



TECHNICAL MANUAL

R438

Automatic Voltage Regulator (AVR)

<https://gensetpart.com/generator-avr/>

COMPATIBLE REPLACEMENT PART

POPULACE has manufactured generator electronic parts in Xiamen, China since 2006.
1000+ SKUs in stock, 1-5 day dispatch, every unit burn-in tested before shipment.

Document contents

- Specification and technical characteristics
- Terminal assignment and wiring diagram
- Installation, adjustment and settings
- Troubleshooting table

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Why source this part from POPULACE

- Factory in Xiamen, China - operating since 2006 (20 years)
- Over 1000 SKUs held in stock; dispatch within 1-5 days
- Every unit burn-in tested at 65 C before shipment
- CE and ISO 9001 production system; full batch traceability
- Free technical support for wiring, settings and fault diagnosis

Get a quote / technical support

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Installation and maintenance

R438
A.V.R.

1 - SUPPLY

1.1 - AREP excitation system

For both AREP & PMG excitation systems, the alternator voltage regulator is the R438. With AREP excitation, the R438 electronic AVR is powered by two auxiliary windings which are independent of the voltage match circuit.

The first winding has a voltage in proportion to that of the alternator (characteristic Shunt), the second has a voltage in proportion to the stator current (compound characteristic: Booster effect).

The power supply voltage is rectified and filtered before being used by the AVR monitoring transistor. This principle ensures that regulation is not affected by distortions generated by the load.

1.2 - PMG excitation system

This excitation system consists of a "PMG" (permanent magnet generator). This is fitted at the rear of the machine and connected to the R438 AVR.

The PMG supplies the AVR with constant voltage which is independent of the main alternator winding. As a result the machine has a short-circuit current capacity and good immunity to distortions generated by the load.

The AVR monitors and corrects the alternator output voltage by adjusting the excitation current.

- 50/60 Hz selection via the ST3 jumper.

1.3 - SHUNT or separate excitation system

A.V.R. can be operated with SHUNT supply (with a transformer / secondary 50V or a 48V battery).

2 - R438 A.V.R.

2.1 - Characteristics

- Standard power supply: AREP or PMG.
- Rated overload current: 8 A - 10 s
- Electronic protection (overload, short-circuit on opening of voltage sensing circuit): excitation overload current for 10 seconds then return to approximately 1A. The alternator must be stopped (or the power switched off) in order to reset the protection.

- Fuse : F1 on X1, X2. 8A ; slow - 250V

- Voltage sensing : 5 VA isolated via transformer ;

• 0-110 V terminals = 95 to 140 V,

• 0-220 V terminals = 170 to 260 V,

• 0-380 V terminals = 340 to 520 V.

- Voltage regulation $\pm 1\%$.

- Normal or rapid response time via ST2 jumper (see below).

- Voltage adjustment via potentiometer P2

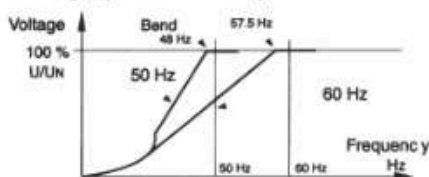
other voltages via adapter transformer

- Current sensing (parallel operation): C.T. 2.5 VA c1, secondary 1 A (optional).

- Quadrature droop adjustment via potentiometer P1.

- Max. excitation current adjustment via P5 (see below).

2.2 - Frequency compared with voltage (without LAM)



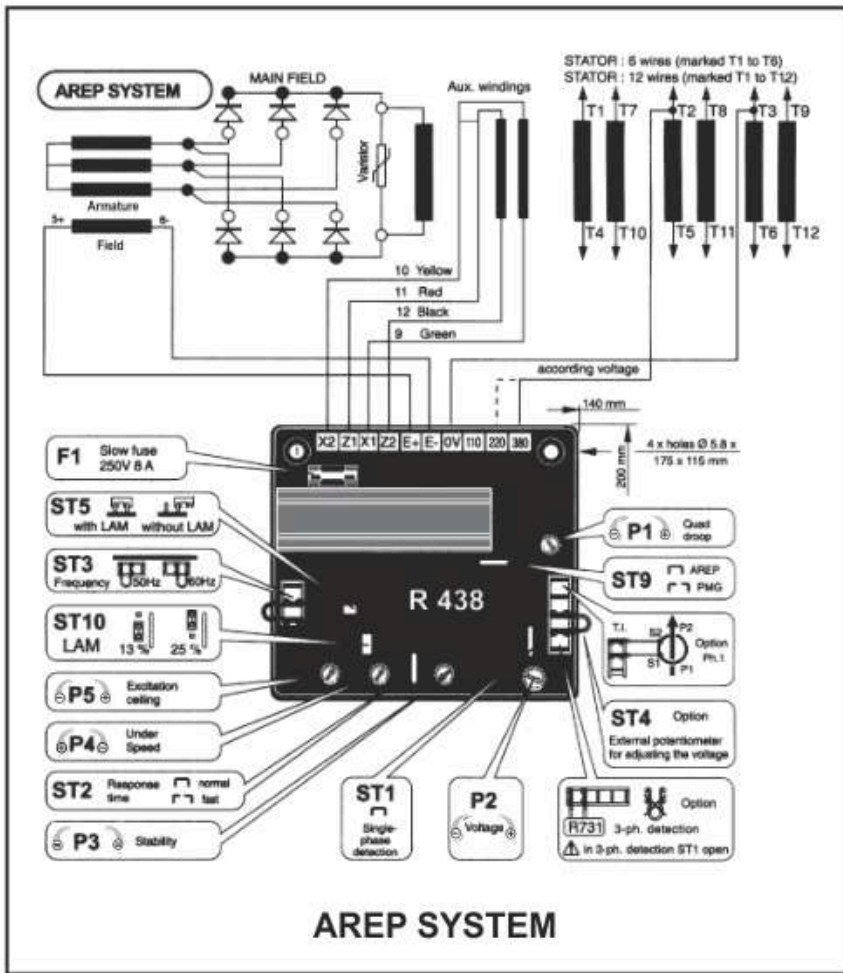
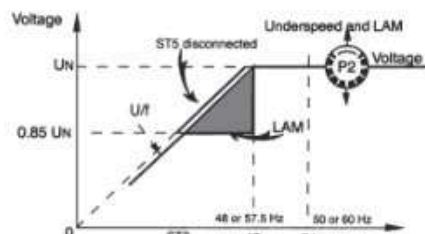
2.3 - LAM (Load Acceptance Module) characteristics

The LAM system is integrated in the R 438 AVR as standard. Role of the "LAM" (Load Adjustment Module) :

On application of a load, the rotation speed of the generator set decreases. When it passes below the preset frequency threshold, the LAM causes the voltage to drop by approximately 13% or 25% and consequently the amount of active load applied is reduced by approximately 25% to 50%, until the speed reaches its rated value again.

Hence the LAM can be used either to reduce the speed variation (frequency) and its duration for a given applied load, or to increase the applied load possible for one speed variation (turbo-charged engine). To avoid voltage oscillations, the trip threshold for the LAM function should be set approximately 2 Hz below the lowest frequency in steady state.

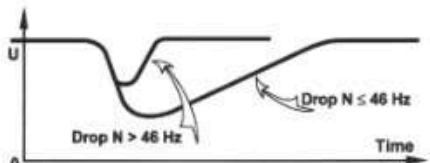
- LAM : action eliminated by cutting the ST5 jumper.



2.3.2 - Gradual voltage return function

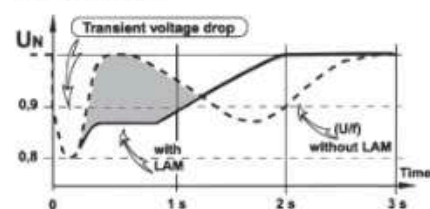
During load impacts, the function helps the genset to return to its rated speed faster thanks to a gradual increase in voltage according to the principle:

- If the speed drops between 46 and 50 Hz, the rated voltage follows a fast gradient as it is restored.
- If the speed drops below 46 Hz, since the engine needs more help, the voltage follows a slow gradient as it returns to the reference value.

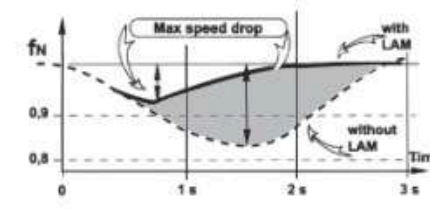


2.4 - Typical effects of the LAM with a diesel engine with or without a LAM (U/F only)

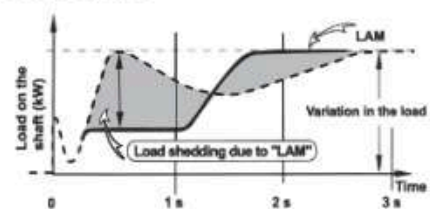
2.4.1 - Voltage



2.4.2 - Frequency



2.4.3 - Power



2.5 - R438 A.V.R. options

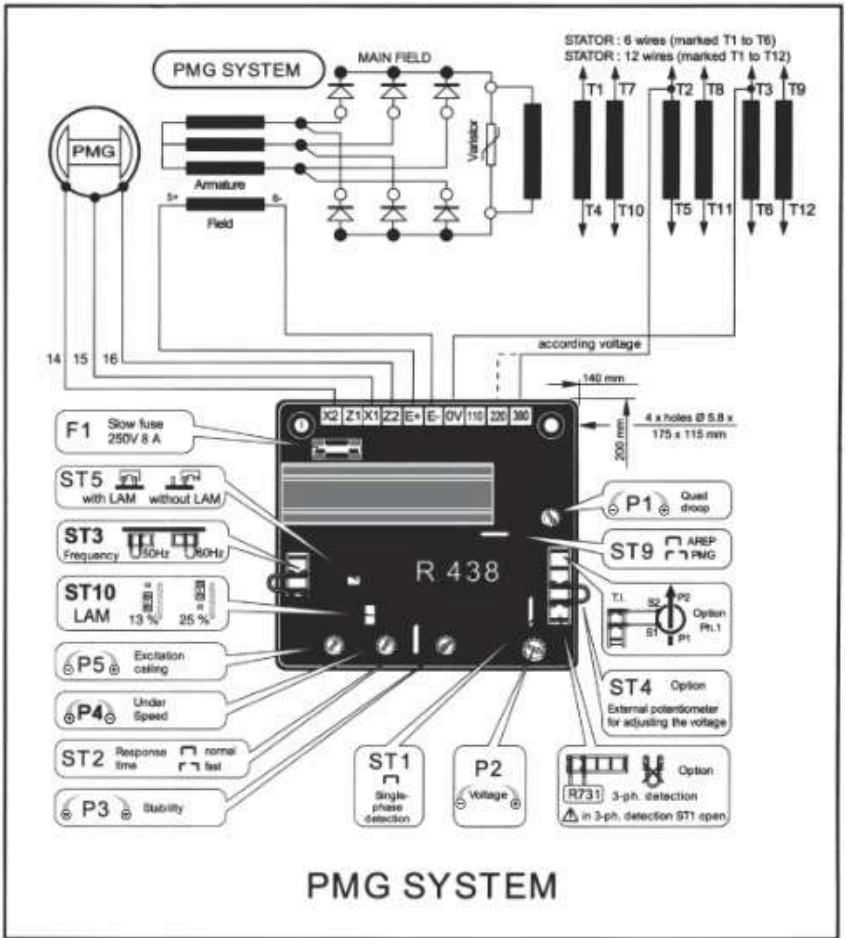
- Current transformer for parallel operation of/1A. 5 VA CL 1.

- Remote voltage adjustment potentiometer: 470 Ω , 0.5 W min: adjustment range $\pm 5\%$ (range limited by internal voltage potentiometer P2). Remove ST4 to connect the potentiometer. (A 1 k Ω potentiometer can also be used to extend the adjustment range).

3 - SPARE PARTS

3.1 - Designation

Description	Type	Code
A.V.R.	R 438	AEM 110 RE 017



3.2 - Electrical faults

Fault	Action	Effect	Check/Cause
No voltage at no load on start-up	Connect a new battery of 4 to 12 volts to terminals E- and E+, respecting the polarity, for 2 to 3 seconds	The alternator builds up and its voltage is still correct when the battery is removed.	- Lack of residual magnetism
		The alternator builds up but its voltage does not reach the rated value when the battery is removed.	- Check the connection of the voltage reference to the AVR
		The alternator builds up but its voltage disappears when the battery is removed	- Faulty diodes - Armature short-circuit - Faulty AVR - Field windings disconnected - Main field winding open circuit - check the resistance
Voltage too low	Check the drive speed	Correct speed	Check the AVR connections (AVR may be faulty)
		Speed too low	- Field windings short-circuited - Rotating diodes burnt out - Main field winding short-circuited - Check the resistance
Voltage too high	Adjust AVR voltage potentiometer	Adjustment ineffective	Increase the drive speed (Do not touch the AVR voltage pot. (P2) before running at the correct speed.)
Voltage oscillations	Adjust AVR stability potentiometer	If no effect : try normal / fast recovery modes (ST2)	Faulty AVR
Voltage correct at no load and too low when on load (*)	Run at no load and check the voltage between E+ and E- on the AVR	Voltage between E+ and E- SHUNT < 20 V - AREP / PMG < 10V	- Check the speed (or U/F bend set too high)
		Voltage between E+ and E- SHUNT > 30V - AREP / PMG > 15V	- Faulty rotating diodes - Short-circuit in the main field. Check the resistance - Faulty AVR - Faulty exciter armature.

(*) Caution : For single-phase operation, check that the sensing wires coming from the AVR are correctly connected to the operating terminals

Voltage disappears during operation (**)	Check the AVR, the surge suppressor, the rotating diodes, and replace any defective components	The voltage does not return to the rated value.	- Exciter winding open circuit - Faulty exciter armature - Faulty AVR - Main field open circuit or short-circuited
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(**) Caution : Internal protection may be activated (overload, open circuit, short-circuit)