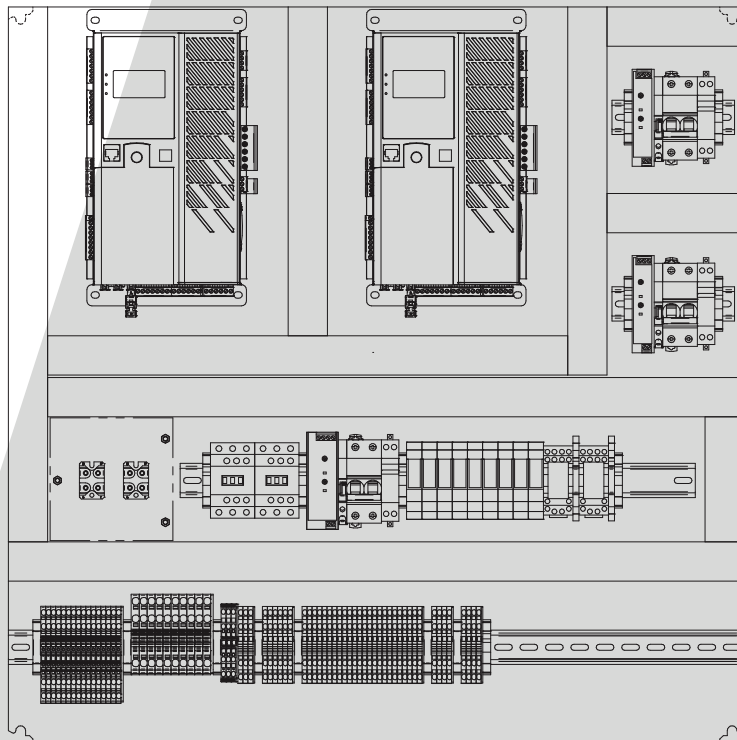




Power



LEROY-SOMER[™]
KATO ENGINEERING[™]

D700

Dual Plate

Installation and maintenance

D700

Dual Plate

**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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Share Capital: 32,239,235 €, RCS Angoulême 338 567 258.

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

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1. General instructions

1.1. Identity card

This dual plate for generator regulation has been made by:

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Internal Leroy-Somer™ reference: P5 198 0003

1.2. General presentation

1.2.1. Of the product

This manual describes the instructions for installation, use, setup and maintenance of the dual plate D700.

This plate is for the regulation of generators with field current of up to 25 A in continuous operation, and 50 A maximum in short-circuit conditions for 10 seconds maximum.¹

This plate has been designed to be installed in a control and power switching cabinet. 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 plate is installed.

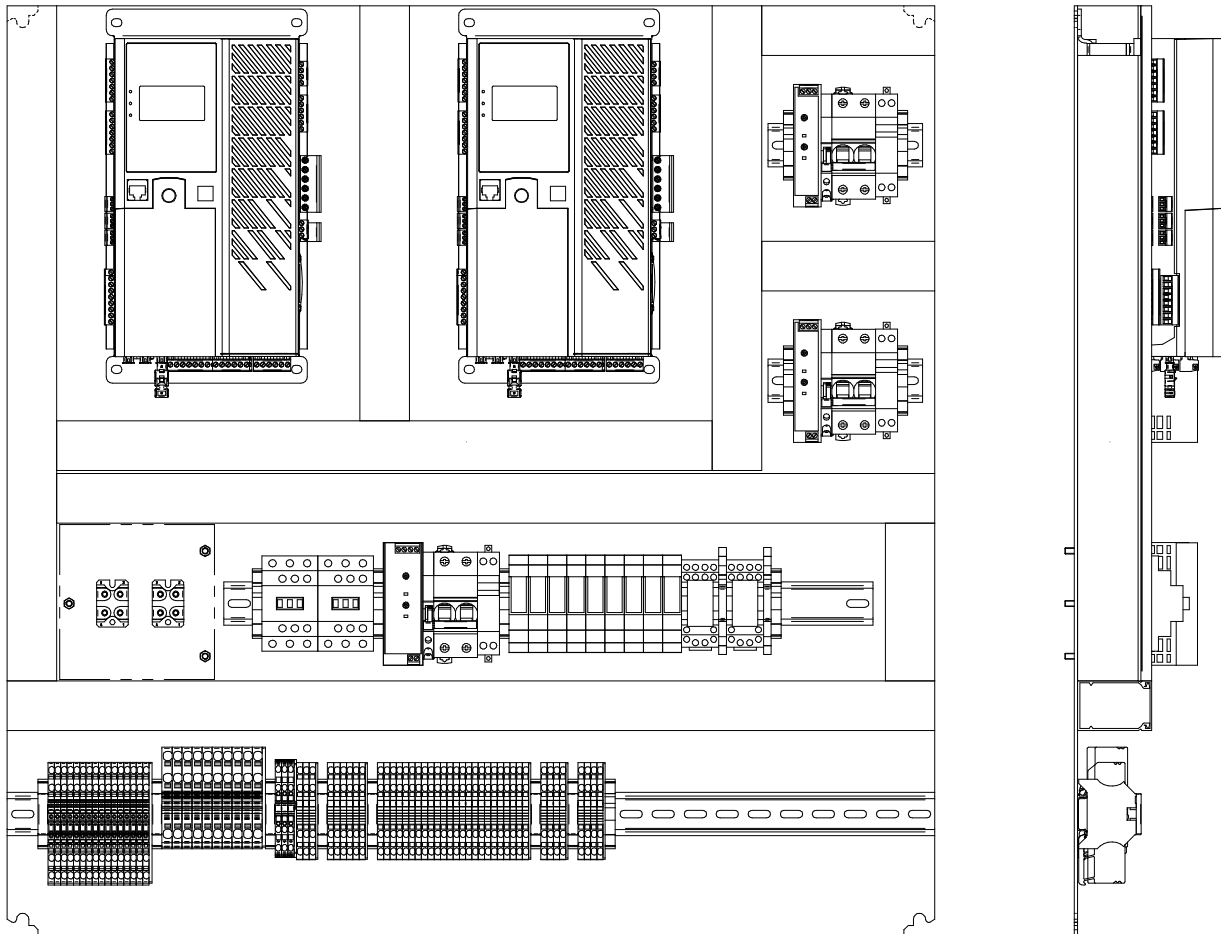
It consists of a frame equipped with two AVRs, a set of 24 VDC power supplies, and a set of relays and terminals. To make it easy to remove and replace a faulty AVR, even when the generator is still running, a set of disconnect terminals has been installed on the measuring and power supply circuits of each AVR.

Note: For more information on AVR operation, please refer to the installation and maintenance manual for D700 AVRs (reference: 5513en).

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

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1.2.2. Of the equipment

The dual plate D700 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 D700 AVR's exchange information via a serial communication bus.
- Three separate 24 VDC power supplies: one for each AVR and one for the control circuit (relay technology).
- 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:

- 9 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.

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.

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1.3. Technical characteristics

Plate 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:

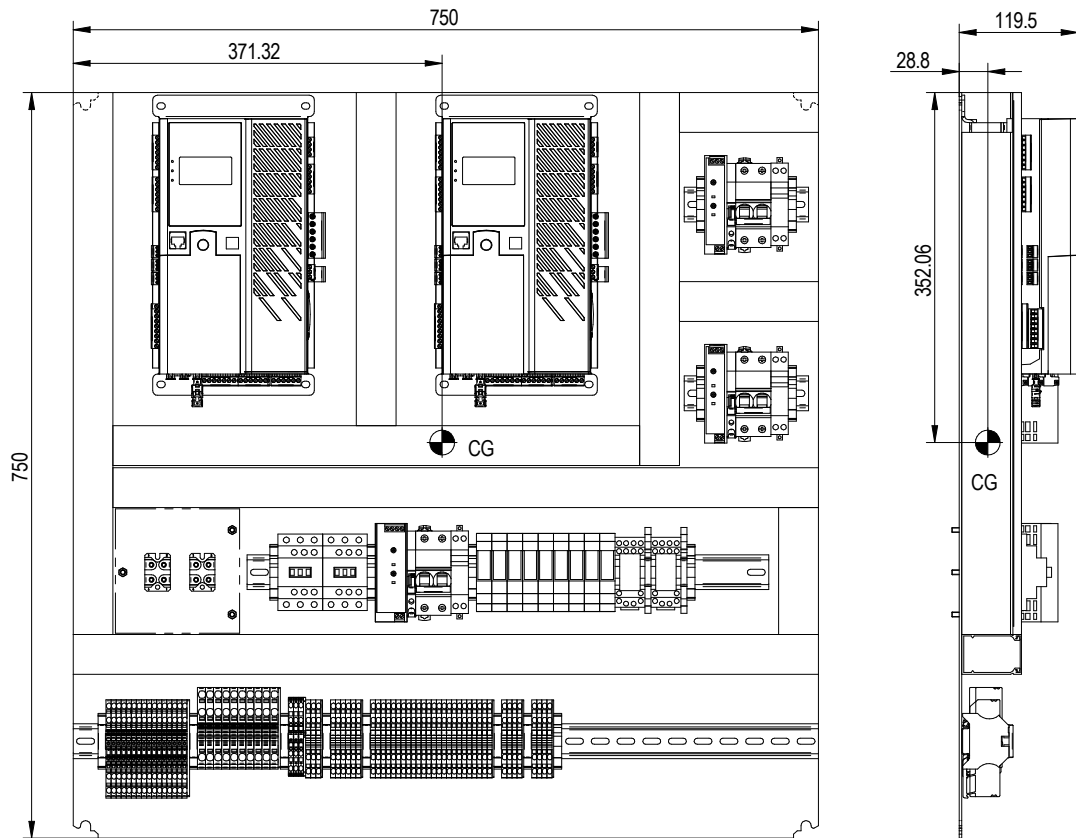
- **Generator voltage sensing:**
 - 3 phases without neutral, 3 phases with neutral, 2 phases or 1 phase with neutral
 - Three-phase range 0-230 VAC or 0-530 VAC (120% max. 2 minutes)
 - Consumption < 2 VA
- **Mains voltage sensing:**
 - 3 phases without neutral, 3 phases with neutral, 2 phases or 1 phase with neutral
 - Three-phase range 0-230 VAC or 0-530 VAC (120% max. 2 minutes)
 - 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:**
 - **AC**
 - 4 terminals for PMG, AREP, SHUNT
 - 2 separate circuits
 - Range 50-277 VAC (115% max. 2 minutes)
 - Consumption < 3000 VA
 - **DC (precharging not managed):**
 - Range 50-400 VDC (110% 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
- **Frequency measurement:**
 - Range 30-400 Hz

For the plate:

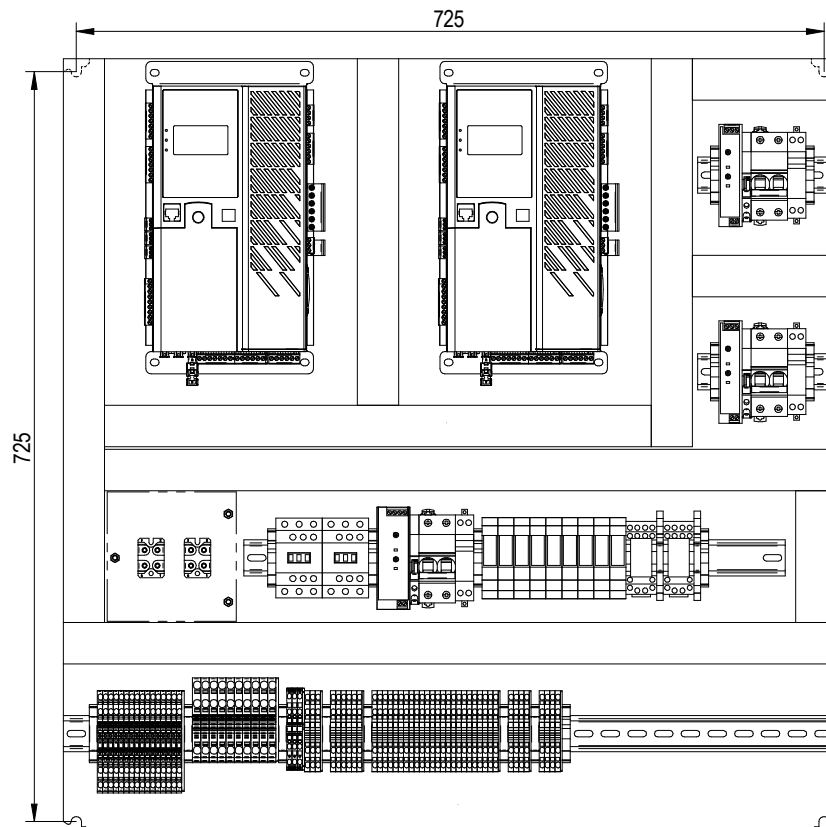
- 3 auxiliary power supplies: 250 VAC max 50/60 Hz – 24 VDC - 2 A max each
- D700 AVRs:
 - Voltage regulation accuracy: +/-0.25% of the rated value, as an average of the three phases on a linear load, with harmonic distortion of less than 5%
 - Voltage adjustment range: 0 to 150% of the rated voltage by means of volt-free contacts or an analog input
 - Quadrature droop adjustment range: -20% to 20%
 - Underspeed protection: integrated, adjustable threshold, slope adjustable from 0.5 to 3 x V/Hz in steps of 0.1 V/Hz
 - Field excitation ceiling: can be adjusted by the configuration at 3 points
 - Environment: ambient temperature of -40°C to +65°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: 750 mm
 - Width: 750 mm
 - Depth: 120 mm
- Weight: <30 kg

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- Fixings:



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Dual Plate

1.4. Safety devices and general safety instructions

For the user's own safety, the dual plate D700 must be connected to approved earth terminals on the plate. The tools needed to make this connection are not included with the plate.

Note: The 0Vs on the circuit boards of D700 AVR's are connected to earth

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

The dual plate D700 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 plate D700 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 considered to 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 plate 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 plate D700 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.

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1.4.2. Use

D700 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 conforms 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 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.

Voltage regulators meet 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 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 installation and cooling of equipment must comply with the specifications in the documentation supplied with the product.

The dual plate D700 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 contact parts.

The dual plate D700 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 plate D700 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".

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1.4.6. Operation

Installations in which dual plate D700s 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 D700 parameters using control software or to the HMI are permitted.

Active parts of the dual plate D700 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 supplies for the AVRs and the control circuit, which are used to provide the AVR and relay internal power supplies, are essential for the plate to work. They should therefore be connected permanently.

Similarly, both the AC and DC AVR power supplies, which are used to create the field current, must be protected by fast-blow fuses or circuit-breakers. Their rating should be suitable for the generator on which the plate is mounted.

2. Installation instructions

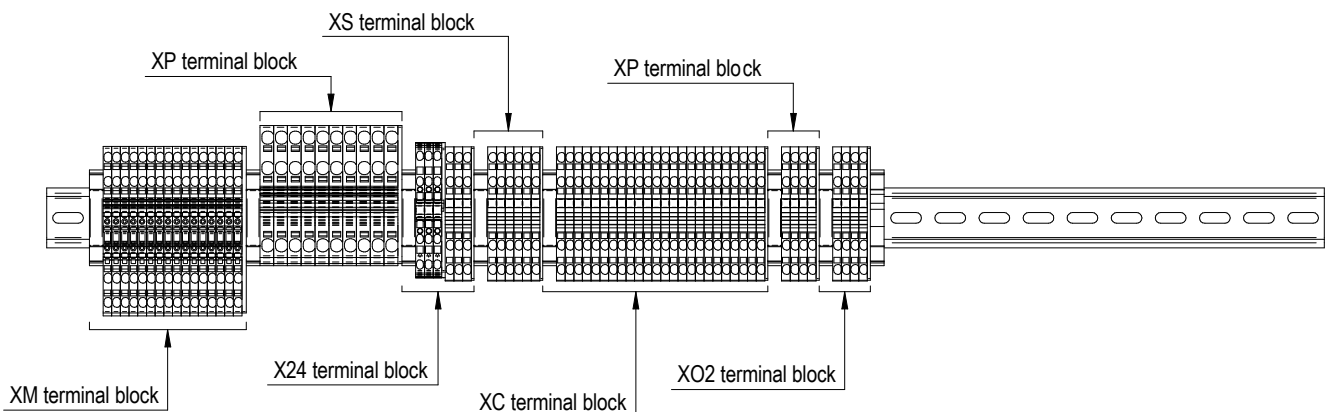
2.1. Layout of the cabinet housing the dual plate

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

A ventilation, cooling or heating system should be installed in the cabinet to maintain the plate within the environmental limits described above.

2.2. Connection block

The plate terminal blocks are separated according to their use:



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- XM: AVR measurement. These are isolating blade terminals.
- XP: AVR power and field excitation
- X24: 24 VDC power supplies, used redundantly with the 230 VAC power supplies on the plate
- XS: 230 VAC power supplies
- XC: Pilot control mode commands (AVR inputs)
- XO1: AVR 1 outputs
- XO2: AVR 2 outputs



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

| Plate Terminals | Generator | D700 | Connection |
|------------------------------|-------------------------------------|----------------------|--|
| XM.1 XM.3 XM.5 | Phase L1 Phase L2 Phase L3 | U V W | Generator voltage measurement – AVR 1 |
| XM.2 XM.4 XM.6 | Phase L1 Phase L2 Phase L3 | U V W | Generator voltage measurement – AVR 2 |
| XM.7 XM.8 | Phase L2 – S2 Phase L2 – S1 | V-S2 V-S1 | Parallel operation CT – AVR 1 |
| XM.9 XM.10 | Phase L2 – S2 Phase L2 – S1 | V-S2 V-S1 | Parallel operation CT – AVR 2 |
| XM.11 XM.13 XM.15 | Phase NW1 Phase NW2 Phase NW3 | L1 L2 L3 | Mains voltage measurement – AVR 1 |
| XM.12 XM.14 XM.16 | Phase NW1 Phase NW2 Phase NW3 | L1 L2 L3 | Mains voltage measurement – AVR 2 |
| XP.1 XP.3 XP.5 XP.7 | Power Power Power Power | X1 X2 Z1 Z2 | Field power – AVR 1 |
| XP.2 XP.4 XP.6 XP.8 | Power Power Power Power | X1 X2 Z1 Z2 | Field power – AVR 2 |
| XP.9 | Exciter | E+ | + excitation |
| XP.10 | Exciter | E- | - excitation |
| X24.1 | +24VDC | - | 24 VDC power supply - AVR 1 (plate power supply redundancy) |
| X24.2 | +24VDC | - | 24 VDC power supply - AVR 2 (plate power supply redundancy) |
| X24.3 | +24VDC | - | 24 VDC power supply - Control circuit (plate power supply redundancy) |
| X24.4 | 0VDC | - | 24 VDC power supply - AVR 1 (plate power supply redundancy) |
| X24.5 | 0VDC | - | 24 VDC power supply - AVR 2 (plate power supply redundancy) |
| X24.6 | 0VDC | - | 24 VDC power supply - Control circuit (plate power supply redundancy) |
| XS.1 | Neutral | - | 230 VAC power supply - AVR 1 (plate power supply redundancy) |
| XS.2 | Neutral | - | 230 VAC power supply - AVR 2 (plate power supply redundancy) |
| XS.3 | Neutral | - | 230 VAC power supply - Control circuit (plate power supply redundancy) |
| XS.4 | Phase | - | 230 VAC power supply - AVR 1 (plate power supply redundancy) |

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| Plate Terminals | Generator | D700 | Connection |
|-----------------|-----------|--------|--|
| XS.5 | Phase | - | 230 VAC power supply - AVR 2 (plate power supply redundancy) |
| XS.6 | Phase | - | 230 VAC power supply - Control circuit (plate power supply redundancy) |
| XC.1 | - | - | Maintenance mode – AVR 1 |
| XC.2 | - | - | Plate +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 |
| XC.8 | - | - | Plate +24VDC |
| XC.9 | - | - | DI2 input command – AVR 1 and 2 |
| XC.10 | - | - | Plate +24VDC |
| XC.11 | - | - | DI3 input command – AVR 1 and 2 |
| XC.12 | - | - | Plate +24VDC |
| XC.13 | - | - | DI4 input command – AVR 1 and 2 |
| XC.14 | - | - | Plate +24VDC |
| XC.15 | - | - | DI5 input command – AVR 1 and 2 |
| XC.16 | - | - | Plate +24VDC |
| XC.17 | - | - | DI6 input command – AVR 1 and 2 |
| XC.18 | - | - | Plate +24VDC |
| XC.19 | - | - | DI7 input command – AVR 1 and 2 |
| XC.20 | - | - | Plate +24VDC |
| XC.21 | - | - | DI8 input command – AVR 1 and 2 |
| XC.22 | - | - | Plate +24VDC |
| XC.23 | - | - | DI9 input command – AVR 1 and 2 |
| XC.24 | - | - | Plate +24VDC |
| XO1.1 | - | DO11.1 | Relay output – AVR 1 |
| XO1.2 | - | DO11.2 | Relay output – AVR 1 |
| XO1.3 | - | DO12.1 | Relay output – AVR 1 |
| XO1.4 | - | DO12.2 | Relay output – AVR 1 |
| XO2.1 | - | DO11.1 | Relay output – AVR 2 |
| XO2.2 | - | DO11.2 | Relay output – AVR 2 |
| XO2.3 | - | DO12.1 | Relay output – AVR 2 |
| XO2.4 | - | DO12.2 | Relay output – AVR 2 |

Note: Unless requested by the customer, our plate contains connection shunts on the XM terminal block so as 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 plate reference WD 198 0003 for more details.

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2.3. Consumption

- **Power supplies:**
 - Consumption < 2A
- **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) and power of the D700s are still available but are not wired up on this plate. Customer-specific cable ducts can be used to make these connections (not supplied).

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 D700 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 (mm ²) | 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 (mm ²) |
|--------------|----------------------------------|
| 30 | 2.5 |
| 50 | 4 |
| 75 | 6 |
| 100 | 10 |

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3. Setup instructions

3.1. Stator voltage and current measurement



For the plate 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 plate is to be installed.

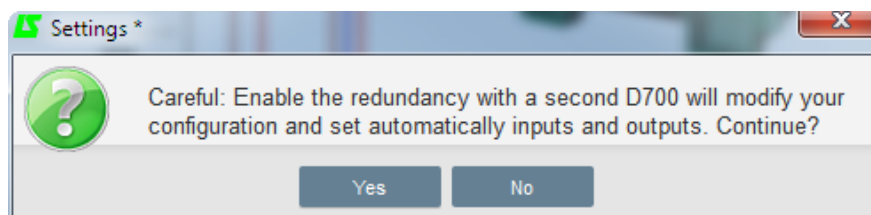
It is therefore important to pay particular attention to the following settings:

- 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

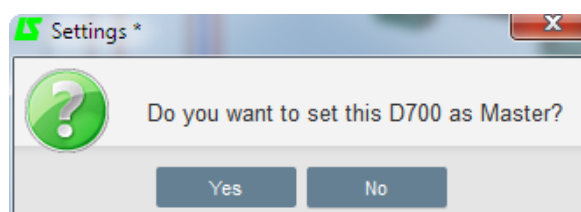


CAUTION, DO NOT OVERWRITE ONE AVR CONFIGURATION WITH THE OTHER AVR CONFIGURATION

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 D700" box. The following message appears:



Click "Yes". A second message appears:

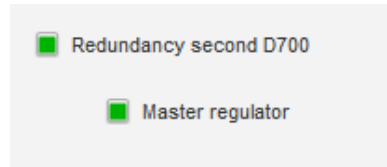


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Click "Yes" for the AVR which should be "active" when the plate starts, and "No" for the AVR which should be "Online".

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 D700.

The screenshot shows a software interface titled "Settings *" with a "Wiring" tab. The interface includes several configuration sections:

- Generator PT:** Generator voltage connection set to "2: 3 Ph". Primary (V): 400, Secondary (V): 100.
- Generator CT:** Generator CT connection set to "0: 1 CT". Primary (A): 50.0, Secondary (A): 1.0, Phase shift (°): 0.0.
- Bus voltage PT:** Grid voltage connection set to "1: Ph-Ph". Primary (V): 400, Secondary (V): 110.
- Grid CT:** Unchecked.
- Step up VT:** Unchecked.
- Cross current CT:** Unchecked.
- Power bridge used:** 0: Internal.
- Redundancy second D700:** Checked.
- Master regulator:** Checked.
- RTD Configurations:** RTD1, RTD2, RTD3, RTD4, RTD5, and RTD6 are all set to "1: RTD 3 Wires".

On the right side, there is a wiring diagram titled "GridLoad" showing a green generator connected to a Nidec inverter. The diagram includes a 50/1 (0°) transformer and various electrical connections labeled L1, L2, L3, U, V, W, and N. The status bar at the bottom indicates "roducts connected" and "RD Mode".

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

- "Machine fault" tab: reactive power inversion fault
- "Regulator fault" tab: loss of sensing fault, battery and IGBT 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.

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On the "Inputs/Outputs" page

- Inputs DI14 to DI16 are assigned as follows:
 - DI14: activation of "Maintenance" mode. This mode can be used to set the D700 offline. Redundancy between the two AVRs is then no longer active: only the second D700 is able to regulate. If maintenance mode has been activated on one of the two D700s, it prevents "Maintenance" mode on the second D700.
 - DI15: indicates that the second D700 is active (in regulation mode)
 - DI16: indicates that the second D700 is online (ready for regulation)

| | | |
|------|------------|-----------------|
| DI14 | Active Low | Maintenance |
| DI15 | Active Low | Other is active |
| DI16 | Active Low | Other is online |

- Outputs DO1, DO2 and DO10 are assigned as follows:
 - DO1: is activated if the AVR is "active"
 - DO2 and DO10: are activated if the AVR is "online"

| | | |
|--------|------------|------|
| Active | Active Low | DO1 |
| Online | 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 |
| Online | Active Low | DO10 |
| None | Active Low | DO11 |
| None | Active Low | DO12 |

3.3. Checks prior to commissioning

First it is necessary to check the wiring and general operation of the plate.

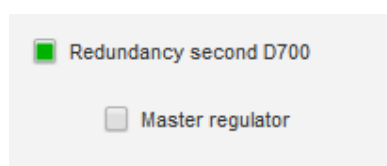
Step 1: Install and check the plate wiring in accordance with the wiring diagrams supplied to you with the plate and possibly with the generator.

Step 2: Supply the AVRs and the control circuit with 250 VAC power. Check that:

- Both AVRs are powered up and running: the displays come on at start-up or when one of the interface keys is pressed, the power supply LED on each D700 is green.
- The control circuit relays are supplied with power.

Step 3: Check that the AVRs are in "redundancy" mode:

- Either with the EasyReg Advanced program, "Wiring" page: the "Redundancy second D700" box should be checked, with the "Master regulator" box checked on AVR 1 and unchecked on AVR 2.



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- Or with the HMI:
 - On the "Master" AVR: the "AVR active" and "AVR online" outputs are active, as well as the output controlling the contactor (DO10).

| Digital Outputs | | | | | |
|-------------------------------------|-------------------------------------|--------------------------|-------------------------------------|--------------------------|--------------------------|
| <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 01 | 02 | 03 | 04 | 05 | 06 |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 07 | 08 | 09 | 10 | 11 | 12 |

- On the "Online" AVR: the "AVR online" output is active as well as the output controlling the contactor (DO10).

| Digital Outputs | | | | | |
|--------------------------|-------------------------------------|--------------------------|-------------------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 01 | 02 | 03 | 04 | 05 | 06 |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 07 | 08 | 09 | 10 | 11 | 12 |

Step 4: Check that the measurement and power data is actually reaching the AVRs:

- The plate 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".

3.4. 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, either using EasyReg Advanced, or from the HMI by going to the Regulation status page:
 - **On the "Master" AVR**, the regulation mode is displayed:

| Regulation status |
|-----------------------|
| Regulation Voltage |
| Setpoint : 380.0 V |

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

| Regulation status |
|--------------------------|
| Regulation Redundancy |
| Ready |

| |
|------------------|
| Redundancy |
| Regulator status |

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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, either with EasyReg Advanced by connecting to both AVRs in succession, or on the HMI display unit. If the voltage on the "waiting" AVR is incorrect ($\pm 1\%$ 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, power factor or kVAr mode).
- Check the stator current reading on both AVRs, either with EasyReg Advanced by connecting to both AVRs in succession, or on the HMI display unit. If the stator current measurement of the "waiting" AVR is incorrect ($\pm 1\%$ 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: Setting the PF

- With the same load, check the PF measurement on the waiting AVR. If the power factor measurement on the "waiting" AVR is incorrect (± 0.01 compared to that on the "active" AVR), correct this by changing the phase shift on the parallel operation CT.

Step 6: Stop the installation.

4. Instructions for use

This plate 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 plate 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 plate does not have any control and signalling devices apart from on the AVR HMI.

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 plate which prevent both AVRs being set to maintenance mode simultaneously.

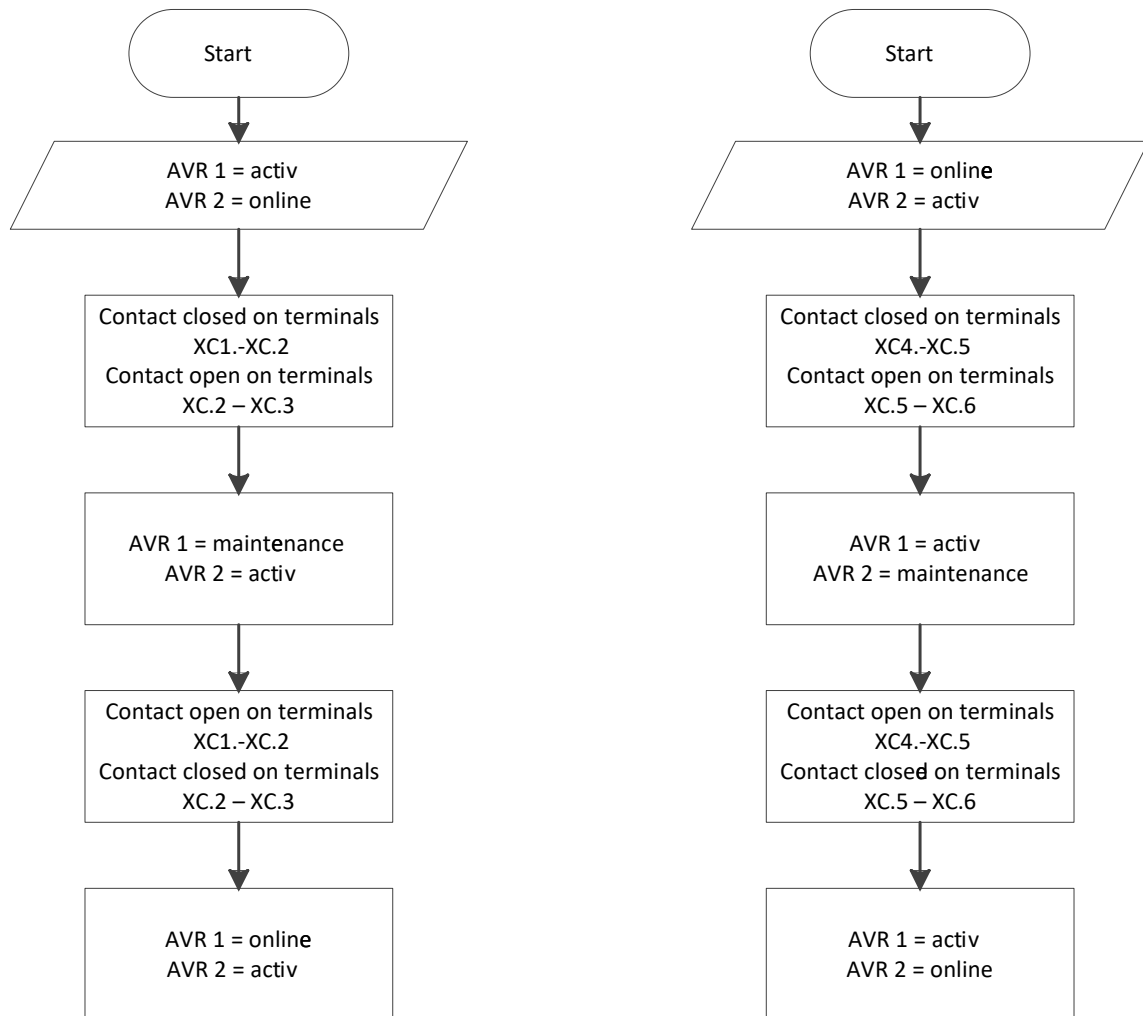
The plate therefore has 4 contact inputs:

- 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

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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 serial link 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 serial link. 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:

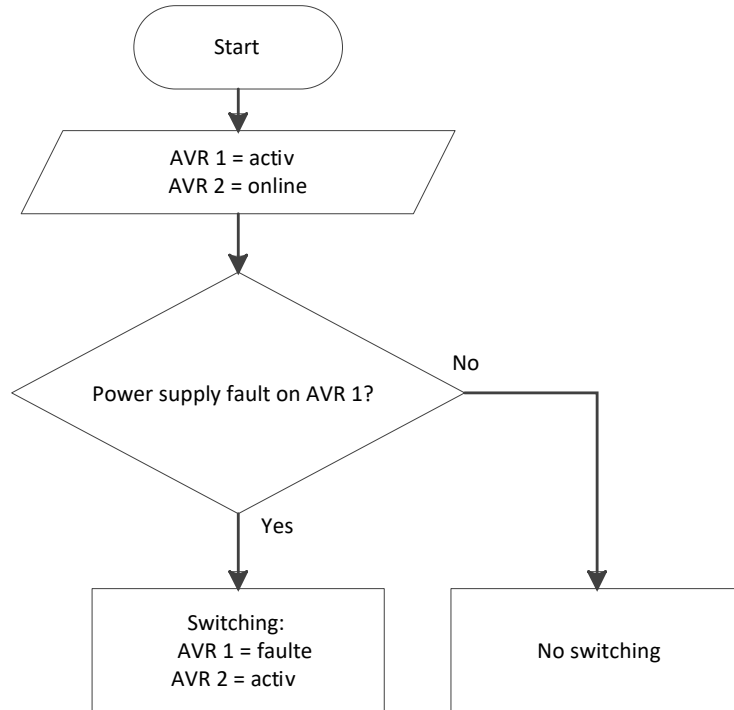
- Loss of the AVR internal or 24 VDC power supply
- A controller fault on the power transistor
- Loss of sensing on the "active" AVR and not on the "online" AVR
- A reactive power inversion fault

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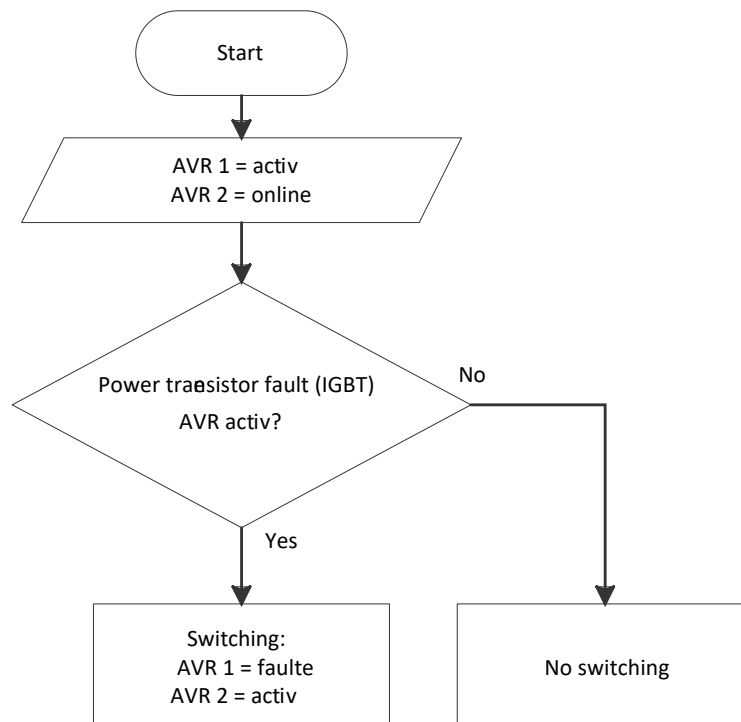
4.3.4.1. Loss of power supply

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



4.3.4.2. Power transistor fault

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



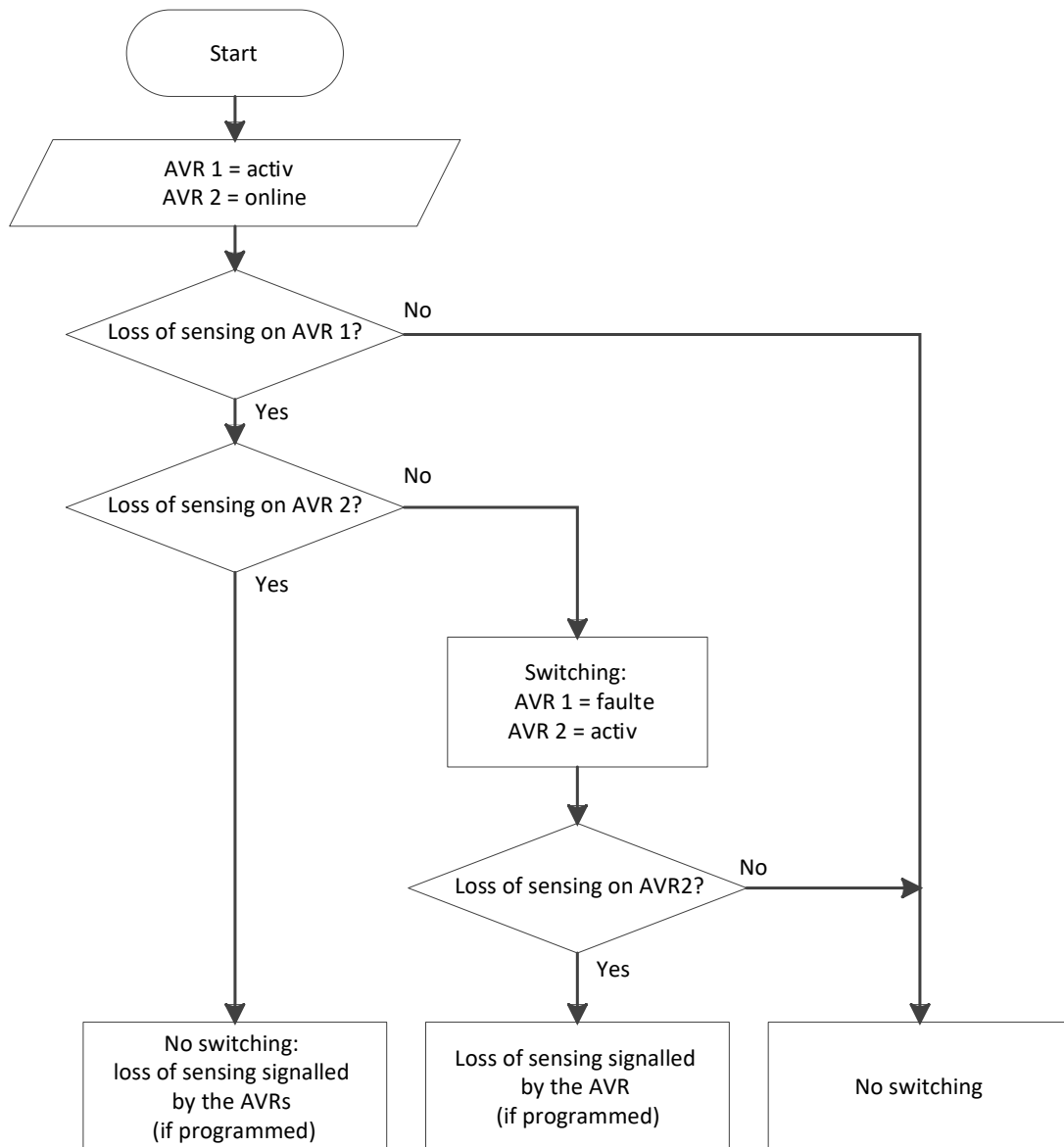
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4.3.4.3. Loss of sensing

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.

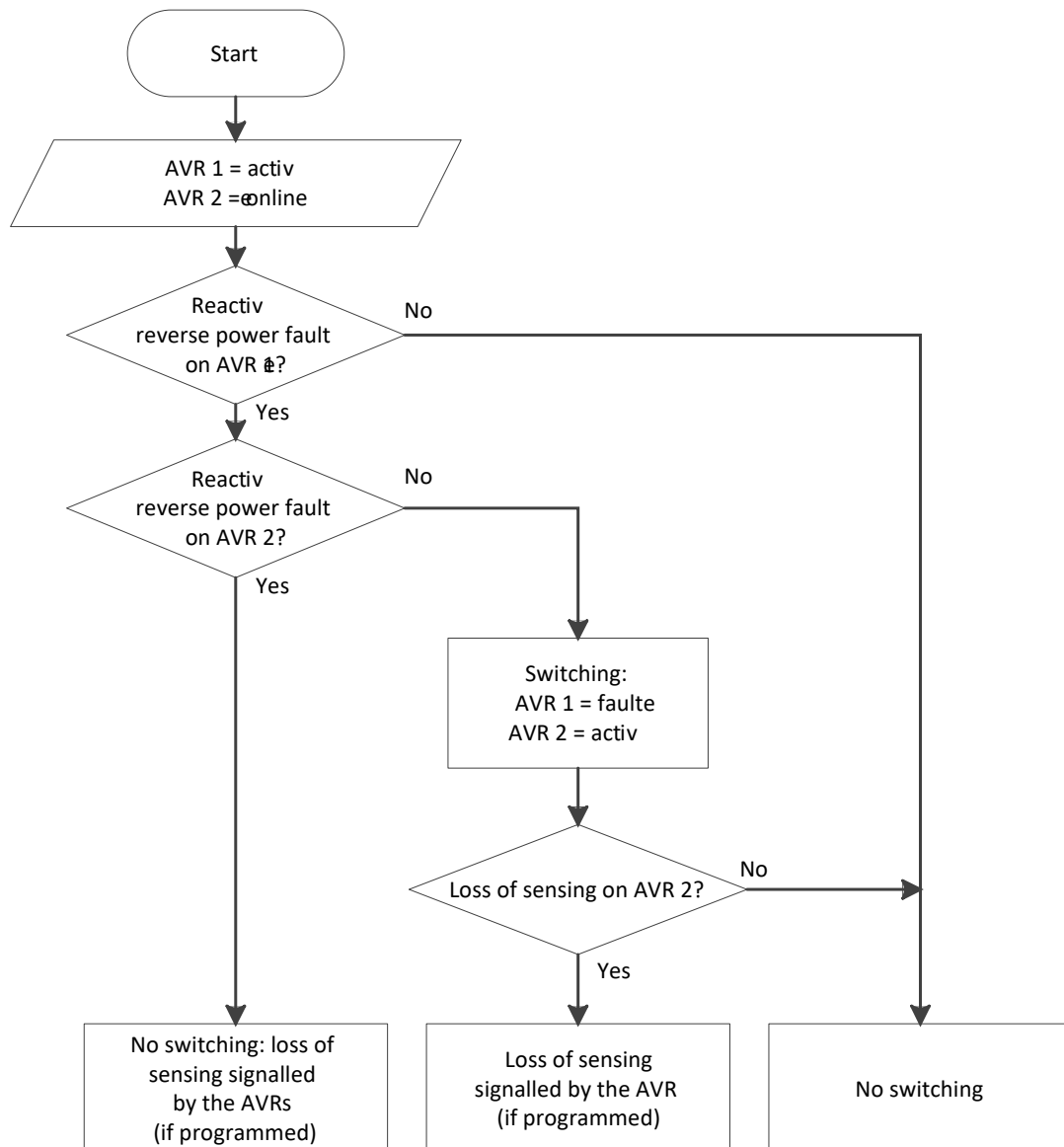
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4.3.4.4. Reactive reverse power fault

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.

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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
- Switch off the 24 VDC power supply which supplies the AVR control circuit

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 plate

Step 5: Electrical connections

- Wire up the earth connection
- Wire up the connectors, in strict compliance with the plate wiring diagram



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

Step 6: Supplying the AVR with power

- Power up the 24 VDC power supply for the AVR control circuit
- 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 measurements.
- 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

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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 plate operation. |
| | AVR internal sensing circuit broken | Replace the AVR | Restart the plate 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 plate with the procedure in section 4.3.5. |
| Power supply fault on one AVR | Power supply fault | Replace the 24 VDC power supply | Restart the corresponding power supply and check the functions work. |
| | AVR internal power supply fault | Replace the AVR | Restart the plate with the procedure in section 4.3.5. |
| Control 24 VDC power supply fault | Plate 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 plate 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 plate 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 serial link between the two AVRs | Restart the plate with the procedure in section 4.3.5. |

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5. Maintenance instructions

5.1. Technical data

5.1.1. Mechanical drawings

The layout plan for the dual plate D700 is available under reference P5 198 0003.

5.1.2. Wiring diagrams

The wiring diagram for the dual plate D700 is available under reference WD 198 0003.

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.

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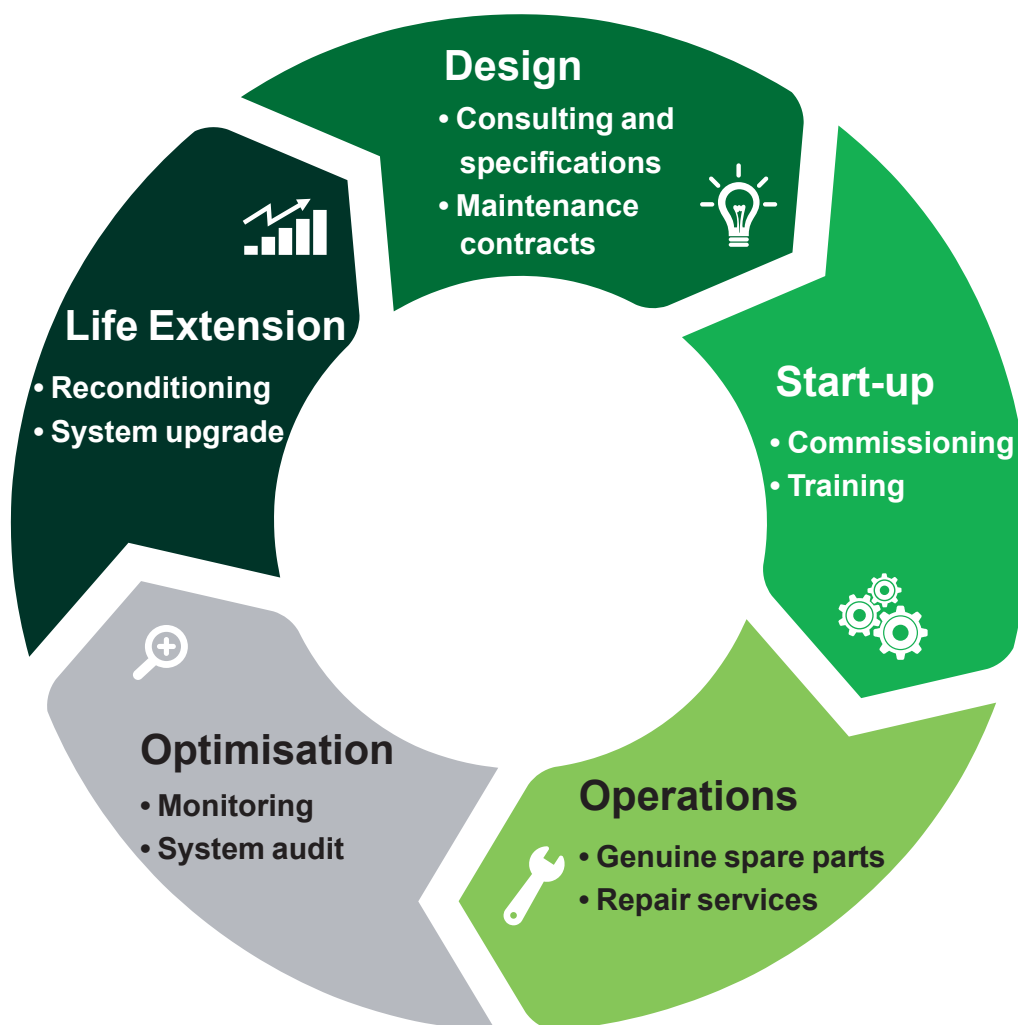
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