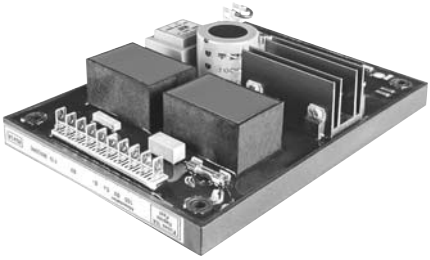
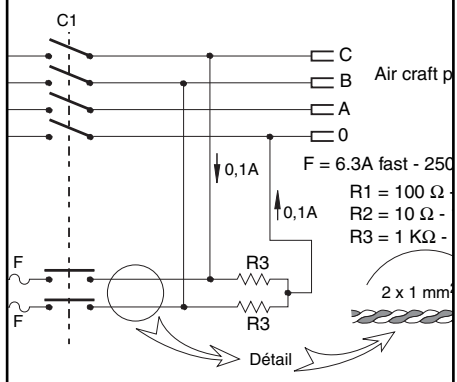
LEROY SOMER

1354 en - 10.2006 / e



This manual is to be given to the end user



R241 A

400 Hz A.V.R.

Installation and maintenance

R241 A
400 Hz A.V.R.

This manual concerns the alternator A.V.R. which you have just purchased.

We wish to draw your attention to the contents of this maintenance manual. By following certain important points during installation, use and servicing of your A.V.R., you can look forward to many years of trouble-free operation.

SAFETY MEASURES

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

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

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

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

This A.V.R. can be incorporated in a machine marked C.E.

WARNING

Warning symbol for an operation capable of damaging or destroying the machine or surround-ing equipment.

Warning symbol for general danger to personnel.

Warning symbol for electrical danger to personnel.

Note: LEROY-SOMER reserves the right to modify the characteristics of its products at any time in order to incorporate the latest technological developments. The information contained in this document may therefore be changed without notice.

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CONTENTS

All such operations performed on the A.V.R. should be undertaken by personnel trained in the commissioning, servicing and maintenance of electrical and mechanical components.

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1 - AUTOMATIC VOLTAGE REGULATOR

1.1 - Description

Supply to AVR is shunt or separate. It acts as a chopper (FET controlled) and has a double action (with reversal of output current). It is very fast (less than 5 ms detection time) and very accurate (±1%).
EMI filters are built-in (suppresssion according VDE 0875 classK). According to more severe regulations (émission, suceptibility) the AVR may be supplied in a shielded box with a plug connector
It is totally encapsulated and designed to be installed in a ventilated panel (ambient ≤ 65 °C), (see outline draving page 9).
Rated heat rejection : 35 W

1.2 - Features

- Power supply : 100 to 140 V AC for shunt operation the supply is taken between lineand neutral for 115 / 200 V machine. Use a voltage transformer (secondary 100 V - 10 A) for other voltages. Input fuse : 6.3 A / fast.
- Voltage sensing :

(115 - 200 V)
(140 - 240 V) } 400 Hz - 5 A

- Output : Max. 10 A / 10 s. An internal adjustable current limitation enables to adjust the maximum excitation current between 4 and 8 A.
- Terminal strips : 1 set of 10 terminals (J1) and 1 set of 5 (J2) for 1/4" spade clips.
- Adjustment means : 9 potentiometers with 1/10" length slot to be set with a screw driver.
- C.T. input : For line voltage dip compensation or parallel operation. C.T. datas : secondary current 1 A, 2 VA, class 1, (400 Hz).
- 2 terminals for connection of remote volt : Adjustment pot 470 Ω - 3 Watts

1.3 - Function of adjustment pots

More detailed explanation are given in ADJUSTMENTS.
- P3 : Voltage (U). Adjustment of voltage (either remote trimmer)
- P7 : Underspeed protection (U/f). Setting of threshold level (380 Hz)
- P9 : Excitation current limitation (I max). Adjustment of maximum excitation current between 4 and 8 A. This adjustment has also an influence on transient voltage dips.

- P1 : Amplitude (â)
- P2 : Phase shift (φ) } On line voltage dip compensation

These adjustments act when a C.T. is connected to regulator.
Also used for parallel operation : for that application P2 is always set fully anticlockwise (ex-works setting).
- P5 : Differential gain (d/dt)
- P4 : No linear (quadratic) gain - GNL
- P6 : Linear (proportional) gain - GL

These last 3 potentiometers enable to set the voltage stability and to get the fastest voltage recovery time during step loading.
- P8 : Current reversal time (dt) enable to get the fastest voltage recovery after sudden unloading.

The machine is tested and set at the factory. When first used with no load, make sure that the drive speed is correct and stable (see the nameplate). After operational testing, replace all access panels or covers.
The only possible adjustments to the machine should be made on the AVR.

2 - CONNECTION OF VOLTAGE REGULATOR

(See diagram on page 10).
The AVR is delivered to be installed in a control panel. Some precautions have to taken concerning the power line connections (voltage dip, EMI), as well for the voltage sensing leads.

2.1 - Power lines

- Input/Output :
The E.M. radiation may be limited by using 2 pairs of twisted wires or shielded audio-type cables. Voltage dip (for a rated current in the range 2 to 4 A according generator rating) : should be limited to 10 V total (DC side + AC 400 Hz side).

2.2 - Voltage sensing

The voltage sensing are generally connected at line end (aircraft plug) with a switch or breaker (C1) at generator output. When C1 is opening the sensing has to be changed over to generator output.
To limit voltage variations due to changing over we recommand the following connection principle diagram for sensing :

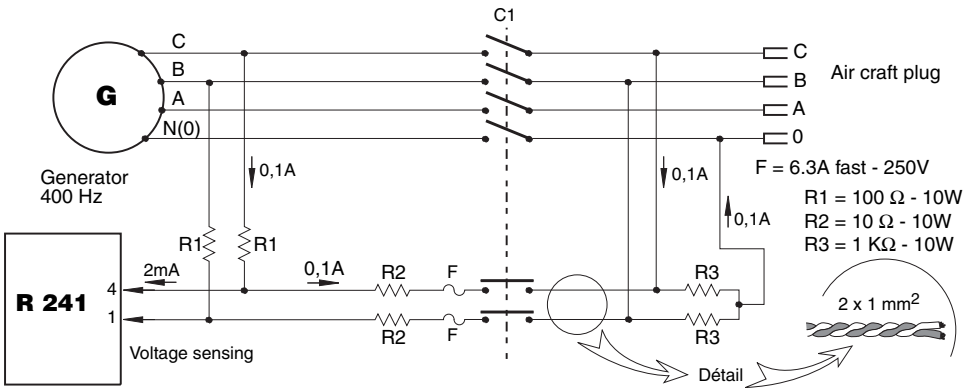
The 2 voltage sensing leads should be twisted or shielded type, and loaded at the ends to reduce the level of induced voltage. This arrangement introduces a sensing error of **about 10 % of the on-line voltage dip.**

2.3 - Voltage sensing across generator's output terminal

See "Compensation of line voltage dip" - with CT- adjustments by P1 and P2. In case of parallel operation, P2 is set fully anticlockwise.

2.4 - Loss of sensing (protection)

If for any reason the sensing circuit is opened the AVR supplies the ceiling excitation current (4 to 8 A according to adjustment) during about 10 seconds. After what the AVR reduces excitation current to about 0,8 A. To reset the protection system, the set shall stopped, or the supply to AVR switched off.

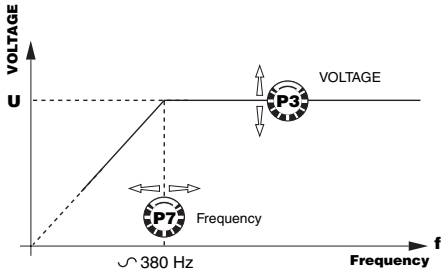


3 - ADJUSTMENTS

The voltage regulators delivered together with the alternators have been adjusted at works, **at the exception of potentiometers P1 and P2** (line voltage dip compensation) which are fully CCW (zero setting).
A form (see page 11) is supplied with each machine indicating all the potentiometers positions set in factory. When installing a spare AVR, set the potentiometers as indicated on this form.
"Line voltage dip compensation has to be readjusted as indicated further in par 3.2".

3.1 - Preliminary setting

As explained here above.
- P3 : (U) adjustment of voltage or with a remote voltage potentiometer 470 Ω.
- P5 : (d/dt) adjustment of differential gain if voltage is unstable.
- P7 : (U/f) Setting of underspeed protection



- At first : adjust P7 fully clockwise the frequency being over 400 Hz
- Adjust voltage with P3 (or remote voltage pot) at the wanted value
- Adjust speed to the acceptable specified minimum value in normal operation (ex : 380 Hz)
- Rotate P7 slowly anticlokwise, observing output voltage of generator. Stop to rotate P7 when voltage drops about 1 %.

3.2 - Line voltage dip compensation

The voltage sensing being at generators' output terminals. Operates with a CT 2,5 VA class 1.
Primary : 1,5 to 1 x I_N (generator)
Secondary : 1 A (S_1, S_2).

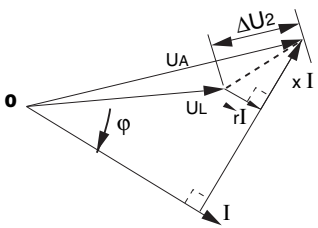
C.T. connexion : the output voltage of generator shall raise when a reactive load (inductive) is applied. If not transpose leads coming from C.T. secondary (S_1,S_2). If $r_{(\Omega)}$ is the line resistance per phase (at 400 Hz AC and not in DC) and $x_{(\Omega)}$ the line reactance (8 times the value at 50 Hz), on line voltage dip ΔU_1 (defined as the difference in Régulateur between the voltage at the output of generator U_A, and the voltage at the end of line U_L when the line current is $I_{(A)}$ and the load power factor cosφ is given by the formula :

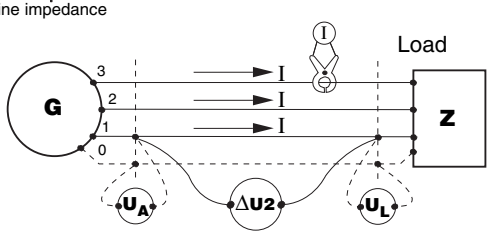
$$|U_A| - |U_L| = \Delta U_{1(V)} = r_{(\Omega)} * I_{(A)} * (\cos\varphi) + x_{(\Omega)} * I_{(A)} * (\sin\varphi) \quad \text{with } \sin\varphi = \sqrt{1 - (\cos\varphi)^2}$$

The voltage "across line" ΔU_2 is :

$$\Delta U_{2(V)} = \sqrt{r^2 + x^2} * I = z_{(\Omega)} * I_{(A)}$$

z = line impedance





3.2.1 - Measurement of feeder line datas

To get the more precise measurements it is necessary to have a very sensitive voltmeter (ex : digital reading ± 0,1 volt - 2 000 points) and 2 load banks :

- 1 resistive (pf = 1)
- 1 inductive (pf = 0)

} more than 1/2 of rated kVA

1 st test at PF =1

notice : U_A(V) ,U_L(V), ΔU_2(V),I_1(A)

Calculate $r_1(\Omega) = \frac{U_A - U_L}{I_1}$

$z_1(\Omega) = \frac{\Delta U_2}{I_1}$ ($x_1(\Omega) = \sqrt{z_1^2 - r_1^2}$)

2 nd test at PF = 0

notice : U_A(V) ,U_L(V), ΔU_2(V),I_2(A)

Calculate $x_2(\Omega) = \frac{U_A - U_L}{I_2}$

$z_2(\Omega) = \frac{\Delta U_2}{I_2}$ ($r_2(\Omega) = \sqrt{z_2^2 - x_2^2}$)

If $r_1 \approx r_2$; $x_1 \approx x_2$; $z_1 \approx z_2$; measurements are good the more precise value are in a square.

3.2.2 - Pre setting of line voltage dip compensation when line datas are known ($r_{(\Omega)}$, $x_{(\Omega)}$, $z_{(\Omega)}$ per phase)

- Adjust no-load line to neutral voltage to the rated value U_N (in example U_N = 115V).
- Set potentiometer P2 (phase) fully anticlokwise.
- Apply the rated load (I_N) at pf = 1.

a) Adjust potentiometer P1 (amplitude â) in order to get the voltage U_{A1} at generators L - N terminals :
$U_{A1} = U_N + zI_N$
(in example : U_N = 115V, z = 0,05Ω, IN = 150A
U_{A1} = 115 + 0,05 x 150 = 122,5 V,
namely : 122,5 x $\sqrt{3}$ = 212,2 V line to line

b) Adjust potentiometer P2 (phase φ) to get the voltage U_{A2} at generator's L - N terminals :
$U_{A2} = U_N + r \times I_N$
(in example : r = 0,02 Ω ; cosφ = 1 ; U_N = 115 V ;
I_N = 150 A
U_{A2} = 115 + 0,02 x 150 = 118 V,
namely : 118 x $\sqrt{3}$ = 204,4 V line to line

3.2.3 - Adjustment of line voltage dip compensation with the real available feeder line

- Set potentiometer P2 (phase) fully anticlokwise.

Let us name U_A the line to neutral voltage at generators terminals, U_L the line to neutral voltage at line end (same phase - see fig. C), and ΔU_2 the voltage between both ends. Full load at pf = 1 must be available at line end.

- Adjust the no load line to neutral voltage to the rated value U_N (in exemple 115 V)
- Apply the rated load (pf = 1)
- Measure ΔU_2 and U_A

a) Adjust potentiometer P1 (amplitude â) in order to get a line to neutral voltage U_{A1} at generators output terminals. U_{A1} being equal to ($U_N + \Delta U_2$).

b) Adjust potentiometer P2 (phase φ) in order to get a line to neutral voltage U_{L2} at line's end $U_{L2} = U_N$.
The load must remain constant during measurements and adjustments.

3.3 - Parallel operation (quadrature droop)

Use the same CT as for line voltage dip compensation, but transpose connection of AVR to CT (S_1-S_2).

Parallel operation is inconsistent with line voltage dip compensation.

- Set the (phase) potentiometer P2 fully anticlockwise.
- Adjust the quadrature droop with potentiometer P1 (amplitude â).

A good operation of 2 alternators in parallel requires :

- the two no-load voltages to be adjusted equal (by P3 or remote potentiometer)
- the two on-load voltages (with the same relative inductive load) to be also adjusted equal, by adjusting P1 potentiometer.

4 - LIMITATION OF MAXIMUM EXCITATION CURRENT (EXCITATION CEILING)

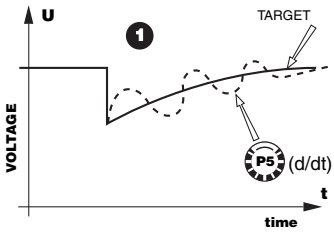
Adjustable by P9 (minimum 4 A fully anticlockwise - maximum 8 A fully clockwise)
- To be adjusted at about 2 times the rated on load excitation current (see nameplate)
- This adjustment has an influence on the transient voltage dip during step loading : any increase in excitation ceiling reduces voltage dip and improves response time.

5 - TRANSIENT VOLTAGE RECOVERY VARIATIONS

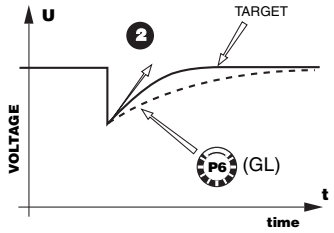
5.1 - Step loading

Adjustments having an influence during step loading (in addition to P9 - explained before) :
- P5 : (d/dt) differential gain
- P4 : GNL non linear (quadratic) gain
- P6 : GL linear (proportionnal) gain

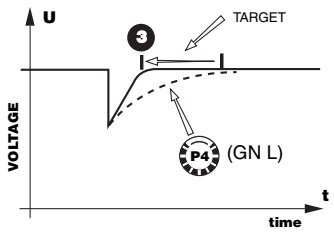
Initial setting : P5 fully anticlockwise
Use a memory scope or a recorder. Time base 20 or 50 ms/div.
Apply sufficient reactive step load (more than half of rated load).



P5 : Damps oscillations



P6 : Acts on curve slope

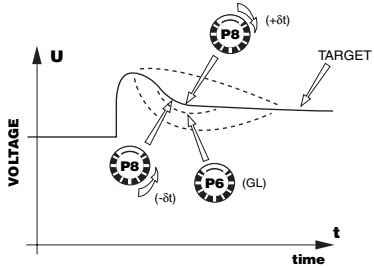


P4 : Acts on knee's shape

5.2 - Unloading

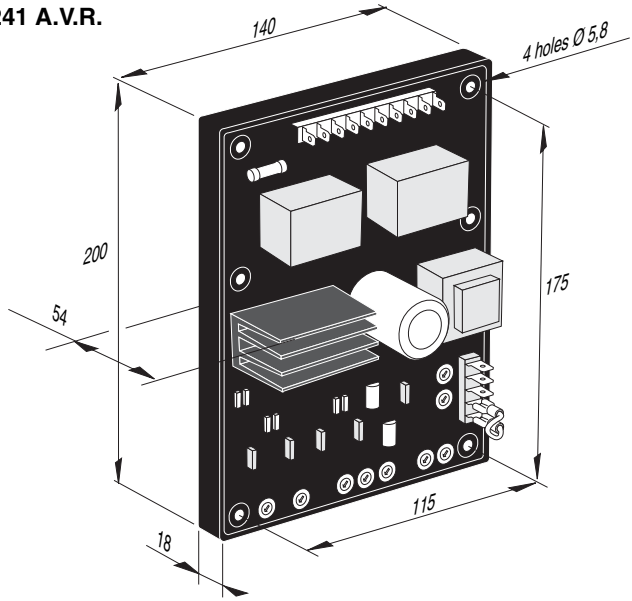
- P8 (δt) reversal time. When unloading, the voltage raises and the AVR reverses the excitation current during a period dt adjustable by P8.

Eventually reset P6 to reduce the residual "undershoot".

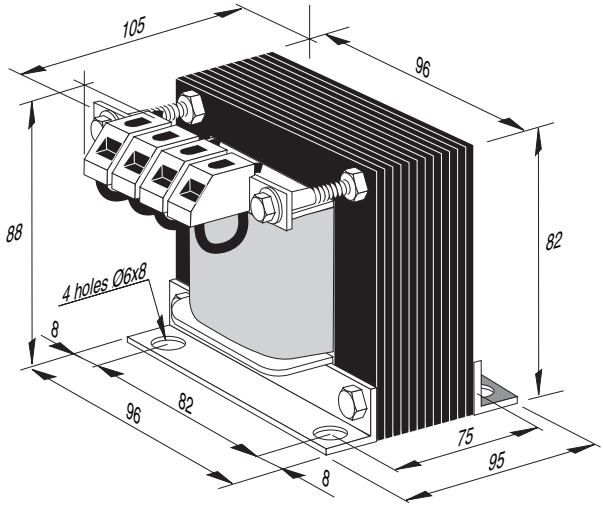


6 - OUTLINES DRAWING

R 241 A.V.R.

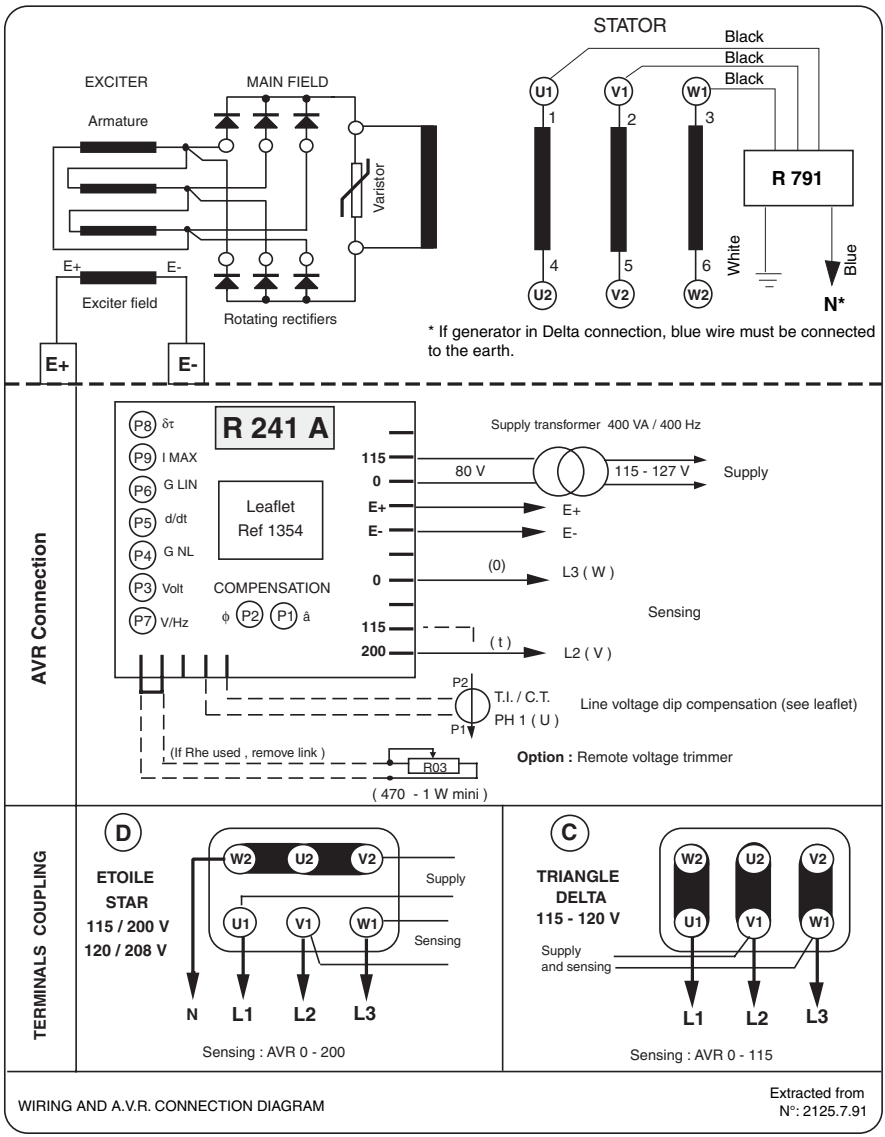


CURRENT TRANSFORMER



7 - CONNECTION DIAGRAM

Any intervention on the A.V.R. terminals during reconnection or checks should be performed with the machine stopped.



WIRING AND A.V.R. CONNECTION DIAGRAM

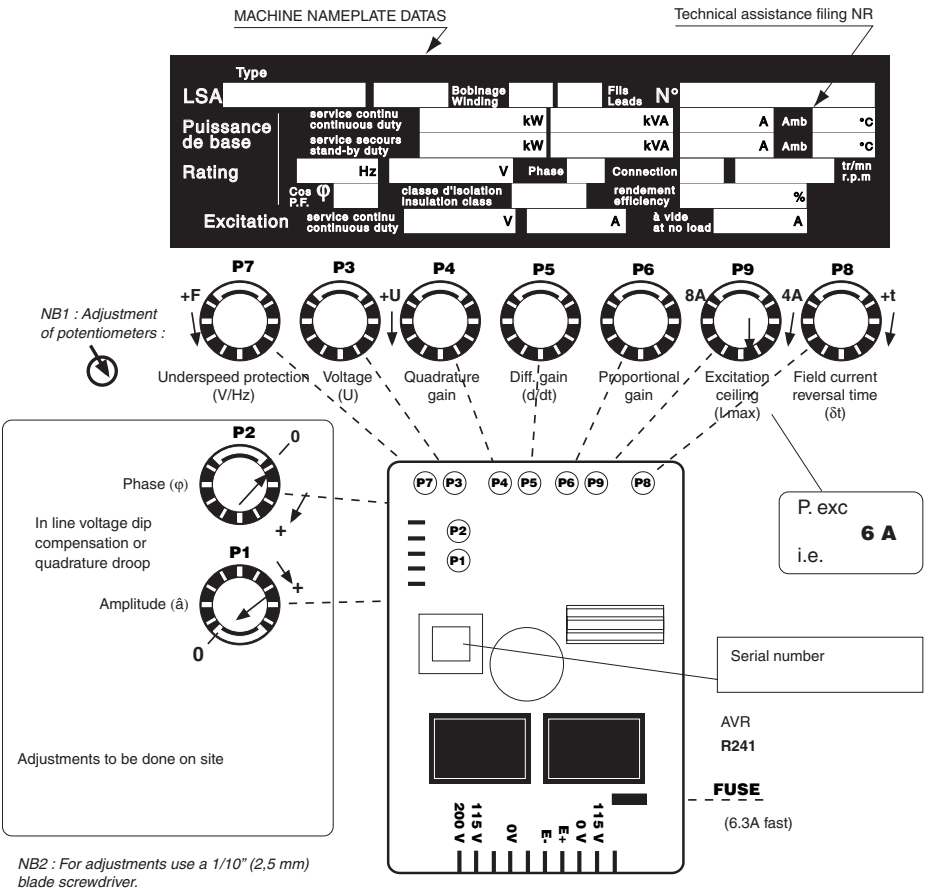
Extracted from
N°: 2125.7.91

8 - FACTORY ADJUSTMENT FORM (Sample)

The various adjustments during tests must be made by a qualified engineer.
One full filled copy is supplied with every machine.

Form to befilled up after test

A.V.R. N° _____



NB2 : For adjustments use a 1/10" (2,5 mm) blade screwdriver.

ADJUSTMENTS	NAME	DATE	VISAS
Done by :			
Checked by :			
Quality control :			

9 - SPARE PARTS

9.1 - Designation

Description	Type	Code
A.V.R.	R 241	AEM 220 RE 2

9.2 - Technical support service

Our technical support service will be happy to provide any information you require.

When ordering spare parts, you should indicate the complete machine type, its serial number and the information indicated on the nameplate.

Part numbers should be identified from the exploded views and their description in the parts list.
Our extensive network of "service stations" can dispatch the necessary parts without delay.
To ensure correct operation and the safety of our machines, we recommend the use of original manufacture spare parts.
In the event of failure to comply with this advice, the manufacturer cannot be held responsible for any damage.

9.3 - Optional items

- Remote voltage trimmer : 470 Ω, 3 W.
- Current transformer /1A according to nominal voltage.
- Shielded box.

9.4 - Repair

The A.V.R. R 241 , totally encapsulated is not repairable. (See Alternator maintenance book).

After operational testing, replace all access panels or covers.

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NOTES

R241 A

NOTES

MOTEURS LEROY-SOMER 16015 ANGOULÊME CEDEX - FRANCE

338 567 258 RCS ANGOULÊME
S.A. au capital de 62 779 000 €

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