S

2006

BELTRAME
CENTRO SERVIZI ENERGIA

USER S MANUAL

DIGITAL AVR

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Important Notice

Our experience has shown that, if the information and recommendations contained in this Operating Instructions are observed, the best possible reliability of our products is assured.
The data contained herein purports solely to describe the product and is not a warranty of performance or characteristics. It is with the best interests of our customers in mind that we constantly strive to improve our products and keep them abreast of advances in technology. This may, however, lead to discrepancies between a product and its "Technical Description" or " Operating Instructions".
This document has been carefully prepared and reviewed, however should in spite of this the reader find an error, he is requested to inform us at his earliest convenience.
It is scarcely possible for the operating instructions for technical equipment to cover every eventuality, which can occur in practice. We would therefore request you to notify us or our agent in the case of all unusual behaviour that does not appear to be covered by these operating instructions.
It is pointed out that all local regulations must be observed when connecting and commissioning this equipment in addition to these operating instructions.
We cannot accept any responsibility for damage incurred as a result of mishandling the equipment regardless of whether particular reference is made in these operating instructions or not.
We lay particular stress on the fact that only genuine spare parts should be used for replacements.

1. SAFETY INSTRUCTIONS

1.1 General

The safety instructions shall be followed during installation, commissioning, operation and maintenance of the excitation system. Read all instructions carefully before operating the device and keep this manual for future reference.

Required Qualification
Personnel involved in installation work and commissioning of the S2006 must be familiar, specially instructed and informed about the residual danger areas according to the regulations currently in force.
Operating personnel is not permitted to work at the control system.
Specially instructed personnel must only carry out maintenance and repair work.
The maintenance personnel must be informed about the emergency shutdown measures and must be capable of turning off the system in case of emergency.
The maintenance personnel must be familiar with the accident prevention measures at their workplace and must be instructed in first aid and fire fighting.

It is the owner's responsibility to ensure that each person involved in the installation and commissioning of the S2006 has received the appropriate training or instructions and has thoroughly read and clearly understood the safety instructions in this chapter.

1.2 Safety Instructions

The safety instructions always appear at the beginning of each chapter and/or precede any instruction in the context where a potentially dangerous situation may appear. The safety instructions are divided into five categories and emphasized by the use of the following layout and safety signs:

	**DANGER!** This symbol indicates an imminent danger resulting from mechanical forces or high voltage. A non-observance leads to life-threatening physical injury or death.
	**WARNING!** This symbol indicates a dangerous situation. A non-observance may lead to bad or life-threatening physical injury or death.
	**NOTICE!** This symbol emphasizes important information. A non-observance may cause damage to the converter or to objects close to it.

2. PRODUCT DESCRIPTION

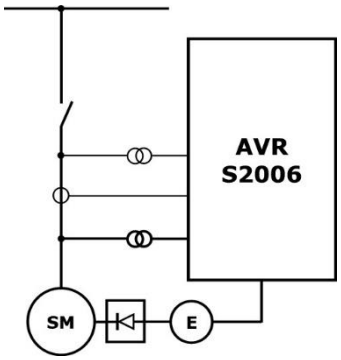
2.1 Preface

From a consolidated operating experience in the energy sector Beltrame has created a device of high performance: the S2006 voltage regulator.
S2006 is an automatic voltage regulator of the latest design for synchronous generators and synchronous motors. The unit contains the most advanced microprocessor technology together with IGBT semiconductor technology (Insulated Gate Bipolar Transistor).
A practical and simple-to-operate panel on the unit is used for all control operations. In addition, user friendly software facilitates commissioning and allows optimization of operation.
The mechanical construction is compact and robust. S2006 is also available in 19-inch rack version.

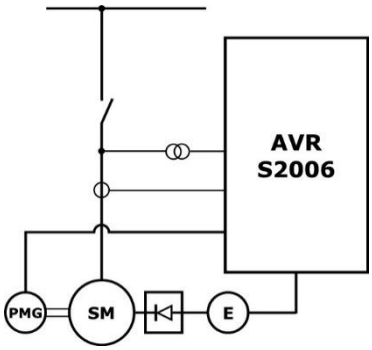
2.2 Area of application

This advanced-design automatic voltage regulator is used for the excitation of indirectly excited synchronous machines. This unit is only suitable for this one area of application.
The regulator can also be switched over to function as a reactive power-, power factor- or field current regulator.

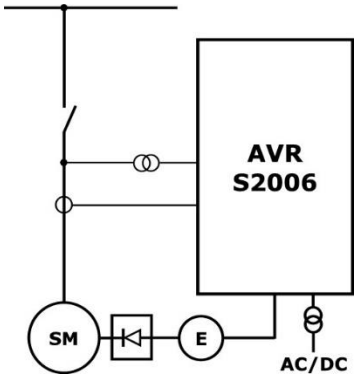
Legend:
SM = Synchronous Machine
E = Brushless Exciter
PMG = Permanent-Magnet-Generator
D=Dynamo exciter



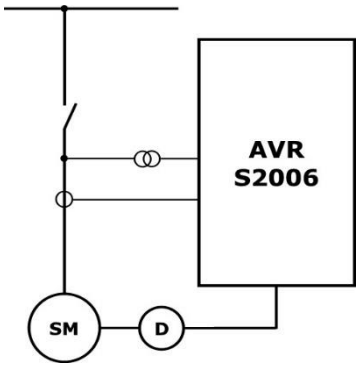
Basic Brushless excitation



Brushless excitation with PMG



Brushless excitation from auxiliary power supply



Direct current Excitation

2.3 Features and Functions

S2006 **BASIC** version features and function include:
Six excitation control modes:

- Automatic Voltage Regulation (AVR)
- Open loop Regulation (PWM)
- Field Current Regulation (FCR)
- Field Voltage Regulation (FVR)
- Power Factor Regulation (PF)
- Var Regulation (VAR)

Main features:

- Soft start ramp and voltage buildup control (black start)
- Two PID stability sets in AVR mode (on grid / off grid)
- Wide range of setpoints sources for each excitation control mode;
- Over-excitation (OEL) and under-excitation (UEL) protection in AVR, VAR and PF control modes;
- Positive and negative reactive power limitation with independent PI stability set;
- Under-frequency compensation or voltage/frequency ratio limitation [V/Hz];
- Grid follow for parallel management
- Field flashing output
- Internal tracking between operating modes
- Possibility of redundancy with a second S2006 regulator (optional)
- Remote setpoint control input accepts analog voltage or current control signal for each control modes
- Real time metering
- 10 alternator protection functions:
    - Excitation over-voltage protection;
    - Excitation over-current protection;
    - Over-temperature protection;
    - Alternator over-voltage protection;
    - Surveillance timer (WATCHDOG);
    - Alternator under-voltage protection;
    - Lack of alternator voltage "sensing";
    - Diode monitoring (optional)
    - Lack of field voltage;
    - Parallel generators with reactive compensation in "droop".

External communication through

- Up to 16 contact sensing inputs (10 default plus 6 optional)
- Up to 16 contact outputs (10 default plus 6 optional)
- Two configurable analog outputs
- Two configurable analog inputs
- CAN communication 2.0B (1Mbit/s) for AVR redundancy purpose
- Modbus RTU communication through RS-485 port half duplex (galvanically separates)
- Serial communication through USB-B port for communication with Beltrame Configurator PC software (Modbus RTU);
- Modbus/TCP communication through Ethernet RJ-45 connectors for register reading (optional)
- Profibus DP, Profinet, IEC61850 through converter (from Modbus RTU).

The basic version can be equipped with the following **OPTIONAL** at ordering:

- Automatic synchronization unit.
- Brushless rotor diodes monitoring.
- On the fly change over to a back-up unit (redundancy with a second S2006 regulator). An external BeltrameCSE excitation current probe required
- Real Time Clock for centralized synchronization.
- Modbus/TCP communication through Ethernet with integrated 2 ports switch for register reading.
- Auxiliary supply power stage for supply from power plant sources (connector 40).

- Extended digital Input and output (connector 18,21).
- Fast de-excitation output to quickly rotor discharge. The kit includes Connector 23, a 24Vdc power relay plus discharge resistor properly dimensioned.
- 10” or 15” HMI panel (plus RS-485 connection cable) for more intuitive management by plant operator.

2.4 Hardware

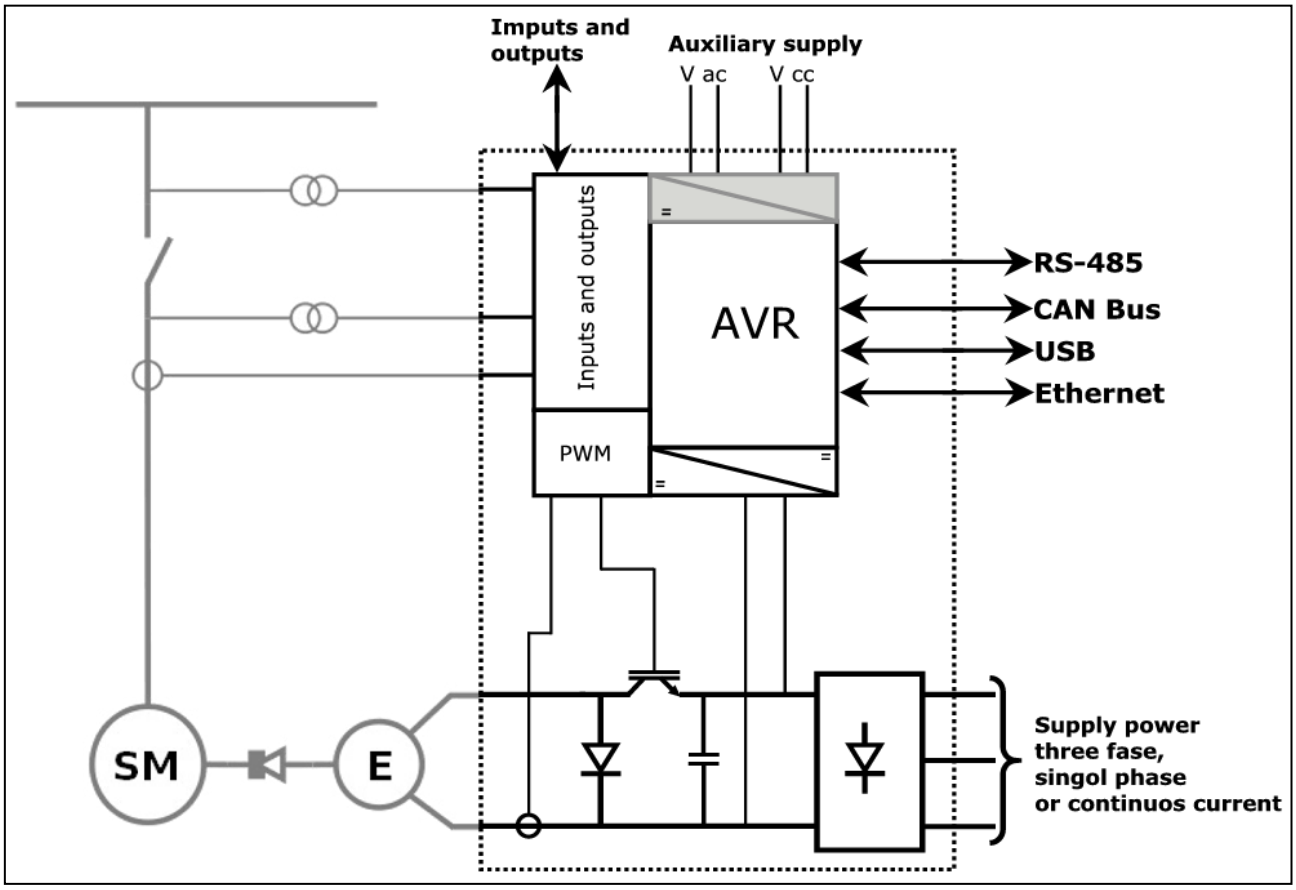
Structure:
The device is built into an aluminum casing with cooling flanges; the connection terminals are integrated around the circuit boards.

Power electronics:
The power part is realized using IGBT chopper-type DC/DC converter with integrated recirculating diode.
The externally provided power input, flows to an integrated Graetz bridge with three-phase input and output connected on a DC bus with leveling capacitor. A pre-charge circuit limits the inrush current draw when AC power supply is applied.
The chopper operates with fixed switching frequency (8kHz) and on-time regulation (PWM).
The static converter transfer characteristic (between pulse generator input and voltage output) is linear type and compensated to the supply voltage
The pulse generator is protected to ensure proper control of the IGBT and possible temporary forcing to maximum excitation.
The chopper output is short-circuit protected.
Chopper control occurs with machine cycle actuation in less than 5ms, the on-time resolution is 12bit.

Control elements:
The operating keys and the display are located on the unit cover (refer to 2.4.1 Control elements and interfaces).

Installation:
The site of installation must be dry and free of dust, the S2006 is designed for wall mounting.
For optimal cooling requires to keep free a minimum distance of 100mm all around the unit.

Connection diagram:



2.4.1 Control elements and interfaces

Carrying out settings on the unit

The display and the four keys are sufficient to allow complete operation.
All settings can be carried out directly on the unit without additional equipment

- Configuration of inputs and outputs
- Parameter setting
- Display of important measuring values.

Interface with PC

Parameter setting and also optimization is possible using the user-friendly software S2006 Configurator for Microsoft Windows.
Connection cable, standard USB with A-B connectors

- Configuration of inputs and outputs
- Parameter setting
- Trending function for optimization of the controller (Oscilloscope, Power chart)
- Display of important measuring values
- Parameter File upload or download.

2.5 Performance

Electrical

Parameters	Unit	Value	Notes
Response time	s	<0.007	
Auxiliary supply max Power	W	25	
Minimum Residual Voltage for Buildup	Vac	3	Auxiliary power supply option needing
Positive Ceiling Voltage	pu VEN	2.2	Depends on the installed excitation transformer (Max Input Voltage 400Vdc/275Vac)
Stator voltage range in AVR mode	%	80÷120	Default values, freely settable (range 0-130%).
Excitation current range in FCR mode	% IEN	0÷150	Depends on the installed excitation transformer. Default values, freely settable (range 0-250%).
Overload time	s	30	@200%IEN 0-25A @150% IEN 40A
		240	@150%IEN 0-25A
Current reduction	A/°C	1	for ambient temperatures >50°C
Accuracy	%	<0.20	
Dead band	%	0	

Environmental condition

Operating temperature	°C	0÷60	
Storage Temperature	°C	-20÷75	

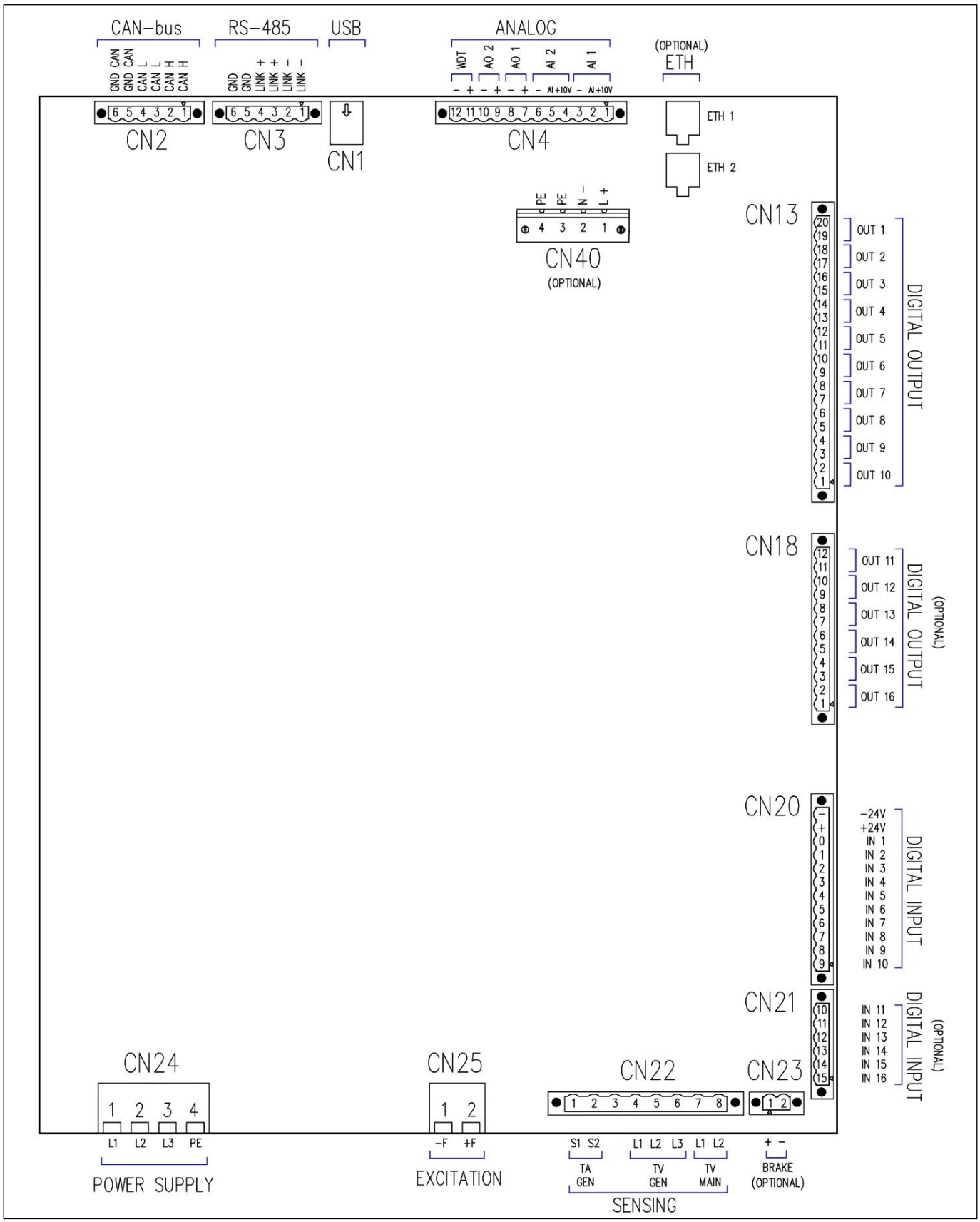
Mechanical*

Weight	Kg	5.6	Layout A
		10	Layout B
Protection class	IP	20	
Dimensions	mm	380x338x150	Layout A (LxBxH)
		420x300x160	Layout B (LxBxH)

*For mounting information refer to 8 Safety instructionsMounting.

Terminal blocks

Overview of the device connections



Connector	Terminals
CN1 **Communication USB (type B)**	1. V USB 2. D- 3. D+ 4. GND USB
CN2 **Communication CANBUS**	1. CAN H 2. CAN H 3. CAN L 4. CAN L 5. GND CAN 6. GND CAN
CN3 **Communication RS485**	1. Link- 2. Link- 3. Link+ 4. Link+ 5. GND RS485 6. GND RS485
CN4 **Analogic inputs/outputs**	1. Output +10V (eventual potentiometer) 2. Analog input 1 (-20mA÷+20mA or -10V÷+10V) 3. Analog input 1 GND 4. Output +10V (eventual potentiometer) 5. Analog input 2 (-20mA÷+20mA or -10V÷+10V) 6. Analog input 2 GND 7. Analog output 1 + 8. Analog output 1 GND 9. Analog output 2 + 10. Analog output 2 GND 11. Watch-dog (C) 12. Watch-dog (E)
ETH **(Optional)**	Ethernet port switch 1 Ethernet port switch 2
CN13 **Digital outputs**	1-2. Digital output K10 3-4. Digital output K9 5-6. Digital output K8 7-8. Digital output K7 9-10. Digital output K6 11-12. Digital output K5 13-14. Digital output K4 15-16. Digital output K3 17-18. Digital output K2 19-20. Digital output K1
CN18 **Digital outputs** **(Optional)**	1-2. Digital output K16 3-4. Digital output K15 5-6. Digital output K14 7-8. Digital output K13 9-10. Digital output K12 11-12. Digital output K11

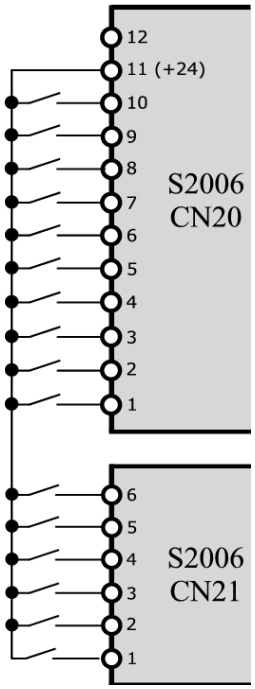
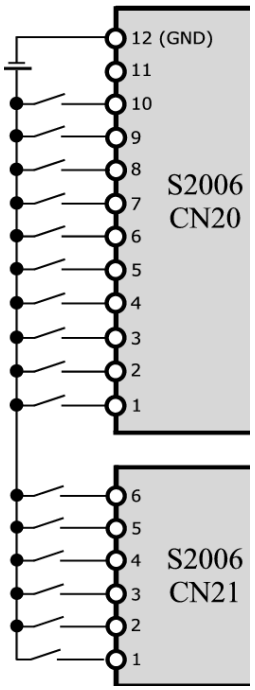
CN20 **Digital inputs**	1. Digital input 10 2. Digital input 9 3. Digital input 8 4. Digital input 7 5. Digital input 6 6. Digital input 5 7. Digital input 4 8. Digital input 3 9. Digital input 2 10. Digital input 1 11. + 24V (for PNP connection) 12. GND (for NPN connection)
CN 21 **Digital inputs** **(Optional)**	1. Digital input 16 2. Digital input 15 3. Digital input 14 4. Digital input 13 5. Digital input 12 6. Digital input 11
CN22 **Sensing inputs**	1. TA-S1 generator 2. TA-S2 generator 3. not connected 4. L1 generator 5. L2 generator 6. L3 generator 7. L1 main 8. L2 main
CN23 **De-energize command** **(Optional)**	1. + 2. -
CN 24 **Power electronics supply input**	1. Phase L1 2. Phase L2 3. Phase L3 4. P.E.
CN 25 **Excitation output**	1. Excitation + 2. Excitation –
CN 40 **Auxiliary power supply** **(Optional)**	1. L(AC) or +(DC) 2. N(AC) or -(DC) 3. P.E. 4. P.E.

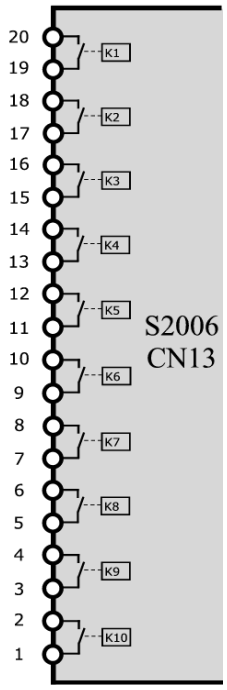
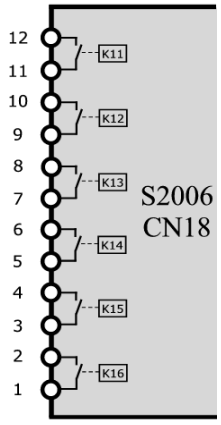
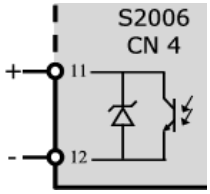
2.5.1 Device connections: power and high voltage

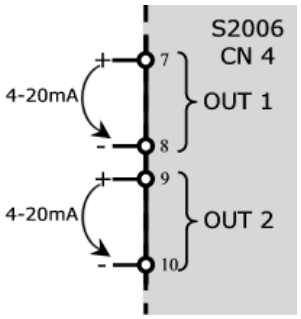
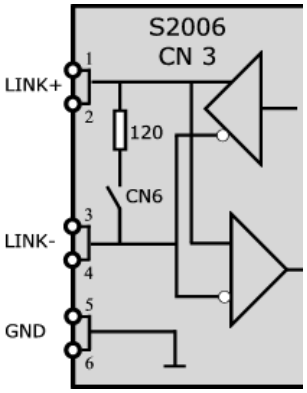
Terminal designation	Signal	Specifications
Auxiliary supply CN 40(optional)	AC input voltage	• 20 to 265 Vrms 50÷60 Hz (single phase)
	DC input voltage	• 20 to 400 Vdc
Power electronics supply CN 23 Refer below for the minimum value.	AC Input 3-phase or single phase 50÷60 Hz	• 70 to 265Vrms (**default**) [1] • 70 to 530Vrms (**upon request**) [1]
	DC input voltage	• 90 to 400Vdc (**default**) [1] • 90 to 800Vdc (**upon request**) [1]
Measurements inputs	3 generator voltage	• Galvanic isolation • 0÷100 or 0÷500 Vrms • Automatic range selection • 50Hz-60Hz
	2 main voltage	
	1 generator current	• Galvanic isolation • 0÷1 or 0÷5 Arms • Automatic range selection
Excitation output		**0 to Vmax**, where Vmax is a function of the input voltage of the power electronics supply: • Up to 98% of DC supply • Up to 90% of rectified AC supply for three-phase • Up to 80% of rectified AC supply for single-phase
		Rated Current IEN (recommended range): • 2A (0A to 2A) [2] • 5A (2 to 5A) • 10A (5 to 10A) • 15A (10 to 15A) • 25A (15 to 25A) • 40A (25 to 40A)
		Excitation Current Overload • 2A 30s @200%IEN • 5A 30s @200% IEN • 10A 30s @200%IEN • 15A 30s @200% IEN • 25A 30s @200% IEN • 40A 30s @150% IEN

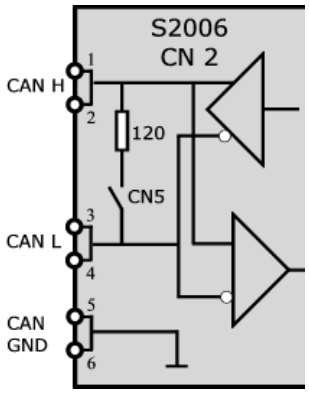
[1] The self-supply of control electronics requires min 70Vac or 90Vdc. When power electronics supply is lower than the indicated value, the auxiliary power supply option is necessary in order to correctly operate the regulator.

[2] An External BeltrameCSE excitation current probe is required.

Terminal designation	Type	Specifications
Digital inputs	16 digital inputs CN20 default CN21 optional	• **Connection with internal supply**  • **connection with external supply**  • opto-isolated • Noise filter • 12-24V / 2,5mA • Programmable function

Terminal designation	Type	Specifications
Digital outputs	16 digital outputs CN13 default CN18 optional	  • NO voltage-free contact • 6A @ 250Vac • 6A @ 30Vdc • 0.2A @ 110Vdc • 0.1A @ 220Vdc • Programmable function
Watchdog	1 digital output	 • Opto-isolated transistor • 1mA @ 24Vdc

Terminal designation	Type	Specifications
Analog inputs	2 analog inputs	• Opto-isolated • Differential input • 0÷20mA / -10÷10V by software selectable • Programmable function
Analog output	2 analog outputs	 • Opto-isolated • 4÷20mA • Maximum voltage 20V • Load 47Ω ≤ Rc ≤ 470Ω
Communication	1 USB	• Opto-isolated • Standard type “B” connector • Virtual Com Port driver • Modbus RTU
	1 RS485	 • Opto-isolated • Half duplex • Multidrop, max 128 devices • Selectable termination • Modbus RTU

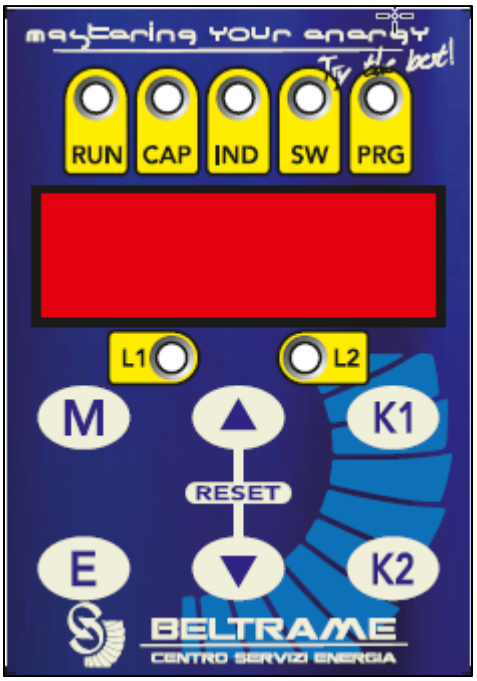
Terminal designation	Type	Specifications
	1 CAN	 • Opto-isolated • Selectable termination • Proprietary protocols for redundancy
	2 Ethernet (optional)	• Galvanic isolation • Standard RJ-45 connectors • Full duplex 10/100Base-TX • Modbus/TCP protocol • 2 ports switch

3. OPERATOR INTERFACE

In this following charter are described the operations of management parameter, using programming keyboard.

3.1 Control keyboard and signaling

The modifications operated on the values of the parameters, also entering in action immediately, are not stored in way automatic, but require a specific action of storage that is obtained by means of the command “C.000” [Save parameters].



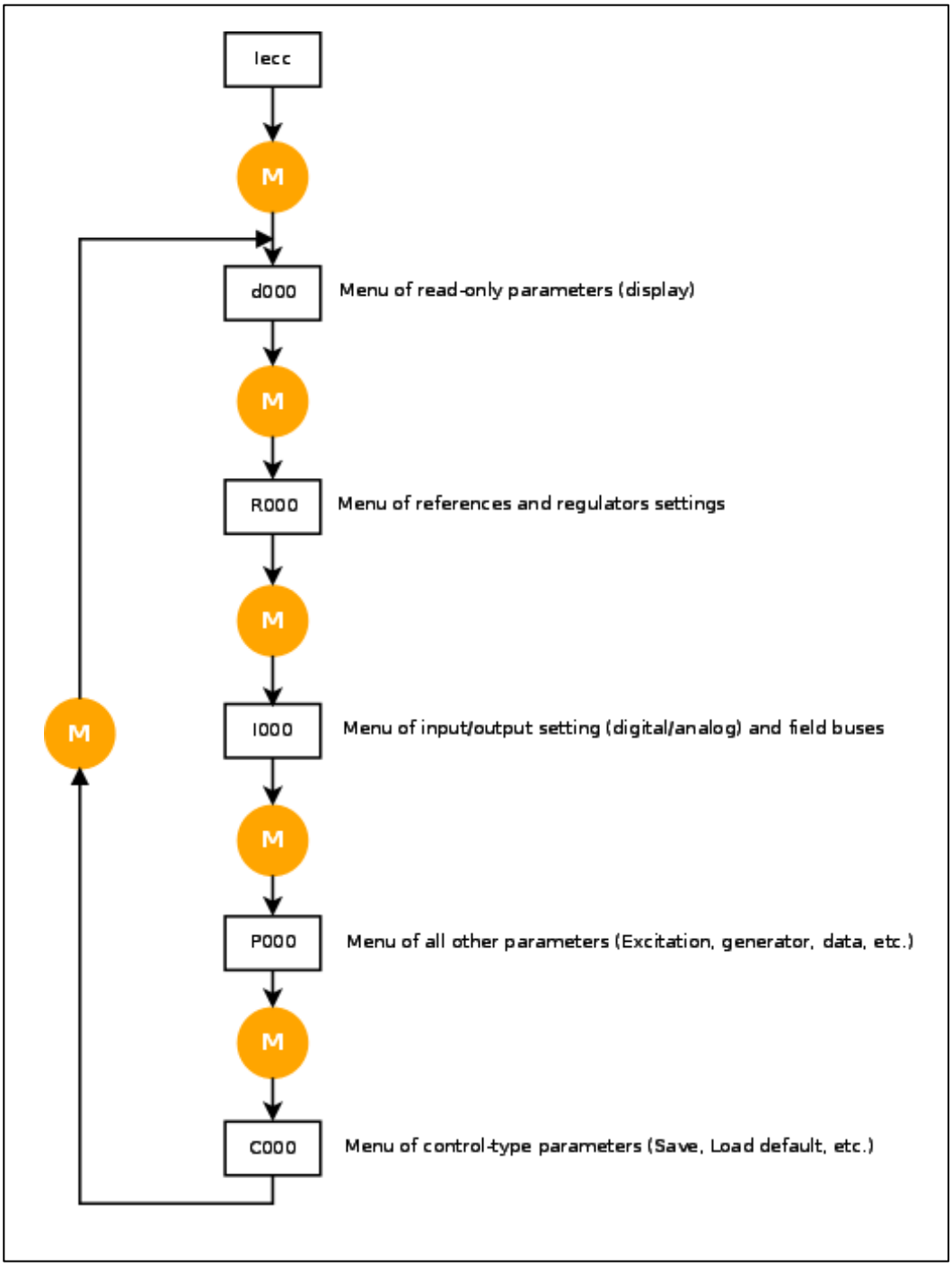
Button	Name	Function
M	Menu	Allows to move between categories of parameters (d.xxx, R.xxx, I.xxx, P.xxx and C.xxx).
E	Enter	Used to enter the selected category and/or confirm the value
▲	UP	Used to increase displaying parameter and/or numerical value
▼	DOWN	Used to decrease displaying parameter and/or numerical value
▲ + ▼	UP + DOWN = RESET	Pushed both execute manual reset
K1		The function is freely programmable by parameter P.900 (refer to 4.2.22 Operator interface)
K2		The function is freely programmable by parameter P.910 (refer to 4.2.22 Operator interface)

LED Meaning :

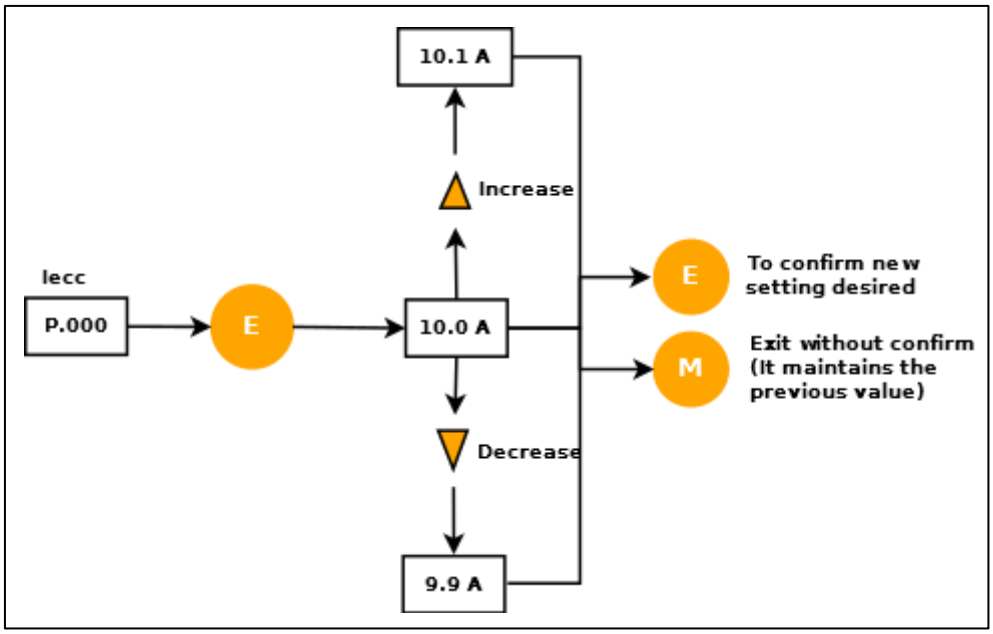
Led	Name	Color	Function
Run	Run	Green	Fixed On: The RUN command is enabled and activated Fast Blinking: The controller is limitation mode
Ind	Inductive	Green	Fixed On: After grid parallel indicates positive reactive power generated
Cap	Capacitive	Green	Fixed On: After grid parallel indicates negative reactive power generated
SW	Switch	Red	Fixed On: Parallel Switch Closed Slow blinking: Operating outside the synchronization window Fast blinking: Operating within the synchronization window
Prg	Program	Yellow	Fixed On: AVR Not ready to run Fast Blinking: Parameter modification is not saved
L1	Led 1	Yellow	Fixed On: Function is freely programmable by parameter P.920 (default = calibrator at minimum) (refer to 4.2.22 Operator interface)
L2	Led 2	Yellow	Fixed On: Function is freely programmable by parameter P.921 (default = calibrator at minimum) (refer to 4.2.22 Operator interface)

3.2 Navigating the menus

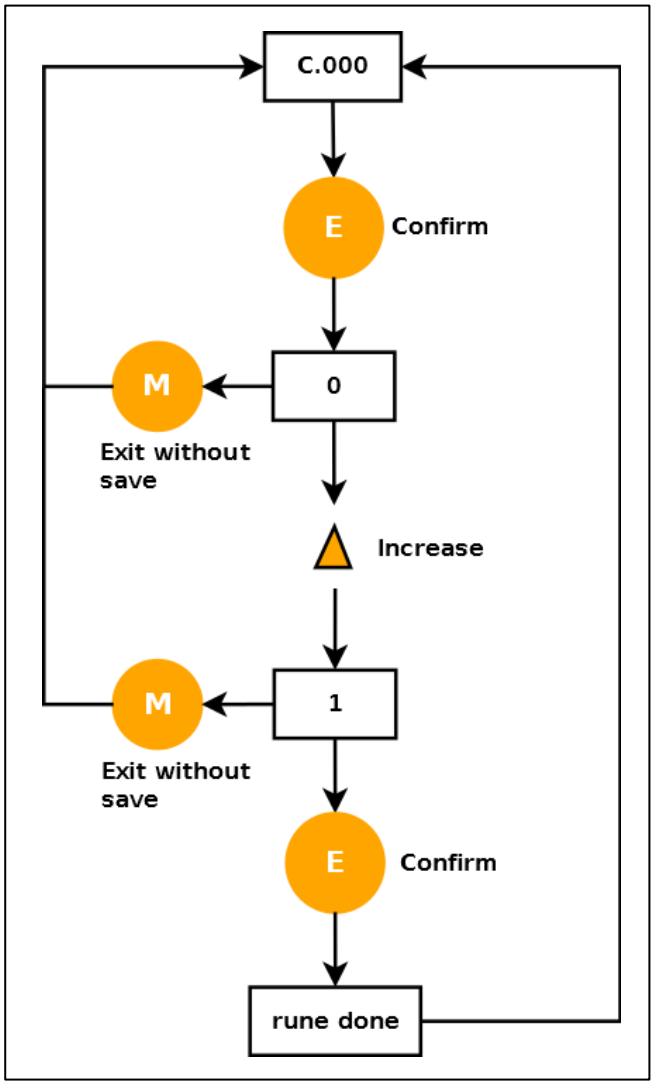
When the S2006 is power on, the display automatically shows parameter d.000 (Field current) in the Display menu.



Example: how to change the Excitation current reference



Example: how to save the parameters after the change



3.3 Display

The display menu show all the system run time values.

3.3.1 Field

Parameter	Description	Unit
d.000	Field current	[%] of the excitation rated current (P.000)
d.001	Field current reference	[%] of the excitation rated current (P.000)
d.005	Ripple level of the field current	[%] of the excitation rated current (P.000)
d.010	Field voltage	[%] of the excitation rated voltage (P.010)
d.011	Field voltage reference	[%] of the excitation rated voltage (P.010)
d.020	Duty Cycle	[%]
d.021	Duty Cycle reference	[%]
d.030	Time left in case of intervention of the limitation of the maximum current of excitation	[s]

3.3.2 Generator

Parameter	Description	Unit
d.100	Generator voltage L1-L2	[%] of the generator rated voltage (P.100)
d.101	Generator voltage L2-L3	[%] of the generator rated voltage (P.100)
d.102	Generator voltage L3-L1	[%] of the generator rated voltage (P.100)
d.103	Generator voltage reference	[%] of the generator rated voltage (P.100)
d.104	Generator frequency	[Hz]
d.110	Generator current	[%]of the generator rated current (P.110)
d.111	Generator power factor	
d.112	Generator power factor reference	
d.120	Generator apparent power	[%] of the generator rated power (P.100xP.110)
d.121	Generator active power	[%]of the generator rated power (P.100xP.110)
d.122	Generator reactive power	[%]of the generator rated power (P.100xP.110)
d.123	Generator reactive power reference	[%]of the generator rated power (P.100xP.110)
d.130	Time left in case of intervention of the limitation of the maximum current of generator	[s]

3.3.3 Mains

Parameter	Description	Unit
d.200	Mains voltage	[%] of the generator rated voltage (P.100)
d.201	Mains frequency	[Hz]
d.210	Sync slip	[Hz]
d.211	Delta Phase	[deg]
d.212	Last circuit breaker closing time	[s]
d.213	Last Synchronization Time	[s]

3.3.4 Actual regulation

Parameter	Description	Notes / Unit
d.300	Control status	0 Fault 1 Stop 2 PWM control 3 FVR control 4 FCR control 5 Wait frequency 6 Ramp 7 AVR control 8 PF/VAR control
d.301	Control mode	As P.300
d.302	Actual PID regulator reference	[%]
d.303	Actual PID regulator feedback [%]	[%]
d.304	Actual PID regulator error [%]	[%]
d.310	Proportional + derivative contribute to actual PID output [%]	[%]
d.311	Integral contribute to actual PID output [%]	[%]
d.312	Actual PID regulator output [%]	[%]
d.330	Active limits	bit mapping (hex codes): 0001 Minimum frequency 0002 V/Hz 0004 Ramp 0008 Under excitation 0010 Minimum current 0020 Minimum reactive power 0040 calibrator at minimum 0080 ---Reserved--- 0100 calibrator at maximum 0200 Over excitation 0400 Field Ixt 0800 Generator Ixt 1000 Generator current 2000 Generator Voltage 4000 Maximum reactive power

3.3.5 Digital & Analog Inputs/Outputs monitor

Parameter	Description	Notes / Unit
d.400	Digital inputs monitor	bit mapping, one bit for each input
d.401	Digital inputs local monitor	As d.400
d.402	Digital inputs remote monitor	As d.400
d.410	Digital outputs monitor	bit mapping, one bit for each output
d.411	Digital outputs local monitor	As d.410
d.412	Digital outputs remote monitor	As d.410
d.420	Analog input 1 monitor (filtered)	[%]
d.421	Analog input 1 monitor (conditioned)	[%]
d.422	Analog input 1 monitor (raw)	[%]
d.423	Analog input 1 monitor (local)	[%]
d.424	Analog input 1 monitor (remote)	[%]
d.430	Analog input 2 monitor (filtered)	[%]
d.431	Analog input 2 monitor (conditioned)	[%]
d.432	Analog input 2 monitor (raw)	[%]
d.433	Analog input 2 monitor (local)	[%]
d.434	Analog input 2 monitor (remote)	[%]
d.440	Analog output 1 monitor (filtered)	[%]
d.441	Analog output 1 monitor (conditioned)	[%]
d.442	Analog output 1 monitor (raw)	[%]
d.450	Analog output 2 monitor (filtered)	[%]
d.451	Analog output 2 monitor (conditioned)	[%]
d.452	Analog output 2 monitor (raw)	[%]

3.3.6 Fieldbus

Parameter	Description	Notes / Unit
d.500	CAN Rx errors	
d.501	CAN Tx errors	
d.502	CAN status	bit mapping (hex)

3.3.7 Alarms

Parameter	Description	Notes / Unit		
d.800	Faults (Mask Low)	Bit mapping (hex codes):		
		0001	Over current	O.C.
		0002	Watchdog	UUdG
		0004	Over heating	OH
		0008	External fault	E.F
		0010	Excitation over load	E.OVL
		0020	Serial time out1	StO.1
		0040	Serial time out 2	StO.2
		0080	PowerSupply Feedback loss	PS.Fb
		0100	Parallel switch fault	PArAL
		0200	TV loss	tV.L
		0400	TV asymmetrical	tV.ASY
		0800	Rotor diode open	r.D.O
		1000	Rotor diode short	r.D.S
		2000	Under voltage	U.V
		4000	Temperature sensor error	t.S.Er
		8000	TA loss	tA.L

d.801	Faults (Mask High)	bit mapping (hex codes):		
		0001	Brake Resistor over heating	b.r.OH
		0002	Generator OverVoltage	G.OV
		0004	External Fault 2	E.F.2
		0008	External Fault 3	E.F.3
		0010	External Fault 4	E.F.4
		2000	Params error	P.Err
		4000	Params file error	P.F.Er
		8000	Configuration file error	C.F.Er
d.810	Warnings (Mask Low)	As d.800		
d.811	Warnings (Mask High)	As d.801		

3.3.8 Fault log details

For more information refer to 4.3.4 Alarm

Parameter	Description	Notes / Unit
d.850	Faults L	As d.800
d.851	Faults H	As d.801
d.852	Warnings L	As d.810
d.853	Warnings H	As d.811
d.854	Power on time L	As d.980
d.855	Power on time H	As d.981
d.856	Run time L	As d.982
d.857	Run time H	As d.983
d.858	Field Current	As d.000
d.859	Field Voltage	As d.010
d.860	Generator Voltage L1-L2	As d.100
d.861	Generator Freq. Out	As d.104
d.862	Generator Current	As d.110
d.863	Generator Power Factor	As d.111
d.864	Control Status	As d.300
d.865	Control Mode	As d.301
d.866	Ref	As d.302
d.867	Feedback	As d.303
d.868	Regulator Out	As d.312
d.869	Active limits	As d.330
d.870	Dig. Inputs monitor	As d.400
d.871	Dig. Out monitor	As d.410
d.872	DC Bus Voltage	As d.999
d.873	RTC time 1	As d.984
d.874	RTC time 2	As d.985
d.875	RTC time 3	As d.986

3.3.9 Exciter

Parameter	Description	Notes / Unit
d.900	Exciter In	[Adc]
d.901	Exciter Ipk	[%]
d.910	Exc. DC bus V max	[Vdc]
d.950	FW ver. & rev.	hex
d.951	FW release	hex
d.952	S/N HI	hex
d.953	S/N LO	hex
d.954	Param checksum	hex
d.980	Power on time L	[hr.min]
d.981	Power on time H	[khr]
d.982	Run time L	[hr.min]
d.983	Run time H	[khr]
d.984	RTC time 1	[mm.ss]
d.985	RTC time 2	[DD.hh]
d.986	RTC time 3	[YY.MM]
d.987	RTC unix-time L	hex
d.988	RTC unix-time H	hex
d.997	Heatsink temp.	[°C]
d.998	Exciter IxT lev.	[%]
d.999	DC Bus Voltage	[Vdc]
d.997	Heatsink temp.	[°C]

4. CONFIGURATION

4.1 Inputs and outputs

4.1.1 Digital inputs

The voltage regulator S2006 has 16 digital inputs.

Parameter	Input	Default value	
I.000	1	3	ENABLE (NO)
I.001	2	1	RUN (NO)
I.002	3	43	GEN SW (NO)
I.003	4	21	GRID FOLLOW (NO)
I.004	5	39	Q = 0 (NO)
I.005	6	31	SET RAISE (NO)
I.006	7	33	SET LOWER (NO)
I.007	8	13	MANUAL FCR (NO)
I.008	9	5	ALARM RESET (NO) (EDGE)
I.009	10	0	NONE
I.010	11	0	NONE
I.011	12	0	NONE
I.012	13	0	NONE
I.013	14	0	NONE
I.014	15	0	NONE
I.015	16	0	NONE

Each input can be configured as desired, the following is the list of possible configurations:

Nr.	Function
0	NONE
1	RUN (NO)
2	RUN (NC)
3	ENABLE (NO)
4	ENABLE (NC)
5	ALARM RESET (NO) (EDGE)
6	ALARM RESET NC (EDGE)
7	EXTERNAL FAULT (NO)
8	EXTERNAL FAULT (NC)
9	MANUAL PWM (NO)
10	MANUAL PWM (NC)
11	MANUAL FVR (NO)
12	MANUAL FVR (NC)
13	MANUAL FCR (NO)
14	MANUAL FCR (NC)
15	AUTO AVR (NO)
16	AUTO AVR (NC)
17	AUTO VDC (NO)
18	AUTO VDC (NC)
19	AUTO VDC GRID2 (NO)
20	AUTO VDC GRID2 (NC)

Nr.	Function
41	PF REF2 (NO)
42	PF REF2 (NC)
43	GEN SW (NO)
44	GEN SW (NC)
45	SUPPLY BUILDUP (NO)
46	SUPPLY BUILDUP (NC)
47	V GEN REF2 (NO)
48	V GEN REF2 (NC)
49	VF LIMIT DISABLE (NO)
50	VF LIMIT DISABLE (NC)
51	BRAKE R THERMAL SENS (NO)
52	BRAKE R THERMAL SENS (NC)
53	V GEN REF3 NO
54	V GEN REF3 NC
55	GRID STARTUP NO
56	GRID STARTUP NC
57	EXTERNAL FAULT 2 NO
58	EXTERNAL FAULT 2 NC
59	EXTERNAL FAULT 3 NO
60	EXTERNAL FAULT 3 NC
61	EXTERNAL FAULT 4 NO

21	GRID FOLLOW (NO)
22	GRID FOLLOW (NC)
23	GRID SYNC (NO)
24	GRID SYNC (NC)
25	GRID PAR SW (NO)
26	GRID PAR SW (NC)
27	AUTO PF (NO)
28	AUTO PF (NC)
29	AUTO VAR (NO)
30	AUTO VAR (NC)
31	SET RAISE (NO)
32	SET RAISE (NC)
33	SET LOWER (NO)
34	SET LOWER (NC)
35	SET PRE POS (NO)
36	SET PRE POS (NC)
37	MASTER FAIL (NO)
38	MASTER FAIL (NC)
39	Q = 0 (NO)
40	Q = 0 (NC)

62	EXTERNAL FAULT 4 NC
63	AVR REF BY ANALOG IN 1 NO
64	AVR REF BY ANALOG IN 1 NC
65	AVR REF BY ANALOG IN 2 NO
66	AVR REF BY ANALOG IN 2 NC
67	VAR REF BY ANALOG IN 1 NO
68	VAR REF BY ANALOG IN 1 NC
69	VAR REF BY ANALOG IN 2 NO
70	VAR REF BY ANALOG IN 2 NC
71	PF REF BY ANALOG IN 1 NO
72	PF REF BY ANALOG IN 1 NC
73	PF REF BY ANALOG IN 2 NO
74	PF REF BY ANALOG IN 2 NC
75	FCR REF BY ANALOG IN 1 NO
76	FCR REF BY ANALOG IN 1 NC
77	FCR REF BY ANALOG IN 2 NO
78	FCR REF BY ANALOG IN 2 NC
79	START EDGE NO
80	START EDGE NC

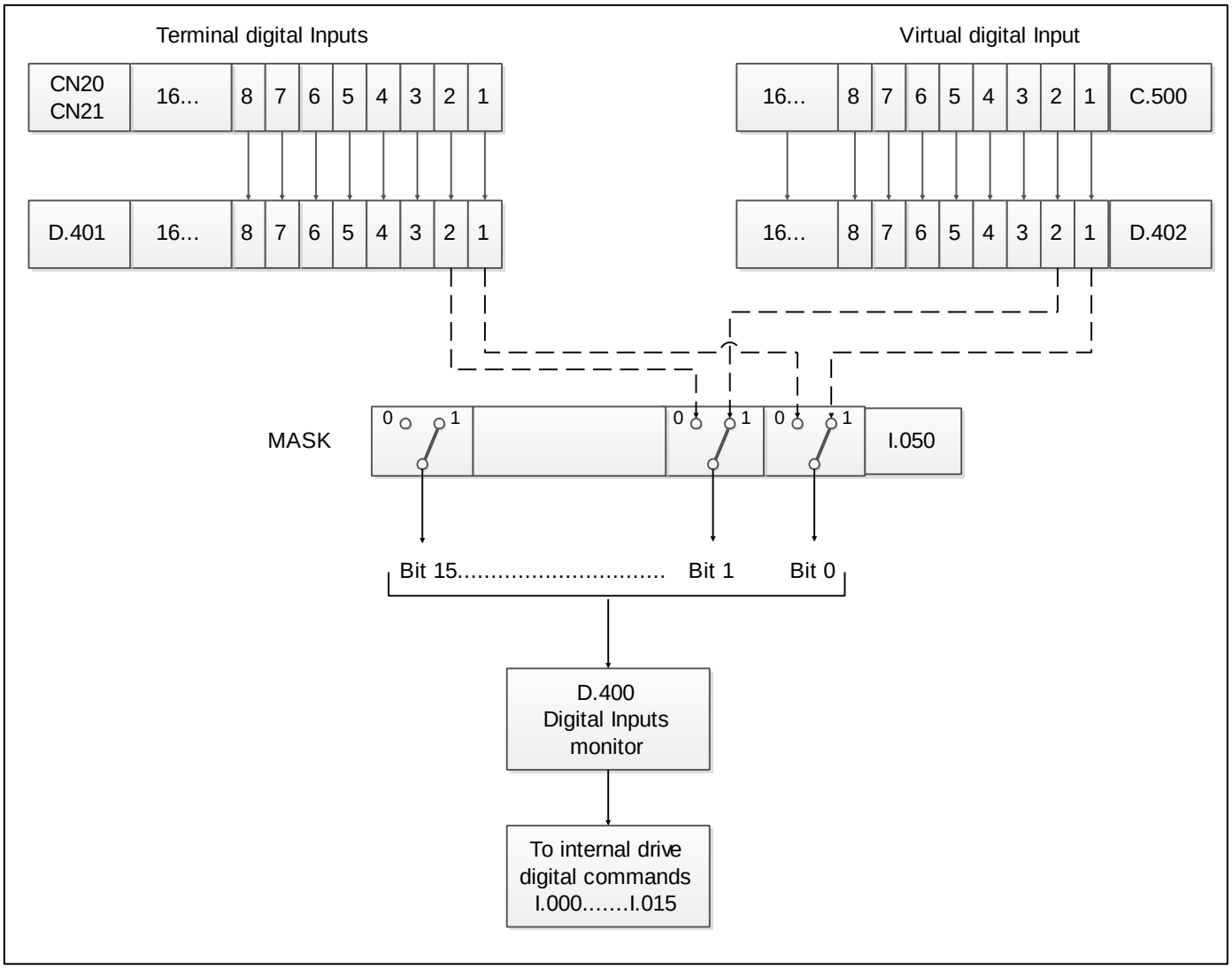
4.1.2 Enabling virtual digital inputs

Through a "virtual setting" via serial line or fieldbus, it is possible to use all the functions available on the digital inputs.
The setting can be carried out in such configurations, where the digital commands are a mix of "virtual" and terminals.
The virtual assignment can be performed through the parameter C.500.
Below is the reported the drawing describing the combination between the data of the virtual inputs and the drive terminals, with the relative decoder mask.
The switch between the "virtual" commands and the terminals is determined by programmable mask I.050.
These parameters have to be managed bitwise. At each bit corresponds a switch, as follows.

Parameter	Description	Notes
I.050	Remote enable mask	0 Terminal 1 Virtual

The formula below describes the result of the virtual inputs setting:

[Digital Input **AND** (**NOT** Mask)] **OR** (Virtual Input **AND** Mask)



4.1.3 Digital outputs

The voltage regulator S2006 has 16 digital outputs.

Parameter	Output	Default	
I.100	1	35	Limits Mask1 (NO)
I.101	2	37	Limits Mask2 (NO)
I.102	3	39	Q = 0 (NO)
I.103	4	13	Calibrator max (NO)
I.104	5	11	Calibrator min (NO)
I.105	6	61	Gen V Rated (NO)
I.106	7	8	Watchdog (NC)
I.107	8	4	Fault (NC)
I.108	9	1	Run (NO)
I.109	10	28	Warning (NC)
I.110	11	0	None
I.111	12	0	None
I.112	13	0	None
I.113	14	0	None
I.114	15	0	None
I.115	16	0	None

Each output can be configured as desired, the following is the list of possible configurations:

Nr.	Function	Nr.	Function	Nr.	Function
0	None	25	Boost (NO)	50	Control mode FVR (NC)
1	Run (NO)	26	Boost (NC)	51	Control mode FCR (NO)
2	Run (NC)	27	Warning (NO)	52	Control mode FCR (NC)
3	Fault (NO)	28	Warning (NC)	53	Control mode AVR (NO)
4	Fault (NC)	29	Warning Mask1 (NO)	54	Control mode AVR (NC)
5	Ready (NO)	30	Warning Mask1 (NC)	55	Control mode PF (NO)
6	Ready (NC)	31	Warning Mask2 (NO)	56	Control mode PF (NC)
7	Watchdog (NO)	32	Warning Mask2 (NC)	57	Control mode VAR (NO)
8	Watchdog (NC)	33	Limits Any (NO)	58	Control mode VAR (NC)
9	Parallel CB (NO)	34	Limits Any (NC)	59	Thermal warning (NO)
10	Parallel CB (NC)	35	Limits Mask1 (NO)	60	Thermal warning (NC)
11	Calibrator min (NO)	36	Limits Mask1 (NC)	61	Gen V Rated (NO)
12	Calibrator min (NC)	37	Limits Mask2 (NO)	62	Gen V Rated (NC)
13	Calibrator max (NO)	38	Limits Mask2 (NC)	63	Speed Up (NO)
14	Calibrator max (NC)	39	Q = 0 (NO)	64	Speed Up (NC)
15	PF = 1 (NO)	40	Q = 0 (NC)	65	Speed Down (NO)
16	PF = 1 (NC)	41	Grid V matching (NO)	66	Speed Down (NC)
17	Exciter Overload (NO)	42	Grid V matching (NC)	67	Redundancy Master (NO)
18	Exciter Overload (NC)	43	Grid F matching (NO)	68	Redundancy Master (NC)
19	Manual mode (NO)	44	Grid F matching (NC)	69	Redundancy Backup (NO)
20	Manual mode (NC)	45	Calibrator at preset (NO)	70	Redundancy Backup (NC)
21	PF 2nd reference (NO)	46	Calibrator at preset (NC)	71	Redundancy Auto Master (NO)
22	PF 2nd reference (NC)	47	Control mode PWM (NO)	72	Redundancy Auto Master (NC)

23	Field Flashing (NO)	48	Control mode PWM (NC)	73	Grid Parallel (NO)
24	Field Flashing (NC)	49	Control mode FVR (NO)	74	Grid Parallel (NC)

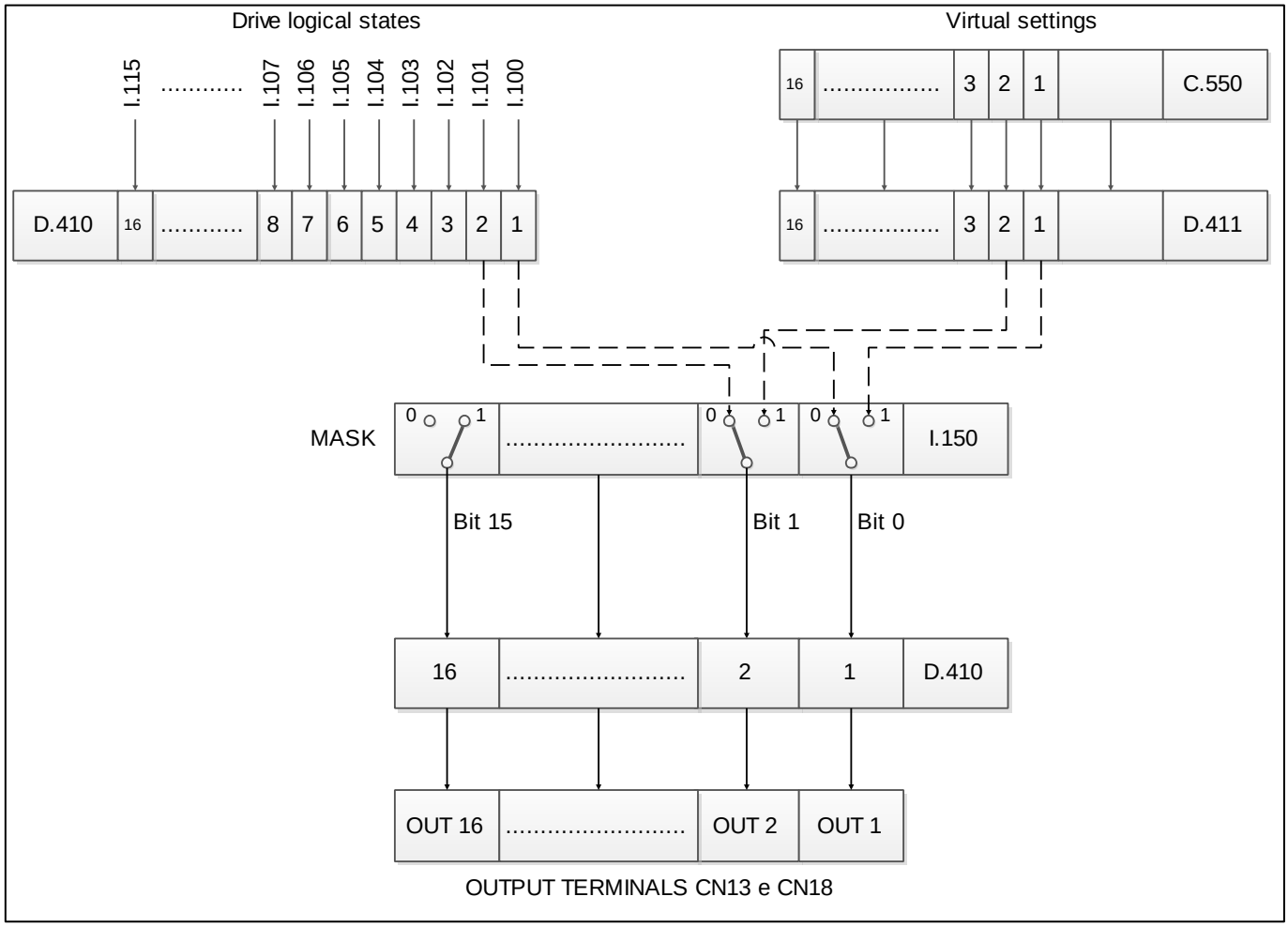
4.1.4 Enabling virtual digital outputs

Through a "virtual setting" via serial line or fieldbus, it is possible to use all the functions available on the digital outputs.
The setting can be carried out in such configurations, where the outputs are a mix of "virtual" and drive function.
The virtual assignment can be performed through the parameter C.550.
Below is the reported the drawing describing the combination between the data of the virtual outputs and the drive terminals, with the relative decoder mask.
The switch between the "virtual" outputs and the drive functions is determined by programmable mask I.150.
These parameters have to be managed bitwise. At each bit corresponds a switch, as follows.

Parameter	Description	Notes
I.150	Remote enable mask	0 Drive function 1 Virtual control

The formula below describes the result of the virtual outputs setting:

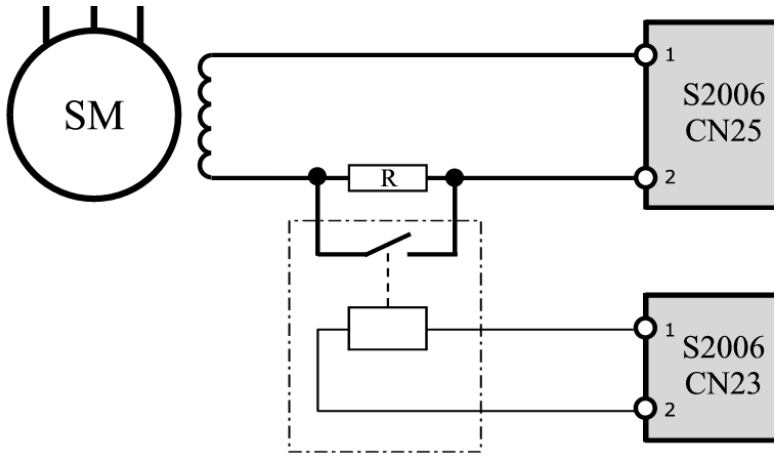
[Digital Output **AND** (**NOT** Mask)] **OR** (Virtual Output **AND** Mask)



4.1.5 Fast De-Excitation output (optional)

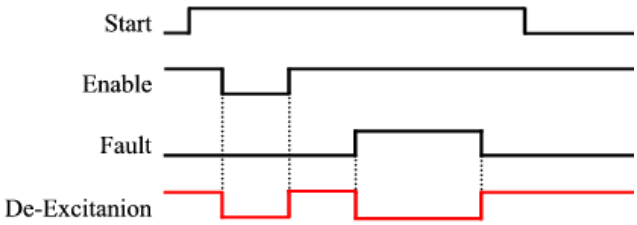
In the event of a fault or stop, the fast de-excitation output command allows all the energy stored in the field circuit to be discharged through an appropriately sized de-excitation resistor.
The regulator through the CN23 connector output can control a de-excitation module (optional) which inserts or short circuits an appropriate resistor (optional) connected in series to the field circuit.
Through the parameter I.160 it is possible to set the function type of the rapid de-excitation output.

Parameter	Description	Notes
I.160	De-Excitation mode	0 Active at FAULT 1 Not-active at FAULT 2 Active at STOP 3 Not-active at STOP



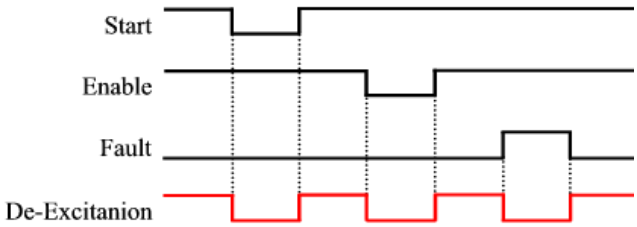
I.160=1
The output will deactivate for one of the following reasons:

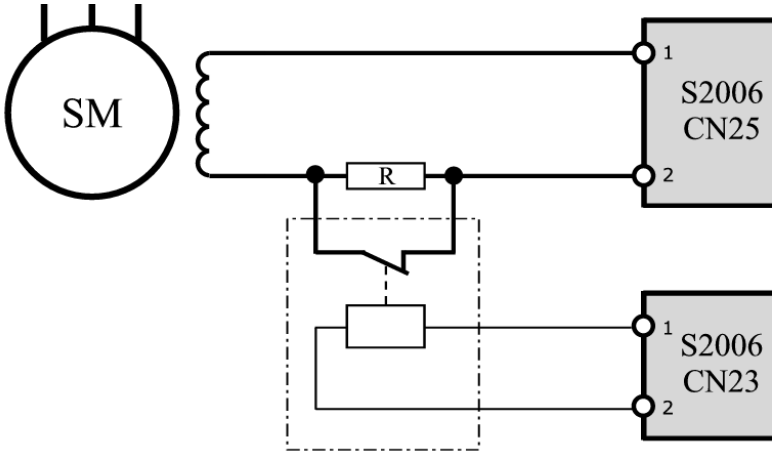
- when there is a fault with the regulator due to internal or external causes (if an input of I.0xx=7 or 8 is configured)
- when disabled



I.160=3
The output will deactivate for one of the following reasons:

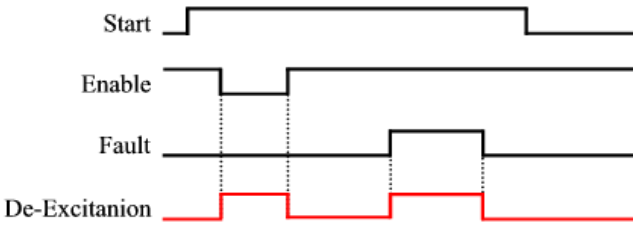
- when it does not START
- when disabled
- in the case of a FAULT





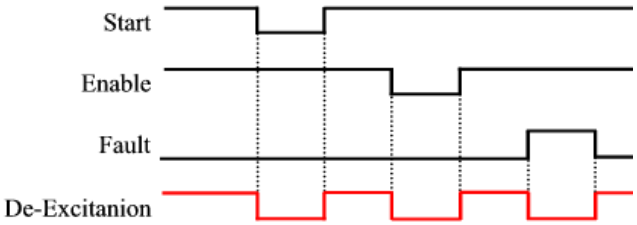
I.160=0
The output will activate for one of the following reasons:

- when there is a fault with the regulator due to internal or external causes (if an input of I.0xx=7 or 8 is configured)
- when disabled



I.160=2
The output will deactivate for one of the following reasons:

- when it does not START
- when disabled
- in the case of a FAULT

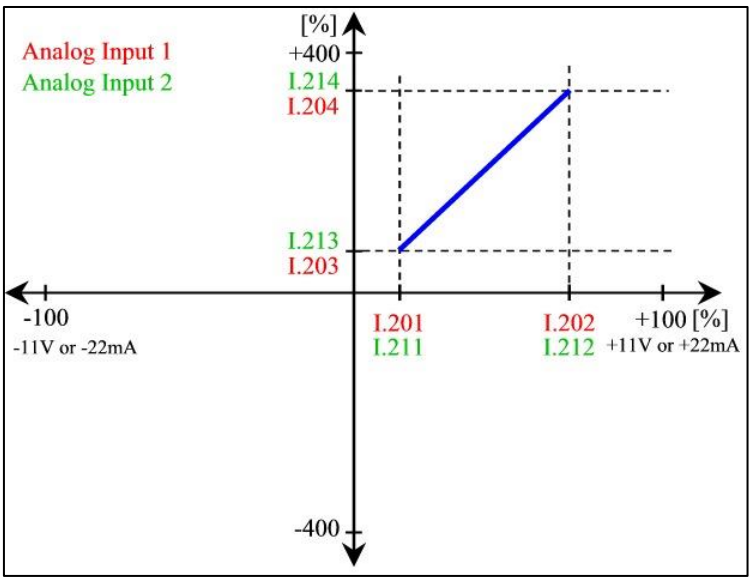


4.1.6 Analog inputs

The voltage regulator S2006 has 16 analog outputs.

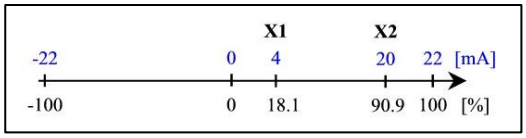
Parameter	Description	Notes
I.200	Type of Input	0 Voltage (rated range -10/+10V, effective range -11/+11V)
		1 Current (rated range-20 / +20 mA, effective range -22mA/+22mA)
I.201	Input coordinate X1	Configurable from -100% to I.202
I.202	Input coordinate X2	Configurable from I.201 to 100%
I.203	Output coordinate Y1	Configurable from -400% to 400%
I.204	Output coordinateY2	Configurable from -400% to 400%
I.205	Filter	Configurable from 0 to 2s

To correctly configure the analog input required, you must configure the range of the analog input and the corresponding range of the output you wish to control. In order to allow the management up to full rated range, the effective (real) range of analog input is 10% wider.

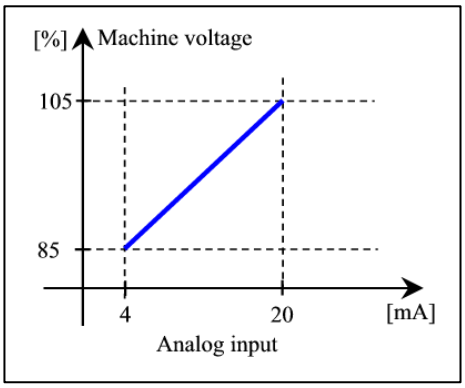


Example:
In case you want to vary the voltage reference in a range that goes from 85 to 105% of the rated voltage through an analog input 4-20mA, where 85% corresponds to 4mA and 105% corresponds to 20mA, proceed as follows:

1. set the parameter I.200=1 (current input)
2. set the parameter I.201=18.1 (the coordinate X1 in input where 4mA correspond to (4/22)*100=18.1%)
3. set the parameter I.202=90.9 (the coordinate X2 in input where 20mA correspond to (20/22)*100=90.9%)
4. set the parameter I.203=85 (the coordinate Y1 in output)
5. set the parameter I.204=105 (the coordinate Y2 in output)



Please note that fine adjustments may be necessary on I.201 and I.202 in order to achieve desired precision.
In this way there is a linear variation of the analog input function voltage reference.



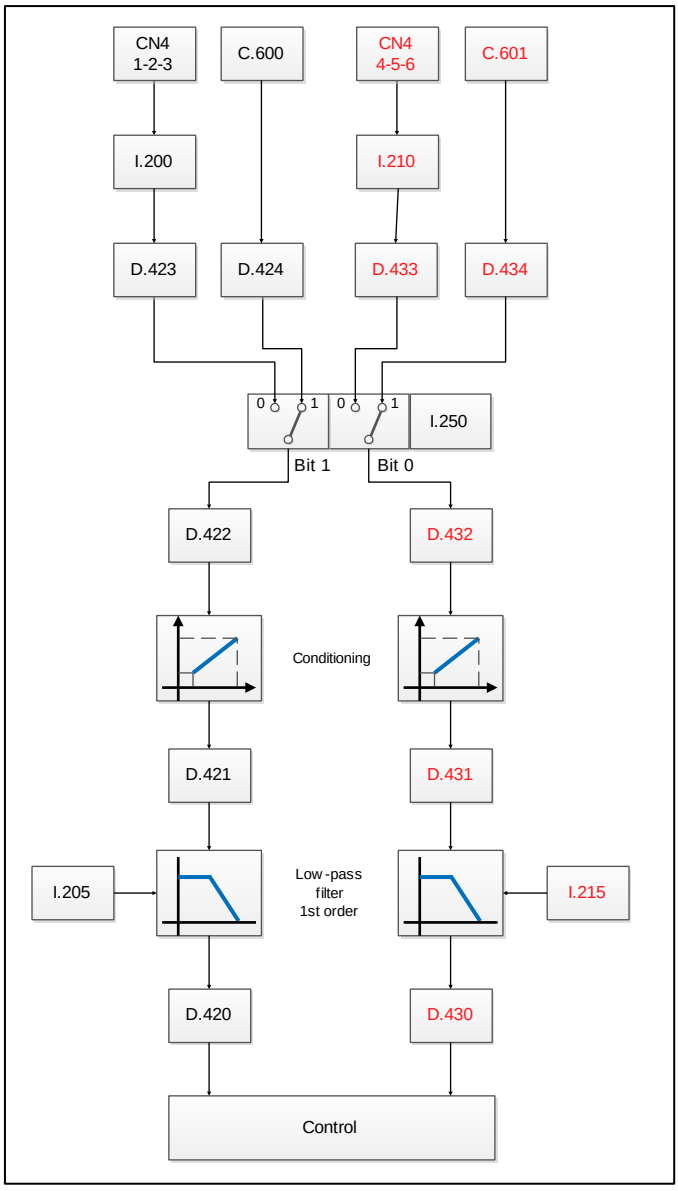
Similar considerations can be made when configuring the second analog input:

Parameter	Description	Notes
I.210	Type of Input	0 Voltage (rated range -10/+10V, effective range -11/+11V) 1 Current(rated range-20/+20mA, effective range -22mA/+22mA)
I.211	Input coordinate X1	Configurable from -100% to I.212
I.212	Input coordinate X2	Configurable from I.211 to 100%
I.213	Output coordinate Y1	Configurable from -400% to 400%
I.214	Output coordinate Y2	Configurable from -400% to 400%
I.215	Filter	Configurable from 0 to 2s

4.1.7 Enabling virtual analog inputs

Through a "virtual setting" via serial line or fieldbus, it is possible to use all the functions available on the analog inputs.
The setting can be carried out in such configurations, where the analog commands are a mix of "virtual" and terminals.
The virtual assignment can be performed through the parameter C.600/C.601.
Below is the reported the drawing describing the combination between the data of the virtual inputs and the drive terminals, with the relative decoder mask.
The switch between the "virtual" commands and the terminals is determined by programmable mask I.050.
These parameters have to be managed bitwise. At each bit corresponds a switch, as follows.

Parameter	Description	Notes
I.250	Remote enable mask	0 Terminal 1 Virtual



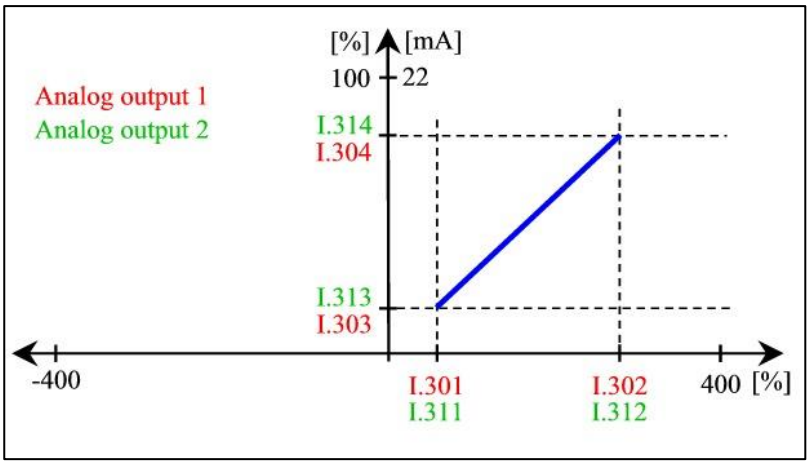
4.1.8 Analog Outputs

The voltage regulator S2006 has two analog outputs configurable between rated range 0-20mA (effective range 0-22mA). Through the analog output controlled current, it is possible to have any size listed in the table (parameter I.300).

Parameter	Description	Notes
I.300	Available measurement	0 Field I 1 Field V 2 Out Duty 3 Generator V 4 Generator I 5 Generator P 6 Generator Q 7 Generator S 8 Generator PF 9 Mains V 10 Actual Reg. Reference 11 Actual Reg. Feedback 12 Actual Reg. Error 13 Actual Reg. P+D 14 Actual Reg. I 15 Actual Reg. Output 16 Remote 17 DC Bus Voltage 18 Sync freq. Adj 19 An Input 1 20 An Input 2 21 Field I Reg. Reference 22 Field I Reg. Feedback 23 Field I Reg. Error 24 Field I Reg. P+D 25 Field I Reg. I Field I Reg. Output 26 Gener V Reg. Reference 27 Gener V Reg. Feedback 28 Gener V Reg. Error 29 Gener V Reg. P+D 30 Gener V Reg. I 31 Gener V Reg. Output 32 Gener PF Reg. Reference 33 Gener PF Reg. Feedback 34 Gener PF Reg. Error 35 Gener PF Reg. P 36 Gener PF Reg. I 37 Gener PF Reg. Output 38 Gener VAR Reg. Reference 39 Gener VAR Reg. Feedback 40 Gener VAR Reg. Error 41 Gener VAR Reg. P 42 Gener VAR Reg. P 43 Gener VAR Reg. I 44 Gener VAR Reg. Output 45 Limit OE Reg. Reference 46 Limit OE Reg. Feedback 47 Limit OE Reg. Error 48 Limit OE Reg. P 49 Limit OE Reg. I 50 Limit OE Reg. Output 51 Limit UE Reg. Reference

		52 Limit UE Reg. Feedback 53 Limit UE Reg. Error 54 Limit UE Reg. P 55 Limit UE Reg. I 56 Limit UE Reg. Output 57 Limit QP Reg. Reference 58 Limit QP Reg. Feedback 59 Limit QP Reg. Error 60 Limit QP Reg. P 61 Limit QP Reg. I 62 Limit QP Reg. Output 63 Limit QN Reg. Reference 64 Limit QN Reg. Feedback 65 Limit QN Reg. Error 66 Limit QN Reg. P 67 Limit QN Reg. I 68 Limit QN Reg. Output 69 Gener V Ref Before Limits
I.301	Input coordinate X1	Configurable from -400% to I.302
I.302	Input coordinate X2	Configurable from I.301 to 400%
I.303	Output coordinate Y1	Configurable from 0 to 100%
I.304	Output coordinate Y2	Configurable from 0 to 100%
I.305	Filter	Configurable from 0 to 2s

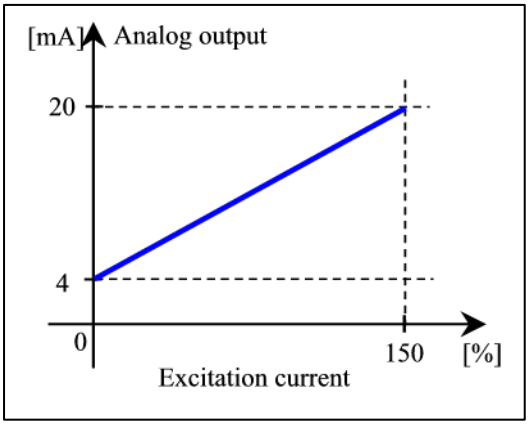
To correctly configure the output, the procedure is similar to that shown in the previous paragraph for the configuration of the analog inputs.
In order to allow the management up to full rated range, the effective (real) range of analog output is about 10% wider.

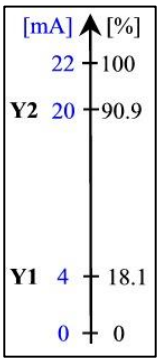


Example:
In case you want to measure the excitation current with a range from 0 to 150% of the rated excitation current through the analog output 4-20mA, where 0 corresponds to 4mA and 150% corresponds to 20mA, you can proceed as follows:

1. set the parameter I.300=0 (excitation current)
2. set the parameter I.301=0 (coordinate X1 of the value selected)
3. set the parameter I.302=150 (the coordinate X2 of the value selected)
4. set the parameter I.303=18.1 (the coordinate Y1 in output where 4mA correspond to (4/22)*100=18.1%)
5. set the parameter I.304=90.9 (the coordinate Y2 in output where 20mA correspond to (20/22)*100=90.9%)

Please note that fine adjustments may be necessary on I.201 and I.202 in order to achieve desired precision.



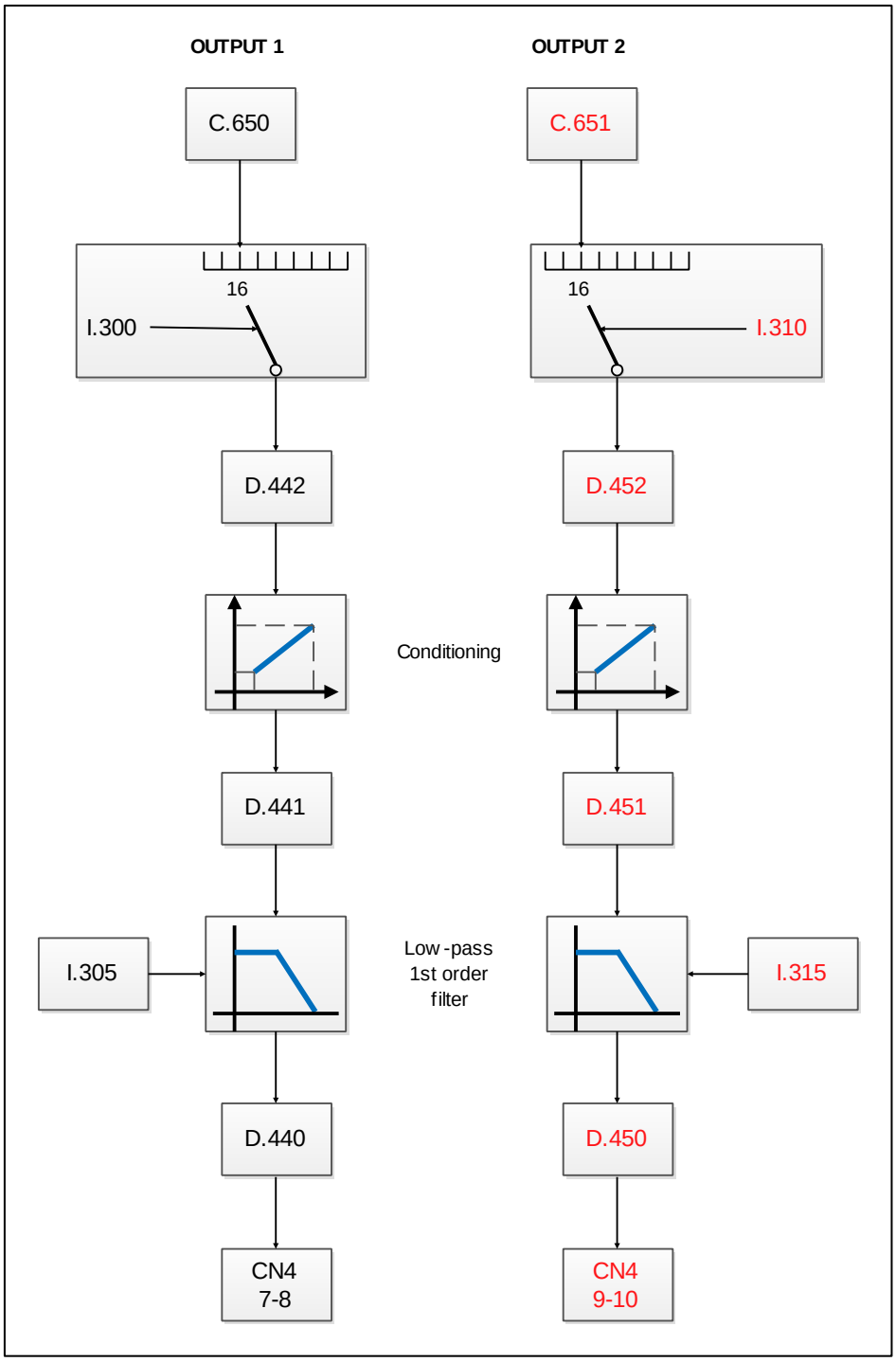


In this way there is a linear analog output variation depending on the excitation current.
Similar considerations can be made to configure the second analog output:

Parameter	Description	Notes
I.310	Size Available	See the previous table
I.311	Input coordinate X1	Configurable from -400% to I.302
I.312	Input coordinate X2	Configurable from I.301 to 400%
I.313	Output coordinate Y1	Configurable from 0 to 100%
I.314	Output coordinate Y2	Configurable from 0 to 100%
I.315	Filter	Configurable from 0 to 2s

4.1.9 Enable Virtual Analog Outputs

This parameter allows, through the “virtual setting” (from field Bus), the remote control of the analog outputs. When the parameter I.300 is set at 16, the analog output 1 is controlled by the value set in parameter C.650, instead when I.310 is set to 16, the analog output 2 is controlled by value C.651.



4.1.10 RS485 Communication

Parameter	Description	Notes
I.400	RS485 config	0 disabled 1 Modbus RTU 8N1 2 Modbus RTU 8E1 3 Modbus RTU 8O1 4 Modbus RTU 8N2
I.401	RS485 bitrate	0 4800 1 9600 2 19200 3 38400 4 57600 5 115200
I.402	RS485 node ID	Configurable from 1 to 247
I.403	RS485 timeout	Configurable from 0-25 seconds
I.404	RS485 delay	Configurable from 0 to 0.1 seconds

4.1.11 USB Communication

Parameter	Description	Notes
I.450	USB config	0 Disabled 1 Modbus RTU 8N1 2 Modbus RTU 8E1 3 Modbus RTU 8O1 4 Modbus RTU 8N2
I.451	USB bitrate	0 4800 1 9600 2 19200 3 38400 4 57600 5 115200
I.452	USB node ID	Configurable from 1 to 247
I.453	USB timeout	Configurable from 0-25 seconds

4.1.12 CAN bus communication

Parameter	Description	Notes
I.500	CAN config	0 Disabled 1 CAN proprietary (for redundancy)
I.501	CAN bitrate	1 50 kBps 2 125 kBps 3 250 kBps 4 500 kBps 5 800 kBps 6 1 MBps
I.502	CAN node ID	Configurable from 1 to 127

4.1.13 Ethernet communication (optional)

Parameter	Description	Notes
I.600	Ethernet mode	0 Disabled 1 Modbus/TCP server
I.610	IP address b1	From 1 to 255
I.611	IP address b2	From 1 to 255
I.612	IP address b3	From 1 to 255
I.613	IP address b4	From 1 to 255
I.620	IP subnet mask b1	From 1 to 255
I.621	IP subnet mask b2	From 1 to 255
I.622	IP subnet mask b3	From 1 to 255
I.623	IP subnet mask b4	From 1 to 255
I.630	IP gateway b1	From 1 to 255
I.631	IP gateway b2	From 1 to 255
I.632	IP gateway b3	From 1 to 255
I.633	IP gateway b4	From 1 to 255

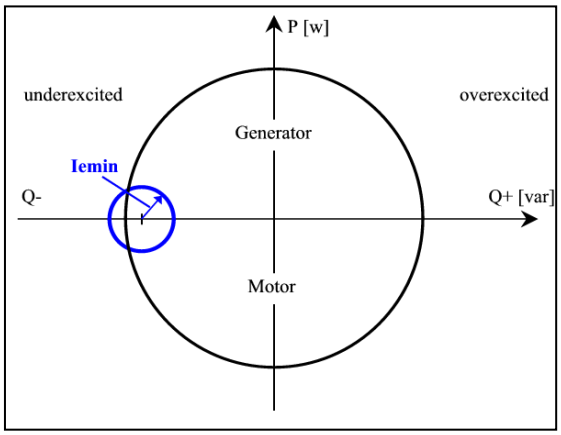
4.2 Description and Configuration Parameters

4.2.1 Field excitation data

Parameter	Description	Unit
P.000	Field rated current	[Adc]
P.001	Field over excitation limit	[%] of the excitation rated current (P.000)
P.002	Field under excitation limit	[%] of the excitation rated current (P.000)
P.003	Field over exctitation limit when generator is unloaded (off-grid) in FCR mode	[%] of the excitation rated current (P.000)
P.010	Field rated voltage	[Vdc]
P.011	Field maximum voltage	[%] of the excitation rated current (P.010)
P.020	Field resistance	[Ω]
P.021	Field inductance	[H]
P.030	Field thermal Current	[%] of the excitation rated current (P.000)
P.031	Field over excitation decay time	[s]
P.032	Field over excitation limit time	[s]
P.050	Rotor poles pair	

4.2.2 Minimum Excitation Current

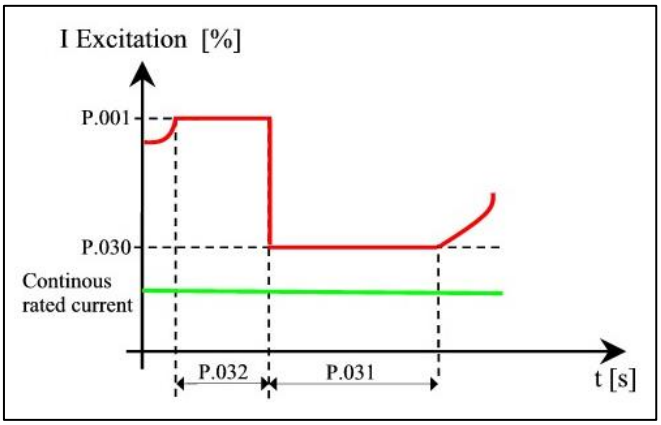
The minimum excitation current is enabled only with machine in parallel to the grid.
It shows the minimum excitation current, under which, the machine cannot work.



Parameter	Description	Notes
P.002	Field under excitation limit	[%] of the excitation rated current (P.000)

4.2.3 Maximum Excitation Current

The limit of maximum excitation current operates a limit on the maximum excitation current.



Parameter	Description	Unit
P.001	Field over excitation limit	[%] of the excitation rated current (P.000)
P.030	Field thermal current	[%] of the excitation rated current (P.000)
P.031	Field over excitation decay time	[s]
P.032	Field over excitation limit time	[s]

4.2.4 Generator data

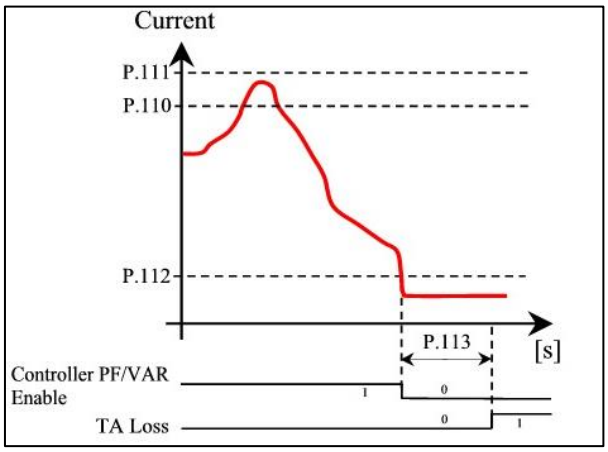
Parameter	Description	Unit
P.100	Generator rated voltage	[V]
P.101	Generator maximum voltage	[%] of the generator rated voltage (P.100)
P.102	Generator minimum voltage	[%] of the generator rated voltage (P.100)
P.110	Generator rated current	[A]
P.111	Generator maximum current	[%] of the generator rated current (P.110)
P.112	Generator minimum current	[%] of the generator rated current (P.110)
P.113	Generator TA loss delay	[s]
P.120	Generator rated frequency	[Hz]
P.130	Generator V/f minimum frequency	[%] of the Generator rated frequency (P.120)
P.131	Generator V/f maximum frequency	[%] of the Generator rated frequency (P.120)
P.132	Generator soft start time	[s]
P.133	Generator grid start time	[s]
P.140	Generator thermal current	[%] of Generator rated current (P.110)
P.141	Generator maximum current decay time	[min]
P.142	Generator maximum current time	[s]
P.150	Generator poles pair	
P.160	Limit minimum reactive power at P = 0%	[%] of the generator rated power (P.100xP.110)
P.161	Limit minimum reactive power at P = 25%	[%] of the generator rated power (P.100xP.110)
P.162	Limit minimum reactive power at P = 50%	[%] of the generator rated power (P.100xP.110)
P.163	Limit minimum reactive power at P = 75%	[%] of the generator rated power (P.100xP.110)
P.164	Limit minimum reactive power at P = 100%	[%] of the generator rated power (P.100xP.110)
P.165	Generator voltage correction factor for Q-	
P.170	Limit maximum reactive power at P = 0%	[%] of the generator rated power (P.100xP.110)
P.171	Limit maximum reactive power at P = 100%	[%] of the generator rated power (P.100xP.110)

P.172	Generator voltage correction factor for Q+	

4.2.5 Generator current

Through these parameters it is possible to set the data relating to the alternator current:

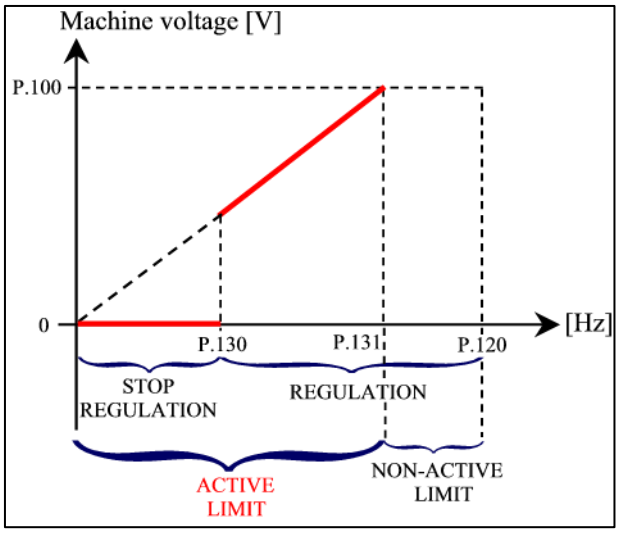
- P.110 Rated alternator current;
- P.111 Maximum current threshold of the alternator, above which the regulator will try to reduce reactive power to bring the current within the limit;
- P.112 Minimum current threshold of the alternator, below which the PF and VAR regulator do not work;
- P.113 If the alternator current continues below the minimum current for a period longer than the “TA loss delay” the alarm “TA Loss” is activated.



Parameter	Description	Unit
P.110	Generator rated current	[A]
P.111	Generator maximum current	[%] of the generator rated current (P.110)
P.112	Generator minimum current	[%] of the generator rated current (P.110)
P.113	Generator TA loss delay	[s]

4.2.6 V/Hz limit

The V/Hz limit is always active during the voltage regulation mode when generator is off-grid. It limits the machine voltage as soon as the frequency falls below the maximum frequency set in parameter P.131. In the event of a reduction in revolutions, this avoids over-fluxing.



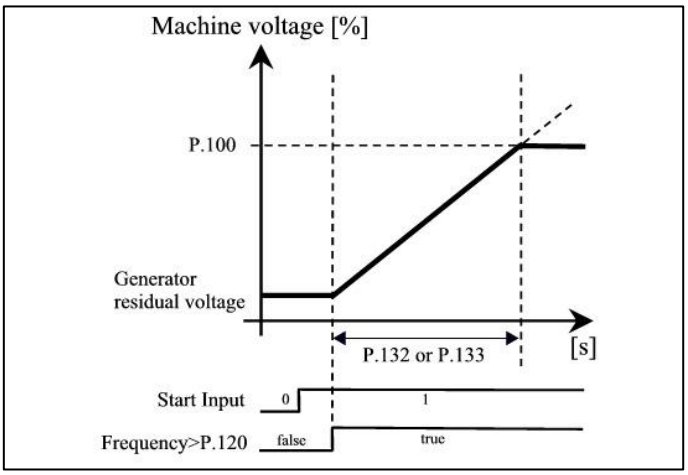
Parameter	Description	Unit
P.100	Generator rated voltage	[V]
P.120	Generator rated frequency	[Hz]
P.130	Generator V/Hz limit minimum frequency	[%] of Generator rated frequency (P.120)
P.131	Generator V/Hz limit maximum frequency	[%] of Generator rated frequency (P.120)

4.2.7 Soft Start

By the configuration of parameter P.132, you can set the ramp of excitation of the machine. The soft start function is only enabled in the Auto mode
The excitation ramp is only activated if all the following conditions are met:

- Start command is active
- The alternator frequency (P.120) is greater than the minimum frequency set (P.130)

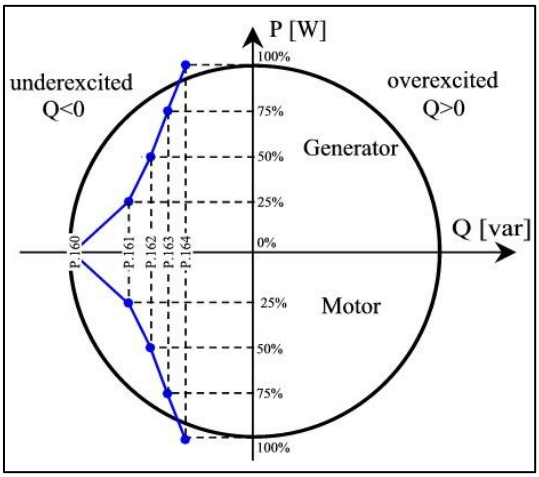
Parameter	Description	Unit
P.132	Generator soft start timer	[s]
P.100	Generator rated voltage	[V]
P.133	Generator grid start time	[s]



P.133 is used as ramp time instead of P.132 only for grid startup (parallel switch closed during generator ramp for grid energizing): this condition is enabled by a digital input configured to 55/56 (GRID STARTUP NO/NC). Parallel switch status will be ingnored till ramp ends.

4.2.8 Minimum Reactive Power limit

The limit of minimum reactive power is determined by 5 points.



Parameter	Description	Notes / Unit
P.160	Limit minimum reactive power at P = 0%	[%] of the generator rated power (P.100xP.110)
P.161	Limit minimum reactive power at P = 25%	[%] of the generator rated power (P.100xP.110)
P.162	Limit minimum reactive power at P = 50%	[%] of the generator rated power (P.100xP.110)
P.163	Limit minimum reactive power at P = 75%	[%] of the generator rated power (P.100xP.110)
P.164	Limit minimum reactive power at P = 100%	[%] of the generator rated power (P.100xP.110)
P.165	Generator Voltage correction factor for Q limit	

When P.165 >0 the Minimum Reactive Power limit move according to the following formula

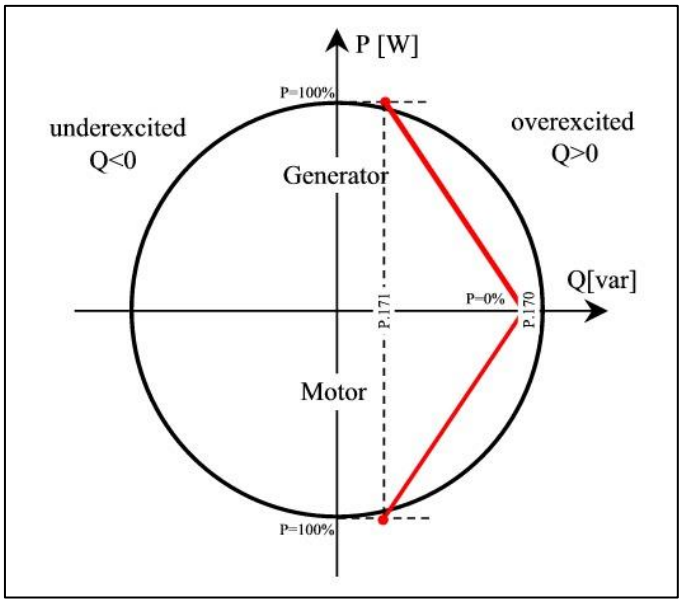
$$Q_{lim}=Q_{lim}(P)- kQ(-)_{\%}\cdot(1-V_{gen}^2)$$

Where:

Q_{lim}	New Reactive power limit value	[%] of the generator rated power (P.100xP.110)
$Q_{lim}(P)$	Reactive power limit value referred to a certain active power value (limit value when P.165=0)	[%] of the generator rated power (P.100xP.110)
$kQ(-)_{\%}$	Generator Voltage correction factor for Q limit (P.165)	
V_{gen}	Instant alternator voltage (from voltage transformer)	[%] of the generator rated voltage (P.100)

4.2.9 Maximum Reactive Power limit

The limit of maximum reactive power is determined by 2 points.



Parameter	Description	Notes / Unit
P.170	Limit maximum reactive power at P = 0%	[%] of the generator rated power (P.100xP.110)
P.171	Limit maximum reactive power at P = 100%	[%] of the generator rated power (P.100xP.110)
P.172	Generator voltage correction factor for Q+	

When P.172 >0 the Maximum Reactive Power limit move according to the following formula

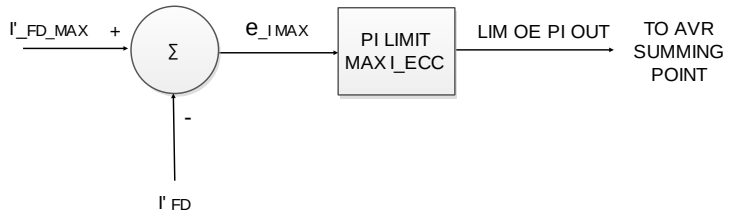
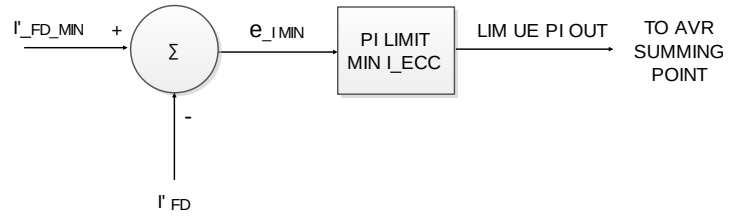
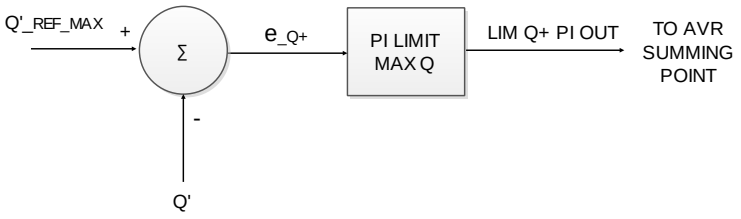
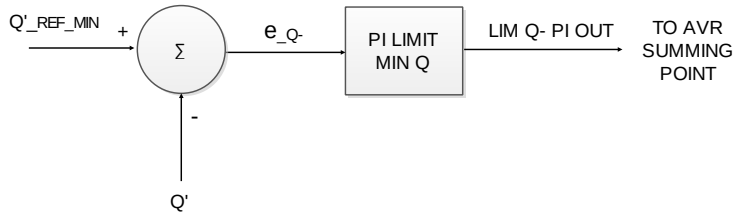
$$Q_{lim}=Q_{lim}(P)+ kQ(+)_{\%}\cdot(1-V_{gen})$$

Where:

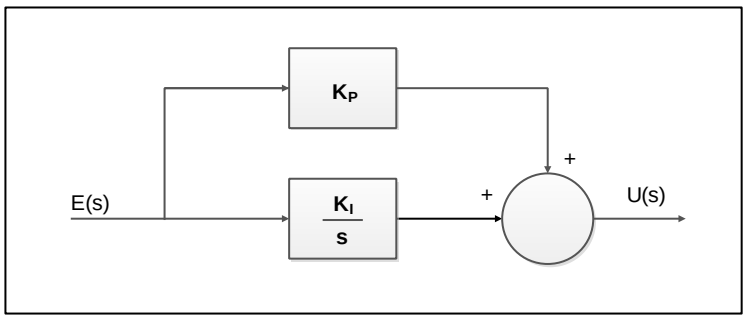
Q_{lim}	New Reactive power limit value	[%] of the generator rated power (P.100xP.110)
$Q_{lim}(P)$	Reactive power limit value referred to a certain active power value (limit value when P.172=0)	[%] of the generator rated power (P.100xP.110)
$kQ(+)_{\%}$	Generator Voltage correction factor for Q limit (P.172)	
V_{gen}	Instant alternator voltage (from voltage transformer)	[%] of the generator rated voltage (P.100)

4.2.10 Limits implementation: Math model

Following figures shows the S2006 model for limiters, each model is defined by PI gains:

Over Excitation limit	
Under Excitation limit	
Maximum reactive power limit	
Minimum reactive power limit	

The **PI controller** is represented by the following block diagram:



$$U(s) = \left(Kp + \frac{Ki}{s}\right) * E(s)$$

E(s) and U(s) are the Laplace transforms of the feedback error and control signal, the value of the PI gain parameter are:

Parametro	Descrizione	Note
r.900	Proportional gain Over excitation limit	Kp OE
r.901	Not normalized integral gain Over excitation limit	Ki' OE
r.910	Proportional gain Under excitation limit	Kp UE
r.911	Not normalized integral gain Under excitation limit	Ki'UE
r.920	Proportional gain Maximum reactive power limit	Kp Q+
r.921	Not normalized integral gain Maximum reactive power limit	Ki' Q+
r.930	Proportional gain Minimum reactive power limit	Kp Q-
r.931	Not normalized integral gain Minimum reactive power limit	Ki' Q-

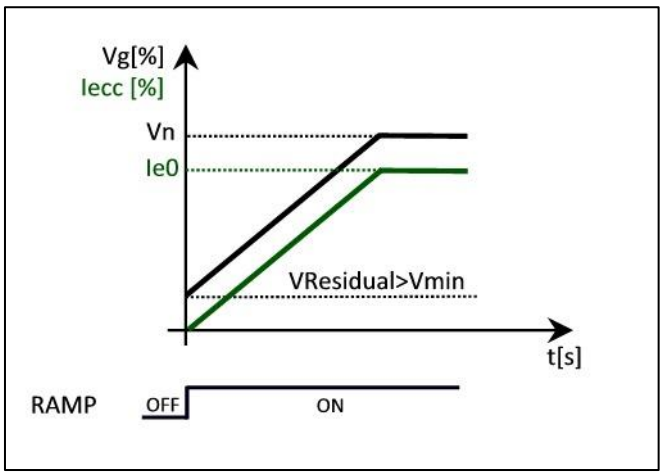
Considering the cycle times of the controller (Tcycle=50ms), the gains are normalized as follows:

$$ki = ki' * 20$$

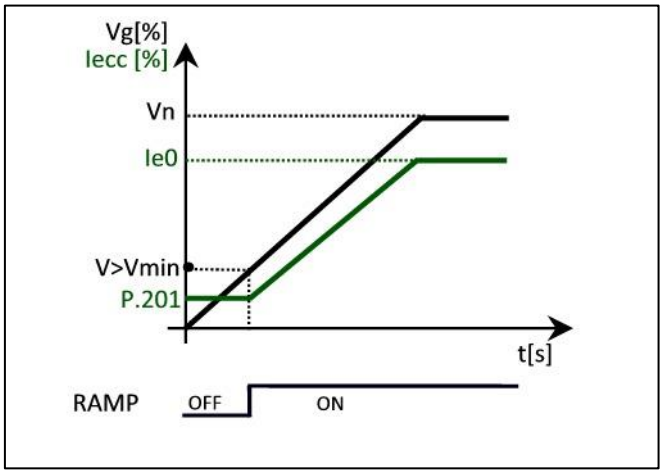
4.2.11 Sensing

Parameter	Description	Notes / Unit
P.200	Generator voltage sensing	0 single phase V sense 1 three-phase V sense
P.201	Field buildup level	[%] of P.000
P.210	TV Mains phase	[deg]
P.211	TV Mains rated V	[Vrms]
P.212	Mains V toll.	[%]
P.213	Mains auto follow	

Usually there is a machine residual voltage such the controller is able to recognize the generator frequency, which is essential for starting up the excitation ramp. In case the residual voltage should be insufficient to allow the controller to ramp, a small excitation current (P.201) is provided from the controller to recognize the generator frequency.



4-2 Generator with residual voltage



4-1 Generator without residual voltage

4.2.12 Power supply

Parameter	Description	Notes / Unit
P.250	Supply rated voltage	[Vac] =0 for supply from generator output
P.251	Supply timeout	[s] Active only when P.250>0 =0 no timeout check

Under Voltage threshold (U.V.th) for Under Voltage alarm is set to 70% of P.250.
Excitation is enabled only when power supply voltage > UVth.

4.2.13 Control mode

The transition between the various function modes is without sensitive variations (bump-less).
It is possible to select the default control mode through parameter p.300. This can be changed at any time through a configurable digital input.

Parameter	Description	Notes
P.300	Control Mode	0 PWM 1 FVR 2 FCR 3 AVR 4 PF 5 VAR

Open Loop (PWM)
When operating in Open loop mode, S2006 regulates the PWM output level supplies to the field.
Note: No limits are active.
For more information, refer to 5.1 PWM reference (PWM)

Manual Control (FVR)
When operating in FVR mode, S2006 regulates the level of field voltage it supplies to the field.
Note: The limits of the synchronous machine are deactivated.
For more information, refer to 5.2 Field voltage reference (FVR)

Manual Regulation (FCR)
When operating in FCR (Field Current Regulation) mode, S2006 regulates the level of current it supplies to the field.
Note: The limits of the synchronous machine are deactivated.
For more information, refer to 5.3 Field current reference and regulator (FCR)

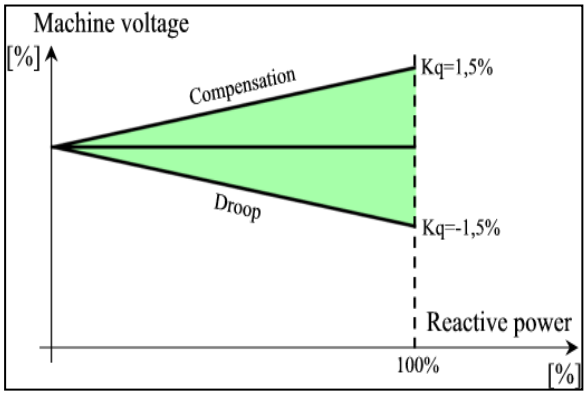
Automatic voltage Regulation (Auto)
When operating in AVR (Automatic Voltage Regulation) mode, S2006 regulates the excitation level in order to maintain the generator terminal voltage setpoint despite changes in load and operating conditions.
Note: Measurement of the alternator current required for compensation/droop mode, stator limiters (capability, maximum); parallel switch must be closed.
For more information, refer to 5.4 Generator voltage reference and regulator (AVR)

Regulation PF
When operating in Power Factor (PF) mode, S2006 controls the var output of the generator to maintain the Power Factor setpoint as the active power load on the generator varies.
Note: This function is only active when the parallel switch is closed, measure of alternator current is mandatory.
For more information, refer to 5.5 Generator PF reference and regulator (PF)

Regulation VAR
When operating in var mode, S2006 regulates the reactive power (var) output of the generator based on the var setpoint.
Note: This function is only active when the parallel switch is closed, measure of alternator current is mandatory.
For more information, refer to 5.6 Generator VAR reference and regulator (VAR)

4.2.14 Droop

The compensation function (K>0) is used to cancel a fall in voltage in the transformer connected downstream of the alternator.
The droop function (K<0) is used when there are more generators running in parallel. A reduction of the voltage is applied depending on the reactive power supplied in order to balance reactive power among generators

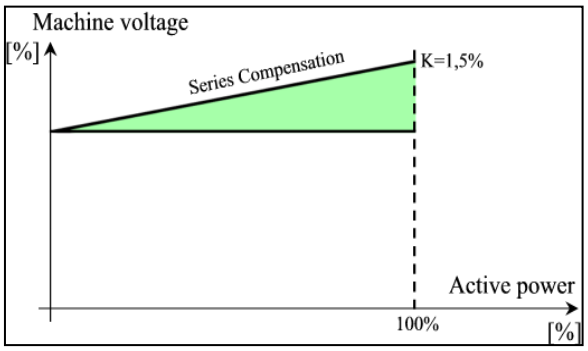


Parameter	Description	Unit
P.400	Voltage compensation K	[%] of P.100 at reactive power=100%
P.401	Compensation ramp time	[s]
P.402	Primary grid ID	
P.403	Altern. grid ID	

4.2.15 Series compensation

The series compensation function corrects the voltage depending on the active power supplied; The purpose is to compensate transformer voltage drop as Droop (see 4.2.14) with k>0.

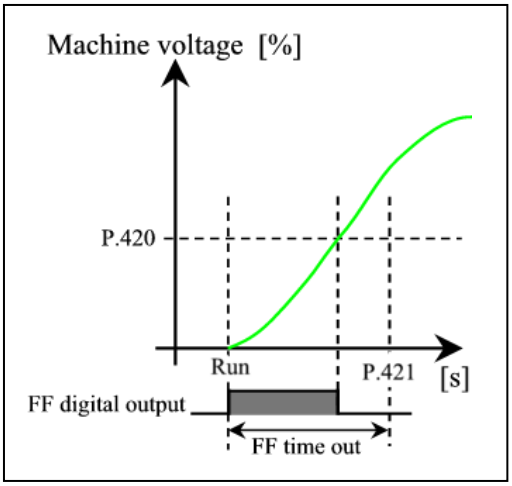
Parameter	Description	Notes
P.410	Voltage compensation K	[%] of P.100 at active power=100%
P.411	Compensation ramp time	[s]



4.2.16 Field flashing

In the case where the machine does not have enough residual voltage and the power supply of the regulator is directly connected to the machine terminals, it is necessary to resort to field-flashing, in this case auxiliary power option is required.
It is possible to configure an output on the regulator to control the pre-excitation circuit.
Once it has received the start signal, the regulator will enable the configured output. Once it has reached a minimum threshold through the parameter “FF off level” (p.420), the output will be deactivated. If after “FF time out”, configured through the parameter (P.421), the voltage does not reach the minimum threshold “FF off level”, the regulator will trip.

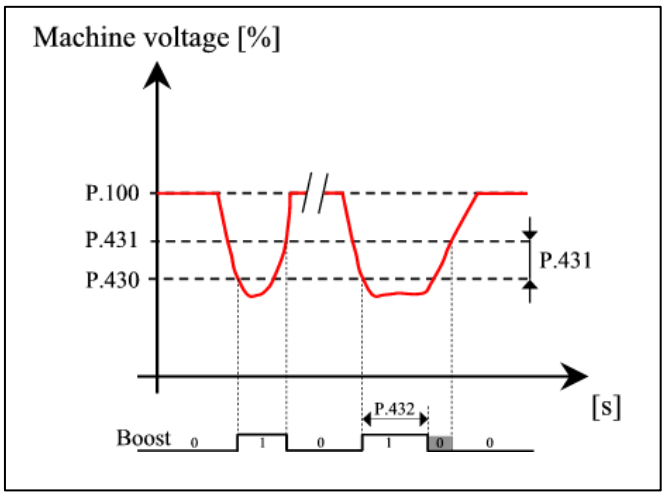
Parameter	Description	Notes
P.420	Field flashing off level	[%] of P.100
P.421	Field flashing maximum time	[s]



4.2.17 Boost

The Boost function enables an external circuit that allows an increase in the excitation current for a maximum set time.
This function improves response to line voltage decrease by providing an increased excitation current.

Parameter	Description	Unit
P.430	Boost on level	[%] of P.100
P.431	Boost off hysteresis	[%] of P.100
P.432	Boost maximum time	[s]

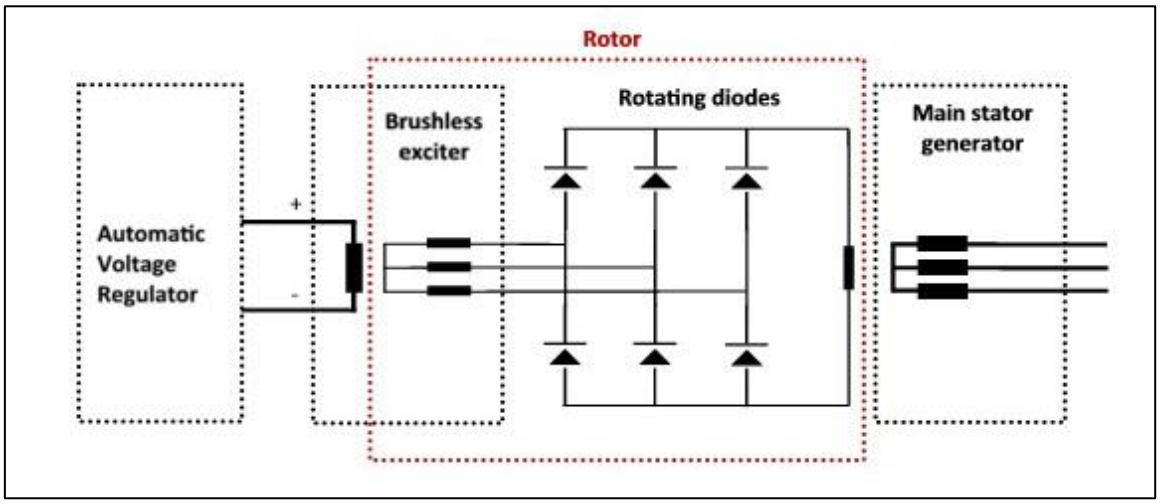


4.2.18 Rotor diode monitor (optional)

The Diode control function allows the detection of the following anomalies:

- Interruption of a diode
- Short circuit of a diode

In the brushless excitation system this function is notably important as it allows the control of the diodes installed on the rotor during its operation.
The block diagram that follows represents the excitation circuit:



To correctly configure the diode control function it is necessary to know the rotor brushless pole pairs and the generator stator pole pairs:

- Rotor brushless poles pair P.050
- Generator stator pole pair P.150

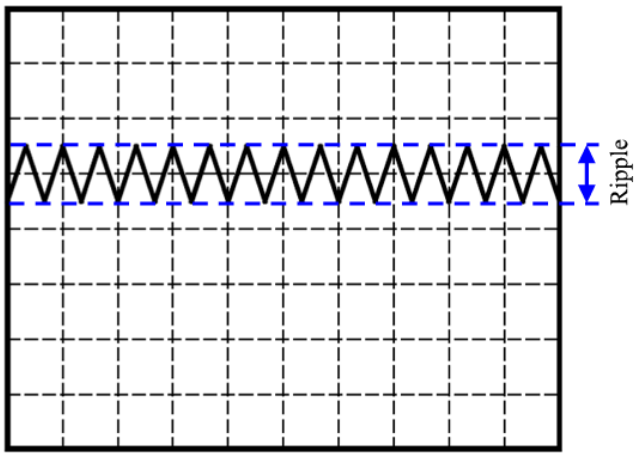
The rotor brushless pole pairs are given by the manufacturer (there are 2 by default) while the generator stator pole pairs can be obtained through the number of revolutions and the frequency using the following formula:

$$2p = \frac{f * 60}{n}$$

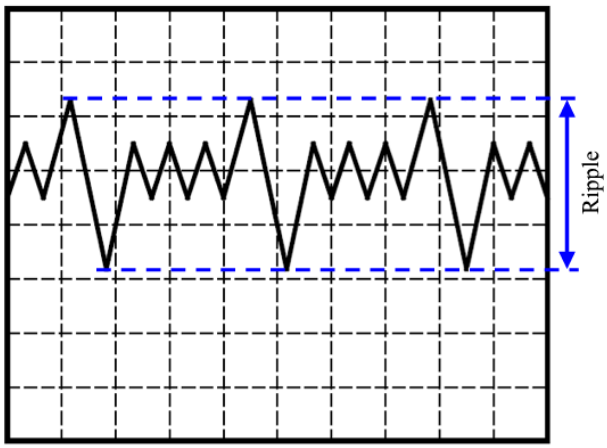
where:

2p is the number of the pole pairs
f is the rated frequency output of the machine [Hz] (tipically 50 or 60Hz)
n is the number of rated revolutions of the machine rotor [rpm]

During normal operations, the current in the field circuit of the exciter circuit has a very low ripple value (d.005)



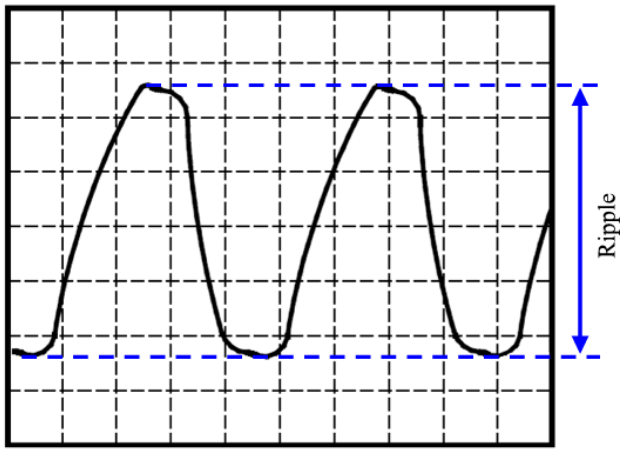
When a diode is interrupted, the ripple increases to around 3 times in relation to the value of the preceding ripple.



To configure the protection intervention it is necessary to specify the level of ripple and the delay in detecting the fault.

- Detect level oc P.600
- Signal delay oc P.601

In the case of diode short circuit, the ripple increases by 5 times in relation to the value of the ripple during normal operation.



To configure the protection intervention it is necessary to specify the level of ripple and the delay in detecting the fault.

- Detect level sc P.610
- Signal delay sc P.611

Parameter	Description	Unit
P.050	Rotor brushless poles pair	
P.150	Generator stator poles pair	
P.600	Detect level open circuit	[%] of P.000
P.601	Signal delay open circuit	
P.610	Detect level short circuit	[%] of P.000
P.611	Signal delay short circuit	

4.2.19 Synchronization (optional)

When the synchroniser is disabled (P.704=0) the parallel consensus output (I.1XX=9/10) activates when voltage and alternator frequency are equal, in order to enable a relay of external synchronisation.
When the synchroniser is enabled (P.704≥1) the parallel consensus output activates on impulse for 500ms when all the following conditions of synchronisation are met:

- Voltage within the admitted tolerance in parameter P.700
- Frequency difference (slip) between the minimum (p.701) and the maximum (P.702).
- Condition of over synchronisation (P.703) if enabled.
- Number of sync cycles reached (P.704).

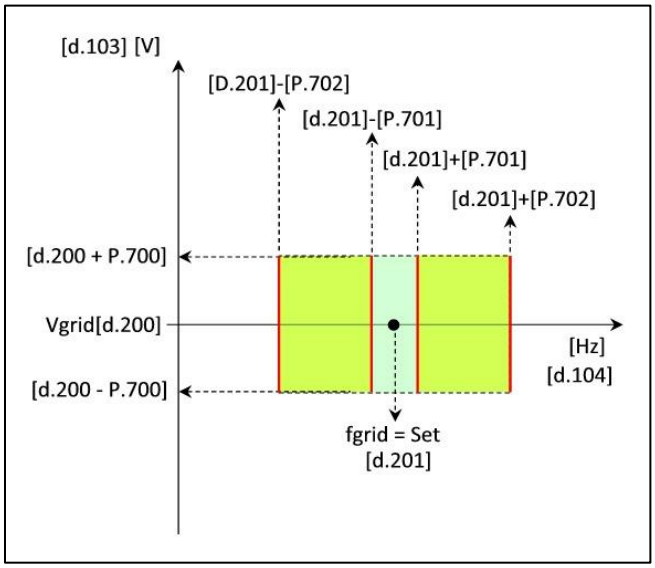
The parallel consensus can be anticipated by the response time of the parallel switch (P.706).
The closure time of the switch is measured and visualised on parameter d.212.

Parameter	Description	Notes / Unit
P.700	Voltage tolerance	[%] of P.100
P.701	Minimum slip	[Hz]
P.702	Maximum slip	[Hz]
P.703	Generator faster than grid	1= active 0= don't care
P.704	Wait cycles	0=sinchronization disabled
P.706	Circuit breaker close time	[s]
P.710	Frequency adjust type	=0 by analog output =1-99 inc/dec pulse duty 1-99% =100 inc/dec pulse time linear
P.711	Frequency adjust span (only for analog adjust or inc/dec pulse time linear)	[Hz]
P.712	Frequency adjust period	[s]

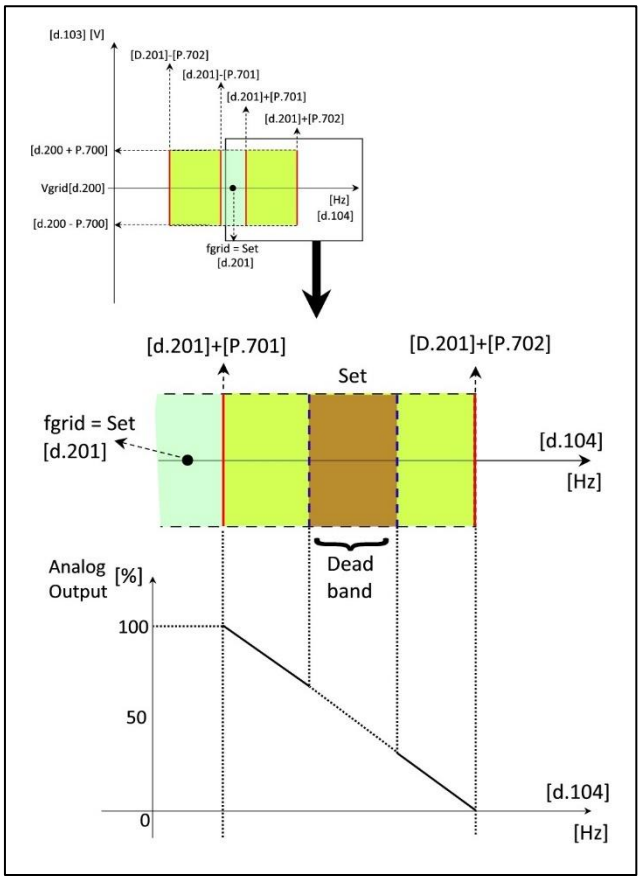
The S2006 can send commands to the speed regulator either digital or analog, the commands are periodically updated based on parameter P712.
S2006 monitors the slip frequency between the generator and grid defined as:

$$s=|f_{gen}-f_{grid}|$$

Through the increase and decrease commands S2006 regulates the slip halfway between the minimum and maximum admitted (parameters P.701 and P.702).



There is a dead band around the slip set (within which S2006 does not generate commands for the speed regulator), equal to 1/3 of the distance between minimum and maximum slip.



With parameter P.710=0 the command is given to analog output whose value is proportional to the slip and has full scale given by parameter P.711.
With parameter P.710 between 1 to 99, the digital commands generated from S2006 have a fixed duty cycle from 1 to 99% while with P.710=100 the duty cycle is proportional to the slip, with full scale given by P.711.

Example: P.712=10s, P.710=2% means a command of 200ms every 10s.

If P.703=0 the generator frequency can be greater or lower than the grid (the slip can be positive or negative) and then the synchronization window is mirrored to the left of vertical axis.

Circuit breaker closing time can be compensated (P.706>0) only if the speed regulation is very steady and stable within the synchronization window (sync wait cycles count restarts every time the generator frequency falls outside of synchronization window).
If speed regulation is coarsy, P.706=0 enable a simplified synchronization algorithm that has less constrains and allowes better synchronization event occurencies.

4.2.20 Alarms and Faults signalling

Parameter	Description	Notes / Unit
P.800	Fault enable mask low	as D.800
P.801	Fault enable mask high	as D.801
P.810	Signal mask 1 low	as D.800
P.811	Signal mask 1 high	as D.801
P.820	Signal mask 2 low	as D.800
P.821	Signal mask 2 high	as D.801
P.830	Thermal warning temperature expressed in °C	[°C]

Every alarm is mapped to a bit of d.800 or d.801 as in the following table. The HEXadecimal notation is just a compact way to represent the binary value (each set of 4 binary digits became a single hexadecimal digit).
The value of d.800 and d.801 is the status of alarms converted to binary value each "1" bit means that the related alarm is active.
See following table:

	Bynary value (16 bits)																
Alarm list	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**	**HEX**
First 16 bits - d.800																	
Over current																1	0001
Watchdog															1		0002
Over heating														1			0004
External fault													1				0008
Excitation over load												1					0010
Serial time out1											1						0020
Serial time out 2										1							0040
PowerSupply Feedback loss									1								0080
Parallel switch fault								1									0100
Tv loss							1										0200
TV asymmetrical						1											0400
Rotor diode open					1												0800
Rotor diode short				1													1000
Under voltage			1														2000
Temperature sensor error		1															4000
TA loss	1																8000
Second 16 bits - d.801																	
Brake Resistor over heating																1	0001
Generator OverVoltage															1		0002
External Fault 2														1			0004
External Fault 3													1				0008
External Fault 4												1					0010
.....																	...
Params error			1														2000
Params file error		1															4000
Configuration file error	1																8000

Alarms (simple warnings) can be "promoted" to Faults (de-excitation and latch till reset) if enabled by P.800 or P.801; every bit is associated to an alarm as listed in D.800 an D.801 descriptions and every alarm that has 1 on the related P.800 or P.801 mask will trip a Fault.
If, for example, it is necessary to consider as fault the two conditions “Excitation over load” or “Power supply feedback loss”, check following instructions:

Alarm	Hex value
Excitation over load	0010
Power supply feedback loss	0080
Program P.800 as the HEX sum:	0090

Or, for example, if it is necessary to consider as fault the three conditions “Under Voltage “ or “Parallel switch fault” or “Serial time out1“, check following instructions:

Alarm	Hex value
Under Voltage	2000
Parallel switch fault	0100
Serial time out1	0020
Program P.800 as the HEX sum:	**2120**

Follow the same procedure for the programming of P.801.

In a similar way, masks P.810 - P.811 and P.820 - P.821 can be used to select which alarms set activate the digital outputs configured as 29/30 (Warning Mask1) or 31/32(Warning Mask2).
If, for example, it is necessary to activate the 29/30 (Warning Mask1) output in case of “Over heating” or “TV loss”, consider following instructions:

Alarm	Hex value
Over heating	0004
Generator voltage missing (PT loss)	0200
Program P.810 as the HEX sum:	**0204**

Or, for example, if it is necessary to activate the 31/32(Warning Mask2) output in case of

- Rotor diode open
- Rotor diode short
- TV loss
- Brake Resistor over heating
- Params file error

consider following instructions:

Alarm	Hex value
Rotor diode open	0800
Rotor diode short	1000
TV loss	0200
Program P.820 as the HEX sum:	**1A00**
Brake Resistor over heating	0001
Params file error	4000
Program P.821 as the HEX sum:	**4001**

P.830 set the heatsink temperature threshold that activate digital output configured as 59/60 (Thermal warning),this can be useful for example to starting an additional switchboard cooling system (as rooftop / door fans).

4.2.21 Limits signalling

Parameter	Description	Notes
P.850	Limit mask 1	as D.330
P.851	Limit mask 2	as D.330

Every limit is mapped to a bit of d.330 in the following table.The HEXadecimal notation is just a compact way to represent the binary value (each set of 4 binary digits became a single hexadecimal digit).
The value of d.330 is the status of limits converted to binary value each "1" bit means that the related limit is active.
See following table:

	Bynary value (16 bit) - d.330																
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	HEX
Minimum Frequency																1	0001
V/Hz															1		0002
Ramp														1			0004
Under Excitation													1				0008
Minimum Current												1					0010
Minimum Reactive Power											1						0020
Calibrator at minimum										1							0040
---Reserved---									1								0080
Calibrator at maximum								1									0100
Over Excitation							1										0200
Field Ixt (Thermal limit)						1											0400
Generator Ixt (Thermal limit)					1												0800
Generator Current				1													1000
Generator Voltage			1														2000
Maximum Reactive Power		1															4000
not used	1																8000

Mask P.850-P.851 can be used to select which limits activate the digital outputs configured as 35/36 (Limits Mask1) or 37/38 (Limits Mask2).
If, for example, it is necessary to activate the 35-36 output in case of “Calibrator at minimum” or “Maximum reactive power”, consider following instructions:

Limiter	Hex value
Calibrator at minimum	0040
Maximum reactive power	4000
Program P.850 as the HEX sum:	**4040**

Or, for example, if it is necessary to activate the 37-38 output in case of “Over Excitation” or “Generator Ixt (Thermal limit)” or “Generator current “, consider following instructions:

Limiter	Hex value
Over Excitation	0200
Generator Ixt (Thermal limit)	0800
Generator current	1000
Program P.851 as the HEX sum:	**1A00**

4.2.22 Operator interface

Parameter	Description	Notes
P.900	F1 key configuration	0 none 1 set point raise 2 set point lower 3 set point pre position 4 alarm reset 5 jump to parameter
P.901	F1 key aux value	
P.910	F2 key configuration	as P.900
P.911	F2 key aux value	
P.920	Led L1 configuration	As I.000
P.921	Led L2 configuration	As I.000
P.980	Password level 1	
P.981	Password level 2	
P.999	Startup param	

4.3 Commands

4.3.1 Non volatile parameters

Parameter	Description	Notes
C.000	Parameters save to Non Volatile Memory	0→1 = save
C.001	Parameters reload from Non Volatile Memory	0→1 = reload
C.002	Parameters default	0→1 = reload default

4.3.2 System test utilities

Parameter	Description	Notes / Unit
C.200	Test step amplitude	[%]
C.201	Test time	[s] =0 continuous
C.202	Test trigger / s	0-->1 start test step cycle (auto return to 0 after C.201) =2 test signal from analog input 1 =3 test signal form analog input 2
C.203	Step target selection	=0 test step applied to Field current reference =1 test step applied to Generator Voltage reference =2 test step applied to PF reference =3 test step applied to VAR reference

4.3.3 Virtual I/O

Parameter	Description	Notes / Unit
C.500	Digital inputs remote status	bit mapping (hex)
C.550	Digital outputs remote status	bit mapping (hex)
C.600	Analogic input 1 remote value	[%]
C.601	Analogic input 2 remote value	[%]
C.650	Analogic output 1 remote value	[%]
C.651	Analogic output 2 remote value	[%]

4.3.4 Alarm

In the event of a fault an alarm code will appear on the display or several codes in rotation in the case of more alarms. When there is an alarm, you can no longer visualise or modify any parameter. The alarm code continues to flash on the display until the following operations are carried out:

- Reset by digital input (I.0xx=5 or 6) after the cause of the fault has been found and remove.
- Manual reset (keys UP + DOWN) after the cause of the fault has been found and remove.
- Identify the alarm (ACK) by pressing the key “M” for more than 1 second, in this case the display continues to flash but it is possible to visualise and/or modify the parameters. In the event you want to see the alarm code that has caused the fault, it is possible to reset the alarm identification (ACK) through parameter C.900=1

Parameter	Description	Meaning
O.C	Over Current	Shot circuit on the excitation circuit or internal hardware failure of regulator output power circuit
UUdG	Watchdog	Microcontroller fails to correctly execute the firmware
OH	Over Heating	Temperature of heatsink exceeded max threshold (typically 80°C)
E.F	External Fault	By digital input configured as 7 EXTERNAL FAULT (NO) or 8 EXTERNAL FAULT (NC)
E.OVL	Exciter OVerLoad	Regulator thermal Image (d.998) reached top level.
S.tO.1	Serial TimeOut 1	Timeout communication RS485 (by parameter I.403).

S.tO.2	Serial TimeOut 2	Timeout Communication USB (by parameter I.453).
PArAL	Parallel switch fault	Parallel switch feedback is active when generator is not excited.
tV.L	TV loss	Failure to read the generator sensing voltage
tV.ASY	TV ASYmmetrical	Imbalance greater than 20% between the 3 sensing voltages observed (valid only if the system is configured in three phases so P200=1)
r.D.O	Rotor Diode Open	Diode failure (open), Excitation current ripple exceeded P.600/P.611.
r.D.S	Rotor Diode Short	Diode failure (short circuit), Excitation current ripple exceeded P.610/P.611.
U.U	Under Voltage	The power supply voltage is lower than the value set in parameter P.250*0.7
t.S.Er	Temperature Sensor ERror	Failure of heatsink temperature sensor
tA.L	TA loss	Generator current signal loss (generator current <P.112 for t>P.113).
b.r.OH	Brake Resistor OverHeating	De-excitation resistor overheating (by digital input configured as 51 BRAKE R THERMAL SENS (NO) or 52 BRAKE R THERMAL SENS (NC).
E.F.2	External Fault 2	by digital input configured as 57 EXTERNAL FAULT 2 (NO) or 58 EXTERNAL FAULT 2 (NC).
E.F.3	External Fault 3	by digital input configured as 59 EXTERNAL FAULT 3 (NO) or 60 EXTERNAL FAULT 3 (NC).
E.F.4	External Fault 4	by digital input configured as 61 EXTERNAL FAULT 4 (NO) or 62 EXTERNAL FAULT 4 (NC).
P.Err	Params ERRor	Parameter data errors with the consequent load of default parameters.
P.F.Er	Params File ERror	Parameter file errors with the consequent load of default parameters configuration.
C.F.Er	Configuration File Error	Calibration data error.

For every fault the regulator stores a series of data in order to allow the analysis of the causes more deeply. Through parameter C.910 it is possible to select the index of data that you want to see (for example 0 if you want to see the data of the last event), and through parameters from d.850 to d.872 the following values:

Parameter	**Description**	**Parameter that is recorded at the time of fault**
d.850	Faults L	As d.800
d.851	Faults H	As d.801
d.852	Warnings L	As d.810
d.853	Warnings H	As d.811
d.854	Power on time L	As d.980
d.855	Power on time H	As d.981
d.856	Run time L	As d.982
d.857	Run time H	As d.983
d.858	Field Current	As d.000
d.859	Field Voltage	As d.010
d.860	Generator Voltage L1-L2	As d.100
d.861	Generator Freq. Out	As d.104
d.862	Generator Current	As d.110
d.863	Generator Power Factor	As d.111
d.864	Control Status	As d.300
d.865	Control Mode	As d.301
d.866	Reference	As d.302
d.867	Feedback	As d.303
d.868	Regulator Out	As d.312
d.869	Active limits	As d.330

d.870	Dig. Inputs monitor	As d.400
d.871	Dig. Out monitor	As d.410
d.872	DC Bus Voltage	As d.999
d.873	RTC time 1	As d.984
d.874	RTC time 2	As d.985
d.875	RTC time 3	As d.986

Parameter	Description	Notes
C.900	Reset al. Ack	0 → 1 Reset
C.910	Faults log index	= 0 to 7 (0= last event, 1= second to last,..,7=oldest event)
C.911	Clear faults log	0→1 Clear

4.3.5 Access control

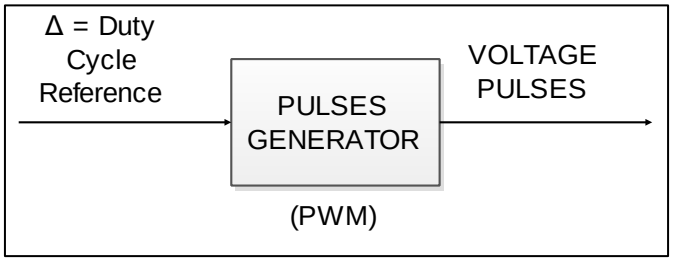
Parameter	Description	Notes
C.980	Password level 1	Configuration parameters protection (setpoints adjustment allowed)
C.981	Password level 2	Full parameters write protection

5. REFERENCE AND REGULATORS

5.1 PWM reference (PWM)

This function mode allows controlling the command duty cycle of the IGBT.
In this case the regulator acts only on the ignition command of the IGBT, without considering what could happen externally.

This function mode could be useful during the commissioning phase of the regulator or in the case of troubleshooting.
The regulator works in open loop with no software limits running on excitation circuit or generator output so pay great attention to not damage the connected equipment.

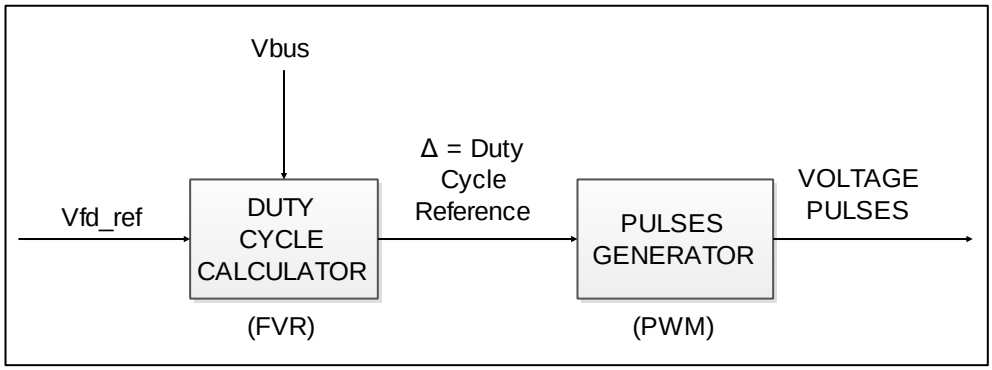


Parameter	Description	Notes / Unit
r.000	PWM duty reference source	0 none 1 analog input 1 2 analog input 2 3 digital
r.001	PWM reference minimum	[%]
r.002	PWM reference maximum	[%]
r.003	PWM digital reference	[%] r.001<r.003<r.002
r.010	PWM ramp time	[s] 0 to 100%. Assuming a change in the reference from 0 to 100%, the actual PWM value will reach 100% in a time defined by r.010.

5.2 Field voltage reference (FVR)

This function mode allows controlling the regulator output voltage.
In this case the regulator only controls the output voltage to the excitation terminals of the regulator, without considering what could happen externally.

This function mode could be useful during the commissioning phase of the regulator or in the case of troubleshooting.
The regulator works in open loop with no software limits running (except P.011) on excitation circuit or generator output so pay great attention to not damage the connected equipment.



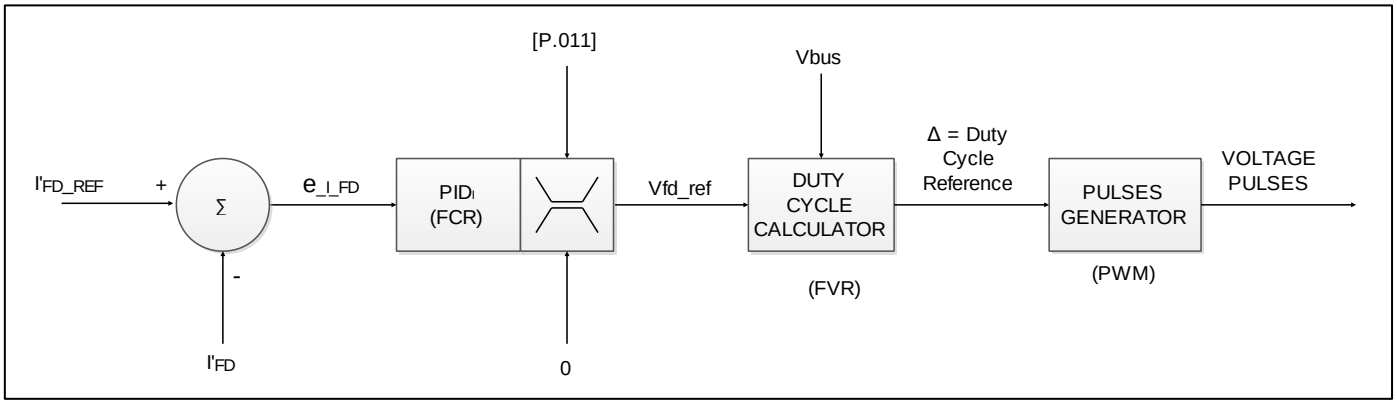
Parameter	Description	Notes / Unit
r.100	Field voltage reference source	0 none 1 analog input 1 2 analog input 2 3 digital
r.101	Field voltage reference minimum	[%] of P.010
r.102	Field voltage reference maximum	[%] of P.010
r.103	Field voltage digital reference expressed in % of P.010	[%] of P.010 r.101<r.103<r.102
r.110	Field voltage ramp time	[s] 0 to 100%. Assuming a change in the reference from 0 to 100%, the actual PWM value will reach 100% in a time defined by r.110.

For Duty Cycle Reference calculation, the FVR block partializes the excitation voltage reference to the total available bus voltage:

$$\text{Duty Cycle Reference} = \left(\frac{Vf\_\text{ref}}{Vbus\_fbk}\right) \quad [\%]$$

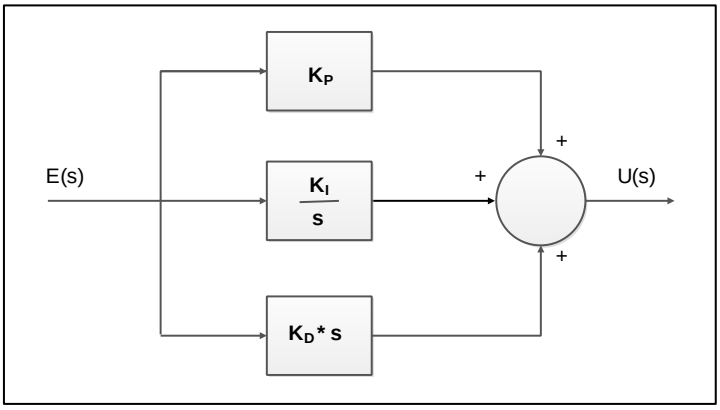
5.3 Field current reference and regulator (FCR)

This function mode allows controlling the regulator output voltage.
In this case the regulator only controls the output current to the excitation terminals of the regulator, without considering what could happen externally.
This function mode could be useful during the commissioning phase of the regulator or in the case of troubleshooting.
The regulator works in excitation current closed loop with software limits running (P.001/P.003 and P.011) only on excitation circuit but no limits on generator output so pay great attention to not damage the connected equipment.



Parameter	Description	Notes / Unit
r.200	Field current reference source	0 none 1 analog input 1 2 analog input 2 3 digital
r.201	Field current reference minimum	[%] of P.000
r.202	Field current reference maximum	[%] of P.000
r.203	Field current digital reference	[%] of P.000 r.201<r.203<r.202
r.210	Field current ramp time	[s] 0 to 100%. Assuming a change in the reference from 0 to 100%, the actual FCR value will reach 100% in a time defined by r.110.
r.250	FCR Proportional gain	
r.251	FCR Not normalized integral gain	
r.252	FCR Not normalized derivative gain	

The **PID FCR controller** is represented by the following block diagram:



$$U(s) = \left(Kp + \frac{Ki}{s} + Kd * s\right) * E(s)$$

E(s) and U(s) are the Laplace transforms of the feedback error and control signal, the value of the PID gain parameter are:

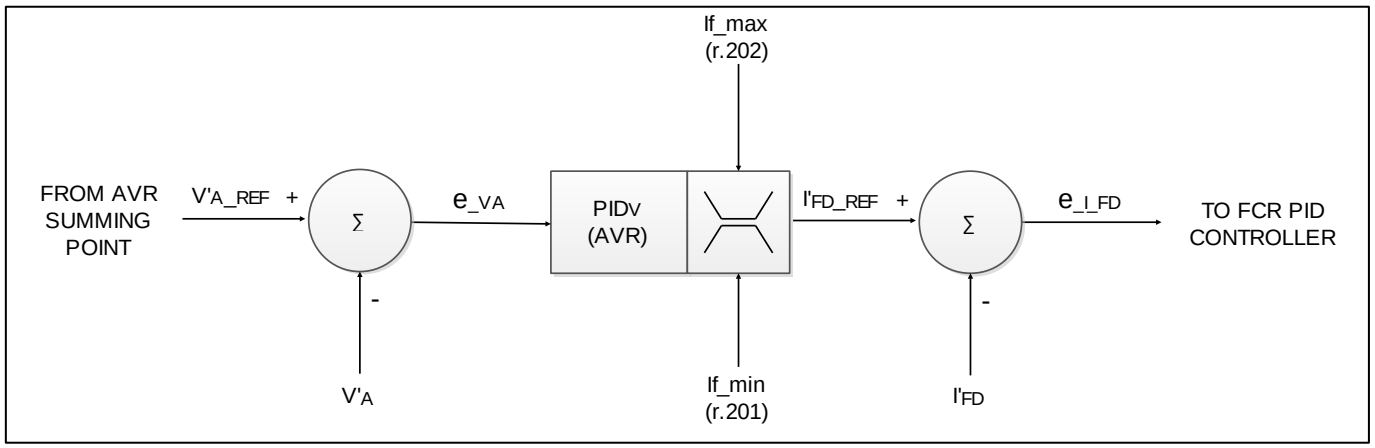
Parametro	Descrizione	Note
r.250	FCR Proportional gain	Kp FCR
r.251	FCR Not normalized integral gain	Ki' FCR
r.252	FCR Not normalized derivative gain	Kd' FCR

Considering the cycle times of the controller (Tcycle=62.5µs), the gains are normalized as follows:

$$ki = ki' * 16000$$
$$kd = kd' / 16000$$

5.4 Generator voltage reference and regulator (AVR)

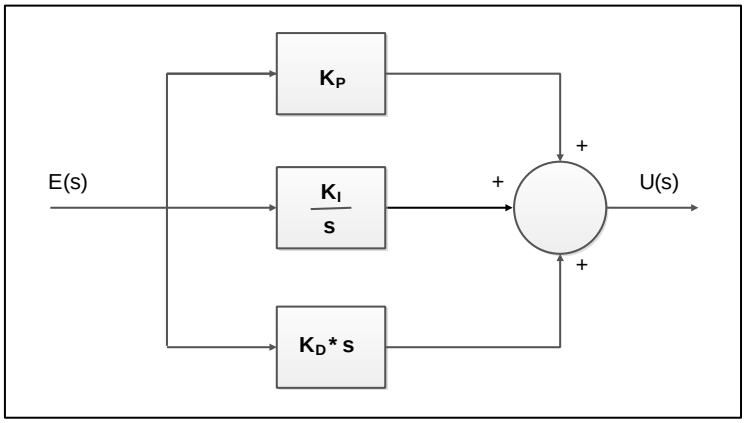
The regulator automatically controls the output voltage to the alternator terminals.
This is the principal function mode.
For maximum flexibility, two controls have been implemented that can be configured with different gains so the system can respond more efficiently to different situations.
The regulator works in generator voltage closed loop and nested excitation current closed loop with all software limits running: if limiters are properly set the generator will always work within its safe area.



Parameter	Description	Notes
r.300	Generator voltage reference source	0 none 1 analog input 1 2 analog input 2 3 digital 4 generator rated 5 mains
r.301	Generator voltage reference minimum	[%] of P.100
r.302	Generator voltage reference maximum	[%] of P.100
r.303	Generator voltage digital reference	[%] of P.100
r.304	Generator voltage digital reference 1	[%] of P.100
r.310	Generator voltage ramp time	[%] of P.100
r.311	Generator voltage calibrator slope	0 to 100%. Assuming a change in the reference from 0 to 100%, the actual AVR value will reach 100% in a time defined by r.311.
r.350	AVR Proportional gain raw	
r.351	AVR Not normalized integral gain raw	
r.352	AVR Not normalized derivative gain raw	
r.360	AVR Proportional gain fine	
r.361	AVR Not normalized integral gain fine	
r.362	AVR Not normalized derivative gain fine	
r.370	Fine gains windows	[%] of reference 0 --> use only raw 25,0 --> raw used for not connected to the grid generator, fine for connected
r.380	G. V avr smpls	Refer to Note 1: Moving Average

r.381	G. V pb filt T	Refer to Note 2: Low-pass filter constant
r.382	G. V filt wind.	[%] Refer to Note 3: Filter bypass

The **PID AVR controller** is represented by the following block diagram:



$$U(s) = \left(Kp + \frac{Ki}{s} + Kd * s\right) * E(s)$$

E(s) and U(s) are the Laplace transforms of the feedback error and control signal, the value of the PID gain parameter are:

Parameter	Description	Notes
r.350	AVR Proportional gain raw	Kp AVR raw
r.351	AVR Not normalized integral gain raw	Ki' AVR raw
r.352	AVR Not normalized derivative gain raw	Kd' AVR raw
r.360	AVR Proportional gain fine	Kp AVR fine
r.361	AVR Not normalized integral gain fine	Ki' AVR fine
r.362	AVR Not normalized derivative gain fine	Kd' AVR fine

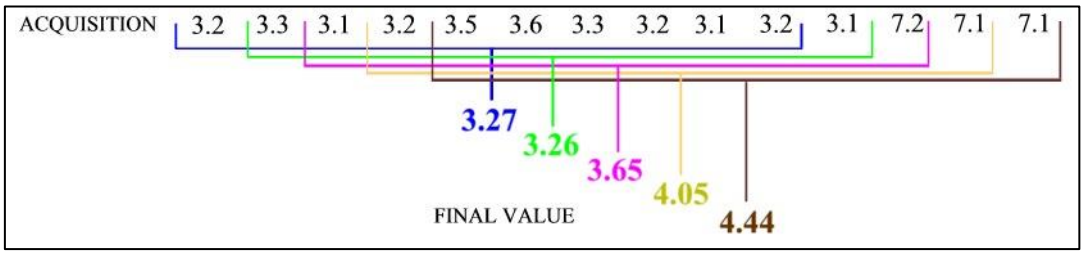
Considering the cycle times of the controller on a **3-phase** 50Hz generator (Tcycle=3.3ms), the gains are normalized as follows:

$$ki = ki' * 300$$
$$kd = kd'/300$$

Considering the cycle times of the controller on a **single-phase** 50Hz generator (Tcycle=10ms), the gains are normalized as follows:

$$ki = ki' * 100$$
$$kd = kd'/100$$

Note 1: Moving Average
By increasing this parameter it is possible to reduce the effects of noise on the voltage sensing; on the other hand, there will be a delay on the reading, since the value returned will be the result of the numerical average performed on a number of samples established by the value r.380.For example, r.380=10, the value read will correspond to the numerical sum of the last 10 values divided by 10; this value will be updated continuously with each successive sampling (moving average). Setting samples to 1 exclude the average filtering.

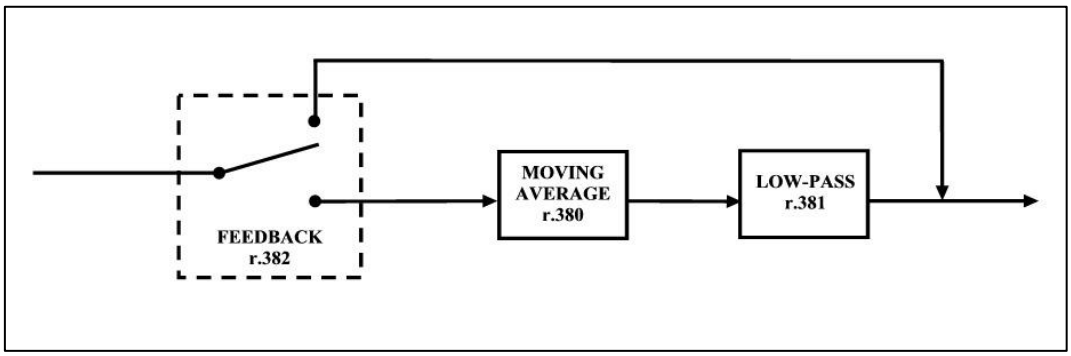


Note 2: Low-pass filter constant

A first order low-pass filter is cascaded to moving averge filter and its cut-frequency can be adjusted by the time constant. Setting to time constant to 1 exclude low-pass filtering.

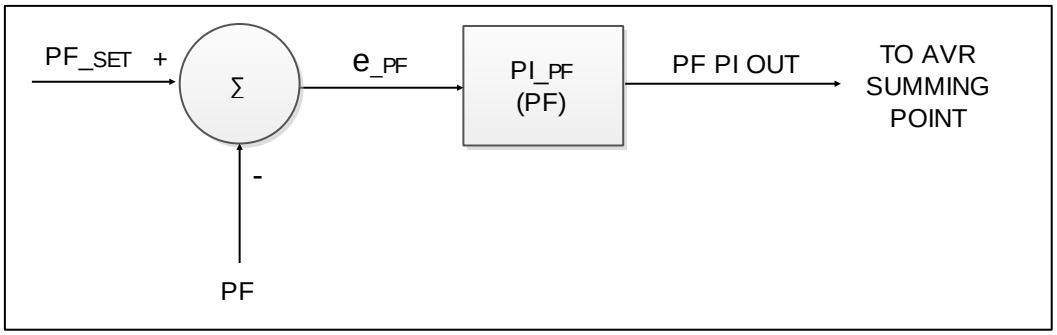
Note 3: Filter bypass

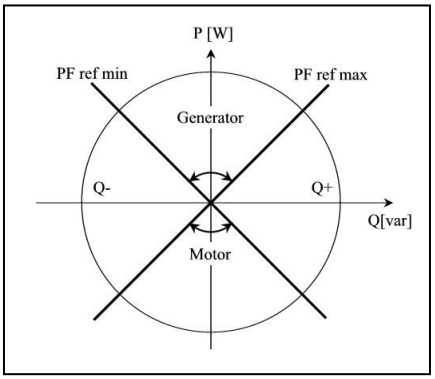
By setting bypass value, a function allows the user to set a percentage change from feedback, exceeded which the value being processed bypass the average and low-pass filtering and be immediately used, avoiding delays in the system response.



5.5 Generator PF reference and regulator (PF)

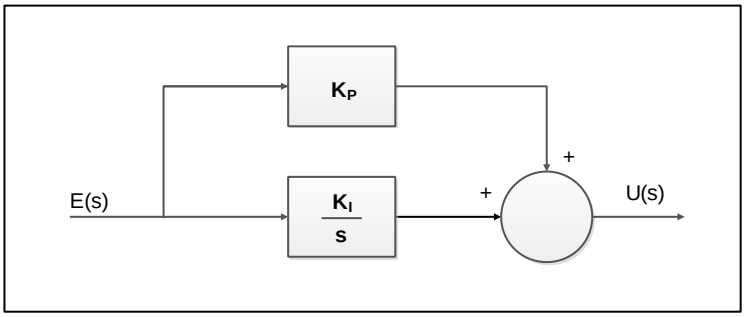
The regulator automatically controls the power factor of the alternator terminals.
The regulator works with an outer Power Factor closed loop over the AVR loop.





Parameter	Description	Notes
r.400	Generator PF reference source	0 None (PF=1) 1 analog input 1 2 analog input 2 3 digital
r.401	Generator PF reference minimum	
r.402	Generator PF reference maximum	
r.403	Generator PF digital reference 1	
r.404	Generator PF digital reference 2	
r.410	Generator PF ramp time	0 to 100%. Assuming a change in the reference from 0 to 100%, the actual PF value will reach 100% in a time defined by r.410.
r.450	PF Proportional gain	
r.451	PF Not normalized integral gain	

The **PF PI controller** is represented by the following block diagram:



$$U(s) = \left(Kp + \frac{Ki}{s}\right) * E(s)$$

E(s) and U(s) are the Laplace transforms of the feedback error and control signal, the value of the PI gain parameter are:

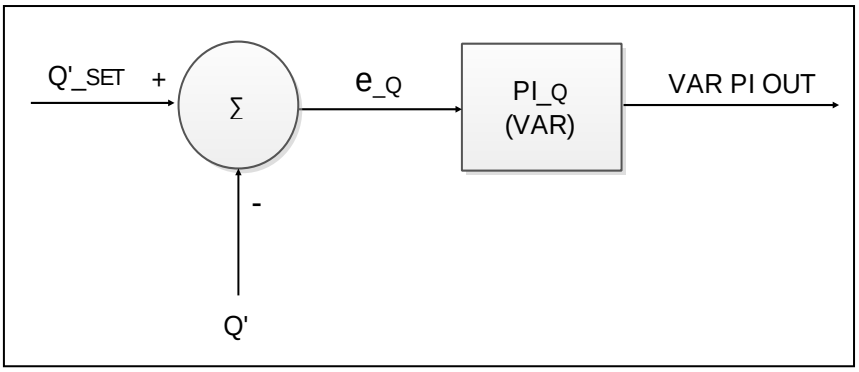
Parameter	Description	Notes
r.450	Proportional gain Over excitation limit	Kp PF
r.451	Not normalized integral gain Over excitation limit	Ki' PF

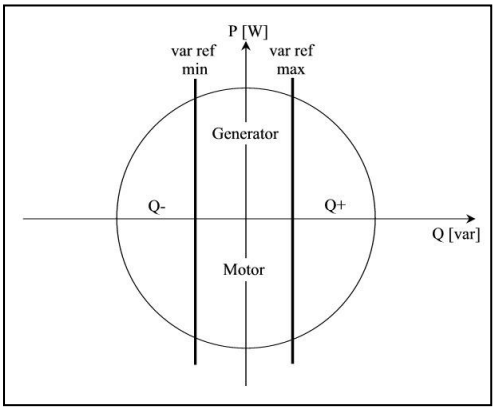
Considering the cycle times of the controller (Tcycle=50ms), the gains are normalized as follows:

$$ki = ki' * 20$$

5.6 Generator VAR reference and regulator (VAR)

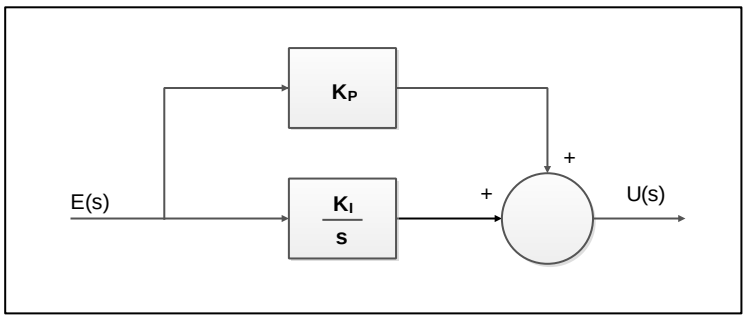
The regulator automatically controls the reactive power of the alternator terminals.
The regulator works with an outer VAR closed loop over the AVR loop.





Parameter	Description	Notes
r.500	Generator VAR reference source	0 None 1 analog input 1 2 analog input 2 3 digital
r.501	Generator VAR reference minimum expressed in	[%] of the generator rated power P.100xP.110
r.502	Generator VAR reference maximum	[%] of the generator rated power P.100xP.110
r.503	Generator VAR digital reference	[%] of the generator rated power P.100xP.110
r.510	Generator VAR ramp time	0 to 100%. Assuming a change in the reference from 0 to 100%, the actual VAR value will reach 100% in a time defined by r.510.
r.550	VAR Proportional gain	
r.551	VAR Not normalized integral gain	

The **VAR PI controller** is represented by the following block diagram:



$$U(s) = \left(Kp + \frac{Ki}{s}\right) * E(s)$$

E(s) and U(s) are the Laplace transforms of the feedback error and control signal, the value of the PI gain parameter are:

Parameter	Description	Notes
r.550	Proportional gain Over excitation limit	Kp VAR
r.551	Not normalized integral gain Over excitation limit	Ki' VAR

Considering the cycle times of the controller (Tcycle=50ms), the gains are normalized as follows:

$$ki = ki' * 20$$

6. COMMISSIONING

6.1 Safety regulations

The S2006 operates with a dangerous voltage up to 400V.
Working on live parts could cause injury to people or damage to the surrounding environment.
Potential risks can be excluded if it is operated in the correct way and following the instructions given here.

After the unit has been switched off, check that there is no voltage over 50V in the terminals.
After disconnecting the circuits, to avoid unintentional closing, it is worth identifying through warning signals, the switch points.

6.2 Connection of the Regulator

6.2.1 Power Supply

The regulator can be supplied through DC voltage, single phase AC or three-phase AC.

When ordering it should be specified the type and level of voltage on which the regulator will be operated.

Once you know the value and the type of rated supply voltage, you can apply a simple formula to find the value to insert in P.250.

$$P.250=k \cdot Vn$$

Where Vn is the rated supply voltage and k can be obtained from the following table:

DC Voltage	k=0,7
Single phase AC Voltage	k=1
Three Phase AC Voltage	k=1

For example, suppose we had a rated voltage of 200Vac three phase, the parameter P.250 would be set at:

$$P.250=1 \cdot 200=200$$

The regulator ignores the run command until the supply voltage reaches the value set in P.250
If the regulator is supplied by PMG or from a source not powered during the starting up, it is necessary to set the parameter P.250=0 and use the auxiliary power supply option.

6.2.2 Voltage Signals

The regulator has 3 terminal inputs for the alternator voltage and 2 terminal inputs for the mains supply.
It is necessary to configure the value of the input voltage to the regulator by setting the parameter P.100 to the correct value.
If there are only two alternator voltages, set the parameter P.200=0.

6.3 Setting the Standard Parameters

In the first commissioning phase it is essential to check all the parameters.

To upload the default parameters set the parameter C.002=1
To save the parameters, set the parameter C.000=1
After reloading of default parameters, the level 2 password has to be unlocked in order to allow modify of parameters.

Write 1 to C.981 in order to unlock default level 2 password.
Level 2 password can be disabled by writing 0 to P.981.

6.4 Standard Programming Procedure

Below, the procedure for an initial parameters configuration, useful during the regulator commissioning :

Parameter	Description	Unit	Set Value
I.000…I.015	Digital input configuration		At least the following inputs must be configured: I.00X= 1 RUN NO (START) I.00Y= 43 GEN SW NO (52G CLOSED) only for parallel operation
I.100…I.115	Digital output configuration		

P.000	Rated excitation current	[Adc]	Rated excitation current value (plate value)
P.001	Over Excitation Limit	[%] of P.000	Tipically the ceiling value 150%, be sure to check the maximum value that can be provided by the regulator
P.002	Under Excitation Limit	[%] of P.000	
P.003	Field OverExcitation unload	[%] of P.000	Tipically 5% above the excitation current value required to reach the rated off-grid alternator voltage (valid only in FCR mode)

P.010	Rated excitation voltage	[Vdc]	Rated excitation voltage value (plate value)
P.011	Maximum field voltage	[%] of P.010	Usually the ceiling value 200%, be sure to check the maximum value that can be provided by the regulator (supp sourse must adequately dimensioned)

P.100	Rated sensing voltage from alternator output voltage transformer	[V rms]	Tipically 100Vac
P.101	Maximum alternator output voltage	[%] of P.100	Tipically 120%
P.110	Rated sensing current from alternator output current transformer	[A rms]	Tipically 5Aac
P.111	Maximum alternator current	[%] of P.110	To disable protection set 99%
P.120	Rated Frequency alternator output	[Hz]	Tipically 50Hz or 60Hz

P.160…P.164	Minimun alternator Capability curve	[%] of P.100xP.110	The setting of the limit must be coordinated with the protections of the alternator. Tipically the regulator limit should be set at least 5% lower. Set at -100% to disable the limitation
P.200	Type of TV Sensing		0 single phase 1 three phase
P.211	Mains/grid/bus rated Voltage	[V rms]	Tipically 100Vac

P.300	Control mode		Predefined Control Mode refer to 4.2.13 Control mode

P.250	Supply rated Voltage	[V]	Refer to 6.2.1 Power Supply

Based on the value set in P.300 and other requirements of the application specified, the following is verified/modified:

- The parameters relative to the references in the control mode used and the gains of the associated regulators (R.xxx, usually at least R2xx, R.3xx, often also R.4xx or r.5xx)
- The parameters related to the configuration of the digital and analog inputs/outputs as well as the field bus used (i.xxx)
- Other functions like compensation or droop, series compensation, recognition faulty diodes, synchronisation, field-flashing, boost etc. on parameters P.xxx

<u>Once calibrated save the changes using parameter C.000=1</u>

6.5 Operations to be done while the generator is stand-still

Preliminary Checks:

- Check the wiring comparing the connections with the electrical diagram.
- Supply auxiliary voltage.
- Adjust the parameters.
- Check the measuring circuits for voltage and currents.
- Measure the field resistance.
- Adjust the limits based on the client's power diagram.

6.6 Operations to be done while the generator is rotating at rated speed

Off-grid (no-load) Test:

- Excitation and De-excitation in automatic and manual mode.
- Soft start in automatic mode.
- Adjust the set point range, optimise the voltage regulator.
- V/Hz Limitations.
- Check the grid voltage following, the synchronization (if present) and the parallel switch command.

Grid parallel test:

- Check the stator current, check the active and reactive power, eventual droop or compensation.
- Test the limit of over excitation and under excitation.
- Optimise the limits of the maximum and minimum excitation current.
- Optimise the limits of the maximum and minimum reactive current.
- The setting of the PQ limits must be coordinated with the protections of the alternator. Typically, the controller limit should be set 5% lower.

7. MAINTENANCE AND BREAKDOWN

Before carrying out any procedure on the voltage regulator it is necessary to cut the power supply and apply protective earthing equipment

7.1 Maintenance

When the system is off it is necessary to check the screw terminals that, due to vibrations, could be loose.
Monthly check that the cooler is not dusty. Clean using a dry cloth or vacuum cleaner.

7.2 Problem Solving

The following instructions can be used to help locate a fault in the excitation system.

List of Possible Faults

Possible Causes	Checks
The machine does not start up	
• Field circuit broken • Field switch open	• Check the wiring • Check the state of the field switch
• The field flashing does not work	• Check the field flashing circuit
• No supply of the U_{AUX} electronics	• Measure the auxiliary supply voltage • Verify any release of the protective switch
• No supply of the U_{PWR} power	• Measure the voltage of the UOWR power circuit • Verify any release of the protective switch
• The machine is only energised by field flashing • The machine is energised and de-energised	• Measure the control and power supply voltage • Check the level of output of the field flashing phase • Check the function mode. Field flashing is normally used automatically • Check the level of output of the field flashing phase • Check the set point • Measure the control and power supply voltage

Over Voltage During Start up	
• Over voltage caused by the regulator	• Measure the alternator voltage at the regulator voltage inputs • Check the configuration data • Check the function mode • Check the set point and the settings • Check the voltage threshold limit
• Field Flashing current too high	• Check the field flashing circuit. Field flashing should supply a current value equal to 10÷15% of the excitation current in a no-load operation.

The machine voltage is not stable during the off grid (unload) operation	
• Regulation Errors	• Check the function mode • Check the set point • Check the automatic regulator parameters
• Set point Error	• Up/down input unstable • External input unstable
• Breakdown of and element	• Check the wiring, verify the input voltage, verify the output current

Parallel working with unstable network. **Periodic oscillations of the reactive and possibly active power**	
• Incorrect regulator setting	Changes have been made to the network configuration? • Yes: reset the regulator • No: check the parameters of the function mode selected

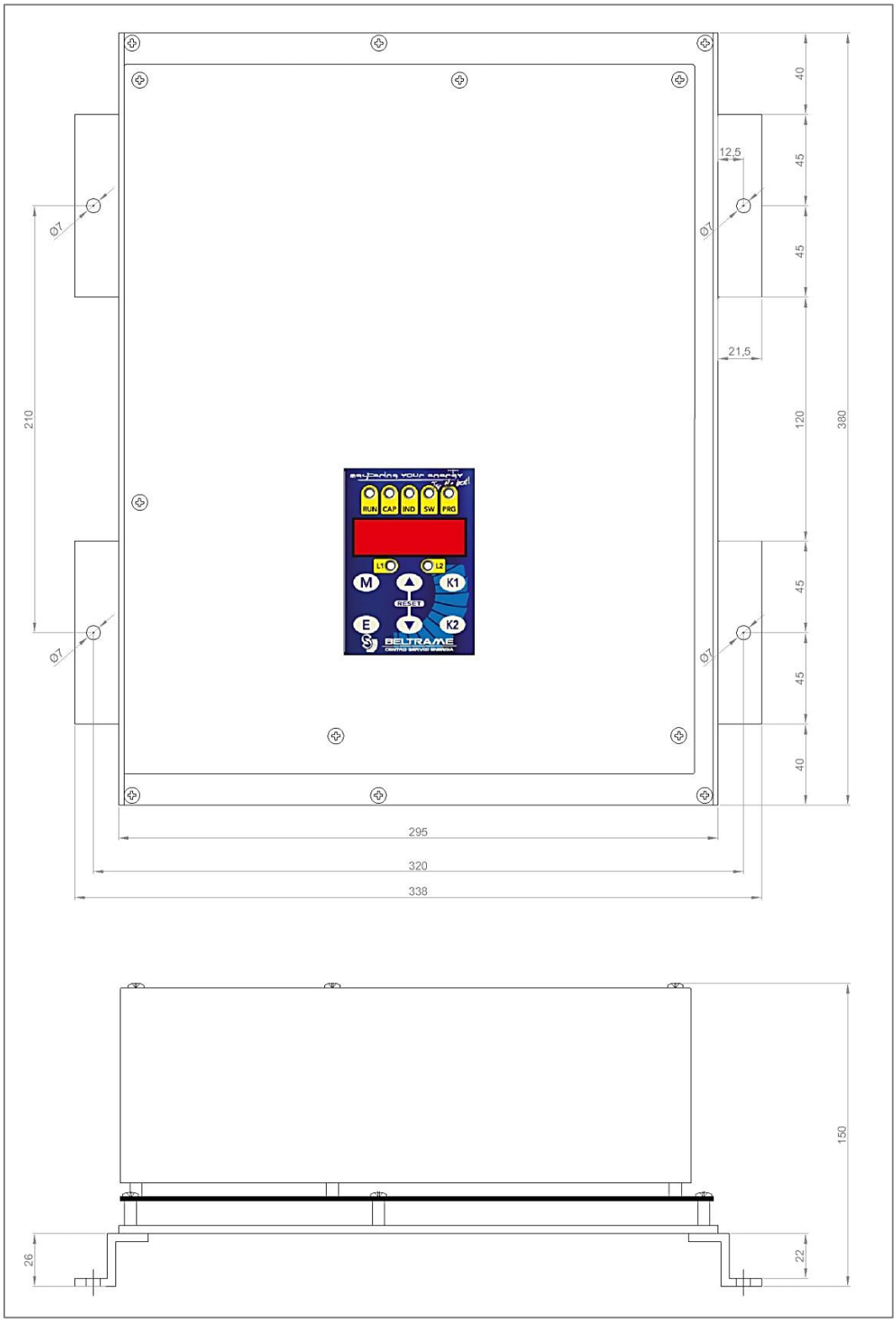
Irregular instability, sporadic over or under excitation not caused by the network	
• The influence of the Droop on the voltage regulator is ineffective or CT is defective	• Check the droop or compensation set • Check the TA external circuit • Alert that the machine switch is not active
• Machine working outside admissible range (normally protected by limits)	• Take the machine to a normal operating range regulating the set point • Check the limits set

The operating point cannot be reached	
• Set point Error	• Check the function mode • Check set point
• Limit active	• Take the machine to a normal operating range regulating the set point • Check the limits set
Excitation of the machine is only supplied by the boost circuit • There is no voltage in the power unit • Regulation Error	• Measure the control and power supply voltage • Verify any release of the protective switch • Check the function mode • Check the set point • Check the automatic regulator parameters

8. MOUNTING

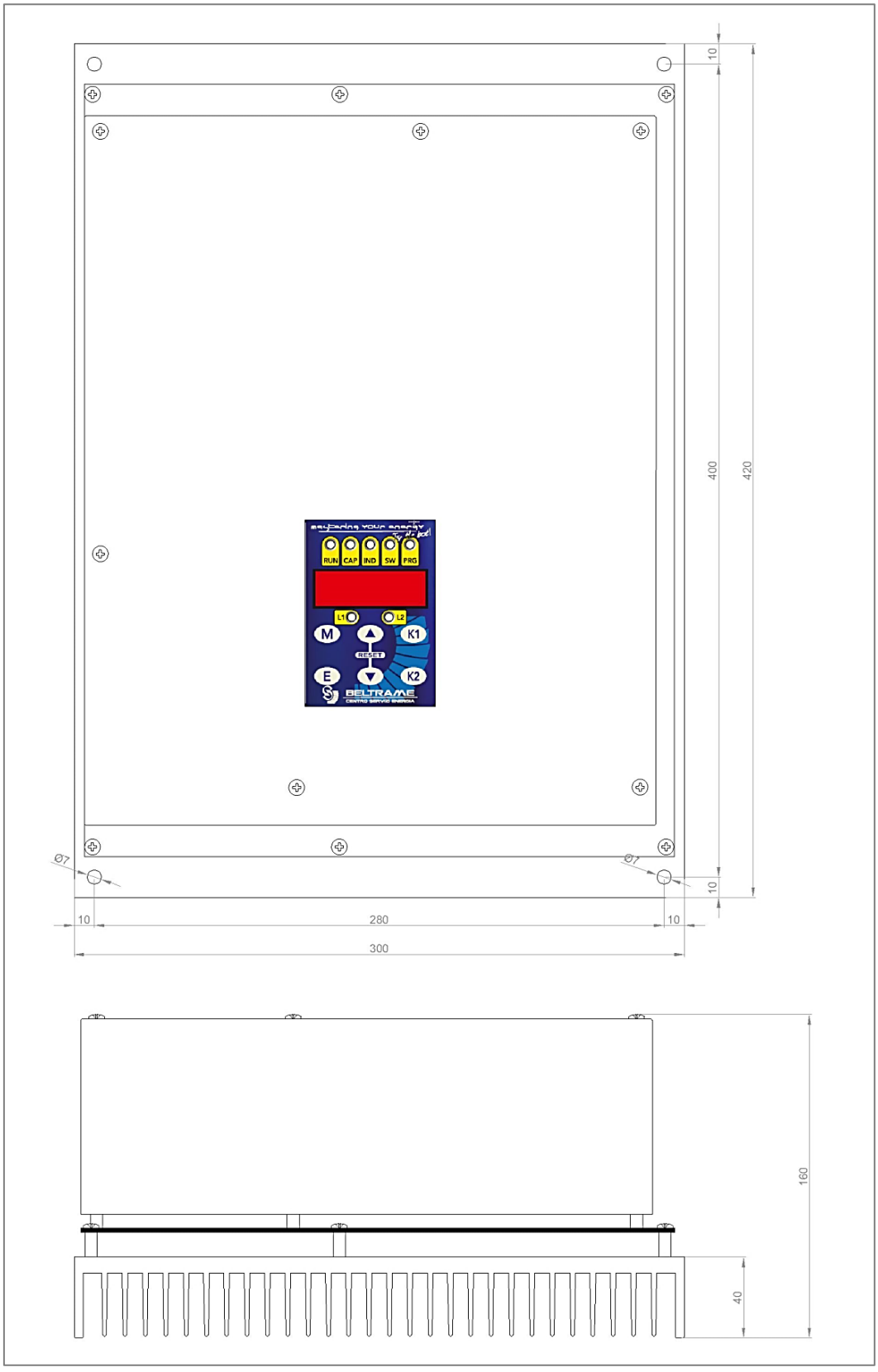
8.1 Layout type A (2A…15A)

Weight ≅ 5,6 kg
Protection class IP20
Dimensions (LxBxH) 380x338x150 mm



8.2 Layout type B (25A…40A)

Weight ≅ 10 kg
Protection class IP20
Dimensions (LxBxH) 380x338x150 mm



9. CONTROL SYSTEM PARAMETERS MENU

Revision:
Param v04 / Config v01 (starting from fw v0.04.16)

Legenda:
R=read only
N=not writable in run mode
L1=need level 1 password
L2=need level 2 password
A= autoreset parameter

9.1 Display parameters

DISPLAYS	Name	R/W	IPA	Description (short)	Unit	Format	Step	Min	Default	Max	Notes, values
			-1								
Field	**d.000**	R	0	Field Current	%	UD	0,1	0,0	-	200,0	% of P.000
	d.001	R	1	Field Curr. Ref.	%	UD	0,1	0,0	-	200,0	% of P.000
	d.005	R	2	D.mon.ripple lev	%	UD	0,1	0,0	-	200,0	% of P.000
	d.010	R	3	Field Voltage	%	UD	0,1	0,0	-	250,0	% of P.010
	d.011	R	4	Field Volt. Ref.	%	UD	0,1	0,0	-	250,0	% of P.010
	d.020	R	5	Out Duty Cycle	%	UD	0,1	0,0	-	100,0	
	d.021	R	6	Out Duty Ref.	%	UD	0,1	0,0	-	100,0	
	d.030	R	7	OE lim time left	s	UD	0,1	0,0	-	P.032	
			7								
Generator output	**d.100**	R	8	Gener. V. L1-L2	%	UD	0,1	0,0	-	-	% of P.100
	d.101	R	9	Gener. V. L2-L3	%	UD	0,1	0,0	-	-	% of P.100
	d.102	R	10	Gener. V. L3-L1	%	UD	0,1	0,0	-	-	% of P.100
	d.103	R	11	Gener. V. Ref.	%	UD	0,01	0,00	-	-	% of P.100
	d.104	R	12	Gener. Freq. Out	Hz	UD	0,01	0,00	-	100,00	
	d.110	R	13	Gener. Current	%	UD	0,1	0,0	-	-	% of P.110
	d.111	R	14	Gener. PowerFact	-	PF	0,001	0,250 c	-	0,250 i	Capacitive / Inductive
	d.112	R	15	Gener. PF Ref.	-	PF	0,001	0,250 c	-	0,250 i	Capacitive / Inductive
	d.120	R	16	Gener. Power S	%	UD	0,1	0,0	-	-	% of P.100xP.110
	d.121	R	17	Gener. Power P	%	SD	0,1	-d.120	-	d.120	% of P.100xP.110
	d.122	R	18	Gener. Power Q	%	SD	0,1	-d.120	-	d.120	% of P.100xP.110
	d.123	R	19	Gener. Q Ref.	%	SD	0,1	-100,0	-	100,0	% of P.100xP.110
	d.130	R	20	GI lim time left	s	UD	0,1	0,0	-	P.142	
Mains	**d.200**	R	21	Mains Voltage	%	UD	0,1	0,0	-	-	% of P.100
	d.201	R	22	Mains Frequency	Hz	UD	0,01	0,00	-	100,00	
	d.210	R	23	Sync slip	Hz	SD	0,01	-100,00	-	100,00	d.104-d.201
	d.211	R	24	Delta Phase	deg	SD	0,1	-180,0	-	180,0	
	d.212	R	101	Last CB close T	s	UD	0,001	0,000	-	-	
	d.213	R	102	Last CB to sync	s	UD	0,001	0,000	-	-	
			24								
Actual regulation	**d.300**	R	25	Control Status	-	UD	1	0	-	8	0 FAULT 1 STOP 2 RUN PWM 3 RUN FVR 4 RUN FCR 5 RUN AVR WAIT FREQ 6 RUN AVR V RAMP 7 RUN AVR 8 RUN PF/VAR

	d.301	R	26	Control Mode	-	UD	1	0	-	5	as P.300
	d.302	R	27	Ref	%	SD	0,1	-	-	-	
	d.303	R	28	Feedback	%	SD	0,1	-	-	-	
	d.304	R	29	Error	%	SD	0,1	-	-	-	
	d.310	R	30	Regulator P+D	%	SD	0,1	-	-	-	
	d.311	R	31	Regulator I	%	SD	0,1	-	-	-	
	d.312	R	32	Regulator Out	%	SD	0,1	-	-	-	
	d.330	R	33	Active limits	-	H	1	0x0000	-	65535	bit mapping (hex codes): 0001 MIN FREQ 0002 V/F 0004 V RAMP 0008 UE 0010 MIN I 0020 MIN Q- 0040 CALIB MIN 0080 -- reserved -- 0100 CALIB MAX 0200 OE 0400 Field IxT 0800 Gener IxT 1000 Gener I 2000 Gener V 4000 Max Q+
Digital & Analog I/O monitor	**d.400**	R	34	Dig. Inp monitor	-	H	bin	0x0000	-	65535	bit mapping
	d.401	R	35	D. Inp local	-	H	bin	0x0000	-	65535	bit mapping
	d.402	R	36	D. Inp remote	-	H	bin	0x0000	-	65535	bit mapping
	d.410	R	37	Dig. Out monitor	-	H	bin	0x0000	-	65535	bit mapping
	d.411	R	38	D. Out local	-	H	bin	0x0000	-	65535	bit mapping
	d.412	R	39	D. Out remote	-	H	bin	0x0000	-	65535	bit mapping
	d.420	R	40	An. Inp1 mon flt	%	SD	0,1	-	-	-	
	d.421	R	41	An. Inp1 mon cnd	%	SD	0,1	-	-	-	
	d.422	R	42	An. Inp1 mon raw	%	SD	0,1	-100,0	-	100,0	
	d.423	R	43	An. Inp1 local	%	SD	0,1	-100,0	-	100,0	
	d.424	R	44	An. Inp1 remote	%	SD	0,1	-100,0	-	100,0	
	d.430	R	45	An. Inp2 mon flt	%	SD	0,1	-	-	-	
	d.431	R	46	An. Inp2 mon cnd	%	SD	0,1	-	-	-	
	d.432	R	47	An. Inp2 mon raw	%	SD	0,1	-100,0	-	100,0	
	d.433	R	48	An. Inp2 local	%	SD	0,1	-100,0	-	100,0	
	d.434	R	49	An. Inp2 remote	%	SD	0,1	-100,0	-	100,0	
	d.440	R	50	An. Out1 mon flt	%	UD	0,1	0,0	-	100,0	
	d.441	R	51	An. Out1 mon cnd	%	UD	0,1	0,0	-	100,0	
	d.442	R	52	An. Out1 mon raw	%	SD	0,1	-250,0	-	250,0	
	d.450	R	53	An. Out2 mon flt	%	UD	0,1	0,0	-	100,0	
	d.451	R	54	An. Out2 mon cnd	%	UD	0,1	0,0	-	100,0	
	d.452	R	55	An. Out2 mon raw	%	SD	0,1	-250,0	-	250,0	
			55								
Filedbus	**d.500**	R	56	CAN Rx errors	-	UD	1	0	-	127	
	d.501	R	57	CAN Tx errors	-	UD	1	0	-	255	
	d.502	R	58	CAN status	-	H	1	0x0000	-	0xFFFF	bit mapped (hex)
			58								
Alarms	**d.800**	R	59	Faults L	-	H	1	0x0000	**0xFFFF**	0xFFFF	bit mapped (hex codes): 0001 O.C Over Current 0002 UUdG WatchDoG 0004 OH OverHeating 0008 E.F External Fault 0010 E.OVL Excitier OVerLoad 0020 S.tO.1 Serial TimeOut 1 0040 S.tO.2 Serial TimeOut 2 0080 PS.Fb PowerSupply Feedback loss

	d.801	R	60	Faults H	-	H	1	0x0000	**0xFFFF**	0xFFFF	0100 PArAL Parallel switch fault 0200 tV.L TV loss 0400 tV.ASY TV ASYmmetrical 0800 r.D.O Rotor Diode Open 1000 r.D.S Rotor Diode Short 2000 U.V Under Voltage 4000 t.S.Er Temperature Sensor ERror 8000 tA.L TA loss bit mapped (hex codes): 0001 b.r.OH Brake Resistor OverHeating 0002 G.OV Generator OverVoltage 0004 E.F.2 External Fault 2 0008 E.F.3 External Fault 3 0010 E.F.4 External Fault 4 2000 P.Err Params ERRor 4000 P.F.Er Params File ERror 8000 C.F.Er Configuration File Error
	d.810	R	61	Warnings L	-	H	1	0x0000	**0xFFFF**	0xFFFF	bit mapped (hex) as D.800
	d.811	R	62	Warnings H	-	H	1	0x0000	**0xFFFF**	0xFFFF	bit mapped (hex) as D.801

Faults log details	**d.850**	R	63	Faults L	-	H	1	0x0000	**0xFFFF**	0xFFFF	d.800
	d.851	R	64	Faults H	-	H	1	0x0000	**0xFFFF**	0xFFFF	d.801
	d.852	R	65	Warnings L	-	H	1	0x0000	**0xFFFF**	0xFFFF	d.810
	d.853	R	66	Warnings H	-	H	1	0x0000	**0xFFFF**	0xFFFF	d.811
	d.854	R	67	Power on time L	hr.min	UD	1	0,00	-	999,59	d.980
	d.855	R	68	Power on time H	khr	UD	1	0	-	200	d.981
	d.856	R	69	Run time L	hr.min	UD	1	0,00	-	999,59	d.982
	d.857	R	70	Run time H	khr	UD	1	0	-	200	d.983
	d.858	R	71	Field Current	%	UD	0,1	0,0	-	200,0	d.000
	d.859	R	72	Field Voltage	%	UD	0,1	0,0	-	250,0	d.010
	d.860	R	73	Gener. V. L1-L2	%	UD	0,1	0,0	-	-	d.100
	d.861	R	74	Gener. Freq. Out	Hz	UD	0,01	0,00	-	100,00	d.104
	d.862	R	75	Gener. Current	%	UD	0,0	0,0	-	-	d.110
	d.863	R	76	Gener. PowerFact	-	PF	0,001	0,250 c	-	0,250 i	d.111
	d.864	R	77	Control Status	-	UD	1	0	-	8	d.300
	d.865	R	78	Control Mode	-	UD	1	0	-	5	d.301
	d.866	R	79	Ref	%	SD	0,1	-	-	-	d.302
	d.867	R	80	Feedback	%	SD	0,1	-	-	-	d.303
	d.868	R	81	Regulator Out	%	SD	0,1	-	-	-	d.312
	d.869	R	82	Active limits	-	H	1	0	-	65535	d.330
	d.870	R	83	Dig. Inp monitor	-	H	bin	0x0000	-	0xFFFF	d.400
	d.871	R	84	Dig. Out monitor	-	H	bin	0x0000	-	0xFFFF	d.410
	d.872	R	85	DC Bus Voltage	V dc	UD	0,1	0,0	-	d.910	d.999
	d.873	R	108	RTC time 1	mm.ss	UD	0,01	0,00	-	59,59	d.984
	d.874	R	109	RTC time 2	DD.hh	UD	0,01	1,00	-	31,23	d.985
	d.875	R	110	RTC time 3	YY.MM	UD	0,01	0,01	-	99,12	d.986

85

Exciter	**d.900**	R	86	Excitier In	A dc	UD	0,1	-	-	-	
	d.901	R	87	Excitier Ipk	%	UD	1	100	-	200	
	d.910	R	88	Exc. DCbus V max	V dc	UD	1	400	-	800	400 800
	d.950	R	89	FW ver. & rev.	-	H	1	-	-	-	x.yy
	d.951	R	90	FW release	-	H	1	-	-	-	z
	d.952	R	91	S/N HI	-	H	1	-	-	-	hex
	d.953	R	92	S/N LO	-	H	1	-	-	-	hex
	d.954	R	93	Param checksum	-	H	1	0x0000	-	0xFFFF	hex

	d.980	R	94	Power on time L	hr.min	UD	1	0,00	-	999,59	
	d.981	R	95	Power on time H	khr	UD	1	0	-	200	
	d.982	R	96	Run time L	hr.min	UD	1	0,00	-	999,59	
	d.983	R	97	Run time H	khr	UD	1	0	-	200	
	d.984	R	103	RTC time 1	mm.ss	UD	0,01	0,00	-	59,59	
	d.985	R	104	RTC time 2	DD.hh	UD	0,01	1,00	-	31,23	
	d.986	R	105	RTC time 3	YY.MM	UD	0,01	0,01	-	99,12	
	d.987	R	106	RTC unix-time L	-	H	1	0x0000	-	0xFFFF	
	d.988	R	107	RTC unix-time H	-	H	1	0x0000	-	0xFFFF	
	d.997	R	98	Heatsink temp.	°C	SD	1	-	-	-	
	d.998	R	99	Exciter IxT lev.	%	UD	0,1	0,0	-	100,0	
	d.999	R	100	DC Bus Voltage	V dc	UD	0,1	0,0	-	d.910	

9.2 References & regulators parameters

REFERENCES & REGULATORS	Name	R/W	IPA	Description (short)	Unit	Format	Step	Min	Default	Max	Notes, values
			199								
PWM reference	**r.000**		200	PWM duty ref src	-	UD	1	0	**0**	3	0 none 1 an inp 1 2 an inp 2 3 digital
	r.001		201	PWM ref min	%	UD	0,1	0,0	**0,0**	r.002	
	r.002		202	PWM ref max	%	UD	0,1	r.001	**100,0**	100,0	
	r.003	L1	203	PWM digital ref	%	UD	0,1	r.001	**0,0**	r.002	
	r.010		204	PWM ramp time	s	UD	0,001	0,000	**10,000**	30,000	
			204								
Field voltage reference	**r.100**		205	F. V ref source	-	UD	1	0	**0**	3	0 none 1 an inp 1 2 an inp 2 3 digital
	r.101		206	F. V ref min	%	UD	0,1	0,0	**0,0**	r.102	% of P.010
	r.102		207	F. V ref max	%	UD	0,1	r.101	**100,0**	P.011	% of P.010
	r.103	L1	208	F. V digital ref	%	UD	0,1	r.101	**0,0**	r.102	% of P.010
	r.110		209	F. V ramp time	s	UD	0,001	0,000	**10,000**	30,000	
			209								
Field current reference and regulator	**r.200**		210	F. I ref source	-	UD	1	0	**3**	3	0 none 1 an inp 1 2 an inp 2 3 digital
	r.201		211	F. I ref min	%	UD	0,1	0,0	**0,0**	r.202	% of P.000
	r.202		212	F. I ref max	%	UD	0,1	r.201	**100,0**	P.001	% of P.000
	r.203	L1	213	F. I digital ref	%	UD	0,1	r.201	**0,0**	r.202	% of P.000
	r.210		214	F. I ramp time	s	UD	0,001	0,000	**10,000**	30,000	
	r.250		215	F. I reg KP	-	UD	0,01	0,00	**1,50**	100,00	
	r.251		216	F. I reg KI	-	UD	0,0001	0,0000	**0,1000**	1,0000	16kHz
	r.252		217	F. I reg KD	-	UD	0,01	0,00	**0,00**	10,00	
			217								
Generator voltage reference and regulator	**r.300**		218	G. V ref source	-	UD	1	0	**4**	5	0 none 1 an inp 1 2 an inp 2 3 digital 4 generator rated 5 mains
	r.301		219	G. V ref min	%	UD	0,1	0,0	**80,0**	r.302	% of P.100
	r.302		220	G. V ref max	%	UD	0,1	r.301	**110,0**	P.101	% of P.100
	r.303	L1	221	G. V dig. ref	%	UD	0,1	r.301	**100,0**	r.302	% of P.100
	r.304	L1	248	G. V dig. ref 1	%	UD	0,1	r.301	**100,0**	r.302	% of P.100
	r.305	L1	254	G. V dig. ref 2	%	UD	0,1	r.301	**100,0**	r.302	% of P.100
	r.310		222	G. V ramp time	s	UD	0,1	0,0	**1,0**	6000,0	
	r.311		249	G. V cal. slope	%/s	UD	0,01	0,01	**0,10**	2,50	
	r.350		223	G. V reg KP raw	-	UD	0,01	0,00	**5,00**	100,00	
	r.351		224	G. V reg KI raw	-	UD	0,0001	0,0000	**0,1000**	1,0000	ZC
	r.352		225	G. V reg Kd raw	-	UD	0,01	0,00	**0,00**	10,00	
	r.360		226	G. V reg KP fine	-	UD	0,01	0,00	**5,00**	100,000	
	r.361		227	G. V reg KI fine	-	UD	0,0001	0,0000	**0,1000**	1,0000	ZC
	r.362		228	G. V reg Kd fine	-	UD	0,01	0,00	**0,00**	10,00	
	r.370		250	Fine gains wind.	%	UD	0,1	0,0	**25,0**	25,0	% of reference 0 --> use only raw 25,0 --> raw used for island, fine for parallel
	r.380		251	G. V avr smpls	-	UD	1	1	**1**	60	
	r.381		252	G. V pb filt T	-	UD	1	1	**1**	250	1/(D.104 x2) (or x6 if P.200=1)

	r.382		253	G. V filt wind.	%	UD	0,1	0,0	**5,0**	25,0	% of feedback
			228								
Generator PF reference and regulator	**r.400**		229	G. PF ref source	-	UD	1	0	**0**	3	0 none (PF = 1) 1 an inp 1 (<0 cap, >0 ind) 2 an inp 2 (<0 cap, >0 ind) 3 digital
	r.401		230	G. PF ref min	-	PF	0,001	0,250 c	**0,750 c**	r.402	Capacitive / Inductive
	r.402		231	G. PF ref max	-	PF	0,001	r.401	**0,750 i**	0,250 i	Capacitive / Inductive
	r.403	L1	232	G. PF dig. ref	-	PF	0,001	r.401	**1,000**	r.402	Capacitive / Inductive
	r.404	L1	233	G. PF dig. ref 1	-	PF	0,001	r.401	**1,000**	r.402	Capacitive / Inductive
	r.410		234	G. PF ramp time	s	UD	0,1	0,0	**60,0**	300,0	
	r.450		235	G. PF reg KP	-	UD	0,001	0,000	**0,200**	10,000	
	r.451		236	G. PF reg KI	-	UD	0,0001	0,0000	**0,0500**	1,0000	
			236								
Generator VAR reference and regulator	**r.500**		237	G. VAR ref src	-	UD	1	0	**0**	3	0 none 1 an inp 1 2 an inp 2 3 digital
	r.501		238	G. VAR ref min	%	SD	0,1	-100,0	**-50,0**	r.502	% of P.100xP.110
	r.502		239	G. VAR ref max	%	SD	0,1	r.501	**50,0**	100,0	% of P.100xP.110
	r.503	L1	240	G. VAR dig. ref	%	SD	0,1	r.501	**0,0**	r.502	% of P.100xP.110
	r.510		241	G. VAR ramp time	s	UD	0,1	0,0	**60,0**	300,0	
	r.550		242	G. VAR reg KP	-	UD	0,001	0,000	**0,200**	10,000	
	r.551		243	G. VAR reg KI	-	UD	0,0001	0,0000	**0,0500**	1,0000	
Limit regulators	**r.900**		244	OE Lim reg KP	-	UD	0,001	0,000	**0,200**	10,000	
	r.901		245	OE Lim reg KI	-	UD	0,0001	0,0000	**0,0500**	1,0000	ZC
	r.910		246	UE Lim reg KP	-	UD	0,001	0,000	**0,200**	10,000	
	r.911		247	UE Lim reg KI	-	UD	0,0001	0,0000	**0,0500**	1,0000	ZC
	r.920		255	Q+ Lim reg KP	-	UD	0,001	0,000	**0,200**	10,000	
	r.921		256	Q+ Lim reg KI	-	UD	0,0001	0,0000	**0,0500**	1,0000	50ms
	r.930		257	Q- Lim reg KP	-	UD	0,001	0,000	**0,200**	10,000	
	r.931		258	Q- Lim reg KI	-	UD	0,0001	0,0000	**0,0500**	1,0000	50ms

9.3 Input & output parameters

I/Os	Name	R/W	IPA	Description (short)	Unit	Format	Step	Min	Default	Max	Notes, values
			599								
Digital inputs	**I.000**	N	600	Dig inp 1 cnf	-	UD	1	0	**1**	80	0 NONE 1 RUN NO 2 RUN NC 3 ENABLE NO 4 ENABLE NC 5 ALARM RESET NO (EDGE) 6 ALARM RESET NC (EDGE) 7 EXTERNAL FAULT NO 8 EXTERNAL FAULT NC 9 MANUAL PWM NO 10 MANUAL PWM NC 11 MANUAL FVR NO 12 MANUAL FVR NC 13 MANUAL FCR NO 14 MANUAL FCR NC 15 AUTO AVR NO 16 AUTO AVR NC 17 AUTO VDC NO 18 AUTO VDC NC 19 AUTO VDC GRID2 NO 20 AUTO VDC GRID2 NC 21 GRID FOLLOW NO 22 GRID FOLLOW NC 23 GRID SYNC NO 24 GRID SYNC NC 25 GRID PAR SW NO 26 GRID PAR SW NC 27 AUTO PF NO 28 AUTO PF NC 29 AUTO VAR NO 30 AUTO VAR NC 31 SET RAISE NO 32 SET RAISE NC 33 SET LOWER NO 34 SET LOWER NC 35 SET PRE POS NO 36 SET PRE POS NC 37 MASTER FAIL NO 38 MASTER FAIL NC 39 Q = 0 NO 40 Q = 0 NC 41 PF REF2 NO 42 PF REF2 NC 43 GEN SW NO 44 GEN SW NC 45 SUPPLY BUILDUP NO 46 SUPPLY BUILDUP NC 47 V GEN REF2 NO 48 V GEN REF2 NC 49 VF LIMIT DISABLE NO 50 VF LIMIT DISABLE NC 51 BRAKE R THERMAL SENS NO 52 BRAKE R THERMAL SENS NC 53 V GEN REF3 NO 54 V GEN REF3 NC 55 GRID STARTUP NO 56 GRID STARTUP NC 57 EXTERNAL FAULT 2 NO 58 EXTERNAL FAULT 2 NC 59 EXTERNAL FAULT 3 NO 60 EXTERNAL FAULT 3 NC 61 EXTERNAL FAULT 4 NO 62 EXTERNAL FAULT 4 NC 63 AVR REF BY ANALOG IN 1 NO 64 AVR REF BY ANALOG IN 1 NC 65 AVR REF BY ANALOG IN 2 NO 66 AVR REF BY ANALOG IN 2 NC 67 VAR REF BY ANALOG IN 1 NO 68 VAR REF BY ANALOG IN 1 NC 69 VAR REF BY ANALOG IN 2 NO 70 VAR REF BY ANALOG IN 2 NC 71 PF REF BY ANALOG IN 1 NO 72 PF REF BY ANALOG IN 1 NC 73 PF REF BY ANALOG IN 2 NO 74 PF REF BY ANALOG IN 2 NC 75 FCR REF BY ANALOG IN 1 NO 76 FCR REF BY ANALOG IN 1 NC 77 FCR REF BY ANALOG IN 2 NO
	I.001	N	601	Dig inp 2 cfg	-	UD	1	0	**43**	80	
	I.002	N	602	Dig inp 3 cfg	-	UD	1	0	**41**	80	
	I.003	N	603	Dig inp 4 cfg	-	UD	1	0	**31**	80	
	I.004	N	604	Dig inp 5 cfg	-	UD	1	0	**33**	80	
	I.005	N	605	Dig inp 6 cfg	-	UD	1	0	**39**	80	
	I.006	N	606	Dig inp 7 cfg	-	UD	1	0	**21**	80	
	I.007	N	607	Dig inp 8 cfg	-	UD	1	0	**13**	80	
	I.008	N	608	Dig inp 9 cfg	-	UD	1	0	**35**	80	
	I.009	N	609	Dig inp 10 cfg	-	UD	1	0	**5**	80	
	I.010	N	610	Dig inp 11 cfg	-	UD	1	0	**8**	80	
	I.011	N	611	Dig inp 12 cfg	-	UD	1	0	**0**	80	
	I.012	N	612	Dig inp 13 cfg	-	UD	1	0	**0**	80	
	I.013	N	613	Dig inp 14 cfg	-	UD	1	0	**0**	80	
	I.014	N	614	Dig inp 15 cfg	-	UD	1	0	**0**	80	
	I.015	N	615	Dig inp 16 cfg	-	UD	1	0	**0**	80	

											78 FCR REF BY ANALOG IN 2 NC 79 START EDGE NO 80 START EDGE NC
			615								79
Digital inputs remote	**I.050**		616	Remote en. mask	-	H	1	0x0000	**0x0000**	0xFFFF	bit mapped: 0 local / 1 remote (hex)
			616								
Digital outputs	**I.100**		617	Dig out 1 cfg	-	UD	1	0	**9**	74	0 None 1 Run (NO)
	I.101		618	Dig out 2 cfg	-	UD	1	0	**39**	74	2 Run (NC) 3 Fault (NO)
	I.102		619	Dig out 3 cfg	-	UD	1	0	**13**	74	4 Fault (NC) 5 Ready (NO)
	I.103		620	Dig out 4 cfg	-	UD	1	0	**11**	74	6 Ready (NC) 7 Watchdog (NO)
	I.104		621	Dig out 5 cfg	-	UD	1	0	**19**	74	8 Watchdog (NC) 9 Parallel CB (NO)
	I.105		622	Dig out 6 cfg	-	UD	1	0	**3**	74	10 Parallel CB (NC) 11 Calibrator min (NO)
	I.106		623	Dig out 7 cfg	-	UD	1	0	**21**	74	12 Calibrator min (NC) 13 Calibrator max (NO)
	I.107		624	Dig out 8 cfg	-	UD	1	0	**0**	74	14 Calibrator max (NC) 15 PF = 1 (NO)
	I.108		625	Dig out 9 cfg	-	UD	1	0	**0**	74	16 PF = 1 (NC) 17 Excitier OVerLoad (NO)
	I.109		626	Dig out 10 cfg	-	UD	1	0	**1**	74	18 Excitier OVerLoad (NC) 19 Manual mode (NO)
	I.110		627	Dig out 11 cfg	-	UD	1	0	**0**	74	20 Manual mode (NC) 21 PF 2nd reference (NO)
	I.111		628	Dig out 12 cfg	-	UD	1	0	**0**	74	22 PF 2nd reference (NC) 23 Field Flashing (NO)
	I.112		629	Dig out 13 cfg	-	UD	1	0	**0**	74	24 Field Flashing (NC) 25 Boost (NO)
	I.113		630	Dig out 14 cfg	-	UD	1	0	**0**	74	26 Boost (NC) 27 Warning (NO)
	I.114		631	Dig out 15 cfg	-	UD	1	0	**0**	74	28 Warning (NC) 29 Warning Mask1 (NO)
	I.115		632	Dig out 16 cfg	-	UD	1	0	**0**	74	30 Warning Mask1 (NC) 31 Warning Mask2 (NO)
											32 Warning Mask2 (NC) 33 Limits Any (NO)
											34 Limits Any (NC) 35 Limits Mask1 (NO)
											36 Limits Mask1 (NC) 37 Limits Mask2 (NO)
											38 Limits Mask2 (NC) 39 Q = 0 (NO)
											40 Q = 0 (NC) 41 Grid V matching (NO)
											42 Grid V matching (NC) 43 Grid F matching (NO)
											44 Grid F matching (NC) 45 Calibrator at preset (NO)
											46 Calibrator at preset (NC) 47 Control mode PWM (NO)
											48 Control mode PWM (NC) 49 Control mode FVR (NO)
											50 Control mode FVR (NC) 51 Control mode FCR (NO)
											52 Control mode FCR (NC) 53 Control mode AVR (NO)
											54 Control mode AVR (NC) 55 Control mode PF (NO)
											56 Control mode PF (NC) 57 Control mode VAR (NO)
											58 Control mode VAR (NC) 59 Thermal warning (NO)
											60 Thermal warning (NC) 61 Gen V Rated (NO)
											62 Gen V Rated (NC) 63 Speed Up (NO)
											64 Speed Up (NC) 65 Speed Down (NO)
											66 Speed Down (NC) 67 Redundancy Master (NO)
											68 Redundancy Master (NC) 69 Redundancy Backup (NO)
											70 Redundancy Backup (NC) 71 Redundancy Auto Master (NO)
											72 Redundancy Auto Master (NC) 73 Grid Parallel (NO)
											74 Grid Parallel (NC)
			632								

Digital outputs remote	**I.150**		633	Remote en. mask	-	H	1	0x0000	**0x0000**	0xFFFF	bit mapped: 0 local / 1 remote (hex)

Fast De-Excitation output	**I.160**	N	684	De-Excit. mode	-	UD	1	0	**0**	3	0 Active at FAULT 1 Not-active at FAULT 2 Active at STOP 3 Not-active at STOP
	I.161		685	Pulse time @ unl	s	UD	0,01	0,00	**0,00**	2,50	
	I.162		686	GenerV err thr	%	UD	0,1	0,0	**0,0**	25,0	
			633								

Analog input 1	**I.200**	N	634	An inp 1 mode	-	UD	1	0	**0**	1	0 voltage (-10 / +10V) 1 current (-20 / +20 mA)
	I.201		635	An inp 1 X1	%	SD	0,1	-100,0	**0,0**	I.202	
	I.202		636	An inp 1 X2	%	SD	0,1	I.201	**100,0**	100,0	
	I.203		637	An inp 1 Y1	%	SD	0,1	-400,0	**0,0**	400,0	
	I.204		638	An inp 1 Y2	%	SD	0,1	-400,0	**100,0**	400,0	
	I.205		639	An inp 1 Time	s	UD	0,01	0,00	**0,05**	2,00	
			639								

Analog input 2	**I.210**	N	640	An inp 2 mode	-	UD	1	0	**0**	1	as I.200
	I.211		641	An inp 2 X1	%	SD	0,1	-100,0	**0,0**	I.212	
	I.212		642	An inp 2 X2	%	SD	0,1	I.211	**100,0**	100,0	
	I.213		643	An inp 2 Y1	%	SD	0,1	-400,0	**0,0**	400,0	
	I.214		644	An inp 2 Y2	%	SD	0,1	-400,0	**100,0**	400,0	
	I.215		645	An inp 2 Time	s	UD	0,01	0,00	**0,05**	2,00	
			645								

Analog inputs remote	**I.250**		646	Remote en. mask	-	H	1	0x0000	**0x0000**	0x0003	bit mapped: 0 local / 1 remote (hex)
			646								

Analog output 1	**I.300**		647	An out 1 config	-	UD	1	0	**0**	69	0 Field I 1 Field V 2 Out Duty 3 Generator V 4 Generator I 5 Generator P 6 Generator Q 7 Generator S 8 Generator PF 9 Mains V 10 Actual Reg. Reference 11 Actual Reg. Feedback 12 Actual Reg. Error 13 Actual Reg. P+D 14 Actual Reg. I 15 Actual Reg. Output 16 Remote 17 DC Bus Voltage 18 Sync freq. Adj 19 An Inp 1 20 An Inp 2 21 Field I Reg. Reference 22 Field I Reg. Feedback 23 Field I Reg. Error 24 Field I Reg. P+D 25 Field I Reg. I 26 Field I Reg. Output 27 Gener V Reg. Reference 28 Gener V Reg. Feedback 29 Gener V Reg. Error 30 Gener V Reg. P+D 31 Gener V Reg. I 32 Gener V Reg. Output 33 Gener PF Reg. Reference 34 Gener PF Reg. Feedback 35 Gener PF Reg. Error 36 Gener PF Reg. P 37 Gener PF Reg. I 38 Gener PF Reg. Output 39 Gener VAR Reg. Reference 40 Gener VAR Reg. Feedback 41 Gener VAR Reg. Error 42 Gener VAR Reg. P 43 Gener VAR Reg. I 44 Gener VAR Reg. Output

											45 Limit OE Reg. Reference 46 Limit OE Reg. Feedback 47 Limit OE Reg. Error 48 Limit OE Reg. P 49 Limit OE Reg. I 50 Limit OE Reg. Output 51 Limit UE Reg. Reference 52 Limit UE Reg. Feedback 53 Limit UE Reg. Error 54 Limit UE Reg. P 55 Limit UE Reg. I 56 Limit UE Reg. Output 57 Limit QP Reg. Reference 58 Limit QP Reg. Feedback 59 Limit QP Reg. Error 60 Limit QP Reg. P 61 Limit QP Reg. I 62 Limit QP Reg. Output 63 Limit QN Reg. Reference 64 Limit QN Reg. Feedback 65 Limit QN Reg. Error 66 Limit QN Reg. P 67 Limit QN Reg. I 68 Limit QN Reg. Output 69 Gener V Ref Before Limits
	I.301		648	An out 1 X1	%	SD	0,1	-400,0	**0,0**	I.302	
	I.302		649	An out 1 X2	%	SD	0,1	I.301	**200,0**	400,0	
	I.303		650	An out 1 Y1	%	UD	0,1	0,0	**0,0**	100,0	
	I.304		651	An out 1 Y2	%	UD	0,1	0,0	**100,0**	100,0	
	I.305		652	An out 1 Time	s	UD	0,01	0,00	**0,05**	2,00	
			652								
Analog output 2	**I.310**		653	An out 2 config	-	UD	1	0	**3**	69	as I.300
	I.311		654	An out 2 X1	%	SD	0,1	-400,0	**0,0**	I.312	
	I.312		655	An out 2 X2	%	SD	0,1	I.311	**120,0**	400,0	
	I.313		656	An out 2 Y1	%	UD	0,1	0,0	**0,0**	100,0	
	I.314		657	An out 2 Y2	%	UD	0,1	0,0	**100,0**	100,0	
	I.315		658	An out 2 Time	s	UD	0,01	0,00	**0,05**	2,00	
			658								
RS485	**I.400**		659	RS485 config	-	UD	1	0	**2**	5	0 disabled 1 Modbus RTU 8N1 2 Modbus RTU 8E1 3 Modbus RTU 8O1 4 Modbus RTU 8N2
	I.401		660	RS485 bitrate	-	UD	1	0	**2**	5	0 4800 1 9600 2 19200 3 38400 4 57600 5 115200
	I.402		661	RS485 node ID	-	UD	1	1	**1**	247	
	I.403		662	RS485 timeout	s	UD	0,1	0,0	**0,0**	25,0	
	I.404		663	RS485 delay	s	UD	0,001	0,000	**0,001**	0,100	
			663								
USB	**I.450**		664	USB config	-	UD	1	0	**1**	5	as I.400
	I.451		665	USB bitrate	-	UD	1	0	**2**	5	as I.401
	I.452		666	USB node ID	-	UD	1	1	**1**	247	
	I.453		667	USB timeout	s	UD	0,1	0,0	**0,0**	25,0	
			667								
CAN bus	**I.500**		668	CAN config	-	UD	1	0	**0**	1	0 disabled 1 CAN proprietary for redundancy 2 CANopen
	I.501		669	CAN bitrate	-	UD	1	1	**3**	6	~~0 20 KBps~~ 1 50 kBps 2 125 kBps 3 250 kBps 4 500 kBps 5 800 kBps 6 1 MBps
	I.502		670	CAN node ID	-	UD	1	1	**1**	127	

Ethernet module	**I.600**		671	Ethernet mode	-	UD	1	0	**0**	1	0 disabled 1 Modbus/TCP server
	I.610		672	IP address b1	-	UD	1	0	**192**	255	
	I.611		673	IP address b2	-	UD	1	0	**168**	255	
	I.612		674	IP address b3	-	UD	1	0	**168**	255	
	I.613		675	IP address b4	-	UD	1	0	**1**	255	
	I.620		676	IP sbnet mask b1	-	UD	1	0	**255**	255	
	I.621		677	IP sbnet mask b2	-	UD	1	0	**255**	255	
	I.622		678	IP sbnet mask b3	-	UD	1	0	**255**	255	
	I.623		679	IP sbnet mask b4	-	UD	1	0	**0**	255	
	I.630		680	IP gateway b1	-	UD	1	0	**192**	255	
	I.631		681	IP gateway b2	-	UD	1	0	**168**	255	
	I.632		682	IP gateway b3	-	UD	1	0	**168**	255	
	I.633		683	IP gateway b4	-	UD	1	0	**1**	255	

9.4 Configuration parameters

CONFIGURATION PARAMETERS	Name	R/W	IPA	Description (short)	Unit	Format	Step	Min	Default	Max	Notes, values
			999								
Field excitation data	**P.000**	N	1000	F. rated I	A dc	UD	0,1	1,0	**d.900**	600,0	max <= d.900*d.901
	P.001		1001	F. OE Lim	%	UD	1	100	**150**	250	% of P.000, max = d.900*d.901/P.000 <= 250%
	P.002		1002	F. UE Lim	%	UD	1	0	**5**	90	% of P.000
	P.003		1096	F. OE Lim unload	%	UD	1	0	**50**	100	% of P.000
	P.010	N	1003	F. rated V	V dc	UD	0,1	10,0	**50,0**	d.910	
	P.011		1004	F. max V	%	UD	1	100	**220**	399	% of P.010, max = d.910/P.010 <400%
	P.020	N	1005	Field resistance	Ohm	UD	0,01	0,10	**P.010/P.000**	100,00	
	P.021	N	1006	Field inductance	H	UD	0,001	0,010	**0,1**	10,000	
	P.030		1007	F. thermal I	%	UD	1	100	**105**	P.001	% of P.000
	P.031		1008	F. OE decay time	s	UD	1	30	**300**	3600	
	P.032		1009	F. OE Lim time	s	UD	1	1	**30**	240	
	P.050		1010	Rotor poles pair	-	UD	1	1	**1**	10	
Generator data	**P.100**	N	1011	G. rated V	V rms	UD	1	50	**400**	500	
	P.101		1012	G. max V	%	UD	1	100	**120**	130	% of P.100, max = (max P.100)/P.100 <= 130%
	P.102		1013	G. min V	%	UD	1	50	**80**	100	
	P.110	N	1014	G. rated I	A rms	UD	0,01	0,10	**5,00**	5,00	
	P.111		1015	G. max I	%	UD	1	99	**150**	200	% of P.110 (99% --> disable limit), max = (max P.110)/P.110 <= 200%
	P.112		1092	G. min I	%	UD	0,1	3,0	**5,0**	25,0	
	P.113		1093	G. TA loss delay	s	UD	1	0	**0**	240	(0 --> TA loss not checked)
	P.120	N	1016	G. rated freq	Hz	UD	0,1	40,0	**50,0**	90,0	
	P.130		1017	G. V/f min freq	%	UD	1	10	**40**	P.131	% of P.120
	P.131		1018	G. V/f max freq	%	UD	1	P.130	**94**	99	% of P.120, min >= 80
	P.132		1091	G. soft start t	s	UD	1	1	**30**	240	
	P.133		1099	G. grid start t	s	UD	1	1	**60**	240	soft-start ramp time during grid startup
	P.140		1019	G. thermal I	%	UD	1	100	**105**	P.111	% of P.110
	P.141		1020	G. max I decay t	min	UD	1	1	**30**	900	
	P.142		1021	G. max I time	s	UD	1	5	**30**	600	
	P.150		1022	G. poles pair	-	UD	1	1	**1**	10	
	P.160		1023	Q- lim @ P 0%	%	SD	1	-100	**-40**	-5	% of P.100xP.110
	P.161		1024	Q- lim @ P 25%	%	SD	1	-100	**-35**	-5	% of P.100xP.110
	P.162		1025	Q- lim @ P 50%	%	SD	1	-100	**-30**	-5	% of P.100xP.110
	P.163		1026	Q- lim @ P 75%	%	SD	1	-100	**-25**	-5	% of P.100xP.110
	P.164		1027	Q- lim @ P 100%	%	SD	1	-100	**-20**	-5	% of P.100xP.110
	P.165		1097	Q- lim KV2	-	UD	0,01	0,00	**0,00**	2,00	% of P.100xP.110
	P.170		1028	Q+ lim @ P 0%	%	UD	1	5	**80**	100	% of P.100xP.110
	P.171		1029	Q+ lim @ P 100%	%	UD	1	5	**60**	100	% of P.100xP.110
	P.172		1098	Q+ lim KV	-	UD	0,01	0,00	**0,00**	2,00	% of P.100xP.110
Sensing	**P.200**	N	1030	G. V sense 3ph	-	UD	1	0	**1**	1	0 single phase V sense 1 three-phase V sense

	P.201		1031	F. buildup level	%	UD	1	0	**0**	50	% of P.000
	P.210		1032	TV Mains phase	deg	SD	0,1	-180,0	**0,0**	180,0	
	P.211		1033	TV Mains rated V	V rms	UD	0,1	50,0	**400,0**	500,0	
	P.212		1094	Mains V toll.	%	UD	1	5	**25**	50	
	P.213		1095	Mains auto foll.	-	UD	1	0	**1**	1	
Power supply	**P.250**		1034	Supply rated V	V rms	UD	1	0	**230**	500	(0 --> don't care)
	P.251		1100	Supply timeout	s	UD	0,1	0,0	**0,0**	25,0	only when P.250>0 (0 --> no timeout check)
Control mode	**P.300**		1035	Control mode	-	UD	1	0	**3**	5	0 PWM 1 FVR 2 FCR 3 AVR 4 PF 5 VAR 6 PS
Voltage Droop Compensation	**P.400**		1036	Voltage comp K	%	SD	0,1	-20,0	**0,0**	20,0	% of P.100 @ Q = 100%
	P.401		1037	Comp ramp time	s	UD	1	1	**60**	240	
	P.402		1038	Primary grid ID	-	UD	1	0	**1**	255	
	P.403		1039	Altern. grid ID	-	UD	1	0	**2**	255	
Series Compensation	**P.410**		1040	Voltage comp K	%	UD	0,1	0,0	**0,0**	20,0	% of P.100 @ P = 100%
	P.411		1041	Comp ramp time	s	UD	1	1	**60**	240	
Field Flashing	**P.420**		1042	FF off level	%	UD	1	0	**0**	80	% of P.100 (0 --> disabled)
	P.421		1043	FF max time	s	UD	1	1	**10**	240	
Boost	**P.430**		1044	B. on Level	%	UD	1	0	**0**	90	% of P.100 (0 --> disabled)
	P.431		1045	B. off Hyst	%	UD	1	1	**10**	30	% of P.100
	P.432		1046	B. max time	s	UD	1	0	**0**	30	
Q=f(V)	**P.450**		1047	Lock-in P	%	UD	1	0	0	80	% of P.100xP.110 (0 --> disabled)
	P.451		1048	Lock-out P	%	UD	1	5	10	P.450	% of P.100xP.110
	P.452		1049	V1 h	%	UD	1	101	108	P.453	% of P.100
	P.453		1050	V2 h	%	UD	1	P.452	110	120	% of P.100
	P.454		1051	Q2 h	%	SD	1	-60	-48	60	% of P.100xP.110
	P.455		1052	V1 l	%	UD	1	P.456	92	99	% of P.100
	P.456		1053	V2 l	%	UD	1	80	90	P.455	% of P.100
	P.457		1054	Q2 l	%	SD	1	-60	48	60	% of P.100xP.110
PF=f(P)	**P.470**		1055	Lock-in V	%	UD	1	100	**100**	120	% of P.100 (100 --> disabled)
	P.471		1056	Lock-out V	%	UD	1	80	**100**	P.470	% of P.100
	P.472		1057	P @ default PF	%	UD	1	5	**50**	80	% of P.100xP.110
	P.473		1058	PF @ P 100%	-	PF	0,001	0,800 c	**0,900 c**	0,800 i	
Rotor diode monitor	**P.600**		1059	Detect level oc	%	UD	1	0	**0**	100	% of P.000 (0 --> disabled)
	P.601		1060	Signal delay oc	s	UD	1	1	**60**	240	

	P.610		1061	Detect level sc	%	UD	1	0	**0**	200	% of P.000 (0 --> disabled)
	P.611		1062	Signal delay sc	s	UD	1	1	**10**	120	
			1062								
Synchronization	**P.700**		1063	V tolerance	%	UD	1	1	**1**	10	% of P.100
	P.701		1064	Min slip	Hz	UD	0,01	0,04	**0,10**	P.702	
	P.702		1065	Max slip	Hz	UD	0,01	P.701	**0,50**	2,50	
	P.703		1066	G. faster	-	UD	1	0	**0**	1	0 --> don't care
	P.704		1067	Wait cycles	-	UD	1	0	**0**	5	(0 --> sync disabled)
	-	-	-		-	-	-	-	-	-	-
	P.706		1069	CB close time	s	UD	0,001	0,000	**0,050**	0,250	0 --> uses semplified synch detection with no CB close time compensation
	P.710		1070	Freq adj type	-	UD	1	0	**100**	100	0 analog out 1-99 inc/dec pulse duty 1-99% 100 inc/dec time linear
	P.711		1071	F adj span	Hz	UD	0,01	0,10	**2,00**	10,00	
	P.712		1072	Freq adj time	s	UD	0,1	0,5	**2,0**	25,0	
Alarms	**P.800**		1073	Fault En. Mask L	-	H	1	0x0000	**0x778F**	0xFFFF	bit mapped (hex) as D.800
	P.801		1074	Fault En. Mask H	-	H	1	0x0000	**0xFFFF**	0xFFFF	bit mapped (hex) as D.801
	P.810		1075	Signal Mask1 L	-	H	1	0x0000	**0xFFFF**	0xFFFF	bit mapped (hex) as D.800
	P.811		1076	Signal Mask1 H	-	H	1	0x0000	**0xFFFF**	0xFFFF	bit mapped (hex) as D.801
	P.820		1077	Signal Mask2 L	-	H	1	0x0000	**0xFFFF**	0xFFFF	bit mapped (hex) as D.800
	P.821		1078	Signal Mask2 H	-	H	1	0x0000	**0xFFFF**	0xFFFF	bit mapped (hex) as D.801
	P.830		1090	Thermal warn thr	°C	UD	1	5	**60**	80	
Limitations	**P.850**		1079	Limits Mask 1	-	H	1	0x0000	**0x007F**	0xFFFF	bit mapped (hex) as D.330
	P.851		1080	Limits Mask 2	-	H	1	0x0000	**0x7F00**	0xFFFF	bit mapped (hex) as D.330
Operator Interface	**P.900**		1081	F1 key config	-	UD	1	0	**1**	5	0 none 1 setpoint raise 2 setpoint lower 3 setpoint pre pos 4 alarm reset 5 jump to parameter
	P.901		1082	F2 key aux val	-	SD	1	-32768	**0**	32767	
	P.910		1083	F2 key config	-	UD	1	0	**2**	5	as P.900
	P.911		1084	F2 key aux val	-	SD	1	-32768	**0**	32767	
	P.920		1085	Free LED1 config	-	UD	1	0	**11**	72	as I.100
	P.921		1086	Free LED2 config	-	UD	1	0	**13**	72	
	P.980	L1	1087	Password lev 1	-	UD	1	0	**0**	65535	0 --> no password
	P.981	L2	1088	Password lev 2	-	UD	1	0	**1**	65535	0 --> no password
	P.999		1089	Startup param	-	UD	1	0	**8**	2047	

9.5 Scope parameters

SCOPE PARAMETERS	Name	R/W	IPA	Description (short)	Unit	Format	Step	Min	Default	Max	Notes, values
Scope	**S.000**		1500	Trk src sel 1	-	UD	1	0		65535	0 NONE 1 GENER_V
	S.001		1501	Trk src sel 2	-	UD	1	0		65535	2 GENER_V_REF 3 MAINS_V
	S.002		1502	Trk src sel 3	-	UD	1	0		65535	4 GENER_F 5 MAINS_F
	S.003		1503	Trk src sel 4	-	UD	1	0		65535	6 GENER_I 7 PF
	S.004		1504	Trk src sel 5	-	UD	1	0		65535	8 PF_REF 9 GENER_S
	S.005		1505	Trk src sel 6	-	UD	1	0		65535	10 GENER_P 11 GENER_Q
	S.006		1506	Trk src sel 7	-	UD	1	0		65535	12 GENER_Q_REF 13 FIELD_I 14 FIELD_V 15 OUT_DUTY 16 DCBUS_V 17 PID_REF 18 PID_FBK 19 PID_ERR 20 PID_P 21 PID_D 22 PID_I 23 PID_LIM_H 24 PID_LIM_L 25 PID_OUT 26 ALARMS_L 27 ALARMS_H 28 WARNINGS_L 29 WARNINGS_H 30 LIMITS 31 DUMMY31 32 FIELD_I_REG_REF 33 FIELD_I_REG_FBK 34 FIELD_I_REG_ERR 35 FIELD_I_REG_P 36 FIELD_I_REG_D 37 FIELD_I_REG_I 38 FIELD_I_REG_LIM_H 39 FIELD_I_REG_LIM_L 40 FIELD_I_REG_OUT 41 GENER_V_REG_REF 42 GENER_V_REG_FBK 43 GENER_V_REG_ERR 44 GENER_V_REG_P
	S.007		1507	Trk src sel 8	-	UD	1	0		65535	45 GENER_V_REG_D 46 GENER_V_REG_I 47 GENER_V_REG_LIM_H 48 GENER_V_REG_LIM_L 49 GENER_V_REG_OUT 50 GENER_PF_REG_REF 51 GENER_PF_REG_FBK 52 GENER_PF_REG_ERR 53 GENER_PF_REG_P 54 GENER_PF_REG_I 55 GENER_PF_REG_LIM_H 56 GENER_PF_REG_LIM_L 57 GENER_PF_REG_OUT 58 GENER_VAR_REG_REF 59 GENER_VAR_REG_FBK 60 GENER_VAR_REG_ERR 61 GENER_VAR_REG_P 62 GENER_VAR_REG_I 63 GENER_VAR_REG_LIM_H 64 GENER_VAR_REG_LIM_L 65 GENER_VAR_REG_OUT 66 LIMIT_OE_REG_REF 67 LIMIT_OE_REG_FBK 68 LIMIT_OE_REG_ERR 69 LIMIT_OE_REG_P 70 LIMIT_OE_REG_I 71 LIMIT_OE_REG_LIM_H 72 LIMIT_OE_REG_LIM_L 73 LIMIT_OE_REG_OUT 74 LIMIT_UE_REG_REF 75 LIMIT_UE_REG_FBK 76 LIMIT_UE_REG_ERR 77 LIMIT_UE_REG_P 78 LIMIT_UE_REG_I

											79 LIMIT_UE_REG_LIM_H 80 LIMIT_UE_REG_LIM_L 81 LIMIT_UE_REG_OUT 82 LIMIT_QP_REG_REF 83 LIMIT_QP_REG_FBK 84 LIMIT_QP_REG_ERR 85 LIMIT_QP_REG_P 86 LIMIT_QP_REG_I 87 LIMIT_QP_REG_LIM_H 88 LIMIT_QP_REG_LIM_L 89 LIMIT_QP_REG_OUT 90 LIMIT_QN_REG_REF 91 LIMIT_QN_REG_FBK 92 LIMIT_QN_REG_ERR 93 LIMIT_QN_REG_P 94 LIMIT_QN_REG_I 95 LIMIT_QN_REG_LIM_H 96 LIMIT_QN_REG_LIM_L 97 LIMIT_QN_REG_OUT 98 GENER_V_RS 99 GENER_V_ST 100 GENER_V_TR 101 GENER_V_RS_IST 102 GENER_V_ST_IST 103 GENER_V_TR_IST 104 GENER_I_IST 105 MAINS_V__IST
	S.010		1508	Trk src type 1	-	UD	1	0	**0**	6	0 pre defined selection 1 RAM unsigned 8bit 2 RAM signed 8bit 3 RAM unsigned 16bit 4 RAM signed 16bit 5 RAM unsigned 32bit 6 RAM signed 32bit
	S.011		1509	Trk src type 2	-	UD	1	0	**0**	6	
	S.012		1510	Trk src type 3	-	UD	1	0	**0**	6	
	S.013		1511	Trk src type 4	-	UD	1	0	**0**	6	
	S.014		1512	Trk src type 5	-	UD	1	0	**0**	6	
	S.015		1513	Trk src type 6	-	UD	1	0	**0**	6	
	S.016		1514	Trk src type 7	-	UD	1	0	**0**	6	
	S.017		1515	Trk src type 8	-	UD	1	0	**0**	6	
	S.050		1516	Trigger src sel	-	UD	1	0		65535	
	S.051		1517	Trig src type	-	UD	1	0	**0**	6	as S.010
	S.052		1518	Trig edge sel	-	UD	1	0	**1**	2	0 falling 1 rising 2 both
	S.053		1519	Trig level	-	SD	1	-32768		32767	
	S.054		1520	Trig position	%	UD	1	0	**10**	100	
	S.080		1521	Sampling time	-	UD	1	1	**1**	65535	x*62,5us, if x > 32768 T=(x-32768)s
	S.100	R	1522	Trk samples	-	UD	1	512	**512**	4096	read only
	S.101	R	1523	State	-	UD	1	0	**0**	2	read only 0 STOP 1 SAMPLING 2 DONE
	S.102	R	1524	Sample index	-	UD	1	0	**-**	4095	read only
	S.103	R	1525	Trigger index	-	UD	1	0	**-**	65535	read only
	S.200		1526	Command	-	UD	1	0	**0**	1	
Trend	**S.500**		1527	Trk src sel 1	-	UD	1	0	**8**	65535	IPAs of D.xxx to sample (65535 = NONE)
	S.501		1528	Trk src sel 2	-	UD	1	0	**11**	65535	
	S.502		1529	Trk src sel 3	-	UD	1	0	**13**	65535	
	S.503		1530	Trk src sel 4	-	UD	1	0	**17**	65535	
	S.504		1531	Trk src sel 5	-	UD	1	0	**18**	65535	
	S.505		1532	Trk src sel 6	-	UD	1	0	**5**	65535	
	S.506		1533	Trk src sel 7	-	UD	1	0	**3**	65535	
	S.507		1534	Trk src sel 8	-	UD	1	0	**0**	65535	
	S.508		1535	Trk src sel 9	-	UD	1	0	**14**	65535	
	S.509		1536	Trk src sel 10	-	UD	1	0	**65535**	65535	
	S.510		1537	Trk src sel 11	-	UD	1	0	**65535**	65535	
	S.511		1538	Trk src sel 12	-	UD	1	0	**65535**	65535	

	S.512		1539	Trk src sel 13	-	UD	1	0	**65535**	65535	
	S.513		1540	Trk src sel 14	-	UD	1	0	**65535**	65535	
	S.514		1541	Trk src sel 15	-	UD	1	0	**65535**	65535	
	S.515		1542	Trk src sel 16	-	UD	1	0	**65535**	65535	

9.6 Commands parameters

COMMANDS	Name	R/W	IPA	Description (short)	Unit	Format	Step	Min	Default	Max	Notes, values
Non volatile parameters	**C.000**		1600	Params save	-	UD	1	0	**0**	1	
	C.001	N	1601	Params reload	-	UD	1	0	**0**	1	
	C.002	N	1602	Params default	-	UD	1	0	**0**	1	
Self commissioning	**C.100**	N	1603	Field autotuning	-	UD	1	0	**0**	1	
System test utilities	**C.200**		1604	Test step	%	SD	0,1	-200,0	**0,0**	200,0	
	C.201		1605	Test time	s	UD	0,1	0,0	**0,0**	300,0	0 --> continuous
	C.202		1606	Test trigger/sel	-	UD	1	0	**0**	3	0 --> 1 start test cycle 2 test signal from analog input 1 3 test signal from analog input 2
	C.203		1618	Step type sel	-	UD	1	0	**1**	3	0 Field current 1 Generator voltage 2 PF 3 VAR
Exciter self-test	**C.299**		1626	Keypad led test	-	UD	1	0	**0**	1	
Virtual I/O	**C.500**		1607	D. inp rem stat	-	H	1	0x0000	**0x0000**	0xFFFF	bit mapped (hex)
	C.550		1608	D. out rem stat	-	H	1	0x0000	**0x0000**	0xFFFF	bit mapped (hex)
	C.600		1609	An inp 1 rem val	%	SD	0,1	-100,0	**0,0**	100,0	
	C.601		1610	An inp 2 rem val	%	SD	0,1	-100,0	**0,0**	100,0	
	C.650		1611	An out 1 rem val	%	SD	0,1	-400,0	**0,0**	400,0	
	C.651		1612	An out 2 rem val	%	SD	0,1	-400,0	**0,0**	400,0	
RTC	**C.800**		1619	Year	-	UD	1	0	-	99	+2000
	C.801		1620	Month	-	UD	1	1	-	12	
	C.802		1621	Day	-	UD	1	1	-	31	
	C.803		1622	Hour	-	UD	1	0	-	23	
	C.804		1623	Minutes	-	UD	1	0	-	59	
	C.805		1624	Seconds	-	UD	1	0	-	59	
	C.806		1625	Write trigger	-	UD	1	0	-	1	
Alarms Utilities	**C.900**	A	1613	Reset al. Ack	-	UD	1	0	**0**	1	
	C.910	A	1614	Faults log index	-	UD	1	0	**0**	7	
	C.911		1615	Clear faults log	-	UD	1	0	**0**	1	
Access control	**C.980**	A	1616	Password lev 1	-	UD	1	0	**0**	65535	
	C.981	A	1617	Password lev 2	-	UD	1	0	**0**	65535	

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