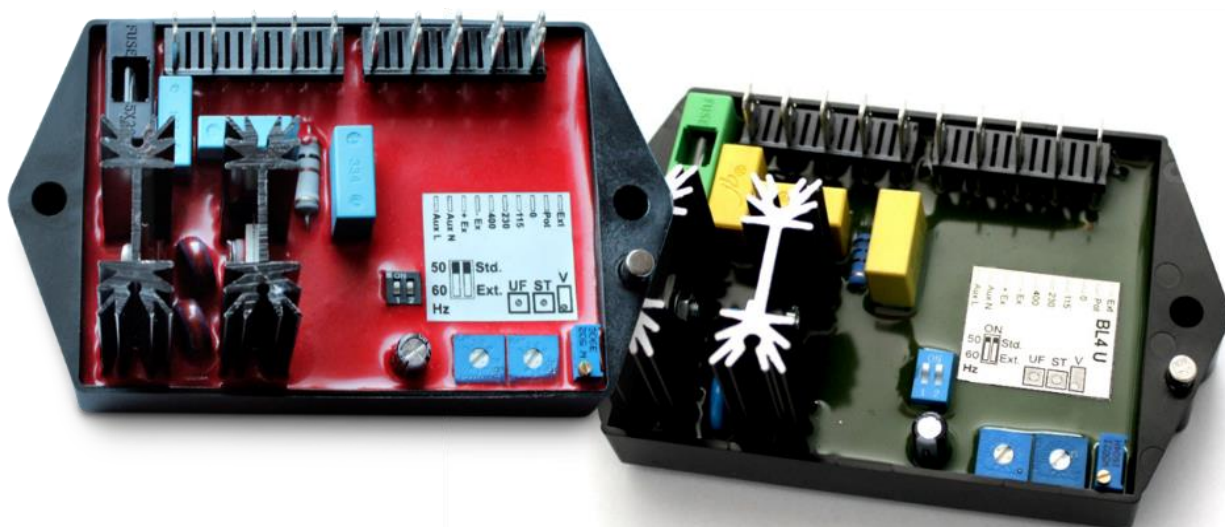


# BL4-U Analogic AVR

Automatic Voltage Regulator

## OPERATION MANUAL



REV02 01/2021



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## GENERAL FEATURES

SINCRO BL4-U is a half-wave phase-controlled thyristor type Automatic Voltage Regulator (AVR) and is part of the alternator excitation system.

In addition to the regulation of the alternator voltage, BL4-U circuitry includes under-speed protection features. Excitation power is derived directly from the alternator terminals.

Positive voltage build up from residual levels is ensured by the use of efficient semiconductors in the power circuitry of AVR BL4-U.

AVR BL4-U is connected with the main stator windings and the exciter field windings to provide closed loop control of the output voltage.

In addition to being powered from the main stator, AVR BL4-U also derives a sample voltage from the output windings for voltage control purposes. In response to this sample voltage, AVR BL4-U controls the power fed to the exciter field, and hence the main field, to maintain the machine output voltage within the specified limits, compensating for load, speed, temperature and power factor of the alternator.

A frequency measuring circuit continually monitors the alternator output and provides output under-speed protection of the excitation system, by reducing the output voltage proportionally with speed below a pre-settable threshold. A manual adjustment is provided for factory setting of the under frequency roll off point, (UF). This can easily be changed to 50 or 60 Hz with two dip switches.

Provision is made for the connection of a remote voltage potentiometer, allowing the user fine control of the alternator's output.

## ADJUSTMENTS

Adjusting elements of AVR BL4-U are described as the figure below. AVR BL4-U has two DIP-Switches: Switch 1 to set the frequency, Switch 2 for remote voltage regulation.

### FREQUENCY SELECTION

The frequency selection is done using Switch 1. Set this switch to “ON” for 50 Hz, to “OFF” for 60 Hz.

### VOLTAGE ADJUSTMENT

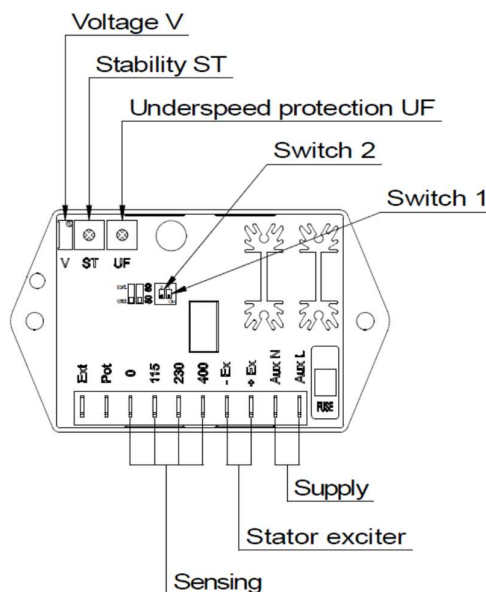
The alternator output voltage is set at the factory, but it can be altered by adjustment of the V potentiometer on the AVR BL4-U board, or by the external hand potentiometer. Set Switch 2 to “Std” for the working without external hand potentiometer, set switch 2 to “Ext” for the working with external hand potentiometer. In this case the external hand potentiometer (5 kohm/3W) has to be fitted at the terminals Ext and Pot.

### STABILITY ADJUSTMENT

The AVR BL4-U includes stability or damping circuit to provide good steady state and transient performance of the alternator.

The correct setting can be found by running the alternator at no load and slowly turning the stability ST anti-clockwise until the alternator voltage starts to become unstable.

The optimum or critically damped position is slightly clockwise from this point (i.e. where the machine volts are stable but close to the unstable region).



*Elements for adjustment on AVR BL4-U*

## UNDER FREQUENCY KNEE ADJUSTMENT

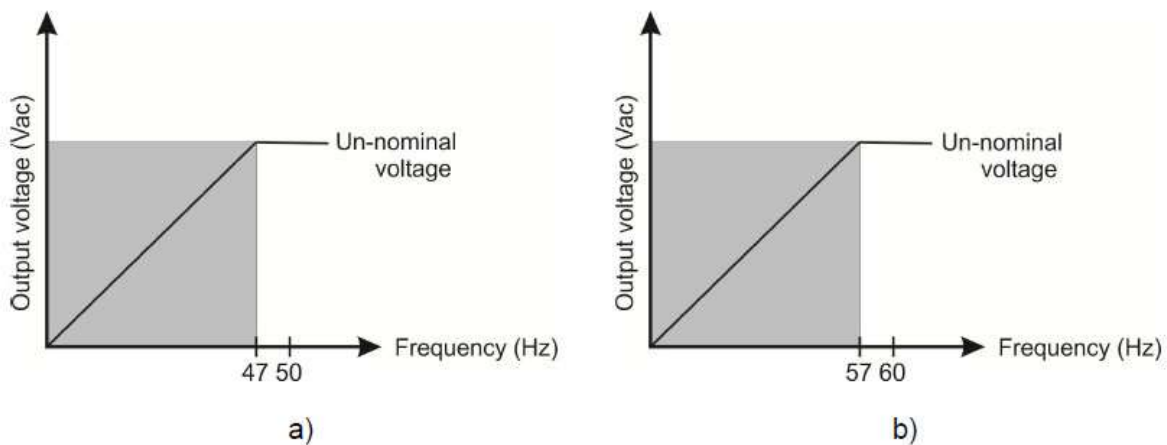
AVR BL4-U incorporates an underspeed protection circuit (UF) which gives a volts/Hz characteristic when the alternator speed falls below a presettable threshold known as the "knee" point.

The UF knee adjustment is preset at factory at the 47Hz on a 50Hz system or 57Hz on a 60Hz system. Selection of 50 / 60Hz can be made using the Switch 1.

Figure 3, shows the curves for voltage variation as a function of frequency variation.

For nominal frequency operation, UF is disabled. When rotation decreases (e.g. when shutting down), excitation decreases, reducing the output voltage of the alternator.

The pre-set "knee" point can be altered, by UF trimpot, according to the needs of each application.



*Under frequency "knee": a) 50 Hz system, b) 60 Hz system*

## PROTECTION FUSE

The fuse is used to limit the input supply current in order to protect the alternator field.

AVR BL4-U regulator possesses a rectifier that controls the field voltage of the alternator.

For the maximum field voltage, the supplied current at input Aux N is half of the field current, and the maximum current of the fuse should be a little more than half of the current supplied by the regulator. The fuse must be: Fast action, 5x20 mm, 3,15A/250V.

## TRIMPOTS

Trim pot functions

V = Voltage adjustments;

ST = Stability adjustments;

UF = UF "knee" adjustments.

Trim pot adjustments

V = Turning clockwise, increases voltage;

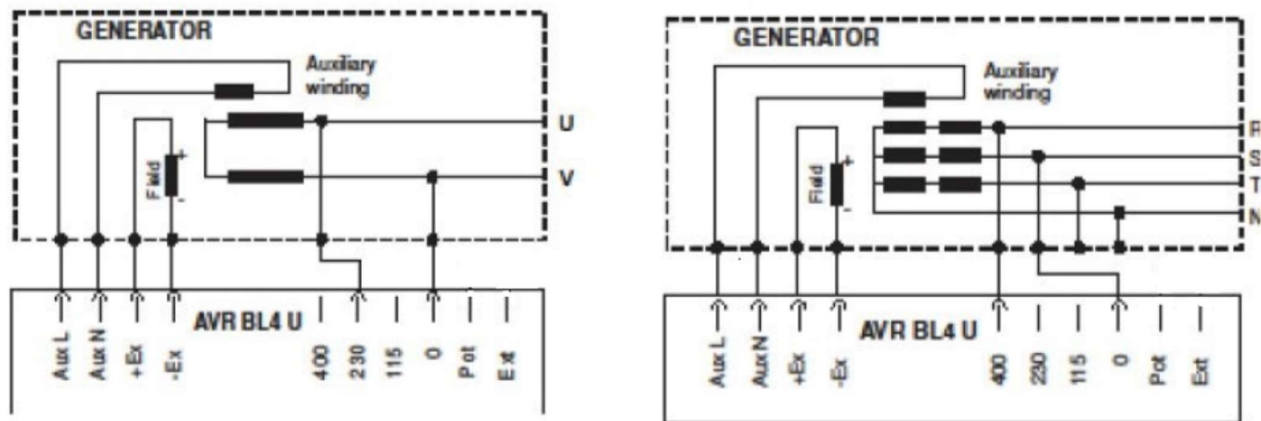
ST = Turning clockwise, speeds up response;

UF = Turning clockwise, increases the UF protection limit.

## INSTALLATION

### CONNECTION DIAGRAMS

The figures below show the connection for a alternator with a nominal line voltage of 1Ph 230 Vac or 3Ph 400Vac. The sensing will be accomplished using the line voltage at input contacts named 400, 230, 115 and 0.



AVR BL4-U Connection diagrams: a) 1Ph - sensing 230V, b) 3Ph - sensing 400 V

### CONNECTION TERMINALS

Sensing voltage

400, 0 = 400 Vac

230, 0 = 230 Vac

115, 0 = 115 Vac

Supply voltage

Aux L, AuxN

Alternator field

+Ex, -Ex

External adjustment potentiometer

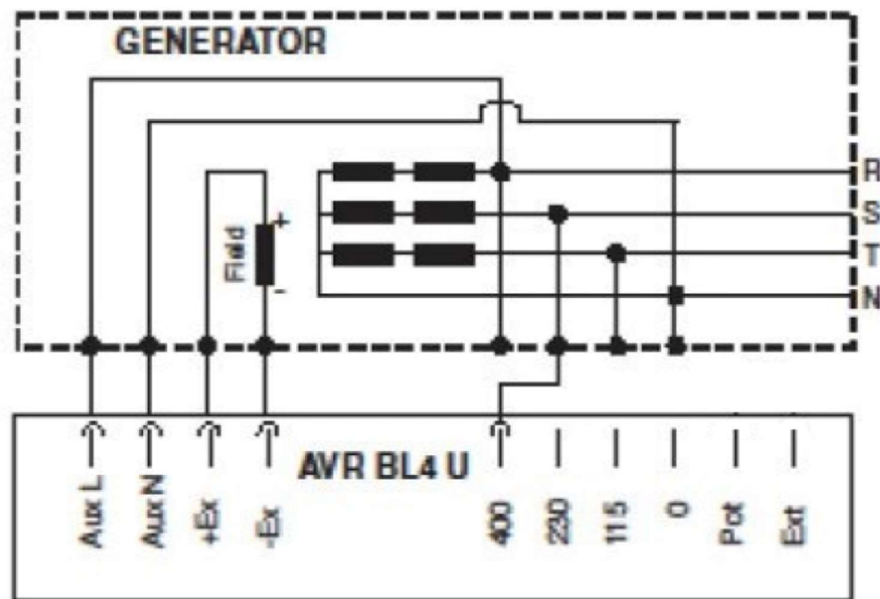
Ext, Pot

## CONNECTION DIAGRAMS WITHOUT AUXILIARY WINDING

The figure below shows the connection for an alternator without the auxiliary winding.

The nominal line voltage are 400Vac. The sensing will be accomplished using the line voltage at input contacts named 400, and 0.

The power supply is 230V. For the machine 3Ph 400V connect the line U and the neutral N to the terminals AuxL and AuxN.



a)

AVR BL4-U Connection diagrams without auxiliary winding : a) 3Ph - sensing 400 V

## STARTING UP

If a replacement AVR has been fitted, or the re-setting of the voltage adjustment is required, please proceed as follows:

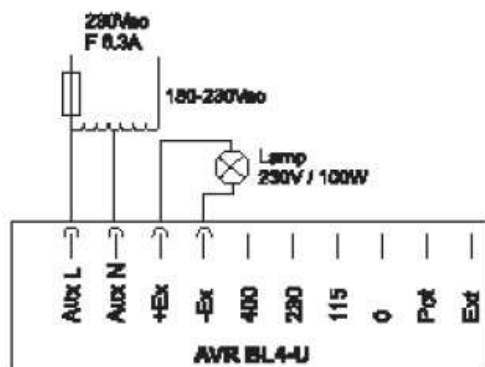
1. Connect the wires coming from the alternator according to the description in the CONNECTION DIAGRAMS and the type of alternator to be used.
2. Before running alternator, turn the volts trimpot "V" fully anti-clockwise.
3. Turn remote volts potentiometer (if fitted) to midway position.
4. Turn stability trimpot "ST" to midway position.
5. Connect a suitable voltmeter (0-300V ac) across line to neutral of the alternator.
6. Start alternator set, and run on no load at nominal frequency e.g. 50-53Hz or 60-63Hz.
7. Carefully turn volts trimpot "V" (or external pot, if fitted) clockwise until rated voltage is reached.
8. If instability is present at rated voltage, refer to stability adjustment, and then re-adjust voltage if necessary.

## TURNING OFF

With the U/F protection properly configured, turning off the alternator is done by turning off the primary mover.

## TESTING WITHOUT ALTERNATOR

The figure below shows the connection diagram for AVR testing without alternator, where the equipment can be verified for proper operation. Changing input voltage in the range 150 -230V ac the lamp will light. The voltage of the lamp should be the same as the voltage applied on input.



*Testing AVR BL4-U without a alternator*

## MAINTENANCE AND TROUBLE-SHOOTING

### PREVENTIVE MAINTENANCE

Periodical inspections of the equipment are required to ensure they are clean, dust and moisture free. It is essential that all terminals and connections are kept free from corrosion.

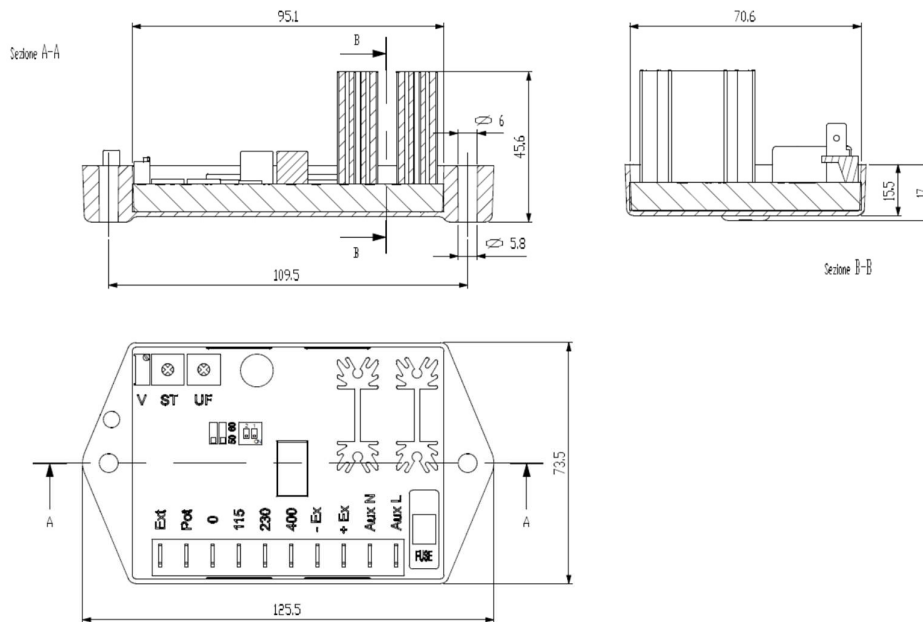
### TROUBLE-SHOOTING

Trouble	Possible causes	Corrective actions
Alternator field voltage does not build up on start-up.	<ul style="list-style-type: none"> <li>- Residual voltage excessively low;</li> <li>- Terminals +Ex and - Ex are inverted.</li> </ul>	<ul style="list-style-type: none"> <li>- Use external battery (12Vdc) to force excitation;</li> <li>- Invert +Ex and – Ex.</li> </ul>
Generated voltage oscillates at no load.	<ul style="list-style-type: none"> <li>- Stability response incorrectly adjusted</li> <li>- Alternator excitation voltage excessively low</li> <li>- Unstable engine speed</li> </ul>	<ul style="list-style-type: none"> <li>- Adjust trim pot ST;</li> <li>- Check the frequency/engine speed</li> </ul>
Voltage surges.	<ul style="list-style-type: none"> <li>- Lack of sensing;</li> <li>- Faulty electronic circuit;</li> <li>- Sensing voltage incompatible with regulator.</li> </ul>	<ul style="list-style-type: none"> <li>- Check if alternator phases are present in the sensing circuit;</li> <li>- If the regulator is encapsulated, replace it;</li> <li>- Use a compatible sensing voltage.</li> </ul>
Generated voltage decreases when load is applied, and it doesn't return.	<ul style="list-style-type: none"> <li>- Speed drop of the prime mover.</li> <li>- U/F protection engaged.</li> </ul>	<ul style="list-style-type: none"> <li>- Correct speed regulation;</li> <li>- Adjust U/F limiter by rotating trimpot UF clockwise (CW).</li> </ul>
During turn-off procedure the regulator fuse blows.	<ul style="list-style-type: none"> <li>- U/F protection adjusted for a very low (or zero) frequency.</li> </ul>	<ul style="list-style-type: none"> <li>- Adjust U/F to a value close to the operating frequency of the alternator.</li> </ul>
Voltage too low	<ul style="list-style-type: none"> <li>- Speed too low</li> <li>- Field windings short-circuited</li> <li>- Main field winding short-circuited</li> <li>- Rotating diodes burnt out</li> </ul>	<ul style="list-style-type: none"> <li>- Increase the drive speed</li> </ul>
Voltage too high	<ul style="list-style-type: none"> <li>- Adjustment ineffective</li> <li>- Faulty AVR</li> </ul>	<ul style="list-style-type: none"> <li>- Adjust the AVR voltage</li> <li>- Change the AVR</li> </ul>

## SPECIFICATIONS

Characteristics	Range
Nominal field current	
Nominal current with forced ventilation	
Peak current (max. 1min)	
External voltage control	Through 5K/3W potentiometer
Power Supply Range	170 to 250Vca ( $\pm 15\%$ of nominal voltage).
Nominal Supply power	230Vac
Maximum field voltage	
Operation Frequency	50 or 60Hz.
Underfrequency protection (UF)	Adjustable via trimpot.
Voltage drop for frequency variation	
Voltage variation in operation (DV/°C)	
Voltage adjustment	Adjustable via trimpot
External voltage adjustment range	$\pm 15\%$ of $V_{Sen}$ .
Temperature of operation.	-40° to + 60°C
EMI Suppression	EMI filter
Approximate weight	

## DIMENSIONS





SINCRO has been manufacturing trustable alternators for over 30 years.  
At the core of your best energy up to 2.6 MVA. Standard and custom.  
Proudly 100% Made in Europe.



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