AS540 AUTOMATIC VOLTAGE REGULATOR

Analogue Phase-Controlled Brushless AVR with Auxiliary Power Capability

DOCUMENT SCOPE: This document adds a verified POPULACE reference cover to the supplied AS540 technical manual. Comprehensive terminal connection tables, auxiliary winding connections, and setting controls follow below.

Technical Parameter	Specification & Operating Limits
Sensing Input	95-130V AC 1-phase or 190-264V AC 1-phase, 50-60 Hz nominal
Power Input	95-264V AC 1-phase, 50-60 Hz nominal
Output Voltage / Current	Continuous 4A DC, Intermittent 7.5A for 10 seconds (15 ohms min)
Voltage Regulation	< ±1.0% (with 4% engine governing)
Protection Features	Under-frequency roll-off (UFRO), auxiliary winding overload protection
External Volts Adjustment	±10% with 1 kOhm trimmer
Applicable Alternators	Stamford S0/S1 and compatible modern industrial alternator frames

TECHNICAL SUPPORT & VERIFICATION: Terminal layouts, sensing jumpers, and excitation field resistance must be verified before energizing. For wiring confirmation, contact POPULACE support with your alternator nameplate details. Complete technical specifications, installation instructions, and connection schematics follow below.

AS540 Automatic Voltage Regulator (AVR)
SPECIFICATION, CONTROLS AND ACCESSORIES

English

Original Instructions

A054N491 (Issue 1)

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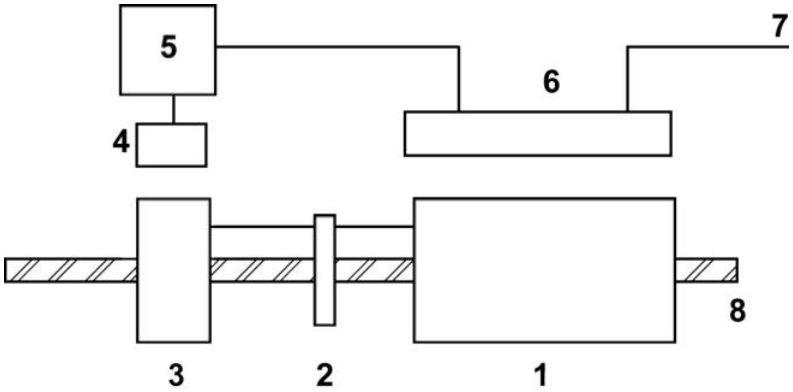
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1 Description

1.1 Self-Excited AVR Controlled Alternators

1.1.1 Main Stator Powered AVR

The AVR provides closed loop control by sensing the alternator output voltage at the main stator windings and adjusting the exciter stator field strength. Voltage induced in the exciter rotor, rectified by the rotating diodes, magnetises the rotating main field which induces voltage in the main stator windings. A self-excited AVR receives power from the alternator output terminals or a special auxiliary winding in the main stator winding.



No

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1 Main field (rotor)

2 Rotating diodes

3 Exciter armature (rotor)

4 Exciter field (stator)

.

5 AVR

6 Main armature (stator) or auxiliary winding (if fitted)

7 Output

8 Rotor shaft

2 Specification
2.1 AS540 Technical Specification

- **Sensing Input**
  - Voltage: 95 VAC to 130 VAC 1 phase or 190 VAC to 265 VAC 1 phase[1]
  - Frequency: 50 Hz to 60 Hz nominal
- **Power Input**
  - Voltage: 95 VAC to 265 VAC 1 phase only
  - Frequency: 50 Hz to 60 Hz nominal
- **Power Output**
  - Voltage: maximum 82 VDC at 200 VAC input
  - Current
    - continuous 4 A
    - transient 7.5 A for 10 seconds
  - Resistance: 15 Ω minimum (10 Ω minimum when power input less than 175 VAC)
- **Regulation**
  - +/- 1.0% RMS[2]
- **Thermal Drift**
  - 0.03% per 1 °C change in AVR ambient temperature[3]
- **Typical Response**
  - AVR response in 20 ms
  - Field current to 90% in 80 ms
  - Machine Volts to 97% in 300 ms
- **External Voltage Adjustment**
  - +/-10% with 1 kΩ, 1 W trimmer[4]
- **Under-Frequency Protection**
  - Set point 94% to 98% Hz [5]
- **Unit Power Dissipation**
  - 12 W maximum
- **Build-up Voltage**
  - 5 VAC at AVR terminals
- **Over-Voltage Detection**
  - Set point: 65 VDC[6]

[1] selected by jumper
[2] With 4% engine governing
[3] After 2 minutes.
[4] Alternator de-rate may apply. Check with factory.
[5] Factory set, semi-sealed, slide switch selectable.

[6] Factory set, semi-sealed.

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- Time delay: 10 s to 15 s (fixed)

- **Environmental**
  - Vibration
    - 20 Hz to 100 Hz: 50 mm/sec
    - 100 Hz to 2 kHz: 3.3 g
  - Operating temperature: -40 °C to +70 °C[7]
  - Relative Humidity 0 °C to 70 °C: 95%[8]
  - Storage temperature: -55 °C to +80 °C

[7] De-rate output current by 5% per 1 °C above 60 °C

[8] Non condensing.

3 Controls

DANGER

Live Electrical Conductors
Live electrical conductors can cause serious injury or death by electric shock and burns.
To prevent injury and before removing covers over electrical conductors, isolate the generator set from all energy sources, remove stored energy and use lock out/tag out safety procedures.

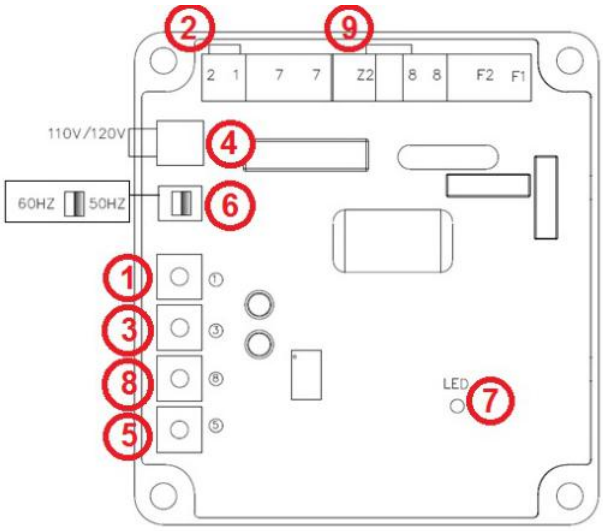
DANGER

Live Electrical Conductors
Live electrical conductors at output, AVR and AVR accessory terminals, and AVR heat sink can cause serious injury or death by electric shock and burns.
To prevent injury, take suitable precautions to prevent contact with live conductors including personal protective equipment, insulation, barriers and insulated tools.

NOTICE

Refer to alternator wiring diagram for connection details.

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Ref. **Cor**

Ref .	Control	Function	**Turn potentiometer CLOCKWISE to** Turnpotentiometer CLOCKWISEto
1	AVR [VOLTS]	Adjust alternator output voltage	increase voltage
2	**Link : Hand trimmer**	Adjust alternator output voltage	increase voltage by
	1-2 : No trimmer		voltage adjustment pot
	None : Trimmer fitted		(1)
3	AVR [STAB]	Adjust stability to prevent voltage hunting	increase damping effect
4	**Link : Supply**	Select AVR supply voltage	N/A
	Link : 110 V/120 V		
	None: 240 V		
5	AVR [UFRO]	Adjust under-frequency roll-off knee point	reduce UFRO frequency
6	**Switch : UFRO**	Select alternator frequency for UFRO	N/A
	frequency		
	Switch Left : 60 Hz		
	Switch Right : 50 Hz		
7	Light Emitting Diode	LED lights in UFRO or O/EXC condition	N/A
8	AVR [O/EXC]	Adjust over-excitation trip	increase trip voltage
9	**Link : Supply**	Select AVR supply source	N/A
	8-Z2 : Main stator		
	None: Auxiliary winding		

NOTICE

The AVR must be setup only by authorised, trained service engineers. Do not exceed the designed safe operating voltage, shown on the alternator rating plate.

The AVR controls are set at the factory for initial running tests. Check that the AVR settings are compatible with your required output. Do not adjust controls that have been sealed. To set up a replacement AVR, follow these steps:

1. Stop and isolate the generator set.
2. Install and connect the AVR.
3. Turn the **AVR [VOLTS]** volts control **Section 3.3 on page 7** fully counter-clockwise.
4. Turn the hand trimmer (if fitted) to 50%, the midway position.
5. Turn the **AVR [STAB]** stability control **Section 3.4 on page 8** to 50%, the midway position.
6. Connect a suitable voltmeter (0 to 300 VAC range) between one output phase and neutral.
7. Start the generator set with no load.
8. Adjust speed to nominal frequency (50 to 53 Hz or 60 to 63 Hz).
9. If the LDE is lit, adjust the **AVR [UFRO]** control **Section 3.5 on page 9**.
10. Carefully turn **AVR [VOLTS]** control clockwise until the voltmeter shows rated voltage.
11. If voltage is unstable, adjust the **AVR [STAB]** stability control.
12. Re-adjust the **AVR [VOLTS]** control, as needed.

3.3 Adjust the AVR [VOLTS] Voltage Control

NOTICE

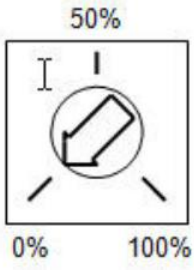
Do not exceed the designed safe operating voltage, shown on the alternator rating plate.

NOTICE

Hand trimmer terminals may be above earth potential. Do not ground any of the hand trimmer terminals. Grounding hand trimmer terminals could cause equipment damage.

To set the output voltage AVR [VOLTS] control on the AVR:

1. Check the alternator nameplate to confirm the designed safe operating voltage.
2. Set the **AVR [VOLTS]** control to 0%, the fully counter-clockwise position.

3. 

hand trimmer is fitted or terminals 1 and 2 are linked.

NOTICE

nmer is connected, set it to 50%, the midway position.

4. Turn the **AVR [STAB]** control to 50%, the midway position.
5. Start the alternator and set at the correct operating speed.
6. If the red Light Emitting Diode (LED) is illuminated, refer to the Under Frequency Roll Off **AVR [UFRO]** adjustment.
7. Adjust the **AVR [VOLTS]** control slowly clockwise to increase the output voltage.

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NOTICE

If the voltage is unstable set the AVR stability before proceeding Section 3.4 on page 8.

8. Adjust the output voltage to the desired nominal value (VAC).
9. If instability is present at rated voltage, refer to the **AVR [STAB]** adjustment, then adjust **AVR [VOLTS]** again, if necessary.
10. If a remote hand trimmer is connected, check its operation.

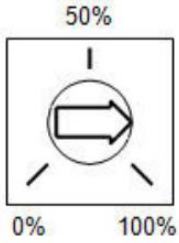
NOTICE

0% to 100% rotation corresponds to 90% to 110% VAC

The **AVR [VOLTS]** control is now set.

3.4 Adjust the AVR [STAB] Stability Control

1. Check the nameplate to confirm the power rating of the alternator.
2. Check that the jumper link or rotary switch selection (depending on AVR type) matches the alternator power rating for optimal stability response.
3. Set the **AVR [STAB]** control to approximately 75% position.



4. Start the alternator and set at the correct operating speed.
5. Verify that the alternator voltage is within safe limits.

NOTICE

If the voltage is unstable go immediately to step 5.

6. Adjust the **AVR [STAB]** control slowly counter-clockwise until the output voltage becomes unstable.
7. Adjust the **AVR [STAB]** control slowly clockwise until the voltage is stable.
8. Adjust the **AVR [STAB]** control a further 5% clockwise.

NOTICE

Readjust the voltage level if necessary (see Section 3.3 on page 7).

The **AVR [STAB]** control is now set.

3.5 Adjust the AVR [UFRO] Under-Frequency Roll-Off Control

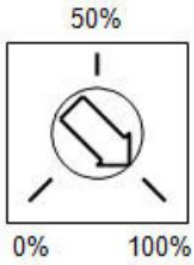
Below an adjustable frequency threshold ('knee' point), the AVR under-speed protection operates to reduce ('roll-off') the excitation voltage in proportion to alternator frequency. The AVR LED lights when UFRO operates.

1. Check the nameplate to confirm the frequency of the alternator.

NOTICE

Power off the AVR before adjusting the slide switch.

2. Check that the slide switch matches the alternator frequency.
3. Set the **AVR [UFRO]** control to 100%, the fully clockwise position.



4. Start the alternator and set at the correct operating speed.
5. Verify that the alternator voltage is correct and stable.

NOTICE

If the voltage is high / low / unstable, use method Section 3.3 on page 7 or Section 3.4 on page 8 before proceeding.

6. Reduce the alternator speed to approximately 95% of correct operating speed. i.e. 47.5 Hz for 50 Hz operation, 57.0 Hz for 60 Hz operation.
7. Adjust the **AVR [UFRO]** control slowly counter-clockwise until the AVR LED lights.



8. Adjust the **AVR [UFRO]** control slowly clockwise until the AVR LED is just OFF.

NOTICE

Do not go past the point at which the LED is just OFF.

9. Adjust the alternator speed back to 100% nominal. The LED should be off.

The **AVR [UFRO]** control is now set.

3.6 Adjust the AVR [EXC] Over-Excitation Control

NOTICE

The AVR [EXC] control is set and sealed at the factory to protect the alternator from over-excitation, usually caused by overload. Incorrect AVR [EXC] control setting could damage the alternator rotor components.

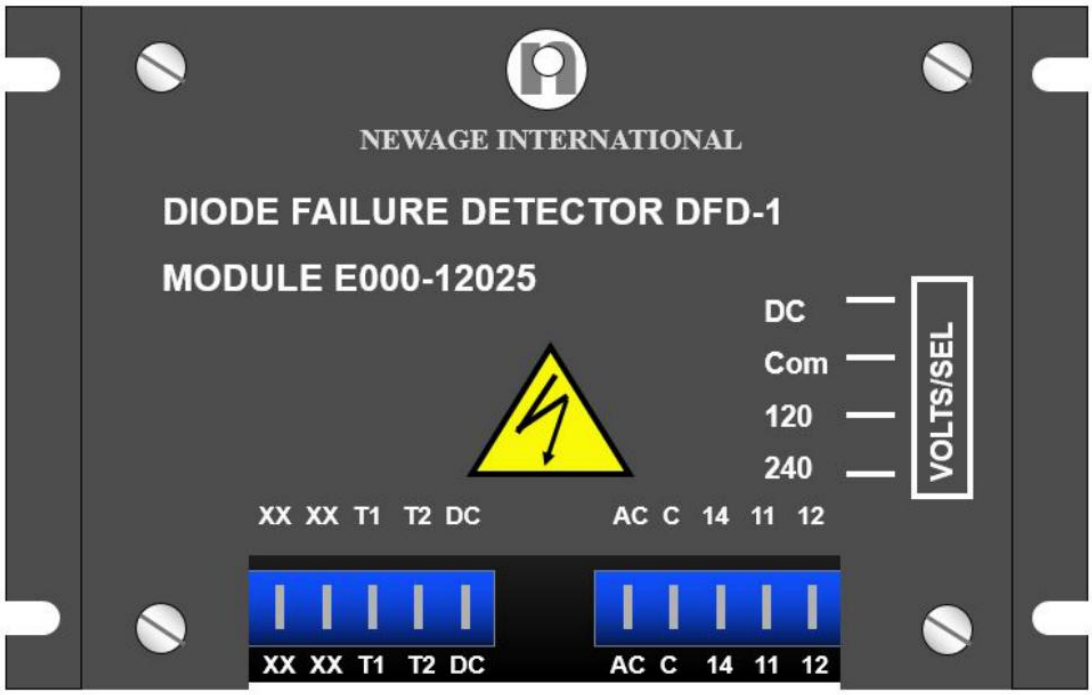
The AVR protects the alternator by removing excitation if it senses that the excitation voltage exceeds a threshold set by the **AVR [EXC]** control.

1. If the excitation voltage exceeds the over-excitation trip setting, the red LED on the AVR turns on.
2. After a short time, the AVR removes the excitation voltage and the red LED flashes (which can also indicate an over-voltage trip or UFRO operation).
3. Stop the alternator to reset the over-excitation condition.

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4 Accessories

4.1 Diode Failure Detector



4.1.2 Description

The Diode Failure Detector (DFD) senses ripple current in the exciter output caused by diode failure in short or open circuit, and switches an internal relay if it persists for 7 seconds. The changeover contacts of the relay can be wired to provide a warning indication of diode failure or initiate an automatic shutdown.

Where the DFD triggers a warning, monitor the exciter field current or voltage and reduce load as necessary, so that the generator set can continue to run until a planned controlled shutdown to replace the diode.

Key features include:

- Robust and reliable solid-state electronics
- Built-in test function
- Selectable power supply
- Simple connection to the alternator.

4.1.3 Specification

- **Sensing Input**
  - Voltage: 0 VDC to 150 VDC
    Input resistance: 100 kΩ
    Sensitivity: 50 V peak
- **Power Supply**
  - Voltage: 12 VDC to 28 VDC

-

- Voltage: 100 VAC to 140 VAC
- Voltage: 200 VAC to 280 VAC
- Current: 0.2 A maximum

- **Output**
  - Single pole changeover relay rating: 5 A @ 30 VDC, 5 A @ 240 VAC
  - Isolation: 2 kV
  - Volt-free contacts
- **Time Delays**
  - Response time: 7 s (approximately)
- **Environmental**
  - Vibration: 30 mm/s @ 20 Hz to 100 Hz, 2 g @ 100 Hz to 2 kHz
  - Relative humidity: 95%9
  - Storage temperature: -55 °C to +80 °C
  - Operating temperature: -40 °C to +70 °C.

4.1.4 Controls

DANGER

Live Electrical Conductors
Live electrical conductors can cause serious injury or death by electric shock and burns. To prevent injury and before removing covers over electrical conductors, isolate the generator set from all energy sources, remove stored energy and use lock out/tag out safety procedures.

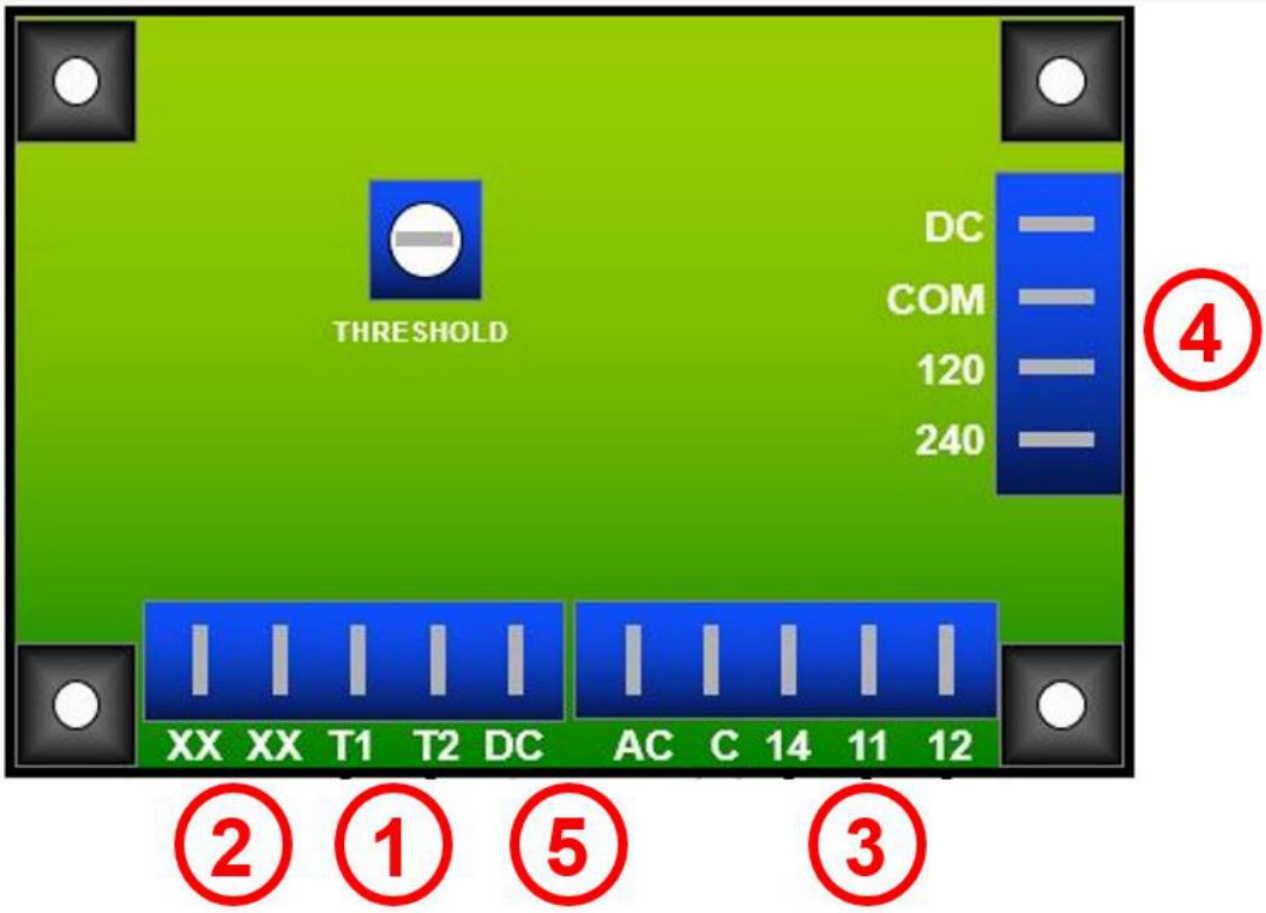
DANGER

Live Electrical Conductors
Live electrical conductors at output, AVR and AVR accessory terminals, and AVR heat sink can cause serious injury or death by electric shock and burns.
To prevent injury, take suitable precautions to prevent contact with live conductors including personal protective equipment, insulation, barriers and insulated tools.

NOTICE

Refer to alternator wiring diagram for connection details. Mount the DFD on a switchboard or bedplate, not in the alternator terminal box.

A054N491 (Issue 1)



Test DFD function

Ref .	Control	Function
1	Link:Test	TestDFDfunction
	T1-T2	
2	**Sensing Input**	Connect F2 in series between exciter
	XX, XX	stator and AVR
3	**Output relay contacts**	Connect to external warning or
	11-14 : Normally-open	shutdown system
	11-12 : Normally-closed	
4	**Link : Supply voltage**	Select VDC or VAC supply voltage
	COM-DC : 12 VDC to 28 VDC	
	COM-120 : 100 VAC to 140 VAC	
	COM-240 : 200 VAC to 280 VAC	
5	**Power Supply**	Connect VDC **or** VAC power supply
	DC : VDC positive (VDC supply)10	
	C : VDC negative (VDC supply)	
	AC : P2 from PMG (VAC supply)	
	C : P3 from PMG (VAC supply)	

disconnect to reset DFD

4.2 Hand Trimmer (for remote voltage adjustment)

A hand trimmer can be fitted in a convenient position (typically in the generator set control panel) and connected to the AVR to provide fine adjustment of the alternator voltage. The hand trimmer value and the adjustment range obtained is as defined in the Technical Specification. Refer to wiring diagram before removing the shorting link and connecting the hand trimmer.

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