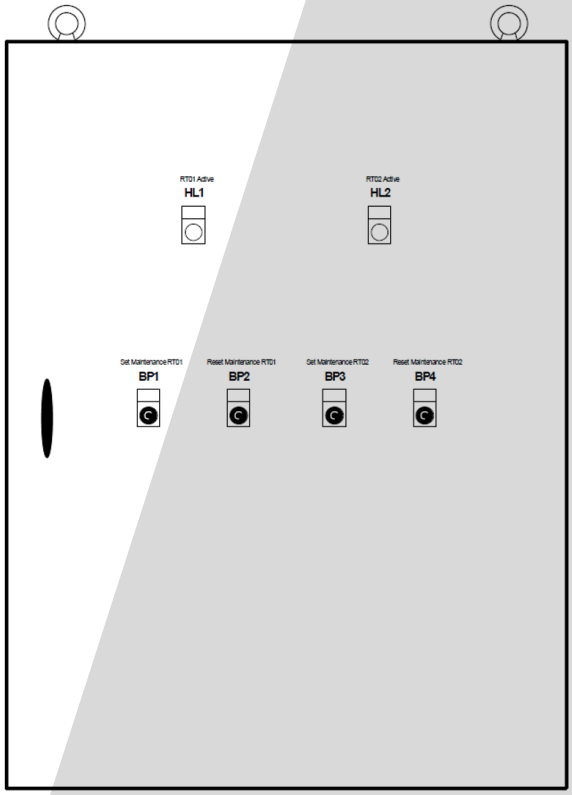
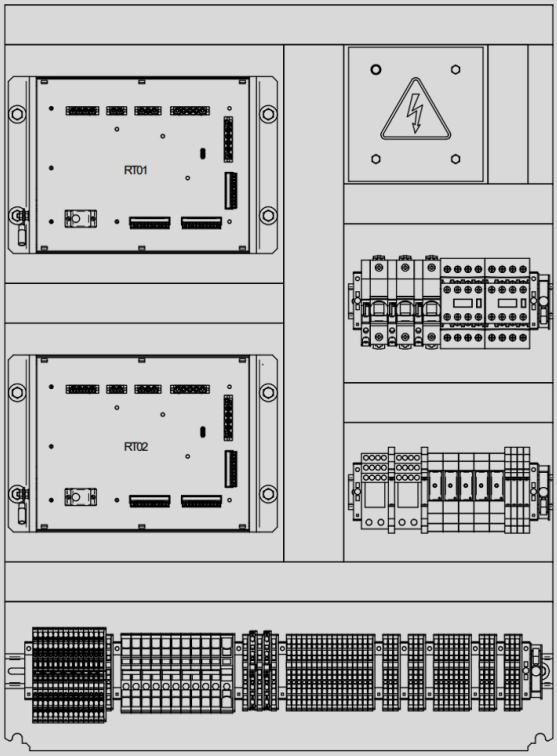
Nidec Power





D550

Dual Cabinet MIL STD 461G

Installation and maintenance

LEROY-SOMER™

D550
Dual Cabinet MIL STD 461G

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.

For field applications relative to for instance nonlinear loads, transformers magnetizations or huge load impacts and load shedding, it is highly recommended to contact our technical support service in order to fine tune the factory settings of the voltage regulator.

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.

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D550
Dual Cabinet MIL STD 461G

Table of contents

D550
Dual Cabinet MIL STD 461G

1. General instructions

1.1. Identity card

This dual cabinet for generator regulation has been made by:

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Internal Leroy-Somer™ reference: CO 029 4536 & P5 199 0046

1.2. General presentation

1.2.1. Of the product

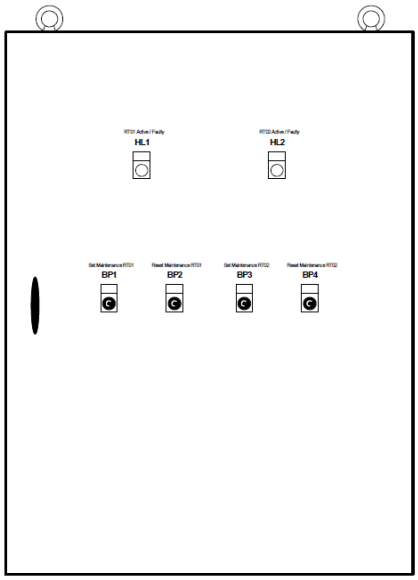
This manual describes the instructions for installation, use, setup, and maintenance of the dual cabinet D550.

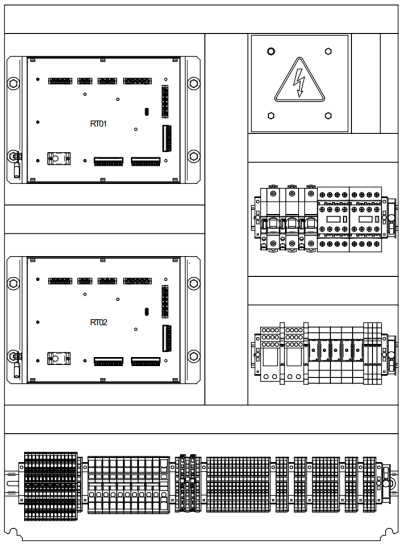
This cabinet is for the regulation of generators with field current of up to 7 A in continuous operation, and 15 A maximum in short-circuit conditions for 10 seconds maximum.[1]

These cabinets must provide the minimum conditions for protection and safety of electrical installations up to 300 VAC phase/neutral, in force in the place where the cabinet is installed.

It consists of a frame equipped with two AVRs, and a set of relays and terminals. To make it easy to remove and replace a faulty AVR, even when the generator is still running, a set of disconnect terminals has been installed on the measuring and power supply circuits of each AVR.

Note: For more information on AVR operation, please refer to the installation and maintenance manual for D550 AVRs (reference: 5744en).





[1] These values are given for a temperature of 25°C. See the detailed technical specifications for the complete values.

1.2.2. Of the equipment

The dual cabinet D550 allows switching from one AVR to a second one, while the generator is running.

To make this switching happen, different components come into play:
- The D550 AVRs exchange information via a CAN communication bus.
- Two contactors allow switching of the generator field circuit.
- Two freewheel diode modules, connected on the field circuit, to ensure it never opens.

All the controls:
- 5 configurable inputs, hard-wired to deliver the same information to each AVR for the regulation modes, ramp start, etc.
- A set of 2 dedicated inputs on each AVR for manual switching between the two.
- A set of 2 configurable outputs on each AVR for general alarm and trip.

Each AVR has 4 operating modes:
- **Active**: The AVR is running and controlling the generator field current.
- **Online**: The AVR is ready and waiting, its regulation mode is the same as the active AVR. However, it is not controlling the field current.
- **Maintenance**: The AVR has stopped, for example while waiting to be replaced.
- **Fault**: The AVR has stopped due to a fault.

1.3. Technical characteristics

Cabinet equipped with two AVRs for generators, with the following main regulation functions: voltage, power factor, voltage match circuit, kVAR, power factor at the delivery point, manual mode.

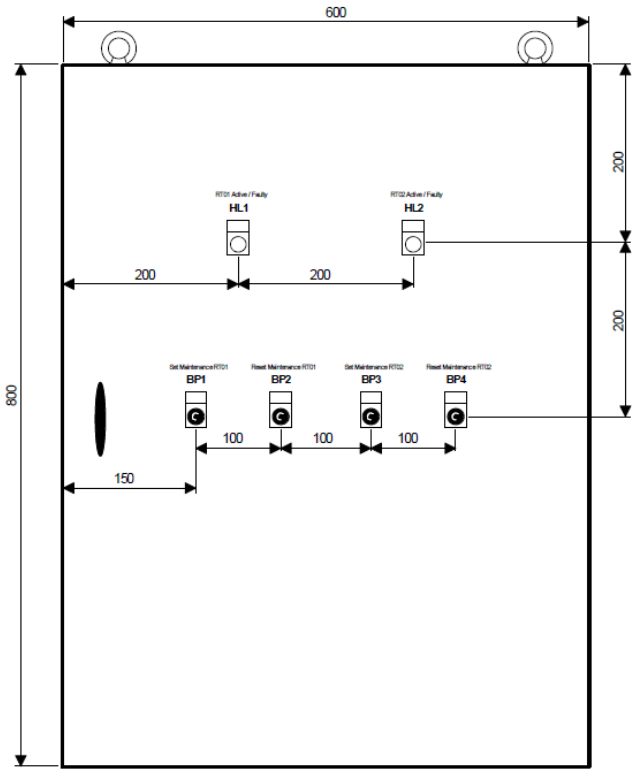
For each AVR:
- **Generator voltage sensing:**
  - 2 phases or 3 phases — 0-530 VAC rms max
  - Consumption — < 2 VA
- **Mains voltage sensing:**
  - 2 phases — 0-530 VAC rms max
  - Consumption — < 2 VA
- **Stator current measurement with a CT:**
  - 1 or 3 phases
  - Range — 0-1 A or 0-5 A (300% max. 30 s)
  - Consumption — < 2 VA
- **Power supply:**
  - 4 terminals for PMG, AREP, SHUNT
  - 2 separate circuits
  - Range — 50-277 VAC (115% max. 2 minutes)
  - Consumption — < 3000 VA
- **Field current:**
  - Rated — 0-25 A
  - Short-circuit — max. 50 A, at 25°C
  - Field winding resistance — > 4 Ohm
- **DC auxiliary supply**
  - Range — 0-35 VDC (rated power: 12V or 24V)
  - Consumption — < 1A
- **Frequency measurement:**
  - Range — 30-400 Hz

For the cabinet:

- D550 AVRs:
  - Voltage regulation accuracy: +/-0.25% of the rated value, as an average of the three phases on a linear load, with harmonic distortion of less than 5%
  - Voltage adjustment range: 0 to 150% of the rated voltage by means of volt-free contacts or an analogue input or CANBUS
  - Quadrature droop adjustment range: -20% to 20%
  - Underspeed protection: integrated, adjustable threshold, slope adjustable k x V/Hz with 0,5<k<5
  - Field excitation ceiling: can be adjusted by the configuration at 3 points.
  - Environment: ambient temperature of -40°C to +70°C, relative humidity up to 95%, no condensation, cabinet-mounted with vibration level up to +/1 mm for frequencies from 0 to 25 Hz and less than 2 g for frequencies from 25 to 100 Hz.

- AVR parameters set with the "EasyReg Advanced" software provided or using communication interfaces.

- Dimensions:
  - Height: 800 mm
  - Width: 600 mm
  - Depth: 200 mm
- Weight: 42 kg



1.4. Safety devices and general safety instructions

For the user's own safety, the dual cabinet D550 must be connected to approved earth terminals on the installation. The tools needed to make this connection are not included with the cabinet.

Note: The 0Vs on the circuit boards of D550 AVRs are connected to earth

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

The dual cabinet D550 contains devices which can, in the event of problems, control generator field weakening or overexcitation. This generator itself can become jammed for mechanical reasons. Finally, voltage fluctuations or power cuts may also cause the unit to stop.

The dual cabinet D550 which is the subject of this manual is designed to be integrated in an installation or an electrical machine and can under no circumstances be a 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 applicable standards, especially safety standards, and to provide any devices required to ensure the safety of equipment and personnel (especially the prevention of direct or indirect contact when the cabinet is powered up).

Nidec Power 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 take note of the different safety instructions provided.

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

This symbol alerts users to a safety instruction warning of electrical danger to personnel.

1.4.1. General information

The dual cabinet D550 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 mean competent people to install, mount, commission and operate the product and possessing the relevant qualifications.

1.4.2. Use

Dual cabinet is 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 conforms with directive 2006/42/EC (Machinery Directive). It is also necessary to comply with standard EN 60204, which stipulates that electrical actuators (which include AVRs) cannot be regarded 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.
Dual cabinet meets the requirements of the Low Voltage Directive 2014/35/EU. The harmonised 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 plate and in the documentation provided must be observed without fail.

1.4.3. Transportation, storage

All instructions concerning transportation, storage and correct handling must be observed.
The climatic conditions specified in this manual must be observed.

1.4.4. Installation

The dual cabinet D550 must be protected against excessive stress. 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 contact parts.
The dual cabinet 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 and/or of electrocution on power-up).

1.4.5. Electrical connection

When work is performed on the dual cabinet D550 while powered up, the national accident prevention regulations must be observed.

The electrical installation must comply with the relevant specifications (for example conductor cross-sections, protection via fused circuit-breaker, 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 an installation in Europe: the current sensors must guarantee initial basic insulation in conformity with the requirements of standard IEC 61869-1, Instrument transformers – "Part 1: General requirements" and IEC 61869-2, "Part 2: Additional requirements for current transformers".
For an installation in the USA: the current sensors must guarantee initial basic insulation in conformity with the requirements of standards IEEE C57.13, "Requirements for Instrument Transformers" and IEEE C57.13.2, "Conformance Test Procedure for Instrument Transformers".

1.4.6. Operation

Installations in which dual cabinet D550s are to be integrated must be fitted with additional protection and monitoring devices as laid down in the current relevant safety regulations, such as the law on technical equipment, accident prevention regulations, etc. Modifications to the D550 parameters using control software is permitted.
Active parts of the dual cabinet D550 and the device live power connections must not be touched immediately after being 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.

1.4.7. 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.

1.4.8. Protection of the equipment

Auxiliary power supply, which is used to provide the AVR and relays, is essential for the operation of the cabinet. It should therefore be connected permanently.

Similarly, the AC AVR power supply, which is used to create the field current, must be protected by fast-blow fuses or circuit-breakers. Its rating should be suitable for the generator on which the cabinet is mounted.

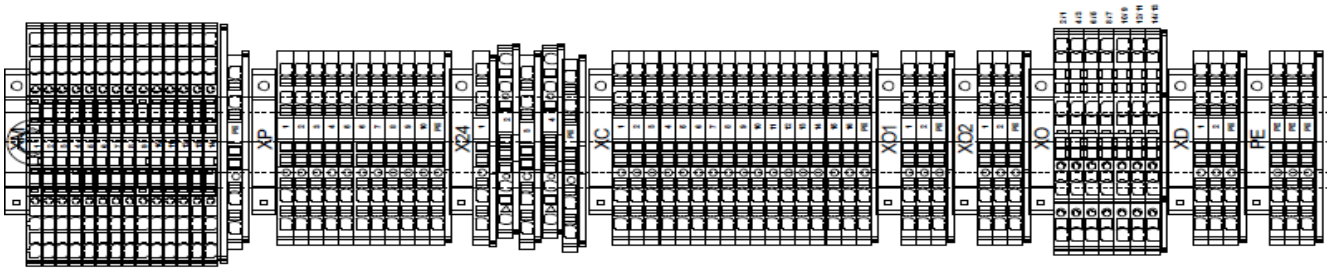
2. Installation instructions

2.1. Layout of the cabinet housing the dual cabinet

The mounting must be vertical.

2.2. Connection block

The cabinet terminal blocks are separated according to their use:



- XM: AVR measurement. These are isolating blade terminals.
- XP: AVR power and field excitation
- X24: 2 x External 24 VDC power supplies
- XC: Regulation mode controls (AVR inputs)
- XO : Output contacts
- XO1: AVR 1 outputs
- XO2: AVR 2 outputs

DO NOT OPEN THESE TERMINAL BLOCKS WHEN THE AVR IS IN "ACTIVE" STATE

Cabinet Terminals	Generator	D550	Connection
XM.1	Phase L1	U	Generator voltage measurement – AVR 1
XM.3	Phase L2	V	
XM.5	Phase L3	W	
XM.2	Phase L1	U	Generator voltage measurement – AVR 2
XM.4	Phase L2	V	
XM.6	Phase L3	W	
XM.7	Phase NW1	L1	Mains voltage measurement – AVR 1
XM.9	Phase NW2	L2	
XM.8	Phase NW1	L1	Mains voltage measurement – AVR 2
XM.10	Phase NW2	L2	
XM.11	Phase L1 – S2	V-S2	Parallel operation CT – AVR 1
XM.12	Phase L1 – S1	V-S1	
XM.13	Phase L2 – S2	V-S2	Parallel operation CT – AVR 2
XM.14	Phase L2 – S1	V-S1	
XP.1	Power	X1	Field power – AVR 1
XP.3	Power	X2	
XP.5	Power	Z1	
XP.7	Power	Z2	

D550
Dual Cabinet MIL STD 461G

Cabinet Terminals	Generator	D550	Connection
XP.2	Power	X1	Field power – AVR 2
XP.4	Power	X2	
XP.6	Power	Z1	
XP.8	Power	Z2	
XP.9	Exciter	E+	+ excitation
XP.10	Exciter	E-	- excitation
X24.1	+24VDC	-	External 24 VDC power supply – AVRs 1 & 2
X24.2	0VDC	-	External 24 VDC power supply – AVRs 1 & 2
X24.3	+24VDC	-	External 24 VDC power supply (Battery Buffered) - Control circuit (cabinet power supply redundancy)
X24.4	0VDC	-	External 24 VDC power supply (Battery Buffered) - Control circuit (cabinet power supply redundancy)
XC.1	-	-	Maintenance mode – AVR 1
XC.2	-	-	Cabinet +24VDC
XC.3	-	-	Maintenance mode reset – AVR 1
XC.4	-	-	Maintenance mode – AVR 2
XC.5	-	-	Common +24VDC for AVR 2 maintenance mode
XC.6	-	-	Maintenance mode reset – AVR 2
XC.7	-	-	DI1 input command – AVR 1 and 2 - Excitation ON
XC.8	-	-	Cabinet +24VDC
XC.9	-	-	DI2 input command – AVR 1 and 2 - Manual Mode
XC.10	-	-	Cabinet +24VDC
XC.11	-	-	DI3 input command – AVR 1 and 2 - Droop enable
XC.12	-	-	Cabinet +24VDC
XC.13	-	-	DI4 input command – AVR 1 and 2 - Up adjustment
XC.14	-	-	Cabinet +24VDC
XC.15	-	-	DI5 input command – AVR 1 and 2 - Down adjustment
XC.16	-	-	Cabinet +24VDC
XO.1	-	-	Digital Output contact – AVR 1 and 2 - General alarm
XO.2	-	-	Output contact – AVR 1 and 2 - General alarm
XO.3	-	-	Output contact – AVR 1 and 2 - Trip
XO.4	-	-	Output contact – AVR 1 and 2 - Trip
XO.5	-	-	Output contact – Circuit breakers monitoring
XO.6	-	-	Output contact – Circuit breakers monitoring
XO.7	-	-	Output contact – AVR 1 faulty
XO.8	-	-	Output contact – AVR 1 faulty
XO.9	-	-	Output contact – AVR 2 faulty
XO.10	-	-	Output contact – AVR 2 faulty
XO.11	-	-	Output contact – AVR 1 faulty
XO.12	-	-	Output contact – AVR 1 faulty
XO.13	-	-	Output contact – AVR 2 faulty
XO.14	-	-	Output contact – AVR 21 faulty
XO1.1	-	RL2.1	Relay output – AVR 1 online
XO1.2	-	RL2.2	Relay output – AVR 1 active
XO2.1	-	RL2.1	Relay output – AVR 2 online
XO2.2	-	RL2.2	Relay output – AVR 2 active

Note: Unless requested by the customer, our cabinet contains connection shunts on the XM terminal block to only have a single source for the generator voltage measurement, generator current, mains voltage

measurement and field excitation power signals. If there are separate sources, remove the corresponding shunts. Please refer to the full diagram of cabinet reference WD 199 0046 and WD 615068 EC for more details.

2.3. Consumption

- **Power supply:**
  - Consumption < 3A
- **Generator voltage sensing:**
  - Consumption < 2VA
- **Mains voltage sensing:**
  - Consumption < 2VA
- **Stator current measurement with a CT:**
  - Consumption < 2VA
- **Power supply:**
  - Consumption < 3000VA
- **Relay output:**
  - Consumption 125VA – 1A max. / 30VDC – 3A max.

Note: The other measurement inputs (mains current, cross-current measurement, etc) are still available but are not wired up on this cabinet.

2.4. Wiring precautions

The cable length must never exceed 100 m. To ensure compliance with standards IEC 61000-6-2, IEC 61000-6-4, and IEC 60255-26, shielded cables are essential in the case of a D550 installed outside the terminal box.

The total ohmic value of the exciter circuit loop (outward and return) must not exceed 5% of the exciter resistance, whatever the cable length.
The ohmic value of the power system cables must not exceed 5% of the exciter resistance, whatever the cable length.

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

Cross-section (mm²)	Resistance (mΩ/m)
1.5	13.3
2.5	7.98
4	4.95
6	3.3
10	1.91

Example of calculation:

For a 10 Ohm exciter
- Maximum cable resistance = 0.5 Ω (2x0.25Ω)
- Cross-section according to the distance between the AVR and generator:

Distance (m)	Cross-section (mm²)
30	2.5
50	4
75	6
100	10

3. Setup instructions

3.1. Stator voltage and current measurement

For the cabinet to work correctly, the stator voltage and current measurement on both AVRs must be identical. For generators with an unbalanced load, using different phases can result in a measurement fault and a bump in regulation on switching from one AVR to the other.

For generators where only one stator current measurement transformer is used, it is possible to put stator current measurements on both AVRs in series.

3.2. Configuration files

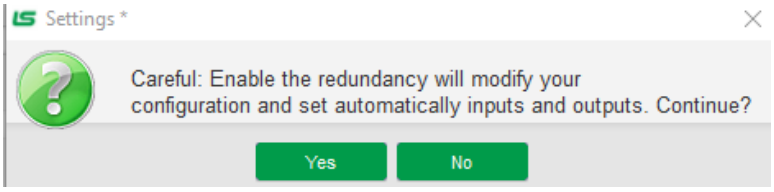
The configuration of both AVRs must be identical, apart from choosing one to be the "master" and must correspond to the technical and electrical data of the generator on which the cabinet is to be installed.

It is therefore important to pay particular attention to the following settings:

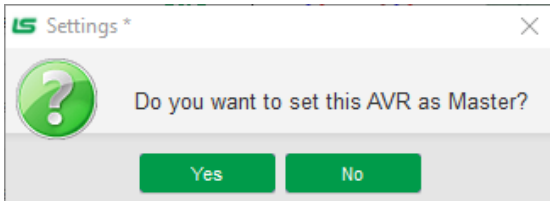
- Generator power, rated voltage, frequency and power factor.
- Voltage transformers for generator voltage sensing
- Voltage transformers for mains voltage sensing
- Current transformer for stator current measurement
- Setpoint adjustment values (voltage, power factor, kVAr - depending on the application) and all types of applied corrections (pushbuttons, potentiometer, etc.)
- PID coefficient values
- Limitations
- Input and output configuration

CAUTION, DO NOT OVERWRITE ONE AVR CONFIGURATION WITH THE OTHER AVR CONFIGURATION

Using the EasyReg Advanced program, selection of AVR redundancy can be found in the "Configuration" menu, then the "Wiring" page. Click on the "Redundancy second D550" box. The following message appears:



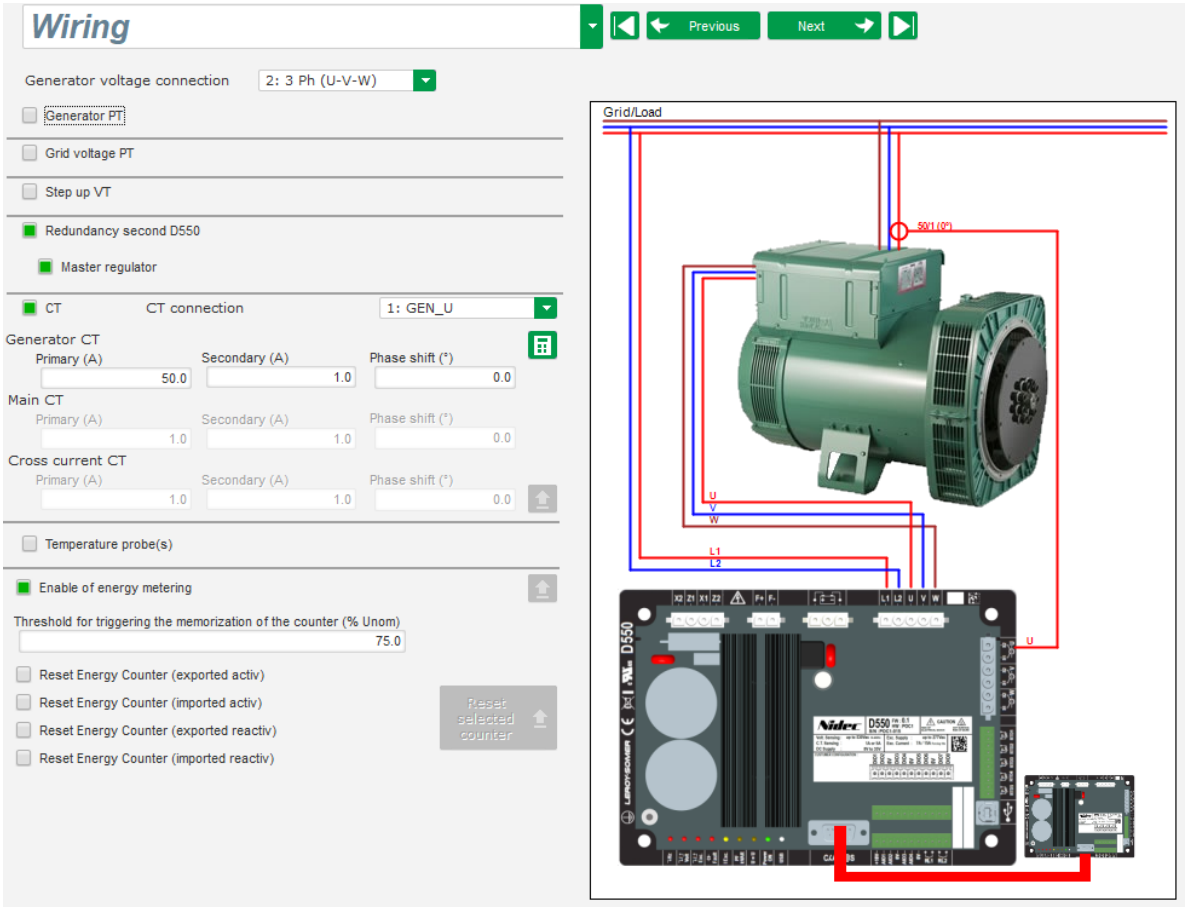
Click "Yes". A second message appears:



Click "Yes" for the AVR which should be "active" when the cabinet starts, and "No" for the AVR which should be "Online".

If the AVR is the "Master", the "Master regulator" box is checked.

In both cases, the drawing on the right is updated with the appearance of a second D550.



On the "Protections" page, the following faults are automatically activated:

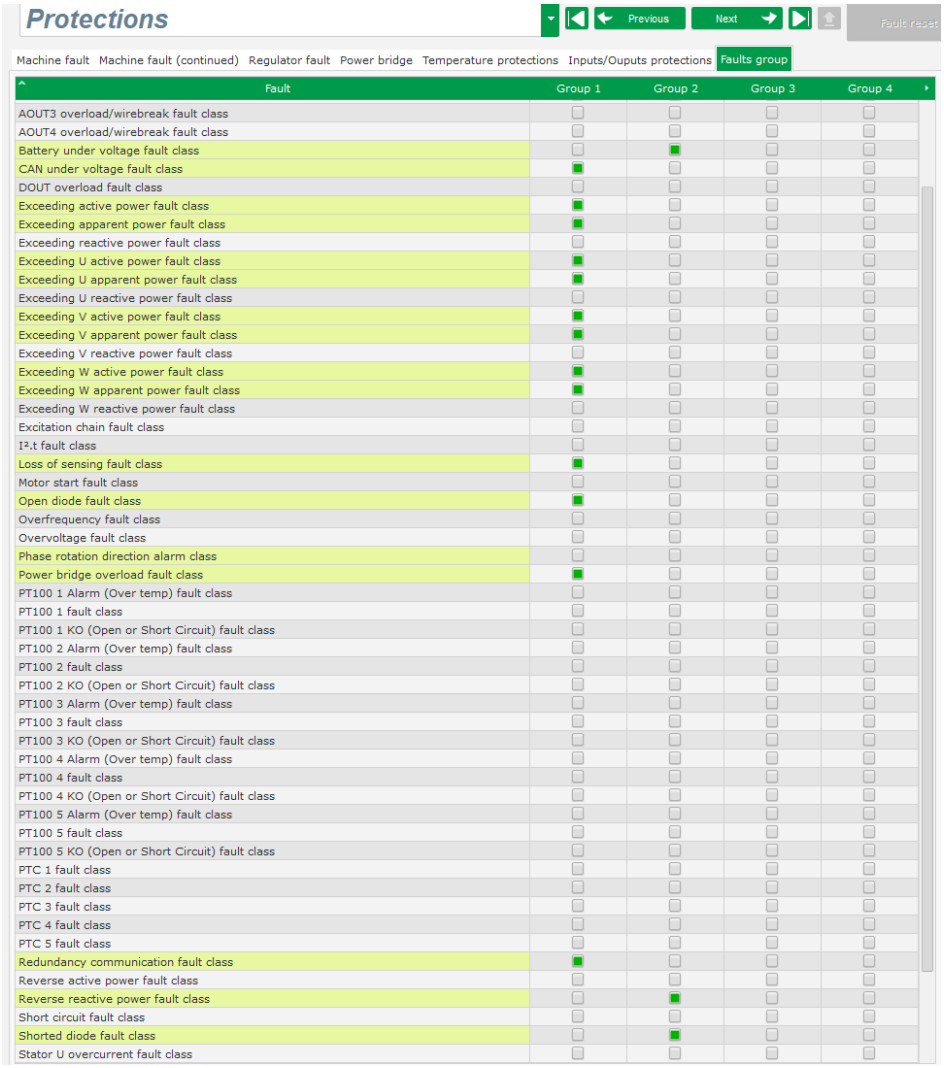
- "Machine fault" tab: reverse reactive fault
- "Regulator fault" tab: loss of sensing fault, battery, and excitation chain fault
- "Power bridge" tab: Redundancy communication fault

Note: Both these faults are active, with auto-reset, but the levels as well as any associated actions should be set to suit your generator and how you want it to work.

3.3. Dedicated cabinet settings

3.3.1. Protection

For this project, several protections have been activated and grouped in two groups (see the following picture), “General alarms” and “Trips” according to the cabinet schematic.



Fault	Group 1	Group 2	Group 3	Group 4
AOUT3 overload/wirebreak fault class	☐	☐	☐	☐
AOUT4 overload/wirebreak fault class	☐	☐	☐	☐
Battery under voltage fault class	☐	■	☐	☐
CAN under voltage fault class	■	☐	☐	☐
DOUT overload fault class	☐	☐	☐	☐
Exceeding active power fault class	■	☐	☐	☐
Exceeding apparent power fault class	■	☐	☐	☐
Exceeding reactive power fault class	☐	☐	☐	☐
Exceeding U active power fault class	■	☐	☐	☐
Exceeding U apparent power fault class	■	☐	☐	☐
Exceeding U reactive power fault class	☐	☐	☐	☐
Exceeding V active power fault class	■	☐	☐	☐
Exceeding V apparent power fault class	■	☐	☐	☐
Exceeding V reactive power fault class	☐	☐	☐	☐
Exceeding W active power fault class	■	☐	☐	☐
Exceeding W apparent power fault class	■	☐	☐	☐
Exceeding W reactive power fault class	☐	☐	☐	☐
Excitation chain fault class	☐	☐	☐	☐
I^2t fault class	☐	☐	☐	☐
Loss of sensing fault class	■	☐	☐	☐
Motor start fault class	☐	☐	☐	☐
Open diode fault class	■	☐	☐	☐
Overfrequency fault class	☐	☐	☐	☐
Overvoltage fault class	☐	☐	☐	☐
Phase rotation direction alarm class	☐	☐	☐	☐
Power bridge overload fault class	■	☐	☐	☐
PT100 1 Alarm (Over temp) fault class	☐	☐	☐	☐
PT100 1 fault class	☐	☐	☐	☐
PT100 1 KO (Open or Short Circuit) fault class	☐	☐	☐	☐
PT100 2 Alarm (Over temp) fault class	☐	☐	☐	☐
PT100 2 fault class	☐	☐	☐	☐
PT100 2 KO (Open or Short Circuit) fault class	☐	☐	☐	☐
PT100 3 Alarm (Over temp) fault class	☐	☐	☐	☐
PT100 3 fault class	☐	☐	☐	☐
PT100 3 KO (Open or Short Circuit) fault class	☐	☐	☐	☐
PT100 4 Alarm (Over temp) fault class	☐	☐	☐	☐
PT100 4 fault class	☐	☐	☐	☐
PT100 4 KO (Open or Short Circuit) fault class	☐	☐	☐	☐
PT100 5 Alarm (Over temp) fault class	☐	☐	☐	☐
PT100 5 fault class	☐	☐	☐	☐
PT100 5 KO (Open or Short Circuit) fault class	☐	☐	☐	☐
PTC 1 fault class	☐	☐	☐	☐
PTC 2 fault class	☐	☐	☐	☐
PTC 3 fault class	☐	☐	☐	☐
PTC 4 fault class	☐	☐	☐	☐
PTC 5 fault class	☐	☐	☐	☐
Redundancy communication fault class	■	☐	☐	☐
Reverse active power fault class	☐	☐	☐	☐
Reverse reactive power fault class	☐	■	☐	☐
Short circuit fault class	☐	☐	☐	☐
Shorted diode fault class	☐	■	☐	☐
Stator U overcurrent fault class	☐	☐	☐	☐

Both groups of protection 1 & 2 are linked to DO6 and DO7, respectively
Group 1:

- CAN under voltage fault
- Exceeding active power fault
- Exceeding apparent power fault
- Exceeding U active power fault
- Exceeding U apparent power fault
- Exceeding V active power fault
- Exceeding V apparent power fault
- Exceeding W active power fault
- Exceeding W apparent power fault
- Loss of sensing fault
- Open diode fault
- Power bridge overload fault
- Redundancy communication fault

Group 2:

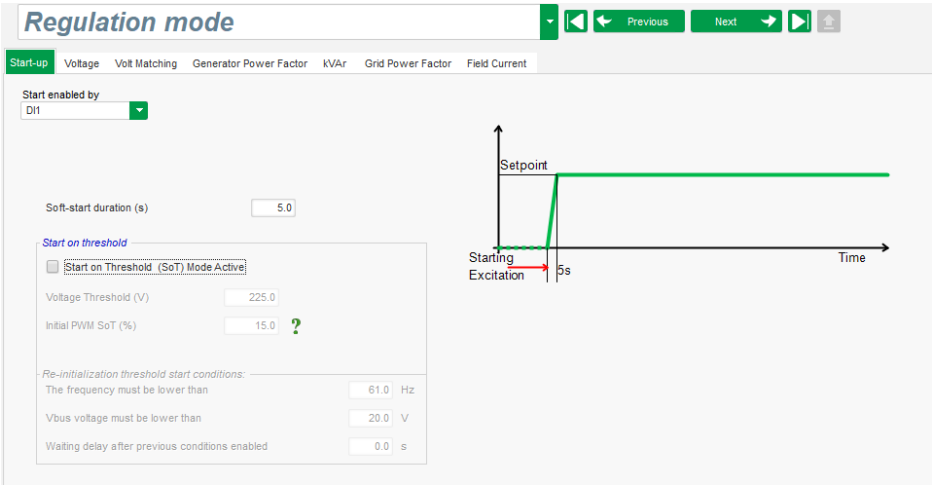
- Battery under voltage fault
- Reverse reactive power fault
- Shorted diode fault

Group 1 fault status	Active Low	DO6	General Alarms
Group 2 fault status	Active High	DO7	Trip

3.3.2. Regulation Mode

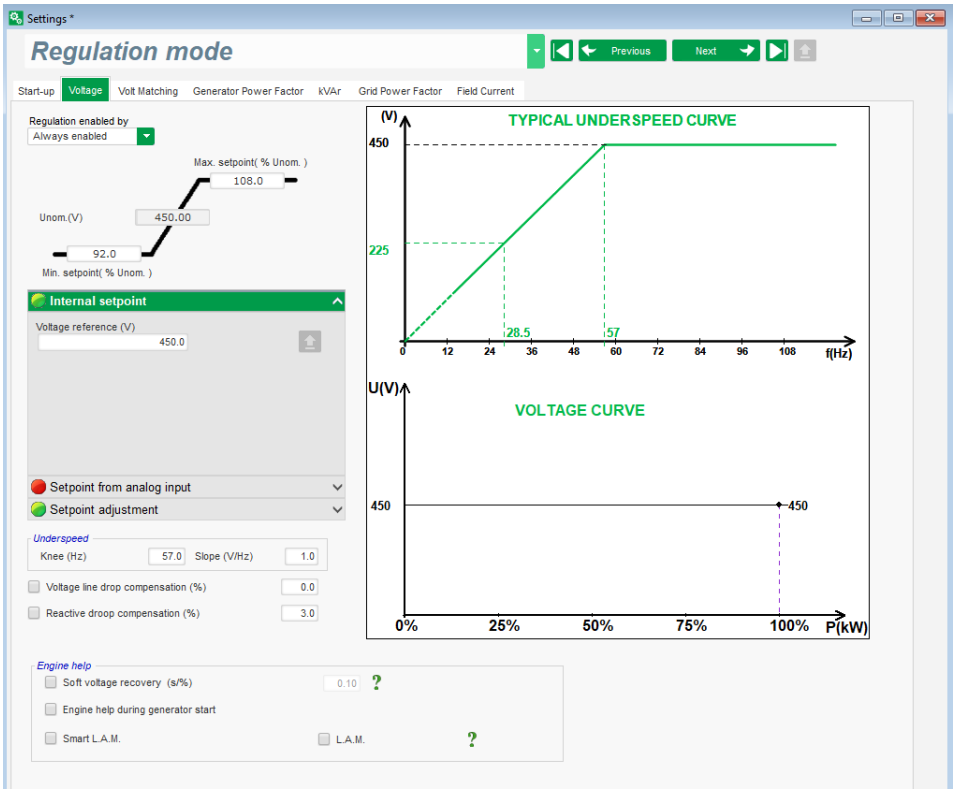
3.3.2.1. Start up

- The start-up of the excitation is enabled by the digital input “DI1” through the external contact between XC.7 and XC.8 terminals (See page 15 in WD 199 0046).
- The start ramp delay is set at 5s



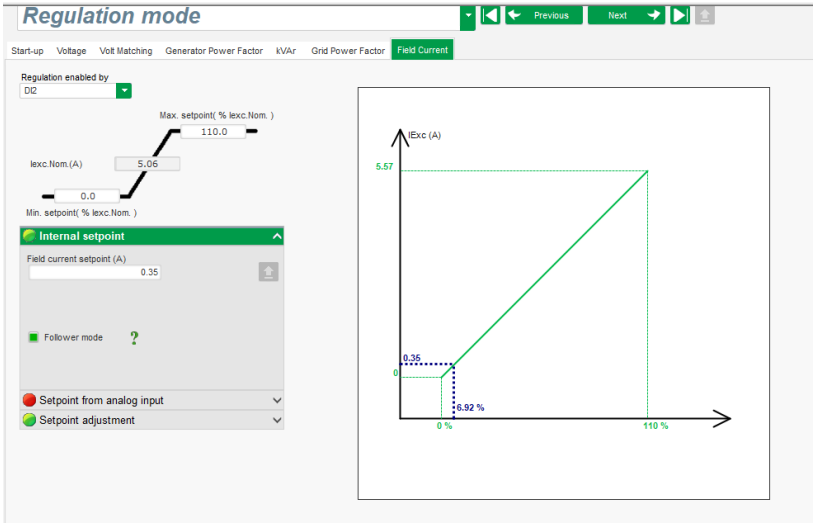
3.3.2.2. Voltage mode

- The voltage regulation is the default mode, so “always enabled” should be selected
- The internal setpoint is set at 450V with the possibility to have a bias at ±10%
- Adjustment is done using inputs DI4 to increase, and DI5 to decrease the setpoint, with a step at ±2V
- Under speed is set with knee at 48Hz, and a slope at 1V/Hz
- Reactive droop compensation is enabled by DI3, through the external contact between XC.11 and XC.12 (See page 15 in WD 199 0046), in remote mode and set at 3%.



3.3.2.3. Field Current

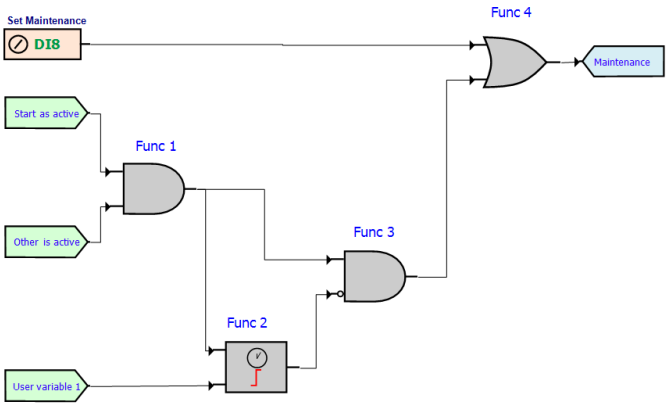
- The field current mode is enabled by DI2
- The internal setpoint is set at 0.35A with the possibility to have a bias at 0%/+10%
- Adjustment is done using inputs DI4 to increase, and DI5 to decrease the setpoint, with a step at ±0.01A
- The Follower mode should be enabled, it allows the bumpless switch from automatic mode to field current regulation mode.



3.3.3. Logic and analogic gates (Master only)

The logic gate has been implemented to ensure that the Master and Slave active LEDs do not lit simultaneously when the master is online following a loss of auxiliary power.
This logic gate is only added on Master's configuration

- The result of function 1 = 1, if the variable "start as active "= 1 and the variable "Other is active" = 1
- The result of function 2 = 1, if the result of the function 1 = 1 more than 0.01s = the "user variable 1"
- The result of function 3 = 1, if the result of the function 1 = 1 and the result of the function 2 = 0
- The result of function 4= "Maintenance" = 1, DI8 =1 and/or the and the result of the function 3 = 1



3.3.4. Inputs/ Outputs

On the "Inputs/Outputs" page:

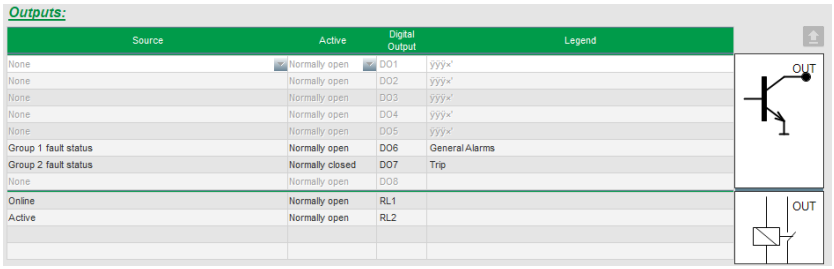
3.3.4.1. Digital inputs

- DI1: activation of the Startup, the voltage regulation mode is activated then.

- DI2: activation of the field current regulation mode.
- DI3: activation of the droop.
- DI4: activation of up adjustment.
- DI5: activation of down adjustment.
- DI8: activation of "Maintenance" mode. This mode can be used to set the D550 offline. Redundancy between the two AVRs is then no longer active: only the second D550 can regulate. If maintenance mode has been activated on one of the two D550s, it prevents "Maintenance" mode on the second D550.

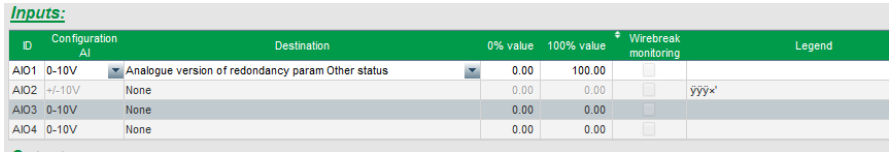
3.3.4.2. Digital outputs

- DO6: General alarms =1, OK=0.
- DO7: Trip = 0, OK= 1.
- RL1 is activated if the AVR is "online".
- RL2 is activated if the AVR is "active".



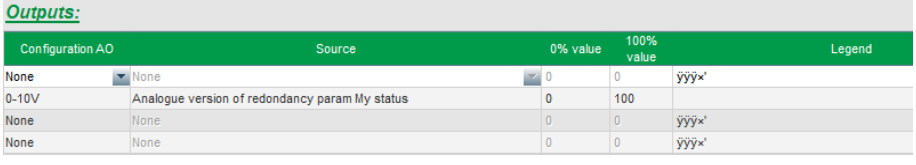
3.3.4.3. Analog inputs

- Input AI1 (0-10V) is configured as follows.
  - < 25%: indicates that the second D550 is neither active nor online.
  - >25% and < 50%: indicates that the second D550 is online but not active.
  - >50%: indicates that the second D550 is active and online.



3.3.4.4. Analog outputs

- Outputs AO2 (0-10V) is configured as follows.
  - < 25%: indicates that the second D550 is neither active nor online.
  - < 25% and < 50%: indicates that the second D550 is online but not active.
  - > 50%: indicates that the second D550 is active and online.

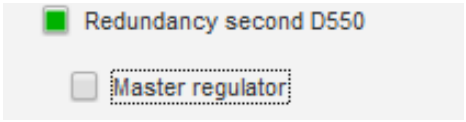


3.4. Checks prior to commissioning.

First it is necessary to check the wiring and general operation of the cabinet.
Step 1: Install and check the cabinet wiring in accordance with the wiring diagrams supplied to you with the cabinet and possibly with the generator.

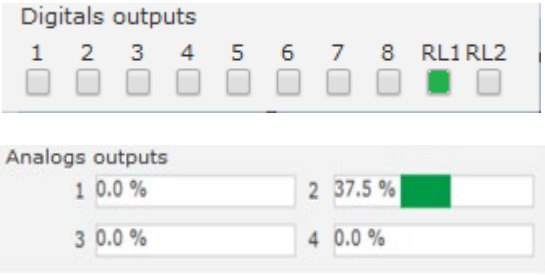
Step 2: Supply the AVRs and the control circuit with 24 VDC power. Check that:
- Both AVRs are powered up and running: the power supply LED on each D550 is green.
- The control circuit relays are supplied with power.

Step 3: Check that the AVRs are in "redundancy" mode:
- With the EasyReg Advanced program, "Wiring" page: the “Redundancy second D550" box should be checked, with the "Master regulator" box checked on AVR 1 and unchecked on AVR 2.



- With the EasyReg Advanced:
  - On the "Master" AVR: the analogue output AO2 is > 50% and the relay RL1 that drives the contactor is active.

  - On the “Online" AVR: the analogue output AO2 is >25% and > 50% and the relay RL1 that drives the contactor is active contactor is active.



Step 4: Check that the measurement and power data is reaching the AVRs:
- The cabinet disconnect terminals are closed properly.
- The generator and power voltage sensing circuit-breakers are closed properly in the generator.
- Check that the status of both AVRs is "OFF".

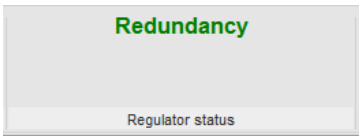
3.5. Aligning measurements

Once these checks have been done, make sure that the measurements on both AVRs give similar results. This is done by using two load points on the machine and checking the measurements on the monitor page:

Step 1: Start the generator
- Build up to rated speed.
- Energise the machine by starting field excitation. The voltage should build up to the voltage setpoint without racing.
- Check that both AVRs are running by using EasyReg Advanced,

- **On the "Master" AVR,** the regulation mode is displayed:

- **On the "Online" AVR,** the regulation mode is "Redundancy":



Step 2: The active AVR will be the reference for voltage and current measurements. The accuracy of its readings should therefore be checked against any devices present on the customer's premises (instruments measuring voltage, current, power factor, etc.).

Step 3: Aligning the voltage measurements.
- Do not apply load to the machine.
- Check the voltage reading on both AVRs with EasyReg Advanced by connecting to both AVRs in succession. If the voltage on the "Online" AVR is incorrect (±1% of the voltage on the "active" AVR), correct this by changing the primary or secondary values of the generator voltage sensing transformer (General machine configuration).

Step 4: Setting the stator current
- If possible, apply a load representing more than 25% of the generator rated power (this operation can be done in voltage).
- Check the stator current reading on both AVRs with EasyReg Advanced by connecting to both AVRs in succession. If the stator current measurement of the "Online" AVR is incorrect (±1% of the current on the "active" AVR), correct this by changing the primary or secondary values of the main stator current transformers and/or isolating transformers (General machine configuration).

Step 5: Stop the installation.

4. Instructions for use

This dual cabinet has been developed to switch automatically from an "active" AVR 1 to an "online" AVR 2, if a fault is detected on AVR 1. Manual switching is possible, however.

4.1. Safety instructions

Before using the cabinet for the first time, please refer to the instructions and make sure that operations are performed in accordance with the safety measures in paragraph 1.4.

4.2. Description of control and signalling devices

The cabinet has two bi colour lights and four push buttons.
- HL1 (Green): RT01 active, HL1 (Red): RT01 faulty
- HL2 (Green): RT01 active, HL2 (Red): RT01 faulty
- BP1: Set Maintenance RT01
- BP2: Reset Maintenance RT01
- BP3: Set Maintenance RT02
- BP4: Reset Maintenance RT02

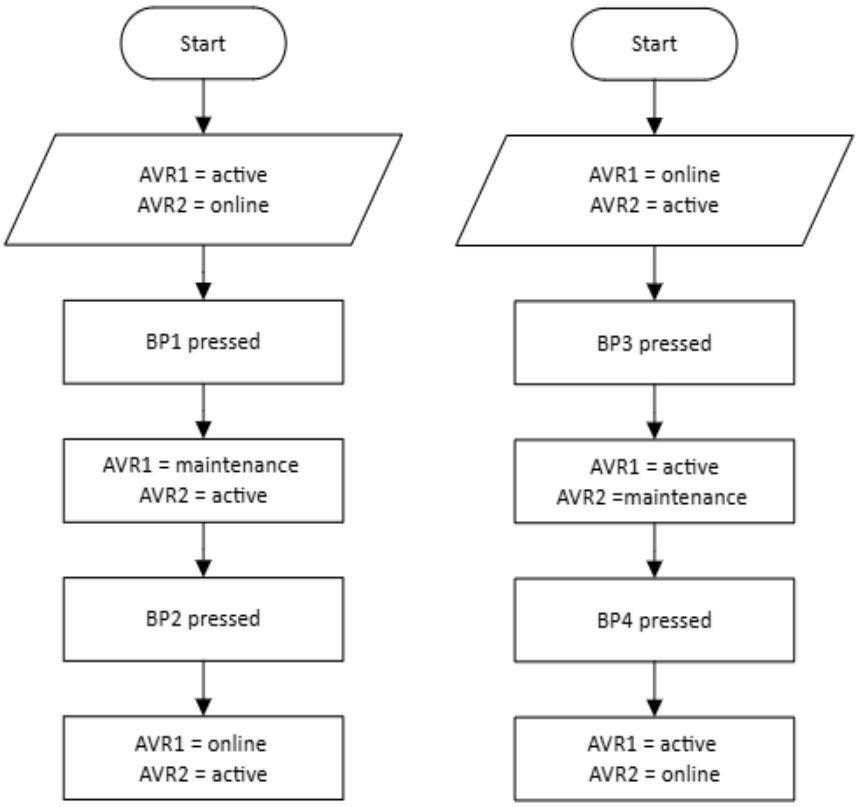
4.3. Description of running modes

4.3.1. Manual switching

As previously mentioned, the AVRs can be switched manually with the "Maintenance" input on each AVR. These inputs depend on the relays on the cabinet which prevent both AVRs being set to maintenance mode simultaneously. The manual switching could be done remotely or locally.

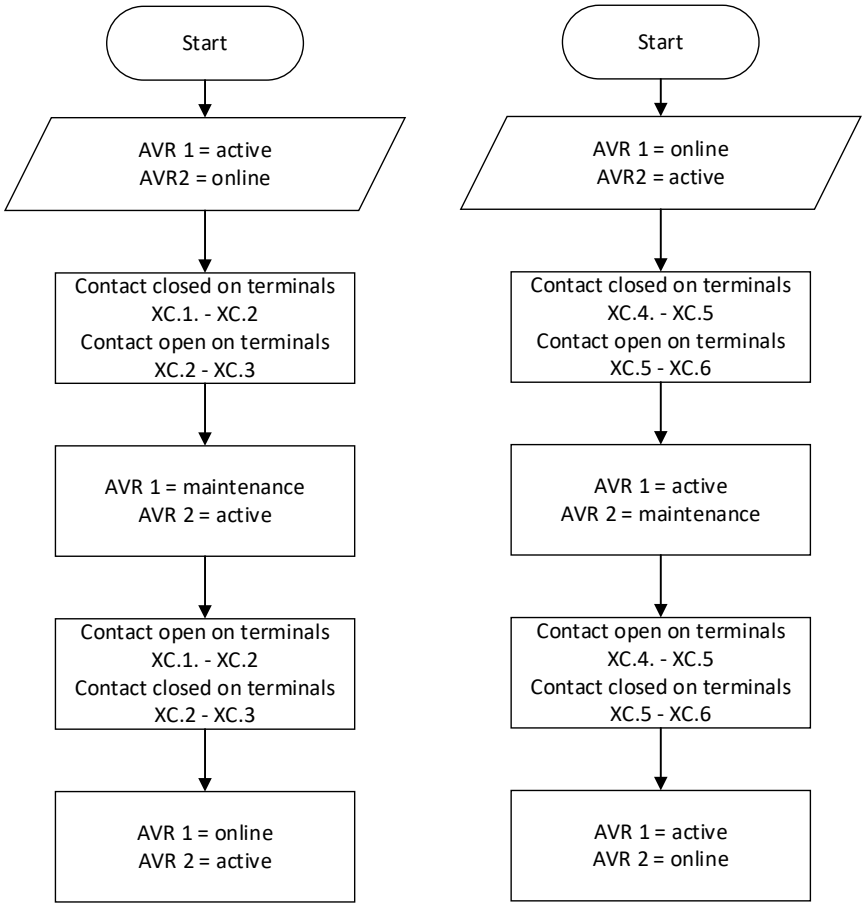
For Local control, the cabinet has 4 push buttons:

- Push button BP1: AVR1 maintenance
- Push button BP2: AVR 1 maintenance reset
- Push button BP3: AVR 2 maintenance
- Push button BP4: AVR 2 maintenance reset



For remote control, the cabinet therefore has 4 contact inputs:
- Terminals XC.1 and XC.2: AVR 1 maintenance
- Terminals XC.2 and XC.3: AVR 1 maintenance reset
- Terminals XC.4 and XC.5: AVR 2 maintenance
- Terminals XC.5 and XC.6: AVR 2 maintenance reset

An "active" AVR can then be switched to an "online" AVR:



Note: The "active" AVR cannot be set to "maintenance" mode if regulation is occurring and the second AVR is in "maintenance" or "fault" mode.

4.3.2. Correction of setpoints with digital inputs

Setpoint corrections are only copied from the "active" AVR to the "online" AVR by the CANBUS if they have been created with digital inputs. The regulation context is then preserved in the event of switching.

4.3.3. Follower

The correction value of the field current given by the follower is copied from the "active" AVR to the "online" AVR by the CANBUS. The regulation context is then preserved in the event of switching and running in manual mode.

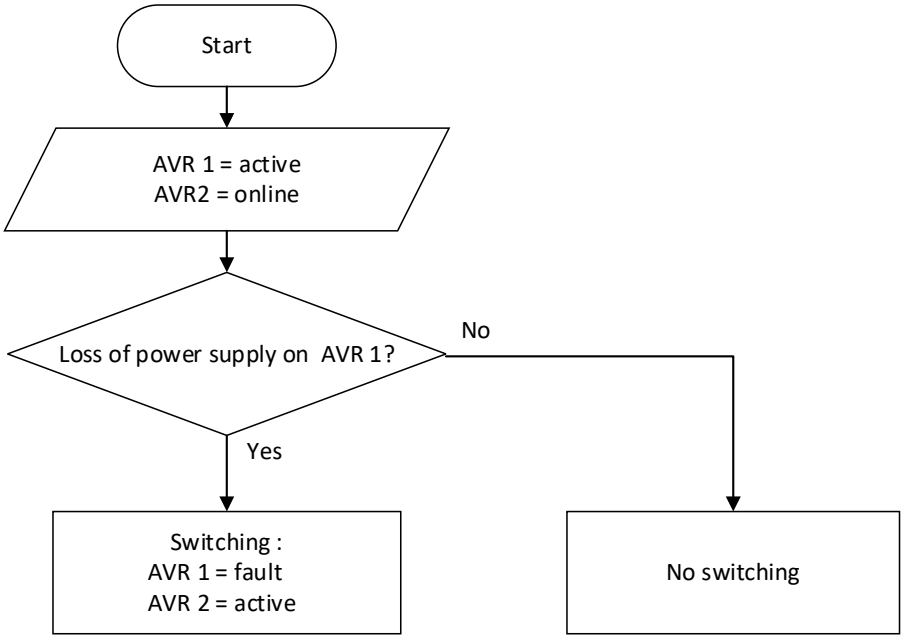
4.3.4. Switching on a fault

Several faults can cause switching from the "active" AVR to the "online" AVR:
- Loss of the AVR internal or 24 VDC power supply
- A controller fault on the power transistor

- Loss of sensing on the "active" AVR and not on the "online" AVR
- A reactive power inversion fault

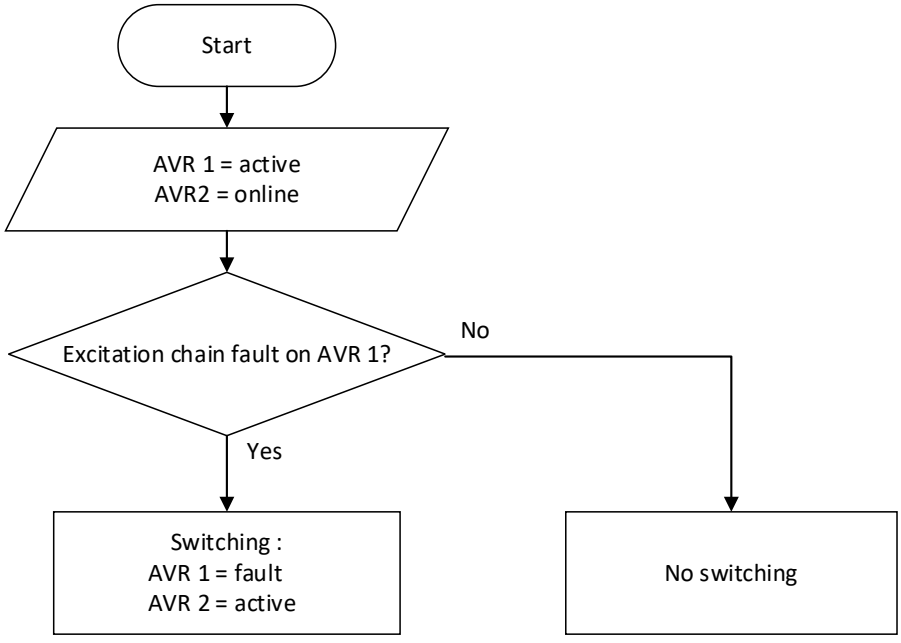
4.3.4.1. Loss of power supply

If the power supply fails, switching to the "online" AVR occurs automatically.



4.3.4.2. Excitation chain fault

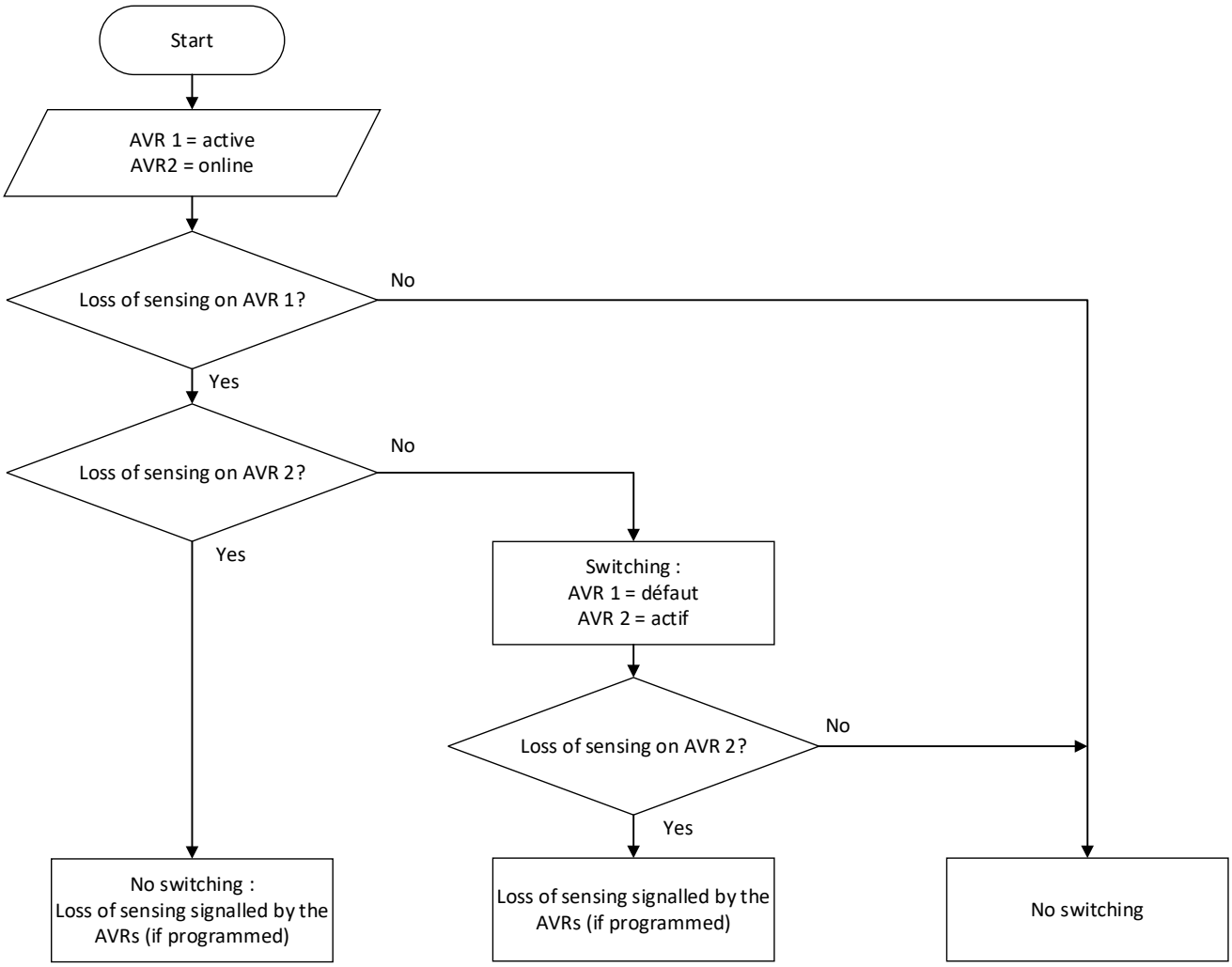
Each AVR has a circuit which monitors the excitation chain. If there is a discrepancy between the excitation chain and its action, the "active" AVR switches to "fault" mode and the "online" AVR switches to "active" mode.



4.3.4.3. Loss of sensing

Loss of voltage sensing on the machine is monitored throughout operation.

- If loss of sensing is detected on the "active" AVR and not on the "online" AVR, the active AVR switches to fault mode.
- If loss of sensing is detected for both the "active" and "online" AVRs, then switching does not occur (that may then come from the sensing VT).

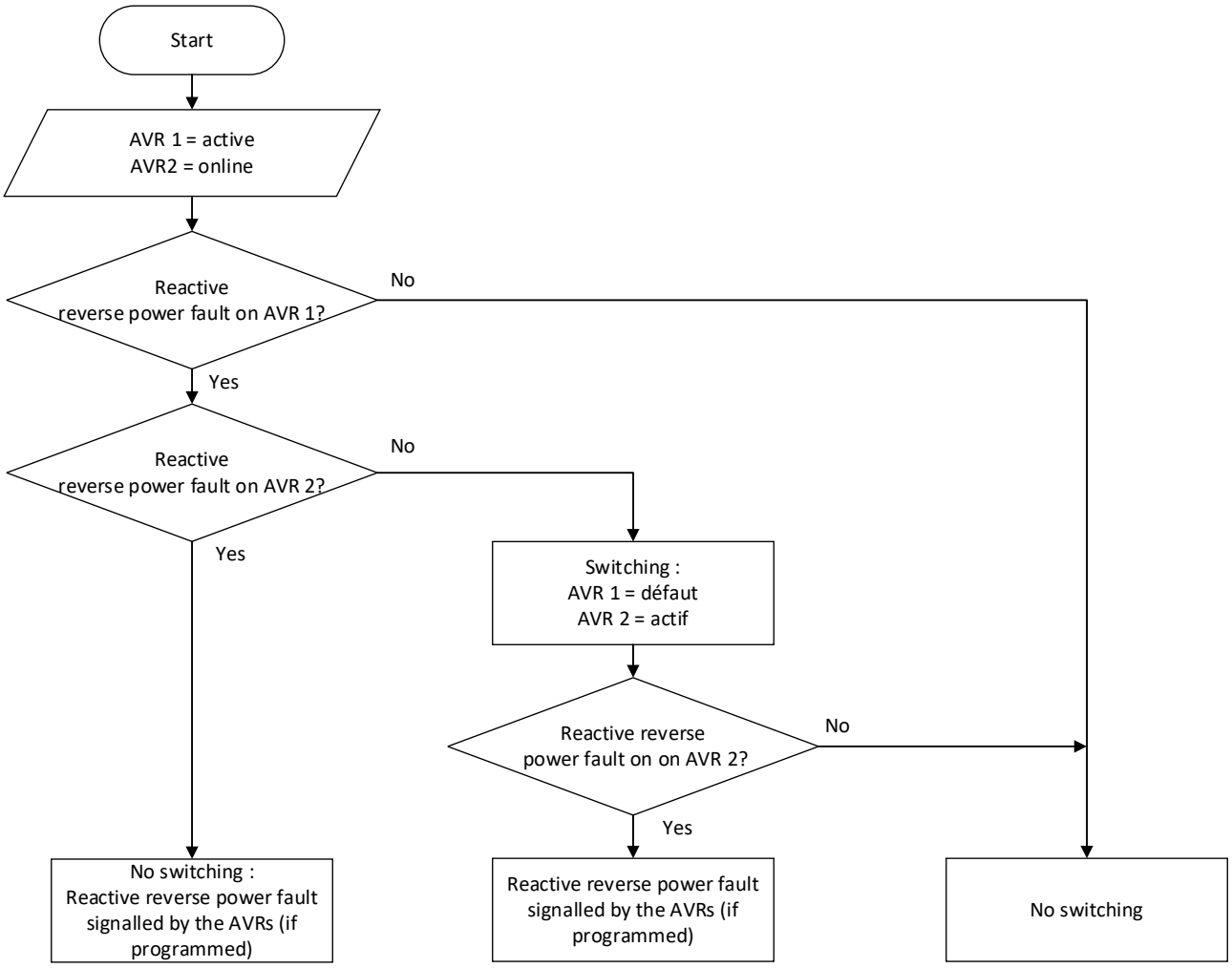


Note: By default, no action has been programmed for loss of sensing. A significant bump may therefore occur on switching to the "online" AVR. This bump may be less noticeable if the "field current before fault" action has been selected.

4.3.4.4. Reactive reverse power fault

The reactive reverse power fault on the machine is monitored throughout operation.

- If this fault is detected on the "active" AVR and not on the "online" AVR, the active AVR switches to fault mode.
- If this fault is detected for both the "active" and "online" AVRs, then switching does not occur (that may then come from a fault in the link to the exciter).



Note: By default, no action has been programmed for reactive reverse power. A significant bump may therefore occur on switching to the "online" AVR. This bump may be less noticeable if the "field current before fault" action has been selected.

4.3.5. Procedure for replacing a faulty AVR

If one of the AVRs is faulty, the AVR concerned must be replaced. This change can be made (while observing the safety conditions), even while the installation is running, by performing the steps below:

Step 1: Isolating the AVR
- Open the power disconnect terminals
- Open the generator and mains voltage measurement disconnect terminals

Step 2: Dismantling the AVR
- Remove the AVR connectors
- Disconnect the earth wiring

Step 3: Physically removing the faulty AVR

Step 4: Installing the spare AVR
- Make sure that the AVR is firmly fixed on the cabinet

Step 5: Electrical connections
- Wire up the earth connection
- Wire up the connectors, in strict compliance with the cabinet wiring diagram

CAUTION: Reversing the wiring can seriously damage the generator and the AVR.

Step 6: Supplying the AVR with power
- Check the AVR operation

Step 7: Loading the AVR configuration with the saved configuration (or if it is not available, using the configuration of the second AVR).

Step 8: Closing the disconnect terminals

Step 9: Checks
- Set the AVR to "maintenance" mode
- Check that the voltage and current measurements are in the same range. If this is not the case, please refer to section 3.4. Aligning measurement
- Reset "maintenance" mode on the AVR concerned
- Check that the AVR reacts OK to the change of "maintenance" mode to "online" on the home page
- Save the configuration of the AVR that has been replaced

4.4. Anomalies and problems

Several anomalies can occur on the AVR, which may result in it being replaced. These faults are listed in the table below.

ANOMALIES	CAUSES	REMEDIES	RESTARTING
Loss of sensing fault	Generator sensing VT broken	Replace the faulty VT	Stop the generator and initialize cabinet operation.
	AVR internal sensing circuit broken	Replace the AVR	Restart the cabinet with the procedure in section 4.3.5.
AVR power transistor short-circuited	Component fault or exciter circuit open which has generated an overvoltage on the transistor	Replace the AVR	Restart the cabinet with the procedure in section 4.3.5.
Power supply fault on one AVR	Internal power supply fault of AVR	Replace the AVR	Restart the cabinet with the procedure in section 4.3.5.
Control 24 VDC power supply fault	Cabinet general fault	Replace the 24 VDC power supply	Restart the corresponding power supply and check the functions work.
Microcontroller fault on one AVR	Component failure	Replace the AVR	Restart the cabinet with the procedure in section 4.3.5.
The AVR is in "fault" mode when an attempt is made to switch it "online"	A condition has not been met for the AVR to switch to "online" mode	Check that the disconnect terminals are closed, the connectors are correctly inserted, the AVR is supplied with power and the measurements comply with the "active" AVR	Restart the cabinet with the procedure in section 4.3.5.
One AVR doesn't change mode when "maintenance" is requested Both AVRs are in regulation mode and the "online" one is not marked "redundancy"	Communication between the two AVRs is faulty	Check the CAN serial link between the two AVRs	Restart the cabinet with the procedure in section 4.3.5.

5. Maintenance

5.1. Technical data

5.1.1. Mechanical drawings

The layout plan for the dual cabinet D550 is available under reference CO 029 4536 & P5 199 0046.

5.1.2. Wiring diagrams

The wring diagram for the dual cabinet D550 is available under reference WD 199 0046 and WD 615068 EC.

5.2. Preventive maintenance instructions

Check that the terminals have been tightened correctly on all the equipment (especially the AVR connectors) with a tightening torque of between 0.6 and 0.8 Nm, and dust as often as necessary for the operating conditions.

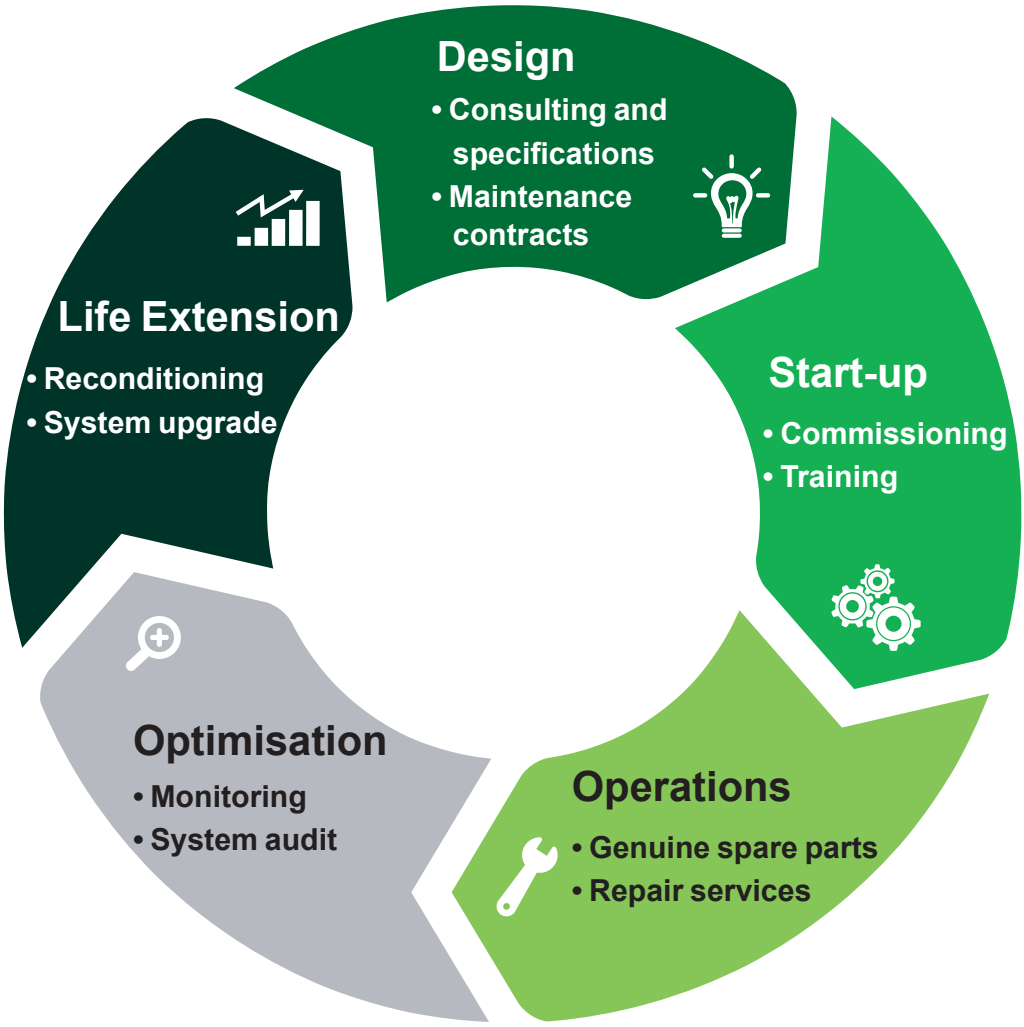
Service & Support

Our worldwide service network of over 80 facilities is at your service. Our local presence is your guarantee for fast and efficient repair, support and maintenance services.

Trust your alternator maintenance and support to electric power generation experts. Our field personnel are 100% qualified and fully trained to operate in all environments and on all machine types.

We have a deep understanding of alternators operations, providing the best value service to optimize your cost of ownership.

How can we help:



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