SPA9000 AF Drives Regenerative Supply Unit

Application Manual

August 2007
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Safety

Definitions and Symbols

⚠ WARNING

This symbol indicates high voltage. It calls your attention to items or operations that could be dangerous to you and other persons operating this equipment. Read the message and follow the instructions carefully.

⚠

This symbol is the "Safety Alert Symbol." It occurs with either of two signal words: CAUTION or WARNING, as described below.

⚠ WARNING

Indicates a potentially hazardous situation which, if not avoided, can result in serious injury or death.

⚠ CAUTION

Indicates a potentially hazardous situation which, if not avoided, can result in minor to moderate injury, or serious damage to the product. The situation described in the CAUTION may, if not avoided, lead to serious results. Important safety measures are described in CAUTION (as well as WARNING).

Hazardous High Voltage

⚠ WARNING

Motor control equipment and electronic controllers are connected to hazardous line voltages. When servicing drives and electronic controllers, there may be exposed components with housings or protrusions at or above line potential. Extreme care should be taken to protect against shock.

Stand on an insulating pad and make it a habit to use only one hand when checking components. Always work with another person in case an emergency occurs. Disconnect power before checking controllers or performing maintenance. Be sure equipment is properly grounded. Wear safety glasses whenever working on electronic controllers or rotating machinery.

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Chapter 1 — Regenerative Application (RGCHST02)

Introduction

The SPA9000 from Eaton's electrical business is a regenerative power converter for the front-end of a common DC bus product line. The SPA9000 is utilized with standard inverter hardware and special application software. An external L(CL)-filter and charging circuit is needed. This unit is selected when low harmonics are required or for dynamic braking energy recovery. The principle connection of the drive has been described in **Figure 1-1**.

The Regenerative Application is easy and flexible to use and normally requires no parameter adjustment. The parameters of the Regenerative Application are explained in **Chapter 2** of this manual.

The basic I/O-configuration of the drive consists of OPTA1 and OPTA2 option cards. The basic I/O configuration has been described in **Table 1-1**. An option card OPTB5 can be used if additional digital outputs are needed. Configuration has been described in **Table 1-2**.

As a default the control place (P3.1) of the drive is Keypad.

Main Contactor Control

The Regenerative Application controls the main contactor of the system with Relay Output RO2. When charging of the DC bus is ready, the main contactor will be closed. The status of the main contactor is monitored via digital input (Default is DIN4). As a default the main contactor monitoring is on but it can be set off with parameter P2.2.1.4 by choosing the option "0 = Not used".

Faults can be set to open the main contactor by choosing a response to fault to be "3 = Fault, DC OFF". When a fault occurs, the main contactor will be opened after one second so the drive will go to stop state first. If the charging is on when the fault is acknowledged, the main contactor will be closed.

An external charging circuit is needed to charge the DC bus.

Start-Up

1. Connect the unit according to **Figure 1-1**.
2. Power up the unit.
3. Check that digital input parameters (P2.2.1.1 – P2.2.1.8) have been set according to connections. All the unused input signals must be set to "0 = Not used" state.
4. Change the control place to I/O (P3.1).
5. Charge the unit.

In Case of Parallel SPA Regenerative Supply Unit:

1. Set Drooping parameter (P2.4.16) = 3% to 5% (same value on all units).
2. Set PWM Synch parameter (P2.4.17) = Enable (in every unit).
3. Set Charge Switch Delay (P2.3.1.6) on following units to prevent all main contactors from closing at the same time.
4. Set Start Up Delay for droop follower units (P2.5.2) to allow each unit to synchronize with line before the next unit starts.

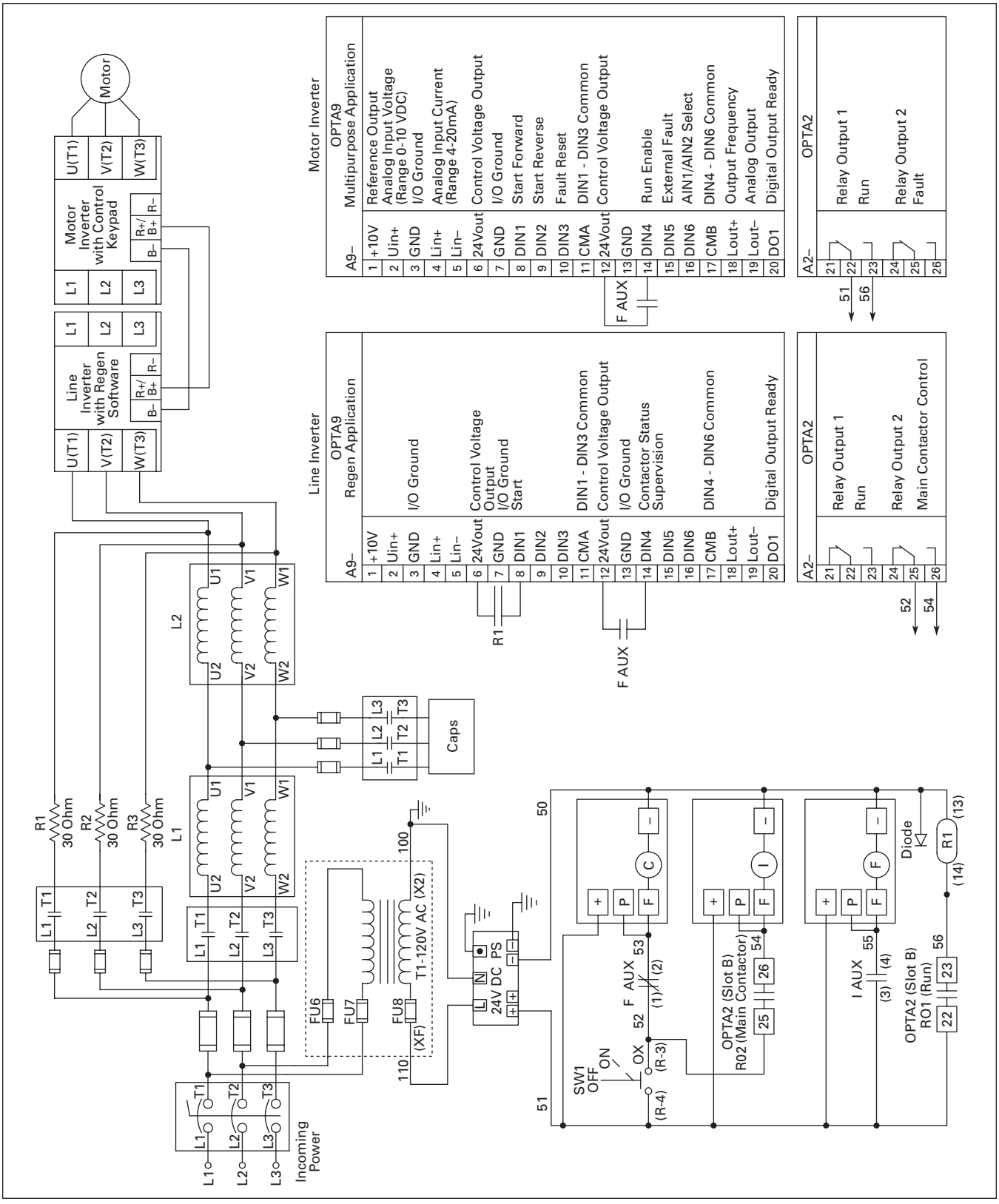

Figure 1-1: Typical SPA9000 Connection

Control I/O

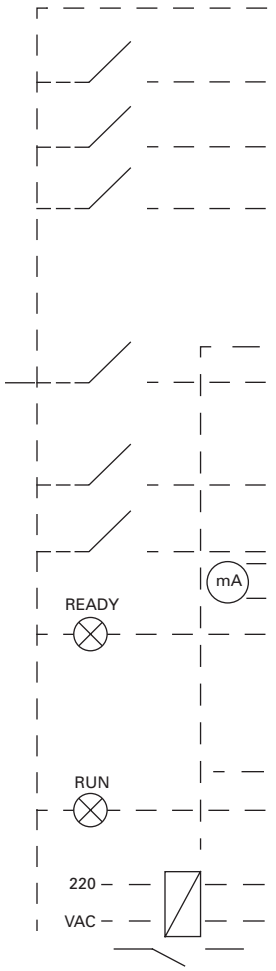

Table 1-1: Regenerative Application Default I/O Configuration

Terminal	Signal	Description
OPTA1		
1	$+10V_{ref}$	
2	AI1+	
3	AI1-	I/O Ground	Ground for reference and controls
4	AI2+		
5	AI2-		
–	+24V	Control voltage output	Voltage for switches, etc. max 0.1 A
7	GND	I/O ground	Ground for reference and controls
– 8	DIN1	Start	0 = Stop, 1 = Run
– 9	DIN2	Not Used	—
– 10	DIN3	Not Used	—
11	CMA	Common for DIN1 – DIN 3	Connect to GND or +24V
12	+24V	Control voltage output	Voltage for switches (see #6)
– 13	GND	I/O ground	Ground for reference and controls
– 14	DIN4	Main contactor status supervision	0 = contactor open 1 = contactor closed
15	DIN5	Not Used	—
– 16	DIN6	Fault Reset	—
17	CMB	Common for DIN4 – DIN6	Connect to GND or +24V
– 18	AO1+		Programmable Range 0 – 20 mA/R_L, max. 500Ω
– 19	AO1-		
– 20	DO1	Digital output READY	Programmable Open collector, I≤50mA, U≤48V DC
OPTA2			
21	RO1	Relay output 1 Running	
– 22	RO1		
– 23	RO1		
24	RO2	Relay output 2 Main contactor control	
– 25	RO2		
– 26	RO2		

Table 1-2: Default I/O Configuration with Option Card OPTB5

Terminal		Signal
22	RO1 Common	Relay Output 1 Fault
23	RO1 NO	
25	RO2 Common	Relay Output 2 Warning
26	RO2 NO	
28	RO3 Common	Relay Output 3 Temperature Warning
29	RO2 NO	

Principle of Operation

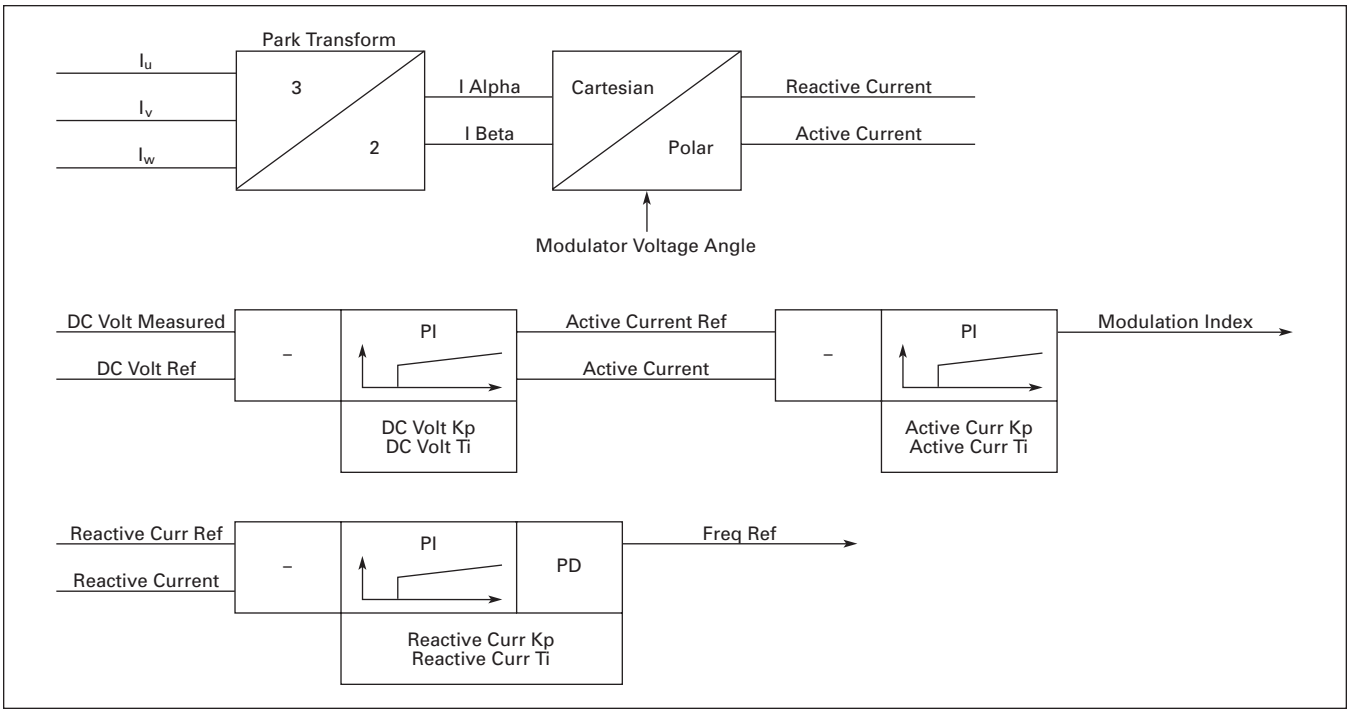

Figure 1-2: SPA9000 Block Diagram

Active current and reactive currents are calculated from the three input phase current measurements (I_u, I_v, I_w) as shown in the block diagram. The DC voltage controller is a PI type regulator. DC voltage reference sets the value of DC link voltage to be maintained. It is compared to measured DC voltage to obtain DC voltage error as the input for DC voltage controller. The response of the controller is adjusted by changing its gain and integral time values. Normally the default values are satisfactory with standard LCL filter and need not be changed.

The output of the DC voltage controller is the active current reference, which is compared to measured active current, and the error between them is the input for active current controller. The output of the active current controller changes the modulation index and controls the inverter voltage.

The reactive current reference can be used for reactive power compensation. Positive reactive current reference indicated inductive and negative reactive current reference indicates capacitive reactive power compensation. The default value of the reactive current reference parameter is zero. The set value of the reactive current reference is compared to its measured value and the error is fed to the PI type regulator. It is also referred to in the interface as synchronizing controller as its job is to keep the inverter synchronized with line supply. Frequency reference to the unit is obtained by derivation of reactive current controller output.

Parameter Lists

On the next pages you will find the lists of parameters within the respective parameter groups. Parameter descriptions are given by ID number in **Chapter 2**.

Column explanations:

Code	=	Location indication on the keypad; Shows the operator the present parameter number
Parameter	=	Name of parameter
Min.	=	Minimum value of parameter
Max.	=	Maximum value of parameter
Unit	=	Unit of parameter value; Given if available
Default	=	Value preset by factory
Cust	=	Customer's own setting
ID	=	ID number of the parameter (used with PC tools)

① = parameter value can only be changed after the drive has been stopped.

Monitoring Values (Control Keypad: Menu M1)

The monitoring values are the actual values of parameters and signals as well as status and measurements. Monitoring values cannot be edited.

See Pub. No. MN04003002E, *SVX9000 AF Drives User Manual*, for more information.

Table 1-3: Monitoring Values

Code	Parameter	Unit	ID	Description
V1.1	Used DC VoltRef	%	1200	Used DC voltage reference by the regenerative unit in % of Nominal DC Voltage
V1.2	DC-link Voltage	V	1108	Measured DC Link voltage in Volts
V1.3	Total Current	A	1104	Total current of the regenerative unit in Amperes
V1.4	Active Current	%	1125	Active current in % of nominal current
V1.5	Reactive Current	%	1157	Reactive current of the regenerative drive in % of nominal current
V1.6	U Phase Current	%	1149	Real Time U phase current 100.0% = nominal current
V1.7	V Phase Current	%	1150	Real Time V phase current 100.0% = nominal current
V1.8	W Phase Current	%	1151	Real Time W phase current 100.0% = nominal current
V1.9	Supply Voltage	V	1107	Incoming supply voltage in Volts
V1.10	Supply Frequency	Hz	1101	Supply frequency in ##. ## Hz. The sign indicates the phase order.
V1.11	DIN1, DIN2, DIN3		15	Digital Inputs A1, A2 and A3 Status (sum)
V1.12	DIN4, DIN5, DIN6		1613	Digital Inputs B4, B5 and B6 Status (sum)
V1.13	DO1, RO1, RO2		1714	Digital Output and Relay 1&2 Status (sum)
V1.14	Unit Temperature	°C	1109	Temperature of the unit in degrees Celsius
V1.15	Unit Nom Voltage	V	1117	Nominal voltage rating for the unit in Volts
V1.16	Unit Nom Current	A	1118	Nominal current rating of the drive in Amperes
V1.17	MainControlWord		1160	See **Appendix A**
V1.18	MainStatusWord		1162	See **Appendix A**
V1.19	Aux Status Word		1163	See **Appendix A**
V1.20	Fault Word 1		1172	See **Appendix A**
V1.21	Fault Word 2		1173	See **Appendix A**
V1.22	AuxControlWord 1		1161	See **Appendix A**
V1.23	Alarm Word 1		1174	See **Appendix A**
V1.24	Analog Input 1	%	13	AI1
V1.25	Analog Input 2	%	14	AI2
V1.26	PT-100 Temperature	°C	50	PT-100 Temperature
V1.27	DIN Status Word 1		56	See **Appendix A**
V1.28	DIN Status Word 2		57	See **Appendix A**

Basic Parameters (Control Keypad: Menu M2 ➠ G2.1)

Table 1-4: Basic Parameters G2.1

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P2.1.1	Supply Voltage	0.00	1000	V	0.00		1201	Nominal Line Voltage
P2.1.2	Supply Frequency	50.00	60.00	Hz	60.00		102	Nominal Line Frequency
P2.1.3	DCVoltReference	105.00%	130% for 500V 115% for 690V	%	110.00%		1462	DC Voltage reference as % of Nominal DC Voltage.
P2.1.4	Current limit	0.00	Unit I_L current	A	7		107	Total current limit in Amperes.
P2.1.5	Start / Stop Function	0	1		0		1274	**0** = (Normal) Regenerative unit starts only with RUN Request. **1** = (Auto) Regenerative unit will start automatically when the energy is fed back to the line (regeneration) and stops when there is no regeneration. RUN Request will force unit to start.

Input Signals (Control Keypad: Menu G2 ➠ G2.2)

Table 1-5: Digital Input Parameters G2.2.1

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P2.2.1.1	Run Request	0	6		1		1206	**0** = Not used **1** = DIN1 **2** = DIN2 **3** = DIN3 **4** = DIN4 **5** = DIN5 **6** = DIN6
P2.2.1.2	Force Main Contactor Open	0	12		0		1508	**0** = Not used **1** = DIN1 **2** = DIN2 **3** = DIN3 **4** = DIN4 **5** = DIN5 **6** = DIN6 **7** = DIN1 (inverted) **8** = DIN2 (inverted) **9** = DIN3 (inverted) **10** = DIN4 (inverted) **11** = DIN5 (inverted) **12** = DIN6 (inverted)
P2.2.1.3	LCL OverTemp. Mon	0	12		0		1179	Same as par. P2.2.1.2
P2.2.1.4	Main contactor Acknowledge	0	6		4		1453	Same as par. P2.2.1.1
P2.2.1.5	LCL Fan Monitor	0	12		0		1178	Same as par. P2.2.1.2
P2.2.1.6	Fault Reset	0	6		6		1208	Same as par. P2.2.1.1
P2.2.1.7	External fault	0	12		0		1214	Same as par. P2.2.1.2
P2.2.1.8	Run Enable	0	6		0		1212	Same as par. P2.2.1.1

Output Signals (Control Keypad: Menu G2 ➠ G2.3)

Table 1-6: Digital Output Parameters G2.3.1

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P2.3.1.1	Digital output 1 function	0	10		9		1216	Signal selection for the digital indication through DO1.
P2.3.1.2	Relay Output 1 function	0	10		2		1217	Signal selection for the digital indication through RO1.
P2.3.1.3	Expander board relay output 1 function	0	10		3		1385	Signal selection for the digital indication through ROE1 (Option card OPTB5).
P2.3.1.4	Expander board relay output 2 function	0	10		5		1386	Signal selection for the digital indication through ROE2 (Option card OPTB5).
P2.3.1.5	Expander board relay output 3 function	0	10		10		1390	Signal selection for the digital indication through ROE3 (Option card OPTB5).
P2.3.1.6	Charge switch delay (RO2)	0	20	s	0		1510	Delay RO2 function after DC bus is charged.

Table 1-7: Analog Output 1 Parameters G2.3.2

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P2.3.2.1	Analog Output 1 signal selection	AnOUT:01	AnOUT:E.10		AnOUT:A1		464	TTF programming method used.
P2.3.2.2	Analog Output 1 function	0	15		0		307	**0** = Not used **1** = Absolute power
P2.3.2.3	Analog Output 1 filter time	0.00	100.00		0.1		308	**0** = No filtering
P2.3.2.4	Analog Output 1 inversion	0	1		0		309	**0** = Not inverted **1** = Inverted
P2.3.2.5	Analog Output 1 minimum	0	1		0		310	**0** = 0 mA **1** = 4 mA
P2.3.2.6	Analog Output 1 scale	10	1000	%	100		311	
P2.3.2.7	Analog Output 1 offset	-100.0	100.0	%	0.00		375	

Drive Control Parameters (Control Keypad: Menu M2 ➠ G2.4)

Note: For advanced system users only. The parameters in this group should not normally be changed. Contact factory before you do any changes in these.

Table 1-8: Drive Control Parameters G2.4

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P2.4.1 ①	Voltage Ctrl Kp	0	32000	Unit	200		1451	Gain for the DC voltage controller of the unit
P2.4.2	Voltage Ctrl Ti	0	1000	ms	50		1452	Integral time for the DC Voltage controller of the regenerative unit
P2.4.3	Active current Kp	0	4000		400		1455	Regen active current controller gain. Init = 400
P2.4.4	Active current Ti	0	1000		15		1456	Regen current time active controller integral (15 = 1.5 mS)
P2.4.5	SyncKp	0	32000		2000		1457	Regen synchronization gain
P2.4.6	SyncTi	0	1000		50		1458	Regen synchronization integral time (15 = 7 mS)
P2.4.7	Power Lim Motor	0.1	300.0	%	300.0		1289	Power limit for the motor side operation
P2.4.8	Power Lim Gen	0.1	300.0	%	300.0		1290	Power limit for the generator side operation
P2.4.9	Restart delay	0	32000	mS	100		1281	Minimum time between previous stop command and next start request to start the regenerative unit
P2.4.10	Stop delay	0	32000	mS	100		1282	Off time delay between removal of RUN request and stopping of the modulation of the regenerative unit.
P2.4.11	Reactive Curr Ref	-100.0	100.0	%	0.0		1459	Regenerative reactive current reference. 1000 = Nominal current Positive = Inductive Negative = Capacitive
P2.4.12	Capacitor size	0.0	100.0	%	5.0		1460	Regenerative filter capacitor size in %
P2.4.13	Inductor size	0.0	100.0	%	10.0		1461	Regenerative filter inductor size in %
P2.4.14	DCVoltSupervLim	0	1000	V	600		1454	DC Voltage supervision limit.
P2.4.15	Switching freq	3.6	16.0	KHz	3.6		601	Switching frequency
P2.4.16	Drooping	0.00	100.0	%	0.00		620	When units are used in parallel in independent mode, drooping can be used for current balancing
P2.4.17	PWM Synch	0	1		0		1501	**0** = Disable **1** = Enable

Table 1-8: Drive Control Parameters G2.4 (Continued)

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P2.4.18	Control Options	0	65535		32		1463	Regen control options to disable harmonic compensation. **Bit 2** = Disable 2nd order compensation, Control Options = 4. **Bit 3** = Disable 3rd order compensation, Control Options = 8. **Bit 5** = Disable 5th order compensation, Control Options = 32. **Bit 7** = Disable 7th order compensation, Control Options = 128.
P2.4.19	Modulator Type	0	3		3		1516	**0** = Hardware **1** = Software
P2.4.20	ModIndexLimit	0	200	%	97		655	

Master Follower Parameters (Control Keypad: Menu M2 ➠ G2.5)

Table 1-9: Master Follower Parameters G2.5

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P2.5.1	Master Follower Mode	0	2		0		1324	**0** = Single **1** = Master **2** = Follower
P2.5.2	Start Up Delay	0.00	327.67	s	0.00		1500	Starting delay when run command is given. Applicable only for Droop follower.
P2.5.3	Master Follower communication timeout	0.02	2.00	s	0.00		1352	Master Follower communication timeout delay in seconds

Fieldbus Parameters (Control Keypad: Menu M2 ➠ G2.6)

Table 1-10: Fieldbus Parameters G2.6

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P2.6.1	Fieldbus data out 1 selection	0	65535		1104		1490	Choose monitoring data with parameter ID
P2.6.2	Fieldbus data out 2 selection	0	65535		1174		1491	Choose monitoring data with parameter ID
P2.6.3	Fieldbus data out 3 selection	0	65535		1172		1492	Choose monitoring data with parameter ID
P2.6.4	Fieldbus data out 4 selection	0	65535		1173		1493	Choose monitoring data with parameter ID
P2.6.5	Fieldbus data out 5 selection	0	65535		56		1494	Choose monitoring data with parameter ID
P2.6.6	Fieldbus data out 6 selection	0	65535		57		1495	Choose monitoring data with parameter ID
P2.6.7	Fieldbus data out 7 selection	0	65535		0		1496	Choose monitoring data with parameter ID

Table 1-10: Fieldbus Parameters G2.6 (Continued)

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P2.6.8	Fieldbus data out 8 selection	0	65535		1107		1497	Choose monitoring data with parameter ID
P2.6.9	Fieldbus data in 1 selection	0	65535		0		876	Choose controlled data with parameter ID
P2.6.10	Fieldbus data in 2 selection	0	65535		1161		877	Choose controlled data with parameter ID
P2.6.11	Fieldbus data in 3 selection	0	65535		0		878	Choose controlled data with parameter ID
P2.6.12	Fieldbus data in 4 selection	0	65535		0		879	Choose controlled data with parameter ID
P2.6.13	Fieldbus data in 5 selection	0	65535		0		880	Choose controlled data with parameter ID
P2.6.14	Fieldbus data in 6 selection	0	65535		0		881	Choose controlled data with parameter ID
P2.6.15	Fieldbus data in 7 selection	0	65535		0		882	Choose controlled data with parameter ID
P2.6.16	Fieldbus data in 8 selection	0	65535		0		883	Choose controlled data with parameter ID

Protections (Control Keypad: Menu M2 ➠ G2.7)

Table 1-11: Protection Parameters G2.7

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P2.7.1	Response to Thermistor fault	0	3		1		732	**0** = No response **1** = Warning **2** = Fault **3** = Fault, DC OFF
P2.7.2	Response to external fault	0	3		2		701	Same as par. P2.7.1
P2.7.3	Response to LCL Overtemperature fault	0	3		2		1505	Same as par. P2.7.1
P2.7.4	Response to Ground fault	0	1		1		1332	**0** = No response **1** = Fault
P2.7.5	Ground Fault current	0.0	100.0	%	50.0		1333	Max level of Earth current in % of unit current.
P2.7.6	PB Watchdog delay	0	5.00	s	2.00		1354	Watchdog delay for PB master. The function can be disabled if set to zero.
P2.7.7	PT100 Numbers	0	3		0		739	If you have a PT100 input board installed in your drive, you can choose here the number of PT100 inputs in use.
P2.7.8	Response to PT100 fault	0	3		2		740	Same as par. P2.7.1
P2.7.9	PT100 Warning Limit	-30.0	200.0	°C	100.0		741	Set here the limit at which the PT100 warning will be activated.
P2.7.10	PT100 Fault Limit	-30.0	200.0	°C	130.0		742	Set here the limit at which the PT100 fault (F56) will be activated.

Table 1-11: Protection Parameters G2.7 (Continued)

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P2.7.11	Response to Overcurrent fault	2	3		2		1506	Same as par. P2.7.1
P2.7.12	Response to Overvoltage fault	2	3		2		1507	Same as par. P2.7.1
P2.7.13	Response to Drive Overtemperature fault	2	3		3		1517	Same as par. P2.7.1
P2.7.14	Response to Input Phase supervision	0	3		2		1518	Same as par. P2.7.1

Auto Restart Parameters (Control Keypad: Menu M2 ➠ G2.8)

Table 1-12: Auto Restart Parameters G2.8

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P2.8.1	Wait time	0.10	10.00	s	0.50		717	
P2.8.2	Trial time	0.00	60.00	s	30.00		718	
P2.8.3	Number of tries after overvoltage trip	0	10		0		721	
P2.8.4	Number of tries after overcurrent trip	0	3		0		722	
P2.8.5	Number of tries after external fault trip	0	10		0		725	
P2.8.6	Number of tries after Line Synch Fault Trip	0	10		0		1511	

Keypad Control (Control Keypad: Menu M3)

Table 1-13: Keypad Control Parameters M3

Code	Parameter	Min.	Max.	Unit	Default	Cust	ID	Note
P3.1	Control place	0	2		2		1403	**0** = Fieldbus **1** = I/O terminal **2** = Keypad (Default)
P3.2	Local Remote Panel	0	1		1		1685	**0** = No **1** = Yes (Default)

System Menu (Control Keypad: Menu M6)

For parameters and functions related to the general use of the drive, such as application and language selection, customized parameter sets or information about the hardware and software, see *SVX9000 AF Drives User Manual*.

Expander Boards (Control Keypad: Menu M7)

The M7 menu shows the expander and option boards attached to the control board and board-related information. For more information, see *SVX9000 AF Drives User Manual*.

Chapter 2 — Description of Parameters

Parameters

102 **Supply frequency**

Sets the incoming line frequency for the regenerative drive. Set this parameter to the nominal line frequency at the installation site.

107 **Current limit**

Sets the current limit for the regenerative supply unit. Set this to correspond to the nominal load of the unit, bearing in mind that the load might consist of several motor drive units. Maximum value corresponds to the rated current of the unit.

307 **Analog output 1 function**

0 = Not used (20 mA / 10V)
1 = Absolute power (0 – 150% ➔ 0 – 20 mA / 0 – 10V)
When PT 100 is used analog output is forced to 10 mA level.

308 **Analog output 1 filter time**

Defines the filtering time of the analog output signal. Setting this parameter value 0 will deactivate filtering.

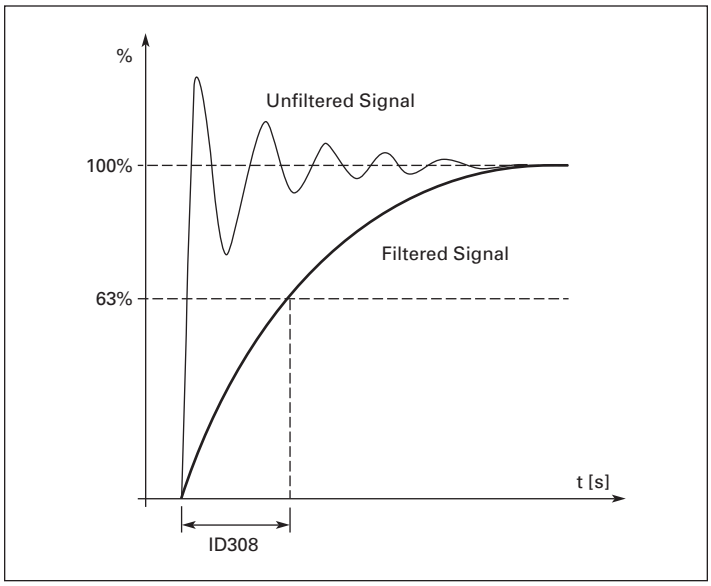

Figure 2-1: Analog Output Filtering

309 Analog output 1 inversion

Inverts the analog output signal:
Maximum output signal = Minimum set value
Minimum output signal = Maximum set value

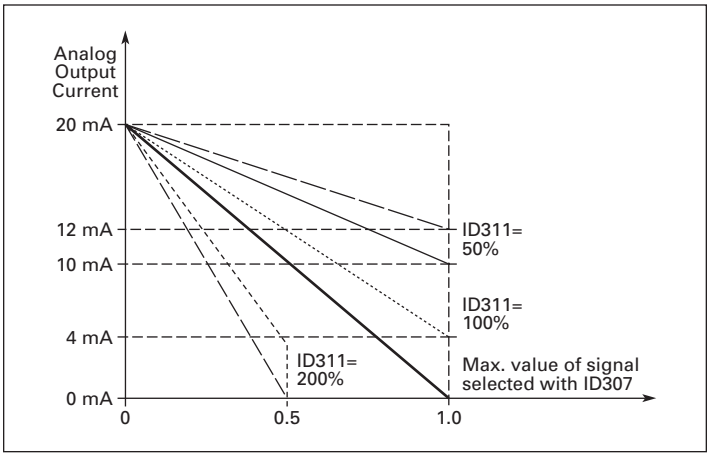

Figure 2-2: Analog Output Invert

310 Analog output 1 minimum

Defines the signal minimum to either 0 mA or 4 mA (living zero). Note the difference in Analog output scaling in ID 311.

0 = Set minimum value to 0 mA
1 = Set minimum value to 4 mA

311 Analog output 1 scale

Scaling factor for analog output.

Table 2-1: Analog Output Scaling

Signal	Max. Value of the Signal
Absolute power	150% of total power

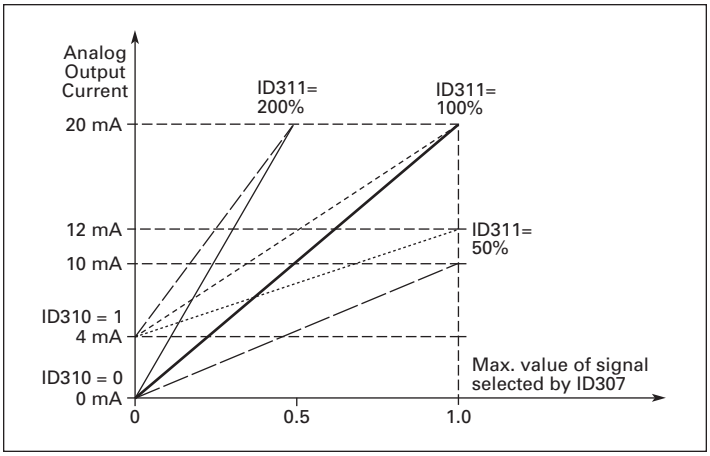

Figure 2-3: Analog Output Scale

375 Analog output 1 offset

Add -100.00 to 100.0 to the analog output.

464 **Analog output 1 signal selection**

This application uses the Terminal to Function programming method (TTF). Functions appear as parameters which the operator defines a certain input/output for. Connect the AO1 signal to the analog output of your choice with this parameter.

601 **Switching frequency**

The switching frequency of the IGBT bridge in kHz. Changing the default value may impact the LCL filter operation.

620 **Drooping**

When units are connected in parallel in independent mode, drooping can be used for current balancing. The drooping is set as % of active current reference on all paralleled units. Eg. if drooping is 3% and DC voltage controller output is 50%, then active current reference is reduced 1.5%. Adjust DC Volt Reference slightly to balance paralleled units.

655 **Modulator Index Limit**

This parameter can be used to control how the drive modulates the output voltage. Lower value may improve current waveform, but causes the DC voltage to increase when line voltage is high.

701 **Response to external fault**

This parameter defines a response to external fault. If the drive monitors the state of external fault input (value of P2.2.1.7 > 0) and a fault occurs, the drive can be set to respond to the fault. See ID 732.

717 **Wait time**

Defines the time before the unit tries to automatically restart modulation after the fault trig has appeared inside trial time.

718 **Trial time**

If the fault trig appears more than defined by ID 721, ID 722 and ID 725, inside trial time permanent fault is generated.

721 **Number of tries after overvoltage trip**

This parameter determines how many automatic restarts can be made during the trial time set by ID 718 after an overvoltage trip.

0 = No automatic restart after overvoltage fault trip.
>0 = Number of automatic restarts after overvoltage fault trip. The fault is reset and the drive is started automatically after the DC-link voltage has returned to the normal level.

722 **Number of tries after overcurrent trip**

Note: IGBT temp fault also included.
This parameter determines how many automatic restarts can be made during the trial time set by ID 718.

0 = No automatic restart after overcurrent fault trip.
>0 = Number of automatic restarts after overcurrent trip and IGBT temperature faults.

725 **Number of tries after external fault trip**

This parameter determines how many automatic restarts can be made during the trial time set by ID 718.

0 = No automatic restart after External fault trip.
>0 = Number of automatic restarts after External fault trip.

732 Response to thermistor fault

0 = No response
1 = Warning
2 = Fault
2 = Fault, DC off (main contactor open)
Setting the parameter to 0 will deactivate the protection.

739 PT100 Numbers

If you have a PT100 input board installed in your drive, you can choose here the number of PT100 inputs in use. See also the I/O boards manual.

Note: If the selected value is greater than the actual number of used PT100 inputs, the display will read 200°C. If the input is short-circuited, the displayed value is –30°C.

740 Response to PT100 fault

0 = No response
1 = Warning
2 = Fault
3 = Fault, DC off (main contactor open)
Setting the parameter to 0 will deactivate the protection.

741 PT100 Warning limit

Set here the limit at which the PT100 warning will be activated.

742 PT100 Fault limit

Set here the limit at which the PT100 fault will be activated.

876 – 883 Fieldbus data in 1-8 selection

Using these parameters, you can control any parameter value from the fieldbus. Enter the ID number of the item you wish to control for the value of these parameters.

1178 LCL Fan monitor

This parameter defines if the drive monitors the status of the LCL Fan of the unit. If the monitoring function is used, the unit monitors the status and will give a warning if the LCL fan stops working.

This signal is normally used in cabinet installations. If status of the LCL fan is not monitored in the system, the option “0 = Not used” must be chosen.

See ID 1508.

1179 LCL Overtemperature monitor

This parameter defines if the drive monitors the status of the LCL overtemperature klix-on signal.

This signal is normally used in cabinet installations. If LCL Overtemperature monitoring signal is not used in the system, the option “0 = Not used” must be chosen.

See ID 1508.

1201 Supply voltage

Sets the incoming line voltage for the regenerative drive. The maximum value is 1000V. Set this parameter to the nominal line voltage at the installation site.

1206 Run Request

This parameter is used for choosing the input used for RUN Request signal. When controlling the unit from I/O, this signal must be connected.

0 = Not used
1 = DIN1
2 = DIN2
3 = DIN3
4 = DIN4
5 = DIN5
6 = DIN6

1208 Fault reset

This parameter defines which digital input is used for fault resetting.

See ID 1206.

1212 Run Enable

This parameter defines which digital input is used for external Run Enable signal. If Run Enable is used the drive does not go to Ready state until the Run Enable goes high.

See ID 1206.

1214 External fault

This parameter defines if the drive monitors the status of the External fault input. The response to the fault can be selected with the ID 701.

See ID 1508.

1216 Digital Output 1 Function

This parameter defines which signal is connected to digital output 1.

0 = Can be set from Fieldbus in Main Control word
1 = Ready
2 = Running
3 = Fault
4 = No Fault
5 = Warning
6 = At ref
7 = Regen Active
8 = Mcont ON FB (Main contactor close from Fieldbus)
9 = Ready / Warning (blink)

1217 Relay Output 1 Function

This parameter defines which signal is connected to relay output 1.

0 = Can be set from Fieldbus in Main Control word
1 = Ready
2 = Running (Can be used to start following unit connected in parallel)
3 = Fault
4 = No Fault
5 = Warning
6 = At ref
7 = Regen Active
8 = Mcont ON FB (Main contactor close from Fieldbus)
9 = Ready / Warning (blink)

1274 Start/Stop function

The parameter determines how the unit behaves when starting and stopping.

0 = Normal. Regenerative unit starts only with the RUN Request.
1 = Auto. Regenerative unit will start automatically when the energy is fed back to main network (regeneration) and stops when there is no regeneration. Run request has to be given.

Note: It should be at least 5% higher than the nominal DC voltage at no load without regenerative control running.

1281 Restart delay

Sets the minimum time delay between the previous stop command and the next start request to start the regen unit.

1282 Stop delay

Sets the delay between the detection of loss of RUN signal and the actual stop of the switching of the IGBT bridge.

1289 Power Lim Motor

This parameter sets the power limit for the motor side operation of the regenerative unit. 100.0% is equal to nominal power.

1290 Power Lim Gen

This parameter sets the power limit for the generator side operation of the regenerative unit. 100.0% is equal to nominal power.

1324 Master Follower mode

Select Master/Follower mode. When the value Follower is selected the RUN Request command is monitored from Master. All other references are selectable by parameters.

0 = Single
1 = Master
2 = Follower

1332 Response to Earth Ground fault

0 = No response
1 = Fault

1333 Earth ground fault current

Trip level of Earth ground current in percent of unit current.

1352 Master Follower communication timeout

Master Follower communication timeout delay in seconds.

1354 PB Watchdog delay

The watchdog pulse of 1 second ON and 1 second off can be sent through main control word bit 11 from the overriding system. The drive monitors the pulse and in case of loss of watchdog pulse, it will generate 53 FB Fieldbus Comm. Fault if the regen unit is being controlled from fieldbus.

1385 Expander board Relay Output 1 Function

This parameter defines which signal is connected to relay output 1 of OPTB5 option card. The parameter will be visible in the panel if an option board has been installed in the drive.

0 = Can be set from Fieldbus in Main Control word
1 = Ready
2 = Running
3 = Fault
4 = No Fault
5 = Warning
6 = At ref
7 = Regen Active
8 = Mcont ON FB (Main contactor close from Fieldbus)
9 = Ready / Warning (blink)
10 = Over temperature fault (Drive over temperature or Fan not working)

1386 Expander board Relay Output 2 Function

This parameter defines which signal is connected to relay output 2 of OPTB5 option card. The parameter will be visible in the panel if an option board has been installed in the drive.

0 = Can be set from Fieldbus in Main Control word
1 = Ready
2 = Running
3 = Fault
4 = No Fault
5 = Warning
6 = At ref
7 = Regen Active
8 = Mcont ON FB (Main contactor close from Fieldbus)
9 = Ready / Warning (blink)
10 = Over temperature fault (Drive over temperature or Fan not working)

1390 Expander board Relay Output 3 Function

This parameter defines which signal is connected to relay output 3 of OPTB5 option card. The parameter will be visible in the panel if an option board has been installed in the drive.

0 = Can be set from Fieldbus in Main Control word
1 = Ready
2 = Running
3 = Fault
4 = No Fault
5 = Warning
6 = At ref
7 = Regen Active
8 = Mcont ON FB (Main contactor close from Fieldbus)
9 = Ready / Warning (blink)
10 = Over temperature fault (Drive over temperature or Fan not working)

1451 Voltage Ctrl Kp

This parameter sets the gain for the DC link PI voltage controller.

1452 Voltage Ctrl Ti

This parameter sets the time constant in mS of the DC link PI controller.

1453 Main Contactor Acknowledge

This parameter defines if the drive monitors the status of the main contactor of the unit. If the monitoring function is used, the unit monitors the status and will not start if the state of the contactor does not correspond to the required status, i.e. is open when it should be shut.

If status of the main contactor is not monitored in the system the option "0 = Not used" must be chosen.

See ID 1206.

1454 DC Voltage supervision limit

Sets a supervision limit for the DC link voltage. If the voltage increases above this, the signal goes HIGH and can be monitored from Main Control Word, Bit 10.

1455 Active curr Kp

This parameter sets the gain of the controller for the active current of the regenerative unit.

1456 Active curr Ti

This parameter sets the time constant of the controller for the active current of the regenerative unit (15 equals 1.5 mS).

1457 Sync Kp

This parameter sets the gain of the synchronization controller used to synchronize switching to the supply.

1458 Sync Ti

This parameter sets the time constant of the controller used to synchronize switching to the supply (15 equals 7 mS).

1459 Reactive current reference

Sets the reference for the reactive current in percent of the nominal current. This can be used for power factor correction of regenerative system or reactive power compensation. Positive value gives inductive compensation, whereas negative value gives capacitive compensation.

1460 Capacitor size

Sets the value of the capacitors used in the input LCL filter as a percent. 100% = at nominal voltage the current in the capacitor is 100% of the nominal current.

1461 Inductor size

Sets the value of the inductors used in the LCL filter as a percent. 100% = at nominal current the voltage across the inductor is 100% of the nominal voltage.

1462 DCVoltReference

Sets the DC Voltage reference in percent of nominal DC voltage. The DC Voltage will be maintained at this level when regenerative unit is running. For 500V units, the maximum limit is 130%, and, for 690V units, the maximum limit 115%.
Nominal DC Voltage = 1.35 x Supply Voltage.

1463 **Control options**

This bit packed word is for enabling/disabling different control options in the regeneration control.

B0 = Disable DCV reduction with reactive reference generation with high line voltage.
B1 = Disable reactive power compensation.
B2 = Enable 2nd harmonic residual elimination.
B3 = Enable pos. seq. 3rd harmonic elimination.
B4 = 4th harmonic elimination.
B5 = Disable 5th harmonic elimination. Also disables all other harmonic elimination controllers.
B7 = Enable 7th harmonic residual elimination.

1490 – 1497 **Fieldbus data out 1 – 8 selection**

Using these parameters, you can monitor any monitoring or parameter value from the fieldbus. Enter the ID number of the item you wish to monitor for the value of these parameters.

1500 **Start up delay**

Starting delay when run command is given. Applicable only for Droop follower.

1501 **PWM Synch**

PWM Synch is used for reducing the circulating current between parallel connected Regenerative Supply Units. If the units are fed from the isolated transformers then there is no need of enabling PWM Synch. Each unit must have its own LCL filter. The drooping parameter (P2.4.16) must be set to at least 3% when PWM Synch is enabled.

0 = Disable
1 = Enable

1505 **Response to LCL overtemperature fault**

This parameter defines a response to LCL overtemperature fault. LCL fault is monitored through digital input defined in parameter P2.2.1.3.

See ID 732.

1506 **Response to Overcurrent fault**

2 = Fault
3 = Fault, DC off (main contactor open)

Note: IGBT temperature fault uses the same response.

1507 **Response to Overvoltage fault**

2 = Fault
3 = Fault, DC off (main contactor open)

1508 Force Main Contactor Open

This parameter is used for choosing the input used for Force Main Contactor Open signal. The signal is used for forcing the main contactor open. Before the contactor can be opened, the charging circuit must be opened. The function of Force Main Contactor Open is Normally Closed (NC) so contactor is opened when signal goes off.

This signal is normally used in cabinet installations. If Force Main Contactor Open signal is not used, the option "0 = Not used" must be chosen.

0 = Not used
1 = DIN1
2 = DIN2
3 = DIN3
4 = DIN4
5 = DIN5
6 = DIN6
7 = DIN1 (inverted)
8 = DIN2 (inverted)
9 = DIN3 (inverted)
10 = DIN4 (inverted)
11 = DIN5 (inverted)
12 = DIN6 (inverted)

1510 Charge Switch Delay

Delays function of Relay Output 2 on each rectifier to stagger the main content closure when more than one regenerative supply unit is connected in parallel on a common DC bus.

1511 Number of Tries After Line Sync Fault Trip

This parameter determines how many automatic restarts can be made during the Trial Time set by ID718.

0 = No automatic restart after Line Sync Fault Trip
>0 = Number of automatic restarts after Line Sync Fault Trip

1516 Modulator type

Parameter for changing modulator type. With ASIC (HW) modulator, the current distortion is lower, but losses are higher compared to Software modulator. Use only Hardware modulator with 251 Control Board.

0 = Hardware modulator: ASIC modulator, which is classical third harmonic injection.
3 = Software modulator 3: Unsymmetric BusClamb, in which one switch always conducts 120 degrees to negative DC-rail to reduce switching losses.

1517 Response to Drive Overtemperature fault

2 = Fault
3 = Fault, DC off (main contactor open)

When the heatsink temperature is over 90°C Overtemperature fault is issued. Overtemperature warning is issued when the heatsink temperature exceeds 85°C.

1518 Response to Input Phase supervision

0 = No response
1 = Warning
2 = Fault
3 = Fault, DC off (main contactor open)

The input phase supervision ensures that the input phases of the drive have an approximately equal current.

Keypad Control

1403 **Control place**

The active control place can be changed with this parameter.

Note: Keypad is the default control place.

0 = Fieldbus
1 = I/O terminal
2 = Keypad (Default)

1685 **Local Remote Panel**

The type of control keypad is selected with this parameter.

Note: Local Remote Panel – Yes is the default selection.

0 = No This panel has ready, run, and Fault LEDs under the LCD display and a select button in the lower left corner.
1 = Yes This panel has local, remote and fault LEDs under the LCD display and a loc/rem button in the lower left corner.

The LCD display is identical on both panel types. The function of the loc/rem and the select button is identical on both panel types. It functions as follows:

Short push is the select function; the menu selections alternate between two selections.

Push and hold in remote mode: Display asks if you want to transfer to keypad mode. Push enter to transfer to keypad control.

Push and hold in local mode: LCD display is transferred to control place selection menu.

Appendix A — Fieldbus Profile for SPA9000 Regenerative Drive

Following document describes profibus profile for SPA9000 Regenerative Drive application. If PROFIBUS is used, then Operate Mode = Bypass is to be used, to be able to read or write the following info.

Table A-1: Signals from Overriding System to SPA9000

Profibus Data Name	Signal Name	Min	Max	FB Scale	Scaling Description
Control Word	Main Control Word				See bitwise description below.
Reference	Voltage Reference	105	130		DC Voltage reference when the unit is controlled from Fieldbus.
Process Data IN1					Reserved for future use.
Process Data IN2	Aux. Control Word 1				See bitwise description below.
Process Data IN3					Reserved for future use.
Process Data IN4					Reserved for future use.
Process Data IN5					Reserved for future use.
Process Data IN6					Reserved for future use.
Process Data IN7					Reserved for future use.
Process Data IN8					Reserved for future use.

Table A-2: Signals from SPA9000 to Overriding System

Profibus Data Name	Signal Name	FB Scale	Scaling Description
Main Status Word	Main Status Word		See bitwise description below.
DC Voltage	DC Voltage	1 = 1V	DC Voltage in Volts.
ProcessDat Out1	Total current	10 = 1A	Total Current.
ProcessDataOut2	Warning Word 1		See bit words below.
ProcessDataOut3	Fault Word1		See bit words below.
ProcessDataOut4	Fault Word2		See bit words below.
ProcessDataOut5	Digital Input Status Word 1		See bit words below.
ProcessDataOut6	Digital Input Status Word 2		See bit words below.
ProcessDataOut7			Reserved for future use.
ProcessDataOut8	Supply Voltage	1 = 1V	Supply voltage in volts.

Table A-3: Main Control Word

Bit	Setting	Description
Bit 0	DC Charge Contactor close	**0** = No Action **1** = Charges the DC (see P2.3.1.1 – P2.3.1.5)
Bit 1	OFF2 = Stop	**0** = Stop Active. Regenerative control is stopped **1** = Stop not active
Bit 2		Reserved for future use.
Bit 3	Run	**0** = Regeneration control not active **1** = Regeneration control active
Bit 4		Reserved for future use.
Bit 5		Reserved for future use.
Bit 6		Reserved for future use.
Bit 7	Reset	0>1 Reset fault.
Bit 8	Set DC Voltage Ref 1	DC Voltage Reference 1 = 115% of Nominal DC Voltage.
Bit 9	Set DC Voltage Ref 2	DC Voltage Reference 2 = 120% of Nominal DC Voltage.
Bit 10	Fieldbus Control	**0** = No control from fieldbus **1** = Control from fieldbus
Bit 11	Watchdog	0>1>0>1…1 sec square wave clock. This is used to check data communication between profibus master and the drive. Used to generate FB Comm. Fault. This monitoring can be switched off by setting P2.14.26 PB Watchdog Delay = 0. Drive´s internal communication monitoring is still active at this time.
Bit 12		Reserved for future use.
Bit 13		Reserved for future use.
Bit 14		Reserved for future use.
Bit 15		Reserved for future use.

Table A-4: Main Status Word

Bit	Setting	Description
Bit 0	Rdy On	**0** = Drive not ready to switch on **1** = Drive ready to switch Main Contactor ON
Bit 1	Rdy Run	**0** = Drive not ready to run **1** = Drive ready and Main Contactor is ON
Bit 2	Running	**0** = Drive not running **1** = Drive running with Regenerative control ON
Bit 3	Fault	**0** = No active fault **1** = Fault is active
Bit 4	Off2 Status	**0** = Stop command Active. Regenerative control is stopped **1** = Stop command not active
Bit 5		Reserved for future use.
Bit 6		Reserved for future use.
Bit 7	Alarm	**0** = No alarm **1** = Alarm active
Bit 8	At Set point	**0** = DC Voltage Ref and Act DC Voltage are not same
Bit 9	Fieldbus Control Active	**0** = Fieldbus control not active **1** = Fieldbus control active
Bit 10	Above Limit	**0** = DC Voltage is below the level specified by P2.4.14 DCVoltSuperVLimit **1** = The DC Voltage is above the specified level by P2.4.14 DCVoltSuperVLimit
Bit 11		Reserved for future use.
Bit 12		Reserved for future use.
Bit 13		Reserved for future use.
Bit 14		Reserved for future use.
Bit 15	Watchdog	Same as received on bit 11 of the main control word.

Table A-5: Auxiliary Control Word

Bit	Setting	Description
Bit 0		Reserved for future use.
Bit 1		Reserved for future use.
Bit 2		Reserved for future use.
Bit 3		Reserved for future use.
Bit 4		Reserved for future use.
Bit 5		Reserved for future use.
Bit 6		Reserved for future use.
Bit 7		Reserved for future use.
Bit 8		Reserved for future use.
Bit 9		Reserved for future use.
Bit 10		Reserved for future use.
Bit 11		Reserved for future use.
Bit 12	Enable DC Level control from MCW	**0** = DC Voltage Level control from MCW is not active and DC Voltage reference is from profibus data (reference value) **1** = DC Voltage Level control from MCW is enabled
Bit 13	DO1 control	Activates the Digital output (see P2.3.1.1 – P2.3.1.5)
Bit 14		Reserved for future use.
Bit 15		Reserved for future use.

Table A-6: Warning Word 1

Bit	Setting	Description
Bit 0	Not used	
Bit 1	Over temperature warning	Thermistor warning, AI PT100 warning or LCL over temperature warning
Bit 2	Not used	
Bit 3	Input Phase loss	
Bit 4	Not used	
Bit 5	Not used	
Bit 6	Not used	
Bit 7	Not used	
Bit 8	Drive over temperature	
Bit 9	Not used	
Bit 10	Fan warning	LCL Fan monitor warning
Bit 11	Not used	
Bit 12	Not used	
Bit 13	Not used	
Bit 14	Not used	
Bit 15	Not used	

Table A-7: Fault Word 1

Bit	Setting	Description
Bit 0	Over Current	
Bit 1	Overvoltage	
Bit 2	Under voltage	
Bit 3	Not used	
Bit 4	Earth Fault	See parameter P2.14.5, P2.14.6, P2.14.7
Bit 5	Not used	
Bit 6	Unit Over Temperature	
Bit 7	Over Temperature	Thermistor or LCL
Bit 8	Input Phase loss	
Bit 9	Brake resistor over temperature	
Bit 10	Device Fault	Device (slot cards). Removed, Added, changed, Unknown
Bit 11	Not used	
Bit 12	Not used	
Bit 13	Not used	
Bit 14	Not used	
Bit 15	Not used	

Table A-8: Fault Word 2

Bit	Setting	Description
Bit 0	Not used	
Bit 1	Charging Switch Fault	
Bit 2	Not used	
Bit 3	Drive Hardware fault	
Bit 4	Under Temperature	
Bit 5	EPROM or Checksum fault	
Bit 6	External fault	
Bit 7	Brake chopper fault	
Bit 8	Internal Communication	
Bit 9	IGBT Temperature	
Bit 10	Not used	
Bit 11	Cooling fan	
Bit 12	Application fault	
Bit 13	Drive Internal fault	
Bit 14	Main Switch open	
Bit 15	Not used	

Table A-9: Digital Input Status Word 1

Bit	Setting	Description
Bit 0	DIA1	Status of Digital input 1 (slot A)
Bit 1	DIA2	Status of Digital input 2 (slot A)
Bit 2	DIA3	Status of Digital input 3 (slot A)
Bit 3	DIA4	Status of Digital input 4 (slot A)
Bit 4	DIA5	Status of Digital input 5 (slot A)
Bit 5	DIA6	Status of Digital input 6 (slot A)
Bit 6	DIB1 (Thermistor)	Thermistor Input Status (slot B)
Bit 7	DIB2	Status of Digital input 2 (slot B)
Bit 8	DIB3	Status of Digital input 3 (slot B)
Bit 9	DIB4	Status of Digital input 4 (slot B)
Bit 10	DIB5	Status of Digital input 5 (slot B)
Bit 11	DIB6	Status of Digital input 6 (slot B)
Bit 12	DIC1 (Thermistor)	Thermistor Input Status (slot C)
Bit 13	DIC2	Status of Digital input 2 (slot C)
Bit 14	DIC3	Status of Digital input 3 (slot C)
Bit 15	DIC4	Status of Digital input 4 (slot C)

Table A-10: Digital Input Status Word 2

Bit	Setting	Description
Bit 0	DIA1	Status of Digital input 1 (slot A)
Bit 0	DIC5	Status of Digital input 5 (slot C)
Bit 1	DIC6	Status of Digital input 6 (slot C)
Bit 2	DID1 (Thermistor)	Thermistor Input Status (slot D)
Bit 3	DID2	Status of Digital input 2 (slot D)
Bit 4	DID3	Status of Digital input 3 (slot D)
Bit 5	DID4	Status of Digital input 4 (slot D)
Bit 6	DID5	Status of Digital input 5 (slot D)
Bit 7	DID6	Status of Digital input 6 (slot D)
Bit 8	DIE1 (Thermistor)	Thermistor Input Status (slot E)
Bit 9	DIE2	Status of Digital input 2 (slot E)
Bit 10	DIE3	Status of Digital input 3 (slot E)
Bit 11	DIE4	Status of Digital input 4 (slot E)
Bit 12	DIE5	Status of Digital input 5 (slot E)
Bit 13	DIE6	Status of Digital input 6 (slot E)
Bit 14	Not used	
Bit 15	Not used	

Appendix B — Fault Codes

The fault codes, their causes and correcting actions are presented in the table below.

Note: When contacting distributor or factory because of a fault condition, always write down all texts and codes on the keypad display.

Table B-1: Fault Codes

Fault Code	Fault	Possible Cause	Solution
1	Overcurrent	Drive has detected too high a current (>4*I_H) in the motor cable: • Sudden heavy load increase • Short circuit in motor cables • Unsuitable motor Subcode in T.14: S1 = Hardware trip S2 = Reserved S3 = Current controller supervision	• Check loading. • Check motor. • Check cables. • Make identification run.
2	Overvoltage	The DC-link voltage has exceeded the drive limit. See user manual. • Too short a deceleration time • High overvoltage spikes in supply Subcode in T.14: S1 = Hardware trip S2 = Overvoltage control supervision	• Make the deceleration time longer. Use brake chopper or brake resistor (available as options). • Activate overvoltage controller. • Check input voltage.
3 ①	Earth fault	Current measurement has detected that the sum of motor phase current is not zero. • Insulation failure in cables or motor	• Check motor cables and motor.
5	Charging switch	The charging switch is open, when the START command has been given. • Faulty operation • Component failure	• Reset the fault and restart. • Should the fault re-occur, contact your local distributor.
6	Emergency stop	Stop signal has been given from the option board.	Check emergency stop circuit.
7	Saturation trip	Various causes: • Defective component • Brake resistor short-circuit or overload	• Cannot be reset from the keypad. • Switch off power. • DO NOT RE-CONNECT POWER! • Contact your local distributor. • If this fault appears simultaneously with Fault 1, check motor cables and motor.

① Different responses may be programmed in the application. See parameter group Protections.

Table B-1: Fault Codes (Continued)

Fault Code	Fault	Possible Cause	Solution
8	System fault	• Component failure • Faulty operation Note exceptional fault data record S1 = Reserved S2 = Reserved S3 = Reserved S4 = Reserved S5 = Reserved S6 = Reserved S7 = Charging switch S8 = No power to driver card S9 = Power unit communication (TX) S10 = Power unit communication (Trip) S11 = Power unit comm. (Measurement)	Reset the fault and restart. Should the fault re-occur, contact your local distributor.
9 ①	Under-voltage	DC-link voltage is under the drive fault voltage limit. See user manual. • Most probable cause: too low a supply voltage • Drive internal fault • One of input fuses is broken • External charge switch not closed	• In case of temporary supply voltage break, reset the fault and restart the drive. • Check the supply voltage. • If it is adequate, an internal failure has occurred. • Contact your local distributor.
10 ①	Input line supervision	Input line phase is missing. Subcode in T.14: S1 = DC-link too low during run S2 = No data from power unit S3 = Undervoltage control supervision	Check supply voltage, fuses and cable.
11 ①	Output phase supervision	Current measurement has detected that there is no current in one motor phase.	Check motor cable and motor.
12	Brake chopper supervision	• No brake resistor installed • Brake resistor is broken • Brake chopper failure	• Check brake resistor and cabling. • If ok, the chopper is faulty. • Contact your local distributor.
13	Drive under-temperature	Heatsink temperature is under -10°C.	
14	Drive over-temperature	Heatsink temperature is over 90°C (or 77°C for 575V, FR6). Overtemperature warning is issued when the heatsink temperature exceeds 85°C (or 72°C for 575V, FR6).	• Check the correct amount and flow of cooling air. • Check the heatsink for dust. • Check the ambient temperature. • Make sure that the switching frequency is not too high in relation to ambient temperature and motor load.
15 ①	Motor stalled	Motor stall protection has tripped.	Check motor and load.
16 ①	Motor overtempera ture	Motor overheating has been detected by drive motor temperature limits. Motor is overloaded.	• Decrease motor load. • If no motor overload exists, check the temperature limits.
17 ①	Motor underload	Motor underload protection has tripped.	Check load.

① Different responses may be programmed in the application. See parameter group Protections.

Table B-1: Fault Codes (Continued)

Fault Code	Fault	Possible Cause	Solution
18 ②	Unbalance	Unbalance between power modules in paralleled units. Subcode in T.14: S1 = Current unbalance S2 = DC-Voltage unbalance	Should the fault re-occur, contact your local distributor.
22	EEPROM checksum fault	Parameter save fault • Faulty operation • Component failure	Should the fault re-occur, contact your local distributor.
24 ②	Counter fault	Values displayed on counters are incorrect.	
25	Micro-processor watchdog fault	• Faulty operation • Component failure	Reset the fault and restart. Should the fault re-occur, contact your local distributor.
26	Start-up prevented	• Start-up of the drive has been prevented. • Run request is ON when new application is loaded to drive.	• Cancel prevention of start-up if this can be done safely. • Remove Run request.
29 ①	Thermistor fault	The thermistor input of option board has detected increase in motor temperature.	• Check motor cooling and loading. • Check thermistor connection. (If thermistor input of the option board is not in use, it has to be short circuited.)
30	Safe disable	OPTAF board input has been opened.	Cancel Safe Disable if this can be done safely.
31	IGBT temperature (hardware)	IGBT Inverter Bridge overtemperature protection has detected too high a short term overload current.	• Check loading. • Check motor size. • Make identification run.
32	Fan cooling	Cooling fan of the drive does not start when ON command is given.	Contact your local distributor.
35	Application	Problem in application software	Contact your local distributor. If you are application programmer, check the application program.
36	Control Unit	Control unit can't control power unit.	Change control unit.
37 ②	Device changed (same type)	Option board or control unit changed. New device of same type and rating.	Reset. Device is ready for use. Old parameter settings will be used.
38 ②	Device added (same type)	Option board or drive added.	Reset. Device is ready for use. Old board settings will be used.
39 ②	Device removed	Option board removed.	Reset. Device no longer available.
40	Device unknown	Unknown option board or drive. Subcode in T.14: S1 = Unknown device S2 = Power1 not same type as Power2	Contact your local distributor.
41	IGBT temperature	IGBT Inverter Bridge overtemperature protection has detected too high a short term overload current.	• Check loading. • Check motor size. • Make identification run.

① Different responses may be programmed in the application. See parameter group Protections.
② A faults (warnings) only.

Table B-1: Fault Codes (Continued)

Fault Code	Fault	Possible Cause	Solution
42 ①	Brake resistor over-temperature	Brake resistor overtemperature protection has detected too heavy braking.	• Set the deceleration time longer. • Use external brake resistor.
43	Encoder fault	Problem detected in encoder signals. Subcode in T.14: 1 = Encoder 1 channel A is missing 2 = Encoder 1 channel B is missing 3 = Both encoder channels are missing 4 = Encoder reversed 5 = Encoder board missing	• Check encoder channel connections. • Check the encoder board. • Check encoder frequency in open loop.
44 ②	Device changed (different type)	Option board or power unit changed. New device of different type or different rating than the previous one.	Reset. Set the option board parameters again if option board changed. Set drive parameters again if power unit changed.
45	Device added (different type)	Option board of different type added.	Reset. Set the option board parameters again.
49	Division by zero in application	Division by zero has occurred in application program.	Contact your local distributor if the fault recurs while drive is in the run state. If you are the application programmer, check the application program.
50 ①	Analog input I_{IN} < 4 mA	Current at the analog input is less than 4 mA. (Range is 4 – 20 mA). • Control cable is proken or loose • Signal source has failed	Check the current loop circuitry.
51	External fault	Digital input fault.	Remove fault situation from external device.
52	Keypad communi-cation fault	The connection between the control keypad or control and the drive is broken.	Check keypad connection and possible keypad cable.
53	Fieldbus fault	The data connection between the fieldbus Master and the fieldbus board is broken.	Check installation. If installation is correct contact your local distributor.
54	Slot fault	Defective option board or slot.	Check board and slot. Contact your local distributor.
56	PT100 board temp. fault	Temperature limit values set for the PT100 board parameters have been exceeded.	Find the cause of temperature rise.
57 ②	Identifi-cation	Identification run has failed.	• Run command was removed before completion of identification run. • Motor is not connected to drive. • There is load on motor shaft.

① Different responses may be programmed in the application. See parameter group Protections.
② A faults (warnings) only.

Table B-1: Fault Codes (Continued)

Fault Code	Fault	Possible Cause	Solution
58 ①	Brake	Actual status of the brake is different from the control signal.	Check mechanical brake state and connections.
59	Follower communi-cation	SysemBus or CAN communication is broken between master and follower.	• Check option board parameters. • Check optical fiber cable or CAN cable.
60	Cooling	Coolant circulation on liquid cooled drive has failed.	Check reason for failure on external system.
61	Speed error	Motor speed is not equal to reference.	• Check encoder connection. • PMS motor has exceeded the pull out torque.
62	Run disable	Run enable signal is low.	Check reason for run eanble signal.
63 ②	Emergency stop	Command for emergency stop received from digital input or fieldbus.	New run command is accepted after reset.
64 ②	Input switch open	Drive input switch is open.	Check the main power switch of the drive.

① Different responses may be programmed in the application. See parameter group Protections.
② A faults (warnings) only.

Company Information

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