

AS440 AUTOMATIC VOLTAGE REGULATOR(AVR)

SPECIFICATION INSTALLATION AND ADJUSTMENTS

General description

AS440 is a half wave phase controlled thyristor type AVR and forms part of the excitation system for a brushless generator. The design employs Surface Mount Technology (SMT) for high integration of features in a small footprint AVR.

Positive voltage build up from residual levels is ensured by the use of efficient semiconductors in the power circuitry of the AVR. The power and voltage sensing circuits have separate terminals, allowing the excitation power to be derived directly from the stator winding for basic applications or from an auxiliary winding if sustained short circuit performance is required.

The AVR is linked with the main stator windings and the exciter field windings to provide closed loop control of the output voltage with load regulation of $\pm 1.0\%$.

The AVR voltage sensing terminals continuously sample the output windings for voltage control purposes. In response to this sample voltage, the AVR 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 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, (UFRO). This can easily be changed to 50 or 60 Hz in the field by push-on link selection.

Over excitation conditions are limited to a safe period by a protection circuit within the AVR.

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

An analogue input is provided allowing connection to the Power Factor controller or other external devices with compatible output.

The AVR has the facility for droop CT connection, to allow parallel running with other similarly equipped generators.

Technical specification

SENSING INPUT

Voltage	Jumper selectable 100-130 Vac 1 phase or 190-264 Vac 1 phase
Frequency	50-60 Hz nominal

POWER INPUT

Voltage	100-264 V ac 1 phase
Frequency	50-60 Hz nominal

OUTPUT

Voltage	82 V d.c. @ 200 Va.c.
Current	continuous 4A (see note 1). transient 7.5A for 10 secs.
Resistance	15 ohms min (10 ohms min when input volts is less than 175 ac)

REGULATION

$\pm 1.0\%$ (see note 2)

THERMAL DRIFT

0.03% per deg. C change in AVR ambient (see note 2)

TYPICAL SYSTEM RESPONSE

AVR response	20 ms
Filed current to 90%	80 ms
Machine Volts to 97%	300 ms

EXTERNAL VOLTAGE ADJUSTMENT

$\pm 1.0\%$ with 1 k ohm 1 watt trimmer (see note 4)
Increasing resistance lowers voltage.

UNDER FREQUENCY PROTECTION

Set point 94-98% Hz (see note 5)

UNIT POWER DISSIPATION

12 watts maximum

BOOBY VOLTAGE

4 Volts @ AVR terminals

ANALOGUE INPUT

Maximum input ± 5 Vdc (see note 6)
Sensitivity 1V for 5% Generator Volts (adjustable)
Input resistance 1k ohm

QUADRATURE DROOP INPUT

10 ohms burden
Max. sensitivity: 0.07 A for 5% droop 0PF
Max. input: 0.33 A

OVER EXCITATION PROTECTION

Set point 65 V dc
Time delay 10-15 seconds (fixed)

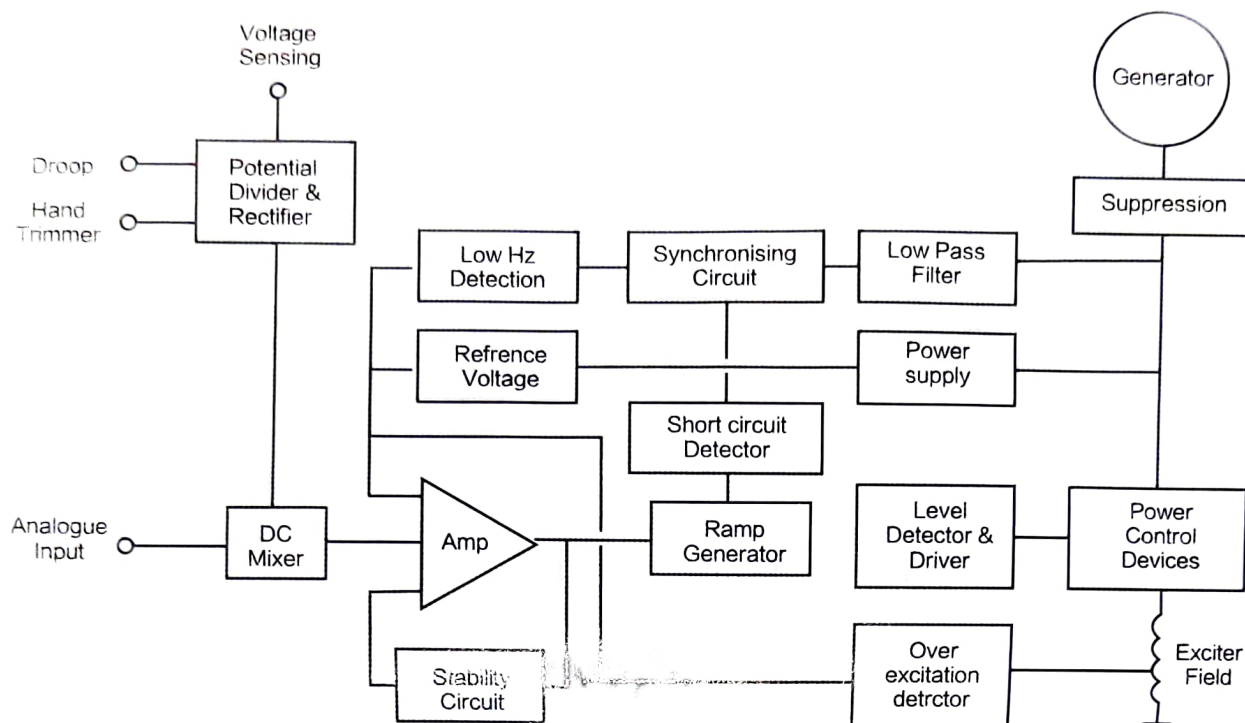
ENVIRONMENTAL

Vibration	20-100 Hz	50mm/sec
	100Hz-2kHz	3.3g
Operating temperature	-40 to +70C (note 7)	
Relative Humidity	0-70C 95% (note 8)	
Storage temperature	-55 to +80C	

NOTES

1. De-rate by 12% if mounted in 'portrait' orientation.
2. With 4% engine governing.
3. After 2 minutes.
4. Generator de-rate may apply. Check with factory.
5. Factory set, semi-sealed, jumper selectable.
6. Any device connected to the analogue input must be fully floating (galvanically isolated from ground), with an insulation strength of 500V ac.
7. De-rate output current by 5% per degree C above 60C.
8. Non condensing.

DESIGN DETAIL



The main functions of the AVR are:

The Potential Divider and Rectifier takes a proportion of the generator output voltage and attenuates it. The potential divider is adjustable by the AVR Volts potentiometer and external hand trimmer (when fitted). The output from the droop CT is also added to this signal. A rectifier converts the a.c. input signal into d.c. for further processing.

The DC Mixer adds the Analogue input signal to the Sensing signal.

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. A Light Emitting Diode gives indication of underspeed running.

The Synchronising 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 control circuit.

The Short Circuit Detector senses the presence of a short circuit on the generator output and forces the Power Control Devices into full conduction. This only occurs when the AVR is powered from an auxiliary winding.

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 Over Excitation Detector continuously monitors the exciter field voltage and provides signals, to collapse the output voltage if an over excitation condition persists for the specified time period.

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

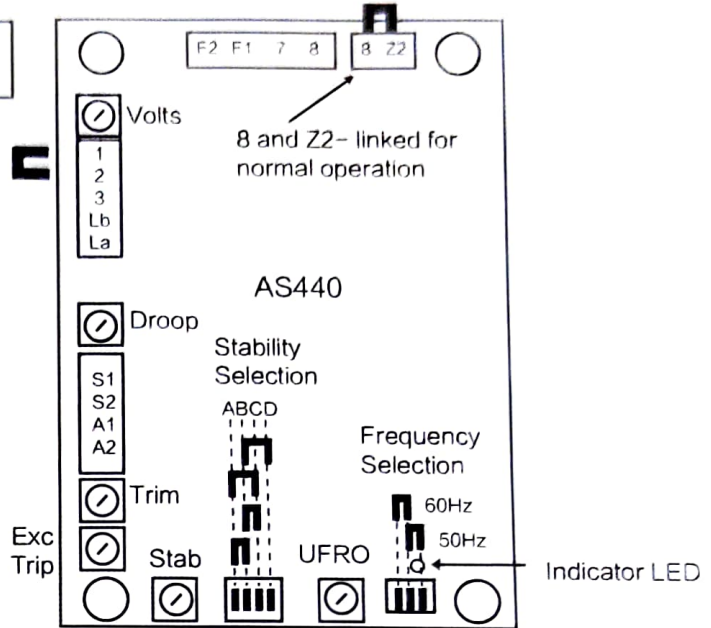
FITTING AND OPERATING

REFER TO GENERATOR WIRING DIAGRAM FOR CONNECTION DETAILS

Hand trimmer terminals. Remove link before fitting hand trimmer. Link must be fitted when hand trimmer is not required.

Stability Selection Table

No.	Power range	Response
B-D	< 100kW	Slow
A-D	< 100kW	Fast
B-C	100-550kW	Fast
A-B	>550kW	Fast



SUMMARY OF AVR CONTROLS

CONTROL	FUNCTION	DIRECTION
VOLTS	TO ADJUST GENERATOR OUTPUT VOLTAGE	CLOCKWISE INCREASES OUTPUT VOLTAGE
STABILITY	TO PREVENT VOLTAGE HUNTING	CLOCKWISE INCREASE THE DAMPING EFFECT
STAB SWITCH	TO OPTIMISE TRANSIENT PERFORMANCE	SEE TABLE ABOVE
UFRO	TO SET THE UFRO KNEE POINT	CLOCKWISE REDUCES THE KNEE POINT FREQUENCY
DROOP	TO SET THE GENERATOR DROOP TO 5% AT OFF	CLOCKWISE INCREASES THE DROOP
VTRIM	TO OPTIMISE ANALOGUE INPUT SENSITIVITY	CLOCKWISE INCREASES THE GAIN OR SENSITIVITY
EXC TRIP	TO SET OVER EXCITATION TRIP CUT OFF LEVEL	CLOCKWISE INCREASES THE CUT OFF LEVEL

ADJUSTMENT OF AVR CONTROLS

VOLTAGE ADJUSTMENT

The generator output voltage is set at the factory, but can be altered by careful adjustment of the VOLTS control on the AVR board, or by the external hand trimmer if fitted. If major adjustment is necessary or you lose stability, follow the 'VOLTAGE SETUP PROCEDURE'.

Terminals 1 and 2 on the AVR will be fitted with a shorting link if no hand trimmer is required. Terminals La and Lb are linked only for special low voltage applications.

WARNING! Do not increase the voltage above the rated generator voltage. If in doubt, refer to the rating plate mounted on the generator case.

WARNING! Do not ground any of the hand trimmer terminals as these could be above earth potential, Failure to observe this could cause equipment damage.

WARNING!

If a replacement AVR has been fitted or re-setting of the VOLTS adjustment is required, turn the VOLTS control fully anti-clockwise before running generator.

VOLTAGE SETUP PROCEDURE

For major adjustments and replacing the AVR.
Read and understand this procedure before attempting to follow it.

1. Before running generator, turn the VOLTS control fully anti-clockwise.
2. Turn remote volts trimmer (if fitted) to midway position.
3. Turn STABILITY control to midway position.
4. Connect a suitable voltmeter(0-300V ac) across line to neutral of the generator.
5. Start generator set, and run on no load at nominal frequency e.g. 50-53Hz or 60-63Hz.
6. If the red Light Emitting Diode(LED) is illuminated, refer to the Under Frequency Roll Off (UFRO) adjustment.
7. Carefully turn VOLTS control clockwise until rated voltage is reached.
8. If instability is present at rated voltage, refer to stability adjustment, then re-adjust voltage if necessary.
9. Voltage adjustment is now completed.