

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

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

For any details concerning standards and emission limits, please refer to the drive Installation Instructions manual.

Differences between the Penta regenerative drive and the Penta standard drive concern the following:

- Disturbance at low frequency:
- The regenerative drive suppresses any harmonic currents in the mains;
- EMI:
- EMI filters integrated into the drive permit not to exceed the limits set in EN61800-3 issue 2 and its following amendment EN61800-3-A11 for the second environment, category C3.

External EMI filters are required if the regenerative drive is to be installed in the first environment. Please contact Elettronica Santerno.

CAUTION

Radio interference may occur if the regenerative drive is installed in domestic environments; additional measures should be taken to suppress radio interference.

3.10. COMMISSIONING

The SINUS PENTA drive for the regenerative application is factory-set as follows:

Drive Class	Rated Voltage (C500)	Rated Frequency (C501)
2T	230.0 V	50 Hz
4T	400.0 V	50 Hz
5T	575.0 V	50 Hz
6T	690.0 V	50 Hz

Table 3: Default values of parameters C500 and C501 (AC mains)

When rated voltage/frequency values are different from the default values, the relevant parameters must be set up *before* activating the drive.
For optimum performance, also adjust parameterization of the drive controlling the motor by setting the Rated Mains Voltage parameter (**C008** for the Sinus Penta) to xT Regen, where "x" is the voltage class of the drive being used.

1) Wiring: Follow the instructions given in the sections of this manual covering the drive wiring diagrams.

CAUTION Wrong wiring can cause the equipment malfunction.

2) Power on: Power on the drive; the link to the ENABLE input (terminal 15) is to be open, so that the drive is disabled.
Make sure that the drive is set up for the regenerative application: this is shown on the start page (see below; line 1 states that the regenerative unit is waiting for the Enable signal) or on the product ID screen in the IDP menu.

```
REGEN.WAIT      ENA
M505=+        0.1kW
M502=       409.2V
[MEA]PAR  CF  IDP
```

NOTE When the regenerative drive is powered on, the motor drive powers on as well. Parameters can be changed for both drives.

3) Parameter alteration: Access the **P000** parameter (Key Parameter) and make sure that it is set up as **P002**. Use the ESC, ↓, ↑ and SAVE/ENTER keys to access the drive parameters. See the "MENU TREE" section in this manual.

Access the MAINS PARAMETERS MENU and set the following:
- **C500** Rated Mains Voltage
- **C501** Rated Mains Frequency
- **C502** Mains Alarm Control:
  - 0: Regenerative drive disable (factory setting)
  - 1: Drive alarm
- **C503** Motor Drive Activation Logic
  - 0: Always enabled if regenerative drive enabled
  - 1: Enabled if regenerative drive running or waiting for Autoreset (factory setting)
  - 2: Enabled only if regenerative drive running
  - **P500** DC-bus setpoint

CAUTION Make sure that the default value of the DC-bus setpoint exceeds by at least 30V the value in **C500*1.41** (this is the rectified mains voltage in the DC-Bus when the inverter is disabled).

4) Regenerative drive parameters:

Drive Class		2T	4T			5T	6T	
C500 Rated Mains Voltage	Default value (V)	230	400			575	690	
	Value to be set (V)	Rated voltage of the mains powering the drive						
C501 Rated Mains Frequency	Default value (Hz)	50						
	Value to be set (Hz)	Rated frequency of the mains powering the drive						
P500 DC-bus voltage setpoint	Rated mains voltage (V)	200 | 240	380 | 415	440 | 460	480	500 | 575	600	660 | 690
	Default value (V)	400	700			960	1050	
	Value to be set (V)	400	700	750	780	960	1050	

Press SAVE to store the new parameter value.

In the motor drive of the Penta series, also set up the following parameters:
1) Parameter **C008** to ensure optimum performance of the motor drive when it is controlled via the regenerative drive.

5) Motor drive parameters:

Motor Drive Voltage Class	2T	4T	5T	6T
C008	1: 2T Regen.	4: 4T Regen.	6: 5T Regen.	7: 6T Regen

2) Parameter **C225** to disable the Mains Loss alarm: **C225**=0:Disabled.

6) Startup:

After synchronization with the mains (the REF LED in the keypad comes on), activate the ENABLE input (terminal 15): the RUN LED in the keypad will come on and the DC-bus voltage will be tuned to the setpoint in **P500**, then the MDO4 input relay will close to enable the activation of the motor drive.

7) Possible failures:

If no failure occurred, go to step 8; otherwise, check links to the drive and check if alarm messages are displayed. The start screen shows the value of the DC-bus voltage (**M501**); before closing the ENABLE, this measure should be more or less equal to the mains voltage (**M502**) multiplied by 1.41; after closing the ENABLE, this value should tune to the setpoint in **P500**.

8) Additional parameter alterations:

Note that you can change **Cxxx** parameters in the CONFIGURATION menu only when the drive is DISABLED.
We suggest that you write down any custom parameter. Parameters that may need alterations are **C503** (enabling mode of MDO4 relay for motor drive activation) and **C502** (alarms relating to the supply mains).

9) Alarm reset:

If an alarm trips, find the cause responsible for the alarm and reset the equipment: enable MDI3 input (terminal 16) for some time, or press the RESET key in the display/keypad.

10) Motor drive starting:

Start up the motor drive as described in the Installation Instructions manual. When the motor drive is operating, make sure that the DC-bus voltage (displayed in the Measure submenu) is kept approx. constant and equal to the setpoint; also make sure that the mains is stable. If load variations strongly affect DC-bus voltage or if it is unsteady, adjust the voltage regulator parameters (**P510** to **P515**).
If overvoltage alarms trip, do the following:

1) For the regenerative drive sizes provided with a built-in braking unit (up to S32 included), you can install a braking resistor between power terminals 47/+ and 48/B of the regenerative drive.

2) For the regenerative drive sizes which are not provided with a built-in braking unit (size > S32), you can use the external braking unit. Configure the external braking unit with a trip voltage higher than the bus setpoint of the regenerative drive (**P500**) but lower than the overvoltage value.

Voltage Class	Overvoltage Threshold
2T	443.3
4T	828.6
5T	992.4
6T	1198.2

4. SOFTWARE DOWNLOAD FOR APPLICATION PROGRAMMING

The Remote Drive software and the PXxxxxF0.mot, PXxxxxF1.mot files of the application are required to download the application to a Sinus Penta drive. The download procedure is detailed in the following section.
The PRxxxxF0.mot and PRxxxxF1.mot files are required for the regenerative application.
For different applications, please refer to the relevant manuals and to the updates available on Elettronica Santerno's website:

santerno.com

NOTE Please refer to the User Manual of the Remote Drive software for more details.

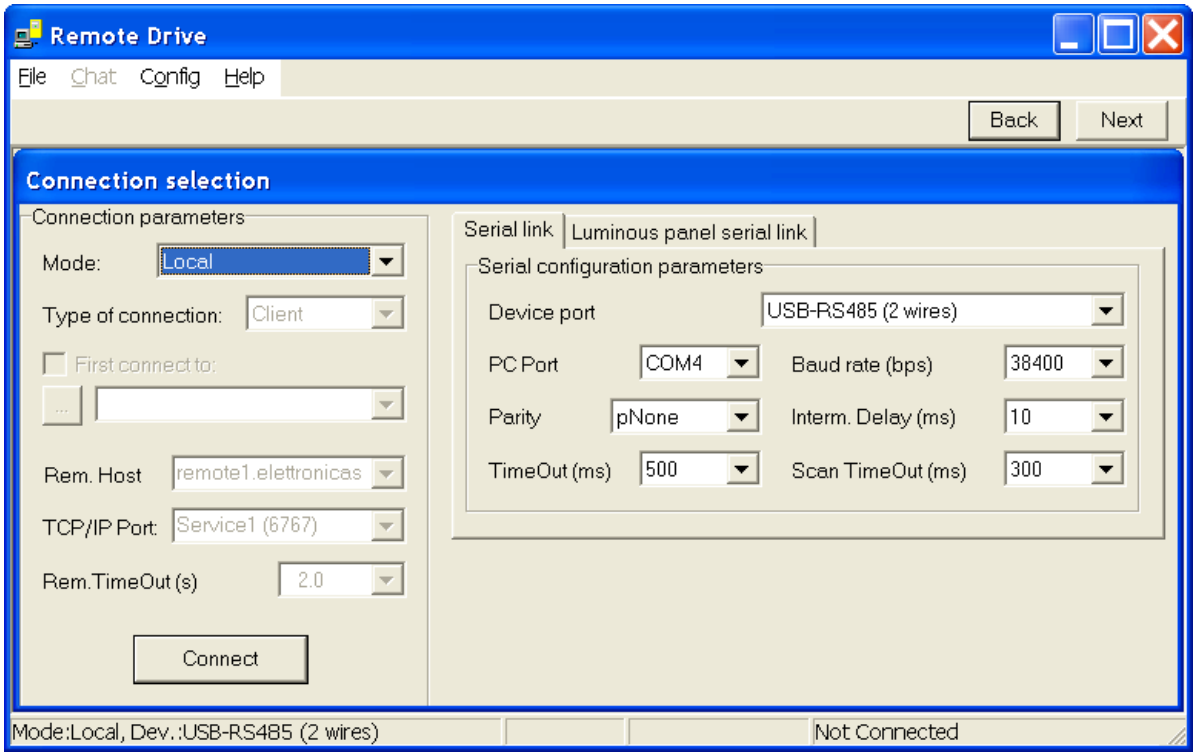
The software of the Sinus Penta drives consists of two files, one containing the firmware and one containing the MMI table for the keypad interface. Both files use hexadecimal files with the MOT format. The filenames ending with "F0" relate to the firmware; the filenames ending with "F1" relate to the MMI table.

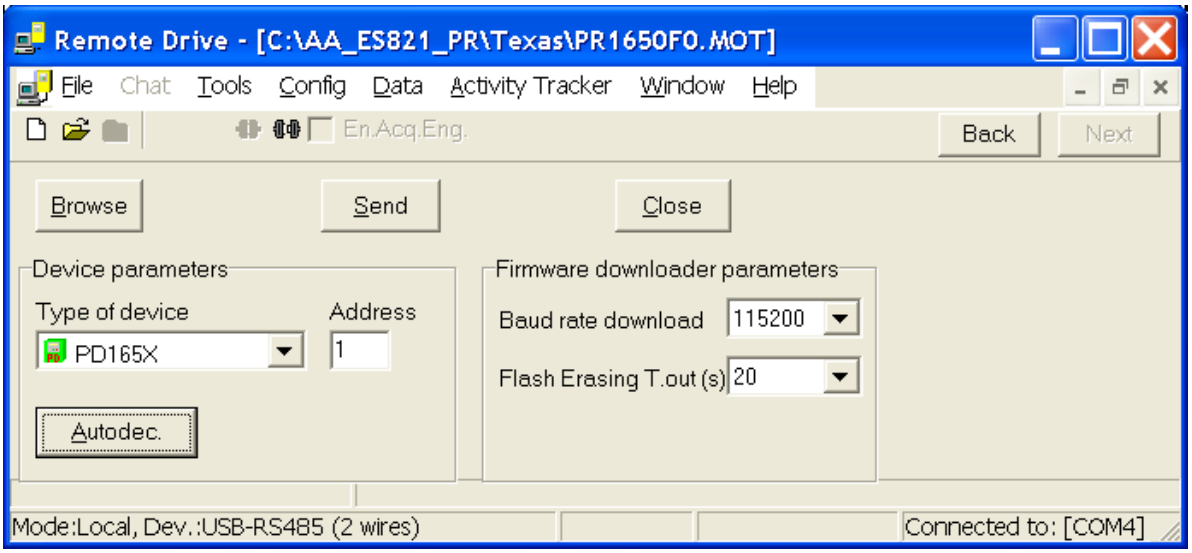
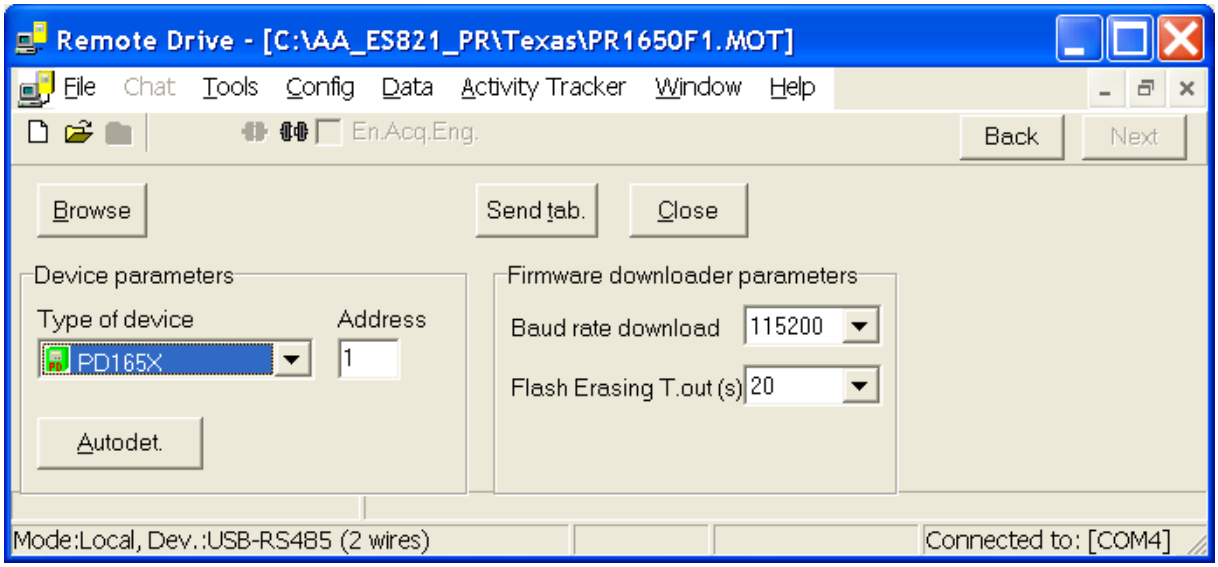
4.1. FIRMWARE UPGRADE

This section covers firmware upgrade and application download.

NOTE

In case of multidrop connection (RS485), only the equipment to be upgraded shall be connected to the network.

1	Launch the Remote Drive.
2	Select the dialog language (click a flag) and press Next.
3	In the "Connection Parameters" window, select the Local mode. In the "Serial Configuration Parameters" window, set the interface device, the COM being used and the baud rate (38400bps); click "Connect", then click the "Next" button. In the example below, USB-RS485 converter is used. 
4	Select "Firmware Upgrade" from the "File" drop-down menu. Enter the path for the PXxxxxF0.mot and PXxxxxF1 files to be downloaded. If only one of the firmware files or MMI tables is to be updated, go to step 7. If an application shall be downloaded to a PXxxxx, select the PXxxxxF0.mot file and click the "Open" button.

5	Send the "Autodet." command to allow the Remote Drive to detect the type of equipment. Once the product is detected, PXxxxx will appear in the Equipment Type window. Press the "Send" button; confirmation for the Flash clearing will appear. Click "Yes" to start downloading. Once download is over, go to step 6. 
6	Click "Browse" to select the PxxxxF1.mot file  Click "SendTab". Once this file is downloaded, the application download is complete (end of the download procedure).
7	Click "Browse" to select the file to be updated, PXxxxxF0.mot for the firmware and PxxxxF1.mot for the MMI table; first click "Open", then click "Send" or "SendTab". Confirm flash clearing. The Upgrade procedure is finished.

5. PROGRAMMING INSTRUCTIONS

5.1. MENU TREE

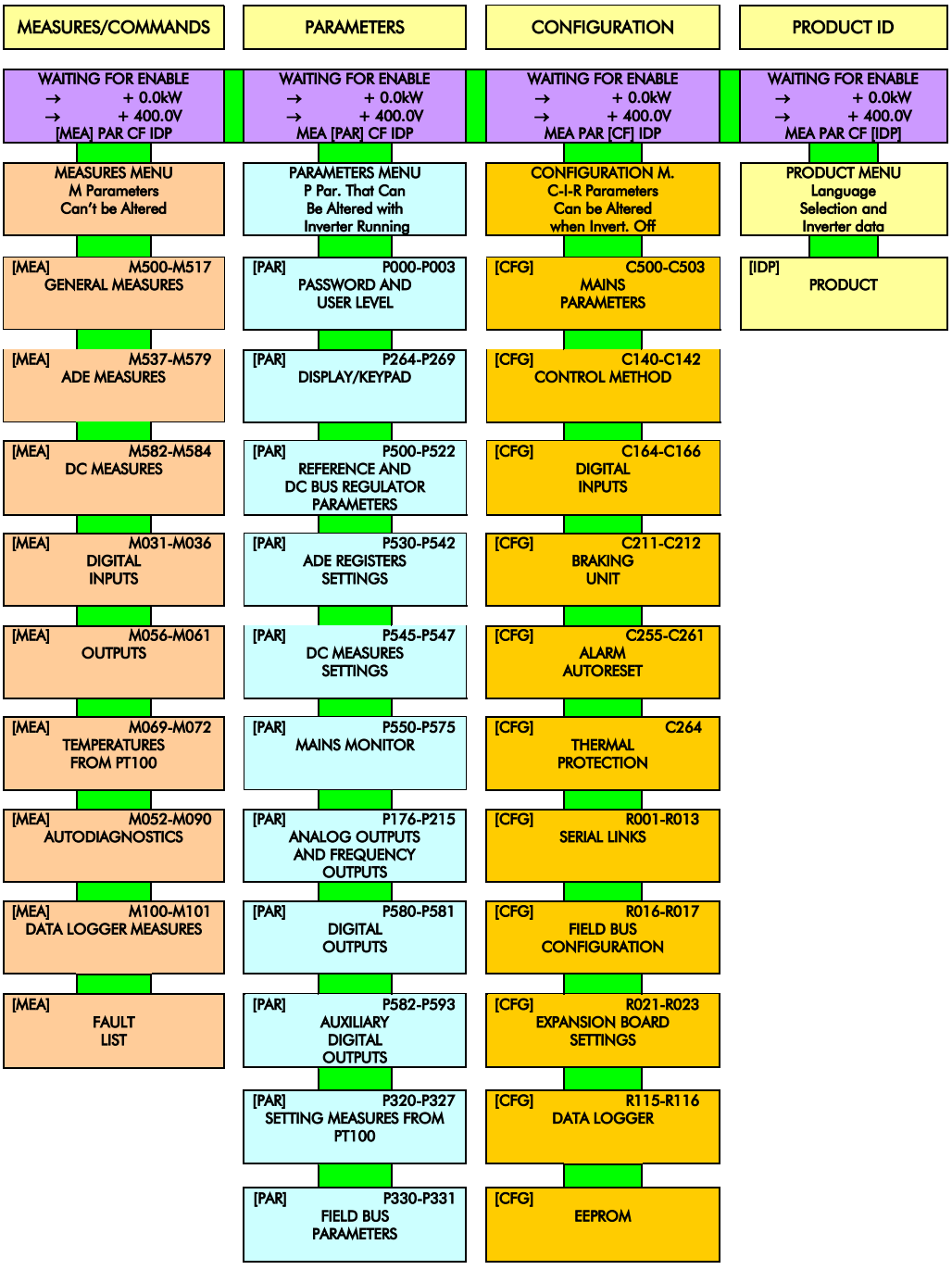


Figure 9: Menu tree for the regenerative drive

5.2. MEASURES MENU

5.2.1. OVERVIEW

The Measures menu contains all the variables measured by the Sinus Penta drive. Measures are divided into the following subunits:

5.2.1.1. MEASURES FOR THE REGENERATIVE SINUS PENTA ONLY

- Menu n.1 – General Measures

This menu includes the current/voltage/power and energy delivered by the drive, the status of the mains and the PLL.

- Menu n.2 – ADE Measures

This menu includes the current/voltage/power and energy measures exchanged between the drive and the AC mains (this menu can be viewed only if ES847 I/O expansion board is fitted).

- Menu n.3 – DC Measures

This menu includes the DC current measures (which are detected through an external, optional current transducer – see ADDITIONAL COMPONENTS FOR THE "ENERGY COUNTER" APPLICATION), the delivered power measures and the performance between Pout and regenerative power (this menu can be viewed only if ES847 I/O expansion board is fitted).

5.2.1.2. MEASURES IN COMMON WITH THE STANDARD SINUS PENTA, BUT HAVING A DIFFERENT MEANING

- Menu n.4 – Digital Inputs

This menu includes the measures of the drive digital inputs, as well as the functions allocated to the drive digital inputs.

- Menu n.5 – Outputs

This menu includes the measures of the drive digital/ analog outputs and frequency outputs.

- Menu n.6 – Temperatures from PT100

This menu includes the temperature measures detected in the analog channels of ES847 I/O expansion board (this menu can be viewed only if ES847 I/O expansion board is fitted).

5.2.1.3. MEASURES IN COMMON WITH THE STANDARD SINUS PENTA

(Please refer to the Sinus Penta's Programming Instructions manual for details)

- Menu n.7 – Autodiagnostics

This menu includes the temperature measures and the functioning time counters, as well as the alarms tripped and the drive operating conditions.

- Menu n.8 – Data Logger Measures

This menu includes the conditions of the connections supported by ES851 Data Logger board (Serial links, Ethernet and modem connections). It can be viewed only if ES851 Data Logger board is fitted.

- Menu n.9 – Fault List

This menu includes the records of the last eight alarms tripped, as well as the list of the measures detected when the alarms tripped.

5.2.2. MENU N.1 – GENERAL MEASURES

M500 DC-Bus Voltage Reference

M500	Range	0 ÷ 14000	0 ÷ 1400.0 V
	Address	1650	
	Function	When the drive is running, this is the measure of the DC-bus voltage reference (parameter **P500**). When the drive is in stand-by, this is the measure of the DC-bus.	

M501 DC-Bus Voltage

M501	Range	0 ÷ 14000	0 ÷ 1400.0 V
	Address	1651	
	Function	This is the measure of the DC-bus voltage.	

M502 Mains Voltage

M502	Range	0 ÷ 10000	0 ÷ 1000.0 V
	Address	1652	
	Function	RMS of the measured line voltage.	

M503 Drive Current

M503	Range	0 ÷ 65000	0 ÷ 6500.0 A
	Address	1653	
	Function	RMS of the current delivered by the drive.	

M504 Mains Frequency

M504	Range	± 10000	± 100.00 Hz
	Address	1654	
	Function	Measured mains frequency.	

M505 Delivered Active Power

M505	Range	± 32000	± 3200.0 kW
	Address	1655	
	Function	Active power exchanged with the mains. The positive sign stands for the power delivered to the regenerative drive (power flow from AC mains to regenerative drive); otherwise, the negative sign is displayed.	

M506 Delivered Reactive Power

M506	Range	± 32000	± 3200.0 kVAR
	Address	1656	
	Function	Reactive power exchanged with the mains.	

M507 Apparent Power

M507	Range	± 32000	± 3200.0 kVA
	Address	1657	
	Function	Apparent power exchanged with the mains.	

M508 Power Factor

M508	Range	± 100	± 1.00
	Address	1658	
	Function	Current power factor exchanged with the mains.	

M509 R-S Voltage (RMS)

M509	Range	0 ÷ 10000	0 ÷ 1000.0 V
	Address	1659	
	Function	RMS of mains-side V_{RS} line voltage.	

M510 S-T Voltage (RMS)

M510	Range	0 ÷ 10000	0 ÷ 1000.0 V
	Address	1660	
	Function	RMS of mains-side V_{ST} line voltage.	

M511 T-R Voltage (RMS)

M511	Range	0 ÷ 10000	0 ÷ 1000.0 V
	Address	1661	
	Function	RMS of mains-side V_{TR} line voltage.	

M512 Phase R Line Current (RMS)

M512	Range	± 32000	± 3200.0 A
	Address	1662	
	Function	RMS of phase R line current.	

M513 Phase S Line Current (RMS)

M513	Range	± 32000	± 3200.0 A
	Address	1663	
	Function	RMS of phase S line current.	

M514 Phase T Line Current (RMS)

M514	Range	± 32000	± 3200.0 A
	Address	1664	
	Function	RMS of phase T line current.	

M515 PLL Status for Synchronization with the Mains

M515	Range	0 ÷ 4	See Table 4
	Address	1665	
	Function	This parameter displays the status of the PLL (Phase Locked Loop) for the synchronisation with the AC mains. The phase sequence is checked as well.	

N.	Display	Description
0	IDLE	PLL stopped
1	INIT POS.	Positive phase sequence detected and waiting for synchronization
2	INIT NEG.	Negative phase sequence detected and waiting for synchronization
3	LOCK POS.	Positive phase sequence synchronized
4	LOCK NEG.	Negative phase sequence synchronized

Table 4: Coding of Measure M515

M516 Mains Status 2

M516	Range	0 ÷ 01FFh Bit-controlled measure	See Table 5
	Address	1666	
	Function	This parameter displays the status of the Mains Faults (see the MAINS PARAMETERS MENU).	

Bit n.	Description
0	Phase R, max. voltage
1	Phase S, max. voltage
2	Phase T, max. voltage
3	Phase R, min. voltage
4	Phase S, min. voltage
5	Phase T, min. voltage
6	Max. frequency
7	Min. frequency
8	PLL Fault

Table 5: Bits of measure M516

M517 Mains Status 1

M517	Range	0 ÷ 007Fh Bit-controlled measure	See Table 6
	Address	1667	
	Function	This parameter displays the status of the Mains Faults (see the MAINS PARAMETERS MENU).	

Bit N.	Description
0	Phase R Undervoltage
1	Phase S Undervoltage
2	Phase T Undervoltage
3	Phase R RMS Fault
4	Phase S RMS Fault
5	Phase T RMS Fault
6	PLL Fault

Table 6: Bits of measure M517

5.2.3. MENU N.2 – ADE MEASURES

This submenu can be viewed only if parameter **R023**=
5:XMDO+ADE+PT100 or
6:XMDO+ADE+PT100+Pout (see the EXPANSION BOARD CONFIGURATION MENU).

ES847 option board and additional external components (see Sinus Penta's Installation Instructions manual) must be installed to view the measures in this submenu (see ADDITIONAL COMPONENTS FOR THE "ENERGY COUNTER" APPLICATION). See also the ADE REGISTERS SETTINGS MENU for the correct tuning of the measures in this submenu.

M537/M538 Exchanged Active Energy

M537/M538	Range	± 999999999	± 99999999.9 kWh
	Address	1687/1688	
	Function	Active Energy exchanged between the system and the AC mains.	

M539/M540 Exchanged Reactive Energy

M539/M540	Range	± 999999999	± 99999999.9 kVARh
	Address	1689/1690	
	Function	Reactive Energy exchanged with the AC mains.	

M541 Exchanged Active Power

M541	Range	± 32000	± 3200.0 kW
	Address	1691	
	Function	Active Power exchanged between the system and the AC mains.	

M542 Exchanged Reactive Power

M542	Range	± 32000	± 320.00 kVAR
	Address	1692	
	Function	Reactive Power exchanged between the system and the AC mains.	

M543 Exchanged Apparent Power

M543	Range	± 32000	± 3200.0 kVA
	Address	1693	
	Function	Apparent Power exchanged between the system and the AC mains.	

M544 Power Factor

M544	Range	± 100	± 1.00
	Address	1694	
	Function	Power factor of the system (ratio between the Active Power and the Apparent Power).	

M545 Active Power, Phase R

M545	Range	± 32000	± 3200.0 kW
	Address	1695	
	Function	Active Power in phase R.	

M546 Reactive Power, Phase R

M546	Range	± 32000	± 320.00 kVAR
	Address	1696	
	Function	Reactive Power in phase R.	

M547 Apparent Power, Phase R

M547	Range	± 32000	± 3200.0kVA
	Address	1697	
	Function	Apparent Power in phase R.	

M548 Power Factor, Phase R

M548	Range	± 100	± 1.00
	Address	1698	
	Function	Power factor in phase R (ratio between the Active Power and the Apparent Power).	

M549 RMS Voltage, Phase R

M549	Range	± 32000	± 3200.0V
	Address	1699	
	Function	Root mean square of the line voltage, phase R.	

M550 RMS Current, Phase R

M550	Range	± 32000	± 3200.0A
	Address	1700	
	Function	Root mean square of the line current, phase R.	

M551 Active Power, Phase S

M551	Range	± 32000	± 3200.0kW
	Address	1701	
	Function	Active Power in phase S.	

M565 Reactive Power, Phase S

M565	Range	± 32000	± 320.00 kVAR
	Address	1715	
	Function	Reactive Power in phase S.	

M566 Apparent Power, Phase S

M566	Range	± 32000	± 3200.0kVA
	Address	1716	
	Function	Apparent Power in phase S.	

M567 Power Factor, Phase S

M567	Range	± 100	± 1.00
	Address	1717	
	Function	Power factor in phase S (ratio between the Active Power and the Apparent Power).	

M568 RMS Voltage, Phase S

M568	Range	± 32000	± 3200.0V
	Address	1718	
	Function	Root mean square of the line voltage in phase S.	

M573 RMS Current, Phase S

M573	Range	± 32000	± 3200.0A
	Address	1723	
	Function	Root mean square of the line current in phase S.	

M574 Active Power, Phase T

M574	Range	± 32000	± 3200.0kW
	Address	1724	
	Function	Active Power in phase T.	

M575 Reactive Power, Phase T

M575	Range	± 32000	± 320.00 kVAR
	Address	1725	
	Function	Reactive Power in phase T.	

M576 Apparent Power, Phase T

M576	Range	± 32000	± 3200.0kVA
	Address	1726	
	Function	Apparent Power in phase T.	

M577 Power Factor, Phase T

M577	Range	± 100	± 1.00
	Address	1727	
	Function	Power factor in phase T (ratio between the Active Power and the Apparent Power).	

M578 RMS Voltage, Phase T

M578	Range	± 32000	± 3200.0V
	Address	1728	
	Function	Root mean square of the line voltage in phase T.	

M579 RMS Current, Phase T

M579	Range	± 32000	± 3200.0A
	Address	1729	
	Function	Root mean square of the line current in phase T.	

5.2.4. MENU N.3 – DC MEASURES

This submenu can be viewed only if parameter **R023**=
2:XMDO+Pout or
4:XMDO+PT100+Pout or
6:XMDO+ADE+PT100+Pout (see the EXPANSION BOARD CONFIGURATION MENU).

ES847 option board and additional external components (see Sinus Penta's Installation Instructions manual and ADDITIONAL COMPONENTS FOR THE "ENERGY COUNTER" APPLICATION), must be installed to view the measures in this submenu (please refer to the Sinus Penta's Installation Instructions manual).

M582 DC Current

M582	Range	± 32000	± 3200.0A
	Address	1732	
	Function	Calculation of the DC current measured with an optional, external current transducer. Positive sign for the Regenerative Penta output current.	

M583 DC Power

M583	Range	± 32000	± 3200.0kW
	Address	1733	
	Function	Calculation of the power delivered based on Idc (**M582**) and Vdc (**M501**). Positive sign for the Regenerative Penta output power.	

M584 Performance

M584	Range	± 1000	± 100.0%
	Address	1734	
	Function	Calculation of the system performance—ratio between the Active Power exchanged with the AC mains (**M541**) and the DC power (**M583**).	

5.2.5. MENU N.4 – DIGITAL INPUTS

This submenu allows checking the status of the digital inputs as well as the status of each control source. Please refer to the standard Sinus Penta's measures.
For the Regenerative Sinus Penta, digital inputs MDI4 and MDI5 are allocated to the confirmation of the closure of bypass contactor TL1 (Prech) and to the status of the capacitor safety switch (FCCB) (C.Prot.) respectively **[this factory setting cannot be changed by the user]**.

Bit n.	Digital Input
0	MDI1
1	MDI2 (ENABLE)
2	MDI3 (RESET)
3	MDI4 (Prech)
4	MDI5 (C.Prot.)
5	MDI6
6	MDI7
7	MDI8

Table 7: Coding of the digital inputs

5.2.6. MENU N.5 – OUTPUTS

This submenu allows checking the status of the digital outputs of the drive. Please refer to the standard Sinus Penta's measures.
For the Regenerative Sinus Penta, digital outputs MDO3 and MDO4 are used for the closure of the coil in bypass contactor TL1 (Prech) and for the indication of the operation of the regenerative drive (to be series-connected to the enable chain of the motor drive – EnSlv) **[this factory setting cannot be changed by the user]**.

Bit n.	Digital Output
0	MDO1
1	MDO2
2	MDO3 (Prech)
3	MDO4 (EnSlv)

Table 8: Coding of the digital outputs

5.2.7. MENU N.6 – TEMPERATURES FROM PT100

This submenu can be viewed only if parameter R023=
3:XMDO+PT100 or
4:XMDO+PT100+Pout
5:XMDO+ADE+PT100 or
6:XMDO+ADE+PT100+Pout (see the EXPANSION BOARD CONFIGURATION MENU).

ES847 option board must be installed to view the measures in this submenu (please refer to the Sinus Penta's Installation Instructions manual).

5.2.8. LIST OF THE OPERATING CONDITIONS OF THE REGENERATIVE SINUS PENTA

Each possible operating condition for the Regenerative Sinus Penta is given in the table below:

Value	Coding	Description
0	Pre-charge	Pre-charge stage; the drive is waiting for the DC-bus voltage to attain Vdc_min.
1	Wait Enable	Drive stopped waiting for the ENABLE command.
2	RUN P=±****.*kW	Drive running; it is delivering ±*****kW.
3	ALR VR MIN KO	The drive is disabled because the mains voltage has dropped below the min. instantaneous voltage or the preset RMS (see the MAINS PARAMETERS MENU).
4	ALR VR MAX KO	The drive is disabled because the mains voltage has exceeded the max. instantaneous voltage or the preset RMS (see the MAINS PARAMETERS MENU).
5	ALR FMAINS KO	The drive is disabled because the mains frequency is out of the preset range (see the MAINS PARAMETERS MENU).
6	ALR PLL KO	The drive is disabled because the PLL is no longer synchronized with the mains.
7	Cooling = ****.*s	COOLING: I*t alarm tripped because excessive current exceeding the rated current was delivered for a too long time. The equipment will cool down in (****.* seconds).
8	ALARM!!!	An alarm tripped.
9	Resetting	The drive is resetting the alarm tripped and is preparing to restart.

Table 9: Coding of the operating conditions of the Regenerative Sinus Penta

5.3. REFERENCE AND REGULATORS MENU

5.3.1. OVERVIEW

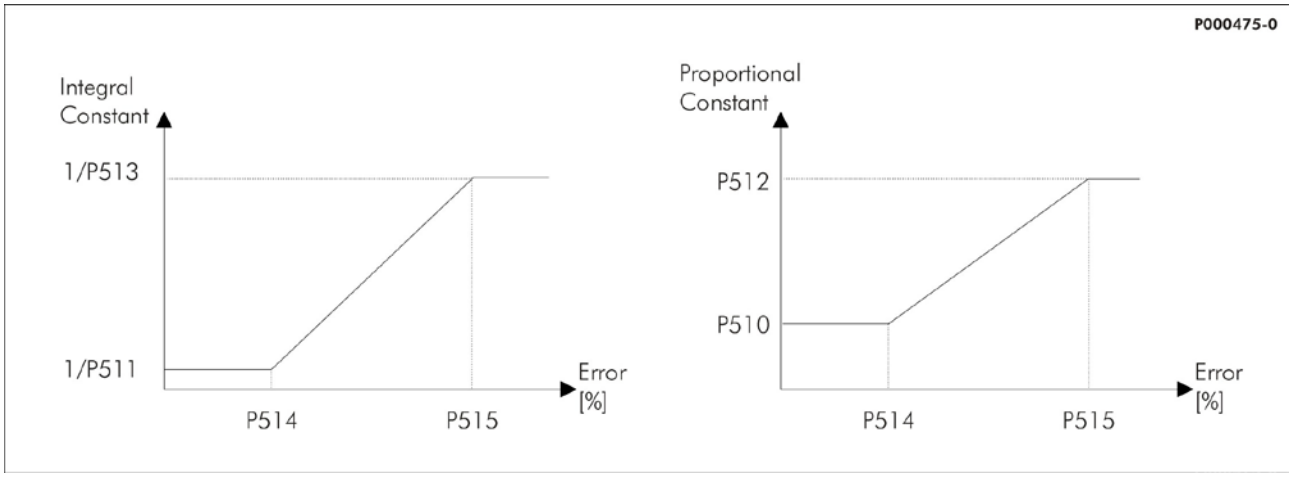
This menu contains the parameters relating to the DC-bus voltage control.
The setpoint is set for the DC-bus voltage stabilization. This depends on the mains voltage; always set a value exceeding the max. rectified mains voltage. The recommended values are given in the section covering the first startup of the equipment.
A PI (proportional-integral) regulator allows the DC-bus voltage to be kept constant. Factory setting suits most applications. However, it can be changed when the DC-bus voltage is unsteady or when overvoltage occurs due to sudden variations of the motor drive load. Increasing the proportional term allows a quicker response of the system, but can cause fluctuations at constant speed. For a quicker response of the regulator to power transients and for a steady control of the equipment at constant speed, you can use the dual parameterization available for the regulator and set two error thresholds percent and two proportional/integral gain sets.
The PI regulator will then have the following features:

1) For wrong values equal to or lower than the min. threshold (**P514**), the regulator parameters **P510** and **P511** will be used.

2) For wrong values equal to or higher than the max. threshold (**P515**), the regulator parameters **P512** and **P513** will be used.

3) For wrong values ranging from the min. threshold (**P514**) to the max. threshold (**P515**), the equipment will use the following terms:

Integral coefficient = (1/**P511**) + [(err–**P514**)* (1/**P513** – 1/**P511**) / (**P515** – **P514**)]
Proportional coefficient = **P510** + [(err–**P514**)* (**P512** – **P510**) / (**P515** – **P514**)]



The error percentage is computed based on the max. value that can be set as a DC-bus voltage reference (**P500**):

Error% = (**P500** –VDC measured)/(Max **P500**)

NOTE

If the min. error threshold is the same as the max. error threshold (**P514** = **P515**), the PI regulator will only use the proportional term (**P510**) and the integral term (**P511**) relating to the minimum error. The remaining terms of the PI regulator become active and can be displayed only if a max. error threshold greater than the min. error threshold (**P515**>**P514**) is set up.

5.3.2. LIST OF PROGRAMMABLE PARAMETERS P500 TO P522

Parameter	FUNCTION	User Level	MODBUS Address	DEFAULT VALUES
P500	DC-Bus Voltage Reference	BASIC	609	Depending on voltage class
P510	Proportional Term of DC-bus Voltage Regulator for Min. Error	ENGINEERING	620	Depending on size and voltage class
P511	Integral Term of DC-bus Voltage Regulator for Min. Error	ENGINEERING	621	
P512	Proportional Term of DC-bus Voltage Regulator for Max. Error	ENGINEERING	622	
P513	Integral Term of DC-bus Voltage Regulator for Max. Error	ENGINEERING	623	
P514	Min. Error Threshold	ENGINEERING	624	2.000%
P515	Max. Error Threshold	ENGINEERING	625	14.000%
P516	Regenerative Inductance	ENGINEERING	626	Depending on size and voltage class
P520	DC-Bus Current Limit	ENGINEERING	630	100.00%
P521	Proportional Term of DC-Bus Current Regulator	ENGINEERING	631	Depending on size
P522	Integral Term of DC-Bus Current Regulator	ENGINEERING	632	

Table 10: List of parameters P500 to P522

P500 DC-Bus Voltage Setpoint

P500	Range	Class 2T → 360 ÷ 400 Class 4T → 700 ÷ 780 Class 5T → 900 ÷ 950 Class 6T → 1000 ÷ 1130	Class 2T → 360 ÷ 400 V Class 4T → 700 ÷ 780 V Class 5T → 900 ÷ 950 V Class 6T → 1000 ÷ 1130 V
	Default	Class 2T → 380 Class 4T → 700 Class 5T → 950 Class 6T → 1050	Class 2T → 380 V Class 4T → 700 V Class 5T → 950 V Class 6T → 1050 V
	Level	BASIC	
	Address	609	
	Function	This parameter defines the setpoint of the DC-bus voltage.	

P510 DC-bus Voltage Regulator → Proportional Term with Min. Error

P510	Range	0 ÷ 65000	0 ÷ 65.000
	Default	See Table 11 and Table 12	
	Level	ENGINEERING	
	Address	620	
	Function	This parameter sets the proportional term of the DC-bus voltage regulator for an error lower than or equal to the min. error threshold. **P510**=1: with a regulation error of 1V of the DC-bus voltage, the drive shall deliver 1 Ampere. If the min. error threshold is the same as the max. error threshold (**P514**=**P515**), the proportional term used by the regulator is always **P510**.	

P511 DC-Bus Voltage Regulator → Integral Term with Min. Error

P511	Range	0 ÷ 65000	0 ÷ 649.99 ms with 650.00 → Disable
	Default	See Table 11 and Table 12	
	Level	ENGINEERING	
	Address	621	
	Function	This parameter sets the integral term of the DC-bus voltage regulator. If the minimum and maximum error threshold match (**P514**=**P515**), the integral term used in the regulator is always **P511**, independently of the error value.	

P512 DC-Bus Voltage Regulator → Proportional Term with Max. Error

P512	Range	0 ÷ 65000	0 ÷ 65.000
	Default	See Table 11 and Table 12	
	Level	ENGINEERING	
	Address	622	
	Function	This parameter sets the proportional term of the DC-bus voltage regulator when the error exceeds the maximum error threshold. **P512**=1: with a regulation error of 1V of the DC-bus voltage, the drive shall deliver 1A current. It activates and can be displayed only if **P515**>**P514**.	

P513 DC-Bus Voltage Regulator → Integral Term with Max. Error

P513	Range	0 ÷ 65000	0 ÷ 649.99 ms with 650.00 → Disable
	Default	See Table 11 and Table 12	
	Level	ENGINEERING	
	Address	623	
	Function	This parameter sets the integral term of the DC-bus when the error exceeds the maximum error threshold. It activates and can be displayed only if **P515**>**P514**.	

P514 DC-Bus Voltage Regulator → Min. Error Threshold

P514	Range	1 ÷ 65000	0.001 ÷ 65.000%
	Default	2000	2.000%
	Level	ENGINEERING	
	Address	624	
	Function	Min. error threshold. If **P514**=**P515** or if the DC-bus voltage regulation error is lower than or equal to **P514**, the DC-bus voltage regulator only uses proportional and integral terms **P510** and **P511**. For the regulator functioning with **P515**>**P514**, see the section above.	

P515 DC-bus Voltage Regulator → Max. Error Threshold

P515	Range	1 ÷ 65000	0.001 ÷ 65.000%
	Default	14000	14.000%
	Level	ENGINEERING	
	Address	625	
	Function	Max. error threshold. If **P515**>**P514**, the regulator parameters relating to max. error **P512** and **P513** activate and can be displayed. In that case, if the regulation error is higher than or equal to **P515**, the DC-bus voltage regulator only uses proportional and integral terms **P512** and **P513**. For the regulator functioning with **P515**>**P514**, see the section above.	

P516 Regenerative Inductance

P516	Range	50 ÷ 32000	0.050 ÷ 32.000mH
	Default	Depends on size and voltage class; see sections Regenerative Reactors for 2T Voltage Class and Regenerative Reactors for 4T Voltage Class, and Regenerative Reactors for 5T-6T Voltage Class.	
	Level	ENGINEERING	
	Address	626	
	Function	Value of the regenerative reactor. The default value of this parameter is the rated value of the reactor which is normally applied to the input of the regenerative drive and which is recommended by Elettronica Santerno.	

NOTE

The setting of **P516** should be changed only if the regenerative reactor being used has different ratings than the default value set by Elettronica Santerno.

P520 DC-bus Current Limit

P520	Range	0 ÷ 1000	0 ÷ 100.00%
	Default	1000	100.00%
	Level	ENGINEERING	
	Address	630	
	Function	This parameter allows limiting the DC-bus current expressed as a percentage of the current relating to the size of the drive being used.	

P521 DC-bus Current Regulator → Proportional Term

P521	Range	0 ÷ 65000	0 ÷ 65000
	Default	1884 1507	1884 1507
	Level	ENGINEERING	
	Address	631	
	Function	This parameter sets the proportional term of the DC-bus current regulator.	

P513 DC-bus Current Regulator → Integral Term

P522	Range	0 ÷ 65000	0 ÷ 649.99 ms with 650.00 → Disable
	Default	Class 2T/4T up to model 0162 S30 included → 106 Class 2T/4T from model 0180 S41 included → 132 Class 5T/6T → 132	Class 2T/4T up to model 0162 S30 included → 1.06 ms Class 2T/4T from model 0180 S41 included → 1.32 ms Class 5T/6T → 1.32 ms
	Level	ENGINEERING	
	Address	632	
	Function	This parameter sets the integral term of the DC-bus current regulator.	

Table 11: Default values of parameters depending on model (size) and voltage class - Class 2T/4T

		2T				4T			
SIZE	MODEL	P510 [kp with err Min]	P511 [Ti with err Min]	P512 [kp with err Max]	P513 [Ti with err Max]	P510 [kp with err Min]	P511 [Ti with err Min]	P512 [kp with err Max]	P513 [Ti with err Max]
S05	0005	---	---	---	---	0.031	600.00	0.186	56.85
	0007	0.082	600.00	0.497	21.32	0.031	600.00	0.186	56.85
	0008	0.082	600.00	0.497	21.32	---	---	---	---
	0009	---	---	---	---	0.031	600.00	0.186	56.85
	0010	0.082	600.00	0.497	21.32	---	---	---	---
	0011	---	---	---	---	0.031	600.00	0.186	56.85
	0013	0.082	600.00	0.497	21.32	---	---	---	---
	0014	---	---	---	---	0.031	600.00	0.186	56.85
	0015	0.082	600.00	0.497	21.32	---	---	---	---
S05/S12	0016	0.124	511.72	0.746	14.21	0.094	600.00	0.565	18.76
	0020	0.124	511.72	0.746	14.21	0.094	600.00	0.565	18.76
S12	0017	---	---	---	---	0.094	600.00	0.565	18.76
	0023	0.376	168.86	2.261	4.69	---	---	---	---
	0025	---	---	---	---	0.125	507.87	0.752	14.10
	0030	---	---	---	---	0.125	507.87	0.752	14.10
	0033	0.376	168.86	2.261	4.69	---	---	---	---
	0034	---	---	---	---	0.158	402.06	0.950	11.16
	0036	---	---	---	---	0.158	402.06	0.950	11.16
	0037	0.376	168.86	2.261	4.69	---	---	---	---
S15	0040	0.207	307.03	1.244	8.52	0.207	307.03	1.244	8.52
	0049	0.207	307.03	1.244	8.52	0.207	307.03	1.244	8.52
S20	0060	0.295	215.57	1.771	5.98	0.295	215.57	1.771	5.98
	0067	0.295	215.57	1.771	5.98	0.295	215.57	1.771	5.98
	0074	0.427	149.00	2.563	4.13	0.427	149.00	2.563	4.13
	0086	0.427	149.00	2.563	4.13	0.427	149.00	2.563	4.13
S30	0113	0.640	99.33	3.845	2.75	0.640	99.33	3.845	2.75
	0129	0.640	99.33	3.845	2.75	0.640	99.33	3.845	2.75
	0150	0.640	99.33	3.845	2.75	0.640	99.33	3.845	2.75
	0162	0.640	99.33	3.845	2.75	0.640	99.33	3.845	2.75
S41	0180	1.005	79.15	6.031	2.19	1.005	79.15	6.031	2.19
	0202	1.005	79.15	6.031	2.19	1.005	79.15	6.031	2.19
	0217	1.256	63.32	7.539	1.75	1.256	63.32	7.539	1.75
	0260	1.256	63.32	7.539	1.75	1.256	63.32	7.539	1.75
S51	0313	1.507	52.77	9.047	1.46	1.507	52.77	9.047	1.46
	0367	1.507	52.77	9.047	1.46	1.507	52.77	9.047	1.46
	0402	1.507	52.77	9.047	1.46	1.507	52.77	9.047	1.46
S60	0457	3.015	26.38	18.095	0.73	3.015	26.38	18.095	0.73
	0524	3.015	26.38	18.095	0.73	3.015	26.38	18.095	0.73
S64	0598	---	---	---	---	2.239	35.53	13.435	0.98
	0748	---	---	---	---	2.239	35.53	13.435	0.98
	0831	---	---	---	---	2.985	26.65	17.914	0.74
S74	0964	---	---	---	---	5.971	13.32	35.829	0.37
	1130	---	---	---	---	5.971	13.32	35.829	0.37
	1296	---	---	---	---	5.971	13.32	35.829	0.37
S84	1800	---	---	---	---	8.957	8.88	53.743	0.24
	2076	---	---	---	---	8.957	8.88	53.743	0.24

Table 12: Default values of parameters depending on model (size) and voltage class - Class 5T/6T

		5T				6T			
SIZE	MODEL	P510 [kp with err Min]	P511 [Ti with err Min]	P512 [kp with err Max]	P513 [Ti with err Max]	P510 [kp with err Min]	P511 [Ti with err Min]	P512 [kp with err Max]	P513 [Ti with err Max]
S12/S14	0003	0.024	600.00	0.149	88.84	0.050	600.00	0.301	43.97
	0004	0.024	600.00	0.149	88.84	0.050	600.00	0.301	43.97
	0006	0.033	600.00	0.199	66.63	0.050	600.00	0.301	43.97
	0012	0.033	600.00	0.199	66.63	0.050	600.00	0.301	43.97
	0018	0.033	600.00	0.199	66.63	0.050	600.00	0.301	43.97
S14	0019	0.050	600.00	0.301	43.97	0.050	600.00	0.301	43.97
	0021	0.050	600.00	0.301	43.97	0.050	600.00	0.301	43.97
	0022	0.067	600.00	0.402	32.99	0.067	600.00	0.402	32.99
	0024	0.067	600.00	0.402	32.99	0.067	600.00	0.402	32.99
	0032	0.083	600.00	0.502	26.38	0.083	600.00	0.502	26.38
S22	0042	0.157	505.31	0.944	14.03	0.157	505.31	0.944	14.03
	0051	0.157	505.31	0.944	14.03	0.157	505.31	0.944	14.03
	0062	0.227	349.24	1.367	9.70	0.227	349.24	1.367	9.70
	0069	0.227	349.24	1.367	9.70	0.227	349.24	1.367	9.70
S32	0076	0.227	349.24	1.367	9.70	0.227	349.24	1.367	9.70
	0088	0.227	349.24	1.367	9.70	0.227	349.24	1.367	9.70
	0131	0.341	232.81	2.050	6.46	0.341	232.81	2.050	6.46
	0164	0.341	232.81	2.050	6.46	0.341	232.81	2.050	6.46
S42	0181	0.670	118.73	4.021	3.29	0.670	118.73	4.021	3.29
	0201	0.670	118.73	4.021	3.29	0.670	118.73	4.021	3.29
	0218	0.837	94.98	5.026	2.63	0.837	94.98	5.026	2.63
	0259	0.837	94.98	5.026	2.63	0.837	94.98	5.026	2.63
S52	0290	1.005	79.15	6.031	2.19	1.005	79.15	6.031	2.19
	0314	1.005	79.15	6.031	2.19	1.005	79.15	6.031	2.19
	0368	1.005	79.15	6.031	2.19	1.005	79.15	6.031	2.19
	0401	1.005	79.15	6.031	2.19	1.005	79.15	6.031	2.19
S64	0457	0.995	79.95	5.971	2.22	0.995	79.95	5.971	2.22
	0524	0.995	79.95	5.971	2.22	0.995	79.95	5.971	2.22
	0598	1.327	59.96	7.962	1.66	1.327	59.96	7.962	1.66
	0748	1.327	59.96	7.962	1.66	1.327	59.96	7.962	1.66
	0831	1.327	59.96	7.962	1.66	1.327	59.96	7.962	1.66
S74	0964	2.654	29.98	15.924	0.83	2.654	29.98	15.924	0.83
	1130	2.654	29.98	15.924	0.83	2.654	29.98	15.924	0.83
	1296	2.654	29.98	15.924	0.83	2.654	29.98	15.924	0.83
S84	1800	3.981	19.98	23.886	0.55	3.981	19.98	23.886	0.55
	2076	3.981	19.98	23.886	0.55	3.981	19.98	23.886	0.55

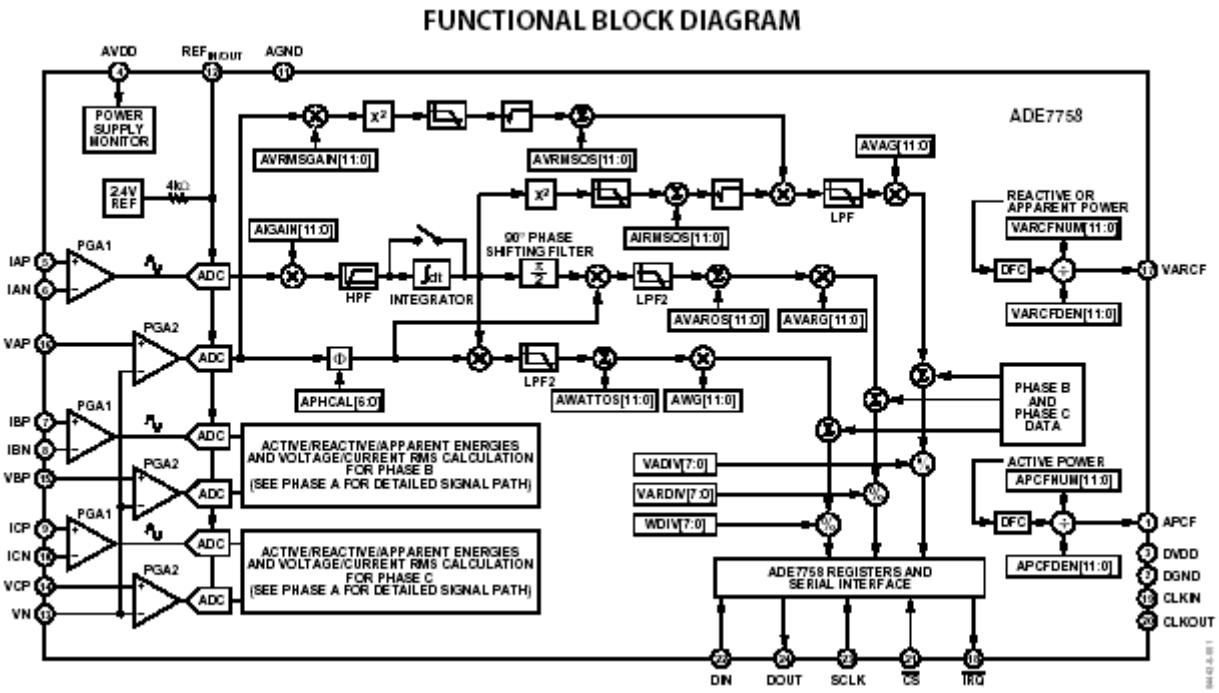
5.4. ADE REGISTERS SETTINGS MENU

5.4.1. OVERVIEW

This submenu allows calibrating the measures contained in Menu n.2 – ADE Measures. ES847 option board and its external components (see ADDITIONAL COMPONENTS FOR THE "ENERGY COUNTER" APPLICATION) are required (please refer to the Sinus Penta's Installation Instructions manual). Measurement devices (such as a power meter, a current probe and a voltmeter) are required to check if the values measured through ES847 board are correct.
To activate ES847 board, set parameter **R023**=
5:XMDO+ADE+PT100 or
6:XMDO+ADE+PT100+Pout (see the EXPANSION BOARD CONFIGURATION MENU).

"ADE" is part of the name of the integrated circuit (ADE7758) installed in ES847 board. This integrated circuit ensures high-precision three-phase measurement of electric energy, and is capable of detecting active energy, reactive energy, apparent energy and of calculating RMS values.
This integrated circuit complies with the following standards: IEC 1036, IEC 61036 and following amendments.
Particularly, standard IEC 61036:1996 covers "Alternating current static watt-hour meters for active energy (classes 1 and 2)".

ADE7758 provides calibration characteristics for each phase, such as offset/gain/phase/power correction. ADE registers are described below.



5.4.2. LIST OF PROGRAMMABLE PARAMETERS P530 TO P542 AND I003

Parameter	FUNCTION	User Level	MODBUS Address	DEFAULT VALUES
P530	Number of Half-line Cycles	ENGINEERING	956	10 T/2
P531a/b/c	Phase R/S/T Voltage RMS Gain	ENGINEERING	958/959/960	0
P532a/b/c	Phase R/S/T Current RMS Gain	ENGINEERING	961/962/963	0
P533a/b/c	Phase R/S/T Active Power Gain	ENGINEERING	964/965/966	0
P534a/b/c	Phase R/S/T Reactive Power Gain	ENGINEERING	967/968/969	0
P535a/b/c	Phase R/S/T Voltage RMS Offset	ENGINEERING	970/971/972	0
P536a/b/c	Phase R/S/T Current RMS Offset	ENGINEERING	973/974/975	0
P537a/b/c	Phase R/S/T Active Power Offset	ENGINEERING	976/977/978	0
P538a/b/c	Phase R/S/T Reactive Power Offset	ENGINEERING	979/980/981	0
P539a/b/c	Phase R/S/T Phase Calibration	ENGINEERING	982/983/984	0
P540	NoLoad Threshold	ENGINEERING	953	0:Disable
P542	CT Coil Ratio for ADE	ENGINEERING	992	See Table 1 and Table 2
I003	Energy Counter Reset	ENGINEERING	1390	Inactive

Table 13: List of parameters P530 to P542 and I003

P530 Number of Half-line Cycles

P530			
	Range	0 ÷ 65535	0 ÷ 65535 T/2
	Default	10	10 T/2
	Level	ENGINEERING	
	Address	956	
	Function	This parameter sets the number of half-line cycles for the accumulation of the active energy and the reactive energy in the respective counters. Example: when frequency is 50Hz, T=20ms and T/2=10ms; if **P530**=100 T/2, energy is accumulated every 100x10=1s. If **P530** is set to high values, the calculation of energy accumulation is slower but accurate; on the other hand, if **P530** is set to low values, the calculation of energy accumulation is faster but less accurate. As a general rule, set short times when high power ratings are required, and set longer times when low power ratings are required.	

CAUTION

When the number of half-line cycles is set too high, overflow can occur, especially in case of high power ratings, thus turning “plus” into “minus” and vice versa.

P531a/b/c Phase R/S/T Voltage RMS Gain

P531a/b/c			
	Range	–2048 ÷ +2047	1±50%
	Default	0	1
	Level	ENGINEERING	
	Address	958/959/960	
	Function	This gain affects both the voltage RMS value and the apparent power RMS value. $V=V^*(1+(P531/2^{12}))$ The overall calibration range is then 1±50%.	

P532a/b/c Phase R/S/T Current RMS Gain

P532a/b/c			
	Range	–2048 ÷ +2047	1±50%
	Default	0	1
	Level	ENGINEERING	
	Address	961/962/963	
	Function	This gain affects both the current RMS value and the apparent power RMS value. $I=I^*(1+(P532/2^{12}))$ The overall calibration range is then 1±50%.	

P533a/b/c Phase R/S/T Active Power Gain

P533a/b/c			
	Range	–2048 ÷ +2047	1±50%
	Default	0	1
	Level	ENGINEERING	
	Address	964/965/966	
	Function	This register calibrates the calculation of Active Power P. $P=P^*(1+(P533/2^{12}))$ The overall calibration range is then 1±50%.	

P534a/b/c Phase R/S/T Reactive Power Gain

P534a/b/c			
	Range	–2048 ÷ +2047	1±50%
	Default	0	1
	Level	ENGINEERING	
	Address	967/968/969	
	Function	This register calibrates the calculation of Reactive Power Q. $Q=Q^*(1+(P534/2^{12}))$ The overall calibration range is then 1±50%.	

P535a/b/c Phase R/S/T Voltage RMS Offset

P535a/b/c			
	Range	–2048 ÷ +2047	±47.4 V
	Default	0	0 V
	Level	ENGINEERING	
	Address	970/971/972	
	Function	Register for the correction of the voltage offset error.	

P536a/b/c Phase R/S/T Current RMS Offset

P536a/b/c			
	Range	–2048 ÷ +2047	±0.3%
	Default	0%	0%
	Level	ENGINEERING	
	Address	973/974/975	
	Function	Register for the correction of the current offset error.	

P537a/b/c Phase R/S/T Active Power Offset

P537a/b/c			
	Range	–2048 ÷ +2047	±0.015%
	Default	0	0%
	Level	ENGINEERING	
	Address	976/977/978	
	Function	Register for the correction of the active power offset error.	

P538a/b/c Phase R/S/T Reactive Power Offset

P538a/b/c			
	Range	–2048 ÷ +2047	±0.015%
	Default	0	0%
	Level	ENGINEERING	
	Address	979/980/981	
	Function	Register for the correction of the reactive power offset error.	

P539a/b/c Phase R/S/T Phase Calibration Register

P539a/b/c	Range	–64 ÷ +63	[–2.72° ÷ +1.36°] @ 50Hz [–3.28° ÷ +1.63°] @ 60Hz
	Default	0	0°
	Level	ENGINEERING	
	Address	982/983/984	
	Function	This register adjusts the phase variation between voltage and current. 1 LSB is equivalent to a delay of 1.2µs, or to 2.4µs in advance. The correction range is then [–151.2µs ÷ 75.6µs], i.e. [–2.72° ÷ +1.36°] @ 50Hz [–3.28° ÷ +1.63°] @ 60Hz	

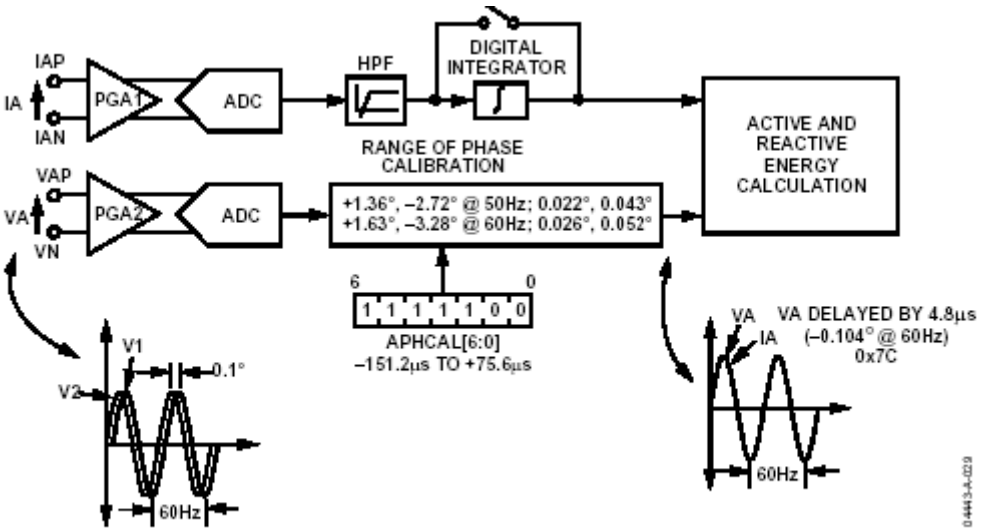


Figure 56. Phase Calibration on Voltage Channels

P540 NoLoad Threshold

P540	Range	0 ÷ 1	0 → Disable 1 → Enable
	Default	0	0 → Disable
	Level	ENGINEERING	
	Address	953	
	Function	If the active power drops below 0.005% of the full-scale value, energy accumulation can be suspended when this happens. Disable: disabled threshold⇒ energy is always accumulated. Enable: enabled threshold ⇒ energy is not accumulated if P<0.005%.	

P542 CT Coil Ratio for ADE

P542	Range	1 ÷ 65535	1 ÷ 65535
	Default	See Table 1 and Table 2	
	Level	ENGINEERING	
	Address	992	
	Function	This parameter indicates the coil ratio between the primary and the secondary of the CTs used for calculating the AC power value.	

I003 Energy Counter Reset

I003	Range	0 ÷ 1	0 → No 1 → Yes
	Default	This is not a parameter: I003 is set to zero at power on and whenever the command is executed.	
	Level	ENGINEERING	
	Address	1390	
	Function	0 → Inactive; 1 → Both energy counters are reset (measures can be viewed in **M537** (Active Energy) and **M539** (Reactive Energy).	

5.5. DC MEASURES SETTINGS MENU

5.5.1. OVERVIEW

This menu allows calibrating DC current measures (detected with an optional, external current transducer; see ADDITIONAL COMPONENTS FOR THE "ENERGY COUNTER" APPLICATION) in Menu n.3 – DC Measures.
It can be viewed only if parameter **R023**=
2:XMDO+Pout, or
4:XMDO+PT100+Pout, or
6:XMDO+ADE+PT100+Pout (see the EXPANSION BOARD CONFIGURATION MENU).

5.5.2. LIST OF PROGRAMMABLE PARAMETERS P545 TO P547

Parameter	FUNCTION	User Level	MODBUS Address	DEFAULT VALUES
P545	DC Current Offset	ENGINEERING	998	0.00 mA
P546	DC Current Input Filter	ENGINEERING	999	100 ms
P547	LEM Coil Ratio for XAIN7	ENGINEERING	991	2000

Table 14: List of parameters P545 to P547

P545 DC Current Offset

P545			
	Range	–2000 ÷ 2000	– 20.00 mA ÷ +20.00 mA
	Default	0	0.00 mA
	Level	ENGINEERING	
	Address	998	
	Function	This parameter selects the offset correction value of the DC current signal that has been measured. The set value is added to the signal measured before saturation or conversion.	

P546 DC Current Input Filter

P546			
	Range	0 ÷ 65000	0 ÷ 65000 ms
	Default	100	100 ms
	Level	ENGINEERING	
	Address	999	
	Function	This parameter selects the value of the time constant for the first order low-pass filter applied to the DC current signal at the end of the signal conversion and saturation chain.	

P547 LEM Coil Ratio for XAIN7

P547			
	Range	1 ÷ 65535	1 ÷ 65535
	Default	2000	2000
	Level	ENGINEERING	
	Address	991	
	Function	This parameter sets the coil ratio between the primary and the secondary of the LEM current transducer used for calculating the DC Power value.	

5.6. MAINS MONITOR MENU

5.6.1. OVERVIEW

The Mains Monitor menu includes the parameters defining the max. variation thresholds of the mains ratings if compared to the rated values (Rated Mains Voltage, **C500**; Rated Mains Frequency, **C501**) during the equipment operation.
The mains frequency/voltage values are monitored, which must not exceed or drop below the ranges set in the parameters of the Mains Monitor menu. Alarm trip can be disabled by setting **C502** = NO: in that case, when the mains is out of range, the regenerative drive is temporarily disabled but no alarm trips. Parameters **P570** to **P575** set the activation/deactivation of each control.
The default values of certain parameters may be automatically assigned to the values imposed by the regulations in force concerning mains voltage and frequency variations. By setting **P576** to a value other than zero, the parameters affected by the selected regulations as well as their access rights will be automatically updated. Parameter **P576** may be changed within **12 hours** from the latest modification. Afterwards, the setting in **P576** becomes permanent.

5.6.2. LIST OF PROGRAMMABLE PARAMETERS P550 TO P576 AND I500

Parameter	FUNCTION	User Level	MODBUS Address	DEFAULT VALUES
P576	Default Mains Settings	ENGINEERING	281	0: No Default
I500	Default Lock Command	ENGINEERING	283	0: No Command
P550	Max. Voltage Trip Threshold	ENGINEERING (*)	670	120% Vn (*)
P551	Max. Voltage Release Ratio	ENGINEERING	671	0.920
P552	Max. Voltage Trip Time	ENGINEERING (*)	672	0.150 s (*)
P553	Max. Voltage Reset Time	ENGINEERING	673	0.100 s
P554	Min. Voltage Trip Threshold	ENGINEERING (*)	674	80% Vn (*)
P555	Min. Voltage Release Ratio	ENGINEERING	675	1.125
P556	Min. Voltage Trip Time	ENGINEERING (*)	676	0.150 s (*)
P557	Min. Voltage Reset Time	ENGINEERING	699	0.010 s
P558a	Instantaneous Overvoltage Trip Threshold	ENGINEERING	677	0.100 s
P559a	Instantaneous Overvoltage Release Ratio	ENGINEERING (*)	696	140% Vn (*)
P560a	Instantaneous Overvoltage Trip Time	ENGINEERING	697	0.970
P561a	Instantaneous Overvoltage Reset Time	ENGINEERING (*)	698	0.010 s (*)
P558	Instantaneous Undervoltage Trip Threshold	ENGINEERING (*)	678	60% Vn (*)
P559	Instantaneous Undervoltage Release Ratio	ENGINEERING	679	1.060
P560	Instantaneous Undervoltage Trip Time	ENGINEERING (*)	680	0.010 s (*)
P561	Instantaneous Undervoltage Reset Time	ENGINEERING	681	0.010 s
P562	Max. Frequency Trip Threshold	ENGINEERING (*)	682	0.30 Hz (*)
P563	Max. Frequency Release Ratio	ENGINEERING	683	0.998
P564	Max. Frequency Trip Time	ENGINEERING (*)	684	0.080 s (*)
P565	Max. Frequency Reset Time	ENGINEERING	685	0.100 s
P566	Min. Frequency Trip Threshold	ENGINEERING (*)	686	–0.30 Hz (*)
P567	Min. Frequency Release Ratio	ENGINEERING	687	1.002
P568	Min. Frequency Trip Time	ENGINEERING (*)	688	0.080 s (*)
P569	Min. Frequency Reset Time	ENGINEERING	689	0.100 s

Parameter	FUNCTION	User Level	MODBUS Address	DEFAULT VALUES
P570	Instantaneous Undervoltage Alarm Enable	ENGINEERING	690	1: On
P571	Min. Voltage Alarm Enable	ENGINEERING	691	1: On
P572	Max. Voltage Alarm Enable	ENGINEERING	692	1: On
P573	RMS Alarm Enable	ENGINEERING	693	1: On
P574	Frequency Alarm Enable	ENGINEERING	694	1: On
P575	Instantaneous Overvoltage Alarm Enable	ENGINEERING	695	1: On

Table 15: List of parameters P550 to P575

NOTE (*)

The User Level and the value of the parameters above depend on **P576**.

The values given in the table above are set when **P576** = 0: No Default (i.e. no regulations selected).

P576 Default Mains Settings

P576	Range	0 ÷ 3	0 → No Default 1 → UL 1741 2 → IEEE 1547 3 → CSA C22.2
	Default	0	0 → No Default
	Level	ENGINEERING	
	Address	281	
	Function	If this parameter is set to a value >0, the following parameters will be affected by the selected regulations: **P550**, **P552**, **P554**, **P556**, **P558**, **P560**, **P562**, **P564**, **P566**, **P568**, **P558a**, **P560a**. Parameter **P576** may be changed either within 12 hours from the latest modification or after executing command **I500**. Afterwards, the setting in **P576** becomes permanent.	

I500 Default Lock Command

I500	Range	0 ÷ 1	0 → NO COMMAND 1 → LOCK
	Default	This is not a parameter: it is set to zero every time the equipment is powered on and every time the command is executed.	
	Level	ENGINEERING	
	Address	283	
	Function	0 → Inactive 1 → Parameter **P576** is not modifiable (only if >0) over the time span of 12 hours. This is a permanent operation.	

P550 Max. Voltage Trip Threshold

P550	Range	105 ÷ 122	105 ÷ 122% of Rated Vmains (**C500**)
	Default	120	120% of Rated Vmains (**C500**)
	Level	ENGINEERING	
	Address	670	
	Function	This parameter is expressed as a percentage of the rated mains voltage and sets the trip threshold for the mains Max. Voltage fault. If **P576** >0, the value in this parameter is affected by the regulations selected and can no longer be changed.	

P551 Max. Voltage Release Ratio

P551	Range	900 ÷ 1000	0.900 ÷ 1.000
	Default	920	0.920
	Level	ENGINEERING	
	Address	671	
	Function	This parameter sets the ratio between the trip voltage of the Max. Voltage fault and its reset value.	

P552 Max. Voltage Trip Time

P552	Range	20 ÷ 1000	0.020 ÷ 1.000 s
	Default	150	0.150 s
	Level	ENGINEERING	
	Address	672	
	Function	This is the time when the max. voltage trip condition is maintained for the mains Max. Voltage fault. If **P576** >0, the value in this parameter is affected by the regulations selected and can no longer be changed.	

P553 Max. Voltage Reset Time

P553	Range	20 ÷ 1000	0.020 ÷ 1.000 s
	Default	100	0.100 s
	Level	ENGINEERING	
	Address	673	
	Function	This is the time when the max. voltage reset condition is maintained to deactivate the mains Max. Voltage fault.	

P554 Min. Voltage Trip Threshold

P554	Range	60 ÷ 90	60 ÷ 90% of Vn
	Default	80	80% of Vn
	Level	ENGINEERING	
	Address	674	
	Function	This parameter is expressed as a percentage of the rated mains voltage and sets the trip threshold for the mains Min. Voltage fault. If **P576** >0, the value in this parameter is affected by the regulations selected and can no longer be changed.	

P555 Min. Voltage Release Ratio

P555	Range	1000 ÷ 1200	1.000 ÷ 1.200
	Default	1125	1.125
	Level	ENGINEERING	
	Address	675	
	Function	This parameter sets the ratio between the trip voltage of the Min. Voltage fault and its reset value.	

P556 Min. Voltage Trip Time

P556	Range	20 ÷ 1000	0.020 ÷ 1.000 s
	Default	150	0.150 s
	Level	ENGINEERING	
	Address	676	
	Function	This is the time when the min. voltage trip condition is maintained for the mains Min. Voltage fault. If **P576** >0, the value in this parameter is affected by the regulations selected and can no longer be changed.	

P557 Min. Voltage Reset Time

P557	Range	20 ÷ 1000	0.020 ÷ 1.000 s
	Default	100	0.100 s
	Level	ENGINEERING	
	Address	677	
	Function	This is the time when the min. voltage reset condition is maintained to deactivate the mains Min. Voltage fault.	

P558a Instantaneous Overvoltage Trip Threshold

P558a	Range	105 ÷ 160	105 ÷ 160% of Vn
	Default	140	140% of Vn
	Level	ENGINEERING	
	Address	696	
	Function	This parameter, expressed as a percentage of the rated mains voltage, defines the activation threshold of the mains Instantaneous Overvoltage. If **P576** >0, the value in this parameter is affected by the regulations selected and can no longer be changed.	

P559a Instantaneous Overvoltage Release Ratio

P559a	Range	950 ÷ 1000	0.970 ÷ 1.000
	Default	970	0.970
	Level	ENGINEERING	
	Address	697	
	Function	Indicates the ratio between the trip voltage of the Instantaneous Overvoltage fault and the relevant reset value.	

P560a Instantaneous Overvoltage Trip Time

P560a	Range	1÷ 1000	0.001 ÷ 1.000 s
	Default	10	0.010 s
	Level	ENGINEERING	
	Address	698	
	Function	Time span of the Instantaneous Overvoltage fault duration for the activation of the mains Instantaneous Overvoltage. If **P576** >0, the value in this parameter is affected by the regulations selected and can no longer be changed.	

P561a Instantaneous Overvoltage Reset Time

P561a			
	Range	1 ÷ 1000	0.001 ÷ 1.000 s
	Default	10	0.010 s
	Level	ENGINEERING	
	Address	699	
	Function	Time span of the Instantaneous Overvoltage fault reset duration for the deactivation of the mains Instantaneous Overvoltage.	

P558 Instantaneous Undervoltage Trip Threshold

P558			
	Range	50 ÷ 90	50 ÷ 90% of Vn
	Default	60	60% of Vn
	Level	ENGINEERING	
	Address	678	
	Function	This parameter is expressed as a percentage of the rated mains voltage and sets the trip threshold for the mains Instantaneous Undervoltage fault. If **P576** >0, the value in this parameter is affected by the regulations selected and can no longer be changed.	

P559 Instantaneous Undervoltage Release Ratio

P559			
	Range	1000 ÷ 1100	1.000 ÷ 1.100
	Default	1060	1.060
	Level	ENGINEERING	
	Address	679	
	Function	This parameter sets the ratio between the trip voltage for the Instantaneous Undervoltage fault and its reset value.	

P560 Instantaneous Undervoltage Trip Time

P560			
	Range	1÷ 1000	0.001 ÷ 1.000 s
	Default	10	0.010 s
	Level	ENGINEERING	
	Address	680	
	Function	This is the time when the instantaneous undervoltage trip condition is maintained for the mains Instantaneous Undervoltage fault. If **P576** >0, the value in this parameter is affected by the regulations selected and can no longer be changed.	

P561 Instantaneous Undervoltage Reset Time

P561			
	Range	1 ÷ 1000	0.001 ÷ 1.000 s
	Default	10	0.010 s
	Level	ENGINEERING	
	Address	681	
	Function	This is the time when the instantaneous undervoltage reset condition is maintained to deactivate the mains Instantaneous Undervoltage fault.	

P562 Max. Frequency Trip Threshold

P562			
	Range	10 ÷ 200	0.10 ÷ 2.00 Hz
	Default	30	0.30 Hz
	Level	ENGINEERING	
	Address	682	
	Function	This parameter sets the max. frequency value if compared to the rated frequency which determines the mains Max. Frequency fault. If **P576** >0, the value in this parameter is affected by the regulations selected and can no longer be changed.	

P563 Max. Frequency Release Ratio

P563			
	Range	995 ÷ 1000	0.995 ÷ 1.000
	Default	998	0.998
	Level	ENGINEERING	
	Address	683	
	Function	This parameter sets the ratio between the trip frequency for the Max. Frequency fault and its reset value.	

P564 Max. Frequency Trip Time

P564			
	Range	40 ÷ 1000	0.040 ÷ 1.000 s
	Default	80	0.080 s
	Level	ENGINEERING	
	Address	684	
	Function	This is the time when the max. frequency trip condition is maintained for the mains Max. Frequency fault. If **P576** >0, the value in this parameter is affected by the regulations selected and can no longer be changed.	

P565 Max. Frequency Reset Time

P565			
	Range	40 ÷ 1000	0.040 ÷ 1.000 s
	Default	100	0.100 s
	Level	ENGINEERING	
	Address	685	
	Function	This is the time when the max. frequency reset condition is maintained to deactivate the mains Max. Frequency fault.	

P566 Min. Frequency Trip Threshold

P566			
	Range	-200 ÷ -10	-2.00 ÷ -0.10 Hz
	Default	-30	-0.30 Hz
	Level	ENGINEERING	
	Address	686	
	Function	This parameter sets the max. frequency value if compared to the rated frequency which determines the mains Min. Frequency fault. If **P576** >0, the value in this parameter is affected by the regulations selected and can no longer be changed.	

P567 Min. Frequency Release Ratio

P567	Range	1000 ÷ 1006	1.000 ÷ 1.006
	Default	1002	1.002
	Level	ENGINEERING	
	Address	687	
	Function	This parameter sets the ratio between the trip frequency for the Min. Frequency fault and its reset value.	

P568 Min. Frequency Trip Time

P568	Range	40 ÷ 1000	0.040 ÷ 1.000 s
	Default	80	0.080 s
	Level	ENGINEERING	
	Address	688	
	Function	This is the time when the min. frequency trip condition is maintained for the mains Min. Frequency fault. If **P576** >0, the value in this parameter is affected by the regulations selected and can no longer be changed.	

P569 Min. Frequency Reset Time

P569	Range	40 ÷ 1000	0.040 ÷ 1.000 s
	Default	100	0.100 s
	Level	ENGINEERING	
	Address	689	
	Function	This is the time when the min. frequency reset condition is maintained to deactivate the mains Min. Frequency fault.	

P570 Instantaneous Undervoltage Alarm Enable

P570	Range	0 ÷ 0007h	0 ÷ 0007
	Default	0007h	Bit 0 → 1 Enable R phase alarm Bit 1 → 1 Enable S phase alarm Bit 2 → 1 Enable T phase alarm
	Level	ENGINEERING	
	Address	690	
	Function	Bit-controlled parameter: bits 0 to 2 allow enabling (Bit = 1) or disabling (Bit = 0) the instantaneous undervoltage alarms of the three mains phases (R, S, T).	

P571 Min. Voltage Alarm Enable

P571	Range	0 ÷ 0007h	0 ÷ 0007
	Default	0007h	Bit 0 → 1 Enable R phase alarm Bit 1 → 1 Enable S phase alarm Bit 2 → 1 Enable T phase alarm
	Level	ENGINEERING	
	Address	691	
	Function	Bit-controlled parameter: bits 0 to 2 allow enabling (Bit = 1) or disabling (Bit = 0) the RMS min. voltage alarm of the three mains phases (R, S, T).	

P572 Max. Voltage Alarm Enable

P572	Range	0 ÷ 0007h	0 ÷ 0007
	Default	0007h	Bit 0 → 1 Enable R phase alarm Bit 1 → 1 Enable S phase alarm Bit 2 → 1 Enable T phase alarm
	Level	ENGINEERING	
	Address	692	
	Function	Bit-controlled parameter: bits 0 to 2 allow enabling (Bit = 1) or disabling (Bit = 0) the RMS max. voltage alarm of the three mains phases (R, S, T).	

P573 RMS Alarm enable

P573	Range	0 ÷ 0007h	0 ÷ 0007
	Default	0007h	Bit 0 → 1 Enable R phase alarm Bit 1 → 1 Enable S phase alarm Bit 2 → 1 Enable T phase alarm
	Level	ENGINEERING	
	Address	693	
	Function	Bit-controlled parameter: bits 0 to 2 allow enabling (Bit = 1) or disabling (Bit = 0) the RMS voltage alarms of the three mains phases (R, S, T).	

P574 Frequency Alarm Enable

P574	Range	0 ÷ 0003h	0 ÷ 0003
	Default	0003h	Bit 0 → 1 Enable Max. Frequency alarm Bit 1 → 1 Enable Min. Frequency alarm
	Level	ENGINEERING	
	Address	694	
	Function	Bit-controlled parameter: bits 0 to 1 allow enabling (Bit = 1) or disabling (Bit = 0) the mains Max. and Min. frequency alarms.	

P575 Instantaneous Overvoltage Alarm Enable

P575	Range	0 ÷ 0007h	0 ÷ 0007
	Default	0007h	Bit 0 → 1 Enable Phase R Alarm Bit 1 → 1 Enable Phase S Alarm Bit 2 → 1 Enable Phase T Alarm
	Level	ENGINEERING	
	Address	695	
	Function	Bit-controlled parameter: bits 0÷2 enable (Bit = 1) or disable (Bit = 0) each individual Instantaneous Overvoltage alarm of the three phases of the mains.	

5.7. ANALOG OUTPUTS MENU

5.7.1. OVERVIEW

The variables assigned to the analog outputs are the following for the Regenerative applications:

AO1: Power

AO2: Output Current (RMS)

AO3: DC-bus Voltage

Item	Full-scale	Kri	Description
Drive power	1000.0 kW	10	Delivered active power
Output current	1000.0 A	10	Current RMS
DC-bus voltage	1000.0 V	10	DC voltage of the DC-bus

Table 16: Items allocated to the analog outputs

The following items are mentioned for each variable:

- the full-scale value;

the internal representation coefficient (Kri) required for scaling the maximum and minimum values in case of programming via serial link;

Example: Max. value to be represented **P179**=100 A → the value to be programmed via serial link is **P179** = (100 A * Kri) = 1000.

The parameters relating to the following items are detailed in the Analog Outputs section in the Sinus Penta's Programming Instructions manual:

- Operating modes of the analog outputs (voltage/current outputs);
- Range of the variable;
- Acquiring mode of the variable ("plus", "minus" or as an absolute value);
- Output values corresponding to the minimum and maximum value of the variable;
- Possible offsets;
- Applicable filter.

NOTE Because the variables allocated to the analog outputs cannot be configured by the user, parameters **P177**, **P185**, and **P193** are not included in this menu.

5.8. DIGITAL OUTPUTS MENU

5.8.1. OVERVIEW

Digital outputs MDO1 and MDO2, Push-Pull and Open Collector outputs respectively, can be set up with the parameters contained in the Digital Outputs menu.
MDO3 cannot be set up because it is assigned to the closure of the pre-charge contactor.
MDO4 is assigned to the motor drive activation; its activation logic can be programmed through **C503**.

5.8.2. LIST OF PROGRAMMABLE PARAMETERS P580 AND P581

Parameter	FUNCTION	User Level	MODBUS Address	DEFAULT VALUES
P580	MDO1 Digital Output Function	BASIC	700	1: Run OK
P581	MDO2 Digital Output Function	BASIC	701	2: Mains Fault

Table 17: List of parameters P580 and P581

P580, P581 MDO1, MDO2 Digital Output Function

P580, P581	Range	0 ÷11	0: Synchronization OK 1: Run OK 2: Mains Fault 3: Drive OK 4: Drive in Alarm 5: W40 Fan Fault 6: Pre-charge OK 7: Command 1 from Fieldbus 8: Command 2 from Fieldbus 9: Command 3 from Fieldbus 10: Command 4 from Fieldbus 11: Fan ON
	Default	1 (**P580**) 2 (**P581**)	1: Run OK (**P580**) 2: Mains Fault (**P581**)
	Level	BASIC	
	Address	700 701	
	Function	These parameters set the functions implemented by digital outputs MDO1 and MDO2. See Table 18 for more details.	

Digital Output Function	Description of the Digital Output Functions
0: Synchronization Ok	The PLL runs smoothly and is synchronized with the mains.
1: Run OK	The drive is running smoothly.
2: Mains Fault	A mains fault has been detected (mains voltage/frequency out of range if compared to the values set in the Mains Monitor menu).
3: DRIVE OK	No alarm tripped.
4: DRIVE in ALARM	Active alarm(s).
5: W40 Fan Fault	The control board has detected a fan fault signal.
6: Pre-charge OK	Successful closure of the DC-Bus Capacitor Pre-charge relay and MDO3 output for the external bypass.
7÷10: Command from Fieldbus	The digital output is controlled directly from the fieldbus (see **Word 6** in the FIELDBUS MENU).
11: Fan ON	The fan internal to the drive is operating.

Table 18: Functions implemented by digital outputs MDO1 and MDO2

5.9. AUXILIARY DIGITAL OUTPUTS MENU

5.9.1. OVERVIEW

Auxiliary digital outputs XMDO1..6 can be programmed using the parameters contained in this menu.
This menu can be viewed only if parameter **R023**≠0 (see the EXPANSION BOARD CONFIGURATION MENU).

5.9.2. LIST OF PROGRAMMABLE PARAMETERS P582 TO P593

Parameter	FUNCTION	User Level	MODBUS Address	DEFAULT VALUES
P582	XMDO1: Signal Selection	ENGINEERING	702	D0: Disable
P583	XMDO1: Output Logic Level	ENGINEERING	703	1: True
P584	XMDO2: Signal Selection	ENGINEERING	704	D0: Disable
P585	XMDO2: Output Logic Level	ENGINEERING	705	1: True
P586	XMDO3: Signal Selection	ENGINEERING	706	D0: Disable
P587	XMDO3: Output Logic Level	ENGINEERING	707	1: True
P588	XMDO4: Signal Selection	ENGINEERING	708	D0: Disable
P589	XMDO4: Output Logic Level	ENGINEERING	709	1: True
P590	XMDO5: Signal Selection	ENGINEERING	710	D0: Disable
P591	XMDO5: Output Logic Level	ENGINEERING	711	1: True
P592	XMDO6: Signal Selection	ENGINEERING	712	D0: Disable
P593	XMDO6: Output Logic Level	ENGINEERING	713	1: True

Table 19: List of parameters P582 to P593

P582/584/586/588/590/592 Variable Selected for Auxiliary Digital Outputs XMDO1/6

	Range	0 ÷ 11	0: Synchronism OK 1: Run OK 2: Mains Fault 3: Drive OK 4: Alarm Tripped 5: W40 Fan Fault 6: Pre-charge OK 7: Command 1 from Fieldbus 8: Command 2 from Fieldbus 9: Command 3 from Fieldbus 10: Command 4 from Fieldbus 11: Fan ON
	Default	3	3: Drive OK
	Level	ENGINEERING	
	Address	702/704/706/708/710/712	
	Function	These parameters set the functions implemented from digital outputs XMDOx. See Table 18 for detailed functions.	

P583/585/587/589/591/593 Logic Applied to Auxiliary Digital Outputs XMDO1/6

	Range	0 ÷1	0: FALSE 1: TRUE
	Default	1	1: TRUE
	Level	ENGINEERING	
	Address	703/705/707/709/711/713	
	Function	**XMDOx** digital output logic function to apply a logic reversal (negation) to the calculated output signal: (0) FALSE = a logic negation is applied; (1) TRUE = no negation is applied.	

5.10. PT100 MEASURES MENU

5.10.1. OVERVIEW

This menu allows programming and adjusting temperature measures detected from PT100.
It can be viewed only if parameter **R023**=
3:XMDO+PT100 or
4:XMDO+PT100+Pout or
5:XMDO+ADE+PT100 or
6:XMDO+ADE+PT100+Pout (see the EXPANSION BOARD CONFIGURATION MENU).

5.10.2. LIST OF PROGRAMMABLE PARAMETERS P320 TO P327

Parameter	FUNCTION	User Level	MODBUS Address	DEFAULT VALUES
P320	Ch1: Measure Mode	ENGINEERING	920	0: no input
P320a	Ch1: Alarm Level	ENGINEERING	918	260°C
P321	Ch1: Offset	ENGINEERING	921	0.00°C
P322	Ch2: Measure Mode	ENGINEERING	922	0: no input
P322a	Ch2: Alarm Level	ENGINEERING	919	260°C
P323	Ch2: Offset	ENGINEERING	923	0.00°C
P324	Ch3: Measure Mode	ENGINEERING	924	0: no input
P324a	Ch3: Alarm Level	ENGINEERING	928	260°C
P325	Ch3: Offset	ENGINEERING	925	0.00°C
P326	Ch4: Measure Mode	ENGINEERING	926	0: no input
P326a	Ch4: Alarm Level	ENGINEERING	929	260°C
P327	Ch4: Offset	ENGINEERING	927	0.00°C

Table 20: List of parameters P320 to P327

P320/P322/P324/P326 Measure Mode for Channels 1/2/3/4

P320 / P322 / P324 / P326			
	Range	0 ÷ 1	0: no input 1: val PT100
	Default	0	0: no input
	Level	ENGINEERING	
	Address	920/922/924/926	
	Function	This parameter selects the type of analog signal available in terminals 27–28, 29–30, 31–32, 33–34 in ES847 option board: **0:** No signal is used. **1**: The acquired signal is transformed into degrees centigrade. (See Measures **M069-M072**).	

P321/P323/P325/P327 Measure Offset in Channels 1/2/3/4

P321 / P323 / P325 / P327	Range	–30000 ÷ 30000	–300.00 ÷ 300.00°C
	Default	0	0.00°C
	Level	ENGINEERING	
	Address	921/923/925/927	
	Function	Value of the measure offset: an offset can be applied to the measure to correct possible errors.	

P320a/P322a/P324a/P326a Alarm Level for Channels 1/2/3/4

P320a / P322a / P324a / P326a	Range	–50 ÷ 260	–50°C ÷ 260°C
	Default	260	260°C
	Level	ENGINEERING	
	Address	918/919/928/929	
	Function	Alarm threshold for **A105**..**A108**. Alarms trip when measures > levels.	

5.11. FIELDBUS MENU

5.11.1. OVERVIEW

NOTE For any detail about the communications protocol, the hardware interface, the implemented functions, etc., please refer to the Fieldbus sections in the Sinus Penta's Installation Instructions and Programming Instructions manuals.

NOTE The section below covers the fieldbus operation for the Regenerative application.

5.11.2. LIST OF PROGRAMMABLE PARAMETERS P330 AND P331

Parameter	FUNCTION	User Level	MODBUS Address	DEFAULT VALUES
P330	Measure 3 from the Fieldbus	ENGINEERING	930	5:M505 Active Power
P331	Measure 4 from the Fieldbus	ENGINEERING	931	2:M502 Mains Voltage

Table 21: List of parameters P330 and P331

P330/P331 Measure 3/Measure 4 from Fieldbus

P330	Range	0 ÷ 91	NONE ÷ M090
	Default	6 (P330) 3 (P331)	M505 Active Power (P330) M502 Mains Voltage (P331)
	Level	ENGINEERING	
	Address	930	
	Function	The user can select Measure 3 and 4 exchanged from the fieldbus among the measures M500 to M090 (see Table 22 below).	

0	NONE		
1	**M500** Vbus DC Ref	32	**M031** Delay, Dig,IN
2	**M501** Vbus DC	33	**M032** Inst, Dig,IN
3	**M502** V Mains	34	**M033** Term, Dig,IN
4	**M503** Current	35	**M034** Ser, Dig,IN
5	**M504** Frequency	36	**M035** Fbus, Dig,IN
6	**M505** Active Power	57	**M056** Digital OUT
7	**M506** Reactive Power	59	**M058** AO1
8	**M507** Apparent Power	60	**M059** AO2
9	**M508** Power Factor	61	**M060** AO3
10	**M509** V(RS)	62	**M061** AuxDig,OUT
11	**M510** V(ST)	63	**M062** Amb,Temp
12	**M511** V(TR)	65	**M064** Hts,Temp
13	**M512** Curr, Phase R	70	**M069** PT100 Temp,1
14	**M513** Curr, Phase S	71	**M070** PT100 Temp,2
15	**M514** Curr, Phase T	72	**M071** PT100 Temp,3
16	**M515** PLL Status	73	**M072** PT100 Temp,4
17	**M516** Mains Status 2	90	**M089** Status
18	**M517** Mains Status 1	91	**M090** Alarm

Table 22: List of the programmable measures for P330/P331

5.11.3. EXCHANGED PARAMETERS

The tables below contain the Sinus Penta's parameters that are exchanged via Fieldbus.

Each table includes:

1) The parameter number (ID);
2) Its description;
3) Its setting range;
4) Its unit of measure (which is also displayed on the display/keypad);
5) The ratio between the value internal to the Regenerative Sinus Penta (which is exchanged via Fieldbus) and the hardware represented value (as displayed).

NOTE Each parameter is exchanged as a 16-bit integer with a ± sign (from –32768 to +32767). The byte exchanging sequence follows the **big-endian** rule (i.e. the most significant value is stored to the lowest address).

5.11.4. FROM THE MASTER TO THE SINUS PENTA

Word	1) ID	2) Description	3) Range	4) Unit of Measure	5) Ratio
1÷4	–	not used	–	–	–
5	M035	Digital inputs from FIELDBUS	–	–	–
6		Commands for digital outputs from FIELDBUS	–	–	–
7	AO1	Analog Output 1 controlled via FIELDBUS	+ 111 ÷ + 1889	–	–
8	AO2	Analog Output 2 controlled via FIELDBUS	+ 111 ÷ + 1889	–	–
9	AO3	Analog Output 3 controlled via FIELDBUS	+ 111 ÷ + 1889	–	–

Word 1..4: not used

Word 5: Digital inputs from FIELD BUS

To activate the drive control from fieldbus, set one of the control sources among **C140÷C142** as Fieldbus.

The simulated virtual terminal board is assigned to the low byte of the word:

bit 15	bit [14..8]	bit [7..0]
1		virtual terminal board

Bitmap:

0 → MDI1
1 → MDI2 (ENABLE)
2 → MDI3 (RESET)
3 → Not Used
4 → Not Used
5 → MDI6
6 → MDI7
7 → MDI8

The logic status of these bits is part of the overall status of the drive digital inputs (measure **M032**) along with the other control sources if at least one among **C140÷C142** is set as Fieldbus.

NOTE Digital inputs MDI4 (external pre-charge closed signals) and MDI5 (filter capacitor protection) are detected in the hardware drive terminal board only, as they are affected by the hardware status of the cabinet where the drive is installed.

NOTE Bit 15 must always be=1; this means that data exchanged from the master to the drive is always consistent; as a result, the watchdog counter is kept reset (see "Alarm A070").

Word 6: Commands for digital outputs from FIELD BUS

The 4 low bits of the word are allocated to the digital commands sent from the fieldbus:

bit [15..4]	bit [3..0]
	digital commands

Bitmap:

Bit	Command	Location in the selector vector
0	Fbus CMD 1	7
1	Fbus CMD 2	8
2	Fbus CMD 3	9
3	Fbus CMD 4	10

The name and the location of the commands sent via fielbdus are given in column 2 and 3.
Example: In order to control MDO1 digital output via fieldbus through command 4, set **P580** in the DIGITAL OUTPUTS MENU as follows:

P580 = 10: Fbus CMD 4

Word 7, 8, 9: Analog outputs controlled from FIELD BUS

In order to control the analog outputs from the Fieldbus, properly set up parameter **R017** (please refer to the Sinus Penta's Programming Instructions manual).

NOTE Once changed and saved, **R017** has no effect until the drive is next powered on, or until the control board is reset by holding down the RESET key for more than 5 secs.

The exchanged value matches the effective value (in volts) as follows:

Exchanged value	Voltage (V)
+ 1889	+ 10
+ 1000	0
+ 111	– 10

5.11.5. FROM THE SINUS PENTA TO THE MASTER

Word	1) ID	2) Description	3) Range	4) Unit of Measure	5) Ratio
1		Status + Alarms	–	–	–
2	**M501**	DC-bus Voltage	0 ÷ 65000	V	1/10
3	**M503**	Drive Current	0 ÷ 65000	A	1/10
4	(default **M505**)	Measure 3 configurable with **P330** *	see Programmed measure		
5	(default **M502**)	Measure 4 configurable with **P331** *	see Programmed measure		
6	DIN	Digital Inputs	–	–	–
7	DOU	Digital Outputs	–	–	–
8	REF	REF Analog Input	– 16380 ÷ + 16380	–	–
9	AIN1	AIN1 Analog Input	– 16380 ÷ + 16380	–	–
10	AIN2	AIN2 Analog Input	– 16380 ÷ + 16380	–	–

* The exchanged parameters can be customized by properly setting **P330** and **P331** (see the FIELDBUS MENU). As per the unit of measure and the scaling range, please refer to the "Range" line in the table relating to the selected measure (Measures section). Example:

M505 Delivered Active Power

M505	Range	± 32000	± 3200.0 kW
	Address	1655	
	Function	Active power exchanged with the mains. The positive sign stands for the power delivered to the regenerative drive (power flow from AC mains to regenerative drive); otherwise, the negative sign is displayed.	

As shown in the "Range" line, the measure of the active power is given with one decimal figure, so the scaling ratio is 1/10.

Word 1: Status + Alarms

The **Status** and **Alarms** bytes are mapped in the word as follows:

bit [15..8]	bit [7..0]
Status	**Alarms**

The **Status** bytes are encoded as in Table 9.
The **Alarms** bytes are encoded as in Table 32—as per the alarms pertaining to the Regenerative application.
More details on the available alarms are given in the Sinus Penta's Programming Instructions Manual.

Word 2: DC bus voltage

The measure of the **DC bus voltage (M501)** is displayed as a value that is to be divided by 10 to get the actual voltage value.

As a result, if the value returned by the Regenerative Sinus Penta to the Master is 7000, the actual voltage value of the DC bus will be 700V.

bit [15..8]	bit [7..0]
DC-bus voltage	

Word 3: Drive current

The **Drive current (M503)** is displayed as a value that is to be divided by 10 to get the actual current value.

As a result, if the value returned by the Regenerative Sinus Penta to the Master is 100, the actual current value of the drive will be 10A.

bit [15..8]	bit [7..0]
Drive current	

Word 4 and Word 5: Measure 3 and Measure 4 programmable with P330 and P331.

Word 4 and Word 5 are programmable through **P330** and **P331** (see the **FIELDBUS MENU**).
They are represented as follows:

bit [15..8]	bit [7..0]
Mxxx represented with **P330** and **P331**	

Word 6: Digital inputs

The status of the drive digital inputs in the word is as follows:

bit [15..8]	bit [7..0]
Digital inputs in option boards	Drive digital inputs

Bitmap:

0	→	MDI1
1	→	MDI2 (ENABLE)
2	→	MDI3 (RESET)
3	→	MDI4 (Prech)
4	→	MDI5 (C.Prot.)
5	→	MDI6
6	→	MDI7
7	→	MDI8
8	→	XMDI1
9	→	XMDI2
10	→	XMDI3
11	→	XMDI4
12	→	XMDI5
13	→	XMDI6
14	→	XMDI7
15	→	XMDI8

Word 7: Digital outputs

The status of the drive digital outputs in the word is as follows:

bit [15..8]	bit [7..0]
Digital outputs in option boards	Drive digital outputs

Bitmap:

0 → MDO1
1 → MDO2
2 → MDO3 (Prech)
3 → MDO4 (EnSlv)
6 → Status of internal pre-charge contactor
8 → XMDO1
9 → XMDO2
10 → XMDO3
11 → XMDO4
12 → XMDO5
13 → XMDO6

Word 8, 9, 10: REF, AIN1, AIN2 Analog signal

The full-scale value of ± 16380 is a nominal value and corresponds to an input range of ± 10V. This value can be automatically changed by the drive due to the tolerance compensation of the input stages.

ALARM A070 COMMUNICATIONS FAILURE

Alarm A070 trips if the Sinus Penta has not received any legal message sent via FIELDBUS for the timeout set in parameter **R016** (please refer to the Sinus Penta's Programming Instructions manual). To disable alarm A070, set **R016** = 0.

A legal message is sent when the master writes the digital input word (**M035**) with bit 15=1.

Important: This activates only when the drive receives the first message with bit 15=1.

NOTE

Once changed and saved, **R016** has no effect until the drive is next powered on, or until the control board is reset by holding down the RESET key for more than 5 secs.

5.12. MAINS PARAMETERS MENU

5.12.1. OVERVIEW

This menu contains the nominal parameters of the mains, the motor drive activation logic and the drive operation when the mains is out of range.
C502 sets whether the drive locks due to a fault trip or is temporarily disabled and automatically restarts as soon as the mains fault disappears (when the mains is OK, the REF LED in the keypad comes on).
C503 sets the motor drive status based on the regenerative drive status (MDO4 control logic; MDO4 is the digital output used for the motor drive activation):

C503 Setting	MDO4 Status	Condition	What happens
1 ENABLED	**CLOSED** (motor drive enabled)	The regenerative drive is enabled; the pre-charge of the internal capacitors is complete.	The motor drive is always enabled when the regenerative drive is enabled and the pre-charge contactor is closed. Faults in the regenerative drive or mains voltage out of range condition do not stop the system. When the RGN drive is locked, sinusoidal absorption and braking energy delivery to the mains will stop.
	OPEN (motor drive disabled)	The regenerative drive is disabled or the pre-charge contactor is not closed.	
2 RESET OR RUNNING	**CLOSED** (motor drive enabled)	The regenerative drive is enabled; the pre-charge of the internal capacitors is complete; possible fault, but the drive is waiting for the autoreset signal.	The motor drive is always enabled when the regenerative drive is enabled and the pre-charge contactor is closed. Faults in the regenerative drive or mains voltage out of range condition do not stop the system if the Autoreset function is active and the autoreset attempts are not over. When the RGN drive is locked, sinusoidal absorption and braking energy delivery to the mains will stop and will be resumed as soon as the alarm is reset.
	OPEN (motor drive disabled)	The regenerative drive is disabled, or the pre-charge contactor is not closed, or an alarm tripped, that cannot be automatically reset.	
3 RUNNING	**CLOSED** (motor drive enabled)	The regenerative drive is running or is disabled because the mains is out of range; no alarm tripped.	The motor drive is enabled only when the regenerative drive is running or is disabled when the mains is out of range and the relevant alarms are disabled.
	OPEN (motor drive disabled)	The regenerative drive is not running (ENABLE open), or an alarm tripped.	

Table 23: Operating mode of the motor drive Enable command

5.12.2. LIST OF PROGRAMMABLE PARAMETERS C500 TO C503

Parameter	FUNCTION	User Level	MODBUS Address	DEFAULT VALUES
C500	Rated Mains Voltage	BASIC	1000	Depending on voltage class
C501	Rated Mains Frequency	BASIC	1001	50.0 Hz
C502	Mains Fault Enable	ENGINEERING	1002	1: Yes
C503	Motor Drive Enabling Mode	ADVANCED	1003	2:REGEN RUN

Table 24: List of parameters C500 to C503

C500 Rated Mains Voltage

C500	Range	Class 2T → 2000 ÷ 2400 Class 4T → 3800 ÷ 4800 Class 5T → 5000 ÷ 6000 Class 6T → 6000 ÷ 6900	Class 2T → 200.0 ÷ 240.0 V Class 4T → 380.0 ÷ 480.0 V Class 5T → 500.0 ÷ 600.0 V Class 6T → 600.0 ÷ 690.0 V
	Default	Class 2T → 2300 Class 4T → 4000 Class 5T → 5750 Class 6T → 6900	Class 2T → 230.0 V Class 4T → 400.0 V Class 5T → 575.0 V Class 6T → 690.0 V
	Level	BASIC	
	Address	1000	
	Function	This parameter sets the rated mains voltage used to calculate the trip thresholds of the mains alarms that can be set through the parameters included in the Mains Monitor menu (**P550** etc.).	

C501 Rated Mains Frequency

C501	Range	400 ÷ 700	40.0 ÷ 70.0 Hz
	Default	500	50.0 Hz
	Level	BASIC	
	Address	1001	
	Function	This parameter sets the rated mains frequency used to calculate the min./max. frequency thresholds set through parameters **P562** and **P566** in the Mains Monitor menu.	

C502 Mains Fault Enable

C502	Range	0÷1	0: No 1: Yes
	Default	1	1: Yes
	Level	ENGINEERING	
	Address	1002	
	Function	This parameter sets the drive operation when a power failure occurs. If **C502** = [0: No], when the mains is out of range if compared to the thresholds set in the Mains Monitor menu, the drive is disabled for some time but is not locked in an emergency; otherwise, if **C502** = [1: Yes], the drive locks.	

C503 MDO4 Digital Output Function

C503	Range	0÷2	0: REGEN ENABLED 1: REGEN RUN or RESET 2: REGEN RUN
	Default	2	2: REGEN RUN
	Level	ADVANCED	
	Address	1003	
	Function	This parameter sets which function is implemented by MDO4 digital output. See Table 23 for details.	

5.13. CONTROL METHOD MENU

5.13.1. OVERVIEW

The Control Method menu allows selecting one of the three control sources below:

0: Disable

1: Terminals

2: Serial Link

3: Fieldbus

For more details, please refer to the Control Method section in the Sinus Penta's Programming Instructions manual (parameters **C140** to **C142**).
If multiple control sources are selected, the logic status of the ENABLE command and the digital inputs programmed as external trips (if any) depend on the control terminals resulting from the AND of all the active control sources.

NOTE For the activation of the **ENABLE** command, always close the MDI2 input in the terminal board, whatever control source is selected.

NOTE Whatever control source is selected, the status of MDI4 (Pre-charge Return) and MDI5 (Filter Capacitor Protection) is detected in the local control terminals of the drive.

The logic status of any other programmed digital input is considered by executing the OR between the selected control sources.

5.14. DIGITAL INPUTS MENU

5.14.1. OVERVIEW

The parameters contained in the Digital Inputs menu allocate particular digital control functions to each digital input on the terminal board. Each parameter implements a particular function, which is assigned to a given terminal on the terminal board.

5.14.2. FACTORY SETTING OF THE DIGITAL INPUTS

Function	Terminal	Description
Not used	MDI1	
ENABLE	MDI2	Enables the Penta drive.
RESET	MDI3	Resets the alarms tripped.
Status of the NO auxiliary contact of the pre-charge contactor	MDI4	Indicates the pre-charge contactor closure; if no closure signal is sent, the drive run is disabled (Alarm **A058**).
Status of the NC auxiliary contact of the thermal/magnetic circuit breaker for the filter capacitors	MDI5	If open, it indicates that the thermal/magnetic CB tripped (alarm A059).
Not enabled	MDI6	
Not enabled	MDI7	
Not enabled	MDI8	

Table 25: Factory-setting of the terminal board

Some functions cannot be programmed, but are assigned to given terminals:

Function	Terminal
ENABLE	MDI2
RESET	MDI3
External pre-charge status	MDI4
Filter capacitor status	MDI5

Table 26: Unprogrammable functions

Function	Terminal
External alarm 1	MDI6 ÷ MDI8
External alarm 2	MDI6 ÷ MDI8
External alarm 3	MDI6 ÷ MDI8

Table 27: Programmable functions

5.14.3. ENABLE (TERMINAL MDI2)

The **ENABLE** input function is assigned to terminal **MDI2**. It **enables the drive operation**. It cannot be programmed for any other terminals. **To enable the drive operation, the** ENABLE **input is to be always active for the drive terminal board and for all active terminal boards when other control sources are selected.**
When the **ENABLE** input is active, the drive starts, the DC-bus voltage attains its reference level and the MDO4 output enables, which activates the motor drive.
When the **ENABLE** input is disabled, the drive deactivates, so the DC-bus voltage attains the rectified mains voltage value.

CAUTION The drive is disabled as soon as the input signal for **MDI2** (**ENABLE**) is disabled.

NOTE When the **ENABLE** is active, C (configuration) parameters cannot be altered.

5.14.4. RESET (TERMINAL MDI3)

The **RESET** function is assigned to input terminal **MDI3**. It resets the alarms to unlock the drive and cannot be programmed for any other terminal.

Reset procedure

Activate the **RESET** input for some time or press the RESET key in the keypad; the drive unlocks only if the cause responsible for the alarm has disappeared.

NOTE Factory-setting: when the drive is shut down, this does not reset the alarm tripped, which is stored to memory and is displayed at next power on to lock the drive. Perform a reset procedure to unlock the drive.
The alarms stored may be automatically reset at power on by setting special parameters (please refer to the Autoreset menu in the Sinus Penta's Programming Instructions manual).

DANGER Electrical shock hazard exists on output terminals (47/+, 49/–) and on the braking resistor terminals (47/+, 48/B) even when the drive is locked.

5.14.5. LIST OF PROGRAMMABLE PARAMETERS C164 TO C166

NOTE

External alarms are the only functions that can be programmed for digital inputs MDI6 to MDI8.

Parameter	FUNCTION	User Level	MODBUS Address	DEFAULT VALUES
C164	External Alarm 1	ADVANCED	1164	Inactive
C164a	External Alarm 1 Trip Delay	ADVANCED	1305	Instantaneous
C165	External Alarm 2	ADVANCED	1165	Inactive
C165a	External Alarm 2 Trip Delay	ADVANCED	1306	Instantaneous
C166	External Alarm 3	ADVANCED	1166	Inactive
C166a	External Alarm 3 Trip Delay	ADVANCED	1307	Instantaneous

Table 28: List of parameters C164 to C166

C164 C165 C166 External Alarm Input

C164 C165 C166			
	Range	5 ÷ 8	Inactive, MDI6 ÷ MDI8
	Default	5	Inactive
	Level	ADVANCED	
	Address	1164, 1165, 1166	
	Function	If one of these 3 functions is programmed for one of the available terminals, the drive locks when the command contact ingoing to the terminal selected by par. **C164**, **C165** or **C166 opens**. Parameters **C164a**, **C165a**, **C166a** allow setting the trip delay for any external alarm. To restart the drive, close the digital input configured as "external alarm" and perform a RESET procedure. Alarms tripped due to those functions are **A083**, **A084**, **A085** respectively. This function is inactive by default.	

CAUTION

If multiple control sources are enabled (see the CONTROL METHOD MENU), each "External Alarm" command signal is obtained by computing the logic AND of the signal ingoing to the selected terminal for all the enabled control sources; to prevent the external alarm from tripping, the signals of all terminal boards must be input signals for the active terminal.
The alarm trips if only one input signal is disabled for one of the enabled control sources. Parameters **C164a**, **C165a**, **C166a** allow setting the trip delay for any external alarm.

C164a C165a C166a External Alarm Trip Delay

C164a C165a C166a	Range	0 ÷ 32000	0 ÷ 32000 msec
	Default	0	Instantaneous
	Level	BASIC	
	Address	1305, 1306, 1307	
	Function	Trip delay of the external alarm. This is a delay time allowing checking if the input set as “external alarm” is open before the alarm trips.	

5.15. BRAKING UNIT MENU

5.15.1. OVERVIEW

A braking resistor connected between power terminals 47/+ and 48/B of the regenerative drive can be used for the RGN drive sizes provided with a built-in braking unit (up to size S32 included). The braking resistor is used only when regeneration can cause overvoltage faults in the regenerative drive.
This menu allows setting the max. duty-cycle of the drive braking resistor.
The maximum allowable duty-cycle of the braking resistor is set through parameters **C211** [Max. Continuous Operation Time (Ton)] and **C212** [Max. Duty- cycle (100 * Ton / (Ton+Toff) [%])]. If Ton = **C212**, when the time set is over, the respective command is disabled for a time equal to Toff = (100 – **C211**) * **C212** / **C211** [sec].

5.15.2. LIST OF PROGRAMMABLE PARAMETERS C211 AND C212

Parameter	FUNCTION	User Level	MODBUS Address	DEFAULT VALUES
C211	Max. Continuous Operation Time	ENGINEERING	1211	2000 sec
C212	Braking Duty-cycle	ENGINEERING	1212	10%

Table 29: List of parameters C211 and C212

C211 Max. Continuous Operation Time

C211			
	Range	0 ÷ 32000	0 ÷ 32000 msec
	Default	2000	2000 sec
	Level	ENGINEERING	
	Address	1211	
	Function	This parameter sets the max. continuous operation time for the braking resistor. If the braking resistor is used for the time set in **C211**, the relevant command is disabled for the rest time set in **C212**.	

C212 Braking Duty-cycle

C212			
	Range	0 ÷ 100	0 ÷ 100%
	Default	10	10%
	Level	ENGINEERING	
	Address	1212	
	Function	**C212** = (Ton/(Ton+Toff))*100 This parameter sets the allowable duty-cycle for the braking resistor. It is expressed as a percentage and sets the rest time of the braking resistor after its max. continuous operation time set in **C211**.	

5.16. AUTORESET MENU

5.16.1. OVERVIEW

The Autoreset function can be enabled in case an alarm trips. You can enter the maximum number of autoreset attempts and the time required for resetting the attempt number. If the Autoreset function is disabled, you can program an autoreset procedure at power on, which resets an active alarm when the drive is shut off. Undervoltage alarms or mains loss alarms can be saved in the fault list in the Autoreset menu.
To activate the Autoreset function, set a number of attempts other than zero in parameter **C255**. If the number of attempts reset within a time interval t < **C256** is equal to the value set in **C255**, the autoreset function is disabled; it will be enabled again only when a time longer than or equal to **C256** has passed.
If the drive is turned off when an alarm is active, the alarm tripped is stored to memory and will be active at next power on. Regardless of the Autoreset function setup, an automatic reset of the last alarm stored can be obtained when the drive is next turned on (**C257** [Yes]).

5.16.2. LIST OF PROGRAMMABLE PARAMETERS C255 TO C261

Parameter	FUNCTION	User Level	MODBUS Address	DEFAULT VALUES
C255	Autoreset Attempt Number	ENGINEERING	1255	0
C256	Attempt Counting Reset Time	ENGINEERING	1256	300 sec
C257	Alarm reset at Power On	ENGINEERING	1257	0: [Disabled]
C258	Enable TLP Fault Autoreset	ENGINEERING	1258	0: [Disabled]
C259	Enable CFilt Fault Autoreset	ENGINEERING	1259	0: [Disabled]
C260	Enable Mains Fault Autoreset	ENGINEERING	1260	0: [Disabled]
C261	Enable External Alarm Autoreset	ENGINEERING	1261	0: [Disabled]

Table 30: List of parameters C255 to C261

C255 Autoreset Attempt Number

C255			
	Range	0 ÷ 100	0 ÷ 100
	Default	0	0
	Level	ENGINEERING	
	Address	1255	
	Function	If set different from Disable (Disable = 0), this parameter enables the Autoreset function and sets the max. number of reset attempts for a time interval set in **C256**. If a time equal to the time set in **C256** passes starting from the last alarm tripped, the autoreset attempt count is reset.	

C256 Attempt Counting Reset Time

C256			
	Range	0 ÷ 1000	0 ÷ 1000 sec
	Default	300	300 sec
	Level	ENGINEERING	
	Address	1256	
	Function	This parameter sets the time that passes from the last alarm tripped to reset the autoreset attempt number.	

C257 Alarm Reset at Power On

C257	Range	0 ÷ 1	0: [Disabled]; 1: [Yes]
	Default	0	0: [Disabled]
	Level	ENGINEERING	
	Address	1257	
	Function	At power on, this parameter enables the automatic reset of the alarms tripped when the drive is powered off.	

C258 Enable TLP Fault Autoreset

C258	Range	0 ÷ 1	0: [Disabled]; 1: [Yes]
	Default	0	0: [Disabled]
	Level	ENGINEERING	
	Address	1258	
	Function	This parameter enables the Autoreset function for the TLP fault; the autoreset attempt number is set in **C255**.	

C259 Enable CFilt Fault Autoreset

C259	Range	0 ÷ 1	0: [Disabled]; 1: [Yes]
	Default	0	0: [Disabled]
	Level	ENGINEERING	
	Address	1259	
	Function	This parameter enables the Autoreset function for the Cfilt fault; the autoreset attempt number is set in **C255**.	

C260 Enable Mains Fault Autoreset

C260	Range	0 ÷ 1	0: [Disabled]; 1: [Yes]
	Default	0	0: [Disabled]
	Level	ENGINEERING	
	Address	1260	
	Function	This parameter enables the Autoreset function for the mains fault; the autoreset attempt number is set in **C255**.	

C261 Enable Autoreset for External Alarm

C261	Range	0 ÷ 1	0: [Disabled]; 1: [Yes]
	Default	0	0: [Disabled]
	Level	ENGINEERING	
	Address	1261	
	Function	This parameter enables the Autoreset function for external alarms; the autoreset attempt number is set in **C255**.	

5.17. EXPANSION BOARD CONFIGURATION MENU

5.17.1. OVERVIEW

NOTE

Parameters in this menu are **Rxxx** parameters.
Once saved, they have no effect until the drive is next powered on, or until the control board is reset by holding down the **RESET** key for more than 5 secs.

5.17.2. LIST OF PROGRAMMABLE PARAMETERS R021 TO R023

Parameter	FUNCTION	User Level	MODBUS Address	DEFAULT VALUES
R021	Data Logger Setting	ENGINEERING	551	1: Disable
R023	I/O Board Setting	ENGINEERING	553	0: None

Table 31: List of parameters R021 to R023

R021 Data Logger Setting

R021	Range	1 ÷ 2	1: Disable 2: Enable
	Default	1	1: Disable
	Level	ENGINEERING	
	Address	551	
	Function	This parameter enables or disables Data Logger initialization (if the ES851 Data Logger board is fitted).	

R023 I/O Board Setting

R023	Range	0 ÷ 6	0: None 1: XMDO 2: XMDO + Pout 3: XMDO + PT100 4: XMDO + Pout + PT100 5: XMDO + ADE + PT100 6: XMDO + ADE + PT100 + Pout
	Default	0	0: None
	Level	ENGINEERING	
	Address	553	
	Function	Based on the settings in the respective parameters, this parameter enables controlling the following items: XMDO: Digital OUTPUTS (see the AUXILIARY DIGITAL OUTPUTS MENU); Pout: DC measures (see the DC MEASURES SETTINGS MENU); PT100: Up to 4 PT100 probes (see the PT100); ADE: Energy measures through ADE7758 (see the ADE REGISTERS SETTINGS MENU).	

NOTE

ES847 is required to control DC measures, PT100 probes and energy measures via ADE7758.
Both ES847 and ES870 can be used for controlling XMDO digital outputs.

5.18. RGN DRIVE ALARMS

5.18.1. OVERVIEW

This section covers the alarms relating to the regenerative application only. The whole alarm set is detailed in the Sinus Penta's Programming Instructions manual.

5.18.2. ALARM CODES

Alarm	Name	Description	Can be enabled by the user	Motor drive disable		
				MDO4=1	MDO4=2	MDO4=3
A058	External bypass not closed	External pre-charge contactor open with closure command	*No*	YES	YES	YES
A059	Filter C. Protection	Filter capacitor T/M circuit breaker open	*No*	YES	NO with active Autoreset	NO
A067	Amb.Overtemp.	Ambient overtemperature	*No*	YES	NO with active Autoreset	NO
A100	ALR Fmains KO	Min. mains frequency fault	*Yes* *	Yes, if enabled	NO with active Autoreset	NO
A101	ALR V MIN KO	Min. mains voltage fault	*Yes* *	Yes, if enabled	NO with active Autoreset	NO
A102	ALR V MAX KO	Max. mains voltage fault	*Yes* *	Yes, if enabled	NO with active Autoreset	NO
A103	PLL KO	No synchronization with the mains	*Yes* *	Yes, if enabled	NO with active Autoreset	NO
A127	ADE COMMUNICATION FAULT	Communication failure with the ADE integrated circuit in option board ES847	*No*	Yes	Yes	Yes

Table 32: List of the alarms for the Regenerative Sinus Penta

* Use parameters **P570-P575** (MAINS MONITOR MENU) to enable/disable the min./max. voltage/frequency faults. If the frequency/voltage monitor mode is enabled (pars. **P570-P575**), the mains faults can be disabled by setting **C502 = No**. In that case, if a mains failure occurs, the regenerative drive is put in stand-by for some time and restarts when the mains voltage/frequency parameters range between the values set in the MAINS MONITOR MENU.

A047 Undervoltage

A047	Description	DC-bus voltage lower than Vdc_min.
	Event	Voltage measured in DC bus capacitors has dropped below the min. value allowed for the proper operation of the drive class being used.
	Possible causes	• Supply voltage has dropped below 200VAC–25% for class 2T, 380V–35% for class 4T, 500V – 15% for class 5T, 600VAC – 15% for class 6T. Also, the drive is not capable of regulating DC-bus voltage due to a great load demand. • Alarm A047 may trip even when the mains voltage drops below the preset threshold for some time (for example due to direct load connection). • Mains voltage failure (even of one phase only). • Failure in DC-bus voltage measure circuit.
	Solutions	1. Check if voltage is supplied to the 3 mains phases (terminals **R**, **S**, **T**). Check mains voltage measured in **M502** and check DC-bus voltage measured in **M501**. Also check the values of these measures which are sampled in the **FAULT LIST** as soon as the alarm trips. 2. If the alarm persists, please contact ELETTRONICA SANTERNO's After-sales service.

A048 Overvoltage

A048		
	Description	Overvoltage in DC-bus.
	Event	Voltage measured in DC-bus capacitors has exceeded the max. value allowed for the proper operation of the drive class being used.
	Possible causes	Overvoltage can be due to the regenerative drive or the motor drive, as they are both connected to the DC-bus. • Too high supply voltage; make sure that it does not exceed 240VAC +10% for class 2T, 480V + 10% for class 4T, 600VAC + 10% for class 5T, 690VAC + 10% for class 6T. • Very inertial load and too short deceleration ramp for the motor drive, which delivers excessive energy to the mains, thus causing failures in the regenerative drive. • Motor pulled by the load (eccentric load). • Failure in DC-bus voltage measure circuit.
	Solutions	1. Check if voltage is supplied to the 3 mains phases (terminals **R**, **S**, **T**). Check mains voltage measured in **M502** and check DC-bus voltage measured **M501**. Also check the values of these measures which are sampled in the **FAULT LIST** as soon as the alarm trips. 2. If a very inertial load is connected and the alarm tripped when decelerating, set a longer deceleration time for the motor drive, or increase the DC-bus voltage regulator gain; make sure that setting is steady. If short stop times are required, or if the motor is pulled by the load even if the regenerative drive is properly tuned, a braking resistor can be installed on the regenerative drive up to Size S32. 3. If the alarm persists, please contact ELETTRONICA SANTERNO's After-sales service.

NOTE Braking resistors can be installed in the regenerative drive only. For sizes greater than S32, please contact Elettronica Santerno.

A058 EXT BYPASS NOT CLOSED

A058	Description	Hardware failure; the external pre-charge contactor is open even after sending a closure signal.
	Event	The control board has forced the closure of the contactor for the short-circuit of the pre-charge external resistors of the DC-bus capacitors, **but has not received any closure signal** (auxiliary contact of the pre-charge relay).
	Possible causes	Wrong wiring, faulty contactor, control board failure.
	Solutions	1. Check wiring and contactor. 2. Reset the alarm: send a **RESET** command. 3. If the alarm persists, please contact ELETTRONICA SANTERNO's After-sales service.

A059 Filter Capacitor Protection

A059	Description	The thermal/magnetic circuit breaker protecting the capacitors of the input filter has tripped.
	Event	The control board has not detected any **filter capacitor protection OK signal** (auxiliary contact of the thermal/magnetic circuit breaker protecting the drive output filter capacitors).
	Possible causes	Wrong wiring, capacitor overcurrent, control board failure.
	Solutions	1. Check capacitors and wiring. 2. Restore the T/M circuit breaker and reset the alarm: send a **RESET** command. 3. If the alarm persists, please contact ELETTRONICA SANTERNO's After-sales service.

A067 Ambient Overtemperature

A067	Description	Too high ambient temperature.
	Event	The ambient temperature detected by the control board is too high.
	Possible causes	Drive or cabinet overheating; control board NTC failure.
	Solutions	1. Open the cabinet to check its conditions; check measure **M062**. 2. Reset the alarm: send a **RESET** command. 3. If the alarm persists, please contact ELETTRONICA SANTERNO's After-sales service.

A100 Mains Frequency KO

A100	Description	The mains frequency is not included in the range set by the values in the MAINS MONITOR MENU.
	Event	Strong variations of the mains frequency.
	Possible causes	Voltage dips during the drive operation.
	Solutions	1. Check the value of the mains frequency measured in **M504.** 2. Also check the values of this measure, that are sampled in the **FAULT LIST** in the instant when the protection tripped. 3. This protection can be disabled or delayed (see the MAINS MONITOR MENU).

A101 Min. Mains Voltage Supply

A101	Description	The characteristic of the mains voltage is under the tolerance set by the values in the MAINS MONITOR MENU.
	Event	Power supply loss.
	Possible causes	• A feeder cable has disconnected. • The mains supply is too low. • A voltage dip has occurred.
	Solutions	1. Check the correct voltage value in the 3 phases (terminals **R**, **S**, **T**). 2. Check the value of the mains voltage measured in **M502.** 3. Also check the values of this measure, that are sampled in the **FAULT LIST** in the instant when the protection tripped. 4. This protection can be disabled or delayed (see the MAINS MONITOR MENU).

A102 Max. Mains Voltage Supply

A102	Description	The characteristic of the mains voltage is above the tolerance set by the values in the MAINS MONITOR MENU.
	Event	Strong variations of the mains voltage.
	Possible causes	The mains supply is too high.
	Solutions	1. Check the correct voltage value in the 3 phases (terminals **R**, **S**, **T**). 2. Check the value of the mains voltage measured in **M502**. 3. Also check the values of this measure, that are sampled in the **FAULT LIST** in the instant when the protection tripped. 4. This protection can be disabled or delayed (see the MAINS MONITOR MENU).

A103 PLL KO

A103	Description	The characteristics of the supply mains are not ranging between the tolerance values set in the MAINS MONITOR MENU.
	Event	Supply mains loss or strong variations of the mains frequency or the mains voltage.
	Possible causes	• A feeder cable is disconnected. • A voltage dip has occurred.
	Solutions	This protection can be disabled or delayed (see the MAINS MONITOR MENU).

A105, A106, A107, A108 PT100 Channel 1,2,3,4 Fault

A105 (Channel 1) A106 (Channel 2) A107 (Channel 3) A108 (Channel 4)	Description	**A105**: PT100 Channel 1 fault **A106**: PT100 Channel 2 fault **A107**: PT100 Channel 3 fault **A108**: PT100 Channel 4 fault
	Event	• Temperature measures **M069..M072** exceeding the thresholds set in **P320a/P322a/P324a/P326a** (see the PT100 MEASURES MENU); • Hardware inputs out of the temperature measure range of the drive (–50°C ÷ +260 °C).
	Possible causes	• Wrong settings of switches **SW1** or **SW2** on ES847 option board; or: • The fault is independent of the drive operation: try to find the reason why temperatures of channels 1..4 exceeded the preset thresholds.
	Solutions	1. Check setting of **SW1** and **SW2.** 2. Check external signals.

A127 ADE COMMUNICATION FAULT

A127	Description	Communication failure with the ADE integrated circuit in option control board ES847.
	Event	No integrated circuit is detected by ES847 control board.
	Possible causes	No ES847 is installed, or a wrong control board is installed.
	Solutions	1. Check if ES847 option board is properly connected. 2. Reset the alarm: send a **RESET** command. 3. If the alarm persists, please contact ELETTRONICA SANTERNO's After-sales service.