

D550

Digital voltage regulator Installation and maintenance

Digital voltage regulator D550

This manual concerns the alternator AVR which you have just purchased.
We wish to draw your attention to the contents of this maintenance manual.

SAFETY MEASURES

Before using your machine for the first time, it is important to read the whole of this installation and maintenance manual.

All necessary operations and interventions on this machine must be performed by a qualified technician.

Our technical support service will be pleased to provide any additional information you may require.

The various operations described in this manual are accompanied by recommendations or symbols to alert the user to potential risks of accidents. It is vital that you understand and take notice of the following warning symbols.

WARNING

Warning symbol for an operation capable of damaging or destroying the machine or surrounding equipment.



Warning symbol for general danger to personnel.



Warning symbol for electrical danger to personnel.



All servicing or repair operations performed on the AVR should be undertaken by personnel trained in the commissioning, servicing and maintenance of electrical and mechanical components.

WARNING

This AVR can be incorporated in a EC-marked machine.

This manual is to be given to the end user.

© - We reserve the right to modify the characteristics of this product at any time in order to incorporate the latest technological developments. The information contained in this document may therefore be changed without notice.

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All brands and models have been registered and patents applied for.

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0. TERMS AND EXPRESSIONS

VT	Voltage transformer, in this manual a voltage transformer is used both for the power supply and for measuring the voltage.
CT	Current transformer, used for measuring the current.
PMG	Permanent Magnet Generator.
AREP	Auxiliary windings installed in the machine which are used to supply the AVR with power. They often consist of 2 windings: the first "H1" which is affected by voltage variations, the second "H3" which is affected by current variations.

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1. General Instructions

1.1. Identity sheet

The D550 AVR has been manufactured by

MOTEURS LEROY SOMER
Boulevard Marcellin Leroy, CS 10015
16915 ANGOULEME Cedex 9
France
Tel: +33 2 38 62 40 00

LEROY SOMER reference: 40041384

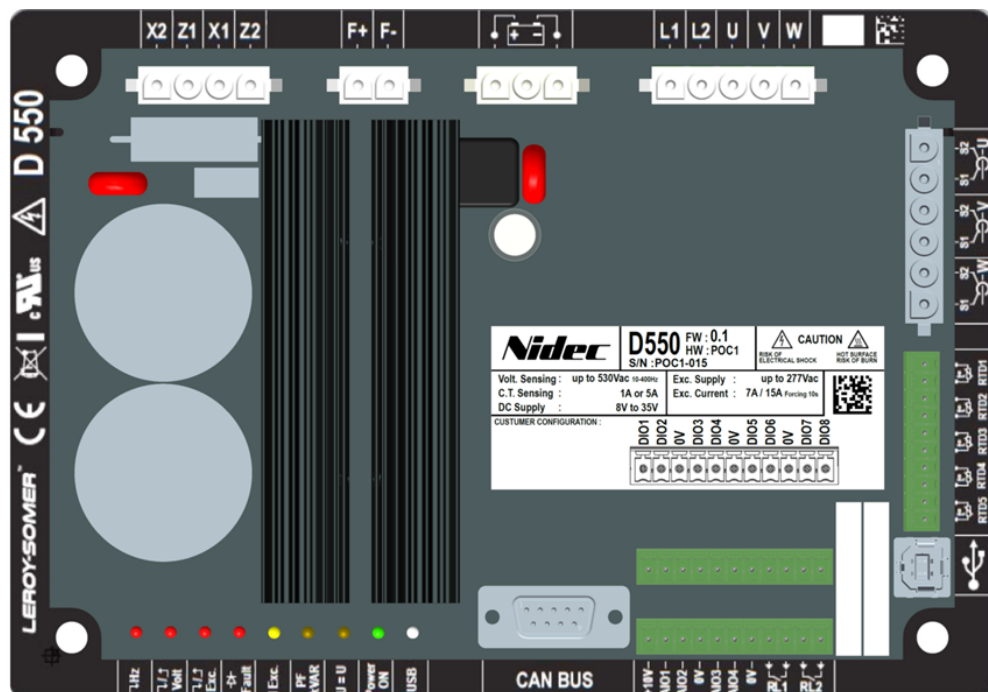
1.2. General overview of the product

This manual describes how to install, use, set up and maintain the D550 AVR.

The purpose of this AVR is to regulate alternators with a field current of less than 7 A in continuous operations, and 15 A maximum in the event of short-circuit for 10 seconds maximum.¹

It is designed for mounting in a generator terminal box or a control cabinet. It must be installed in compliance with local protection and safety standards, especially those specific to electrical installations with a maximum voltage of 300 VAC phase/neutral.²

It takes the form of a compact unit with a set of connectors and USB on the front.



¹ These values are given for a temperature of 70°C. See the detailed technical specification for the full range of values.

² A set of mounting brackets supplied with the AVR, is required to mount the AVR to the back of the cabinet or in the terminal box.

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The D550 AVR consists of several function blocks:

- A power bridge (that supplies a field current)
- A measuring circuit for the various signals such as voltage, current
- A set of digital and analog I/O: for control of regulation modes, operating information, correcting references
- A set of connectors
- A set of communication modes for dialogue and remote parameter-setting

Various additional features are integrated in the D550:

- 5 Pt100 or CTP temperature sensors
- 1 incremental encoder input for the rotor angular position with Easy Log PS option
- 1 CAN BUS connector
- 1 USB connector

1.3. Technical characteristics

1.4. Components

The D550 AVR is a digital voltage regulator used to control the alternator field current using separate control loops. The regulation mode is managed either by parameter-setting, or via the D550 digital inputs or via the communication mode.

These regulation modes are:

- Voltage regulation
 - With or without quadrature droop to allow parallel machine operation (1F)
 - With or without cross-current compensation
 - With or without load compensation³
- Matching of the machine voltage and grid voltage prior to connection to a grid (called “3F” or “U=U”)
- Power factor regulation, only when the alternator is connected to a grid (2F)
- Reactive power (kVAr) regulation, only when the alternator is connected to a grid
- Regulation of cos phi at the installation delivery point within the drive system capacity, from an analog input (remote measurement mode by a converter supplied by the customer) or by directly calculating the power factor at the delivery point.⁴
- Regulation of the field current, or manual mode, which allows direct control of the field current value

³ Quadrature droop, cross-current and load compensation cannot be enabled at the same time and require the use of an optional current transformer.

⁴ Obligation to have the Grid code VTs and Grid code current measurement CT placed at the delivery point and wired on the D550.

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The D550 can also be used to:

- Adjust the reference for the regulation mode in progress, using:
 - up/down volt-free contacts
 - an analog input (4-20 mA, 0-10 V, ± 10 V, Potentiometer)
- Monitor 5 temperature sensors (Pt100 or CTP)
- Limit the minimum field current delivered to the exciter field
- Limit the maximum stator current
- Detect loss of phase
- Withstand a sudden short-circuit for 10 seconds maximum in AREP, PMG or Shunt
- Protect the alternator in the event of a rotating diode failure
- Monitor (trips) and support electrical networks (Grid Code)
- Monitor signals (event logger)
- Record signals (scope meter feature with the utility SW)

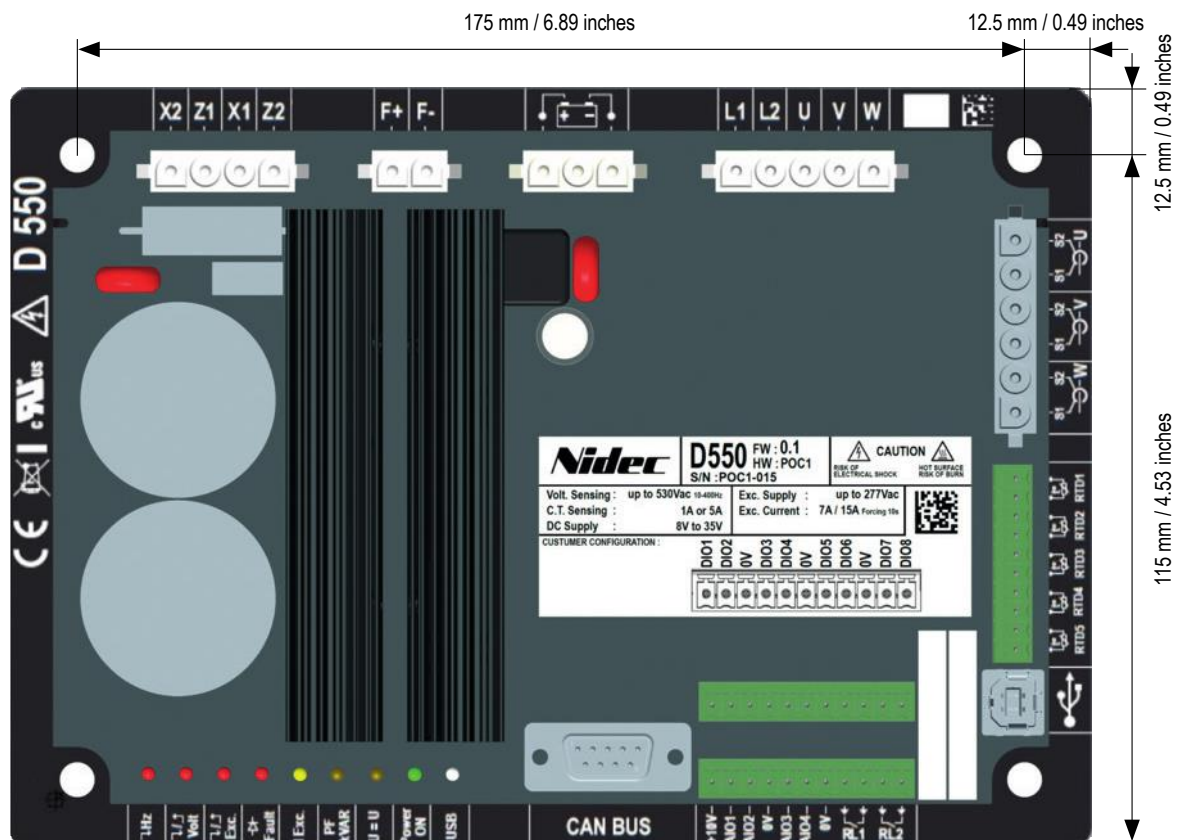
The various faults regulation mode and measurement data items can be delivered to the 8 digital configurable outputs or inputs and/or 4 analog configurable outputs or inputs (4-20 mA, 0-10 V, ± 10 V).

1.5. Operating values

- **Alternator voltage sensing:**
 - 3 phases, 2 phases
 - Two-phase range 0-230 VAC or 0-530 VAC (120% max. 2 minutes)
 - Consumption < 2 VA
- **Grid code voltage sensing:**
 - 2 phases
 - Two-phase range 0-230 VAC or 0-530 VAC (120% max. 2 minutes)
 - Consumption < 2 VA
- **Stator current measurement by CT:**
 - 1 or 3 phases
 - Range 0-1 A or 0-5 A (300% max. 30s)
 - Consumption < 2 VA
- **Power supply:**
 - **AC:**
 - 4 terminals for PMG, AREP, SHUNT
 - 2 independent circuits
 - Range 50-277 VAC (115% max. 2 minutes)
 - Max Consumption < 3000VA
- **Field excitation**
 - Rated 0-7 A
 - Short-circuit 15A max. at 70°C for 10 seconds
 - Field winding resistance > 4 ohms
- **Auxiliary supply:**
 - Range 8-35 VDC
 - Consumption < 1 A
- **Frequency measurement**
 - Range 30-400 Hz
- Regulation accuracy: $\pm 0.25\%$ of the average of the three phases on a linear load, with harmonic distortion less than 5%

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- Voltage adjustment range: 0 to 150% of the rated voltage by means of volt-free contacts or an analog input
- Quadrature droop adjustment range: -20% to 20%
- Under frequency protection: integrated, adjustable threshold, slope adjustable from $k \times V/Hz$ with $0.5 < k < 5$ in steps of 0.1 V/Hz
- Excitation ceiling: adjustable by a time dependent curve 3 points
- Environment: ambient temperature from -40°C to $+70^{\circ}\text{C}$, relative humidity of less than 95%, non-condensing, mounted in a cabinet or in a terminal box without excessive vibration
- AVR parameters set using software EasyReg Advance supplied with the product or via communication interfaces
- Conformity to standards
 - EMC: IEC 61000-6-2, IEC 61000-6-4 and IEC 61010-1
 - Humidity: IEC 60068-1 and test in accordance with IEC 60068-2-14
 - Dry heat: IEC 60068-2-2
 - Damp heat: IEC 60028-2-30
 - Cold: IEC 60068-2-1

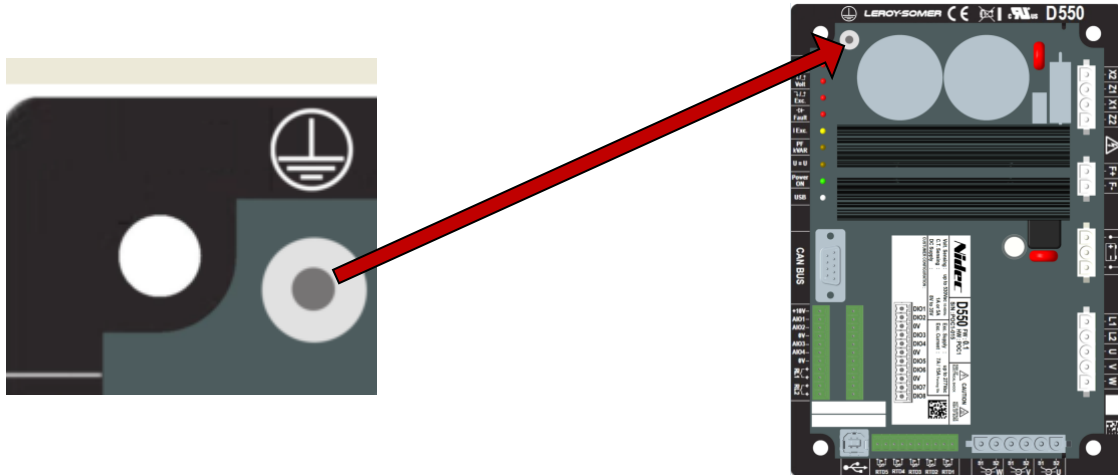


Same footprint as Leroy-Somer D510C

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1.6. Safety devices and general warning symbols

For the user's own safety, the D550 must be connected to an approved earth using the earth terminal shown below. The tooling for this connection is not included with the D550. A tightening torque of 2.5Nm +/- 0.5Nm must be applied to the screw.



Note: All 0V of electronic boards are connected to the earth.

It is essential to comply with the power connection diagrams recommended in this manual.

The D550 includes devices which, in the event of problems, can de-energize or over excite the generator. The generator itself can also become jammed for mechanical reasons. Finally, voltage fluctuations or power cuts may also cause the unit to stop.

The D550 is designed to be integrated in an installation or electrical machine and can under no circumstances be considered of the safety device. It is therefore the responsibility of the machine manufacturer, the designer of the installation or the user to take all necessary precautions to ensure that the system complies with current standards, and to provide any devices required to ensure the safety of the equipment and personnel (especially direct contact with connectors when the AVR is running).

LEROY-SOMER declines all responsibility in the event of the above recommendations not being observed.

The various interventions described in this manual are accompanied by recommendations or symbols to alert the user to potential risks of accidents. It is vital that you understand and comply with the various warning symbols below.

- Throughout the manual, this symbol warns against consequences which may arise from inappropriate use of the AVR, since electrical risks may lead to material or physical damage as well as constituting a fire hazard.



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- This symbol warns of electrical danger to personnel:



1.7. General information

The D550 AVR may contain unprotected live parts, as well as hot surfaces, during operation. Unjustified removal of protection devices, incorrect use, faulty installation or inappropriate operation could represent a serious risk to personnel and equipment.

For further information, consult the documentation.

All work relating to transportation, installation, commissioning and maintenance must be performed by experienced, qualified personnel (see IEC 364, CENELEC HD 384 or DIN VDE 0100, as well as national specifications for installation and accident prevention).

In these basic safety instructions, qualified personnel means persons competent to install, mount, commission and operate the product and possessing the relevant qualifications.

1.8. Use

D550 voltage regulators are components designed for integration in installations or electrical machines.

When integrated in a machine, commissioning must not take place until it has been verified that the machine complies with directive 2006/42/EC (Machinery Directive). It is also necessary to comply with standard EN 60204, which stipulates in particular that electrical actuators (which include voltage regulators) cannot be considered as circuit-breaking devices and certainly not as isolating switches.

Commissioning can take place only if the requirements of the Electromagnetic Compatibility Directive (EMC 2014/30/EU) are met.

The voltage regulators meet the requirements of the Low Voltage Directive 2014/35/EU. The harmonized standards of the DIN VDE 0160 series in connection with standard VDE 0660, part 500 and EN 60146/VDE 0558 are also applicable.

The technical characteristics and instructions concerning the connection conditions specified on the nameplate and in the documentation provided must be observed without fail.

1.9. Transportation and storage

All instructions concerning transportation, storage and correct handling must be observed.

The climatic conditions specified in this manual must be observed.

1.10. Installation

The installation and cooling of equipment must comply with the specifications in the documentation supplied with the product.

The D550 must be protected against excessive stress. In particular, there must be no damage to parts and/or modification of the clearance between components during transportation and handling. Avoid touching the electronic components and any live parts.

The D550 contains parts which are sensitive to electrostatic stress and may be easily damaged if handled incorrectly. Electrical components must not be exposed to mechanical damage or destruction (risks to health!).

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1.11. Electrical connection

When work is performed on D550s which are powered up, national accident prevention specifications must be respected.

The electrical installation must comply with the relevant specifications (for example conductor cross-sections, protection via fused circuit-breaker, or/and connection of protective conductor). More detailed information is given in this manual.

Instructions for an installation which meets the requirements for electromagnetic compatibility, such as screening, earthing, presence of filters and correct insertion of cables and conductors, are also given in this manual. These instructions must be followed in all cases, even if the AVR carries the CE mark. Adherence to the limits given in the EMC legislation is the responsibility of the manufacturer of the installation or the machine.

For EU application: Instrument transformers shall provide basic insulation according to the requirements of IEC 61869-1, "Instrument transformers – Part 1: General requirements" and IEC 61869-2, "Additional requirements for current transformers"

For US application: Instrument transformers shall provide basic insulation according to the requirements of IEEE C57.13, "Requirements for Instrument Transformers," and IEEE C57.13.2, "Conformance Test Procedure for Instrument Transformers."

1.12. Operation

Installations incorporating D550s must be fitted with additional protection and monitoring devices as laid down in the current relevant safety regulations: law on technical equipment, accident prevention regulations, etc. Modifications to the D550 parameters using control software are permitted.

Active parts of the device and live power connections must not be touched immediately after the D550 is powered down, as the capacitors may still be charged. In view of this, the warnings fixed to the voltage regulators must be observed.

During operation, all doors and protective covers must be kept closed.

1.13. Service and maintenance

Refer to the manufacturer's documentation.

Our technical support service will be pleased to provide you with any additional information you may require.

This manual is to be given to the end user.

1.14. Protection of components

The AVR auxiliary power supply, which sources the product's internal power supplies, is essential for AVR operation. It should therefore be connected permanently and should be protected by 1 A slow-blow fuses.

Similarly, both the AC and DC AVR power supplies, which are used to create the field current, should be protected by fast-blow fuses or circuit-breakers.

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2. Mounting and connection instructions

2.1. Layout of the space housing the AVR

- Dimensions (excluding connectors)
 - Height: 175 mm (6.89")
 - Width: 115 mm (4.53")
 - Depth: 58 mm (2.27")
- Weight: 850 g

The product has to be placed with enough space around the heat sink in order to have sufficient cooling.

Ventilation, cooling or even heating system may be needed to keep the AVR within the environmental limits described earlier.

NOTE: If you wish to integrate components which do not comply with the above minimum prerequisites, please consult technical support.

2.2. Warning symbols

See section "Safety devices and general warning symbols."



While the AVR is running, do not unplug any connectors or make any wiring modifications, as this may lead to electric shock and/or destruction of the AVR and/or damage to the alternator.

The same goes for modifications to the main alternator settings, such as: machine data, voltage and current measurement transformer wiring, upper or lower reference limits, starting control, etc. which must be made When the alternator stopped.

The D550 operating ranges must always be adhered to. Changing the settings to inappropriate voltages or currents may cause partial or total destruction of the AVR and/or alternator.

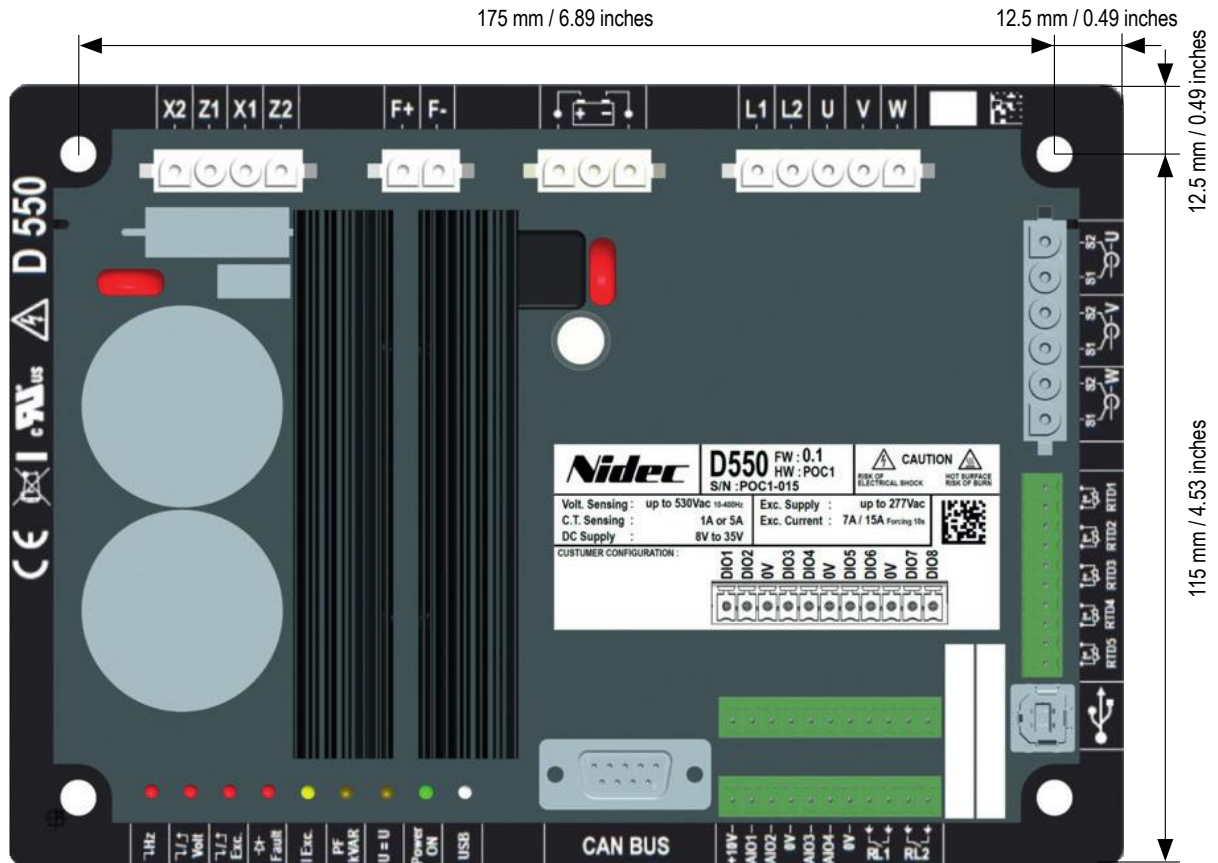
The power input must be protected by a circuit-breaker or fuses in order to avoid irreparable damage to the AVR in the event of short-circuit or voltage surge.

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2.3. Mounting

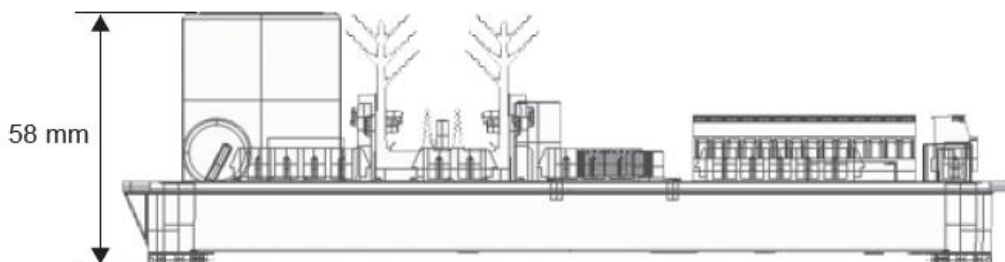
The mounting is done via 4xM5 type screws, the nominal torque must be 2.5Nm.

Top View



Same footprint as Leroy-Somer D510C

Side View



2.4. Connections

The D550 must be connected to the various measurement, power and control signals to be able to perform its regulation functions:

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- Alternator voltage measurement⁵:

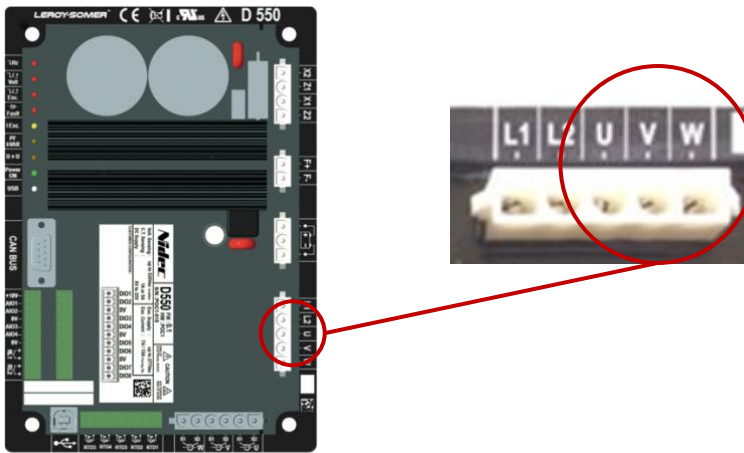


Figure 1: voltage sensing connection

Voltage transformers are mandatory if the alternator voltage measurement is higher than 480 VAC rms phase-to-phase (686 VAC rms maximum for 10 seconds).

Connection	Electrical schematic
Phase/Phase	
3-Phase	

NOTE: The alternator voltage measurement connection must match the alternator current measurement transformer mounting phase(s). If there is only one current transformer, it should be mounted on phase U or V. If this wiring is not complied with, the resulting power and power factor calculations will be incorrect. It also depends on the direction of rotation.

NOTE 2: If necessary, see the appendix for examples of vector permutations.

⁵ The connector intermediate contacts are not connected.

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For greater accuracy, there are 2 possible measurement ranges:

Measurement range	
Low range	110 VAC RMS Max
High range	530 VAV RMS Max

- Grid voltage measurement⁶:

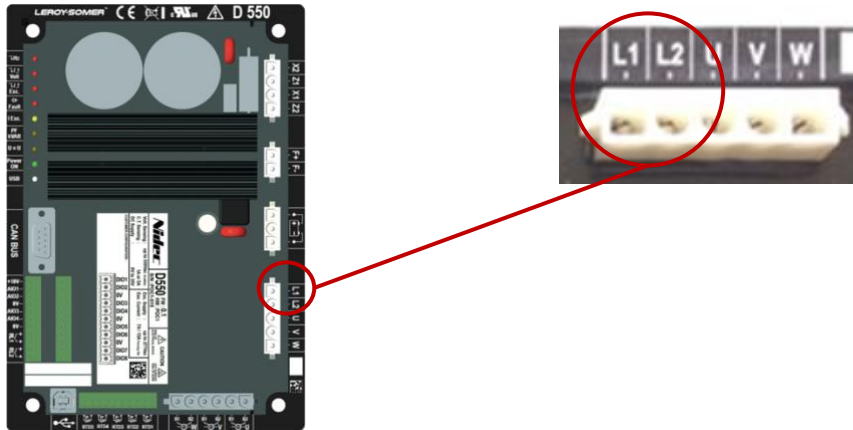
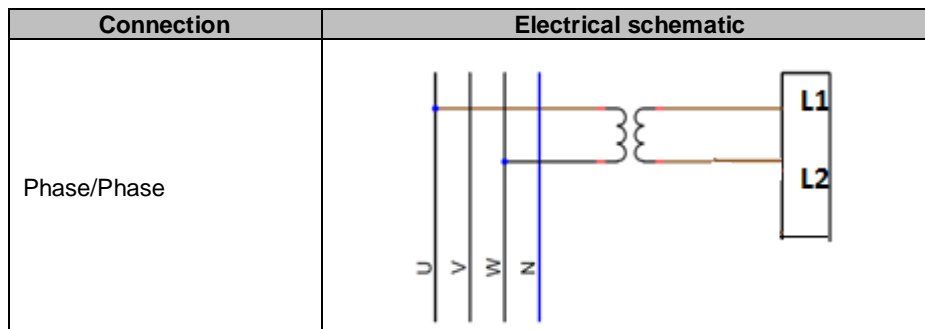


Figure 2: voltage sensing connection

Voltage transformers are mandatory if the alternator voltage measurement is higher than 480VAC rms phase-to-phase (686VAC rms maximum for 10 seconds).



⁶ The connector intermediate contacts are not connected.

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- Temperature measurement inputs

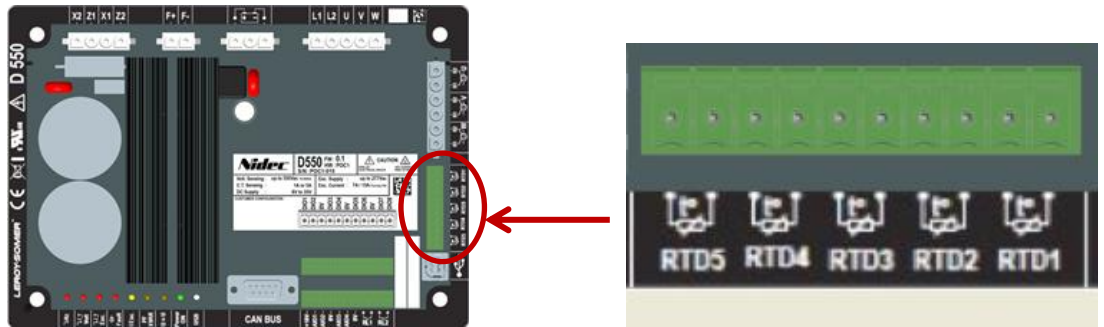


Figure 3: Temperature sensor connections

2-wire Pt100 and CTP temperature sensors can be connected:

Connection	Electrical schematic
Without compensation	

The measurement range for these temperature sensor inputs is between -50°C and 250°C. For each connected sensor, two thresholds can be defined: the alarm threshold and the trip threshold.

CAUTION: The PT100 inputs are non-isolated and referenced to the product the ground.

- Inputs/outputs and Relay:
 - Configurable Analog inputs and Outputs
 - Configurable Digital inputs and Outputs
 - 2 relays

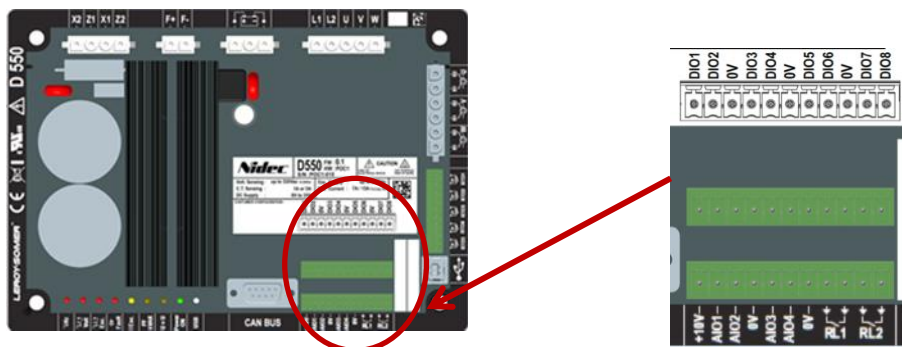
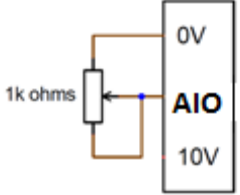
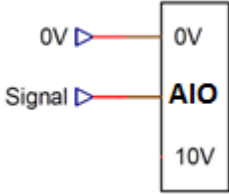


Figure 4: Inputs/outputs connection

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- **Analog Inputs:**

Each analog input can be configured with several modes:

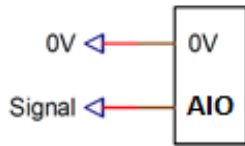
Connection	Electrical schematic
Potentiometer	
4-20 mA +/-10 V 0/+10 V	

Each input is defined by a destination parameter and its signal type (potentiometer, 4-20 mA, ± 10 V, 0/10 V) and by its minimum and maximum limits. The 10 V is only present on the terminal block to create a voltage reference or to use potentiometers with a value > 1 k ohms configured in 0-10 V mode.

CAUTION: The analog inputs are non-isolated. The 0 V is referenced to the product earth.

- **Analog outputs:**

Each analog output can be configured with several modes:

Connection	Electrical schematic
4-20 mA +/-10 V 0/+10 V	

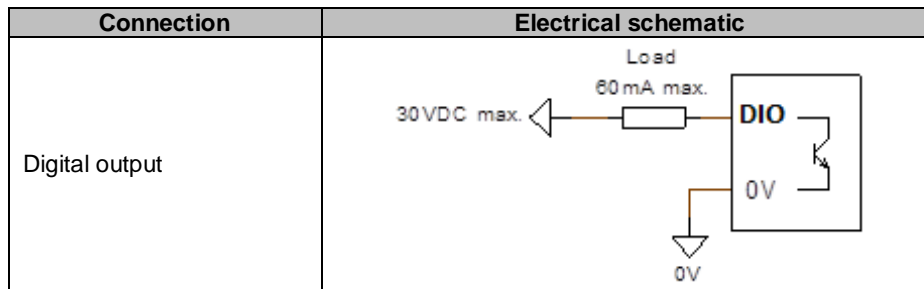
Each output is defined by a source parameter and its signal type (4-20 mA, ± 10 V, 0/10 V) and by its minimum and maximum limits.

CAUTION: The analog outputs are non-isolated. The 0 V is referenced to the product earth.

- **Digital outputs:**

Each digital output is open collector transistor type. They can each withstand a maximum voltage of 24 VDC and 60 mA maximum.

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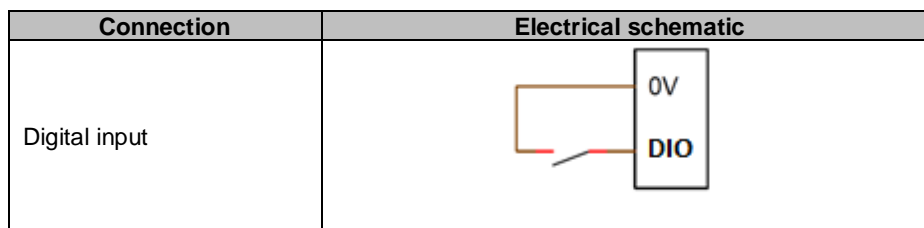


They are configured by a source parameter (alarm, regulation mode in progress, etc.) and their activation mode: normally open (active low) or normally closed (active high).

CAUTION: The digital outputs are non-isolated. The 0 V is referenced to the product earth. Watch out for the risk of reversed polarity on the voltage which could cause the output to break.

- **Digital inputs:**

Each digital input should be controlled by a volt-free contact.



They are configured by a destination parameter (control of a regulation mode, starting, etc.) and their activation mode: normally open (active low) or normally closed (active high).

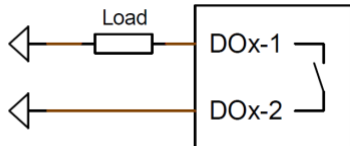
CAUTION: The digital inputs are non-isolated. The 0 V is referenced to the product earth.

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- Relay outputs:

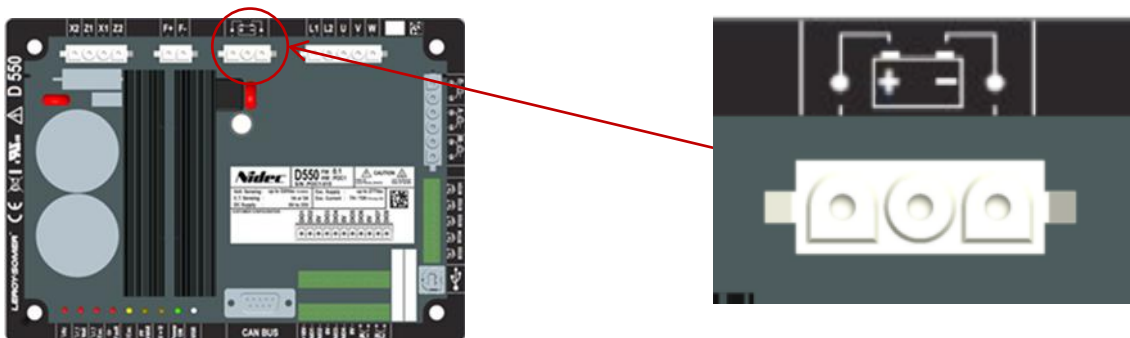
The relay outputs are volt-free contacts, isolated from the product earth. They can withstand a maximum voltage of 125 VAC-1 A or 30 VDC-3 A maximum.

The relay switching maximum power is 90 W/1290 VA.

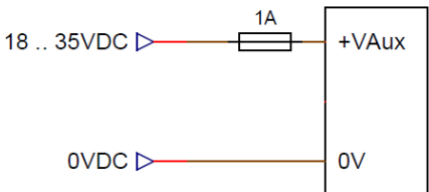
Connection	Electrical schematic
Relay output	 <p>125VAC - 1A max. 30VDC - 3A max.</p>

They are configured by a source parameter (alarm, regulation mode in progress, etc.) and their activation mode: normally open (active low) or normally closed (active high).

- Auxiliary DC voltage power supply:

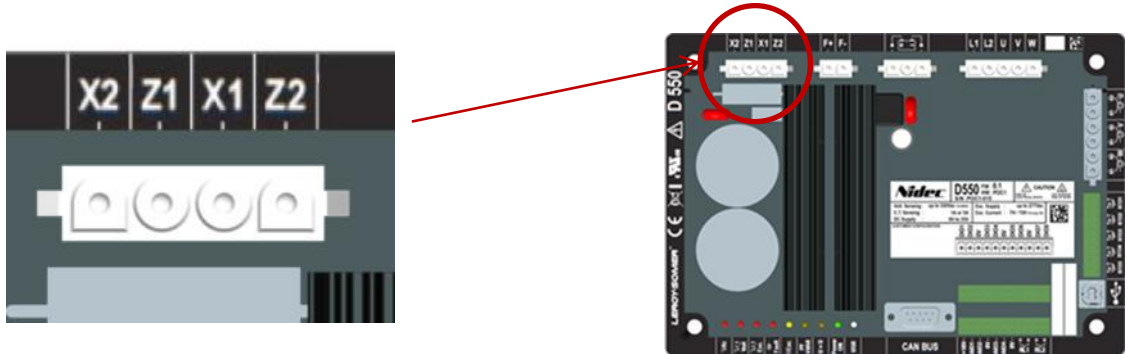


The auxiliary power supply is used to produce the voltages needed for the AVR measurement, control and monitoring circuits. The minimum voltage value is 18 VDC and maximum is 35 VDC.

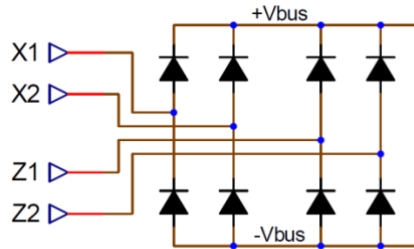
Connection	Electrical schematic
Auxiliary power supply	 <p>18 .. 35VDC</p> <p>0VDC</p>

Digital voltage regulator D550

- AC Power supply:



The D550 power stage can take several different source types: shunt, PMG, AREP, or external power supply. This stage consists of rectifier diodes as in the electrical schematic below.



NOTE: According power supply, a suitable capacitor preloading system will be implemented to avoid damaging them. Total capacitor value: 940 µF. Maximum preloading current: 2 A

The maximum power supply voltage is 300 VAC between each of the connection points X1, X2, Z1, Z2. For US applications, this supply input must be protected by fuses from listed Class CC Fuse (25A max) or listed inverse time circuit breaker (20A max).

Connection	Electrical schematic
AREP	
PMG	
Phase/neutral SHUNT (low voltage)	

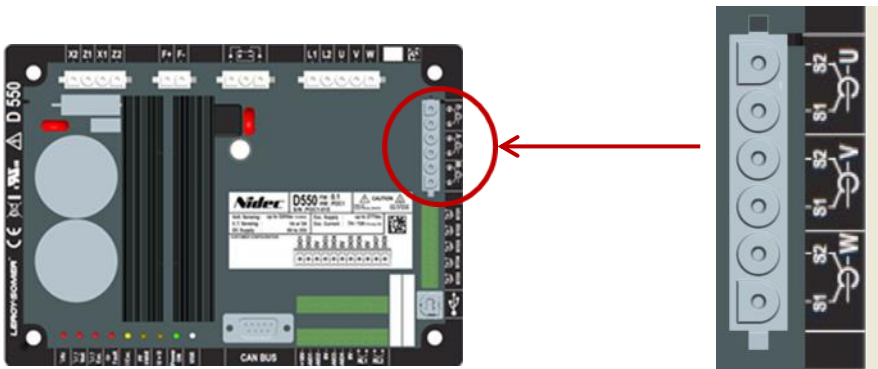
Digital voltage regulator D550

- Exciter Field:



Connection	Electrical schematic
Exciter Field : F+ F-	

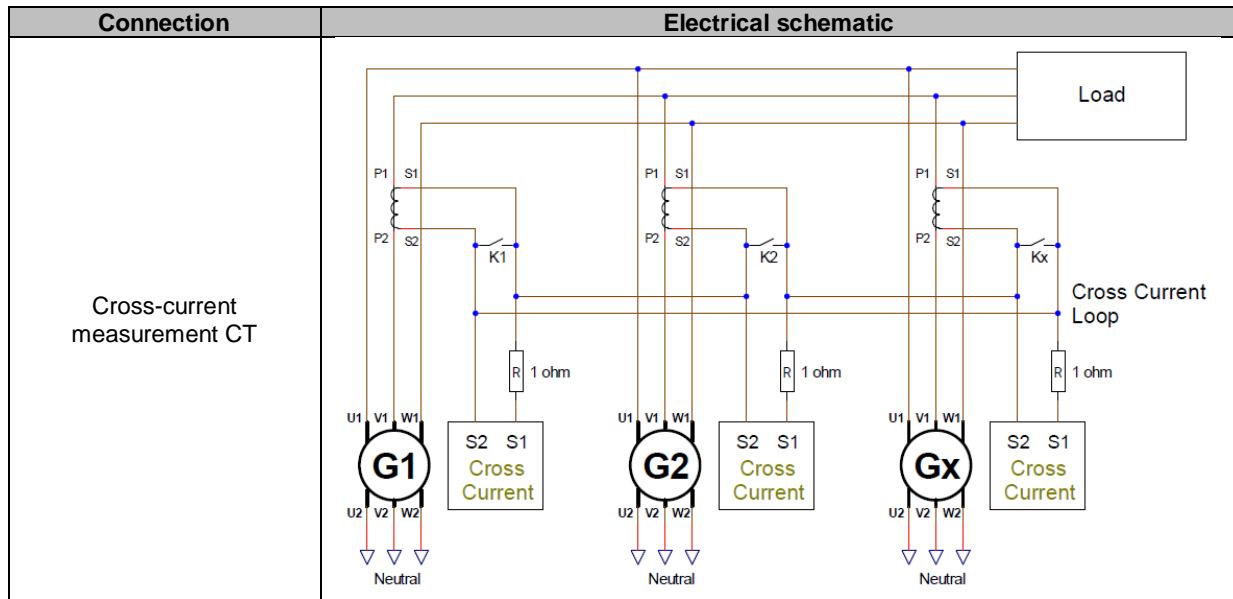
- Alternator current measurement (parallel operation CT):



The alternator current can be measured on 1 phase or 3 phases. If there is only one CT, it should always be mounted on phase V.

Connection	Electrical schematic
With one CT per phase	
With only one CT	

Digital voltage regulator D550



2.5. Wiring precautions

Cables must never exceed 100 m in length.

To ensure respect of standards IEC 61000-6-2, IEC 61000-6-4, IEC 60255-26, shielded cables are imperative in case of a D550 installed outside of the terminal box.

The total ohmic value of the exciter loop (out and back) must not exceed 5% of the exciter resistance, regardless of the cable length.

The total ohmic value of the power system cables must not exceed 5% of the exciter resistance, regardless of the cable length.

For information, the resistance at 20°C in mΩ/m for copper cables is approximately:

Cross-section (mm ²)	Resistance (mΩ/m)
1.5	13.3
2.5	7.98
4	4.95
6	3.3
10	1.91

Calculation example:

For a 10Ω exciter

- Maximum cable resistance = 0.5Ω (2 x 0.25Ω)
- Cross-section as a function of the distance between the AVR and the alternator:

Distance (m)	Cross-section (mm ²)
30	2.5
50	4
75	6
100	10

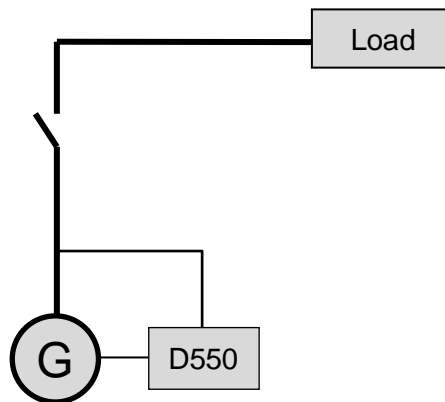
Digital voltage regulator D550

3. Description of operating running modes

3.1. Regulation modes

The various regulation modes to be configured depend on the alternator operation (standalone, parallel between machines, parallel with the grid). Based on these different operating modes, certain regulation modes will need to be enabled (some of which are strongly recommended, or even mandatory, and others optional).⁷ The simplest examples are shown below:

- **Example no. 1: The alternator is only connected to a load (factory, lighting, pump, etc.)**

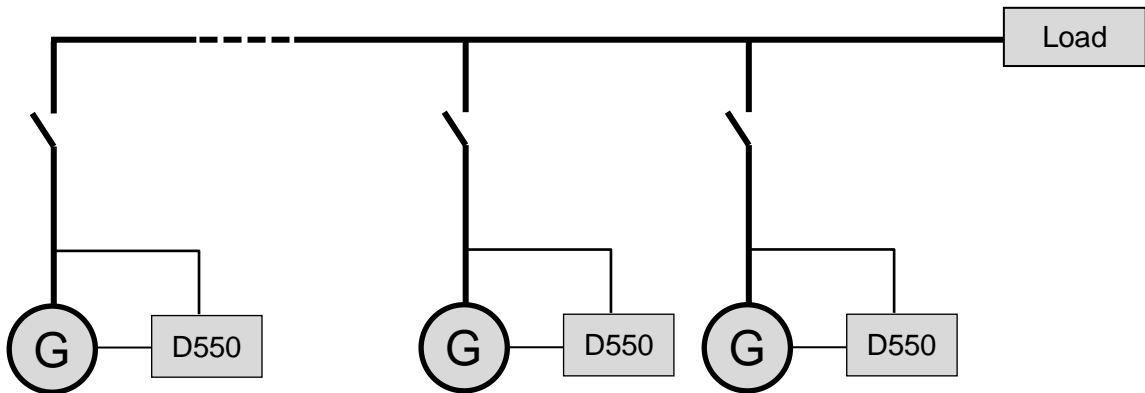


- **The AVR is operating in voltage regulation mode only.**
- There is no need to measure the alternator current. In this example, no power rating can be indicated, and the stator current limit cannot be enabled, nor load compensation nor quadrature droop.
- **Field current regulation is optional.** In this case, the reference must be permanently set so that it matches the existing load and will not risk any damage to the load or the machine (risk of overvoltage or under voltage and risk of over excitation).

⁷ The following schematics are given for information only, they do not take into account any step-up transformers or voltage sensing transformers. The presence of a transformer for measuring the alternator current is however indicated depending on the regulation mode.

Digital voltage regulator D550

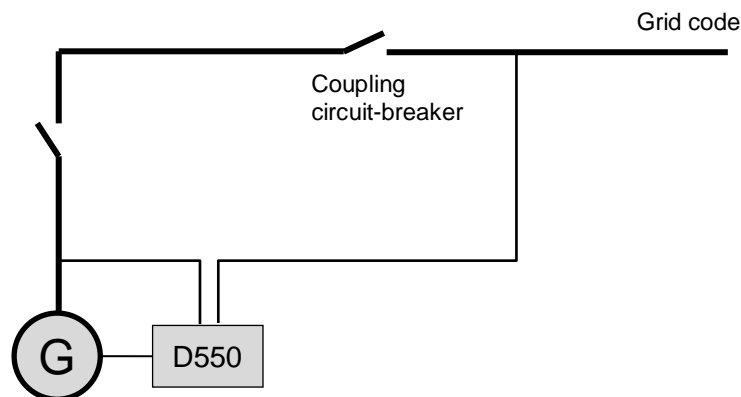
- **Example no. 2: The alternator is connected to other alternators and a load (factory, lighting, pump, etc.).**



- **The AVR is operating in voltage regulation mode only.**
- In order to divide the load reactive power equally between all the machines which are running, select one of the two following modes:
 - Quadrature droop: voltage drop according to the percentage of rated reactive load applied to the machine. In this case, alternator current measurement is mandatory on the alternator current measurement input.
 - Cross current: reactive load sharing from a current loop. In this case, a dedicated CT needs to be connected and a current loop needs to be created on the “Cross current” input.
- **NOTE:** Load compensation cannot be enabled if quadrature droop or cross current is active.
- **Field current regulation is optional.** In this case, the reference must be permanently set so that it matches the existing load and will not risk damaging the load or the machine (risk of overvoltage or under voltage and over excitation).

Digital voltage regulator D550

- **Example no. 3: The alternator is in parallel with the grid⁸**



- **The AVR is operating in voltage regulation mode when the alternator starts.** Quadrature droop or cross-current correction is not needed only if the alternator is connected to the grid.
- **The voltage match circuit is used to adjust the alternator voltage to the grid voltage prior to connection.** This can be done automatically by directly measuring the voltage after the coupling circuit breaker, or by changing the alternator reference.
- **Regulation of the alternator power factor, kVAr, or power factor at one point of the grid must be enabled once the coupling circuit breaker is closed.**
 - Alternator current measurement is essential in all these regulation scenarios.
 - Regulation of the power factor at one point of the grid also requires alternator voltage and current measurements:
 - Measurement of the grid voltage and current at the required point (in this case, the power factor is calculated by the D550).
 - Remote measurement of this power factor through a D550 analog input or by a fieldbus provided that the delay introduced into the measuring circuit loop is not too long (need to match the delay and the speed of the PID).
- **Field current regulation is optional.** In this case, the reference must be permanently set so that it matches the existing load and will not risk damaging the load or the machine.

NOTE: Different regulation types have priority. The order is as follows (highest priority down to lowest priority):

- **Field current**
- **If the grid code connection contactor is closed:**
 - **Grid power factor**
 - **Alternator kVAr**
 - **Alternator power factor**
- **Voltage matching circuit**
- **Voltage**

See appendix 9.2. for AVR regulation .

NOTE: Switching from one regulation mode to another is bumpy.

⁸ A grid is deemed to be any electricity supply whose power rating is at least ten times higher than the alternator rated power.

Digital voltage regulator D550

3.2. Control of modes and information

Switching from one regulation mode to another, transferring operating modes, and monitoring of alarms or trips can be done by several means: inputs and outputs or communication.

Also, see the schematic for the alternator on which your AVR is installed.

3.3. Protection functions

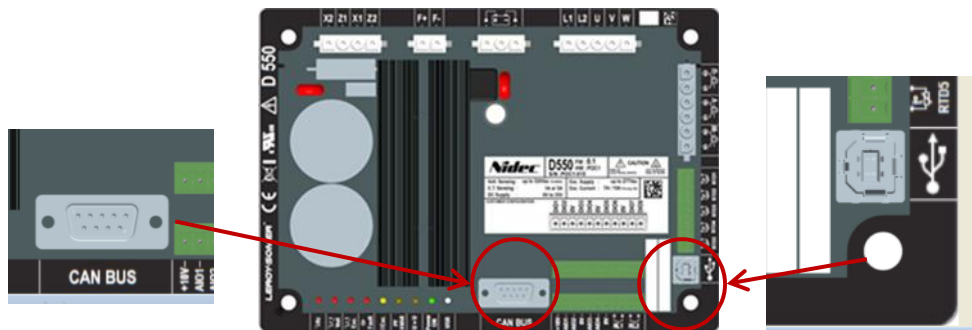
The D550 integrates certain protection devices.

- Under voltage (Code ANSI 27);
- Open diode and diode short-circuited failures
- Overvoltage (Code ANSI 59);
- Under frequency (Code ANSI 81L);
- Over frequency (Code ANSI 81H);
- Active reverse power (Code ANSI 32P);
- Reactive reverse power (Code ANSI 32Q);
- Synchro check (Code ANSI 25).

3.4. Related functions

Other D550 functions can be used to record events, supervise the phase synchronizing the alternator with the grid, or create simple control systems or functions for monitoring references.

4. Communication



4.1. USB

- For "USB" communication, use the dedicated cable with connector USB "A" on computer side, and USB "B" connector on AVR side
- If a D550 is connected, it must appear on the bottom left of the PC software

D 550 CONNECTED

Digital voltage regulator D550

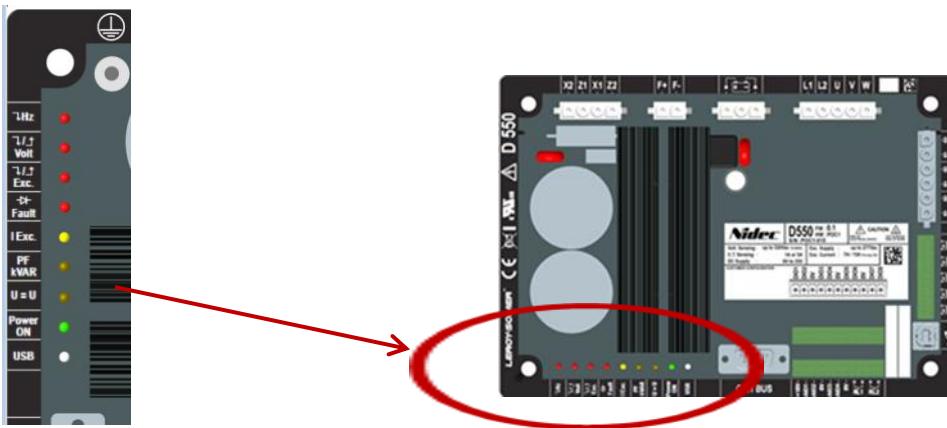
4.2. CAN

CAN configuration

- Activate CAN bus function:** Enable CAN (checked)
- Define D550 address in J1939 protocol:** D550 Address: 144
- Enable J1939 periodic frame generation:** Enable J1939 broadcasts/requests (checked)
- Add a delay between product startup and CAN bus module startup:** Boot delay of CAN module (ms): 0
- Define CAN bus speed (Speed define in Kbits/s):** Data transfer Rate: 1000 Kb (L <= 30m)
- Enable proprietary periodic frame generation:** CAN Enable proprietary broadcast (checked)
- Enable power supply on CAN bus connector (use for EasyLog/EasyLogPS product):** SUB-D9 Power supply enable (checked)

More detail about the frame generate and received by this product are available in D550 CAN bus documentation.

4.3. LED



Silkscreen printing	Color	Signification	
(Under) Hz	RED	Frequency Fault	ON = Underspeed operation
(Under/Over) Volt	RED	Voltage Fault	ON = Under or Over Voltage
(Under/Over) Exc.	RED	Excitation Fault	ON = Rotor overheating BLINK = Rotor Overload or Under Excitation or Minimum excitation
Fault (diode)	RED	Diode Fault	ON = Diode Open or in short circuit
I Exc.	YELLOW	Iexc regulation	ON = Manual excitation mode
PF / kVAR	YELLOW	PF or kVAR Regulation	ON = PV or kVAR regulation mode
U=U	YELLOW	Voltage equalization	ON = Voltage equalization mode
Power ON	GREEN	Power ON	ON = Regulation in operation BLINK = Product Energized
USB	BLUE	USB OK	ON = USB connected

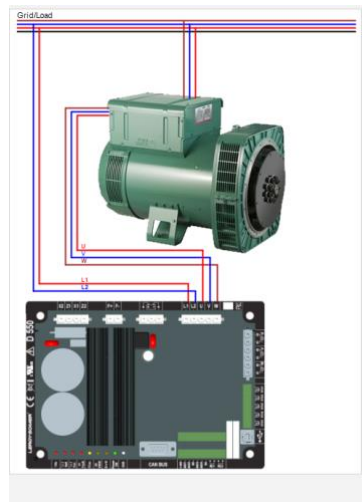
Digital voltage regulator D550

5. Description of the “Configuration” window

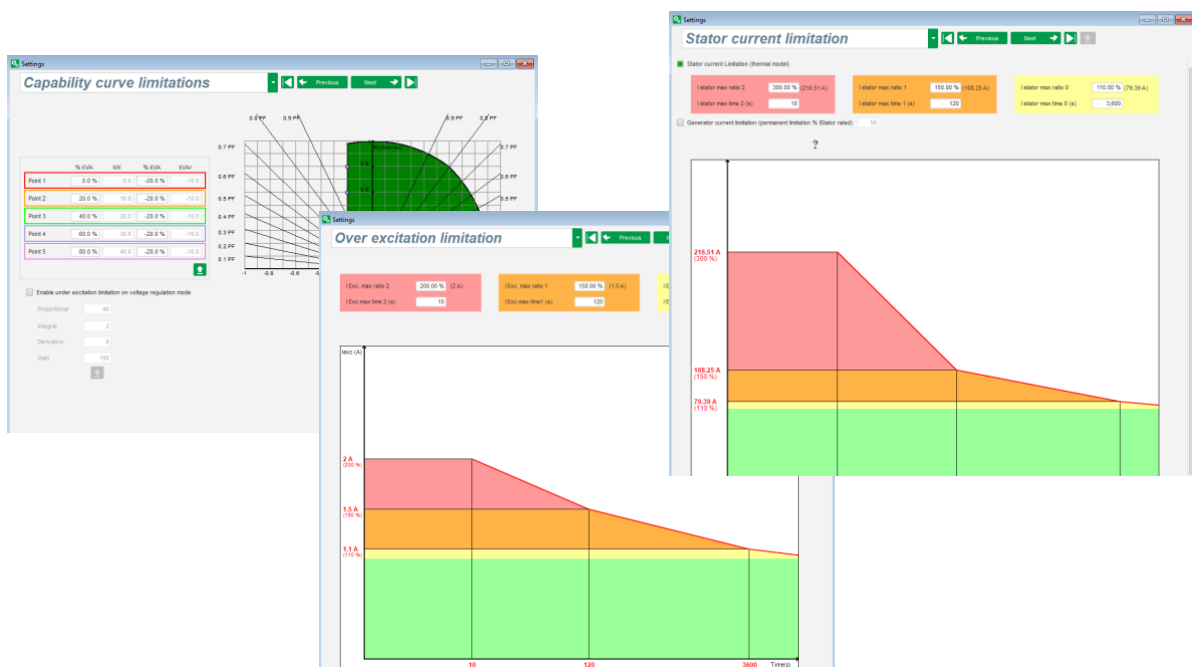
This window consists of several pages for configuring the entire alternator operation. To scroll through the pages use the “Next” or “Previous” buttons or click on the list of pages.

NOTE: More details on these pages are given in the section describing how to create a new configuration.

- **Description of the alternator:** this page contains all the alternator electrical characteristics, and the field excitation data.
- **Wiring:** this page contains all the D550 wiring data for the measurement inputs (alternator voltage, alternator current, grid voltage, grid current). Each time the wiring is modified by selection of a VT or CT, the drawing is changed.



- **Limits:** this page contains the parameter settings for the various machine limits (maximum and minimum field current, stator current limit).



Digital voltage regulator D550

- **Protection devices:** this page contains the parameter settings for the protection devices provided by the D550 (rotating diode failure, overvoltage and under voltage, temperatures, etc.).

One page allows doing some faults groups or summarize information as "fault synthesis".

Fault	Group 1	Group 2	Group 3	Group 4
Overvoltage fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Undervoltage fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Overfrequency fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Underfrequency fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Open diode fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Shorted diode fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reverse active power fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reverse reactive power fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PT100 1 Alarm (Over temp) fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PT100 1 fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PT100 2 Alarm (Over temp) fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PT100 2 fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PT100 3 Alarm (Over temp) fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PT100 3 fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PT100 4 Alarm (Over temp) fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PT100 4 fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PT100 5 Alarm (Over temp) fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PT100 5 fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PTC 1 fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PTC 2 fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PTC 3 fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PTC 4 fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PTC 5 fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Loss of sensing fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Unbalance voltage fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Unbalance current fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Short circuit fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
IGBT fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Motor start fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Power bridge overload fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Battery under voltage fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CAN under voltage fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Digital voltage regulator D550

- **I/O:** this page contains an overview of the digital and analog I/O parameter settings.

Inputs/Outputs

Previous
Next

Digital Inputs

Digital Input	Active	Destination
DI1	Active Low	None
DI2	Active Low	None
DI3	Active Low	None
DI4	Active Low	None
DI5	Active Low	None
DI6	Active Low	None
DI7	Active Low	None
DI8	Active Low	None

Digital Outputs

Source	Active	Digital Output
None	Active Low	DO1
None	Active Low	DO2
None	Active Low	DO3
None	Active Low	DO4
None	Active Low	DO5
None	Active Low	DO6
None	Active Low	DO7
None	Active Low	DO8
None	Active Low	DO9
None	Active Low	DO10

Analog Inputs/Outputs

ID	Configuration AI	Destination	0% value	100% value	Source	Configuration AO	0% value	100% value
AI01	0-10V	None	0.00	0.00	None	None	0	0
AI02	0-10V	None	0.00	0.00	None	None	0	0
AI03	0-10V	None	0.00	0.00	None	None	0	0
AI04	0-10V	None	0.00	0.00	None	None	0	0

- **Curve functions:** this page is used to define the control functions of a parameter as a function of another by plotting 5 points.

Settings

Curves Functions

Previous
Next

X axis: Generator Average Voltage (Ph-Ph)

Y axis: Reactive power setpoint

Reset

Reactive power setpoint=f(Generator Average Voltage (Ph-Ph))

X axis: None

Y axis: None

Reset

None=f(None)

Point 1: 384.00, 1,400.00

Point 2: 389.00, 0.00

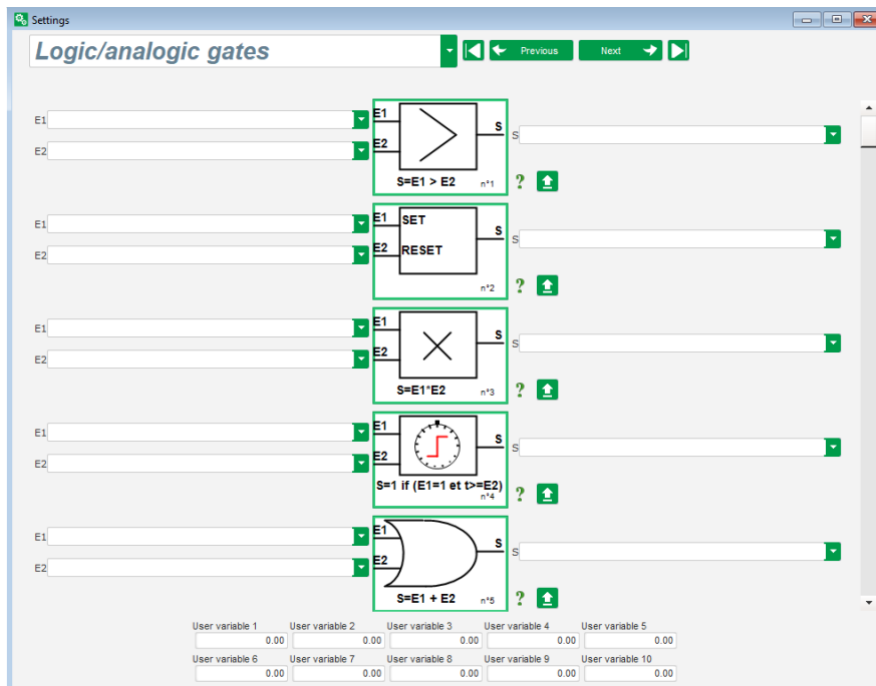
Point 3: 400.00, 0.00

Point 4: 415.00, 0.00

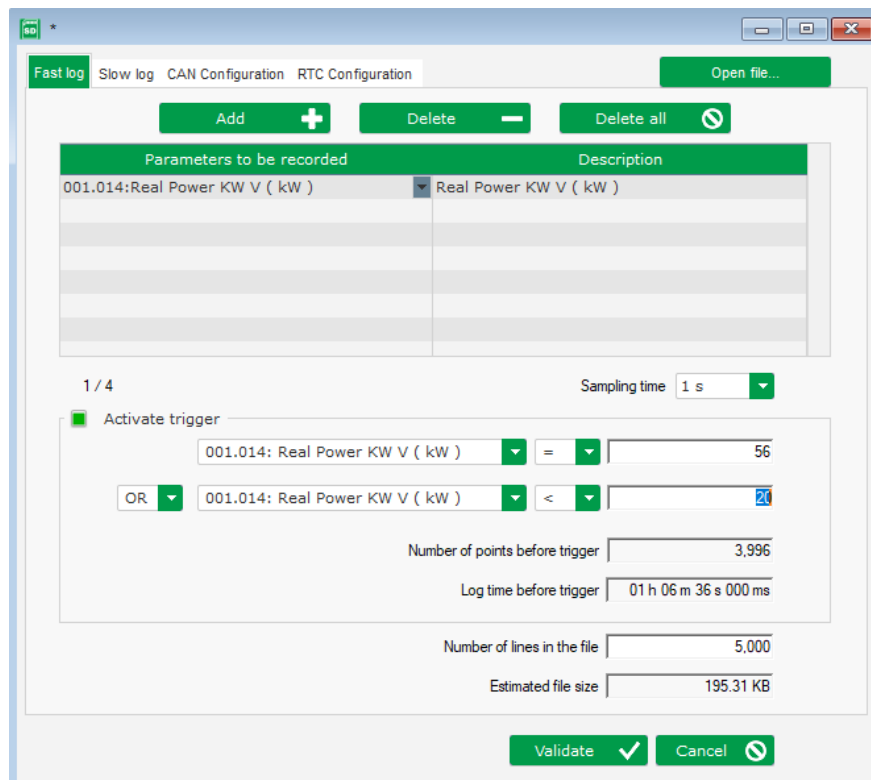
Point 5: 420.00, -1,400.00

Digital voltage regulator D550

- **Logic functions:** this page is used to configure simple logic functions at I/O level and the type of gate.

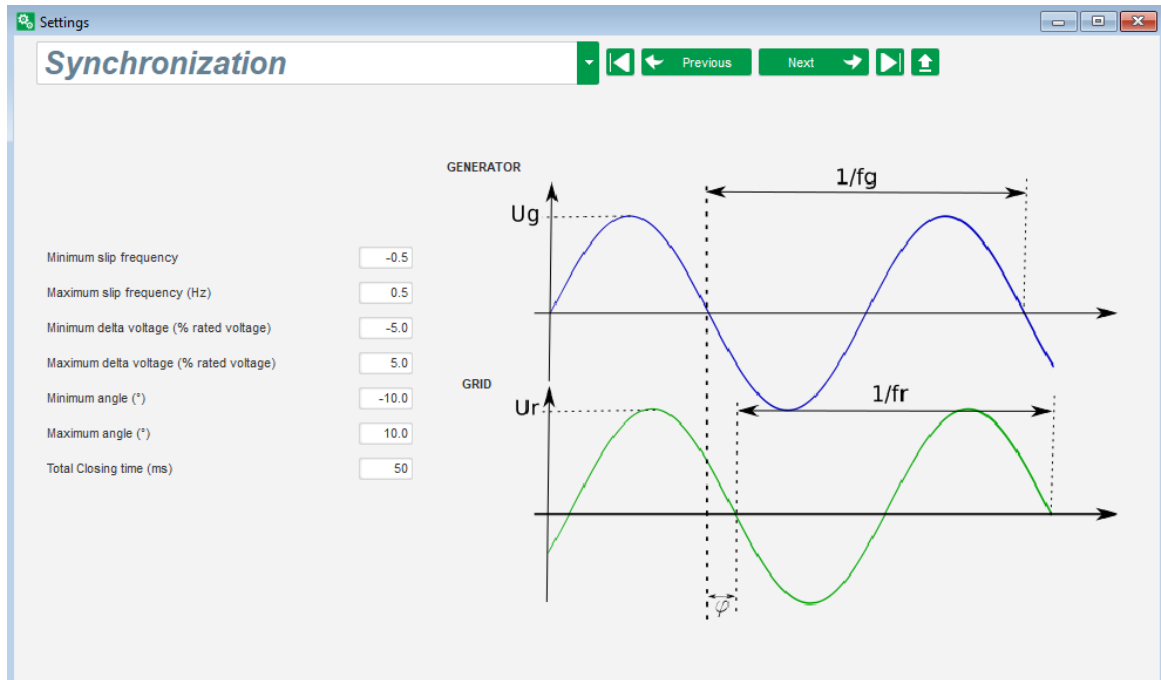


- **Data logger:** this function is available when the optional modules Easy Log or Easy Log PS are connected. This page is accessible from the CAN page. This page is used to define the parameters and triggers for saving in a log file. The various operating modes for these triggers, the parameter trigger values and the sampling speed can be configured.

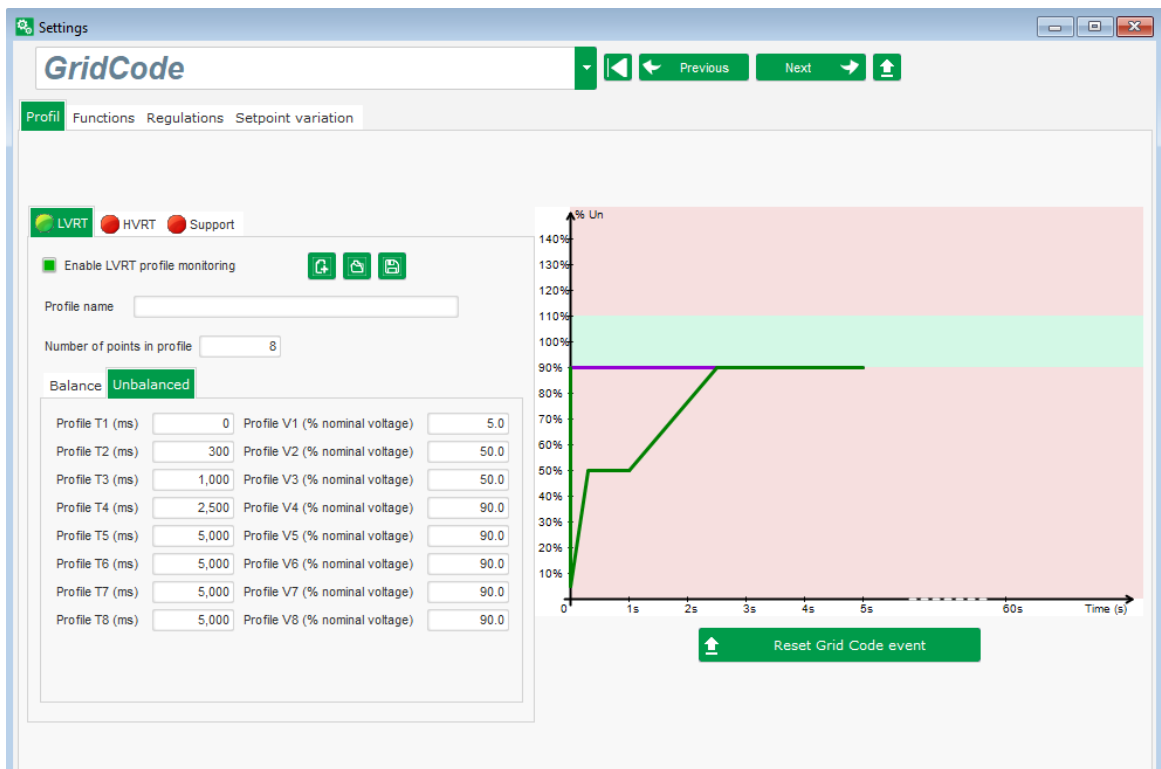


Digital voltage regulator D550

- **Synchronization:** this page is used to define the parameters for synchronization between the alternator and the grid.



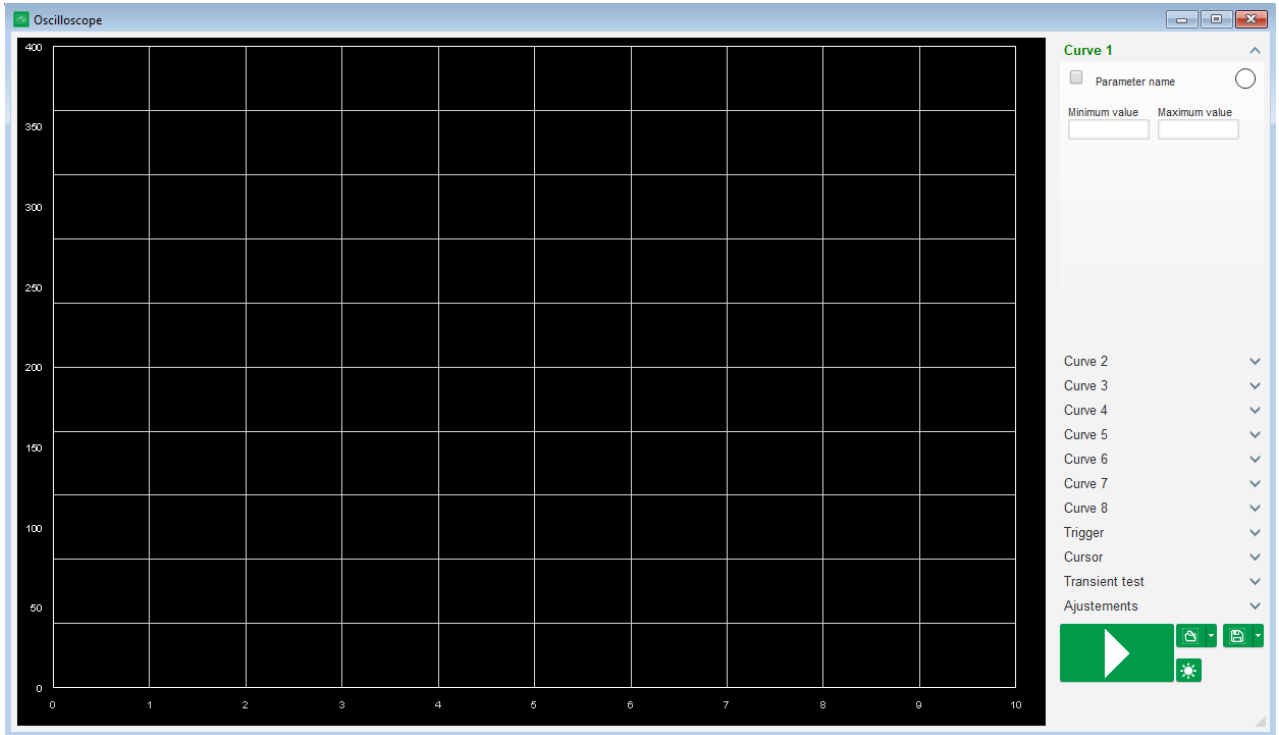
- **Grid code:** This function is available when the optional modules Easy Log or Easy Log PS are connected. This page is used to define the parameters dedicated to grid code protections.



Digital voltage regulator D550

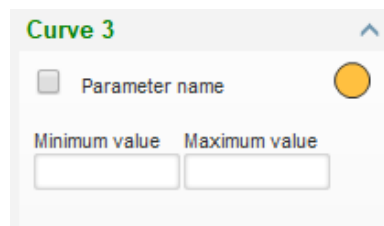
5.1.1. "Oscilloscope" window

This window is used to trace the evolution if the measured values of up to 8 parameters simultaneously.

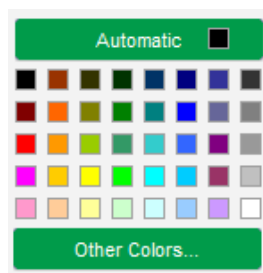


5.1.1.1. Curves

Each curve is described by: its color, its source parameter, its minimum and maximum values. It has its own axis, which is the same color as the curve.



- **To change the color:**
 - Click on the colored disk on the right of the curve name, and a predefined color palette will open.



- Click on the new curve color from those available.

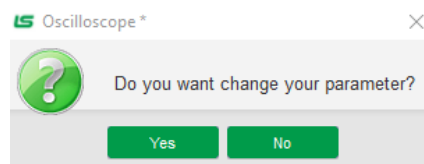
Digital voltage regulator D550

- The color selection window is then automatically closed, and the disk then takes on its selected color.
- Should you wish to configure a color not available in the color palette, click on the “Other colors...” button. The palette is then transformed. Move the black cross to the selected color or fill in the text boxes (each value between 0 and 255) to define the RGB color values. Then click “OK”.

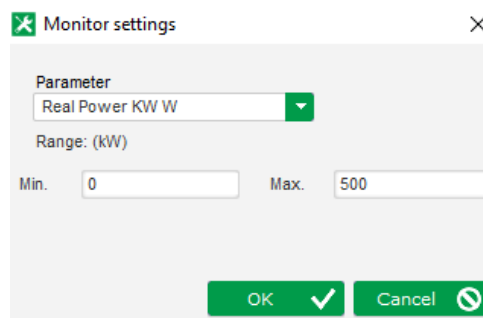


NB: When you no longer wish to change the color, just click outside the palette. It will be closed automatically.

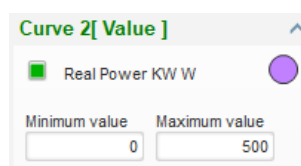
- **Select a parameter to plot**
 - Click on the tick box.
 - If the box was already selected, a confirmation message appears. By clicking on, “Yes”, a window opens with the list of parameters.



- If the box was not already selected, the window with the list of parameters opens directly.
- Select the parameter you wish to track from the drop-down list. This parameter can be an analog or digital value (regulation mode for example).
- Click “OK” to use the selected parameter, or “Cancel” if you don’t wish to change anything.



- **Refine the plotting range:** change the minimum and maximum values if necessary. These values are taken into account and the trace is re-scaled as soon as one of the boxes is exited or the keypad “Enter” key is pressed.

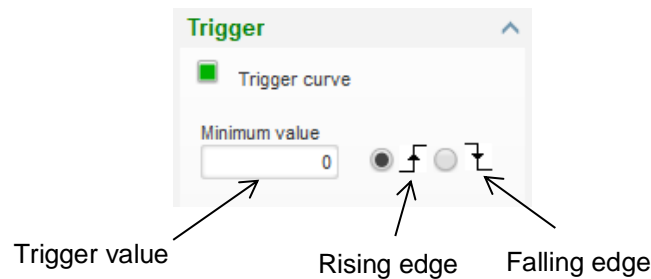


When the monitor is on, the current value appears in square brackets.

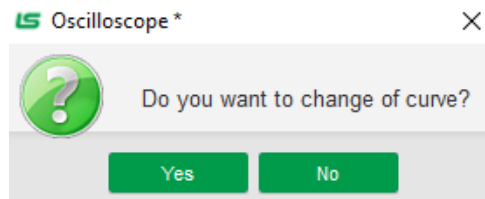
Digital voltage regulator D550

5.1.1.2. Trigger

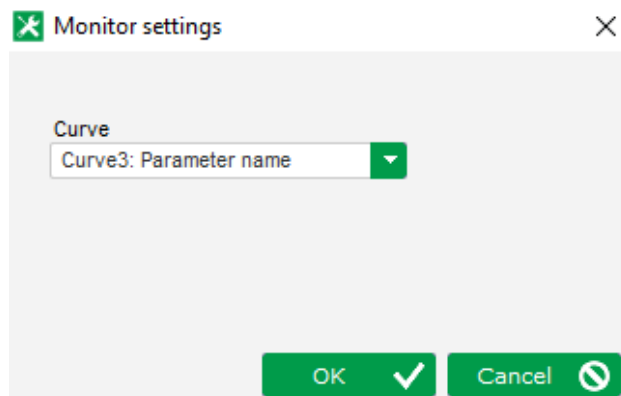
The trigger is used to launch oscilloscope operation once the chosen parameter value exceeds the value entered either upwards (arrow facing up) or downwards (arrow facing down).



- **Select whichever of the curves caused the trip**
 - Click on the tick box.
 - If the box was already selected, a confirmation message appears. By clicking on “Yes”, a window opens with the list of parameters.



- If the box was not already selected, the window with the list of parameters opens directly.
- Select the parameter you wish to track from the drop-down list. This parameter can be an analog or digital value (regulation mode for example).
- Click “OK” to use the selected parameter, or “Cancel” if you don't wish to change anything.



- **Enter the threshold value** to be exceeded
- **Choose the overshoot direction** (up or down)
- **To launch the trigger, click “GO”**
- **To cancel the trigger, deselect the curve**

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5.1.1.3. Cursors

Two cursors are available for browsing the curves. The difference between the two values of Y (curve value) is displayed in the “Delta Y” part for each curve and of “Delta X” (time in seconds) for the time between the two cursors.

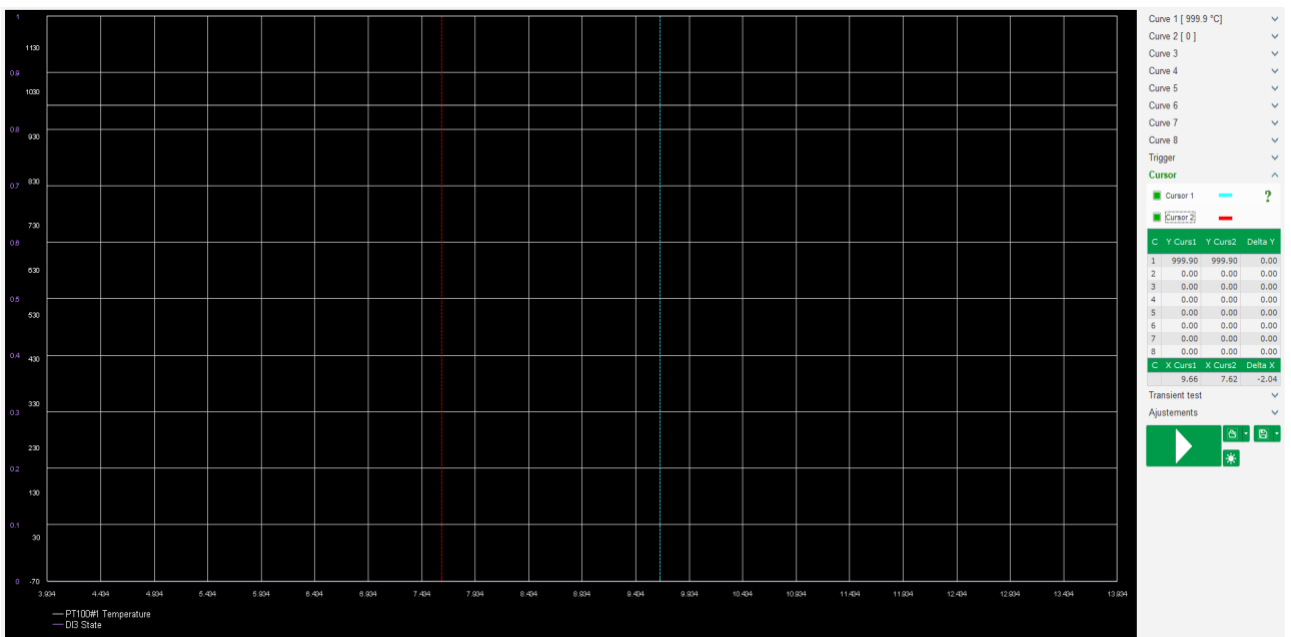
Cursor

Cursor 1 — ?

Cursor 2 —

C	Y Curs1	Y Curs2	Delta Y
1	0.00	0.00	0.00
2	999.90	999.90	0.00
3	0.00	0.00	0.00
4	0.00	0.00	0.00
5	0.00	0.00	0.00
6	0.00	0.00	0.00
7	0.00	0.00	0.00
8	0.00	0.00	0.00

C	X Curs1	X Curs2	Delta X
	2.10	3.87	1.77



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5.1.1.4. Transient test

The transient test is used to check the PID response when changing the reference of current regulation mode.

It is divided into 5 steps maximum, each one can take a different reference value. The PID parameters can be changed directly when the command is sent.

- Click on the “Start a transient test” button. The following window opens:

- To configure your transient test:
 - Select between 1 and 5 steps by clicking on the corresponding tick box
 - For each selected step, define the reference value
 - Define the time between each step
- The PID values can be changed in order to adjust the gains.

Once the parameters have been set, click “OK”.

The test then starts. Steps in progress are shown by the reference turning green.

NOTE:

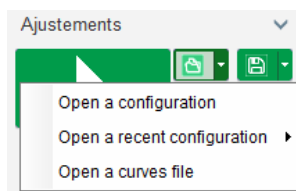
- This test can be stopped at any time by clicking on the “Stop the transient test” button. The display then reverts to the original reference.
- Transient tests cannot be performed if the control reference input is controlled by an analog input, as this control mode has priority.
- During this transient test, the defined minimum and maximum upper and lower limits are not exceeded.

Digital voltage regulator D550

5.1.1.5. Open a curve or an oscilloscope display configuration

The “Open” button (folder icon) at the bottom right of the oscilloscope window can be used to open an oscilloscope display configuration file (curves, minimum and maximum values, etc.).

By clicking on this folder's right-hand arrow, you can choose to also open a file saved in “.csv” format. Caution, only files generated by the software can be opened.



When a curve in “.csv” format is opened, the curve configuration in progress is replaced by the saved curve configuration.

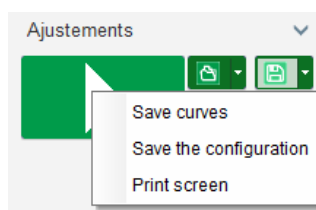
There are two ways to zoom in:

- Click in the oscilloscope plotting area
- Holding the “Ctrl” key and use the mouse wheel: both the X and Y axes are then modified
- Holding the “Alt” key and scroll the mouse wheel: only the X axis is modified, the scales on the Y axis remain the same
- Holding the “Shift” key and scroll the mouse wheel: only the Y axis is modified, the scales on the X axis remain the same

5.1.1.6. Save a curve or an oscilloscope display configuration

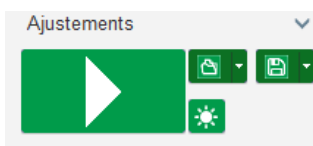
The “Save” button (disk icon) at the bottom right of the oscilloscope window can be used to save an oscilloscope display configuration file (curves, minimum and maximum values, etc.).

By clicking on this folder's right-hand arrow, you can choose to also save the oscilloscope curves as a “.csv” file.



5.1.1.7. Change the plotting area background

The oscilloscope background color can be changed to black by clicking on the "☀️". And for back on the black background, click on the "🌙".

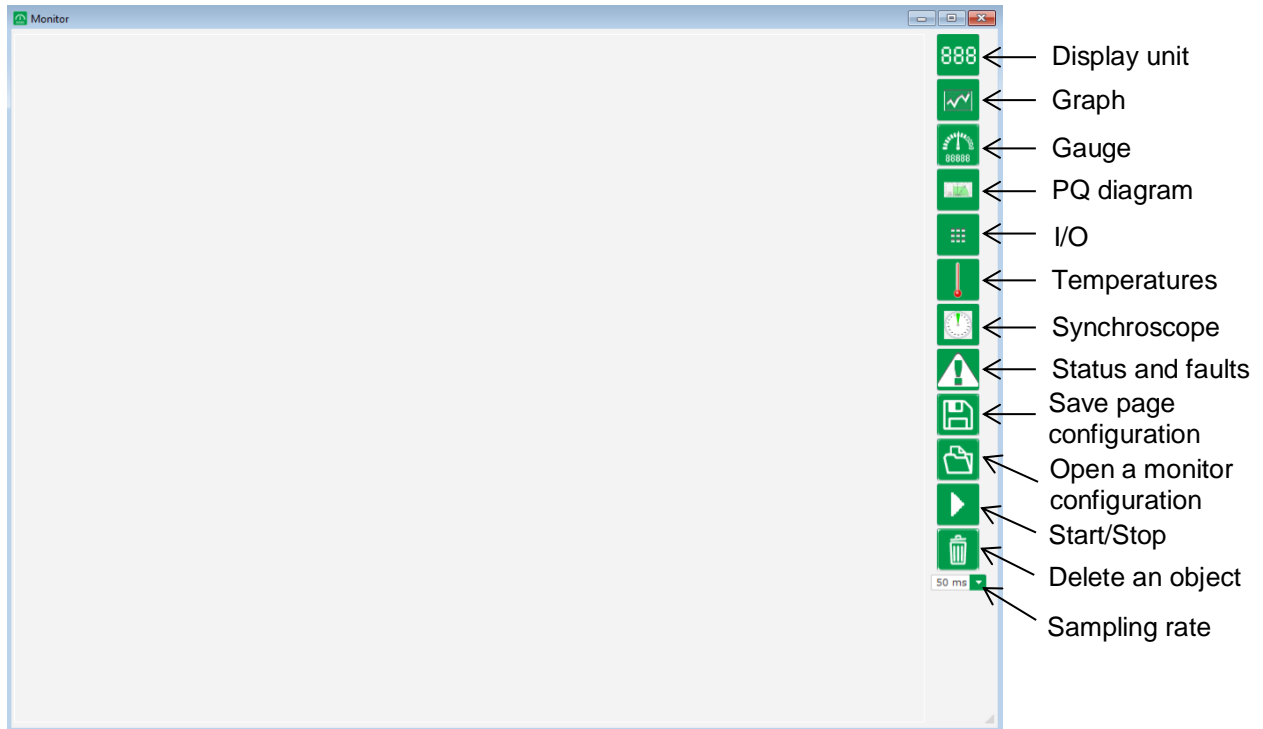


Digital voltage regulator D550

5.1.2. “Monitor” window

This window is used to configure the parameter display in different forms (gauges, graphs, display units), as well as certain AVR-specific components: PQ diagram, I/O, temperatures.

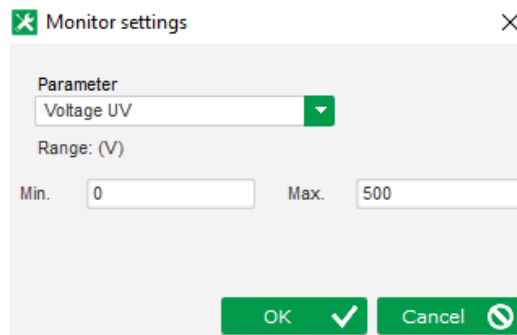
It is fully configurable and the various objects can be added, moved, modified and/or deleted.



5.1.2.1. Display units

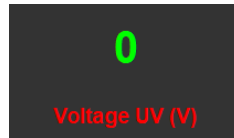
To add a new display unit:

- Click on the “Display” button, a window is opened.
- Select the parameter you wish to track from the drop-down list. This parameter can be an analog or digital value (regulation mode for example).



- Click “OK” to use the selected parameter, or “Cancel” if you don't wish to change anything.
- The display unit is then inserted in the monitor in the first free slot (from left to right and then from top to bottom).

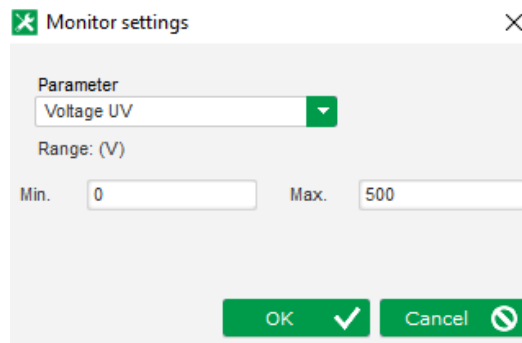
Digital voltage regulator D550



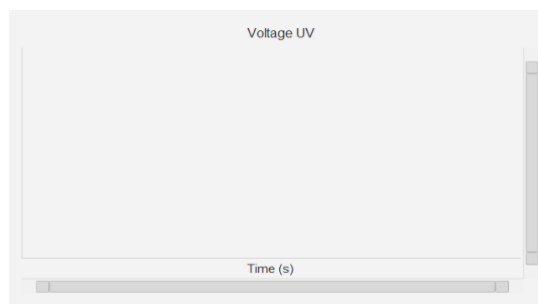
5.1.2.2. Graph

To add a new graph:

- Click on the “Graph” button, a window is opened.
- Select the parameter you wish to track from the drop-down list. This parameter can be an analog or digital value (regulation mode for example).



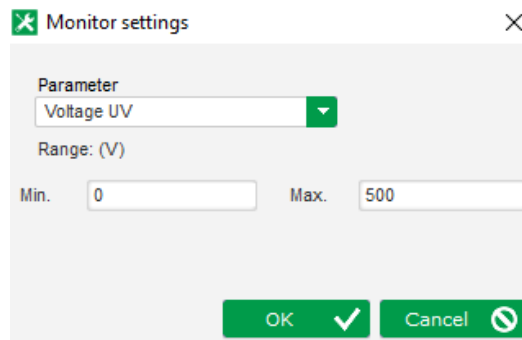
- Click “OK” to use the selected parameter, or “Cancel” if you don't wish to change anything.
- The graph is then inserted in the monitor in the first free slot (from left to right and then from top to bottom).



5.1.2.3. Gauges

To add a new gauge:

- Click on the “Gauge” button, a window is opened.
- Select the parameter you wish to track from the drop-down list. This parameter can be an analog or digital value (regulation mode for example).



- Click “OK” to use the selected parameter, or “Cancel” if you don't wish to change anything.

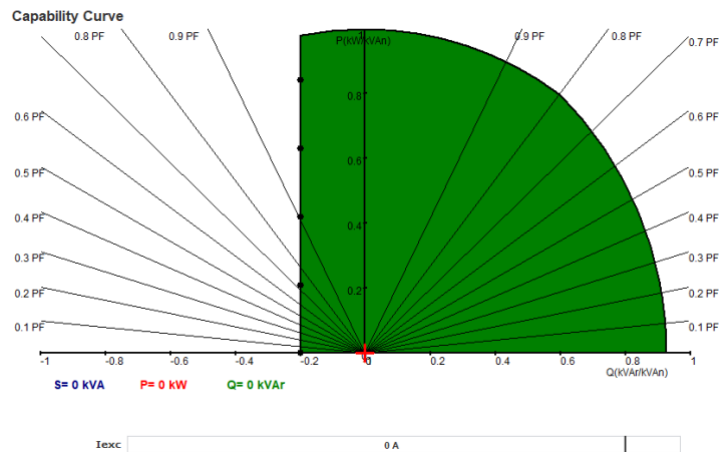
Digital voltage regulator D550

- The gauge is then inserted in the monitor in the first free slot (from left to right and then from top to bottom).



5.1.2.4. Capability curve

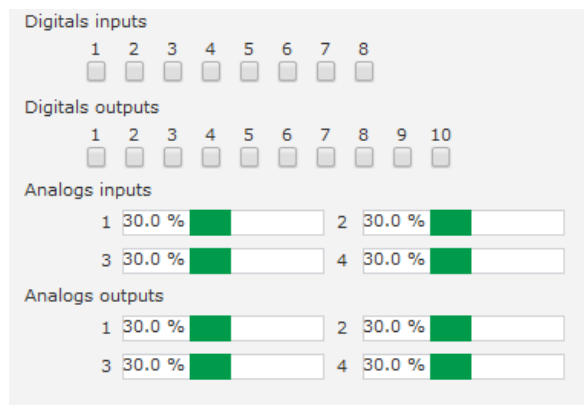
To add a capability curve, click on the corresponding button. The curve is then inserted in the monitor in the first free slot (from left to right and then from top to bottom).



NB: Only one PQ diagram can be displayed.

5.1.2.5. I/O

To add the I/O module, click on the corresponding button. The module is then inserted in the monitor in the first free slot (from left to right and then from top to bottom).

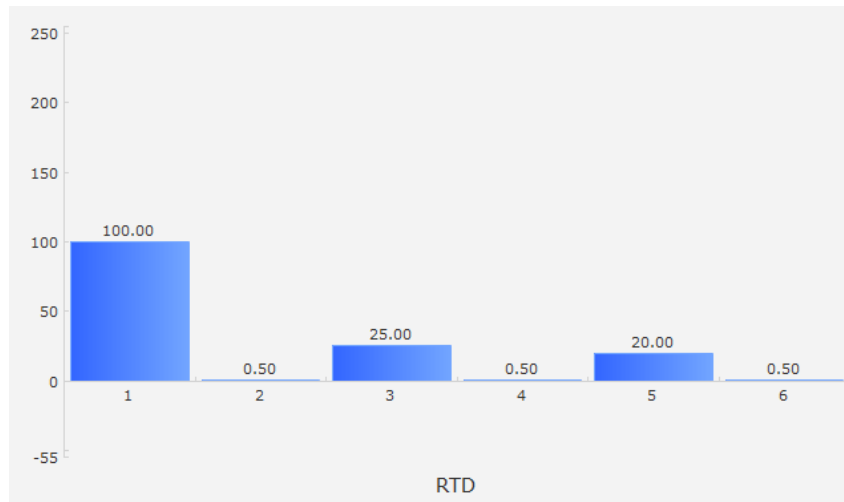


NB: Only one I/O module can be displayed.

Digital voltage regulator D550

5.1.2.6. Temperatures

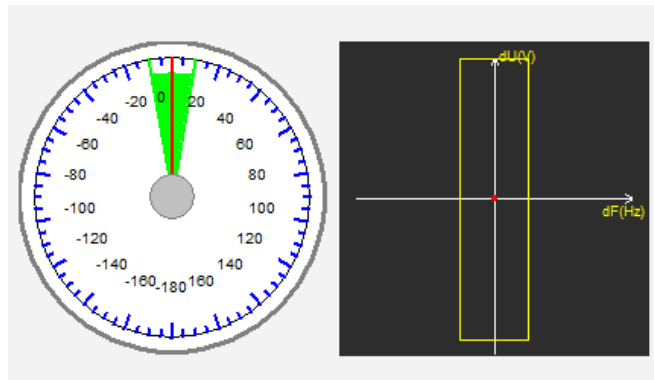
To add the temperature module, click on the corresponding button. The module is then inserted in the monitor in the first free slot (from left to right and then from top to bottom).



NB: Only one temperature module can be displayed.

5.1.2.7. Synchronization

To add the synchronization module, click on the corresponding button. The module is then inserted in the monitor in the first free slot (from left to right and then from top to bottom).



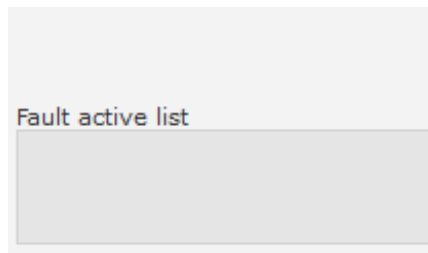
In the left-hand section, the gauge indicates the angle difference between the grid and alternator voltages. In the right-hand section, the graph indicates with a red dot whether the difference in frequency and voltage between the alternator and the grid voltage is in the configured range.

NB: Only one synchronization module can be displayed.

5.1.2.8. AVR status and faults

To add the AVR status and fault module, click on the corresponding button. The module is inserted in the monitor in the first free slot (from left to right and then from top to bottom).

Digital voltage regulator D550

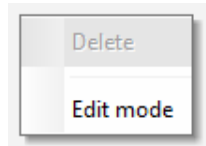


This module contains the D550 operating information, the regulation mode in progress, as well as the list of active faults.

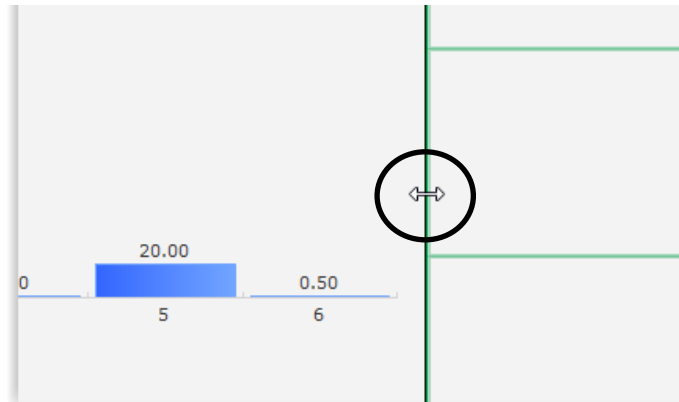
5.1.2.9. Change the size of an object

It is possible to change the size of graphs, gauges and the PQ diagram.

- Switch to Edit mode by right-clicking in the monitor area
- Click on "Edit mode"



- Go to the middle of one side or corner of the diagram: the cursor becomes a double arrow.



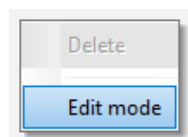
- Click, hold and drag until it is the desired size.

Exit "Edit mode" either by pressing the "Esc" key or by right-clicking in the monitor area and deselecting "Edit mode".

5.1.2.10. Delete an object

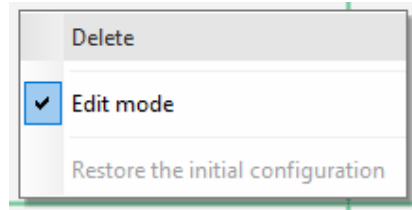
To delete an object (display unit, graph, gauge, etc.):

- Switch to Edit mode by right-clicking in the monitor area
- Click on "Edit mode"



Digital voltage regulator D550

- A grid then appears indicating the position of the various objects
- Right-click on the display unit you wish to delete
- Click “Delete”



Exit “Edit mode” either by pressing the “Esc” key or by right-clicking in the monitor area and deselecting “Edit mode”.

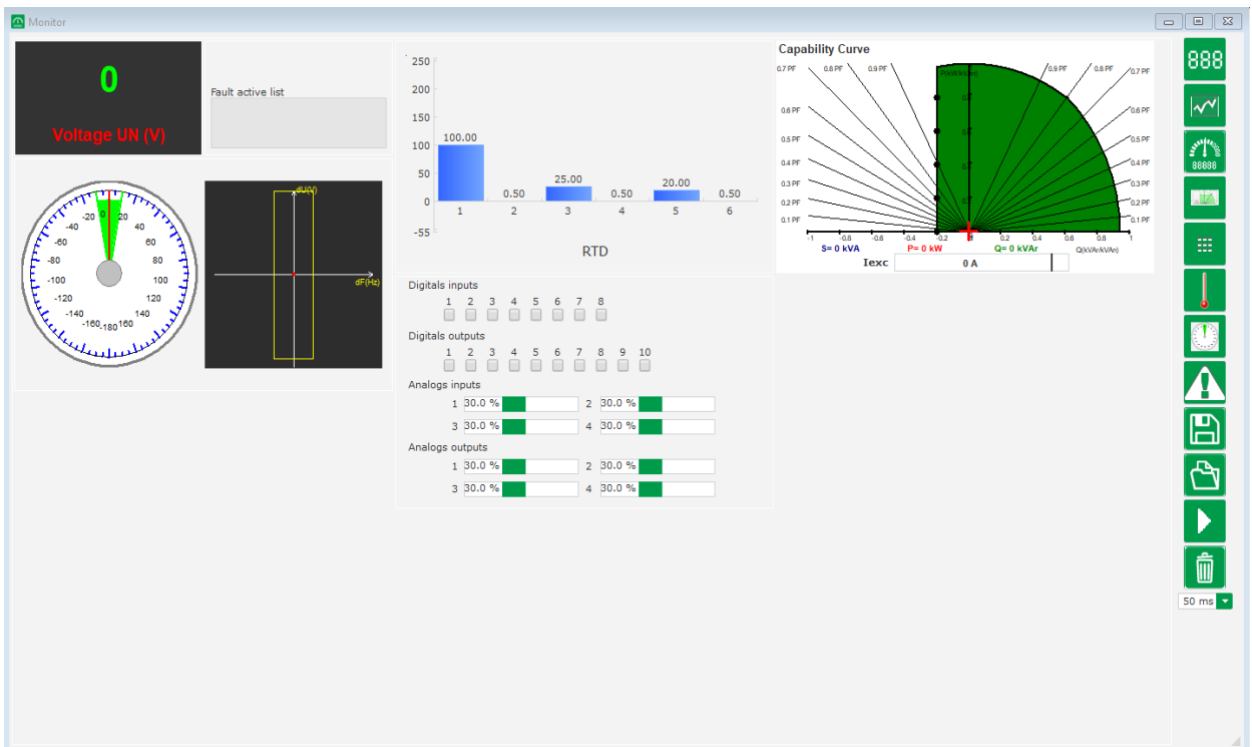
5.1.2.11. Save a monitor configuration

A monitor configuration can be saved in order to be reused later. Click on the “Save” button and a window will be opened. Give the name of the desired monitor configuration, and select “Save”.



5.1.2.12. Open a monitor configuration

Click on the “Open” button to retrieve a monitor configuration and a window will be opened. Select the desired monitor configuration, and select “Open”.



Digital voltage regulator D550

6. Setting instructions

6.1. PC Software

All the D550 settings can be entered using the "EasyReg Advanced" software supplied with the AVR. The parameter-setting pages describe primarily the alternator parameters, regulations, limits, and protection devices.

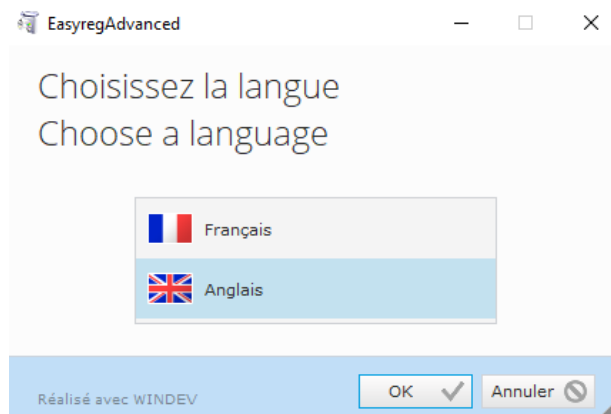
6.1.1. Software Installation

EasyReg Advanced® is the software to be used for configuring the regulator.

Note: This program is only compatible with computers running WINDOWS® versions Windows 7 and Windows 10 operating systems.

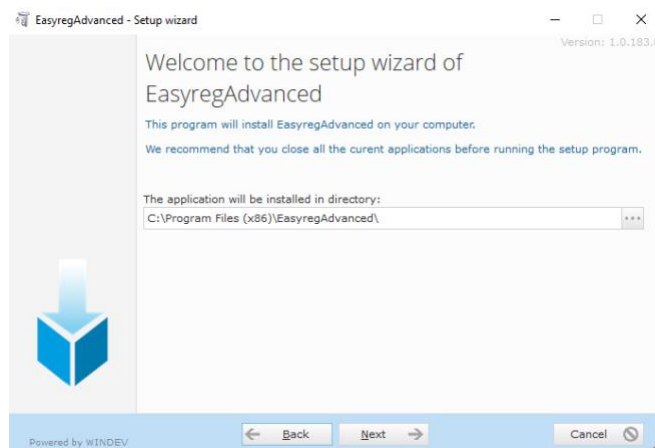
Execute this program, checking first that you have "Administrator" rights for your terminal.

Step 1: Choose the installation language



Step 2: Choose the installation type:

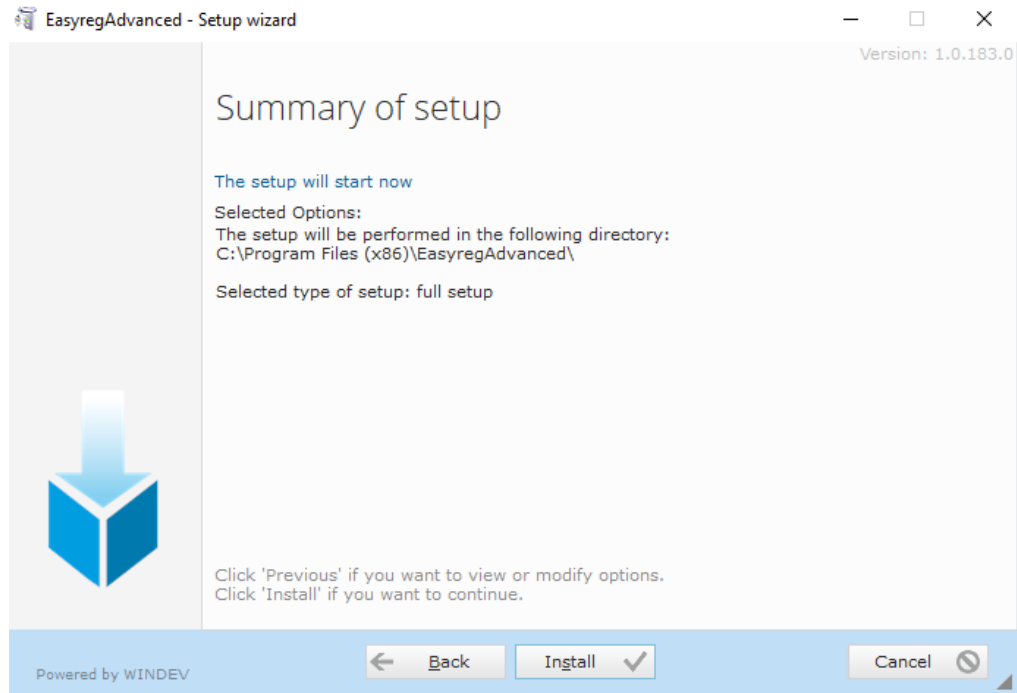
- Quick installation: the files are copied automatically and the software directory is created
- Custom installation:
 - Choose the installation directory



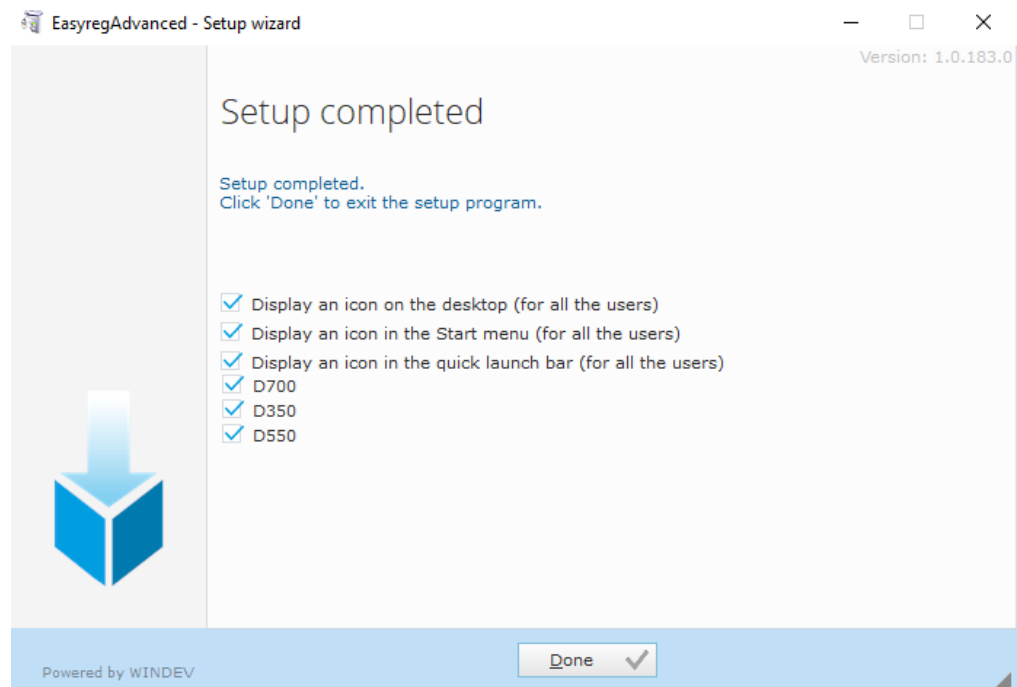
- After selecting the directory, click "Next"

Digital voltage regulator D550

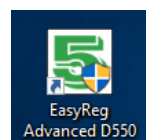
- Confirm by clicking “Install” if the path is as expected



Step 3: Once installation is complete, you can choose to start the software (box ticked by default) and to manage the shortcuts. Click on “Done” to quit the installation page.



A shortcut is created on your desktop:

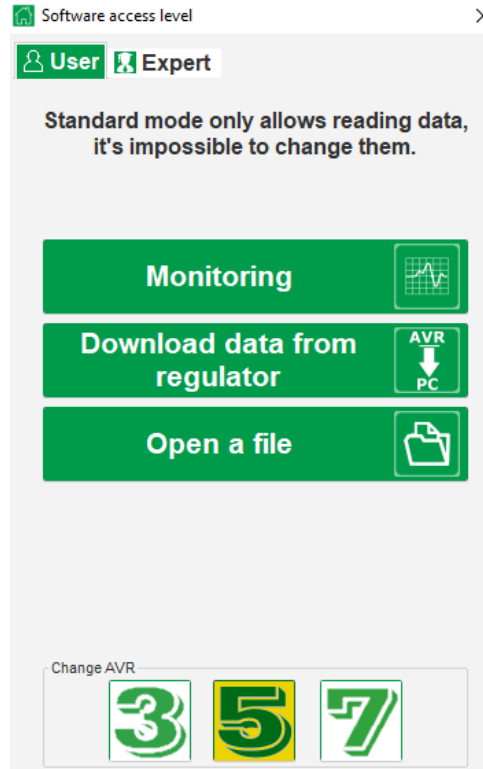


Digital voltage regulator D550

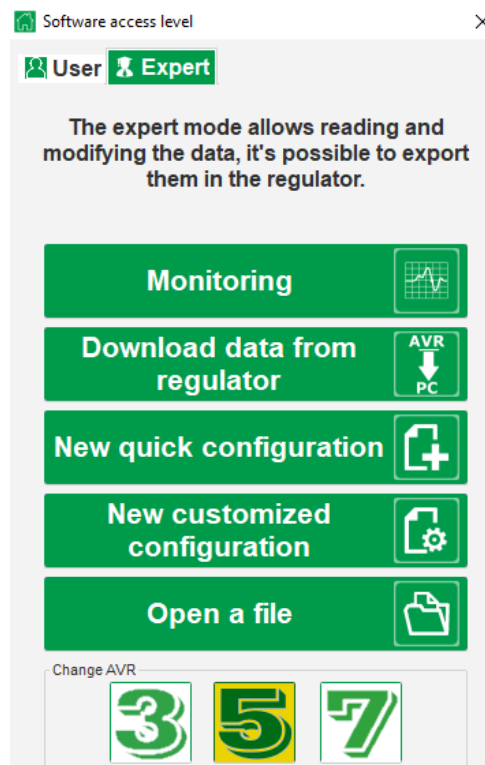
6.1.2. Different access levels of Easyreg Advanced

Two modes are available:

- **User (standard)**: for read only access to the parameters.



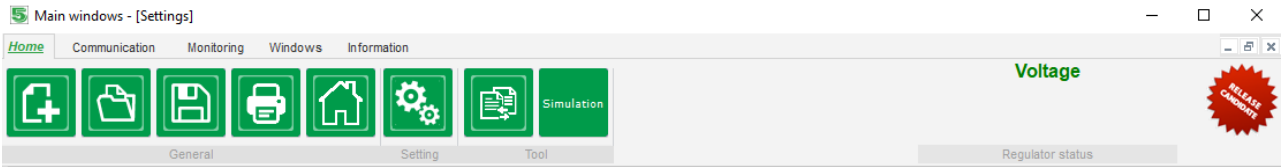
- **Expert**: for full access to the different functions of the regulator in read and write modes.



Digital voltage regulator D550

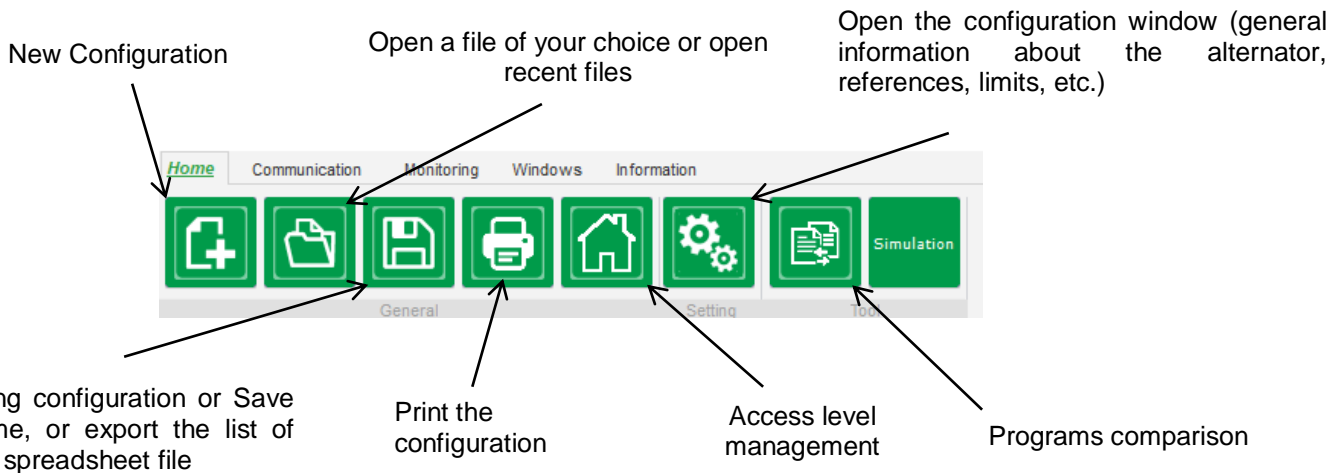
6.1.3. Description of the banner and tabs

The software takes the form of a single window with a general banner and a bottom zone where sub-windows are opened.

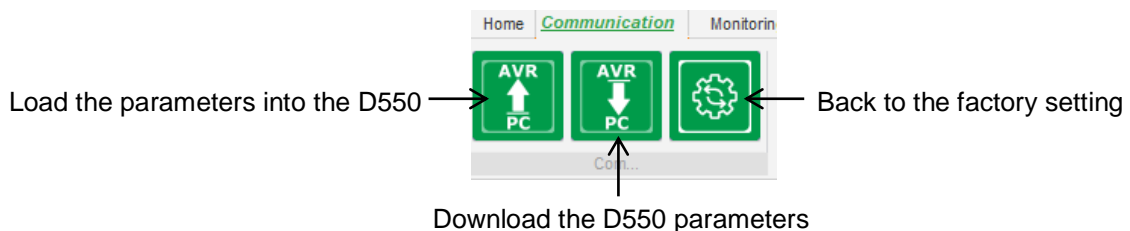


The banner consists of 5 tabs:

- "Home" tab:



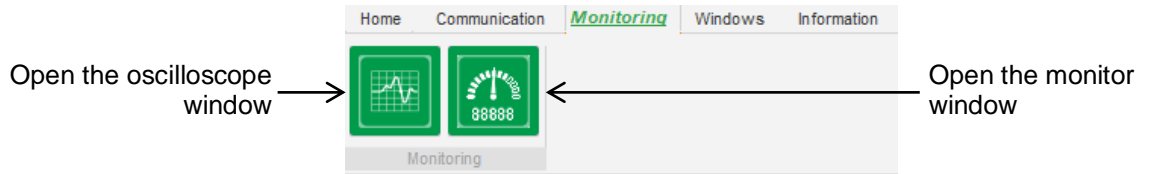
- "Communication" tab:



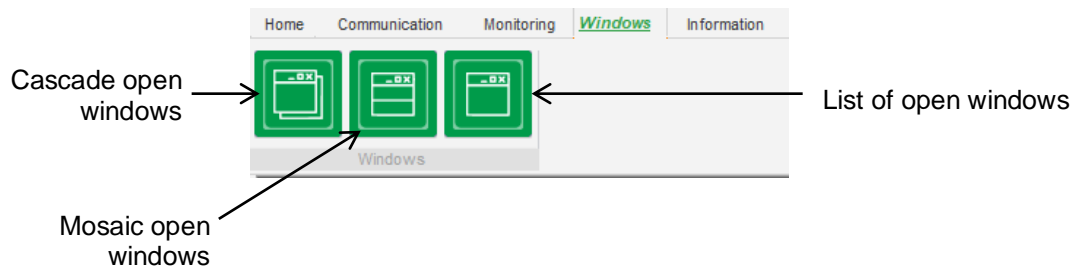
Note: Before parameters are exported the user will be asked to confirm and to check the product status (regulation in progress or not). If regulation is in progress, confirmation is requested again.

Digital voltage regulator D550

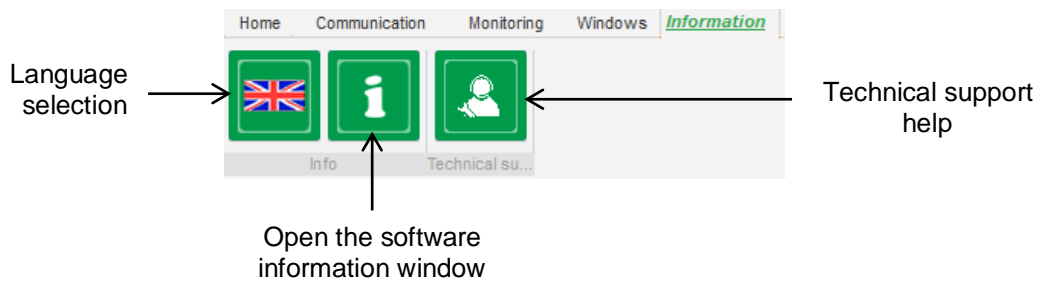
- “Monitoring” group:




- “Windows” group:

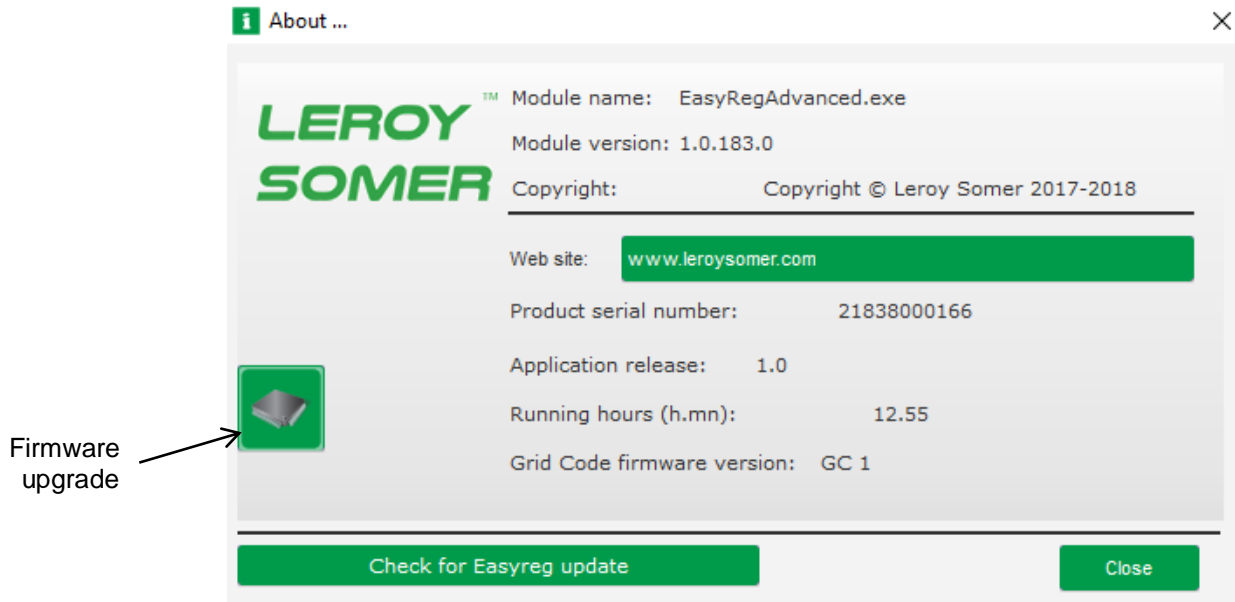


- "Information" group:



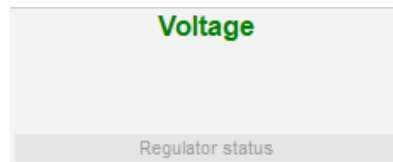
Digital voltage regulator D550

The D550 is equipped with running hours counter accessible in the « About  » window (given in hours and minutes). The firmware update can also be done in this window as shown below.



Note: This counter is updated every 10min and only when the voltage regulation setpoint is reached.

- "Regulator state" window:



6.1.4. Communication with the D550

Communication between the D550 and the PC software. When the communication is established, a confirmation message is displayed on the bottom left of the PC software as shown below.



Digital voltage regulator D550

6.2. Create a new quick configuration

This window consists of several pages for configuring the entire alternator operation. To scroll through the pages, use the “Next” or “Previous” buttons or click on the list of pages.

Note: More details of these pages are given in the sections describing how to create a new customized configuration.

- **Description of the alternator:** this page contains all the alternator electrical characteristics, and the field excitation data.

Generator description
Next

Alternators

LSA 44.3	TAL 0 46	LSA 46.2	LSA 46.3	TAL 0 47
LSA 47.2	TAL 0 49	LSA 49.1	LSA 49.3	LSA 50.2

Length	<input type="text" value="L9"/>
Excitation type	<input type="text" value="AREP"/>
Nominal frequency (Hz)	<input type="text" value="50.0"/>
Number of stator outputs	<input type="text" value="6 wires"/>
Stator connection diagram	<input type="text" value="CONNECTION: D"/>
Rated voltage (V)	<input type="text" value="400"/>
Service T°C/Class T°K	<input type="text" value="H / 125°K"/>

Ⓧ

3 phases

T1 L1(U)

T2 L2(V)

T3 L3(W)

T4 N

T5

T6

Digital voltage regulator D550

- **Wiring:** this page contains all the D550 wiring data for the measurement inputs (alternator voltage and current). Each time the wiring is modified by selecting a VT or CT, the drawing is changed.

Voltage sensing:
Generator and Grid

Current sensing:
Generator and Grid

Temperature sensors

Wiring
Previous Next

Generator PT Generator voltage connection 2: 3 Ph (U-V-W)

Primary (V): Secondary (V):

Bus voltage PT

Primary (V): Secondary (V):

Step up VT

Primary (V): Secondary (V): Phase shift (°):

CT CT connection 0: GEN_UVW

Generator CT	Primary (A) <input type="text" value="1.0"/>	Secondary (A) <input type="text" value="1.0"/>	Phase shift (°) <input type="text" value="0.0"/>
Main CT	Primary (A) <input type="text" value="1.0"/>	Secondary (A) <input type="text" value="1.0"/>	Phase shift (°) <input type="text" value="0.0"/>
Cross current CT	Primary (A) <input type="text" value="1.0"/>	Secondary (A) <input type="text" value="1.0"/>	Phase shift (°) <input type="text" value="0.0"/>

Temperature probe(s)

RTD1 Configuration: <input type="text" value="0: None"/>	RTD4 Configuration: <input type="text" value="0: None"/>
RTD2 Configuration: <input type="text" value="0: None"/>	RTD5 Configuration: <input type="text" value="0: None"/>
RTD3 Configuration: <input type="text" value="0: None"/>	

When the CT only measures part of the generator total current, the help button to access to the advanced level of CT settings as shown above.

Digital voltage regulator D550

- **Regulation modes:** this page contains all the regulation parameter settings: active regulations, references and their adjustments.

Regulation mode

Start-up
Voltage
Volt Matching
Generator Power Factor
kVAr
Grid Power Factor
Field Current

Regulation enabled by
Always enabled

Unom.(V)
400.00

95.0
103.8

Min. setpoint(% Unom.)
Max. setpoint(% Unom.)

Internal setpoint

Voltage reference (V)
400.0

Setpoint from analog input
▼

Setpoint adjustment
▼

Underspeed

Knee (Hz) 48.0 Slope (V/Hz) 1.0

Voltage line drop compensation (%)
 0.0

Reactive droop compensation (%)
 0.0

Cross Current (% Voltage setpoint)
 0.0

Engine help

Soft voltage recovery (s/%) 0.10 ?

Smart L.A.M. (%) L.A.M. (%) ?

TYPICAL UNDERSPEED CURVE

VOLTAGE CURVE

Digital voltage regulator D550

- **PID settings:** this page contains all the values for the PID settings.

PID settings Previous

	Voltage	Field current	PF/kVAR	Grid PF
Proportional	9,000	2,000	100	100
Integral	80	50	30	30
Derivative	1,000	30	200	200
Gain	100	100	100	100

Regulation loop speed
0: 2.5 ms

Negative forcing ?

DC Bus voltage compensation ?

Continue configuration in custom mode

6.2.1. Configurations

6.2.1.1. Definition of the alternator features

Length	L10
Excitation type	PMG
Nominal frequency (Hz)	50.0
Number of stator outputs	12 wires
Stator connection diagram	CONNECTION: D
Rated voltage (V)	400
Service T°C/Class T°K	H / 125°K

- Select the alternator core length
- Define the excitation type (AREP, SHUNT or PMG)
- Select the frequency and the connection diagram. The right-side picture is updated according to the user's selection.
- Selection the rated voltage and the thermal class
- Then click on «Next »

Digital voltage regulator D550

6.2.1.2. Wiring

Wiring

Generator PT Generator voltage connection 2: 3 Ph (U-V-W)

Primary (V): 690 Secondary (V): 400

Bus voltage PT

Step up VT

CT CT connection 1: GEN_U

Generator CT	Primary (A)	Secondary (A)	Phase shift (°)
	100.0	5.0	0.0

Main CT	Primary (A)	Secondary (A)	Phase shift (°)
	1.0	1.0	0.0

Cross current CT	Primary (A)	Secondary (A)	Phase shift (°)
	1.0	1.0	0.0

Temperature probe(s)

When PT is used: Tick the « Alternator PT » box and fill the primary and the secondary of the voltage transformer.

When a CT is used: Tick the « Alternator CT » box and fill the primary and the secondary of the current transformer.

6.2.1.3. Regulation mode selection

Regulation mode

Start-up Voltage Volt Matching Field Current

Start enabled by Always enabled

Soft-start duration (s) 0.0

Start on threshold

Start on Threshold (SoT) Mode Active

Voltage Threshold (V) 0.0

Initial PWM SoT (%) 0.0 ?

Minimum frequency threshold to reset the threshold start (Hz) 6.0

Minimum Vbus voltage threshold to reset the threshold start (V) 20.0

Delay to reset the threshold start (s) 0.0

Soft Start duration: This function can be used to ensure a smooth voltage build up.

Start on threshold: A percentage of PWM is applied until the predefined voltage threshold is reached. This function allows having a linear slope during the buildup by reducing variation.

Digital voltage regulator D550

6.2.1.4. Voltage setting points

Regulation mode

Start-up Voltage Volt Matching Generator Power Factor kVAr Grid Power Factor Field Current

Regulation enabled by: Always enabled

Unom (V): 400.00

Max. setpoint(% Unom.): 105.0

Min. setpoint(% Unom.): 95.0

Internal setpoint

Voltage reference (V): 400.0

Setpoint from analog input

Setpoint adjustment

Underspeed

Knee (Hz): 48.0 Slope (V/Hz): 1.0

Voltage line drop compensation (%): 0.0

Reactive droop compensation (%): 0.0

Cross Current (% Voltage setpoint): 0.0

Engine help

Soft voltage recovery (s/%): 0.10

Smart L.A.M. (%)

L.A.M. (%)

TYPICAL UNDERSPEED CURVE

(V) vs f(Hz)

VOLTAGE CURVE

U(V) vs P(kW)

Voltage setting point range

Voltage Set point from internal or external actions

U/F and Engine help settings

Voltage regulation range: This part is to define the rated voltage and setting range.

Set point adjustment: Allow to select the way to set the voltage: Potentiometer, analog input, internal, step adjustment.

Underspeed: Setting of the U/F slope and Knee position (ex: 48Hz for a rated speed at 50Hz with a slope of 1).

LAM (Load Acceptance Module): Allow to set the different way to set the engine help to reduce the frequency dip according to the load impact.

6.2.1.5. Voltage Matching activation

This setting allows activating or deactivating the voltage equalization between the generator and the grid voltage by a Digital Input or by selection of the regulation driving way.

Regulation mode

Start-up Voltage Volt Matching Generator Power Factor kVAr Grid Power Factor Field Current

Regulation enabled by: None

Digital voltage regulator D550

6.2.1.6. Manual Mode activation

The excitation current is set according to a setting point define manually defined in the configuration which can be an internal or external setting point.

Activate the regulation

Manual Setting point from internal or external actions

Follower mode

Regulation mode
Previous Next

Start-up Voltage Volt Matching Generator Power Factor KVAr Grid Power Factor Field Current

Regulation enabled by None

lexc.Nom (A) 1,00

Max. setpoint(% lexc.Nom.) 100,0

Min. setpoint(% lexc.Nom.) 0,0

Internal setpoint

Field current setpoint (A) 1,00

Follower mode ?

● Setpoint from analog input

● Setpoint adjustment

Voltage regulation range: This part is to define the rated voltage and setting range.

Set point adjustment: Allow to select the way to set the voltage: Potentiometer, analog input, internal, step adjustment.

Follower mode: This function allows to copy the excitation current before the switching in manual mode to reduce the voltage variation.

6.2.1.7. PID Settings

PID setting

Optional PID features

Upload the configuration

PID settings
Previous Next

	Voltage	Field current	PF/KVAr	Grid PF
Proportional	7,000	2,100	10	1
Integral	100	60	10	1
Derivative	500	15	0	0
Gain	100	100	100	100

Regulation loop speed: 0: 2.5 ms

Negative forcing ?

DC Bus voltage compensation ?

AVR PC Upload your configuration

Digital voltage regulator D550

PID: The factory PID is already uploaded but each part can be tune if needed.

Optional PID features:

- Allow to set the PID sampling rate, a setting of 2.5 ms allow by having a standard response. Increase the sampling increase the time response of the PID.
- Negative forcing, allow to reduce the voltage rise particularly in case of unsaturated voltage generator.
- DC BUS compensation: automatic adaptation of the PID according to the excitation DC voltage level.
- Current limitation gain: setting of the excitation current limitation stability.

Click on « **Upload your new configuration** » to upload the configuration into the regulator. In that case, the unfilled parameters will be completed thanks to the Easyreg Advanced database.

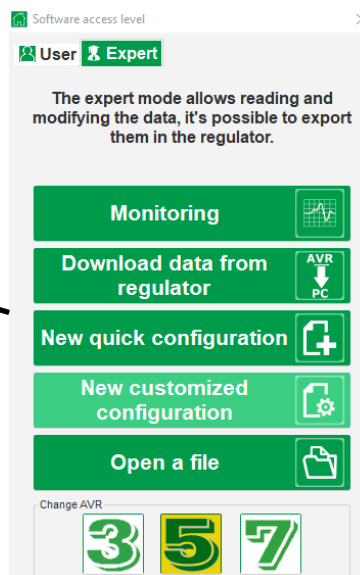
When clicking on « **Continue the configuration in custom mode** », the user will have access to a configuration mode which contains all the parameters menus initialized with the values that were defined on quick configuration mode.

6.3. Create a new configuration: Advanced settings

Click on the “Home” button, which opens the settings window.



CLIC « New customized Configuration »




6.3.1. Description of the alternator

- Describe all the alternator characteristics: voltage (in Volts), apparent power (in kVA), frequency (in Hz), and power factor.
- Fields: rated current, reactive power and active power are calculated automatically.
- Pole ratio for diode fault (exciter poles number divided by generator poles number).

Digital voltage regulator D550

Generator data

Rated voltage (V)	<input type="text" value="400.00"/>
Rated frequency (Hz)	<input type="text" value="50.00"/>
Rated power factor	<input type="text" value="0.80"/>
Rated apperant power (kVA)	<input type="text" value="50.00"/>
Rated nominal power (kW)	<input type="text" value="40.00"/>
Rated reactive power (kVar)	<input type="text" value="30.00"/>
Rated current (A)	<input type="text" value="72.17"/>
Pole ratio between exciter and generator	<input type="text" value="0.0"/> 

- Describe all the field excitation characteristics: exciter field resistance (in ohms), shutdown field current (in Amps), and rated field current (in Amps).

Excitation data

Field inductor resistance (Ohms)	<input type="text" value="0.00"/>
Shutdown field current (A)	<input type="text" value="0.50"/>
Rated field current (A)	<input type="text" value="1.00"/>

- Click on the “Next” button.





6.3.1.1. AVR wiring

This wiring must be typical of the connections between the AVR and the alternator. As your configuration evolves, the wiring diagram in the right of the window is changed: representation of VT and/or CT, number of conductors, etc.

NOTE: By default, the alternator voltage measurement and the grid code voltage measurement are shown.

- Alternator voltage measurement VTs:**
 - If these are present, tick the box. The various parameters can then be set.
 - State the primary and secondary winding voltages (in Volts).
 - State the type of measurement: phase-neutral, phase-phase, 3 phases or 3 phases and neutral using the drop-down menu.

Generator PT Generator voltage connection 2: 3 Ph (U-V-W) 

Primary (V): Secondary (V): 

- Alternator current measurement CTs:**
 - If these are present, tick the box. The various parameters can then be set.
 - State the primary and secondary winding currents (in Amps).
 - Indicate the IT configuration using the drop-down menu.

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CT		CT connection		0: GEN_UVW
Generator CT	Primary (A)	Secondary (A)	Phase shift (°)	
	250.0	1.0	0.0	
Main CT	Primary (A)	Secondary (A)	Phase shift (°)	
	1.0	1.0	0.0	
Cross current CT	Primary (A)	Secondary (A)	Phase shift (°)	
	1.0	1.0	0.0	

NOTE:

- The phase shift value should be set during tests and commissioning. It is used to compensate for the phase difference caused by the CTs and VTs.
- If an isolation CT is present, the secondary parameter value should correspond to the isolation CT secondary.
- **Bus voltage measurement VTs:**
 - If these are present, tick the box. The various parameters can then be set.
 - State the primary and secondary winding voltages (in Volts).

Bus voltage PT	
Primary (V):	Secondary (V):
1	1

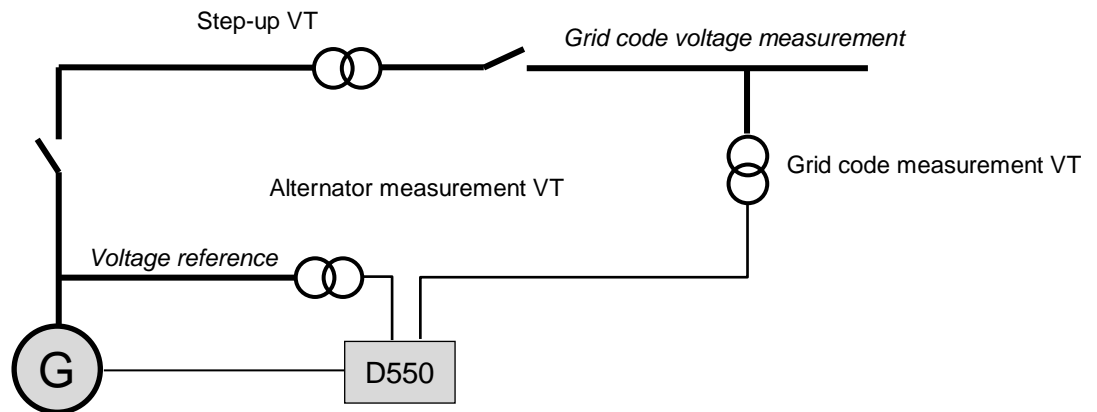
- **Bus current measurement CT: Placed in the V phase**
 - If this is present, choose the 4 mode. The various parameters can then be set.
 - State the primary and secondary winding currents in Amps).
 - This input is also used for Grid code over current detection.

CT		CT connection		4: GEN_U_MAIN_V
Generator CT	Primary (A)	Secondary (A)	Phase shift (°)	
	250.0	1.0	0.0	
Main CT	Primary (A)	Secondary (A)	Phase shift (°)	
	1.0	1.0	0.0	
Cross current CT	Primary (A)	Secondary (A)	Phase shift (°)	
	1.0	1.0	0.0	

- **Step-up VT:**
 - This VT corresponds to a power transformer which can be found between the alternator and the grid. It makes it easier to calculate the voltage when matching the grid voltage, especially if the ratios between the primary and secondary on the various measurement VTs are not identical.

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- The “primary” corresponds to the machine (on the production side) and the secondary on the grid side.



- Hence when matching the grid voltage, the voltage reference given to the AVR is calculated using the formula below:

$$\text{Voltage reference} = \text{Grid code voltage measurement} \times \frac{\text{Step - up VT primary}}{\text{Step - up VT secondary}}$$

- If this is present, tick the box. The various parameters can then be set.
- Indicate the primary and secondary winding voltages (in Volts)

Step up VT

Primary (V): Secondary (V): Phase shift (°):

- PT100 and CTP:**

Select PT100 or CTP inputs

Temperature probe(s)

RTD1 Configuration:

RTD2 Configuration:

RTD3 Configuration:

RTD4 Configuration:

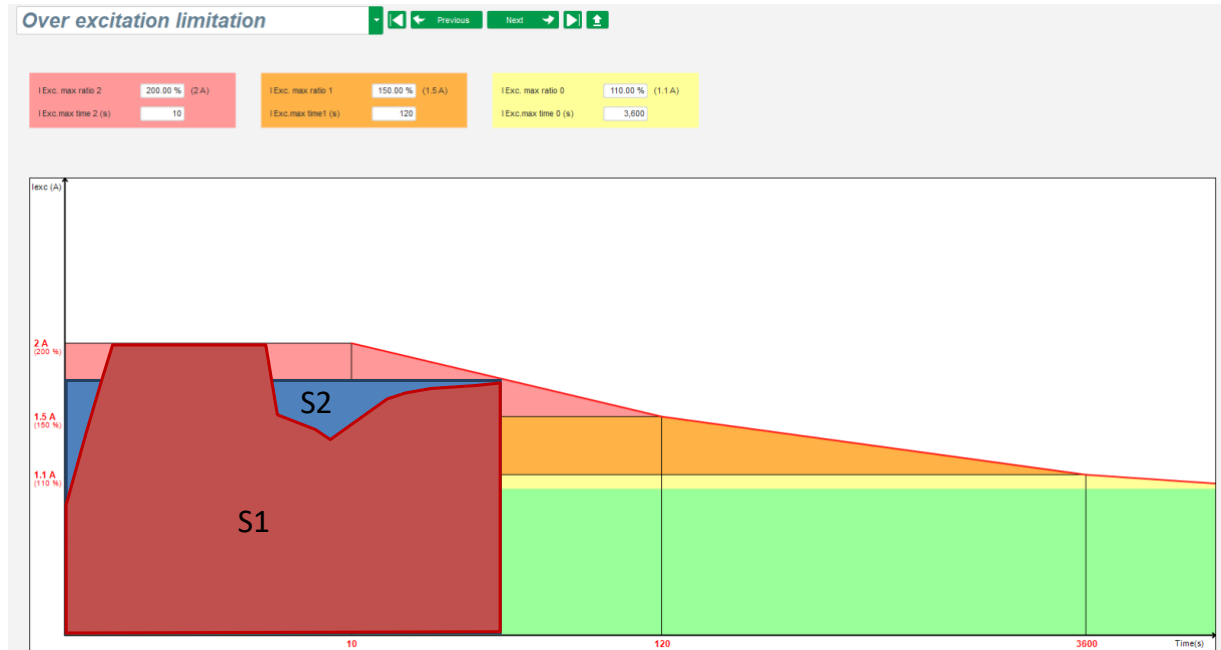
RTD5 Configuration:

6.3.1.2. Definition of the over excitation limit

- This limit is divided into 3 different parts using 3 points which define the areas. These points are determined according to the machine capability. The common adjustment values are:
 - 2.5 time of the rated field current for 10 seconds for the stator short-circuit
 - 1.5 times the rated field current for 10 seconds up to 120 seconds
 - 1.1 times the rated field current for 10 seconds up to 3600 seconds

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- As soon as the field current exceeds the value of the rated current, a counter is triggered. The S1 “field current measurement x time” area (shown in red below) is then compared with the “maximum field current x time” area (shown in blue below). If S1 equals S2, the limit is active and the D550 limits the field current to 99% of the rated current (which in this case results in the interruption of the regulation mode in progress).



- If the limit is active, in order to protect the machine, it is only possible to have a current higher than 99% of the rated current after 24 hrs.

6.3.1.3. Definition of the protection functions

There are 3 types of protections:

- Generator faults
- Regulator faults
- The alarm and trip thresholds for each temperature sensor

All protections have the same architecture:

- An activation of the protection
- A threshold
- A delay
- An action to realize (or not) when the delay is over. This action is chosen in a list:
 - No action: the regulation will continue
 - Regulation stopped: the excitation is then stopped
 - Regulation in field current mode at shutdown value
 - Regulation in field current mode at the field current value before fault: no bump in the regulation

Each protection has an auto-reset option:

- If this option is selected: if fault disappears, regulation will return to the automatic mode (voltage mode, or PF mode, etc.)
- If this option is not selected, the chosen action is maintained

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Below is an example for overvoltage

Under voltage fault detected

Activation Undervoltage % setpoint (%) 85.00 Auto-Reset

Undervoltage delay (s) 1.00 Action after fault 0: No action

On activation of this fault, background becomes light green

Under voltage fault detected

Activation Undervoltage % setpoint (%) 85.00 Auto-Reset

Undervoltage delay (s) 1.00 Action after fault 0: No action

- **Under voltage and overvoltage:** These protections can be enabled by ticking the checkboxes "Activation" and defining a threshold (in percentage of the rated voltage) and a delay before the activation of the protection. In the case below:
 - Under voltage fault is activated if the generator voltage is less than 85% of the rated voltage for at least 1 second. This fault is active only if the regulation is enabled and the soft start ramp achieved.
 - Overvoltage fault is active if the generator voltage is higher than 115% of the rated voltage and for at least 1 second.

Under voltage fault detected

Activation Undervoltage % setpoint (%) 85.00 Auto-Reset

Undervoltage delay (s) 1.00 Action after fault 0: No action

Over voltage fault detected

Activation Overvoltage % setpoint (%) 115.00 Auto-Reset

Overvoltage delay (s) 1.00 Action after fault 0: No action

- **Under frequency and over frequency:** These protections can be enabled by ticking the checkboxes "Activation" and defining a frequency value and a delay before the activation of the protection. In the case below:
 - Under frequency fault is activated if the generator frequency is less than 47Hz for at least 1 seconds. This fault is active only if the regulation is enabled.
 - Over frequency fault is active if the generator frequency is higher than 53Hz for at least 1 seconds.

Under frequency fault detected

Activation Underfrequency setpoint (Hz) 47.00 Auto-Reset

Underfrequency delay (s) 1.00 Action after fault 0: No action

Over frequency fault detected

Activation Overfrequency setpoint (Hz) 53.00 Auto-Reset

Overfrequency delay (s) 1.00 Action after fault 0: No action

- **Diode fault:** These protections can be enabled by ticking the checkboxes "Activation" and defining a percentage of harmonics of the field current and a delay before the activation of the protection.
 - If the pole ratio (number of exciter poles divided by the number of poles of the generator) is known, the percentage of harmonics supervised by the AVR is the sum of the two

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harmonics closer of the ratio. For example, for an exciter of 16 poles, and a generator of 6 poles, pole ratio is 2.66, so the percentage of harmonics 2 and 3 are summed.

- If the pole ratio is unknown, percentage of harmonics supervised by the AVR is the sum of all of harmonics.

In the case below:

- Open diode fault is activated if the percentage of the field current harmonics is higher than 5% for at least 1 second. This fault is active only if the regulation is enabled.
- Diode shorted fault is active if the percentage of the field current harmonics is higher than 10% for at least 1 seconds.

Open diode fault detected

Activation

Open diode percentage of field current (%) Auto-Reset

Open diode delay (s) Action after fault

Shorted diode fault detected

Activation

Shorted diode percentage of field current (%) Auto-Reset

Shorted diode delay (s) Action after fault

- **Start motor fault:** This protection can be enabled by ticking the checkbox "Activation" and defining a delay. In the case below, fault is activated if the generator voltage is less than the voltage setpoint when the 30 second delay is complete.

Motor start fault detected

Activation

Motor start delay (s) Auto-Reset

Action after fault

- **Active power reversal:** this protection device can be enabled by ticking the checkbox "Activation" and defining an active power threshold (as a percentage of the rated active power), as well as a delay before activation of the protection device.

NOTE: In this case, the power is negative, in other words the alternator is then in "motor" mode.

Reverse active power fault detected

Activation

Reverse active power % setpoint (-) (%) Auto-Reset

Reverse active power delay (s) Action after fault

- **Reactive power reversal:** this protection device can be enabled by ticking the checkbox "Activation" and defining a reactive power threshold (as a percentage of the rated reactive power), as well as a delay before activation of the protection device.

NOTE: In this case, the reactive power is negative.

Reverse reactive power fault detected

Activation

Reverse reactive power % setpoint (-) (%) Auto-Reset

Reverse reactive power delay (s) Action after fault

- **Loss of sensing:** this protection can be enabled by ticking the checkbox "Activation" and defining a voltage threshold in percentage of the generator voltage setpoint, as well as a

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delay before activation of the protection device. In the case below, the fault is activated if the generator voltage is less than 20% of the voltage setpoint after 1 second.

This function is deactivated during the short circuit, the soft start and when the voltage is regulated according to the U/F slope.

Loss of sensing fault detected

Activation

Lost of sensing % (%) Auto-Reset

Lost of sensing delay (s) Action after fault

- **Unbalance voltage:** this protection can be enabled by ticking the checkbox "Activation" and defining a percentage of voltage unbalance as well as a delay before activation of the protection device. Calculation of the voltage unbalance is according to the NEMA standard: This function is deactivated during the soft start.

$$\text{Unbalance percentage} = \frac{\text{Maximum generator voltage}}{\text{Average of generator voltage}} \times 100$$

In the case below, this fault is activated if the percentage of unbalance is at least 20% after 1 second.

Unbalanced voltage fault detected

Activation

Unbalanced voltage % (%) Auto-Reset

Unbalanced voltage delay (s) Action after fault

- **Short-circuit:** this protection can be enabled by ticking the checkbox "Activation" and defining a minimum stator current threshold in percentage of the generator rated current, as well as a delay before activation of the protection device. In the case below, the fault is active if the generator current measurement is higher than 200% of the rated stator current after 10 seconds.

Short circuit fault detected

Activation

Short circuit % (%) Auto-Reset

Short circuit delay (s) Action after fault

- **Unbalance current:** this protection can be enabled by ticking the checkbox "Activation" and defining a percentage of current unbalance as well as a delay before activation of the protection device. Calculation of the current unbalance is realized with the same formula as the unbalance voltage. This function is deactivated during the soft start:

$$\text{Unbalance percentage} = \frac{\text{Maximum generator current}}{\text{Average of generator current}} \times 100$$

In the case below, this fault is activated if the percentage of unbalance is at least 20% after 1 second.

Unbalanced current fault detected

Activation

Unbalanced current % (%) Auto-Reset

Unbalanced current delay (s) Action after fault

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- **Power supply fault:** this protection can be enabled by ticking the checkbox "Activation". It's the result of a control of supply voltage of the D550. In the case below, the fault is active if the supply voltage is below at 10 V during 10s or more.

Battery under voltage fault detected

Activation
 Battery under voltage fault (V)
 Auto-Reset

Battery under voltage fault delay (s)
 Action after fault:

- **IGBT fault:** this protection can be enabled by ticking the checkbox "Activation". The fault is activated if a coordination fault between the command and the action of the power transistors is detected, if no action is set, the AVR will continue to regulate the setpoint but with a degradation in the accuracy. It is necessary to change the D550 quickly.

IGBT fault detected

Activation
 Action after fault:

- Click on "Next" button
- **Power bridge overload detected:** this protection can be enabled by ticking the checkbox "Activation" and defining a percentage of current unbalance as well as a delay before activation of the protection device. In the case below, the fault is active if the field current is higher than 1A after 30 seconds.

Power bridge overload fault detected

Activation
 Excitation current for power bridge overload fault (A)
 Auto-Reset

Power bridge overload fault delay (s)
 Action after fault:

- **Temperature protection:** these protections can be enabled by ticking the checkbox "Activation" and defining the trip and alarm temperature thresholds. The screenshot below demonstrates RTD 1 only (identical for RTD 2 to 6).

PT100 1 fault

Activation
 PT100 1 alarm temperature (°C)
 Auto-Reset

PT100 1 fault temperature (°C)
 Action after fault:

On the last protections page, fault groups can be defined: all protections can be grouped to activate one or several signals (digital output for example) to do a synthesis of several faults. If one of these faults is activated, the entire group is activated. This information can be a destination for one output or can be used in logical functions. In example below, group1 corresponds to diode faults and group 2 to temperature faults.

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Protections

Machine fault Regulator fault Power bridge Temperature protections **Faults group**

Fault	Group 1	Group 2	Group 3	Group 4
Overvoltage fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Undervoltage fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Overfrequency fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Underfrequency fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Open diode fault class	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Shorted diode fault class	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reverse active power fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reverse reactive power fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PT100 1 Alarm (Over temp) fault class	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PT100 1 fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PT100 2 Alarm (Over temp) fault class	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PT100 2 fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PT100 3 Alarm (Over temp) fault class	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PT100 3 fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PT100 4 Alarm (Over temp) fault class	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PT100 4 fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PT100 5 Alarm (Over temp) fault class	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PT100 5 fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PTC 1 fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PTC 2 fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PTC 3 fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PTC 4 fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PTC 5 fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Loss of sensing fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Unbalance voltage fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Unbalance current fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Short circuit fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
IGBT fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Motor start fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Power bridge overload fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Battery under voltage fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CAN under voltage fault class	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- Click on "Next" button

6.3.1.4. Setting the ramp

- The ramp time corresponds to the time taken to reach the machine's voltage reference (or field current reference). If starting needs to be instantaneous, put "0" in the ramp time.

Regulation mode

Start-up Voltage Volt Matching Generator Power Factor kVAr Grid Power Factor Field Current

Start enabled by
Always enabled

Soft-start duration (s)

Start on threshold

Start on Threshold (SoT) Mode Active

Voltage Threshold (V)

Initial PWM SoT (%) ?

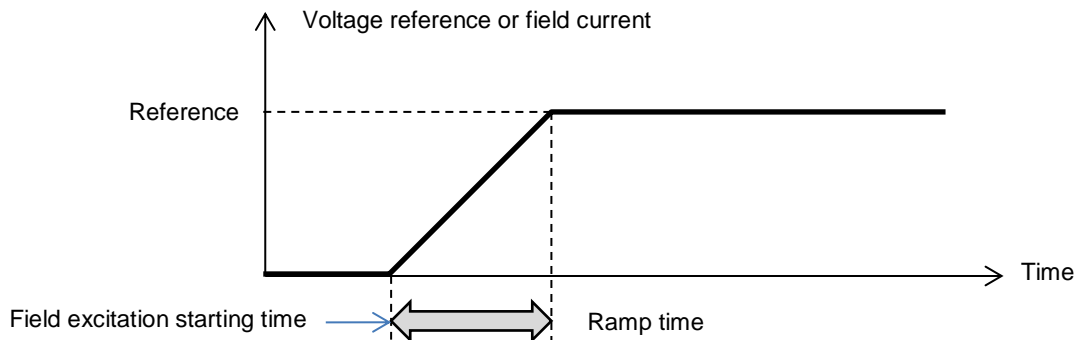
Minimum frequency threshold to reset the threshold start (Hz)

Minimum Vbus voltage threshold to reset the threshold start (V)

Delay to reset the threshold start (s)

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- Select the field excitation starting mode from the drop-down list. This can be:
 - Controlled by a digital input (DI1 to DI8).
 - Always enabled by selecting “Always active”. In this case, the field excitation is always energized as soon as the product is powered up.
 - Not controlled directly, but the result of a logic gate for example.



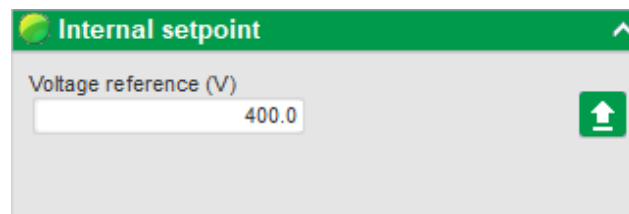
- Click on the “Next” button.

6.3.1.5. Voltage regulation

- This regulation must always be active, so select “Always active” in the drop-down list.



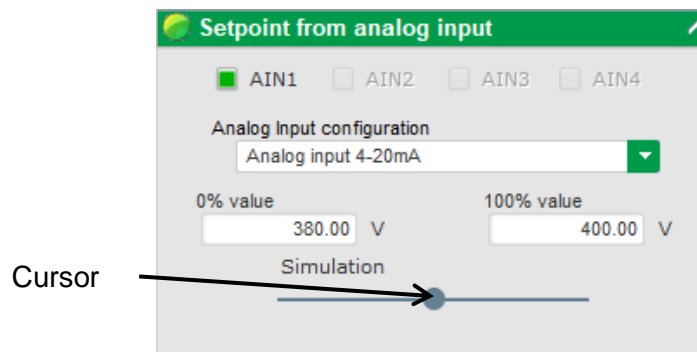
- **The home reference point** is determined by the different tabs: via a fixed value in the configuration, or by an analog input with a range to be determined. If a value is selected this value can be changed by the fieldbus.



- **If the “Analog input” option is selected**, the “Setpoint from analog input” part becomes active. Select the desired analog input box, determine its mode (+/-10 V, 0/10 V, 4-20 mA, potentiometer) and the voltage values at 0% and 100%.⁹

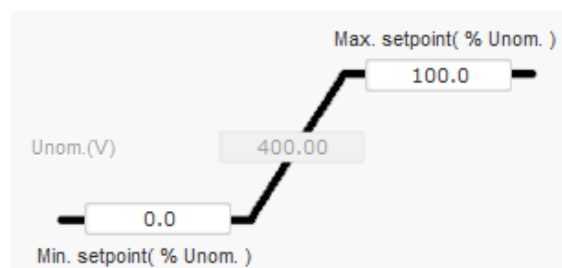
⁹ The voltage terminals can be swapped: the minimum voltage for 100% of the analog input, and the maximum voltage for 0% of the analog input.

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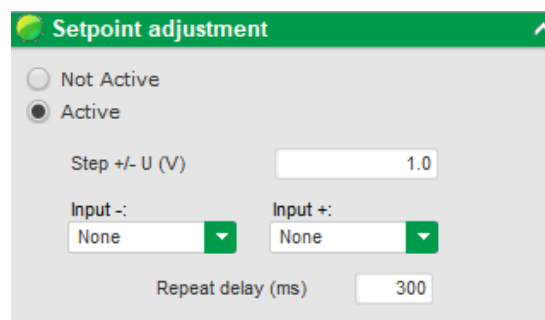


NOTE: By moving the cursor, it is possible to view the values obtained on the voltage and under frequency curves displayed on the right.

- **The limits of this reference** should be fixed, depending on the machine capability (in the example below, the minimum voltage reference is 0% of 400 V, and the maximum voltage reference is 100% of 400 V).

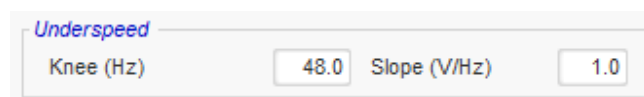


- **With a fixed reference, the reference can be adjusted** by two up and down inputs, one pulse corresponding to going up one “step” or down one “step”. Both the inputs, the value of the step and the delay need to be fixed, and this adjustment can be accessed by setting the selector to “Active”:



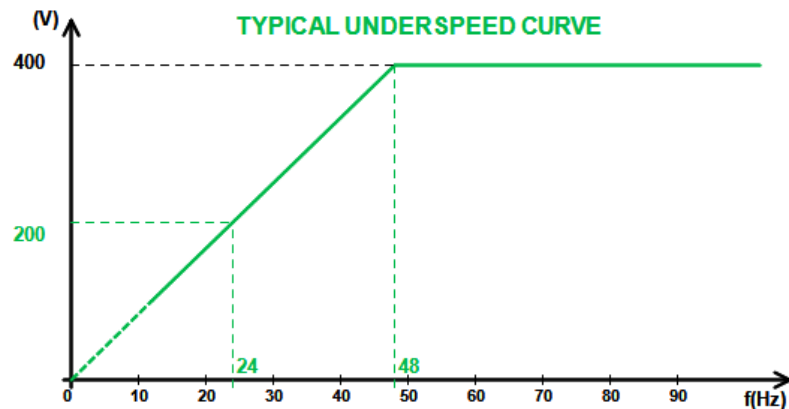
NOTE: The “+” and “-” inputs are the same for all regulation modes, but only affect the regulation modes in which they were enabled.

- **Underfrequency:** These two fields are used to set the voltage drop as a function of the alternator speed.
 - **Knee-point value:** The typical values are 48 Hz for an alternator at 50 Hz, 57 Hz for an alternator with 60 Hz rated frequency and 380 Hz for an alternator at 400 Hz.
 - **Slope:** Adjustable from 0.5 to 3. The higher the slope value, the greater the voltage drop will be if the drive motor speed drops.



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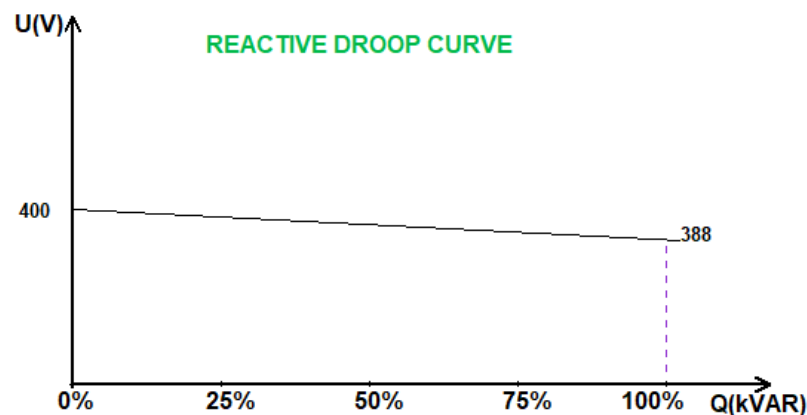
- The curve drawing is changed as a function of these two values.



- Quadrature droop:** Select the box to enable this function and give a voltage drop percentage between -20% and +20% (caution, a negative value corresponds to an increase in voltage). This function is mainly used in the case of alternators operating in parallel with one another. This value is set to 3% by default.

Reactive droop compensation (%)

The quadrature droop curve drawing is changed as a function of the reference.



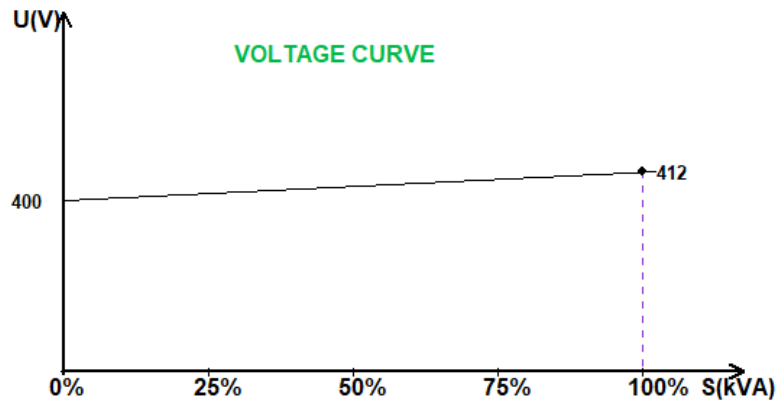
NOTE: If quadrature droop has been enabled, it is no longer possible to have load compensation or cross-current function.

- Load compensation:** Select the box to enable this function and give a voltage reference change percentage between -20% and +20%. This function is mainly used, depending on the kVA delivered by the machine, to:
 - Increase the voltage reference (with a percentage between 1 and 20%) in the case of particularly long distribution lines.
 - Decrease the voltage reference (with a percentage between -20% and -1%) to balance the loads for machines connected to a rectifier (DC bus).

Voltage line drop compensation (%)

The compensation curve drawing is changed as a function of the reference.

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NOTE: If load compensation has been enabled, it is no longer possible to have quadrature droop or the cross-current function.

- **Cross current:** Select the box to enable this function and give a voltage correction percentage as a function of the measured residual kVAr. The system automatically corrects the voltage (temporarily) to permanently cancel the kVAr difference between machines, yet without lowering the regulation point. This function requires special wiring.

Cross Current (% Voltage setpoint)

NOTE: If the cross-current function has been enabled, it is no longer possible to have quadrature droop or load compensation.

- **Motor start:** Select the box to enable the starting motor function and give a percentage of rated stator current. This function is active only in voltage regulation mode and allows limiting the stator current at a defined value.

Generator current limitation (permanent limitation % I_{stator} rated)

When the breaker is closed between the motor and the generator, the D550 continues regulating the voltage until the stator current measured reaches the limitation value. In this case, the D550 regulates the stator current. When the motor reaches its rated speed, the current will decrease naturally and the voltage will increase. The D550 will then return to voltage regulation mode.

To prevent and detect a possible bad motor starting event, a delay can be set between 1s to 60s in the protections page. If the voltage is not at its voltage setpoint when the delay is over, the regulator will then respond based on the chosen action, as for all the others fault:

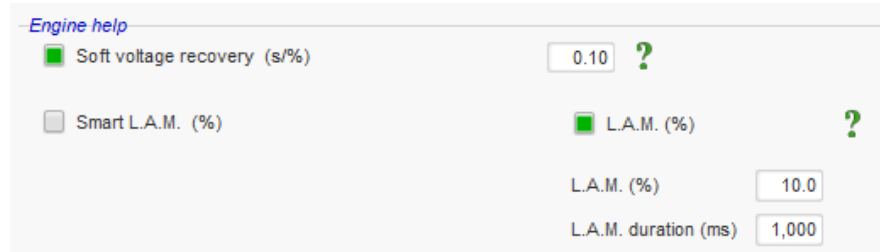
- No action
- Stop the regulation
- Field current regulation mode at shutdown value
- Field current regulation mode at value before the fault

If the motor breaker is closed before energizing, this limitation has the priority and ramp time is not respected.

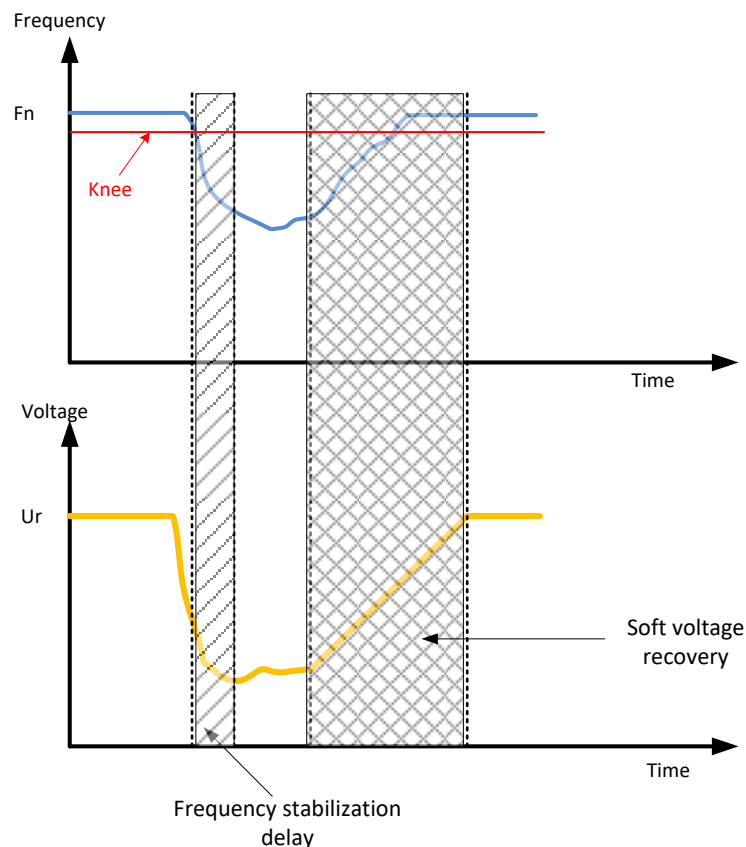
- **LAM:** Load Acceptance Module. This function improves the generator response reducing the voltage set point during a load impacts.

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When generator frequency measured is below the under-speed knee defined in the configuration (example 48Hz or 57Hz), voltage set point is decreased to a defined value (in example below, 10% under the rated voltage).



- If frequency continues to fall, the voltage is regulated according to the U/f law.
- Soft voltage recovery helps the speed recovery of the genset: it is given in seconds per percent of the rated voltage (s/%). For example, the above setting means that if the frequency decreases by 10% then the progressive rise time will be 1 second (i.e. $0.100\text{s}/\% * 10\%$). Note that if the slope of progressive rise is greater than the U/f law, then the latter will be used to raise the voltage.
- The frequency stabilization delay corresponds to the waiting time before the voltage setpoint is raised gradually (according to the increase of the frequency).
- The figure below shows the operating details of the LAM:



- **Self-adaptive LAM:** it has the same role as the classical LAM described above. The difference lies in the fact that the percentage of voltage drop is no longer fixed by the user but is automatically adapted to the level of the load impact. Thus, for each load impact:

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- The controller measures the operating frequency and calculates its derivative permanently.
- From this derivative value, an attenuation coefficient (K) of the voltage is calculated according to the parameters configured by the user. In the example below, for a frequency variation of 10Hz/s, the applied voltage drop will be 10% of the nominal voltage.

-Engine help
 Soft voltage recovery (s/%) 0.10 ?
 Smart L.A.M. (%) L.A.M. (%) ?
 L.A.M. 10.0 % for 10.0 Hz/s frequency drop speed.
 L.A.M. duration (ms) 1,000

For each load impact, the voltage attenuation is determined by the formula $\Delta U = K \times U_r$ where U_r is the rated voltage of the alternator.

The frequency stabilization delay corresponds to the waiting time before the voltage setpoint is raised gradually (according to the increase of the frequency).

Note: During the motor starting, all the other limitations, faults and protections (under voltage, over voltage, stator limitation, under speed, under excitation, over excitation) has to be inactivated.

- Click on the "Next" button

6.3.1.6. Determination of the regulation modes

The various regulation modes to be configured depend on the alternator operation (standalone, parallel between machines, parallel with the grid).

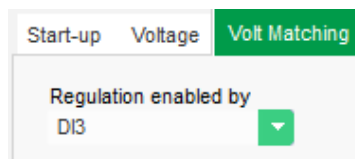
NOTE: If the alternator is not connected to the grid, skip directly to step 11.

6.3.1.7. Voltage matching circuit

- To connect an alternator to the grid, the grid voltage and the alternator voltage must be very close in value (less than 5% difference between the two measurements). The voltage matching circuit function is used to measure the instantaneous grid voltage as an alternator voltage reference.¹⁰
- To enable the voltage matching circuit, select the activation type from the drop-down list. This can be:
 - Controlled by a digital input (DI1 to DI8).
 - Always enabled by selecting "Always active". In this case, the voltage matching circuit is always switched on, depending on the order of priority of the regulations.
- If "None" is selected, the voltage matching circuit is never enabled or is enabled by a logic gate.

¹⁰ This function requires one or two grid voltage measurement transformer(s).

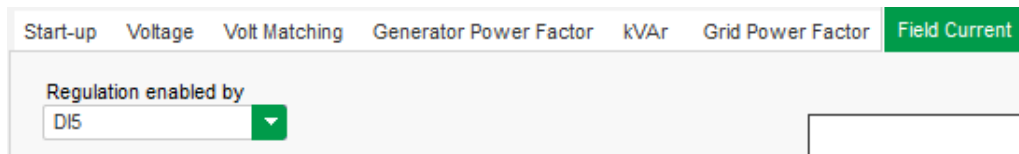
Digital voltage regulator D550



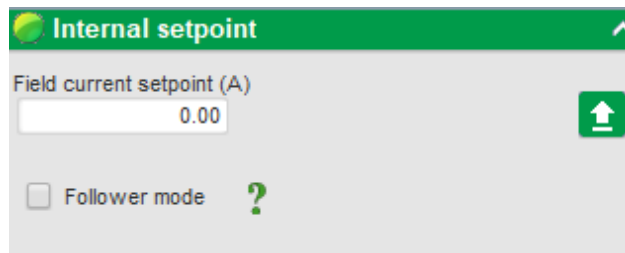
- Click on the "Next" button.

6.3.1.8. Regulation of the field current (manual mode)

- This regulation is used to control the value of the field current directly. It is mainly used during commissioning or as fallback mode if a measurement is incorrect on the AVR (alternator voltage measurement or alternator current measurement for example).
- It takes priority over all the other regulation modes that might be active.
- To enable field current regulation, select the activation type from the drop-down list. This can be:
 - Controlled by a digital input (DI1 to DI8).
 - Always enabled by selecting "Always active".
- If "None" is selected, field current regulation is never enabled or is enabled by a logic gate.



- **The home reference point** is determined by the different tabs: by a fixed value in the configuration. In this case, this value can be changed by the fieldbus.



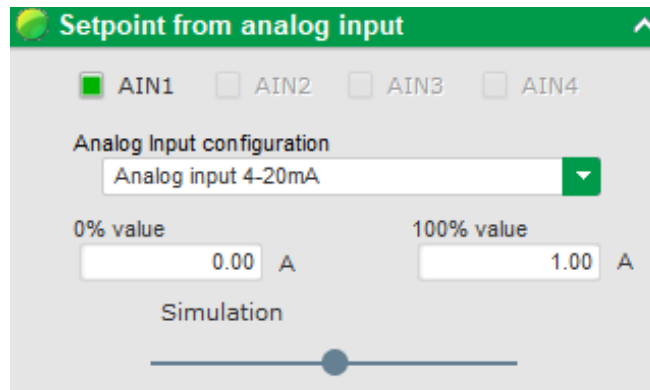
- **The "tracking" function**, when switching from a regulation mode to manual mode, allows the field current measurement to be used as a reference. This prevents any visible "jumps" of the operating point of the machine. The reference can then be changed using the up and down inputs.

NOTE: This function is only possible if the home reference point is fixed.

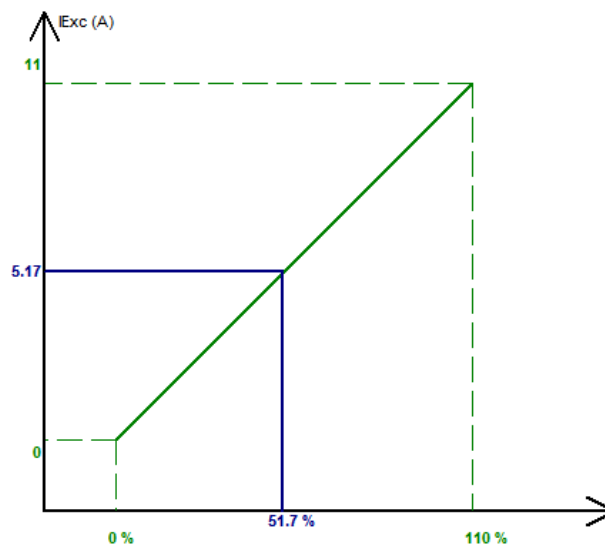
- **If the "Analog input" option is selected**, the "Reference via analog input" part becomes active. Select the desired analog input box, determine its mode (+/-10 V, 0/10 V, 4-20 mA, potentiometer) and the values at 0% and 100%. ¹¹

¹¹ The minimum and maximum field current reference terminals can be swapped: the minimum field current limit for 100% of the analog input, and the maximum field current for 0% of the analog input.

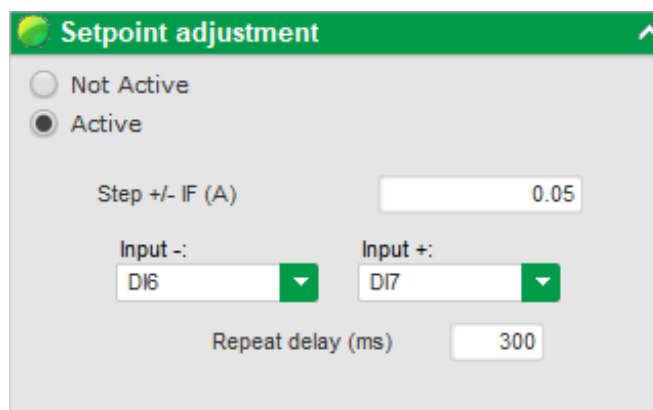
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NOTE: By moving the cursor, it is possible to view the corresponding value of the field current reference (blue line) on the graph located on the right of the shape.



- **With a fixed reference, the reference can be adjusted** with 2 inputs (up and down), one pulse corresponding to going up one “step” or down one “step”. Both the inputs, the value of the step and the delay need to be fixed, and this adjustment is enabled by setting the selector to “Active”:



NOTE: The “+” and “-” inputs are the same for all regulation modes.

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6.3.1.9. Setting the PID gains

- Set the various PID gains. Default values are always given in the fields.

	Voltage	Field current	PF/kVAR	Grid PF
Proportional	7,000	2,100	10	1
Integral	100	60	10	1
Derivative	500	15	0	0
Gain	100	100	100	100

Regulation loop speed
0: 2.5 ms

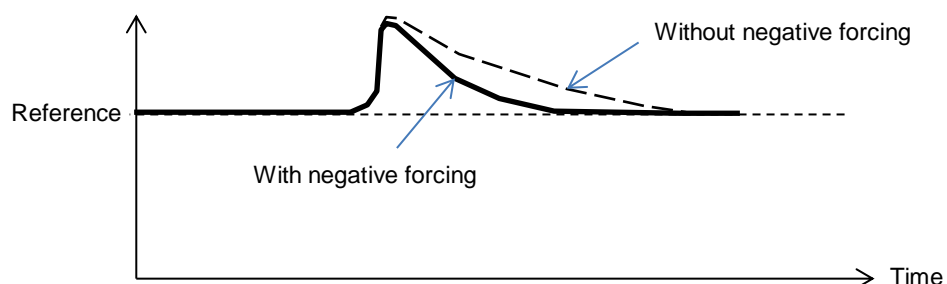
Negative forcing ?

DC Bus voltage compensation ?

AVR
↑
PC

Upload your configuration

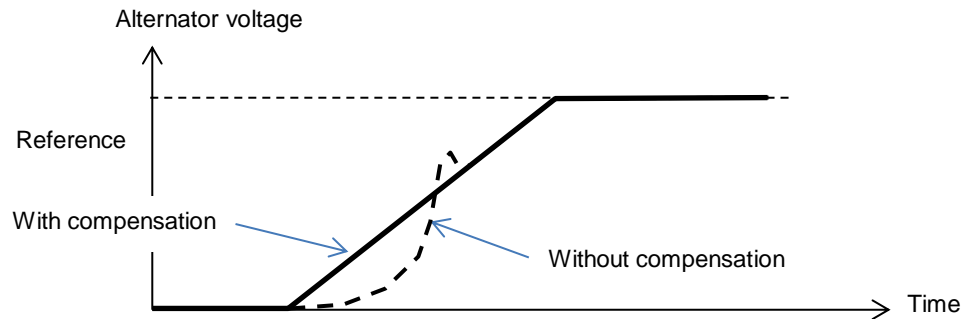
- Regulation loop speed can be modified according to the response time of the generator, between 2.5ms and 20ms by 2.5ms steps. If this value is modified, it will be necessary to adjust PID gains.
- If alternator operation requires various load steps, whether adding and/or shedding (standalone operation or parallel machine operation), it may be a good idea to select the "negative forcing". This function is used to invert the voltage at the exciter field terminals briefly in order to minimize the time to recover the rated voltage to the rated voltage.



- If a shunt or AREP type field is being used, the power supply voltage depends directly on the voltage at the alternator terminals. As a result, it can fluctuate with the load and therefore influence the PID's behavior. To compensate these fluctuations, it may be advisable to

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activate the “VBus compensation” function. Below is an example of ramp starting with and without compensation in the case of a shunt excitation:



- Click on the “Next” button.

6.3.1.10. I/O management

- Go to the I/O page.
- Additional inputs can be configured on top of those used in the regulation configuration pages (which are already shown greyed out).
- **The analog inputs/outputs** can be configured by defining the source, the configuration and the 0% and 100% values.

Analog Inputs/Outputs

ID	Configuration AI	Destination	0% value	100% value	Source	Configuration AO	0% value	100% value
AI01	4-20mA	None	0.00	0.00	None	None	0	0
AI02	0-10V	None	0.00	0.00	None	None	0	0
AI03	0-10V	None	0.00	0.00	None	None	0	0
AI04	0-10V	None	0.00	0.00	None	None	0	0

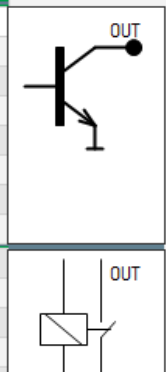
- **The digital outputs/inputs** can be configured by defining the source, the activation (active low = closed if the condition is fulfilled, “active high” = output open if the condition is fulfilled). The configured type is shown in the picture on the right of the screen (relay or transistor).

Digital Inputs

Digital Input	Active	Destination
DI1	Active Low	None
DI2	Active Low	None
DI3	Active Low	Volt Matching Regulation
DI4	Active Low	None
DI5	Active Low	Field Current Regulation
DI6	Active Low	Down Adjustment
DI7	Active Low	Up Adjustment
DI8	Active Low	None

Digital Outputs

Source	Active	Digital Output
None	Active Low	DO1
None	Active Low	DO2
None	Active Low	DO3
None	Active Low	DO4
None	Active Low	DO5
None	Active Low	DO6
None	Active Low	DO7
None	Active Low	DO8
None	Active Low	DO9
None	Active Low	DO10



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6.4. Curve functions

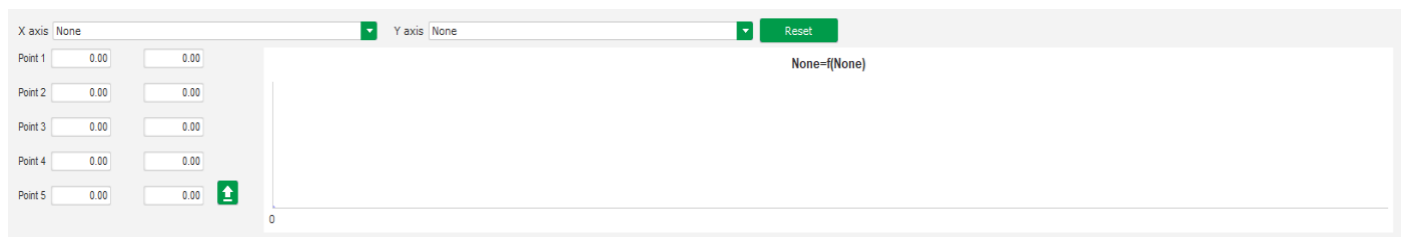
6.4.1.1. Overview

Curve functions are used to control a parameter as a function of another parameter. For example:

- The kVAr reference as a function of the voltage during kVAr regulation
- The maximum stator current as a function of the stator temperature
- The maximum field current as a function of the temperature or an analog input
- The voltage reference as a function of the speed
- The field current as a function of the active power
- Specific scaling
- Etc.

Curve functions can be created.

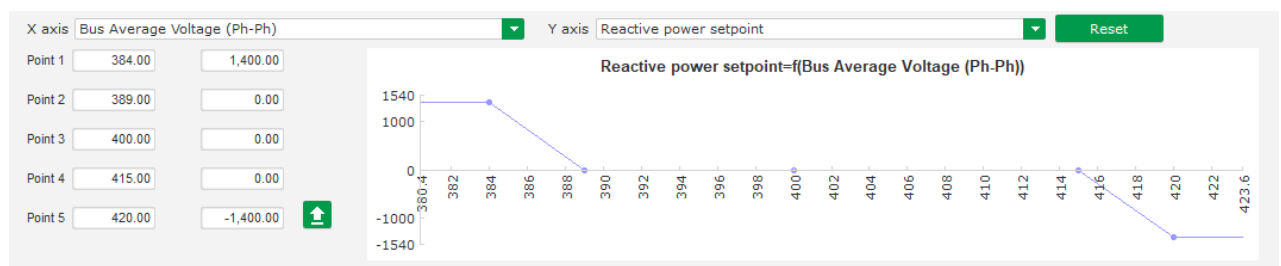
For the curve function to work, the X and Y axis parameters need to be defined, as well as 5 points. These functions are active as soon as the curve is created.



The curve fields can be reset by clicking on the “Reset” button of each curve.

6.4.1.2. Examples curve functions

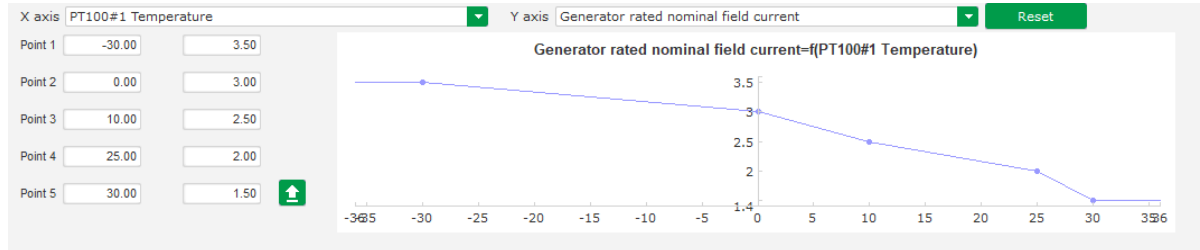
- **Reactive power reference as a function of the grid voltage for a 400 V machine.**



NOTE: We can see that for a voltage value lower than the one defined at point “1” the power reference is held at the value defined at point “1”. For a voltage value higher than the one defined at point “5”, the reactive power reference is held at the value defined at point “5”.

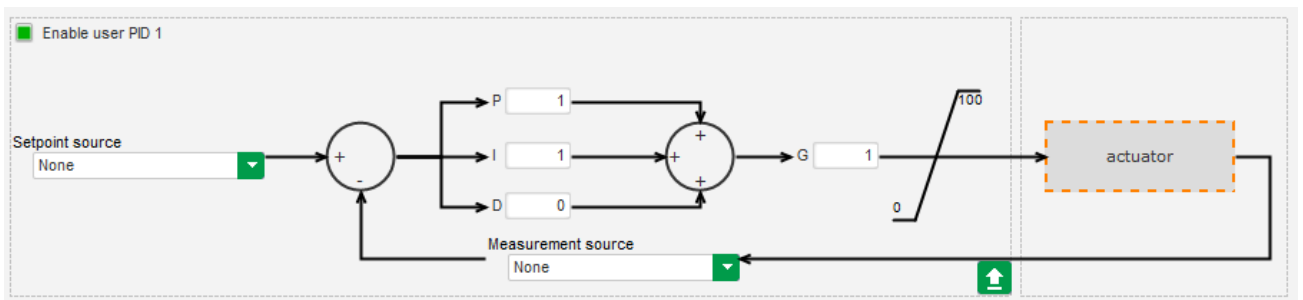
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- **Field current reference as a function of the temperature measured at the stator** (in our example temperature 1). For a low temperature, increasing the field current is then authorized.



6.5. User PID gain:

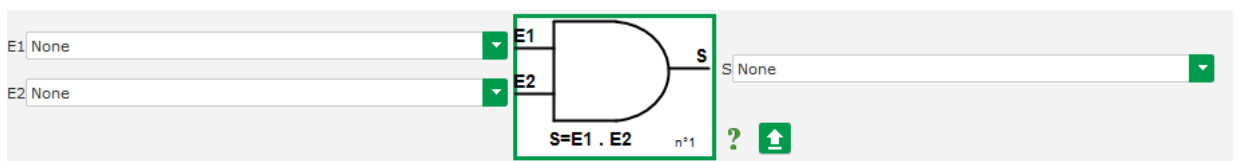
This feature allows having an independent PID which can be used to regulate another component.



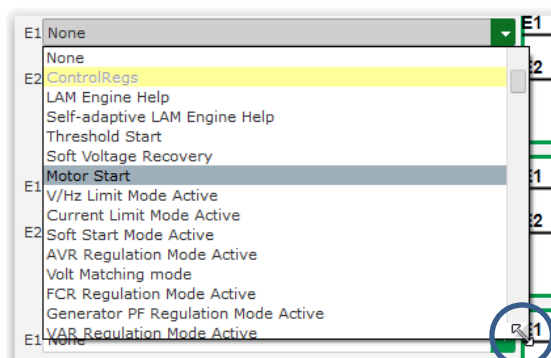
6.6. Logic gates

6.6.1.1. Overview

Logic gates are used for simple control with one or two inputs and one configurable output by means of drop-down lists.



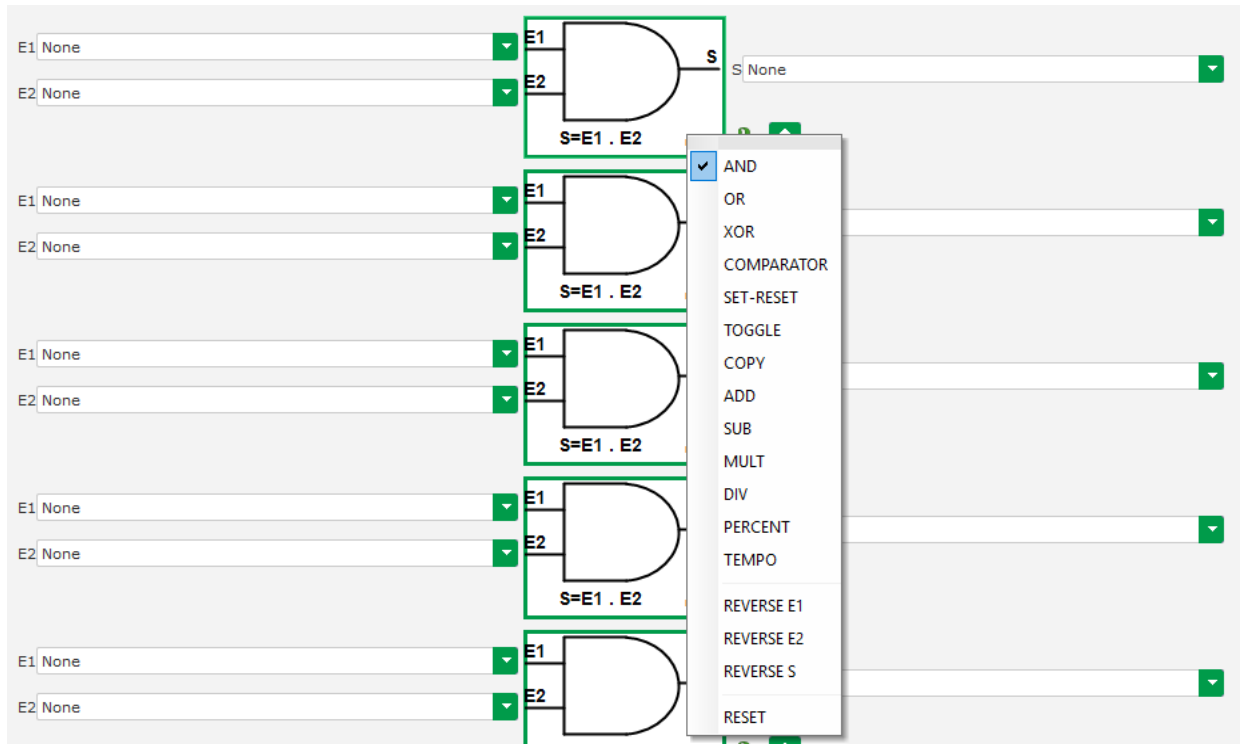
The parameter lists can be enlarged by clicking at the bottom right of the list and holding down until the desired size:



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TIP: To select a parameter more quickly, you can enter its first few letters in the drop-down list.

The type of gate can be changed by clicking on the relevant gate. A pop-up menu then appears:



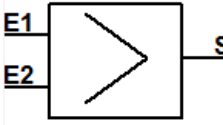

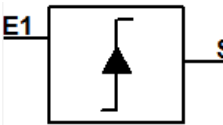
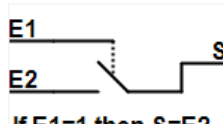
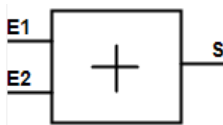
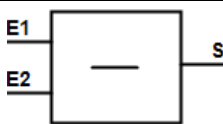
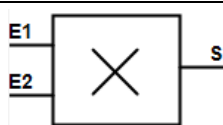
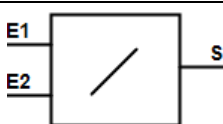
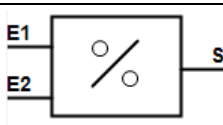
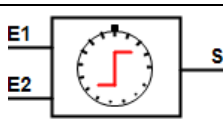
A maximum of 20 gates with 2 inputs can be used.

They can be linked in sequence (using an output gate as an input condition for another gate). Digital “user” variables can be used as a gate input parameter in comparator mode.

The following gates are available:

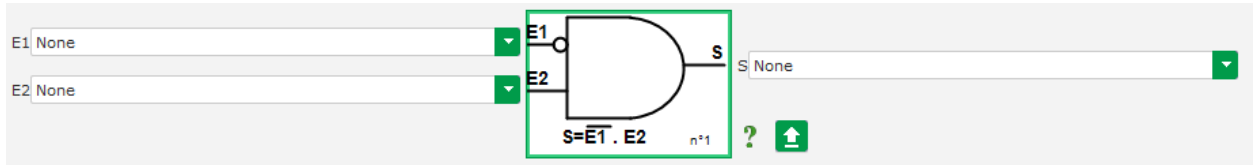
Gate type	Representation	Parameter type	Truth table															
AND		Binary	<table border="1"> <thead> <tr> <th>E1</th> <th>E2</th> <th>S</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>0</td> <td>1</td> <td>0</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> </tr> </tbody> </table>	E1	E2	S	0	0	0	0	1	0	1	0	0	1	1	1
E1	E2	S																
0	0	0																
0	1	0																
1	0	0																
1	1	1																
OR		Binary	<table border="1"> <thead> <tr> <th>E1</th> <th>E2</th> <th>S</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>0</td> <td>1</td> <td>1</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> </tr> </tbody> </table>	E1	E2	S	0	0	0	0	1	1	1	0	1	1	1	1
E1	E2	S																
0	0	0																
0	1	1																
1	0	1																
1	1	1																
Exclusive OR		Binary	<table border="1"> <thead> <tr> <th>E1</th> <th>E2</th> <th>S</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>0</td> <td>1</td> <td>1</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> </tr> </tbody> </table>	E1	E2	S	0	0	0	0	1	1	1	0	1	1	1	0
E1	E2	S																
0	0	0																
0	1	1																
1	0	1																
1	1	0																

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Gate type	Representation	Parameter type	Truth table															
COMPARATOR	 <p>$S = E1 > E2$ <small>n°1</small></p>	Decimal E1 and E2 Binary O	<table border="1"> <thead> <tr> <th></th> <th>O</th> </tr> </thead> <tbody> <tr> <td>$E1 < E2$</td> <td>0</td> </tr> <tr> <td>$E1 = E2$</td> <td>0</td> </tr> <tr> <td>$E1 > E2$</td> <td>1</td> </tr> </tbody> </table>		O	$E1 < E2$	0	$E1 = E2$	0	$E1 > E2$	1							
	O																	
$E1 < E2$	0																	
$E1 = E2$	0																	
$E1 > E2$	1																	
SET-RESET	 <p><small>n°5</small></p>	Binary	<table border="1"> <thead> <tr> <th>E1</th> <th>E2</th> <th>S</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>S</td> </tr> <tr> <td>0</td> <td>1</td> <td>0</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> </tr> <tr> <td>1</td> <td>1</td> <td>O</td> </tr> </tbody> </table>	E1	E2	S	0	0	S	0	1	0	1	0	1	1	1	O
E1	E2	S																
0	0	S																
0	1	0																
1	0	1																
1	1	O																
SWITCHING	 <p>$S = \bar{S}$ <small>n°8</small></p>	Binary	On the rising edge of I1, S changes state															
COPY	 <p>If $E1 = 1$ then $S = E2$ <small>n°1</small></p>	E1 Binary E2 and S Decimal	<table border="1"> <thead> <tr> <th>E1</th> <th>E2</th> <th>S</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>0</td> <td>E2</td> <td>0</td> </tr> <tr> <td>1</td> <td>E2</td> <td>E2</td> </tr> </tbody> </table>	E1	E2	S	0	0	0	0	E2	0	1	E2	E2			
E1	E2	S																
0	0	0																
0	E2	0																
1	E2	E2																
ADDITION	 <p>$S = E1 + E2$ <small>n°2</small></p>	Decimal E1 and E2 S Decimal	$S = E1 + E2$															
SUBSTRACTION	 <p>$S = E1 - E2$ <small>n°3</small></p>	Decimal E1 and E2 S Decimal	$S = E1 - E2$															
MULTIPLICATION	 <p>$S = E1 * E2$ <small>n°4</small></p>	Decimal E1 and E2 S Decimal	$S = E1 * E2$															
DIVISION	 <p>$S = E1 / E2$ <small>n°5</small></p>	Decimal E1 and E2 S Decimal	$S = E1 / E2$ S value is not changed if E2 is null															
PERCENTAGE	 <p>$S = (E1 / E2) * 100$ <small>n°6</small></p>	Decimal E1 and E2 S Decimal	$S = (E1 / E2) * 100$															
TEMPORIZATION	 <p>$S = 1$ if ($E1 = 1$ et $t \geq E2$) <small>n°7</small></p>	E1 Binary E2 decimal (in seconds) S Binary	$S = 1$ if ($E1 = 1$ and $t \geq E2$) $S = 0$ if $E1 = 0$ or $t < E2$															

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The inputs and the output can be reversed in the case of AND, OR, EXCLUSIVE OR gates, again using the gate pop-up menu. In this case a white circle symbolizes the reversal and the gate equation is updated. Example below with the E1 input reversed on an AND gate:



A logic gate's fields can be reset by using the gate pop-up menu and clicking "RESET".

A help is available by clicking on the question mark, which brings up the truth table for the active gate. This is an AND gate¹².

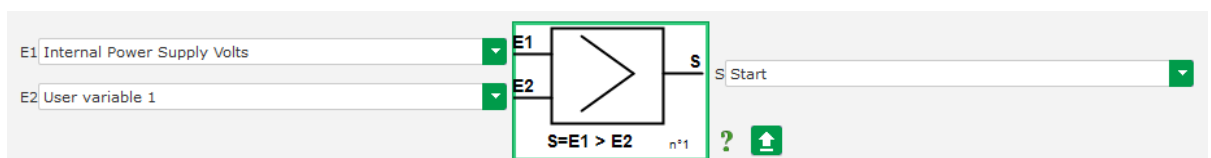
E1	E2	S
0	0	0
0	1	0
1	0	0
1	1	1

6.6.1.2. Examples of gate programming

- **Starting the AVR on power supply voltage threshold:** as soon as the power is switched on, the power supply voltage increases. A threshold should therefore be set above which the ramp will be able to be executed. A user-defined variable is used.

The "COMPARATOR" gate is then chosen with the following variables:

- E1 "Internal power supply Volts"
- E2 "User variable 1", set at 10 (DC bus 10 V)
- S "Starting"



NOTE: the value of "User variable 1" depends on the voltage your field excitation system can be provided by the residua magnetization. In our example we will put 10 V.

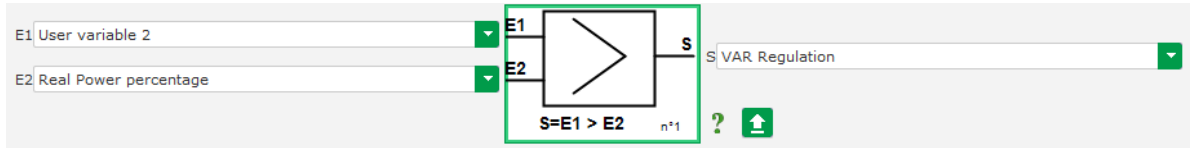
- **VAr regulation for a load less than 10% of the rated power (connected to the grid):** as soon as the machine is connected to the grid, without a load being present, instabilities can appear due to the stator current measurement interference. We therefore recommend kVAR regulation if the active power is less than 10% of the alternator rated power.

¹² Truth take into account any reversals configured on the gate.

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The “COMPARATOR” gate is then chosen with the following variables:

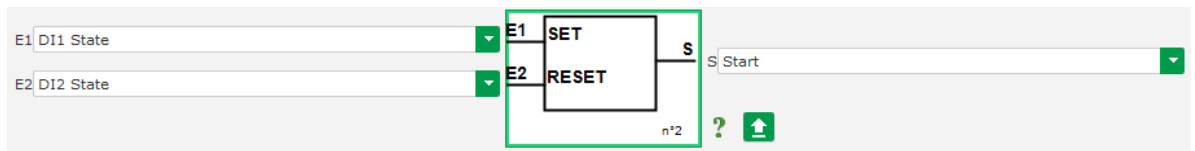
- E1 “User variable 2”, set at 10 (10% reactive power)
- E2 “Real power percentage”
- S “VAR regulation”



- **Pulsed Starting and Stopping:** The regulation function is switched on by a maintained input. As soon as this input changes state, field excitation is stopped. Pulsed starting and stopping can be configured using a SET-RESET gate:

- E1 “DI1”, which sends the start pulse
- E2 “DI2”, which sends the stop pulse
- S “Starting”

The result is then as follows:



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6.7. Log events

Log event

Previous Next

Enabled / Disabled

Event

Event counter

lexc during last loss of sensing fault detected

<input type="checkbox"/>	Enable overvoltage fault detected log	0	0
<input type="checkbox"/>	Enable undervoltage fault detected log	0	0
<input type="checkbox"/>	Enable overfrequency fault detected log	0	0
<input type="checkbox"/>	Enable underfrequency fault detected log	0	0
<input type="checkbox"/>	Enable open diode fault detected log	0	0
<input type="checkbox"/>	Enable short diode fault detected log	0	0
<input type="checkbox"/>	Enable reverse active power fault detected log	0	0
<input type="checkbox"/>	Enable reverse reactive power fault detected log	0	0
<input type="checkbox"/>	Enable PT100 1 alarm detected log	0	0
<input type="checkbox"/>	Enable PT100 1 fault detected log	0	0
<input type="checkbox"/>	Enable PT100 2 alarm detected log	0	0
<input type="checkbox"/>	Enable PT100 2 fault detected log	0	0
<input type="checkbox"/>	Enable PT100 3 alarm detected log	0	0
<input type="checkbox"/>	Enable PT100 3 fault detected log	0	0
<input type="checkbox"/>	Enable PT100 4 alarm detected log	0	0
<input type="checkbox"/>	Enable PT100 4 fault detected log	0	0
<input type="checkbox"/>	Enable PT100 5 alarm detected log	0	0
<input type="checkbox"/>	Enable fault detected log	0	0
<input type="checkbox"/>	Enable CTP 1 fault detected log	0	0
<input type="checkbox"/>	Enable CTP 2 fault detected log	0	0
<input type="checkbox"/>	Enable CTP 3 fault detected log	0	0
<input type="checkbox"/>	Enable CTP 4 fault detected log	0	0
<input type="checkbox"/>	Enable CTP 5 fault detected log	0	0
<input type="checkbox"/>	Enable loss of sensing fault detected log	0	0
<input type="checkbox"/>	Enable unbalanced voltage fault detected log	0	0
<input type="checkbox"/>	Enable unbalanced current fault detected log	0	0
<input type="checkbox"/>	Enable short circuit fault detected log	0	0
<input type="checkbox"/>	Enable IGBT fault detected log	0	0
<input type="checkbox"/>	Enable motor start fault detected log	0	0
<input type="checkbox"/>	Enable power bridge overload fault detected log	0	0
<input type="checkbox"/>	Enable main field overload detected log	0	0
<input type="checkbox"/>	Enable main field overheating detected log	0	0
<input type="checkbox"/>	Enable stator overload detected log	0	0
<input type="checkbox"/>	Enable stator overheating detected log	0	0
<input type="checkbox"/>	Enable battery under voltage detected log	0	0
<input type="checkbox"/>	Enable CAN under voltage detected log	0	0

Event reset

For each selected event, the corresponding counter will be increased anytime it appears. In case of an event, the excitation current is recorded.

6.8. Second Configuration

This function is usually known as the “50/60Hz switch function”, but it offers much more features and flexibilities.

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Second configuration

2nd configuration driving by DI1

Parameter 1 value	50.000	Parameter destination 1	V/Hz knee frequency
Parameter 2 value	400.000	Parameter destination 2	Voltage setpoint
Parameter 3 value	1.500	Parameter destination 3	V/Hz slope
Parameter 4 value	0.000	Parameter destination 4	None
Parameter 5 value	0.000	Parameter destination 5	None
Parameter 6 value	0.000	Parameter destination 6	None
Parameter 7 value	0.000	Parameter destination 7	None
Parameter 8 value	0.000	Parameter destination 8	None
Parameter 9 value	0.000	Parameter destination 9	None
Parameter 10 value	0.000	Parameter destination 10	None
Parameter 11 value	0.000	Parameter destination 11	None
Parameter 12 Value		Parameter destination 12	None
Parameter 13 Value		Parameter destination 13	None
Parameter 14 Value		Parameter destination 14	None
Parameter 15 Value		Parameter destination 15	None
Parameter 16 value		Parameter destination 16	None

- Choose the activation source of second configuration.

2nd configuration driving by DI1

The activation of DI1 leads the switching to the second configuration and its deactivation brings the regulation back to the base configuration.

Note: The switch is only taken into account at the regulation starting. Any activation or deactivation when the regulator is in operation will be ignored.

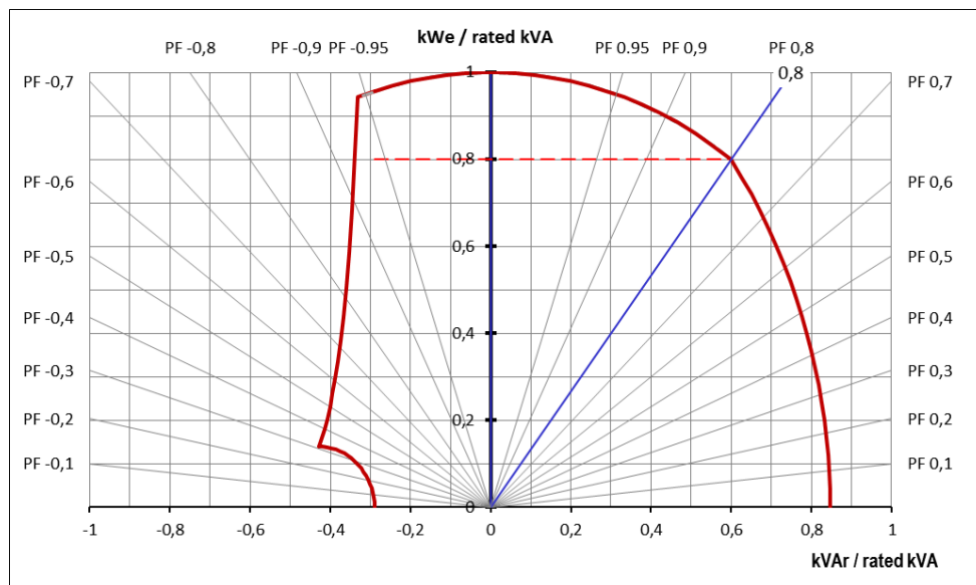
- **Select the parameters** which will be affected when switching to that second configuration. In the example above, we define a new frequency knee at 58Hz, a new voltage setpoint at 480V and the V/Hz slope is set to 1.5.

Digital voltage regulator D550

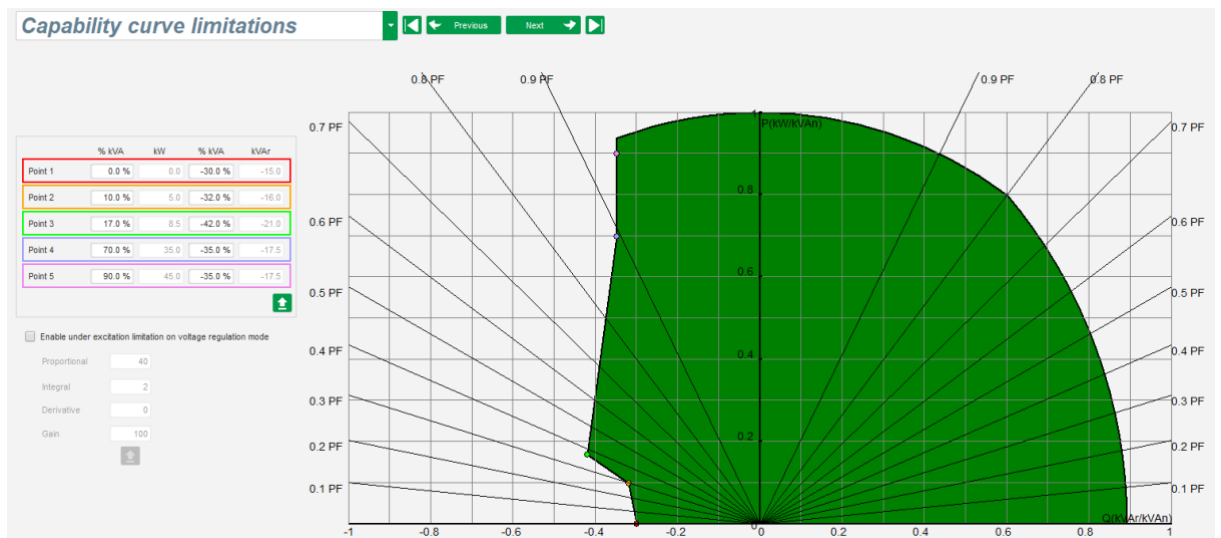
6.9. Modes and Functions details

6.9.1.1. Definition of the under-excitation limit

- This limit corresponds to the absorption limit defined in the capability curve. It is drawn thanks 5 points which define the areas. We recommend using kVAR values slightly higher than the curve point so that the alternator can operate in complete safety. These points can be defined as an actual value (kVAR and kW) or as a percentage of kVA. Example of a capability curve:



By choosing the points carefully, the software representation gives a similar diagram:

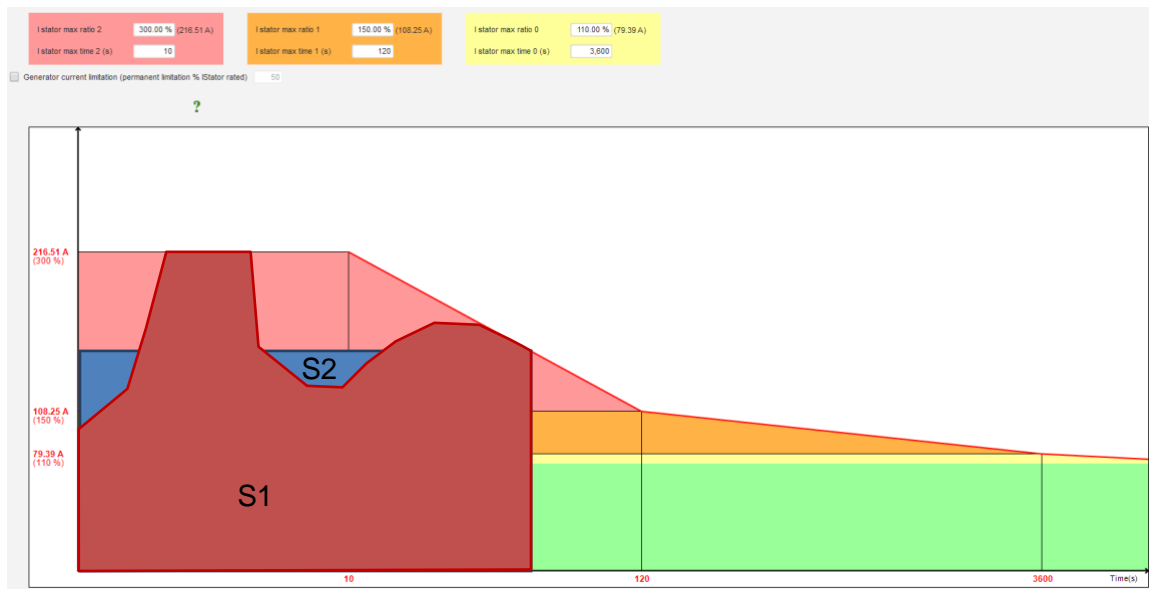


- This limitation is active as soon as the operating point reaches this limit. The field current is then controlled so that the alternator stays in the domain defined by the capability curve.

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6.9.1.2. Definition of the stator current limit

- In principle this limit is identical to the field current maximum limit.
- It can only be enabled in voltage regulation mode.
- It is divided into 3 different parts using 3 points which define the areas. These points are determined according to the machine capability. The common adjustment values are:
 - 3 times the rated stator current for 10 seconds for the stator short-circuit
 - 1.5 times the rated stator current for 120 seconds
 - 1.1 times the rated stator current for 3600 seconds
- As soon as the stator current exceeds the value of the rated current, a counter is triggered. The S1 “stator current measurement x time” area (shown in red below) is then compared with the “maximum stator current x time” area (shown in blue below). If S1 equals S2, the limit is active and the D550 limits the stator current to 99% of the rated current (which in this case results in the voltage reference not being tracked).



6.9.1.3. Regulation of the generator power factor

- This regulation must be enabled as soon as the machine is connected to the grid (grid contactor closing) data item and disabled as soon as the machine is disconnected from the grid. The source of the grid connection contactor should be stated at the bottom of the page:

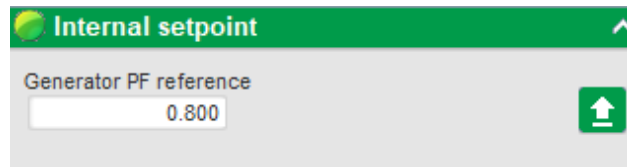
Grid breaker Input:

D14

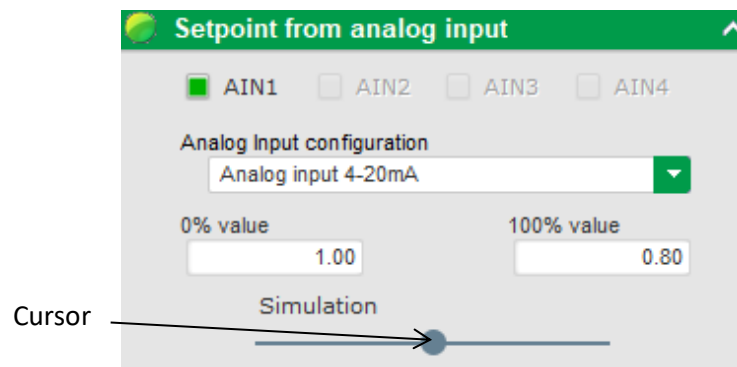
- It can be chosen with kVAR regulation and regulation of the power factor at one point of the grid for machines connected to the grid.
- This function is used to regulate the power factor at the machine terminals. For this purpose, the alternator current measurement must be connected (1 or 3 current transformers).

Digital voltage regulator D550

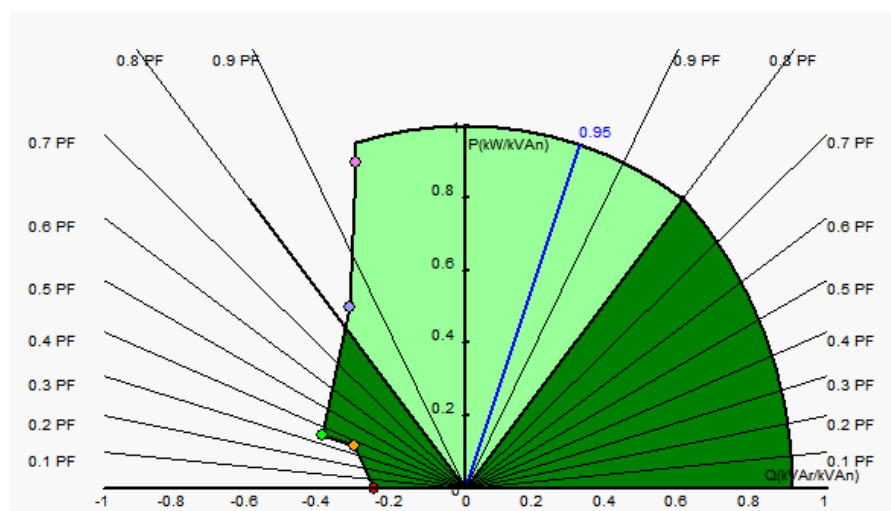
- This regulation is activated by default as soon as the grid breaker is closed. The other regulation modes kVAr or power factor at a grid point, have the priority on this regulation.
- **The reference point** is determined by the different tab: by a fixed value in the configuration. In this case, this value can be changed by the fieldbus.



- If the “Analog input” option is selected, the “Reference via analog input” part becomes active. Select the desired analog input box, determine its mode (+/-10 V, 0/10 V, 4-20 mA, potentiometer) and the power factor values at 0% and 100%. ¹³



NOTE: By moving the cursor, it is possible to view the power factor reference (blue line) on the capability diagram located on the right of the page.



¹³ The power factor reference can be swapped and the limits reversed: the minimum power factor for 100% of the analog input, and the maximum power factor for 0% of the analog input.

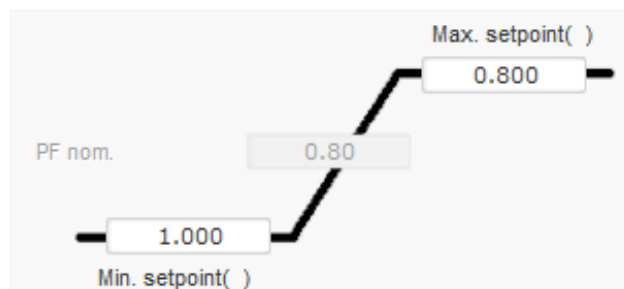
Digital voltage regulator D550

- **With a fixed reference, the reference can be adjusted** by two inputs (up and down), one pulse corresponding to going up one “step” or down one “step”. Both the inputs, the value of the step and the delay need to be fixed, and this adjustment is enabled by setting the selector to “Active”:

The screenshot shows a configuration window titled "Setpoint adjustment". It has a green header bar with a back arrow. Below the header, there are two radio buttons: "Not Active" (unselected) and "Active" (selected). Underneath, there is a "Step +/- PF" field with a value of 0.000. Below that, there are two dropdown menus: "Input -" set to DI6 and "Input +" set to DI7. At the bottom, there is a "Repeat delay (ms)" field with a value of 300.

NOTE: The “+” and “-” inputs are the same for all regulation modes.

- **The limits of this reference** should be fixed according to the machine capability (in the example below, the power factor reference is fixed between 1 and 0.8 (supplying reactive power as seen by the generator)).



These reference limits define the light green area on the capability diagram in which the reference can vary.

6.9.1.4. Regulation of generator kVAr

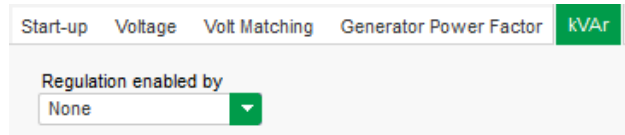
- This regulation must be enabled as soon as the machine is connected to the grid (“grid contactor closing” data item), and disabled as soon as the machine is disconnected from the grid. The grid connection contactor source should be stated at the bottom of the page:

The screenshot shows a configuration field labeled "Grid breaker Input:". Below the label is a dropdown menu with a green arrow pointing down, and the selected value is DI4.

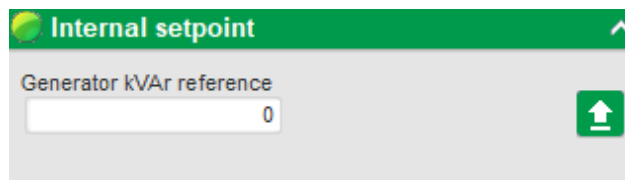
- The other options are regulation of the generator power factor or regulation of the power factor at one point of the grid for machines connected to the grid (see steps 10 and 12).
- This regulation is used to regulate the kVAr value at the machine terminals. For this purpose the alternator current measurement must be connected (1 or 3 current transformers).

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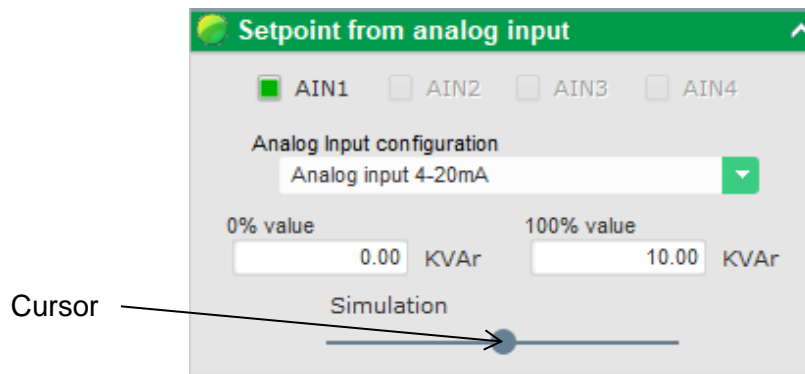
- To enable kVAr regulation, select the activation type from the drop-down list. This can be:
 - Controlled by a digital input (DI1 to DI8).
 - Always enabled by selecting “Always active”. In this case, kVAr regulation is always active, depending on the order of priority of the regulations.
- If “None” is selected, kVAr regulation is never enabled or is enabled by a logic gate.



- The home reference point** is determined by the different tabs: by a fixed value in the configuration. In this case, this value can be changed by the fieldbus.



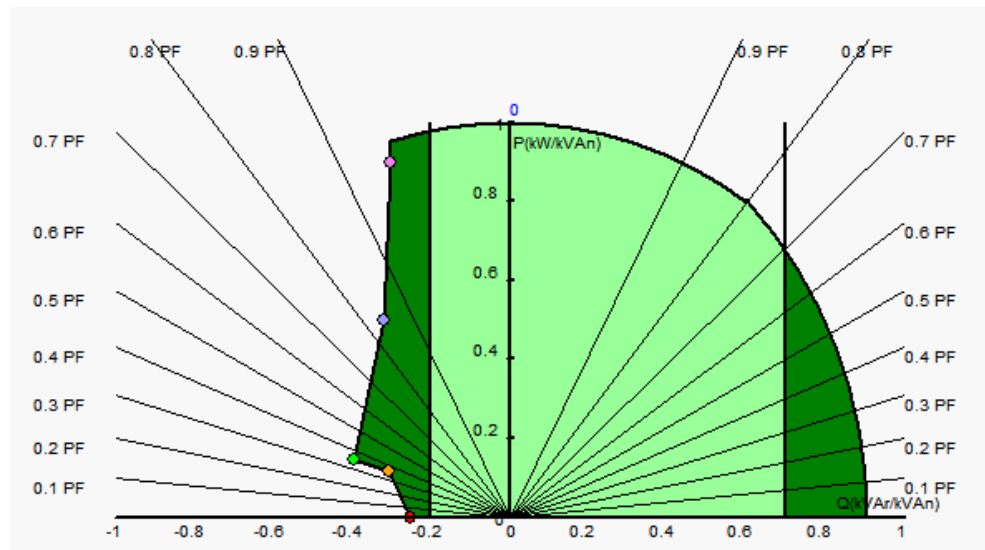
- If the **“Analog input” option is selected**, the “Reference via analog input” part becomes active. Select the desired analog input box, determine its mode (+/-10 V, 0/10 V, 4-20 mA, potentiometer) and the kVAr values at 0% and 100%.¹⁴



NOTE: By moving the cursor, it is possible to view the kVAr regulation (blue line) on the capability diagram located on the right of the page.

¹⁴ The kVAr regulation terminals can be swapped and the limits reversed: the minimum value for 100% of the analog input, and the maximum value for 0% of the analog input.

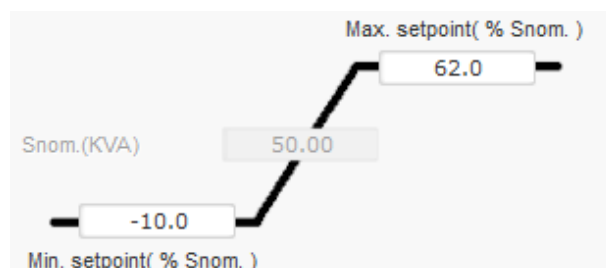
Digital voltage regulator D550



- **With a fixed reference, the reference can be adjusted** by two inputs (up and down), one pulse corresponding to going up one “step” or down one “step”. Both the inputs, the value of the step and the delay need to be fixed, and this adjustment is enabled by setting the selector to “Active”:

NOTE: The “+” and “-” inputs are the same for all regulation modes.

- **The limits of this reference** should be fixed according to the machine capability (in the example below, the kVAr regulation is fixed between -10% of the alternator rated kVA power (drawing reactive power as seen by the generator) and 62% of the alternator rated kVA power (supplying reactive power as seen by the generator)).

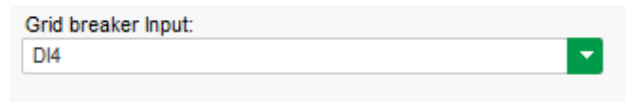


These reference limits define the light green area on the capability diagram in which the reference can vary.

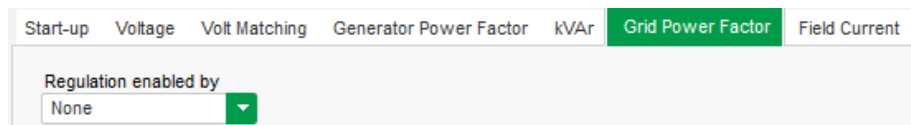
Digital voltage regulator D550

6.9.1.5. Regulation of power factor at one point of the grid

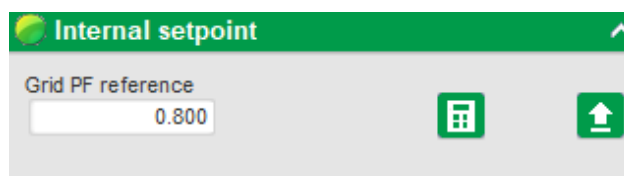
- This regulation must be enabled as soon as the machine is connected to the grid “grid contactor closing” data item) and disabled as soon as the machine is disconnected from the grid. The grid connection contactor source should be stated at the bottom of the page:



- The other options are regulation of the generator power factor and kVAR regulation for machines connected to the grid (see steps 10 and 11).
- This regulation is used to regulate the power factor at one point of the grid. For this purpose, the alternator current measurement must be connected.
- To enable regulation of the power factor at one point of the grid, select the activation type from the drop-down list. This can be:
 - Controlled by a digital input (DI1 to DI8).
 - Always enabled by selecting “Always active”. In this case, regulation of the power factor at one point of the grid is always enabled, according to the order of priority of the regulations.
- If “None” is selected, regulation of the power factor at one point of the grid is never enabled or is enabled by a logic gate.



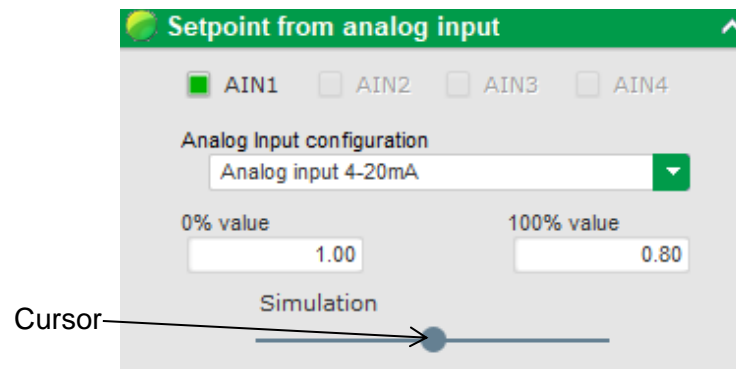
- **The home reference point** is determined by the different tabs: by a fixed value in the configuration. In this case, this value can be changed by the fieldbus.



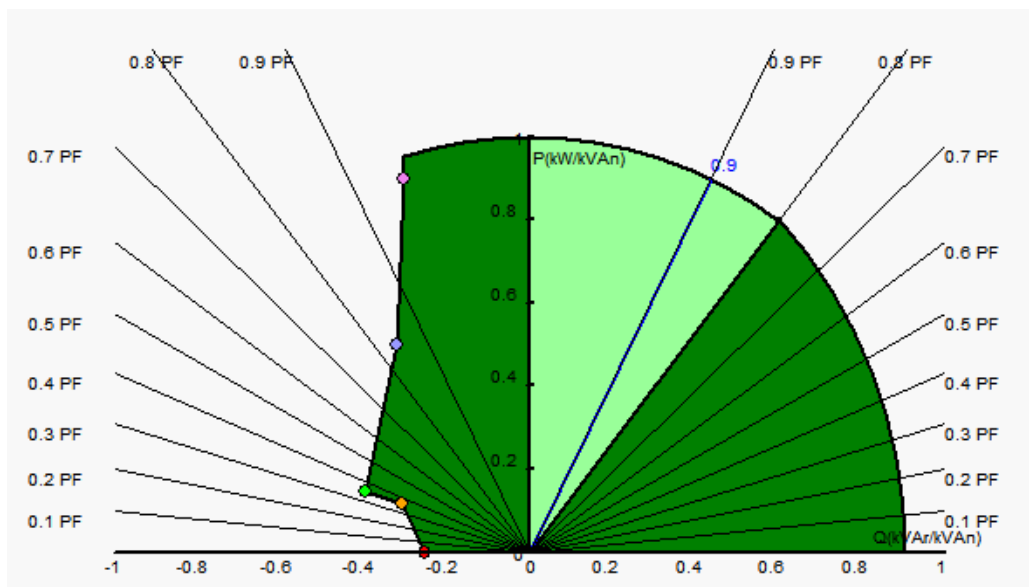
- If the “Analog input” option is selected, the “Reference via analog input” part becomes active. Select the desired analog input box, determine its mode (+/-10 V, 0/10 V, 4-20 mA, potentiometer) and the power factor values at 0% and 100%.¹⁵

¹⁵ The minimum and maximum power factor reference terminals can be swapped and the limits reversed: the minimum power factor for 100% of the analog input, and the maximum power factor for 0% of the analog input.

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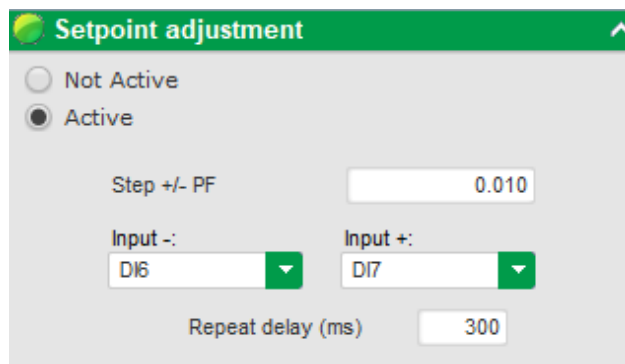


NOTE: By moving the cursor, it is possible to view the power factor reference (blue line) on the capability diagram located on the right of the page.



NOTE: This capability diagram is fictitious because it describes evolution of the power factor at one point of the grid, not at the alternator terminals.

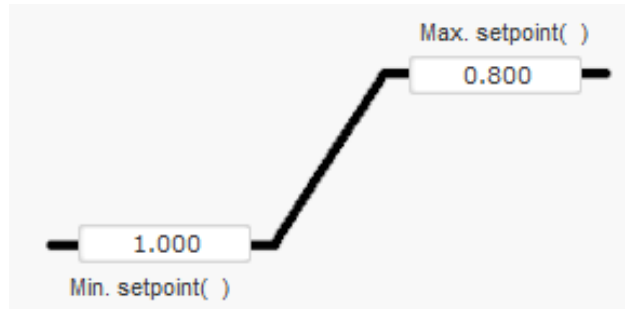
- With a fixed reference, the reference can be adjusted by two inputs (up and down), one pulse corresponding to going up one “step” or down one “step”. Both the inputs the value of the step and the delay need to be fixed, and this adjustment is enabled by setting the selector to “Active”:



NOTE: The “+” and “-” inputs are the same for all regulation modes.

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- The limits of this reference should be fixed as required. In the screenshot below they are 1 and 0.8 (supplying reactive power as seen by the generator). The active limits should be those of the alternator to keep the machine in its capability diagram, but also those fixed in this page. In certain conditions, there can be a grid power factor reference limit without actually being at the limit of this reference because the machine power factor reference is active.



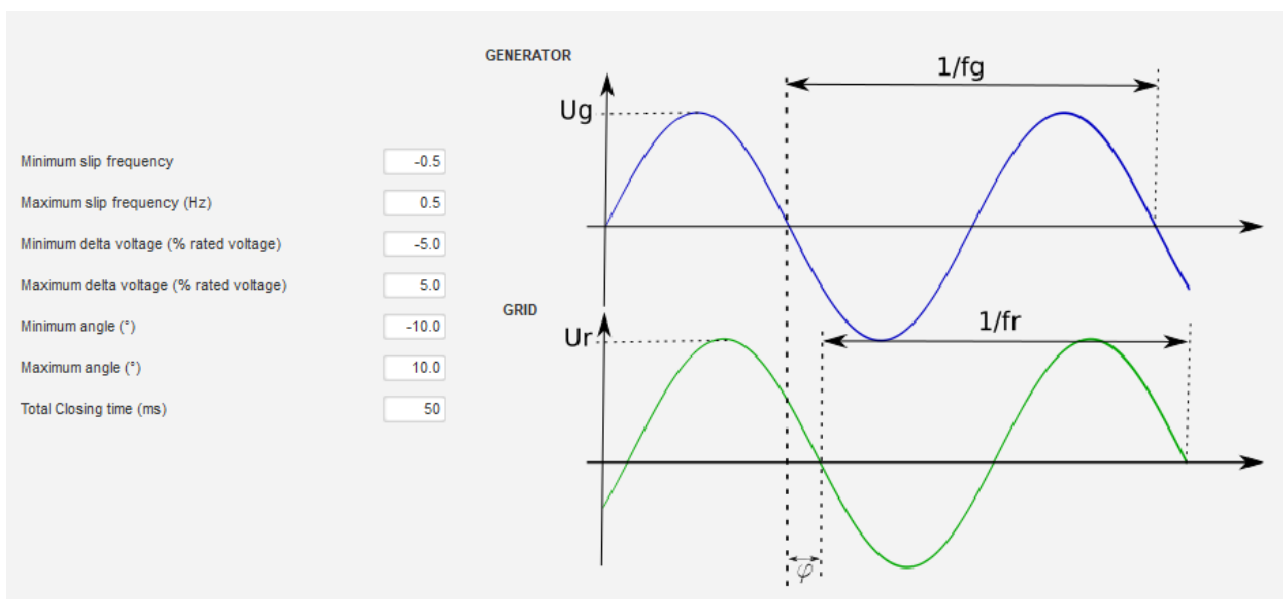
These reference limits define the light green area on the capability diagram in which the reference can vary.

6.10. Synchronization

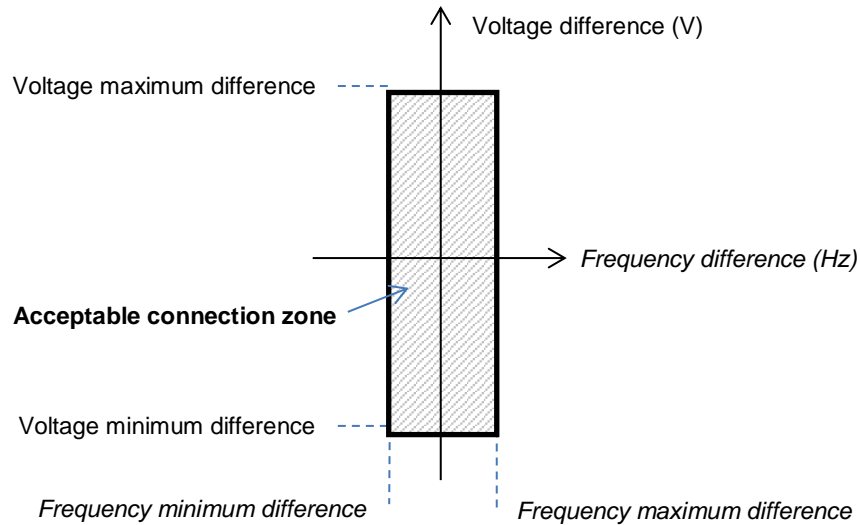
As long as the grid code voltage measurement is wired, the D550 is capable of running the grid synchronization sequence. In this case, check that the phase order is correct (since the D550 does not do this) and that the grid and the generator have the same measurement type (single-phase, or three-phase).

The frequency, voltage and phase angle ranges must then be set. These must be complied with so that connection can take place without damaging the machine.

The closing time of the circuit breaker between the alternator and the grid must also be configured. This ensures that synchronization can be performed and completed before leaving of the configured connection zone.



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The synchronization sequence is controlled by a parameter which is kept active (controllable from an input, communication, or a logic gate).

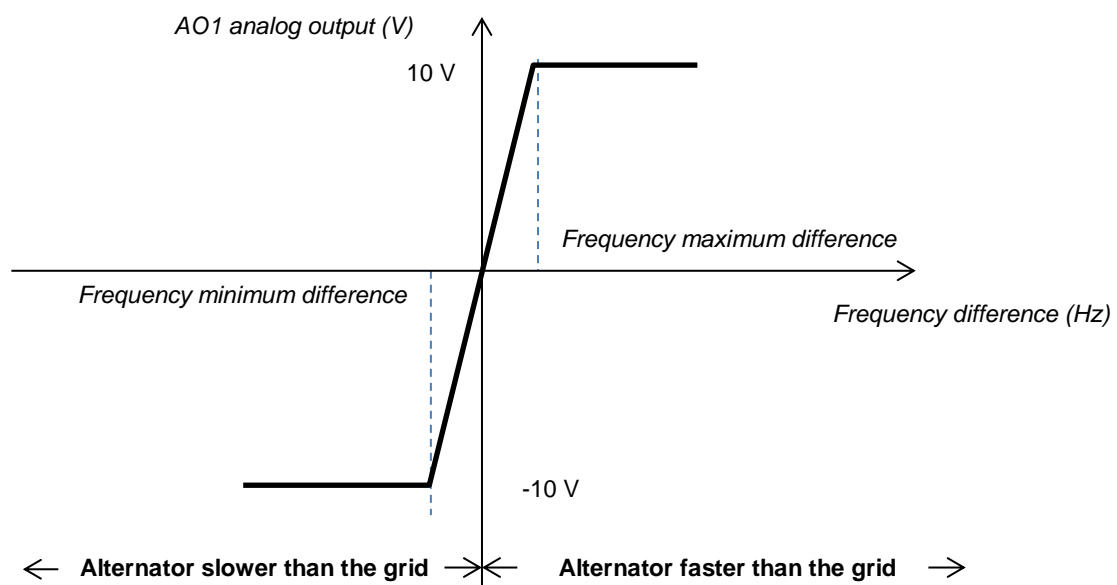
The possible synchronization pulse remains active as long as the frequency difference and voltage difference are in the range defined by the upper and lower limits. A signal should therefore be provided for closing the grid connection contactor.

The frequency difference can be used to control an analog output to inform the genset controller (or any other control device) that the driving system frequency needs to be increased or decreased. The parameters should be set in the "I/O" page. An example for a frequency difference between -0.5 Hz and +0.5 Hz is given below.

Analog Inputs/Outputs									
ID	Configuration AI	Destination	0% value	100% value	Source	Configuration AO	0% value	100% value	
AI01	4-20mA	None	0.00	0.00	Delta frequency for synchronisation	+/-10V	-0.5	0.5	
AI02	0-10V	None	0.00	0.00	None	None	0	0	

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This corresponds to the following diagram:



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6.11. Grid code

Grid code function allows activating one or several protections detect faults coming from the grid, as LVRT events (Low Voltage Ride Through) or FRT (Fault Ride Through). These events can damage the generator. 4 independent functions are embedded in the D550:

- Voltage measurement monitoring for grid code fault
- Grid code profile monitoring
- Pole slipping monitoring
- Maximum stator current monitoring

It allows saving some parameters as well, as for example generator voltage measures, generator current measures or internal angles.

This function is available when the option coder is mounted and Easy Log module is wired.

6.11.1.1. Voltage measurement monitoring

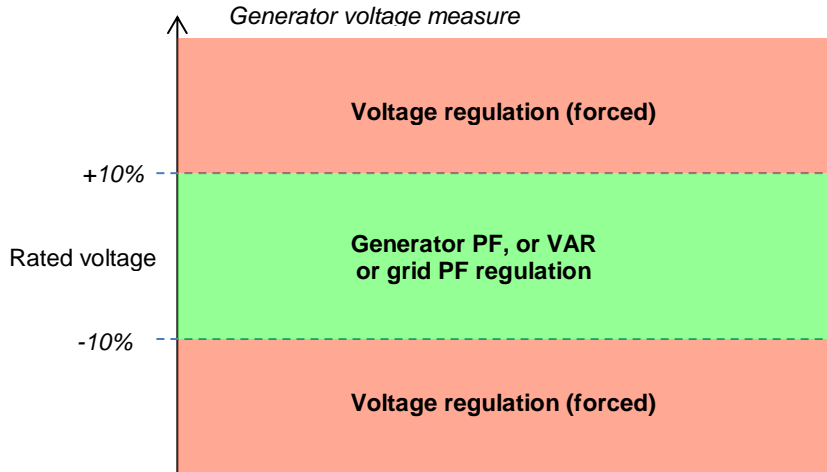
This device is activated by selecting "Enable voltage monitoring in PF mode". A delay before switching to voltage mode can be configured (in ms), as well as the voltage difference in percentage of the rated grid voltage and the voltage difference in percentage of the rated grid voltage.

The screenshot shows the 'GridCode' configuration interface. At the top, there is a title bar with 'GridCode' and navigation buttons: a dropdown arrow, a left arrow, a 'Previous' button, a 'Next' button, and an up arrow. Below the title bar, there are four tabs: 'Profil', 'Functions', 'Regulations', and 'Setpoint variation'. The 'Functions' tab is selected. The main content area contains several configuration options:

- Enable pole slipping detection
- Enable I stator Max
- Enable voltage monitoring in PF mode
- Delay before switching to voltage regulation (ms):
- Difference in % of nominal grid voltage:
- Grid rated voltage (V):
- Enable high voltage monitoring in PF mode

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When the measured voltage is outside the predefined range, the voltage regulation mode is activated and enables to sustain the grid by absorbing or producing reactive power, for example, with a difference of 10%:

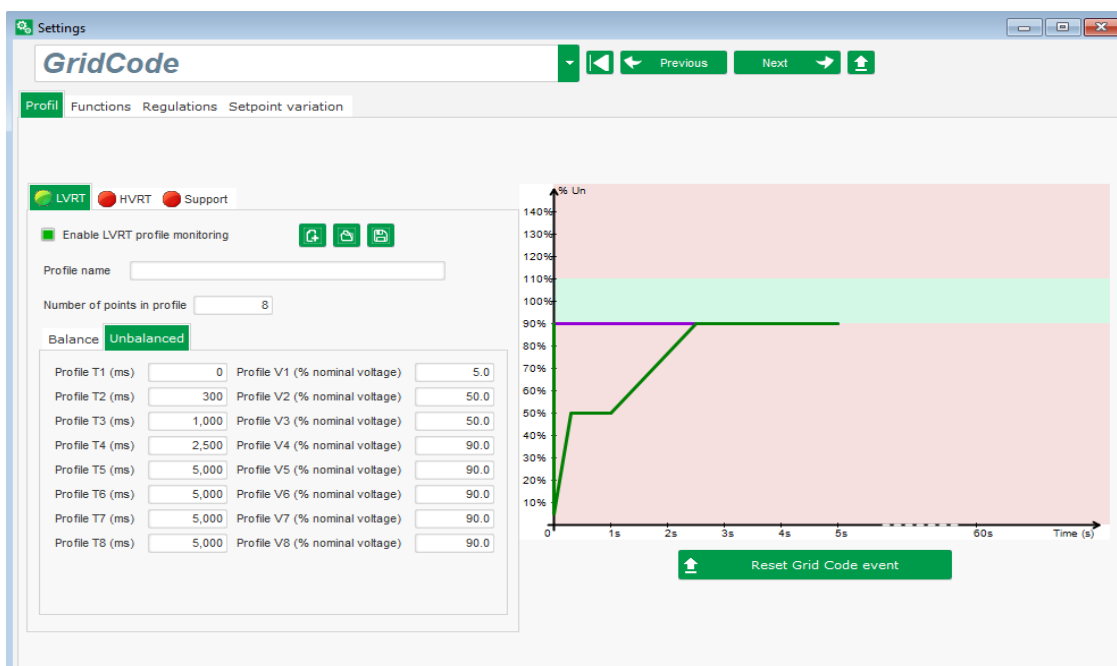


Status of this monitoring can be affected to a logical output or used in logical functions. Below an example with this fault addressed on output DO2 in "Inputs/Outputs page".

Digital Outputs		
Source	Active	Digital Output
None	Active Low	DO1
Voltage monitoring state	Active Low	DO2

6.11.1.2. Grid code profile monitoring

This function is activated by selecting "Enable grid code profile monitoring". It's also imperative to fill in values of the profile, imposed by the grid code standard applied in the location where the D550 is implemented. It allows monitoring that generator voltage is always at least greater or equal to the value given in the profile, as soon as the grid code event is started. If the voltage is lower than the value determined by the profile, the fault flag is activated.



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The status of this monitoring can be affected to a logical output or used in a logical function. Below an example with this fault addressed on DO2 in "Inputs/outputs" page.

Digital Outputs		
Source	Active	Digital Output
None	Active Low	DO1
State of grid code profile monitoring	Active Low	DO2
None	Active Low	DO3

6.11.1.3. Stator current monitoring

This protection is activated by selecting "Enable I stator Max" and giving values for maximum current hat the generator can withstand (in times of rated stator current). Such an over current can occur when the grid recovers after a grid code fault, if the difference between angular position of the rotor and electric angle is too high.

The measure of overcurrent is realized with a dedicated CT connected on "Grid code" CT input. Values for the primary and the secondary have to be set in "Wiring" page. Hereunder is an example with a coefficient set at "2".

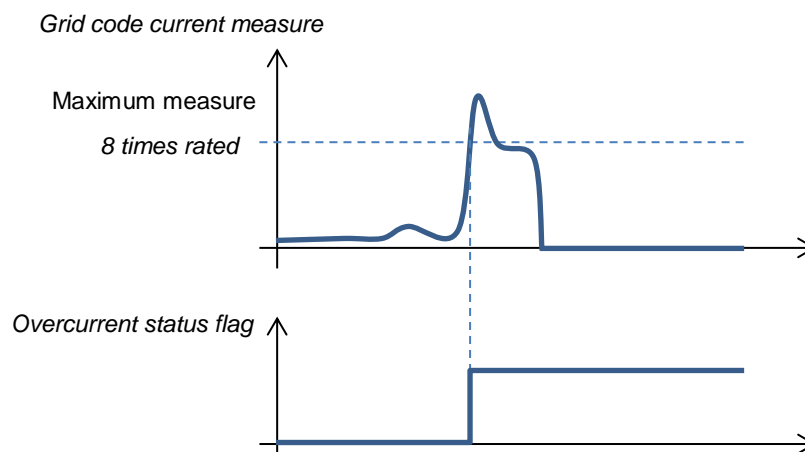
Enable I stator Max

I stator maximum coeff

NOTE: as the overcurrent is very fast, the fault status won't be an auto reset fault.

The overcurrent status can be affected to an output or used in a logical function. Below, an example with this fault affected on DO2 in "Inputs/outputs".

Digital Outputs		
Source	Active	Digital Output
None	Active Low	DO1
Max I stator detection state	Active Low	DO2
None	Active Low	DO3



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6.11.1.4. Pole slipping monitoring

This monitoring system is possible only if an encoder is wired and plugged in the D550 encoder input.

This function is available when the optional coder is mounted and an Easy Log module is wired.

This function is activated by selecting "Enable pole slipping detection" and giving values for the different parameters:

- Alert angle value (in degrees)
- Maximum angle (in degrees)
- Encoder resolution (in points)
- Encoder offset
- Number of generator pole pairs

The internal angle monitoring, when grid voltage is significantly reduced or lost, controls that the generator internal angle does not exceed a defined value. Indeed, if the internal angle is shifted, when the grid reappears, important mechanical and electrical damages can occur, and can lead to destruction of some elements in the generator.

An auto-calibration function for pole slipping is also possible.

Enable pole slipping detection

Value alert angle Encoder offset

Value maximum angle Pole pair

Encoder resolution

The pole slipping status can be affected to an output or used in a logical function.

6.12. Comparison window

This window is available by clicking on the button in the home page banner:



The "Comparison" is used to:

- Compare the D550 configuration with a file
 - Click on the file 1 "... " button to select the configuration file.

File 1

File 2

- Click on the "Run the comparison between the AVR and the file" button.
- The modified parameters appear in the list below.

Parameter Number	Parameter name	AVR Value	Unit
002.008	Cross Current Enable	Active	Not active
002.010	Stator current Limit Enable	Active	Not active
002.017	LAM Engine Help	Enabled	Not enabled
002.020	Soft Voltage Recovery	Enabled	Not enabled
003.001	Voltage regulation proportional gain	7000	9000
003.002	Voltage regulation integral gain	100	120

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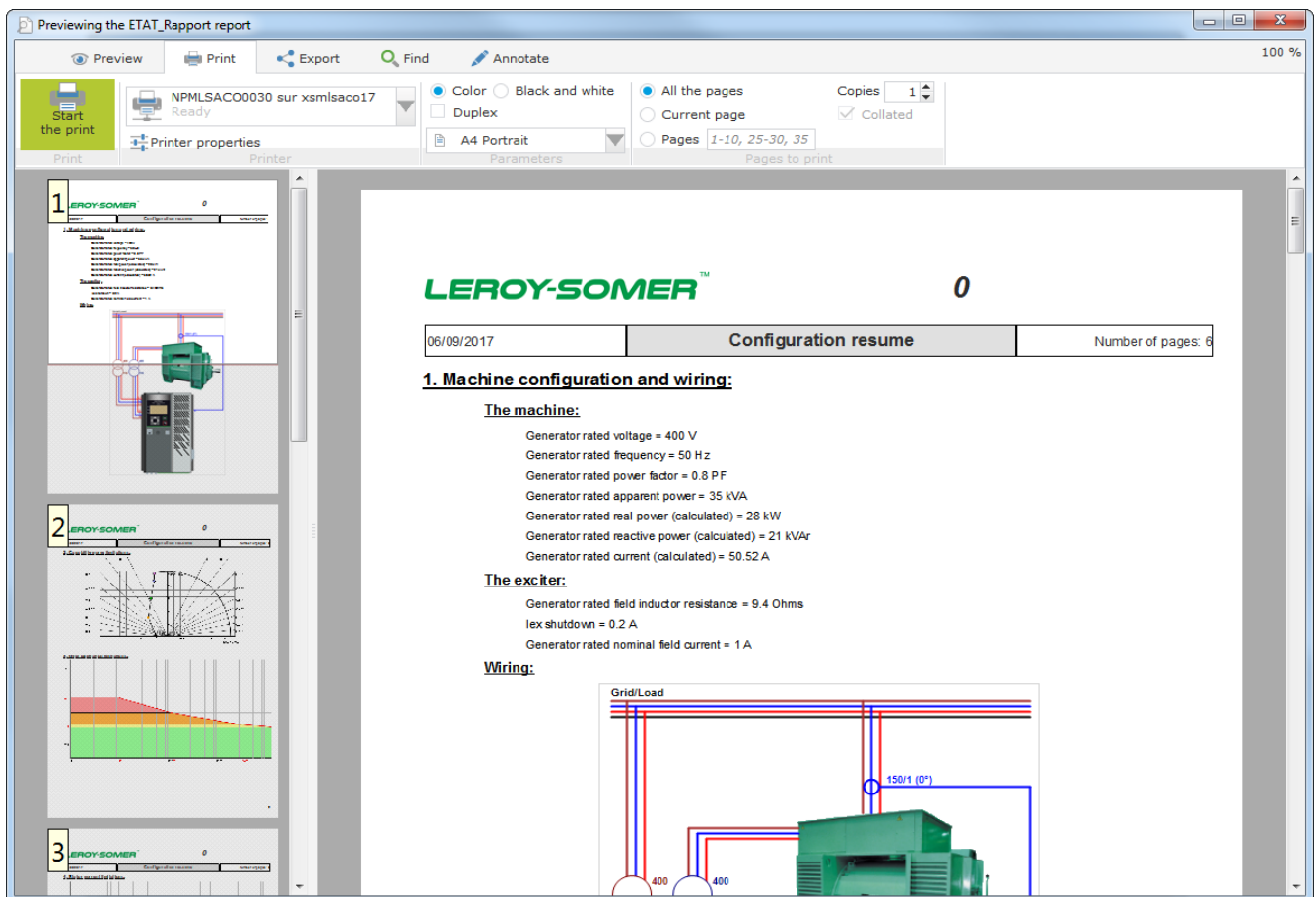
- **Compare two configuration files**
 - Click on the file 1 “...” button to select the first configuration file.
 - Click on the file 2 “...” button to select the second configuration file.
 - Click on the “Compare” button on the right.



- The modified parameters appear in the list.

6.13. Print reports

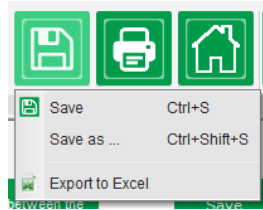
To obtain a of the configuration as a report is possible using "Print" button (this one is active only if settings page is open). This report indicates configuration data of the regulator. A form is opened and this report can be printed or/and exported in another format.



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6.14. Excel Export

Configuration can be exported as an excel file by a click on the Save button arrow:



The file created contains each parameter with:

- Identifier (Id)
- Parameter name
- Minimum value
- Maximum value
- Value “measured”
- Default value
- Unit

Values in grey are “read only” access, others are in read/write.

Id	Parameter name	Minimum value	Maximum value	Value	Initial value	Unit
000.000	Monitor Menu					
000.001	U	0	100000	0	0	V
000.002	I	0	10000	0.0	0	A
000.003	P	0	1000000	0	0	kW
000.004	PF	-1	1	0.000	0	PF
000.005	F	0	500	0.0	0	Hz
000.006	U21	0	100000	0	0	V
000.007	U32	0	100000	0	0	V
000.008	U13	0	100000	0	0	V
000.009	I1	0	10000	0.0	0	A
000.010	I2	0	10000	0.0	0	A
000.011	I3	0	10000	0.0	0	A
000.012	Q	0	1000000	0	0	kVAR
000.013	S	0	1000000	0	0	kVA
000.014	If	0	50	0.00	0	A
000.015	Vf	0	500	0.0	0	V
000.016	Vbus	0	500	0.0	0	V
001.000	SystemData					
001.001	Voltage UN	0	100000	44	0	V
001.002	Voltage VN	0	100000	44	0	V
001.003	Voltage WN	0	100000	45	0	V
001.004	Voltage UV	0	100000	77	0	V
001.005	Voltage VW	0	100000	77	0	V
001.006	Voltage WU	0	100000	77	0	V
001.007	Line Current U	0	10000	5.2	0	A

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7. Maintenance instructions

7.1. Warning symbols



See section safety chap 1.4.

Preventive maintenance on the D550 AVR should be performed with the alternator stopped, and all power sources switched off and isolated.

7.2. Preventive maintenance instructions

During phases of alternator downtime for preventive maintenance, check that the wires are tight in the connectors (tightening torque between 0.6 Nm and 0.8 Nm), blow dry air through to get rid of any dust that may have settled on and around the D550. Special care should be taken to ensure free circulation of air around the aluminum heatsink at the back of the device.

The D550 has a timer, accessible via parameter 254.008 (parameter 8 of menu 254) (in hours and minutes). Keep an eye on the running time and if this exceeds 40,000 hours, consider changing the AVR.

NOTE: This timer is only incremented every 10 minutes, and only if the voltage reference is reached.

7.3. Anomalies and incidents

A number of anomalies can occur on the AVR which may lead to its replacement. The main faults are listed in the table below:

ANOMALIES	CAUSES	REMEDIES	RESTARTING
Voltage sensing fault	Alternator sensing VT broken	Replace faulty VT	Stop the alternator and once the faulty VT has been replaced, restart the alternator
	Internal measurement broken	Replace the AVR	Replace the AVR as described in section 7.4
Excitation fault	Faulty component or opening of the field excitation circuit which caused a voltage surge on the transistor	Replace the AVR	Replace the AVR as described in section 3.5
24 VDC auxiliary supply fault	External supply fault	Replace the 24 VDC power supply	Stop the alternator and once the faulty power supply has been replaced, restart the alternator
	Voltage converter fault	Replace the AVR	Replace the AVR as described in section 3.5
The AVR is not responding (display frozen, no communication, etc.)	Microcontroller fault	Replace the AVR	Replace the AVR as described in section 3.5

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ANOMALIES	CAUSES	REMEDIES	RESTARTING
The regulation mode controlled by an input is not active	Faulty input	Switch control of the regulation mode to another input	Stop the alternator and once the new settings have been entered, restart the alternator
		Replace the AVR	Replace the AVR as described in section 3.5
	The wiring is faulty	Check that the input has been enabled by shunting the 0 V and the local input and checking the input state on the HMI	Restart the alternator
The field excitation does not start	Faulty starting input	Switch control of starting to another input	Stop the alternator and once the new settings have been entered, restart the alternator
	The AVR power is not switched on	Check the VBus voltage on the HMI	Restart the alternator
	The 24 VDC power supply is faulty	Check that the AVR is powered up by looking at the HMI LEDs (green power LED on)	Restart the alternator
Regulation of the power factor is unstable	The active power is too low to have a correct power factor measurement	Use kVAr mode for low load regulation (less than 10% of rated load)	Change the AVR settings and restart the alternator
	The stator current measurement is incorrect	Check the CT wiring on the current measurement input and the CT	Restart the alternator
		Replace the AVR if the wiring is correct	Replace the AVR as described in section 3.5

Digital voltage regulator D550

7.4. Replacing a faulty AVR

These operations must be performed by qualified staff. See the warning symbols in section 2.2.

To replace a faulty D550 AVR, proceed as follows:



- Stop the alternator if not already done.
- Switch off and electrically isolate the auxiliary supply and power supply, and check that no voltage is present.
- Carefully remove all the AVR connectors, noting their position.
- Undo all the AVR mounting brackets so it can be removed from its position.
- If you do not have the AVR configuration file, the factory output configuration can be found on the D550 SD card.
- Still using the PC software, export the retrieved configuration to the new D550 AVR.
- Disconnect the D550 USB stick.
- Fix the new D550 in place of the faulty AVR.
- Reconnect all the connectors on the new AVR.
- Power up the auxiliary supply and check that the AVR is energized
- Start up the alternator drive system.
- Power up the power supply without exciting the machine.
- Before exciting the alternator, check the alternator voltage measurement and power supply voltage (VBus).
- Switch on the alternator excitation.
- Check all the AVR measurements and regulation modes, and any controlled outputs.

Digital voltage regulator D550

8. Recycling instructions

LEROY-SOMER is committed to minimizing the environmental impacts of its manufacturing operations and of its products throughout their life cycle. To this end, we operate an Environmental Management System (EMS) which is certified to the International Standard ISO 14001.

The automatic voltage regulators manufactured by LEROY-SOMER and KATO ENGINEERING have the potential to save energy and (through increased machine/process efficiency) reduce raw material consumption and scrap throughout their long working lifetime. In typical applications, these positive environmental effects far outweigh the negative impacts of product manufacture and end-of-life disposal.

Nevertheless, when the products eventually reach the end of their useful life, they must not be discarded but should instead be recycled by a specialist recycler of electronic equipment. Recyclers will find the products easy to dismantle into their major component parts for efficient recycling. Many parts snap together and can be separated without the use of tools, while other parts are secured with conventional fasteners. Virtually all parts of the product are suitable for recycling.

Product packaging is of good quality and can be re-used. Large products are packed in wooden crates; while smaller products come in strong cardboard cartons which themselves have high recycled fiber content. If not re-used, these containers can be recycled. Polythene, used on the protective film and bags for wrapping product, can be recycled in the same way. When you will be preparing to recycle or dispose of any product or packaging, please observe local legislation and best practice.

Digital voltage regulator D550

9. APPENDIX

9.1. Vector permutations

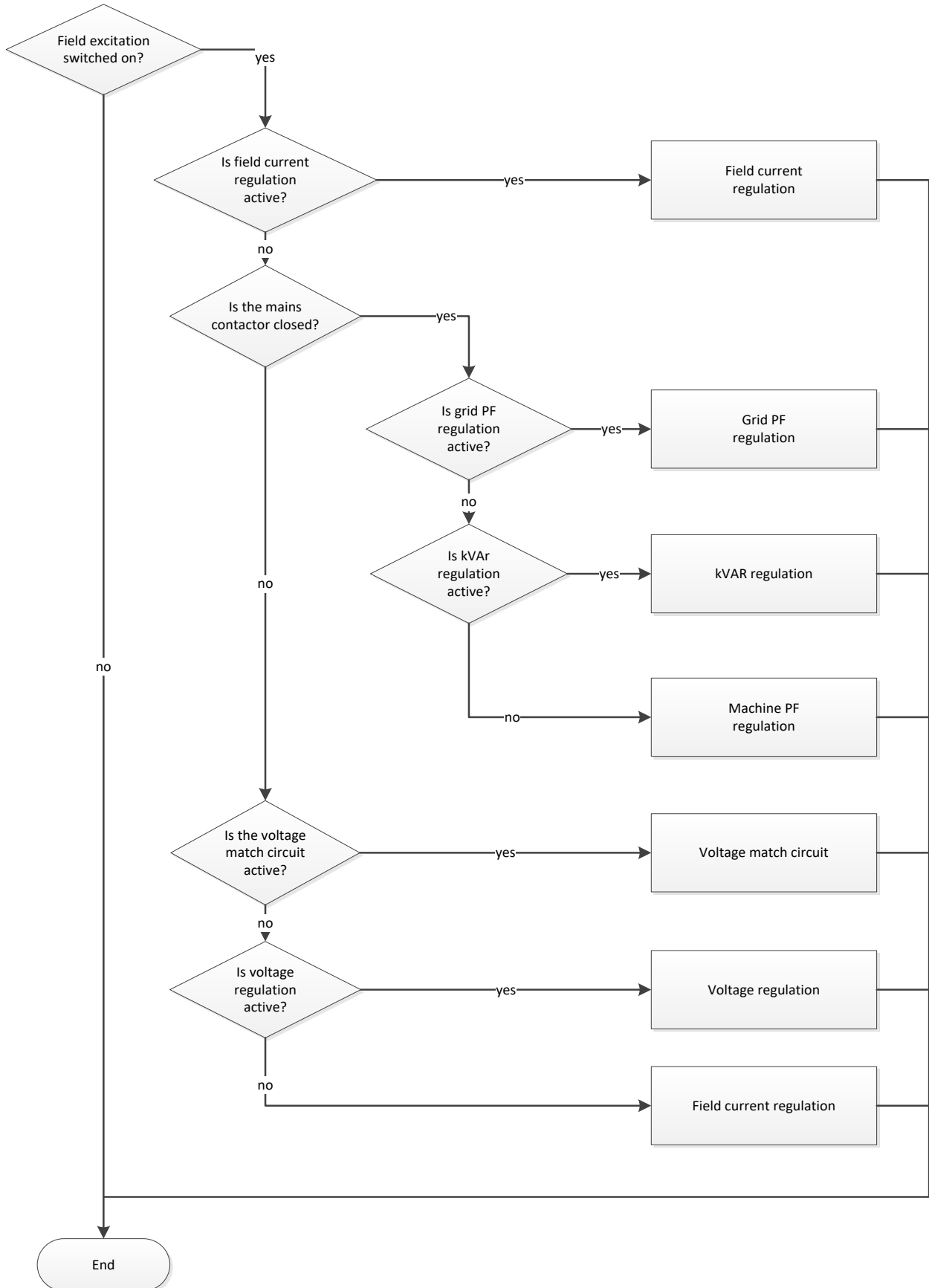
If only one stator current measurement CT is wired up, the vector permutations can compensate for voltage measurement and current measurement transformer layouts which generate incorrect power and power factor (cos phi) calculations.

The D550 wiring then needs to be altered. The table below gives the possible permutations according to the phase used for the stator current measurement CT.

Position of stator current measurement CT	Alternator direction of rotation (a/c IEC 60034-1)	Alternator voltage measurement			
		AVR terminals	U	V	W
Phase V (standard)	Clockwise	Alternator phases (three-phase measurement)	U	V	W
		Alternator phases (phase/phase single-phase measurement)	U	-	W
	Anti-clockwise	Alternator phases (three-phase measurement)	W	V	U
		Alternator phases (phase/phase single-phase measurement)	W	-	U
Phase U	Clockwise	Alternator phases (three-phase measurement)	W	U	V
		Alternator phases (phase/phase single-phase measurement)	W	-	V
	Anti-clockwise	Alternator phases (three-phase measurement)	V	U	W
		Alternator phases (phase/phase single-phase measurement)	V	-	W
Phase W	Clockwise	Alternator phases (three-phase measurement)	V	W	U
		Alternator phases (phase/phase single-phase measurement)	V	-	U
	Anti-clockwise	Alternator phases (three-phase measurement)	U	W	V
		Alternator phases (phase/phase single-phase measurement)	U	-	V

Digital voltage regulator D550

9.2. AVR regulation mode priority



Service & Support

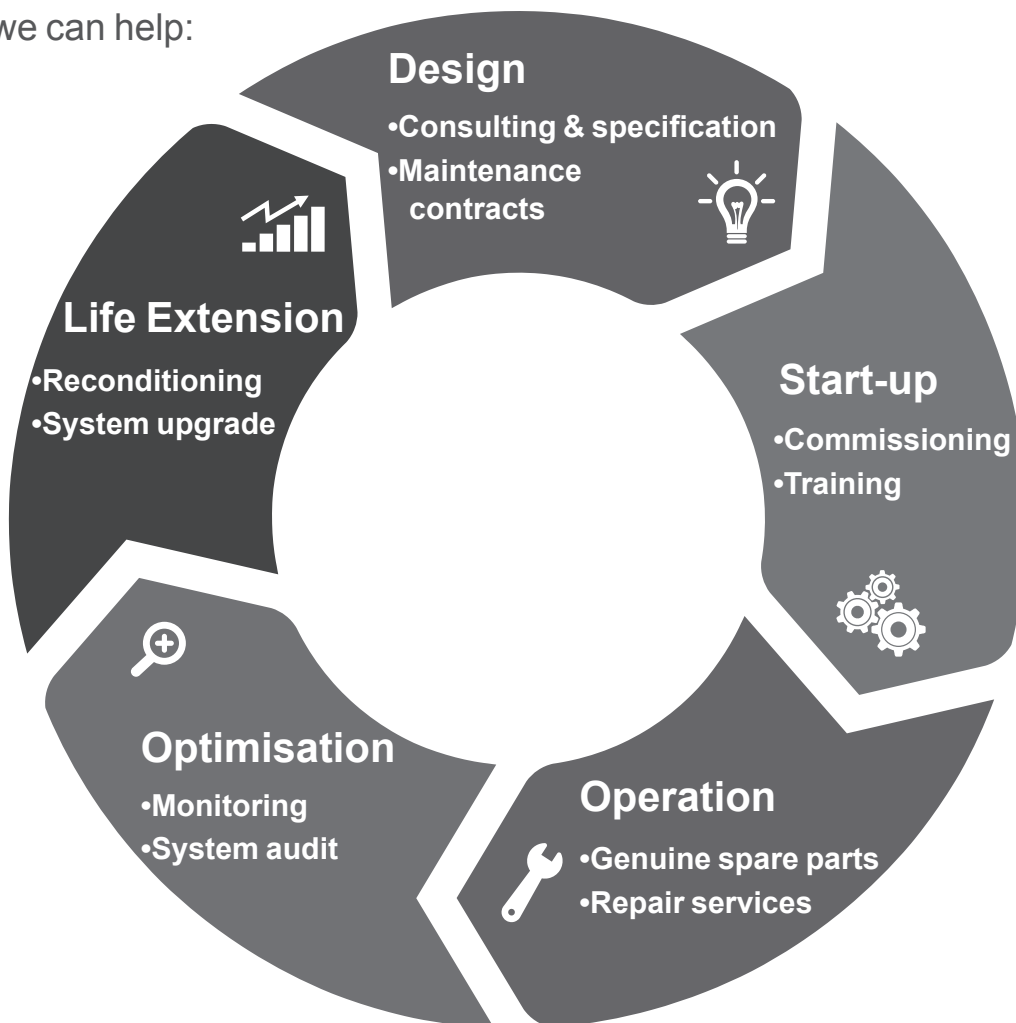
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