

## **DUAL PLATE D610**

### **Installation and Maintenance**



# DUAL PLATE D610

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## 1. General instructions

### 1.1. Identity card

This dual plate for generator regulation has been made by:

MOTEURS LEROY SOMER  
1, rue de la Burelle  
45800 SAINT JEAN DE BRAYE  
France  
Phone : +33 2 38 60 40 00  
Mail: [savorleans.ials@emerson.com](mailto:savorleans.ials@emerson.com)

Internal LEROY SOMER reference: P5 195 0450

**Note: This reference does not include the reference of D610 AVR, because these are adapted to the excitation type, generator voltage and options requested.**

### 1.2. General presentation

#### 1.2.1. Of the product

This manual deals with the instructions of installation, using, settings and maintenance of the dual plate D610.

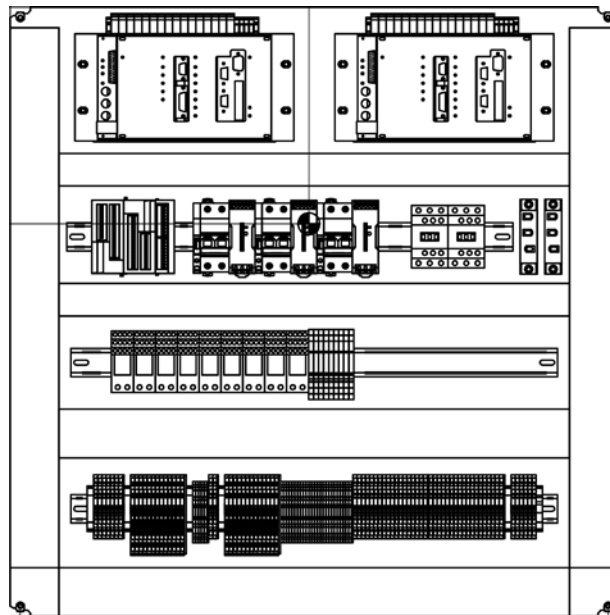
This plate is for the regulation of generators, which field current is up to 10A in nominal conditions, and 20A maximum in case of short-circuit conditions during 10s maximum.

This plate has been designed to be installed in an electrical command and power panel. These panels must insure the minimum conditions for protections and health for electrical rules up to 450Vac, prevailing in the country where the plate is installed.

It consists of a plate equipped with two AVRs, a PLC, a set of power supply 24Vcc, relays and terminals. To remove easily and replace a faulty AVR even if the generator is running, a set of disconnect terminals has been put on the measure circuits and for the piloting of the AVR.

**Note: For further help about AVR running, please refer to the installation and maintenance manual of regulators D610 (LEROY SOMER reference: 4899en)**

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### 1.2.2. Of the mean

The dual plate D610 allows a changeover from an AVR to a second one, even if the generator is running.

To ensure this changeover, different elements are in place:

- The D610 AVR's exchange information from a CAN Bus,
- A small box with buttons and lights to
  - Pilot in local mode the switching between two AVR's,
  - Indicate the operating state of each AVR
- Three separated 24Vcc power supply : one for each AVR and one for the command circuit (relays and PLC)
- One PLC to :
  - Have a "third vision" of the AVR's statement
  - Pilot the changeover in case of the regulation mode is discordant between both AVR's.
  - Inform, with dry contacts, the operating state of AVR's
- Two contactors allow switching the field circuit of the generator.
- Two diode modules, connected in the field circuit, to have it never opened.

All piloting such as:

- Regulation mode (voltage, power factor, VAr, Volt matching mode, manual mode)
- Ramp start,
- Corrections of the settings with digital inputs upper and lower

Are present simultaneously on both AVR's.

For the regulation modes, they are also monitored by the PLC.

They are 4 modes of running for each AVR:

- **Active** : The AVR is running and pilot the field current of the generator,
- **Waiting**: The AVR is waiting and ready, its regulation mode is the same as the active regulator. It not pilots the field current.

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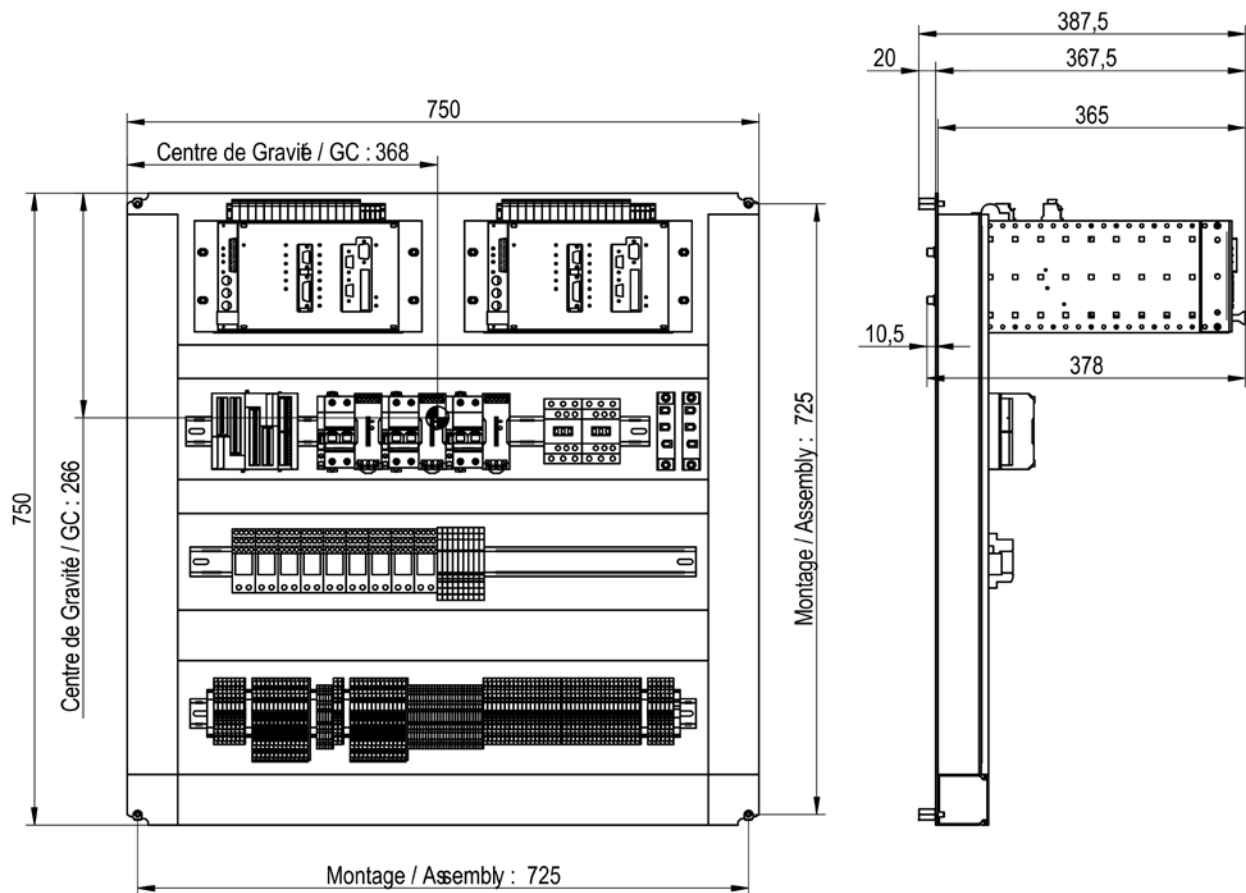
- **Maintenance:** The AVR is stopped, for example for maintenance or to be replaced.
- **Fault:** The AVR is stopped due to an issue.

### 1.3. Technical specifications

Plate equipped with two regulators for generators, with regulation modes: voltage, power factor, volt matching mode, VAR.

- Voltage sensing of the generator (according the reference mounted on the plate):
    - 100/115Vac 50Hz, 100/130Vac 60Hz
    - 380/420Vac 50Hz, 380/450Vac 60Hz
  - Power supply (270Vac maximum) according the reference mounted on the plate,
    - Shunt + Booster = power transformers
    - AREP = auxiliaries windings
    - PMG
  - Auxiliaries power supply : 250Vac max 50/60HZ – 24Vcc - 2A max each
  - Field current : 10A nominal, 20A maximum during 10s for 5Ω minimum
  - Accuracy of the regulation:  $\pm 0.5\%$  of the average of the three phases, with linear charges, without droop
  - Voltage setting range:  $\pm 10\%$  of the nominal voltage, by dry contacts or external potentiometer (optional)
  - Droop setting range: 0-10% of the nominal voltage, at P.F=0
  - Under-speed protection : included, threshold settable, slope settable for V/Hz at 3V/Hz
  - Field current ceiling : permanent at 110% of the nominal field current
  - Environment: maximum ambient conditions -10°C to +50°C, panel mounting without excessive vibrations.
- 
- Setting of the AVRs with the SUPD600 supervisor, included with the plate.
- 
- Sizes:
    - Height : 750mm
    - Width : 750mm
    - Depth : 387.5mm
- 
- Mass : 34.4kg
- 
- Fixing : **Schematics next page**

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## 1.4. Devices and general safety instructions

### 1.4.1. Protection of the mean

- Auxiliary power supplies 24Vcc for both AVR's and command circuit are protected by breaker 2A,
- AVR's D610 are equipped with breakers 20A to protect the power supply circuit
- Spring terminal used can be equipped with optional accessories for measurement.

### 1.4.2. Personal safety

Before starting your generator with the dual plate, this installation and maintenance manual must be read.

All operations and interruption to do for using this plate must be done by authorized personnel.

Our customer support is at your disposal to give you all information you need.

The different operations described in this manual are accompanied by recommendations or symbols to make each operator aware of the risks. You must absolutely understand and respect the safety instructions below:



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- Safety instruction for an operation capable of damaging or destroying the machine or surrounding equipment.



- Safety instruction for an operation with electrical risk for the operator :



## 2. Installation instructions

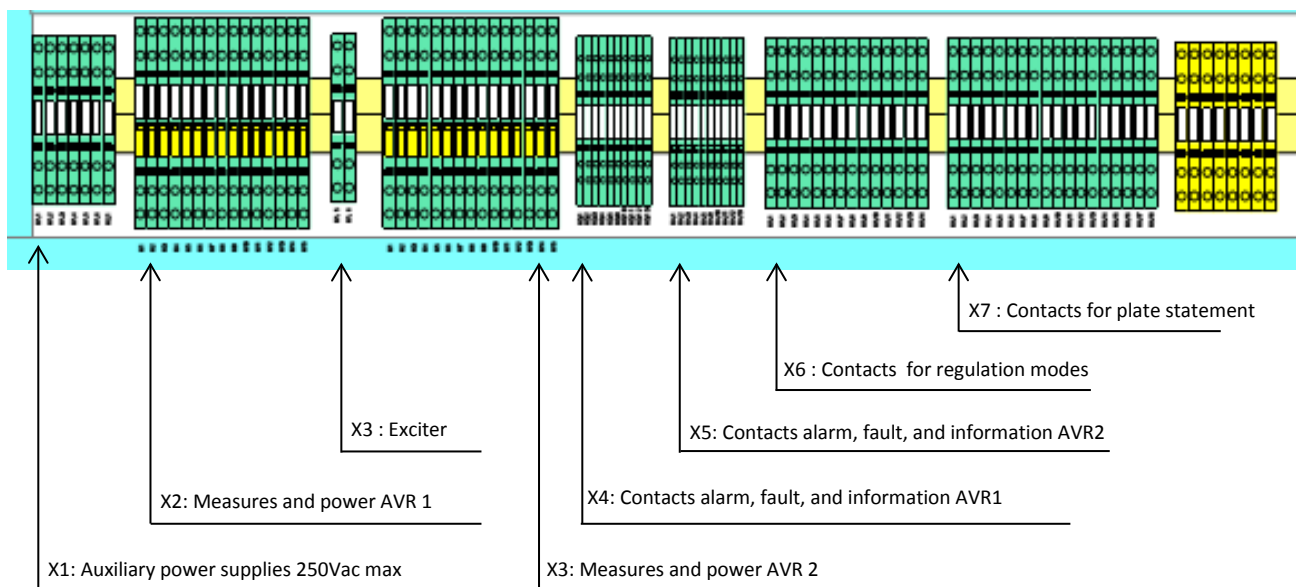
### 2.1. Development of the panel for the dual plate

Mounting must be vertical, and an area free of obstructions of 50mm must be respected around the plate.

A ventilation, a cooling or heating system will be installed in the panel to maintain the plate in environmental limits described above.

### 2.2. Terminal blocks

Terminal blocks of the plate are separated according to their use:



Terminal blocks X2 and X4, corresponding to measure and power circuits of AVR1 and AVR2. Disconnect terminals are used.

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**DO NOT OPEN THESE DISCONNECT TERMINALS WHEN THE AVR IS IN "ACTIVE" MODE**

### 2.3. Consumption

- Auxiliary supplies 250Vac max / 2A maximum each
- Exciter power supply : 270Vac max / 20A maximum
- Generator voltage sensing and mains voltage sensing: voltage according to Generator I/O block of the AVR, 0.75A maximum for each phase.
- Stator current measure : 1A

### 2.4. Wiring procedure

For an AVR wired with not shielded wires, the maximum distance is 30m. Beyond this distance, shielded wires must be used. The maximum distance is 100m.

The ohmic value of the wires for the exciter circuit (go and go back) must not exceed 5% of the resistance of the exciter, whatever the length of the wire. This allows to not oversize the power system for excitation (AREP, PMG, and shunt)

The ohmic value of the wires for the excitation system must not exceed 5% of the resistance of the exciter, whatever the length of the wire. This allows to not oversize the power system for excitation (AREP, PMG, and shunt).

The ohmic value of the wires for the droop current transformer (go and go back) must not exceed 1 ohm, whatever the length of the wire. This allows to not oversize the power of the droop current transformer.

The ohmic value of the wires for the generator sensing or the mains sensing (go and go back) must not exceed 1 ohm, whatever the length of the wire. This allows to not oversize the voltage transformers.

For information: Resistance per unit length up to 20 ° C for copper cables in ohms / km

Section (mm <sup>2</sup> )	Resistance (Ω/km)
1,5	13,3
2,5	7,98
4	4,95
6	3,3
10	1,91

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Sample:

For an exciter of 10 ohms

- Maximum resistance of the wires = 0.5 ohms (2x0,25 ohms)
- Section according to the distance between the AVR and the generator :

Distance (m)	Section (mm <sup>2</sup> )
30	2,5
50	4
75	6
100	10

In case of shielded wires, we prefer the shield connection to ground dual plate side. The connection will be as close as possible to the plate and without loop. The alternator, regulator and shield should have an equipotential ground.

## 2.5. Handling

This plate mass is 23kg. Its gravity center, as shown in the plan below, is placed very high compared to the center of the plate. Accordingly, means should be taken adequately for its implementation in the control panel.



**DO NOT HANDLE BY ARVS**

## 3. Settings instructions

### 3.1. Transformer for stator current measure

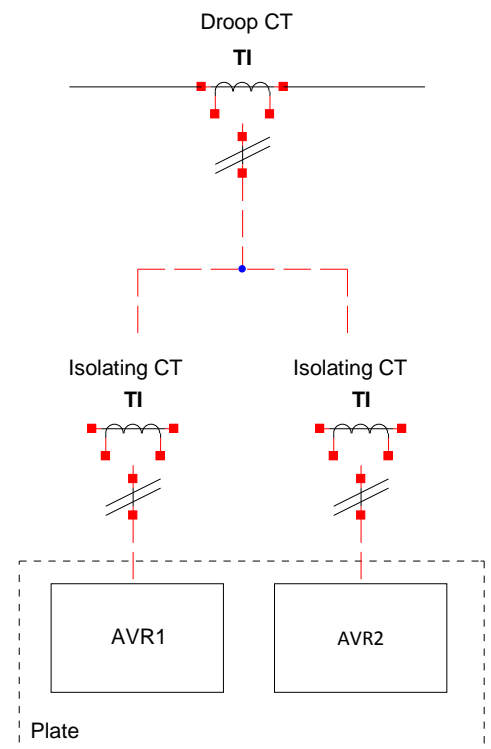


To have a good running of the plate, it's necessary that stator current measure arrives from the same phase for both AVRs. Indeed, for generators with unbalanced load, using two different phases can affect the measure and induce a bump in the regulation when changeover from one AVR to the other occurs.

For generators where one stator current transformer is used, it's necessary to use isolating current transformers for each AVR.

### 3.2. Configuration files

The configuration of both AVRs must be identical and correspond to the technical and electrical data of the generator where the plate is going to be installed.



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So, it's important to verify particularly the settings of:

- Nominal power, nominal voltage, frequency and power factor of the alternator
- Voltage transformer for Generator voltage sensing,
- Voltage transformer for Mains voltage sensing,
- Current transformer for stator current measure,
- Values for the set points (voltage, power factor, VAR – according to the application) and values for all the corrections applied (push buttons, potentiometers...etc.)
- Values of PID coefficients,
- Limitations,
- Inputs and outputs configuration.



**CARREFUL DO NOT ERASE THE CONFIGURATION OF AN AVR WITH THE CONFIGURATION OF THE OTHER AVR.**

### **3.3. Controls before the commissioning**

The first need is to control the external wiring and the general running of the plate.

**Step 1:** Realize and control the wiring of the plate, accordingly with the schematics given with the plate and eventually the generator.

**Step2:** Supply the AVRs and the command circuit with 250VAc power supply. Verify that:

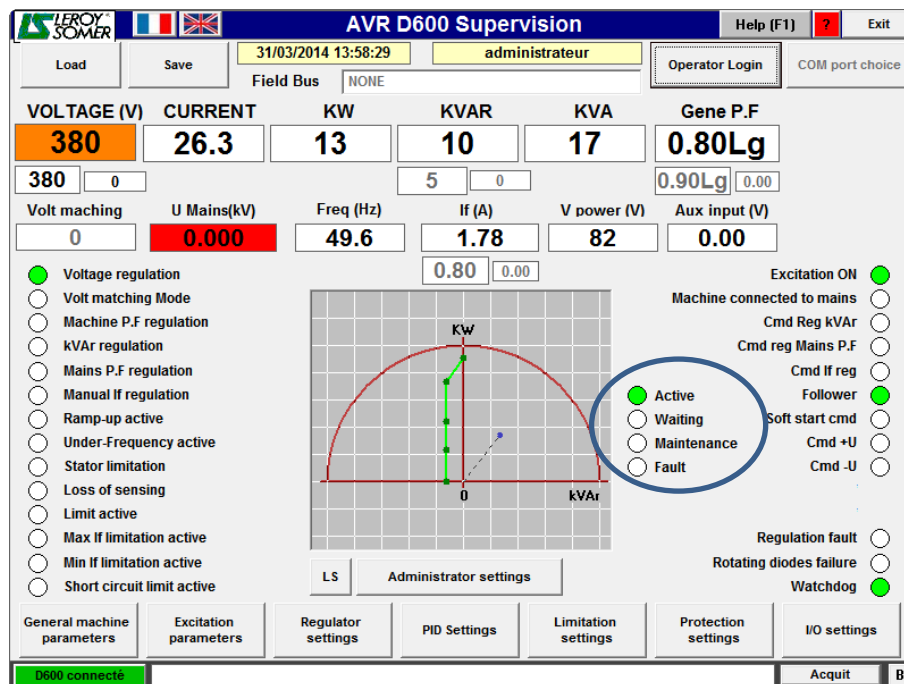
- Both AVRs are turned on and running:
- The watchdog DEL is blinking
- DELs of the redundant card of the AVR are on
- The PLC is correctly powered and running (DEL fault is not turned on)

**Step 3:** Verify that both AVRs are in "redundancy" mode with:

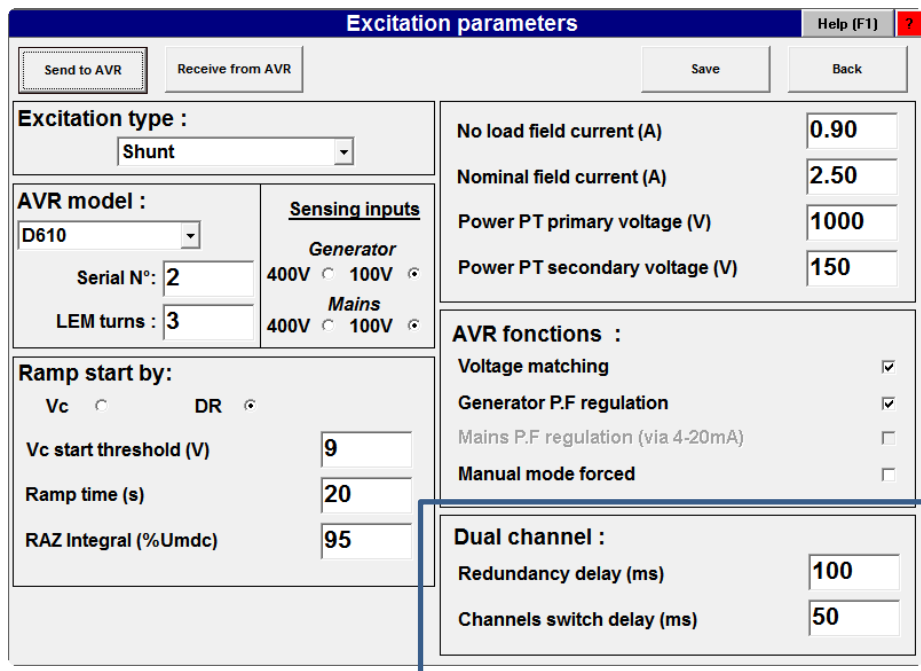
- One AVR in "active" mode
- The second AVR in "waiting" mode

**Note:** The redundancy card taken in account in the AVR can be seen in the SupD600 supervisor on the home page (presence of 4 DEL showing the AVR statement: "Active", "Waiting", "Maintenance" or "Fault")

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For page "Excitation parameters"



**Step 4:** Verify that the information for measure and power are on the AVRs

- Disconnect terminals for both AVRs are well closed
- Breakers for voltage sensing and power supply of the generator are closed in the generator terminal box.
- Verify that the "Starting ramp" contact is opened on both AVRs.

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### 3.4. Alignment of measures

Once the previous controls are done, it's necessary to verify that the values of measures on both AVRs are similar. For that, it's necessary to use two points of load with the generator and control the measures with the main page of the SupD600.

#### Step 1: Start the generator

- Start the generator at nominal speed,
- Excite the machine, closing the starting ramp contact (or closing the power supply contactor if the "start on threshold" is selected in the configuration). The ramp-up must be performed without runaway to the voltage set point.
- Control that both AVRs are running with supervisor.

**Step 2:** The "active" AVR will be the reference for measures of voltage and current. So, the accuracy of its measures should be compared with eventual customer devices present in the power plant (measure of voltage, current, power factor... etc.)

#### Step 3: Voltage measure alignment

- Do not apply load on the machine
- Verify the voltage measure for the generator on both AVRs with the supervisor, connecting successively on both. If the voltage of the "waiting" AVR is wrong ( $\pm 1\%$  of the voltage of the AVR "active"), correct modifying the values of the primary or secondary value of the sensing voltage transformer (General machine parameters)

#### Step 4: Stator current alignment

- Apply if possible a load representing almost 25% of the nominal power of the generator (this operation can be done in voltage, power factor or VAr mode)
- Verify the current stator measure
- Verify the current stator measure on both AVRs with the supervisor, connecting successively on both. If the current of the "waiting" AVR is wrong ( $\pm 1\%$  of the voltage of the AVR "active"), correct modifying the values of the primary or secondary value of the current transformer or/and isolating transformer (General machine parameters)

#### Step 5: Power factor measure alignment

- With the same load, verify the measure of the power factor on the "waiting" AVR. If the measure is wrong ( $\pm 0.01$  of the "active" AVR), correct modifying the "Phase difference offset CT" (Page administrator)

#### Step 6:

- Remove the load,
- Stop the excitation and the generator.

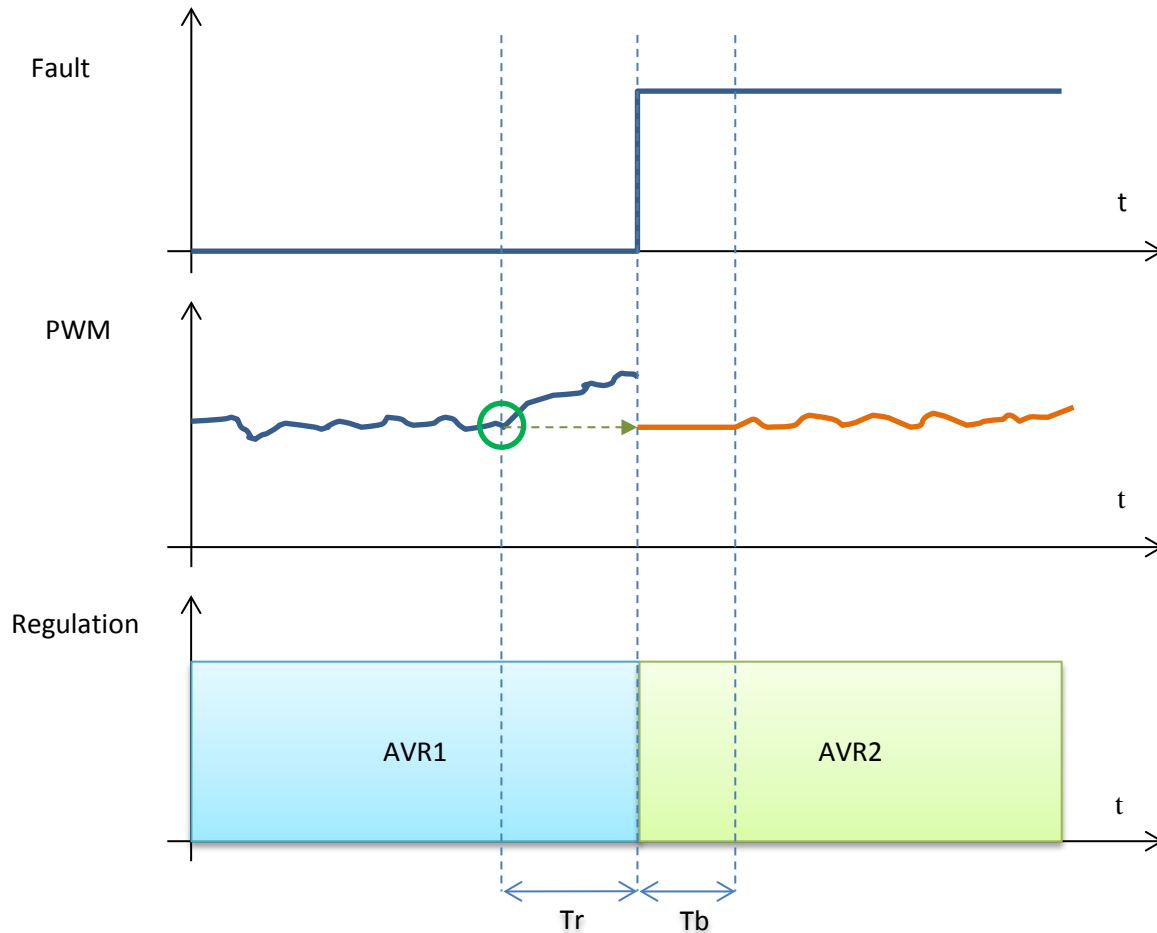
### 3.5. Setting of the redundancy values

Two values must be set in the AVRs for the redundancy:

- **Redundancy delay (Tr):** settable between 0 and 1000ms. This temporization defines the PWM value that you consider as good in normal regulation running conditions, and that you want to transmit to the "waiting" AVR when an issue occurs on the "active" AVR. This value is set according to the reaction delay of the generator.

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- **Channel switch delay (Tb):** settable between 0 and 1000ms, but naturally below the redundancy delay. It corresponds to the delay during which the value of the PWM at "Tr" is applied before the "waiting" AVR becomes "active".



### 3.6. Commissioning

Once all the controls and settings are realized, turn on the generator.

**Note: At the end of all the settings and the plate commissioning, save the configuration of each AVR.**

## 4. Using instructions

This plate has been developed to switch automatically from an "active" AVR1 to a "waiting" AVR2, if an issue occurs on AVR1. A manual changeover with local push buttons is also possible.

### 4.1. Security instructions

Before all operation on the plate, please refer to the running instruction and ensure that operations are realized accordingly with security of chapter 1.4.

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### **4.2. Description of control devices and signalization**

#### **4.2.1. Local push buttons**

There are 4 push buttons to switch manually from an AVR 1 "active" to an AVR 2 "waiting" to do eventually maintenance operations on it.

- Button "Maintenance" of AVR 1 (switch to "Maintenance" mode)
- Button "Maintenance" of AVR 2 (switch to "Maintenance" mode)
- Button "Reset maintenance" of AVR 1 (switch from "maintenance" to "waiting")
- Button "Reset maintenance" of AVR 2 (switch from "maintenance" to "waiting")

#### **4.2.2. Signalization**

The plate is also equipped with 9 lights, whose statement is copied on dry contacts:

- AVR1 "active"
- AVR1 "waiting"
- AVR1 "maintenance"
- AVR1 "fault"
- AVR2 "active"
- AVR2 "waiting"
- AVR2 "maintenance"
- AVR2 "fault"
- PLC "fault"

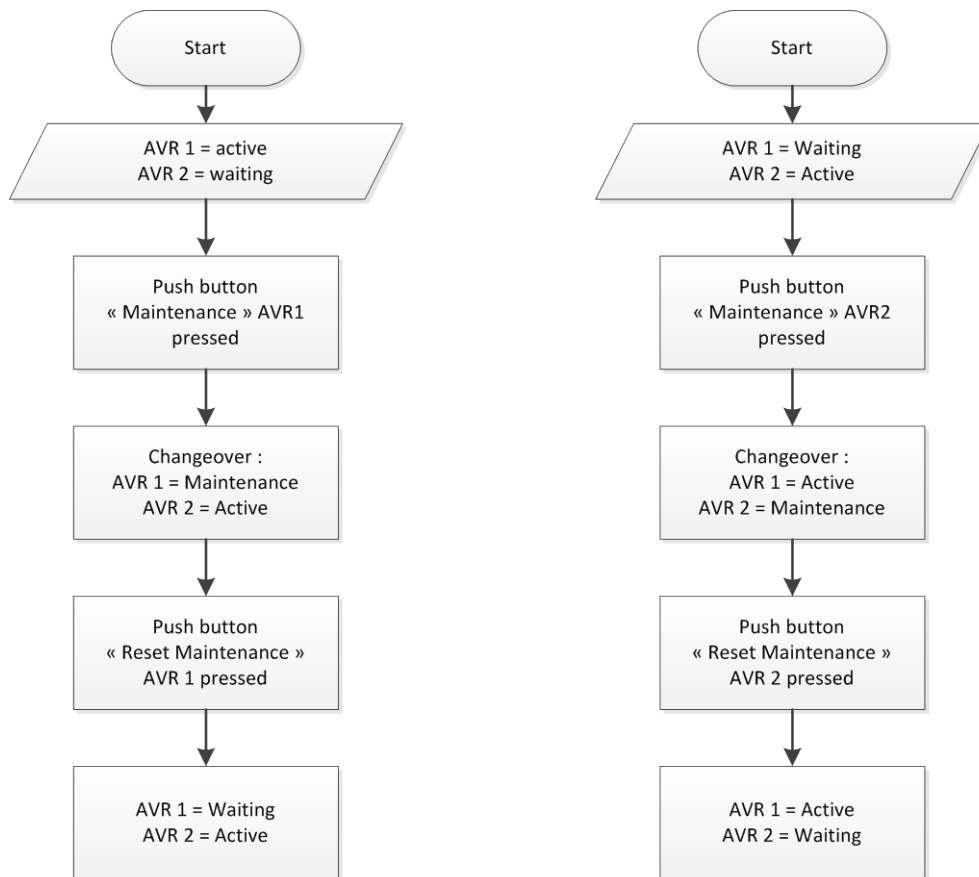
### **4.3. Description of running modes**

#### **4.3.1. Switch with push buttons**

As previously said, it's possible to switch manually the AVR mode with local push buttons. In this case the operations are:



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**Note: It's not possible to change AVR 1 from "Active" mode to "Maintenance" mode if the regulation is running and if AVR 2 is in "Maintenance" mode or "Fault".**

#### 4.3.2. Corrections of set-points with digital inputs cases

The set-point corrections are copied from the "Active" AVR to "Waiting" AVR by CAN bus, only if they are realized with digital inputs. The regulation context is then conserved in case of changeover.

#### 4.3.3. Follower

The correction value of the field current given by the follower is copied from the "Active" AVR to the "Waiting" AVR by CAN bus. The regulation context is then conserved in case of changeover and if the AVR runs in manual mode.

#### 4.3.4. Changeover on fault cases

Several faults can lead to change the regulation from the AVR from "Active" to "Waiting"

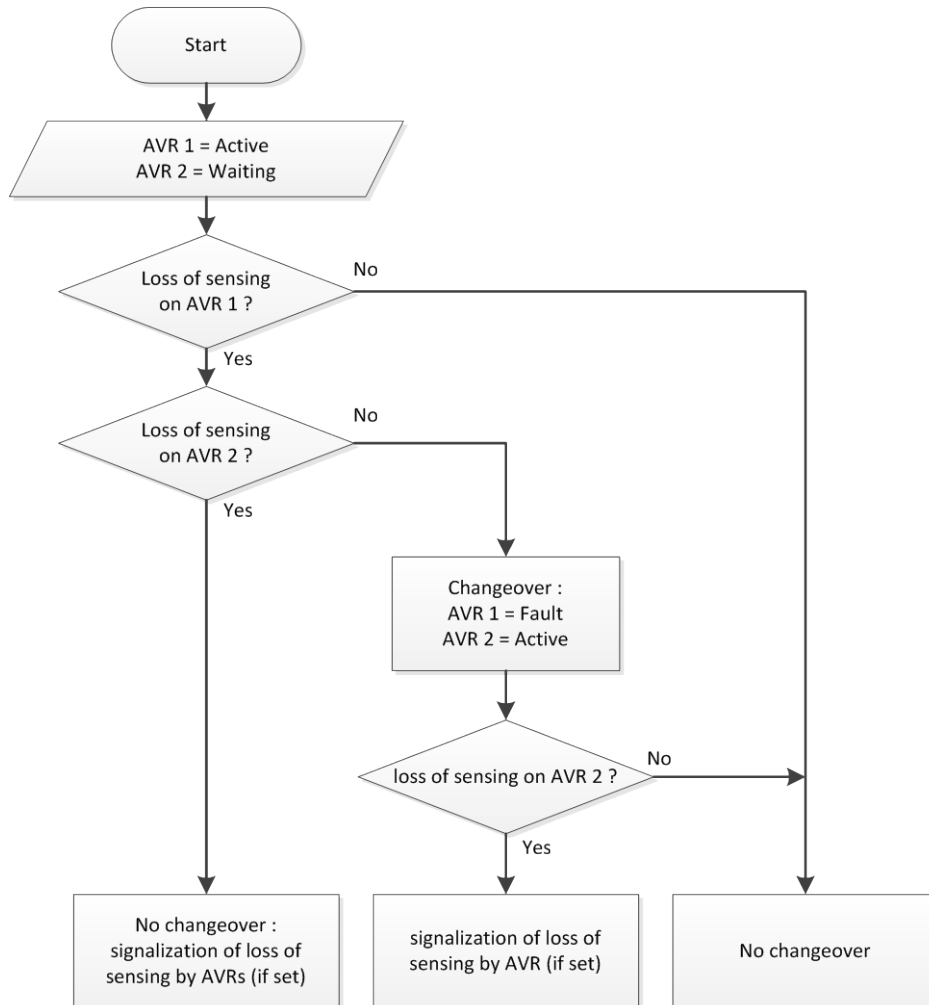
- A loss of sensing on the "Active" AVR and not on the "Waiting" AVR,
- A loss of stator current measure on the "Active" AVR,
- An issue in the control loop of the power transistor
- A discordant mode between the PLC and the "Active" AVR (power factor, VAr, volt matching mode, manual mode)
- If the AVR breaker opens during a regulation mode.

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## 4.3.4.1. Loss of sensing

The loss of sensing on the generator is monitored during all the running

- If the loss of sensing is detected
- In case the loss of sensing is detected for both AVR's "active" and "waiting", then the changeover doesn't occur (that can come from the sensing voltage transformer or wiring in the machine).



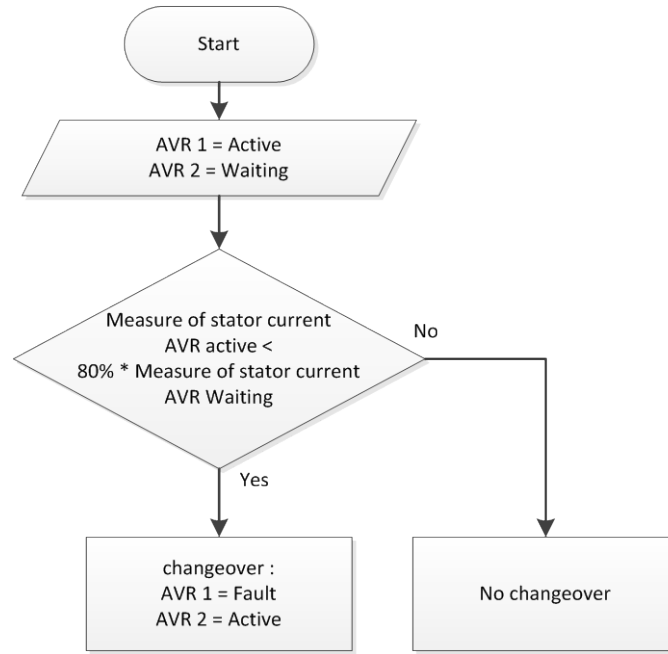
**Note:** if the loss of sensing occurs before both AVR's, the active AVR keeps the field current at the previous value and gives the information of loss of sensing. Then, it's possible to switch in manual mode and pilot the field current directly with push buttons (careful, when switching from automatic to manual, to be bumpless, the follower must be active)

**Nota2:** In case both AVR's are in manual mode, the loss of sensing is not monitored.

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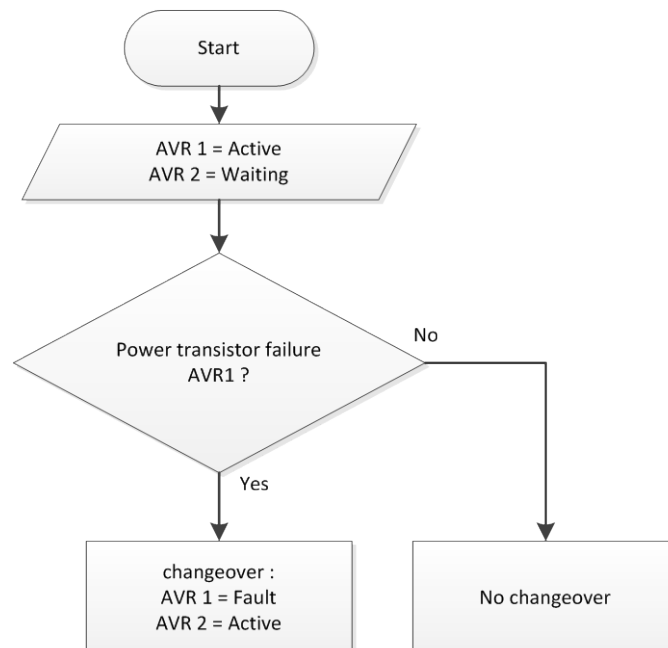
### 4.3.4.2. Stator current

The stator current measured by the AVR is compared permanently with the current measured by the waiting AVR, when the ramp is ended. In case the value measure by the "Active" AVR is less than 80% of the current measured by the "Waiting" AVR, the "Active" AVR go to "Fault" and the "Waiting" AVR go to "Active" mode



### 4.3.4.3. Failure of the power transistor

The AVR is equipped with a monitoring circuit of the power transistor. In case there is discordance between the command of the power transistor and its output, the "Active" AVR go to "Fault" and the "Waiting" AVR go to "Active" mode



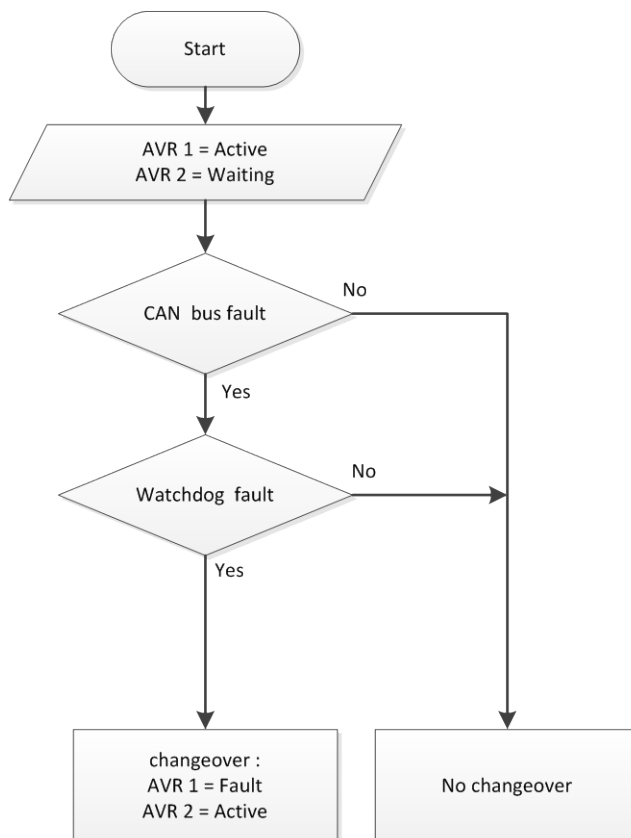
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### 4.3.4.4. Watchdog and CAN Bus

Several data are exchanged between AVRs:

- The communication CAN bus allows to the "Waiting" AVR to have the running context for the "Active" AVR,
- The watchdog information is also exchanged between both AVRs to control each other.

In case the watchdog or CAN bus in on fault, the "Waiting" AVR becomes "Active" if the fault is confirmed by a watchdog information lack.

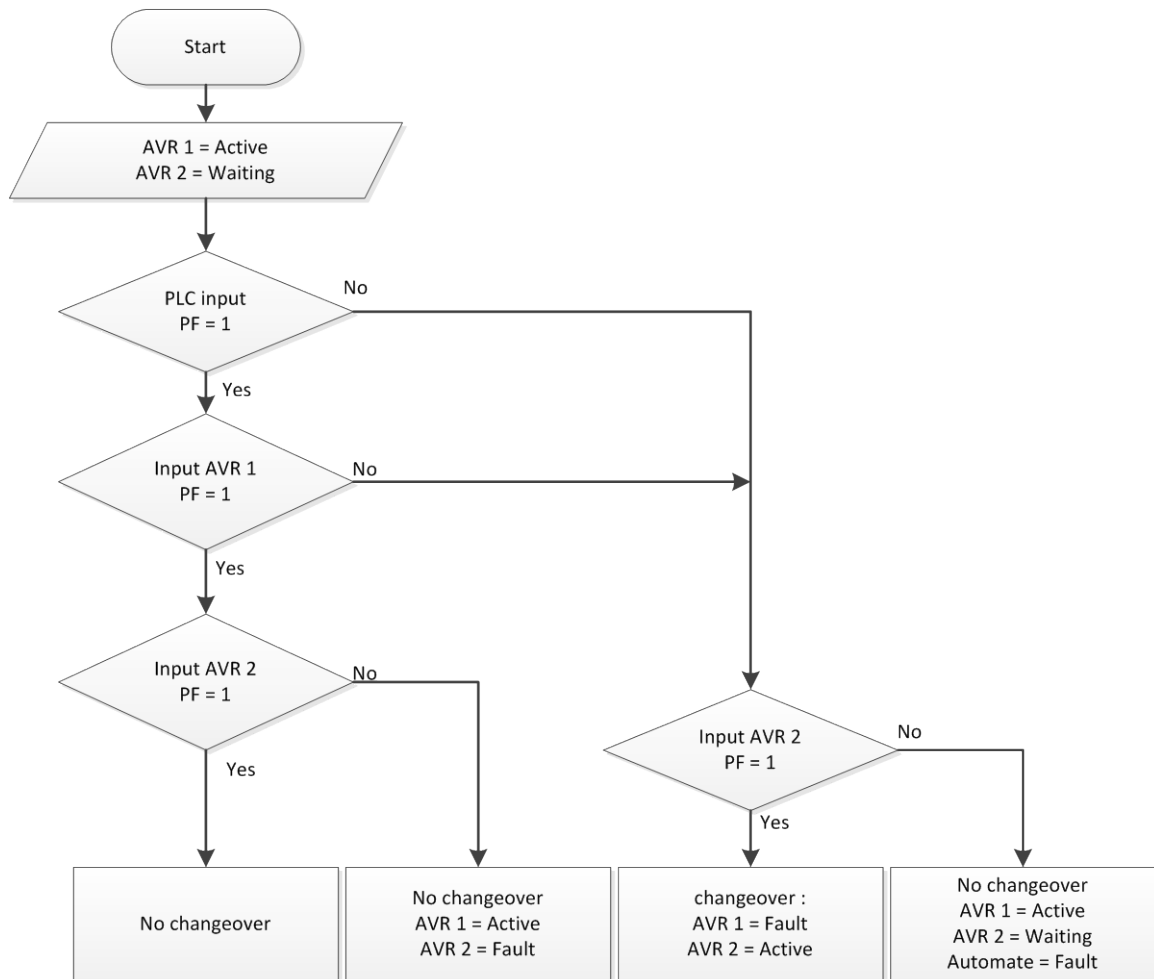


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## 4.3.4.5. Regulation mode

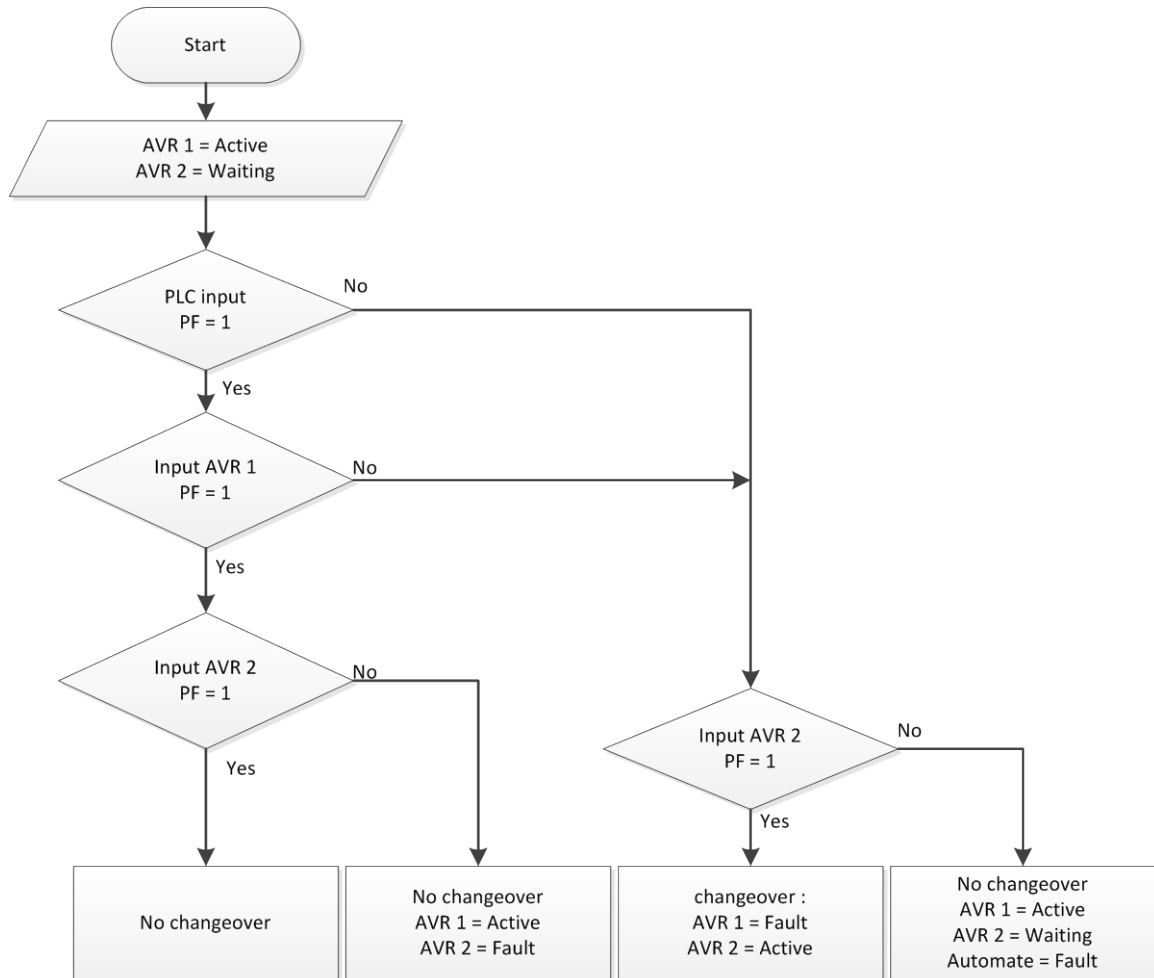
This failure is controlled by the PLC. That allows verifying that the regulation mode defined on the generator is well taken in account by the active AVR. In case of discordance, the "Active" AVR go to "Fault" and the "Waiting" AVR go to "Active" mode.

- **Power factor regulation mode**



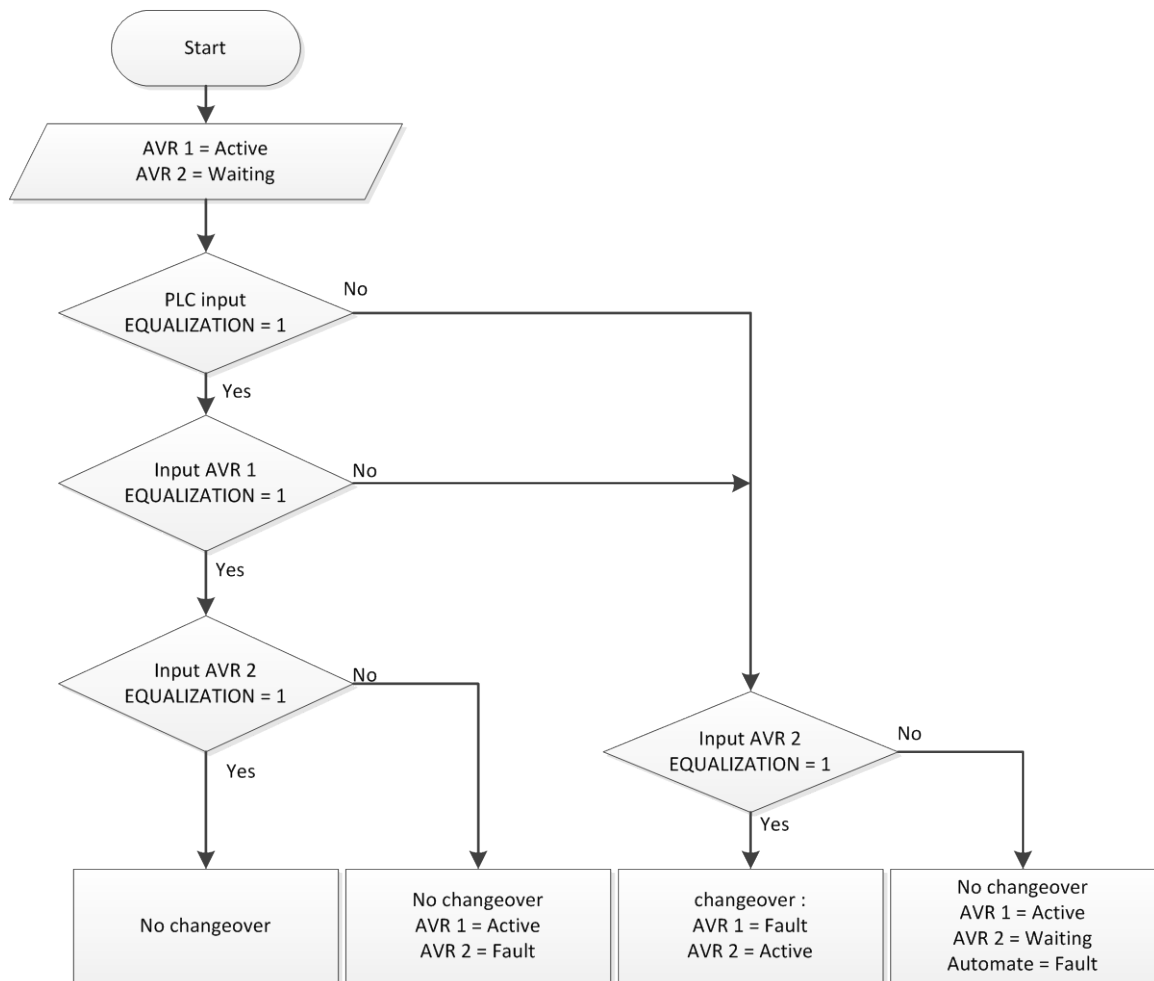
# DUAL PLATE D610

- VAr regulation mode



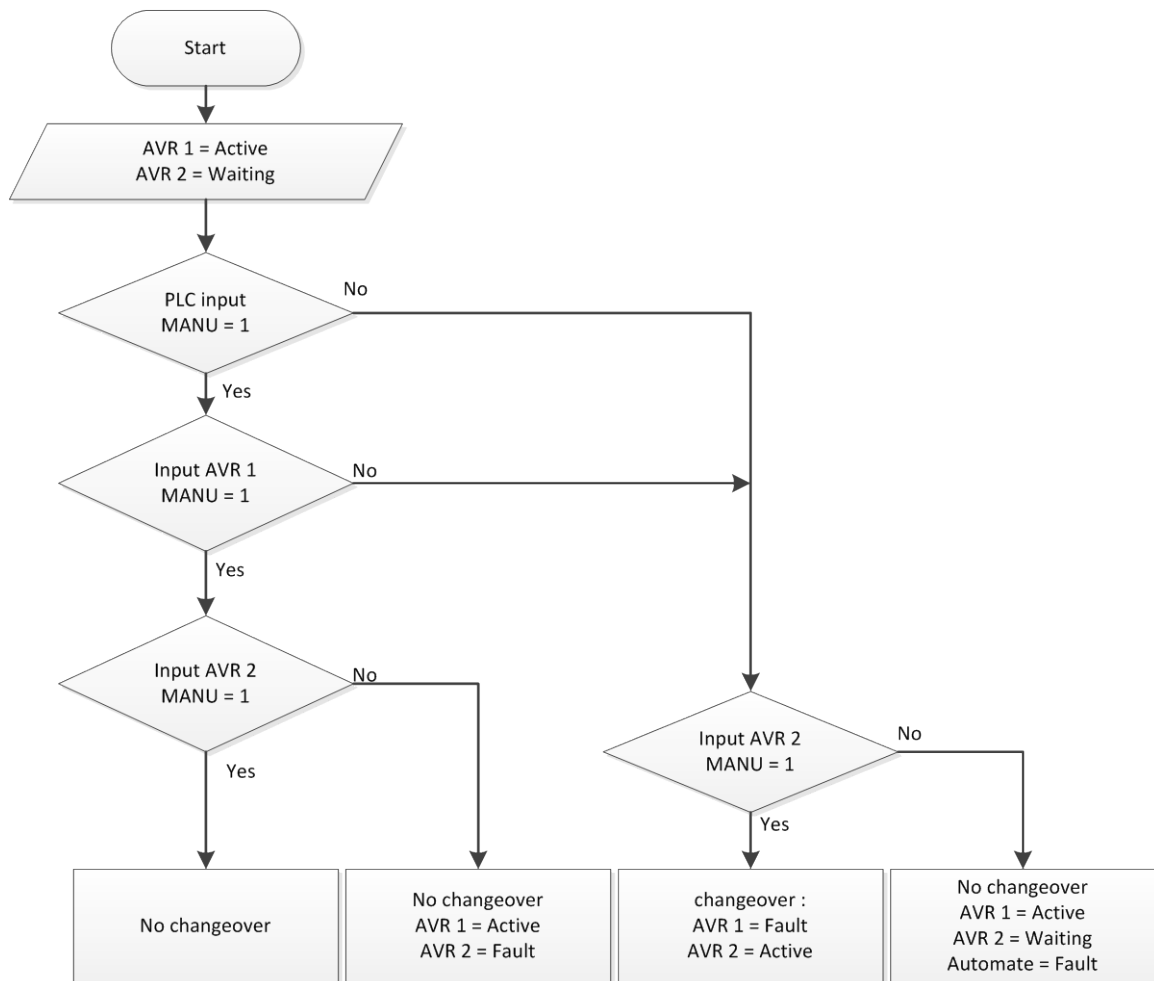
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- Volt matching mode



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- Manual mode**

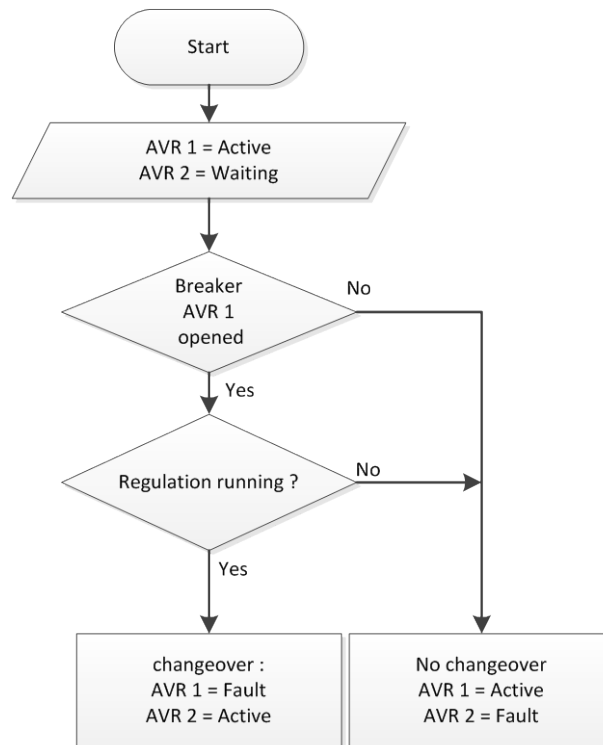




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### 4.3.4.6. Power breaker of the AVR opened

The power breaker of the AVR is monitored by the PLC: if a regulation is running and the breaker of the "Active" AVR is opened, the "Active" AVR go to "Fault" and the "Waiting" AVR go to "Active" mode.



### 4.3.5. Procedure to replace a faulty AVR

If an AVR is faulty, it's necessary to replace it, following the next steps:

#### Step 1: Isolate the AVR

- Open the power disconnect terminals,
- Open the measure disconnect terminals,
- Stop the 24Vcc power supply which supply the AVR concerned

#### Step 2: Remove the AVR

- Remove the wiring for connectors J2 and J3 and redundancy card
- Remove the wiring on the terminals on the top of the AVR



#### **CARREFUL:**

Even if there is no voltage present in case the AVR is in "Maintenance" or "Fault" statement, isolate both wires of the exciter terminals (terminals 5 and 6 of the AVR).

**Step 3:** Remove the faulty AVR mechanically.

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**Step 4** : Install the spare AVR

- Ensure that the AVR is correctly fixed on the plate.

**Step 5** : Electrical wiring

- Wire the AVR, according strictly to the schematics of the plate.



**CARREFUL: An invert of wires can damage the AVR or the generator**

- Wire the connectors of the supply card of the AVR, J2 and J3,
- Wire the connectors of the redundancy card.

**Step 6**: Supply the AVR

- Switch on the power supply 24Vcc for the supply of the AVR
- Verify the AVR is running

**Step 7**: Load the configuration of the AVR with the saved configuration (or if it's not possible, use the configuration of the "Active" AVR as a base)

**Note: Careful to change the serial number of the AVR in the "Regulator setting" page**

**Step 8**: Close the disconnect terminals**Step 9**: Controls

- Change the AVR status in "Maintenance" mode, pressing the push button "Maintenance" of the AVR concerned,
- Verify that the measures of the voltage and current are in the same range. If it's not the case, please refer to chapter 3.4.
- Press the button "Reset maintenance" of the AVR concerned,
- Verify that the AVR correctly change its mode from "Maintenance" to "Waiting" on the home page of the supervisor,
- Save the configuration file.

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### 4.4. Defects and events

Several defects can occur on the AVR, resulting its replacement. These faults are listed in the tab below:

DEFECTS	CAUSES	CURE	RESTART
Loss of sensing fault	Generator voltage transformer for sensing fault	Replace of the faulty voltage transformer	Stop the generator and initialize the running.
	Internal AVR voltage transformer for sensing fault	Replace the AVR	Restart the plate with procedure of the chapter 4.3.5.
AVR power transistor in short-circuit	Transistor fault or exciter circuit opened which has generated an over voltage on the transistor	Replace the AVR	Restart the plate with procedure of the chapter 4.3.5.
Fault of the power supply 24Vcc of one AVR	Power supply 24V faulty	Replace the 24V power supply	Restart the 24V power supply and verification of functionalities
	Fault of the converter on the power supply card of the AVR	Replace the power supply card of the AVR	Restart the plate with procedure of the chapter 4.3.5.
Fault of the power supply 24Vcc for the PLC and command	General fault of the plate	Replace the 24V power supply	Restart the 24V power supply and verification of functionalities
Microcontroller card fault	Failure of the component	Replace the AVR	Restart the plate with procedure of the chapter 4.3.5.
Internal AVR droop Resistance fault	Over current or component fault	Replace the AVR	Restart the plate with procedure of the chapter 4.3.5.
The AVR is in "fault" when "Waiting" mode is commanded	One condition is not good to have the AVR in "Waiting" mode	Verify that the breaker is closed and disconnect terminals are closed, and connectors are correctly inserted	Restart the plate with procedure of the chapter 4.3.5.
An AVR doesn't change its mode when a local push button is pressed	The analog output of the PLC is faulty	Replace the analogic card of the PLC	Restart the plate with procedure of the chapter 4.3.5.
The "Waiting" AVR is on fault when "Active" mode is commanded	CAN Bus is on fault between both AVRs	Verify that the DEL "CAN" of both AVRs is lightened	Restart the plate with procedure of the chapter 4.3.5.
	The stator current measure is in fault	Verify that the current is correct on the "waiting" AVR	Restart the plate after control of the measure with supervisor

# DUAL PLATE D610

## 5. Maintenance instructions

### 5.1. Technical data

#### 5.1.1. Mechanical schematic

The board layout of the dual plate D610 is available under reference P5 195 0450 on request to MOTEURS LEROY SOMER Orléans

#### 5.1.2. Electrical schematic

The electrical schematic of the dual plate D610 is available under reference S4 195 0450 on request to MOTEURS LEROY SOMER Orléans

### 5.2. Preventive maintenance instructions

No maintenance is necessary on the plate.

# DUAL PLATE D610

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# DUAL PLATE D610

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