STAMFORD

STAMFORD VITA™ 01 Digital Voltage Regulator

SPECIFICATION, CONTROLS AND ACCESSORIES

English
Original Instructions

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1 Foreword

1.1 General

This document is an important guide to the intended use and operation of the product(s) detailed on the front cover. Read the information and procedures in this document. The information and procedures must be obeyed at all times. Failure to obey the information and procedures can be considered misuse and can lead to injury, loss or damage to personnel or equipment.

TABLE 1. COMPANY ADDRESSES

Company and European Authorized Representative Addresses	
Cummins Generator Technologies Fountain Court Lynch Wood Peterborough PE2 6FZ United Kingdom	Cummins Generator Technologies Bvd. Decebal 116A Craiova Dolj 200746 Romania

1.2 Legal

The STAMFORD VITA™ range of Digital Voltage Regulators are the intellectual property of Cummins Generator Technologies Ltd (also referred to as 'CGT' or 'the manufacturer' or by the brand names 'STAMFORD®' or 'AvK®' within this manual).

1.3 Component Manual

This manual contains specifications, control and accessory information for a STAMFORD VITA™ Digital Voltage Regulator, commonly known as an Automatic Voltage Regulator (AVR) or Digital Voltage Regulator (DVR).

STAMFORD VITA ™ voltage regulators are intended for use with STAMFORD® and AvK® alternators, produced by Cummins Generator Technologies Ltd (CGT).

Before installing, operating, servicing or repairing the equipment, read this manual. Make sure that all personnel who work on the equipment have access to the manual and all related documentation supplied with it. Misuse, failure to obey the instructions or use of non-approved parts, may invalidate the product warranty and lead to loss injury or damage.

This manual is an essential part of the equipment. Make sure that the manual is available to all applicable personnel throughout the life of the equipment.

The manual is written for skilled electrical and mechanical technicians and engineers, who have prior knowledge and experience of equipment of this type. If in doubt, contact your local CGT subsidiary.

NOTICE
Information in this manual was correct when published. It may be superseded due to our policy of continuous improvement. Visit www.stamford-avk.com for latest documentation.

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2 Safety Precautions

2.1 Safety Information and Notices used in this Manual

Danger, Warning and Caution panels used in this manual describe the sources of hazards, their consequences and how to avoid injury. Notice panels emphasize important or critical instructions.

⚠ DANGER

Danger indicates a hazardous situation which, if not avoided, WILL result in death or serious injury.

⚠ WARNING

Warning indicates a hazardous situation which, if not avoided, COULD result in death or serious injury.

⚠ CAUTION

Caution indicates a hazardous situation which, if not avoided, COULD result in minor or moderate injury.

NOTICE

Notice refers to a method or practice which can result in product damage, or to draw attention to additional information or explanations.

2.2 General Guidance

- These safety precautions are for general guidance. The information is intended to supplement your own safety procedures and applicable rules, laws and regulations.

2.3 Training and Skill Requirements for Personnel

Operation, installation, service and maintenance tasks and/or procedures can only be done by personnel, who:

- Have completed related, applicable and approved training.
- Know the equipment, understand the task(s) and procedure(s) and know the related hazards / risks.
- Know and obey site / location specific emergency procedures and applicable laws and regulations.

2.4 Risk Assessment

- The installer / operator / service / maintenance company must do a risk assessment to establish all related hazards and risks.
- During operation, access to the alternator must be restricted to personnel who are trained and who know all relevant hazards and risks. Refer to: **Section 2.3 on page 3**.

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2.5 Personal Protective Equipment (PPE)

Personnel who install, operate, service or maintain the alternator must:

- Have access to the minimum recommended protective equipment (refer to the figure below). The protective equipment must be approved for the task or procedure.
- Know how to correctly use protective equipment, refer to: **Section 2.3 on page 3**
- Use protective equipment as directed by the risk assessment, refer to: **Section 2.4 on page 3**.

FIGURE 1. MINIMUM RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT (PPE)

2.6 Tools and Equipment

All personnel must know how to use tools and equipment safely, refer to: **Section 2.3 on page 3**.

All tools and equipment used, must be:

- Suitable for the task and procedure.
- Electrically insulated (not below the alternator output voltage), refer to: **Section 2.4 on page 3**.
- In a serviceable condition for safe use.
- Included within the risk assessment, refer to: **Section 2.4 on page 3** .

2.7 Safety Information Signs

Safety information signs are provided on the equipment to indicate hazards and emphasize instructions. Before operating the equipment:

- Personnel must know and understand alternator safety information signs and the associated hazards / risks.

FIGURE 2. EXAMPLE SAFETY INFORMATION SIGNS

Safety information signs vary depending on alternator specification.

2.8 Automatic Voltage Regulator Safety Precautions

⚠ DANGER

Live Electrical Conductors

Live electrical conductors can cause serious injury or death by electric shock and burns. To prevent injury and before working on live conductors:

- ***Shut down and isolate the alternator from all energy sources.***
- ***Remove or isolate stored energy.***
- ***Test isolated parts for electrical isolation using a suitable voltage tester.***
- ***Use lock out/tag out safety procedures.***

⚠ DANGER

Live Electrical Conductors

Output, AVR, AVR accessory terminals, and AVR heat sink can cause serious injury or death by electric shock and burns. To prevent injury:

- ***Use applicable precautions to prevent contact with live conductors, such as: insulation, barriers, insulated tools and personal protective equipment, refer to: Safety Precautions Chapter.***

⚠ WARNING

Installing Automatic Voltage Regulator (AVR)

An incorrectly configured AVR can result in equipment malfunction or damage which can cause injury or death. Prior to installing, operating / adjusting or replacing an automatic voltage regulator, all personnel must:

- ***Read and obey with instructions within this manual.***
- ***Read and obey with all instructions within the original operator manual for the alternator that work is being undertaken on.***
- ***Know the equipment, understand the task(s) and procedure(s).***
- ***Know all related hazards / risks.***
- ***Know and understand all location specific emergency procedures and locally applicable laws and regulations.***

NOTICE

Refer to alternator wiring diagram for connection details.

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3 Description

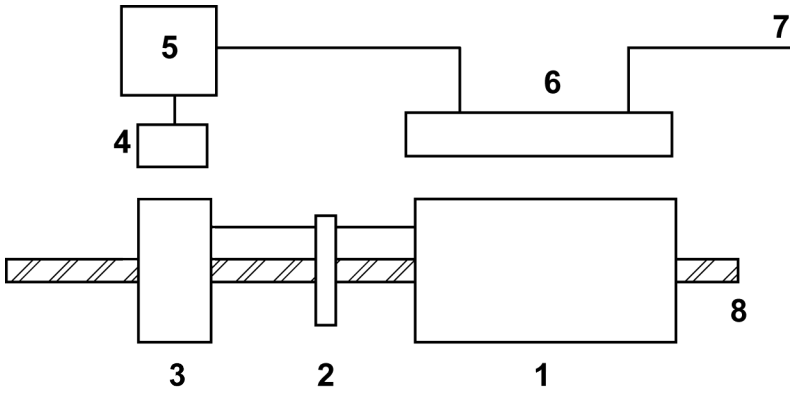
3.1 Self-Excited / Auxiliary Winding Excited AVR Controlled Alternators

A self-excited / auxiliary winding excited AVR receives power from the alternator output terminals or auxiliary winding. The AVR controls the alternator output voltage by automatic adjustment of the exciter stator field strength.

3.1.1 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, magnetizes 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.

TABLE 2. MAIN STATOR POWERED AVR



No.	Description	No.	Description
1	Main field (rotor)	5	AVR
2	Rotating diodes	6	Main armature (stator) or auxiliary winding (if fitted)
3	Exciter armature (rotor)	7	Output
4	Exciter field (stator)	8	Rotor shaft

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4 Specification

4.1 STAMFORD VITA™ 01 Technical Specification

- **Sensing Input**
  - Voltage: 95 VAC to 132 VAC or 170 VAC to 300 VAC 1 phase[1]
  - Frequency: 50 Hz to 60 Hz nominal[2]
- **Power Input**
  - Voltage: 95 VAC to 300 VAC 1 phase only
  - Frequency: 50 Hz to 60 Hz nominal
- **Power Output**
  - Voltage: 90 VDC at 240 VAC input
  - Current:
    - Continuous 4 A
    - Overload 6 A for 1 minute
    - Transient 10 A for 10 seconds
  - Resistance: 13 Ω minimum at 20 °C
- **Regulation**
  - +/- 0.5% RMS[3]
- **Thermal Drift**
  - 0.025% for 1 °C change in ambient temperature[4]
- **Typical Response**
  - AVR response in 20 ms
  - Field current to 90% in 80 ms
  - Machine Volts to 97% in 300 ms
- **External Voltage Adjustment Pot**
  - +/- 10% with 1 kΩ, 1 W trimmer[5]
- **Under-Frequency Protection**
  - Set point 94% to 98% Hz[6]
- **Unit Power Dissipation**
  - 10 W maximum
- **Build-up Voltage**
  - 4 VAC RMS at AVR power input terminals

[1] Selected by Switch 1.
[2] Selected by jumper.
[3] With 4% engine governing.
[4] After 2 minutes.
[5] Alternator deration may apply. Check with factory.
[6] Factory set, semi-sealed jumper for 50 Hz selection.

- **Quadrature Droop Input**
  - Burden: 0.15 Ω
  - Maximum Sensitivity: 0.1 A for 5% droop, Zero Power Factor
  - Maximum Input: 0.33 A
- **Over-Voltage Excitation Detection**
  - Set point: 65 VDC to 80 VDC[7]
  - Time delay: 10 to 15 seconds (fixed)
- **Environmental**
  - Vibration:
    - 20 Hz to 100 Hz: 50mm/sec
    - 100 Hz to 2 KHz: 3.3 g
  - Operating temperature: -40 °C to +70 °C[8]
  - Relative Humidity 0 °C to 70 °C: 95%[9]
  - Storage temperature: -55 °C to +80 °C

[7] Factory set, semi-sealed.
[8] De-rate output current by 5% per 1 °C above 60 °C.
[9] Non-condensing.

5 Controls

⚠ DANGER

Live Electrical Conductors

Live electrical conductors can cause serious injury or death by electric shock and burns. To prevent injury and before working on live conductors:

- ***Shut down and isolate the alternator from all energy sources.***
- ***Remove or isolate stored energy.***
- ***Test isolated parts for electrical isolation using a suitable voltage tester.***
- ***Use lock out/tag out safety procedures.***

⚠ DANGER

Live Electrical Conductors

Output, AVR, AVR accessory terminals, and AVR heat sink can cause serious injury or death by electric shock and burns. To prevent injury:

- ***Use applicable precautions to prevent contact with live conductors, such as: insulation, barriers, insulated tools and personal protective equipment, refer to: Safety Precautions Chapter.***

⚠ WARNING

Installing Automatic Voltage Regulator (AVR)

An incorrectly configured AVR can result in equipment malfunction or damage which can cause injury or death. Prior to installing, operating / adjusting or replacing an automatic voltage regulator, all personnel must:

- ***Read and obey with instructions within this manual.***
- ***Read and obey with all instructions within the original operator manual for the alternator that work is being undertaken on.***
- ***Know the equipment, understand the task(s) and procedure(s).***
- ***Know all related hazards / risks.***
- ***Know and understand all location specific emergency procedures and locally applicable laws and regulations.***

NOTICE

Refer to alternator wiring diagram for connection details.

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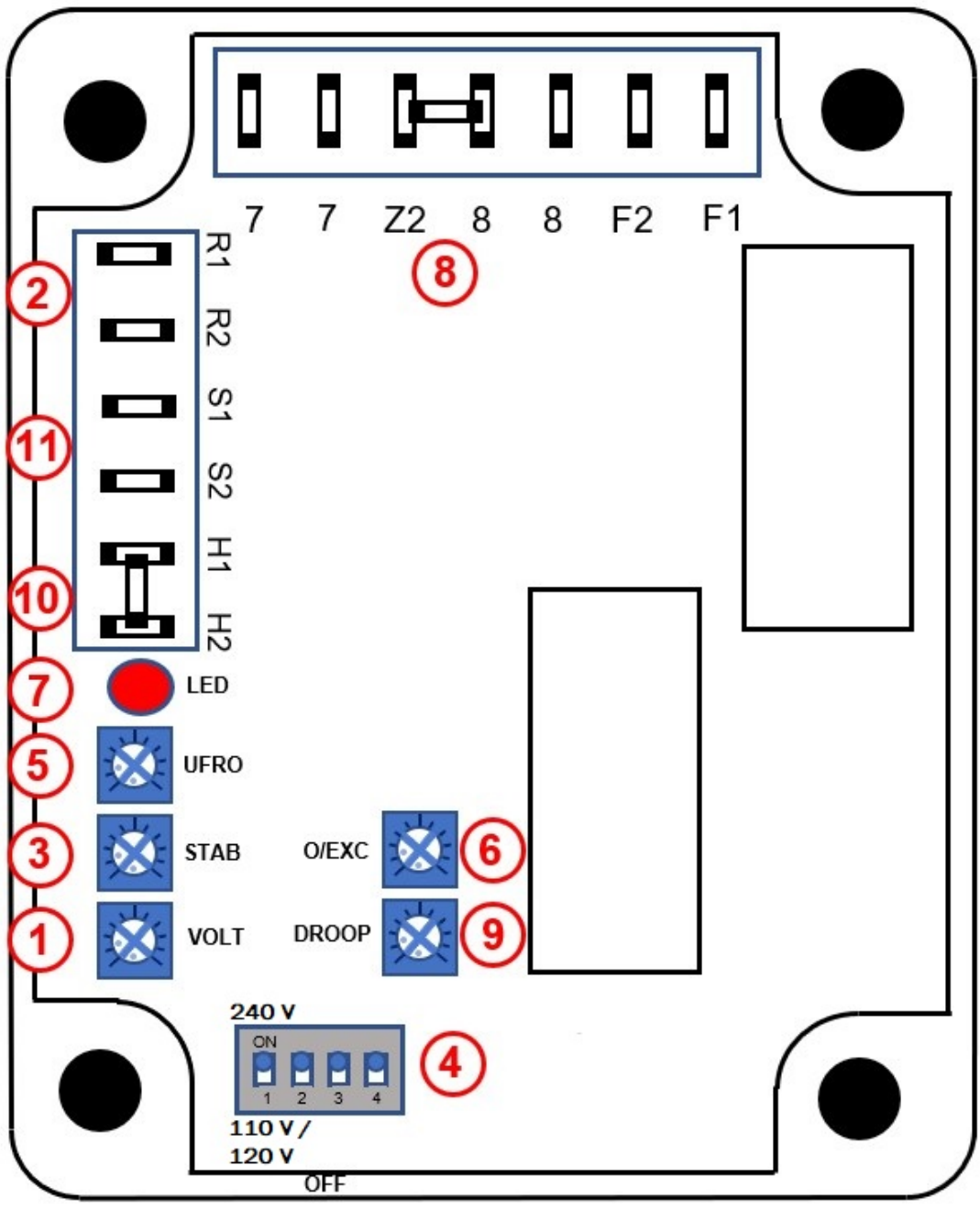
5.1 Controls and Adjustments

TABLE 3. CONTROLS AND ADJUSTMENTS



ON and OFF switch positions are referenced from this view, AVR facing.

Ref.	Control	Function	Turn potentiometer CLOCKWISE to
1	**AVR [VOLTS]**	Adjust alternator output voltage	Increase voltage
2	R1-R2 Open: No Trimmer 1 KΩ,1 W in R1-R2: Hand trimmer	Adjust alternator output voltage remotely	Increase voltage

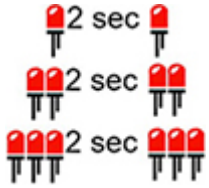
3	**AVR [STAB]**	Adjust stability to prevent voltage hunting	Increase damping effect
4	Switch 1: Supply voltage Switch **ON**: 240 V Switch **OFF**: 110 V/120 V	Select AVR supply voltage	N/A
	Stability Selection Switches: 2, 3, 4: Refer to **Table 4 on page 13**.	Switch selection based on alternator frame	N/A
5	**AVR [UFRO]**	Adjust under-frequency roll-off knee point	Increase **UFRO** knee point frequency
6	**AVR [O/EXC]**	Adjust over-excitation trip	Increase trip voltage
7	Light Emitting Diode (LED) 1 Blink: UFRO active 2 Blinks: O/EXC limit active 3 Blinks: UFRO and O/EXC both active	LED lights up in UFRO and/or O/EXC condition(s)	
8	Link: SUPPLY 8-Z2: Main Stator No link: Auxiliary winding	Power input and sensing input terminals of AVR	N/A
9	**AVR [DROOP]**	Alternator droop to 5% at zero power factor	Increase droop
10	H1-H2 Link frequency: 50 Hz : Use link 60 Hz : No link	Select alternator frequency	N/A
11	S1-S2 DROOP CT Connection Maximum 0.33 A Secondary for rated primary current	Current input for DROOP feature	N/A

TABLE 4. STABILITY SELECTION SWITCHES

Frame	**Stability Switch Numbers**		
	2	**3**	**4**
S0L1	OFF	OFF	OFF
S0L2 and S2	ON	OFF	OFF
S1L2	OFF	ON	OFF
UC22	ON	ON	OFF
UC27 and S3	OFF	OFF	ON

-

5.2 Initial AVR Setup

NOTICE
The AVR must be setup only by authorized, trained service Personnel. 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 for the end user. 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. Disconnect and remove the existing AVR (if fitted). Install and connect the replacement AVR. Refer to the connection diagram: **Section 5.1 on page 12**.
3. Turn the **AVR [VOLTS]** volts control fully counter-clockwise. Refer to: **Section 5.3 on page 14**.
4. Turn the hand trimmer (if fitted) to 50%, the midway position.
5. Turn the **AVR [STAB]** stability control to 50%, the midway position. Refer to: **Section 5.4 on page 15**.
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), If the LED is lit, adjust the **AVR [UFRO]** control. Refer to: **Section 5.5 on page 16**.
9. Carefully turn **AVR [VOLTS]** control clockwise until the voltmeter shows rated voltage.
10. If voltage is unstable, adjust the **AVR [STAB]** stability control. Refer to: **Section 5.4 on page 15**.
11. Re-adjust the **AVR [VOLTS]** control, as needed.

5.3 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.

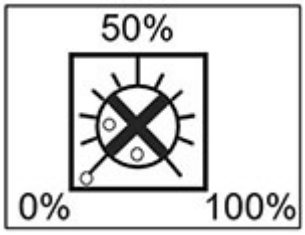


FIGURE 3. 0% POSITION

3. R1 and R2 terminals are kept open with no hand trimmer option. Connect remote hand trimmer across R1 and R2 when required.

NOTICE
If a remote hand trimmer is connected, set it to 50%, the midway position. If R1 and R2 are linked the terminal voltage will drop to a minimum voltage level.

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: **Section 5.5 on page 16** for Under Frequency Roll Off **AVR [UFRO]** adjustment .
7. Adjust the **AVR [VOLTS]** control slowly clockwise to increase the output voltage.

NOTICE
If the voltage is unstable set the AVR stability before proceeding, refer to: Section 5.4 on page 15.

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, refer to: **Section 6.2 on page 21** for hand trimmer operation.

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

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

5.4 Adjust the AVR [STAB] Stability Control

1. Check the nameplate to confirm the power rating of the alternator.
2. Check that the switches 2,3 and 4 selections match the alternator frame for optimal stability response.
3. Set the **AVR [STAB]** control to approximately 75% position.

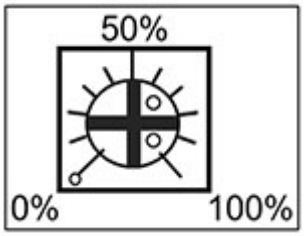


FIGURE 4. 75% POSITION

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, refer to: Section 5.3 on page 14 immediately.

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
If necessary, refer to: Section 5.3 on page 14 to readjust the voltage level.

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

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

Below the UFRO threshold frequency ('knee' point), the AVR under-speed protection operates to reduce ('roll-off') the excitation voltage in proportion to alternator frequency. The AVR LED lights with 1-blink when UFRO is activated.

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

NOTICE
Isolate the power supply to the AVR (stop alternator and prime mover). Adjusting the frequency selection jumper link to 60 Hz mode for a 50 Hz alternator may result in low voltage. Adjusting the frequency selection jumper link to 50 Hz mode for a 60 Hz alternator may result in overheating of field windings during under-speed conditions.

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

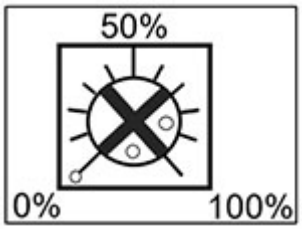


FIGURE 5. 100% POSITION

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 the methods detailed in Section 5.3 on page 14 or Section 5.4 on page 15 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 with 1 blink.

FIGURE 6. ILLUMINATED LED

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

FIGURE 7. EXTINGUISHED LED

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.

FIGURE 8. EXTINGUISHED LED

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

5.6 Adjust the AVR [O/EXC] Over-Excitation Control

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

The AVR protects the alternator by limiting the excitation if it senses that the excitation voltage exceeds a threshold set by the **AVR [O/EXC]** control. The AVR LED flashes with 2-blinks when the O/EXCITATION is activated.

1. If the excitation voltage exceeds the over-excitation limit setting, the red LED on the AVR turns ON.
2. After a pre-set time delay, the AVR limits the excitation voltage and the red LED flashes with 2-blinks.
3. Stop the alternator to investigate the cause of over-excitation.

NOTICE
When both UFRO and O/EXC features get activated, the LED lights up with 3 blinks.

5.7 Adjust the AVR [DROOP] Voltage DROOP Control for Parallel Operation

NOTICE
The AVR [DROOP] control is set and sealed at the factory to protect the alternator from undesirable voltage droop, as it is to be used only when paralleling the alternator with other alternators. Incorrect AVR [DROOP] control setting could cause undesirable voltage drop.

-

A correctly fitted and adjusted droop current transformer (CT) allows the alternator to share reactive current for stable parallel operation.

1. Mount the droop CT to the correct phase lead of the main output windings of the alternator.
2. Connect the two secondary leads marked S1 and S2 from the CT to the terminals S1 and S2 of the AVR.
3. Turn the AVR [DROOP] control to the midway position.
4. Start the alternator(s) and set at the correct operating speed and voltage.
5. Parallel the alternator(s) according to manufacturer original installation manual(s) and all applicable local regulations.
6. Set the AVR [DROOP] control to produce the required balance between individual alternator output currents. Set the AVR droop off-load and then check the currents when the output load is applied, on-load.
7. If the individual alternator output currents rise (or fall) in an uncontrolled way, isolate and stop the alternators then check that:

   • The droop transformer is fitted to the correct phase and in the correct polarity (see the machine wiring diagrams).

   • The droop transformer secondary S1 and S2 leads are connected to AVR terminals S1 and S2.

   • The droop transformer is the correct rating.

NOTICE
Please refer droop kit instruction and connection diagram when added as accessory.

6 Accessories

Accessories to support AVR functions are factory-fitted or supplied separately with instructions for fitting and wiring by a competent technician.

6.1 Diode Failure Detector Module

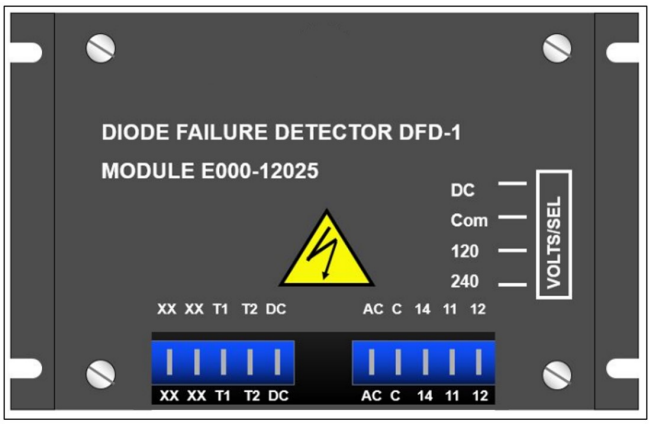


FIGURE 9. DIODE FAILURE DETECTOR MODULE

6.1.1 DFD Description

The STAMFORD 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.

6.1.2 DFD Technical 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

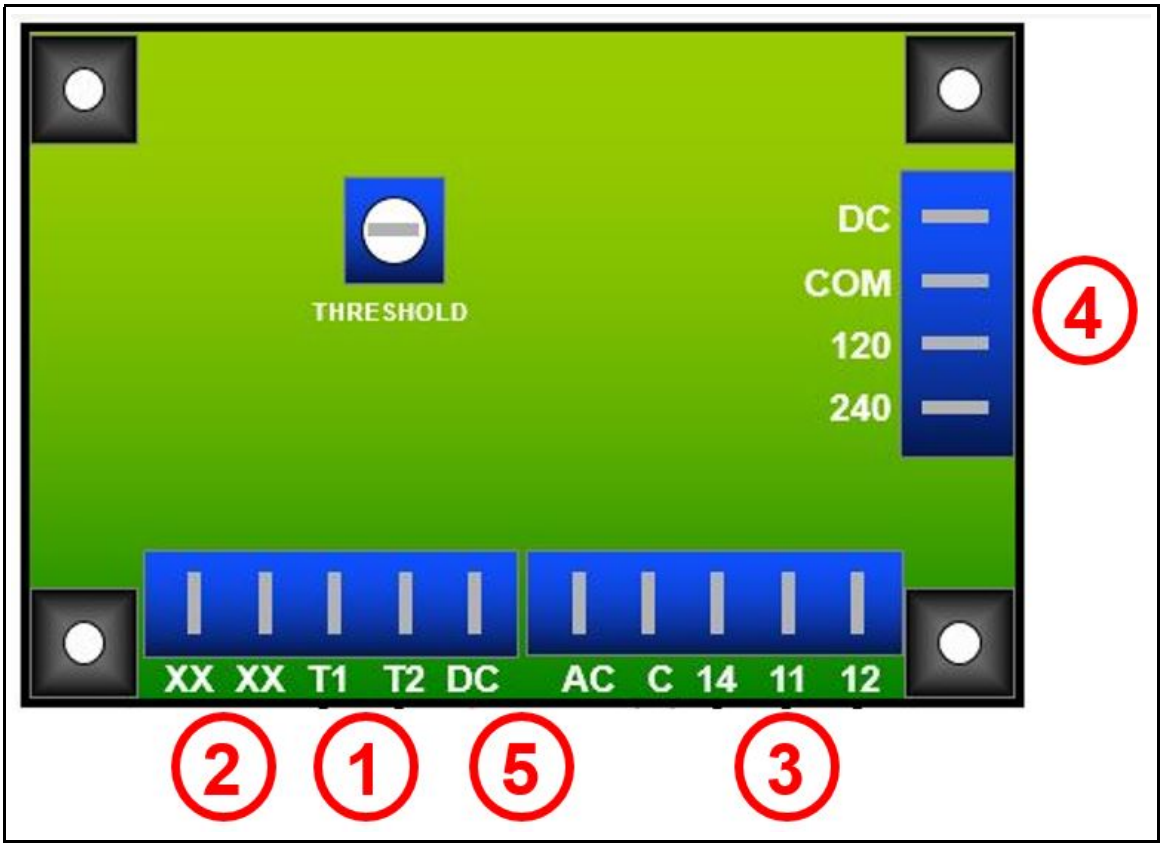
- **Output**
  - Single pole changeover relay rating: 5 A @ 30 VDC, 5 A @ 240 VAC
  - Isolation: 2 kV
  - Volt-free contacts
- **Time Delays**
  - Response time: 7 s (approximately)
- **Environmental**
  - Vibration: 30 mm/s @ 20 Hz to 100 Hz, 2 g @ 100 Hz to 2 kHz
  - Relative humidity: 95%
  - Storage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

6.1.3 DFD Mounting

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

6.1.4 Controls

TABLE 5. DIODE FAILURE DETECTOR CONTROLS



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

6.2 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** chapter. Refer to wiring diagram before removing the shorting link and connecting the hand trimmer.

[10] Disconnect to reset DFD.

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