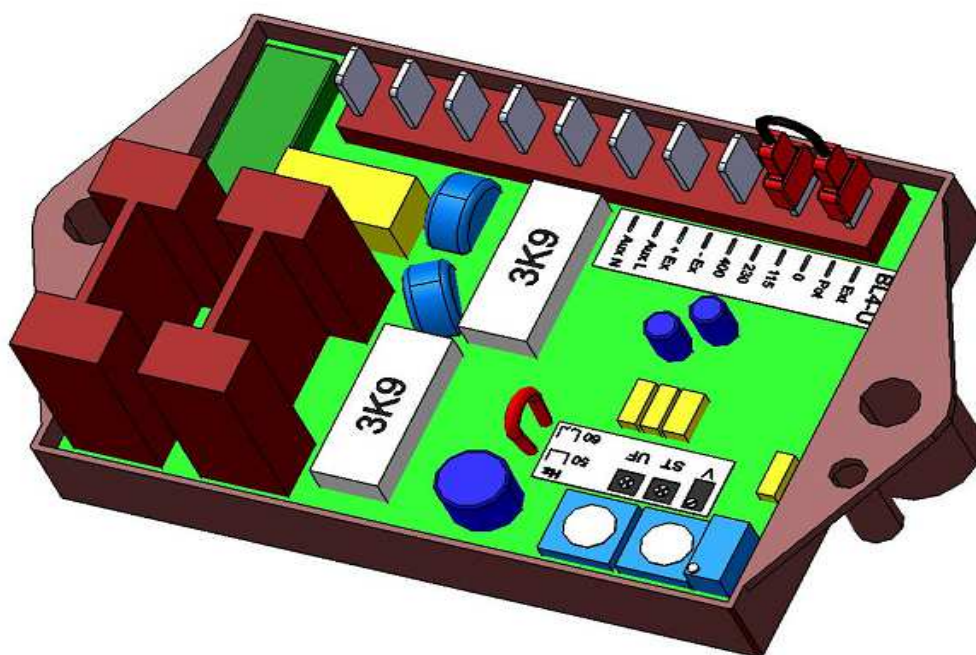


INSTRUCTION MANUAL FOR ANALOG VOLTAGE REGULATOR

AVR BL4-U



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GENERAL INFORMATION

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

In addition to regulating the generator voltage, the AVR BL4-U circuitry includes under-speed protection features. Excitation power is derived directly from the generator terminals.

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

The AVR AVR BL4-U is linked 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, the AVR BL4-U also derives a sample voltage from the output windings for voltage control purposes. In response to this sample voltage, the AVR 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 generator.

A frequency measuring circuit continually monitors the generator 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 in the field two position jumper.

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

FUNCTIONAL DESCRIPTION

BLOCK DIAGRAM

The block diagram of AVR AVR BL4-U is on the Figure 1.

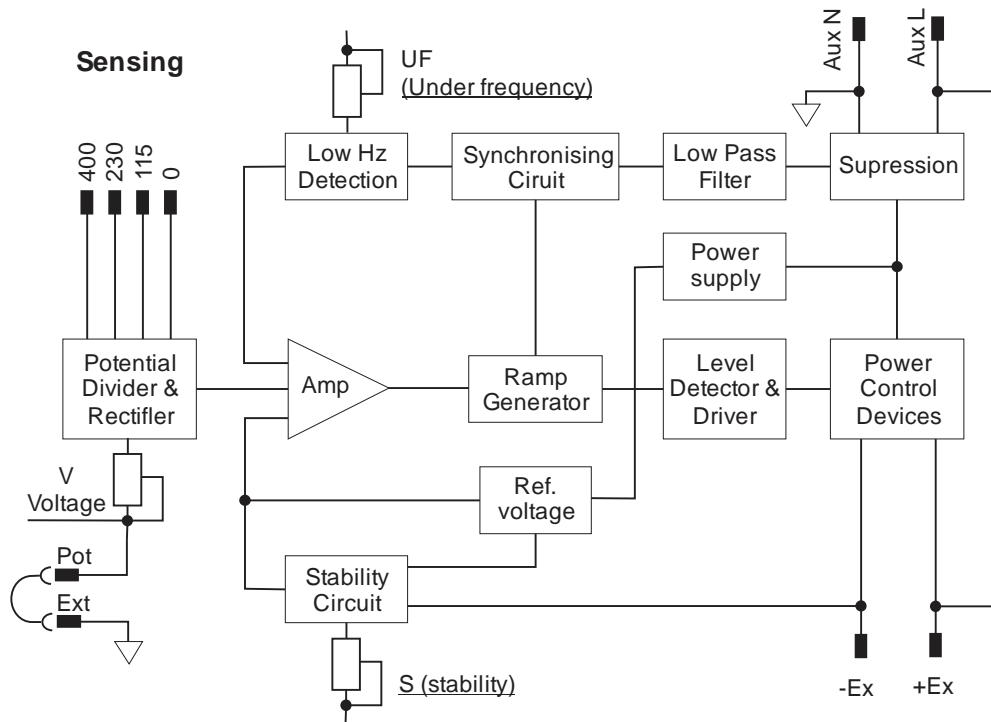


Figure 1. The block diagram of the AVR BL4-U

MAIN FUNCTIONS

The main functions of the AVR are:

Potential Divider and Rectifier takes a proportion of the generator output voltage and attenuates it. This input chain of resistors includes the range potentiometer and hand trimmer which adjust the generator voltage. A rectifier converts the a.c. into d.c. for further processing.

The Amplifier (Amp) compares the sensing voltage to the Reference Voltage and amplifies the difference (error) to provide a controlling signal for the power devices.

The Ramp Generator and Level Detector and Driver infinitely control the conduction period of the Power Control Devices and hence provides the excitation system with the required power to maintain the generator voltage within specified limits.

The Stability Circuit provides adjustable negative ac feedback to ensure good steady state and transient performance of the control system.

The Low Hz Detector measures the period of each electrical cycle and causes the reference voltage to be reduced approximately linearly with speed below a presettable threshold.

The Synchronizing circuit is used to keep the Ramp Generator and Low Hz Detector locked to the generator waveform period.

The Low Pass Filter prevents distorted waveforms affecting the operation of the AVR.

Power Control Devices vary the amount of exciter field current in response to the error signal produced by the Amplifier.

Suppression components are included to prevent sub cycle voltage spikes damaging the AVR components and also to reduce the amount of conducted noise on the generator terminals.

The Power Supply provides the required voltages for the AVR circuitry.

ADJUSTMENTS

Adjusting elements of AVR BL4-U are shown on the Figure 2.

FREQUENCY SELECTION

The frequency selection is done using two position jumper. When the jumper is in position 1-2 the frequency is 50 Hz, and when the jumper is in position 2-3 the frequency is 60 Hz.

VOLTAGE ADJUSTMENT

The generator output voltage is set at the factory, but can be altered by adjustment of the V control on the AVR BL4-U board, or by the external hand potentiometer. External hand potentiometer (5 k Ω /3W) have to be fitted at the terminals Ext and Pot instead of shorting link. If no hand potentiometer is required terminals Ext and Pot will be fitted with a shorting link.

STABILITY ADJUSTMENT

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

The correct setting can be found by running the generator at no load and slowly turning the stability control ST anti-clockwise until the generator 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).

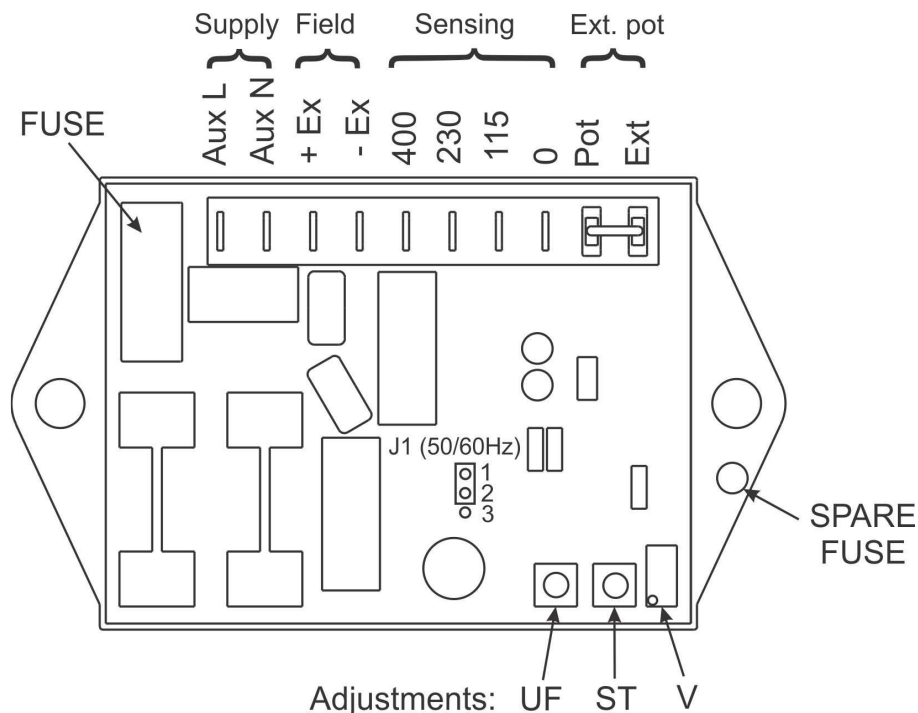


Figure 2. Elements for adjustment on the AVR BL4-U pcb

UNDER FREQUENCY KNEE ADJUSTMENT

The AVR BL4-U incorporates an underspeed protection circuit (UF) which gives a volts/Hz characteristic when the generator 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 jumper link. Figure 3, shows the curves for voltage variation as a function of frequency variation. For nominal frequency operation, UF is disabled. When rotation decreases (for ex. when shutting down), excitation diminishes, reducing the output voltage of the generator. The pre-set "knee" point can be altered, by UF trim pot, according to the needs of each application.

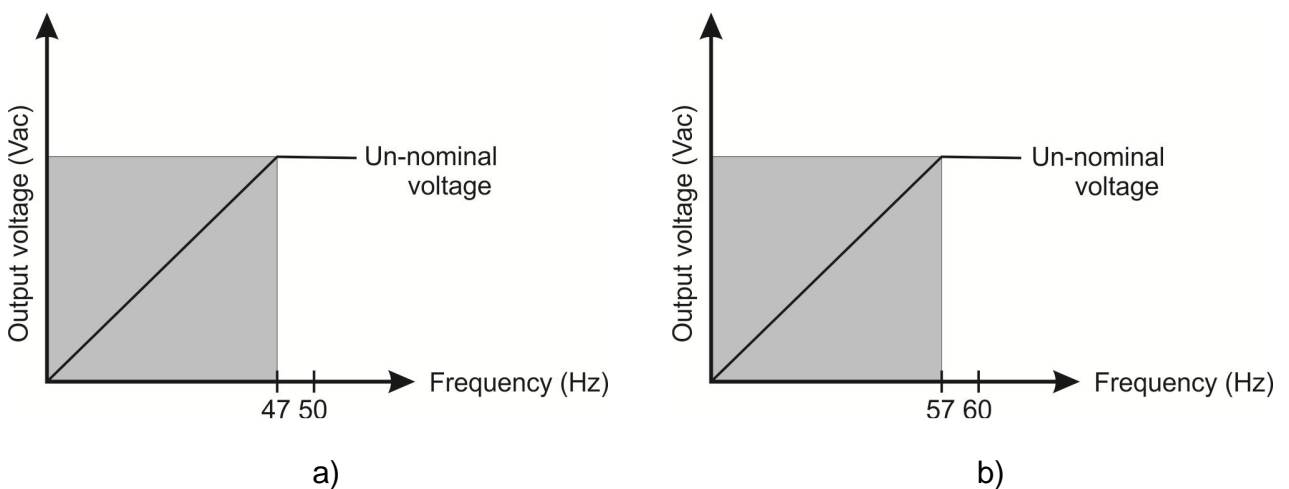


Figure 3. Under frequency "knee": a) 50 Hz system, b) 60 Hz system

PROTECTION FUSE SELECTION

The fuse is used to limit the input supply current in order to protect the generator field. The AVR BL4-U regulator possesses a rectifier that controls the field voltage of the generator. 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 range.

INSTALLATION

CONNECTION DIAGRAMS

Figure 4 shows the connection for a generator 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.

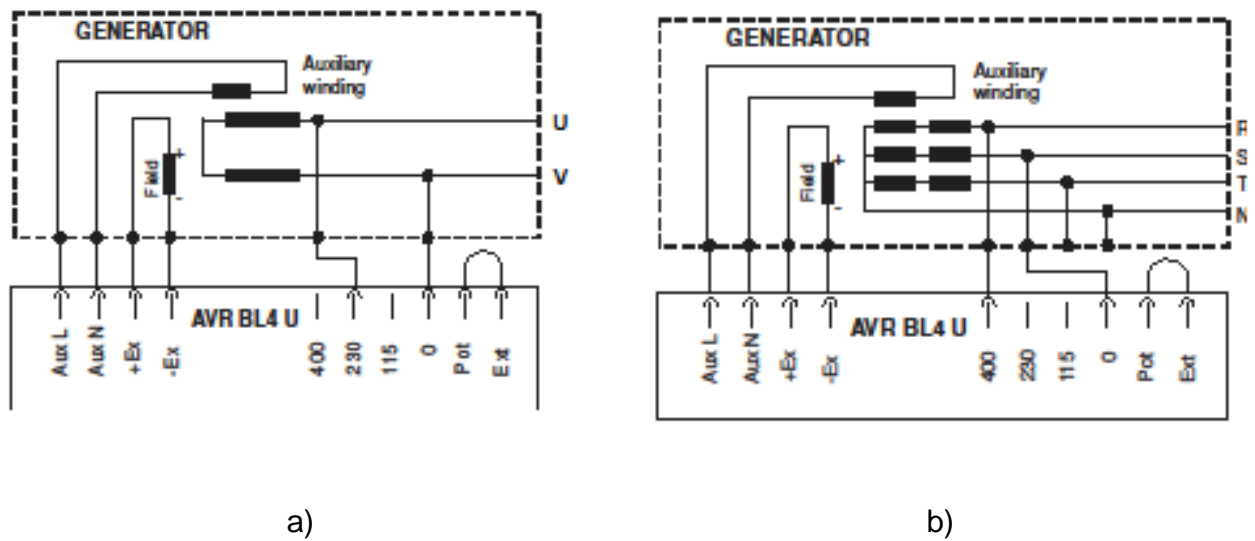


Figure 4. AVR BL4-U Connection diagrams: a) 1Ph - sensing 230V, b) 3Ph - sensing 400 V

CONNECTION TERMINALS

Sensing voltage
400, 0 = 400 Vac
130, 0 = 230 Vac
115, 0 = 115 Vac

Supply voltage
Aux L, AuxN

Generator field
+Ex, -Ex

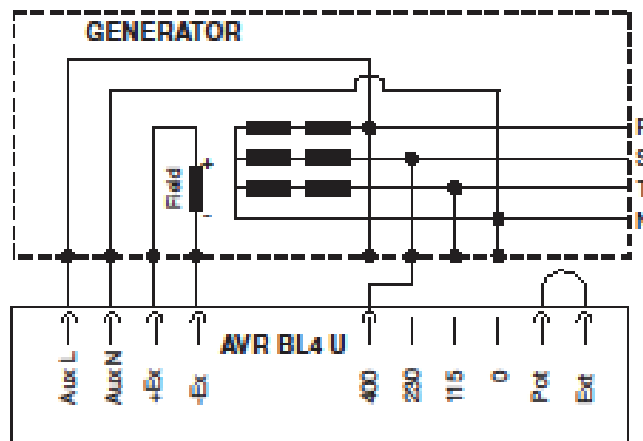
External adjustment potentiometer
Ext, Pot

CONNECTION DIAGRAMS WITHOUT AUXILIARY WINDING

Figure 5 shows the connection for a generator 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)

Figure 5. AVR BL4-U Connection diagrams without auxiliary winding : a) 3Ph - sensing 400 V

STARTING UP

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

1. Connect the wires coming from the generator according to the description in the CONNECTING DIAGRAMS and the type of generator to be used.
2. Before running generator, turn the volts control trimpot V fully anti-clockwise.
3. Turn remote volts potentiometer (if fitted) to midway position.
4. Turn stability control trimpot S to midway position.
5. Connect a suitable voltmeter (0-300V ac) across line to neutral of the generator.
6. Start generator set, and run on no load at nominal frequency e.g. 50-53Hz or 60-63Hz.
7. Carefully turn volts control trimer 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 generator is done by turning off the primary mover.

TESTING WITHOUT A GENERATOR

On the Figure 6 is the connection diagram for AVR testing without generator, where the equipment can be verified for proper operation. Changing input voltage in the range 150 -230 V ac the lamp will light. The voltage of the lamp should be the same as the voltage applied on input.

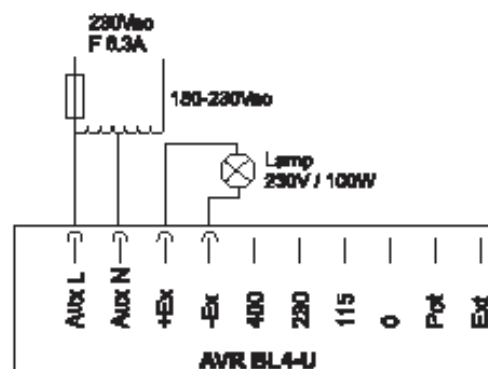


Figure 6. Testing AVR BL4-U without generator

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 terminal and connections are kept free from corrosion.

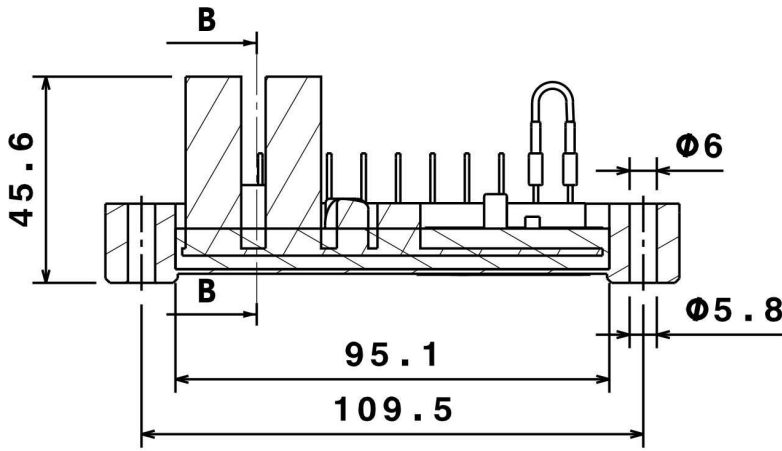
TROUBLESHOOTING

Trouble	Causes	Corrective
Generator field voltage does not build up on start-up.	<ul style="list-style-type: none"> - Residual voltage excessively low; - Terminals +Ex and - Ex are inverted. - External Potentiometer terminals (Ext, Pot) not short circuited or potentiometer is open (if present) 	<ul style="list-style-type: none"> - With the regulator switched-on use external battery (12Vdc) to force excitation; - Invert +Ex and – Ex. - Short circuit (Ext, Pot) or change external potentiometer(if present)
Generated voltage oscillates at a no load.	<ul style="list-style-type: none"> - Stability response incorrectly adjusted; - Generator excitation voltage excessively low. 	<ul style="list-style-type: none"> - Adjust trim pot S; - Insert 10W/100W resistor in series with field.
Voltage surges.	<ul style="list-style-type: none"> - Lack of sensing; - Faulty electronic circuit; - Sensing voltage incompatible with regulator. 	<ul style="list-style-type: none"> - Check if generator phases are present in the sensing circuit; - If the regulator is encapsulated, replace it; - Use a compatible sensing voltage.
Generated voltage decreases when load is applied, and it doesn't return.	<ul style="list-style-type: none"> - Speed drop of the prime mover. - U/F protection engaged. 	<ul style="list-style-type: none"> - Correct speed regulation; - Adjust U/F limiter by rotating trimpot UF clockwise (CW).
During turn-off procedure the regulator fuse blows.	<ul style="list-style-type: none"> - U/F protection adjusted for a very low (or zero) frequency. 	<ul style="list-style-type: none"> - Adjust U/F to a value close to the operating frequency of the generator.
Voltage too low	<ul style="list-style-type: none"> - Speed too low - Field windings short-circuited - Main field winding short-circuited - Rotating diodes burnt out 	<ul style="list-style-type: none"> - Increase the drive speed
Voltage too high	<ul style="list-style-type: none"> - Adjustment ineffective - Faulty AVR 	<ul style="list-style-type: none"> - Adjust AVR voltage - Change AVR

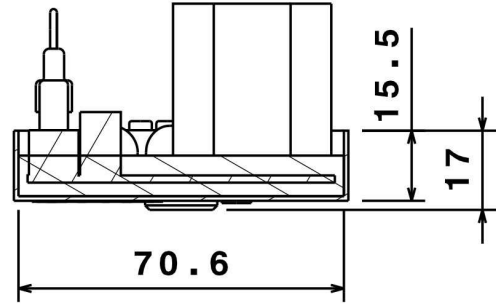
SPECIFICATION

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



Section view A-A



Section view B-B

