

James Hamilton Electrical Pty Ltd (Inc in Qld) A.C.N. 010 848 389 trading as

# ***Power Drive Systems***

***Generator Control Specialists***

48A Ainsdale Street  
West Chermside, Qld 4032  
Australia  
email: [info@powersystems.com.au](mailto:info@powersystems.com.au)

Telephone: 0500 800 225  
Facsimile: 3350 1654  
Mobile: 0427 22 00 18

P.O. Box 30  
Grange, Qld 4051  
Australia  
[www.powersystems.com.au](http://www.powersystems.com.au)

**DUNLITE UVR100  
AUTOMATIC VOLTAGE REGULATOR**

## POWER DRIVE SYSTEMS

### DUNLITE UVR100 AUTOMATIC VOLTAGE REGULATOR

#### **GENERAL**

This regulator is a solid-state device primarily designed to give precise and stable voltage regulation of an alternator under adverse operating conditions.

The regulator is suitable for operation on either single or three phase 240/415 or 120/208 volt brushless alternators.

#### **OPERATION**

The regulator senses the output voltage of the alternator and compares this value with a pre-set voltage reference within its circuitry. The regulator constantly adjusts the field excitation of the alternator to compensate for variations in load and prime mover speed, and holds the output voltage to within plus or minus 1.5% no load to full load, unity to 0.8 power factor lagging, and a speed variation of 4.5%.

#### **CONNECTION DETAILS**

There are 14 screw terminals on the regulator and their functions are as follows. Early models are labelled R.W.B in place of U.V.W.

N - Must always be connected to the neutral of the alternator.

U & V - Sensing terminals for voltage regulation.

W - Power terminal for exciter field.

F+ F- - Alternator exciter field terminals.

pp - Terminals for a 5k remote voltage adjustment potentiometer.

D1,D2 - Terminals for the addition of drooping circuit for parallel operation.

S+ S1 - Terminals for remote indication of the SCOOP operation, Series 2000 control (later models only).

#### **THREE PHASE OPERATION**

The regulator must be adjusted for either 415 or 208 volts sensing, depending on the available sensing leads on the alternator. If in doubt, contact Dunlite, stating alternator serial number.

Open the regulator box by unclipping the side catches, and adjacent to the transformer, will be found four pins connected to various taps of the transformer. The purple fly lead must be connected to the relevant pin to match the regulator to the available sensing outputs of the alternator.

Starting from the pin nearest the transformer, the sensing voltages are 120V, 208V, 240V, 415V.

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#### NOTE

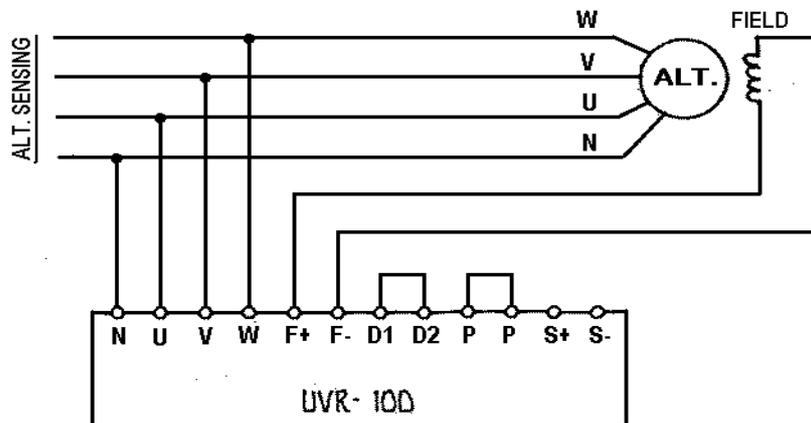
When the regulator is fitted within a separate control cubicle, the terminals U, V, W and N will have been factory connected to AC supply points within the cubicle.

Similarly, the voltage adjustment terminals PP may have been connected to a separate potentiometer - normally these terminals will be bridged, as will also the droop circuit terminals D1, D2.

The only terminals requiring connection when installing the plant will be the F+ and F- (grey and white respectively) and a small terminal block is fitted within the alternator terminal box for interconnection purposes.

Once the above has been completed, the regulator may be connected to the alternator. N to neutral, U to Red phase, V to White phase, W to Blue phase, F+ and F- to Field. D1 D2 and PP must be bridged if not connected to external potentiometers ~ see diagram.

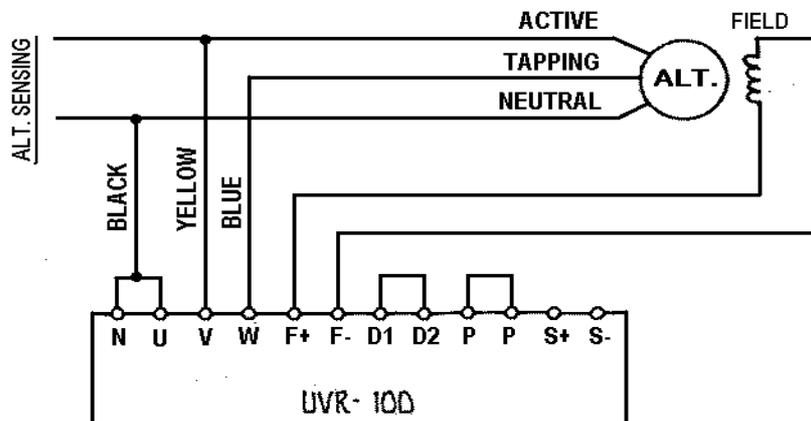
Note: Later model UVR100 regulator violet wires to S+ & S- (See SCOOP Section)



#### SINGLE PHASE OPERATION

As for three phase operation, the regulator must be adjusted for either 240 or 120 volt sensing. This can be done by the purple fly lead as for three phase operation.

For single phase operation, terminals N and U are bridged and connected to neutral, terminals V and W are bridged and connected to the alternator sensing. The remaining terminals are connected as for three phase operation. See diagram.



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#### CONTROLS

There are three standard controls on each regulator. They are -

##### 1. Voltage Adjust

This potentiometer varies the internal voltage reference of the regulator, hence varying the alternator output voltage over a range of plus or minus 10%. An external 5K potentiometer may be added to terminals PP for remote voltage adjustment. Under these circumstances RVI, should be fully clockwise.

##### 2. Stability

This potentiometer varies the stability the system and should initially be set in an anti-clockwise position and rotated clockwise to give optimum stability and response characteristics. Once set it should not be necessary to carry out further adjustment to this control.

##### 3. SCOOP

All UVR100 regulators incorporate SCOOP (Speed, Current Operated, Overload Protection) as a standard feature.

If the engine slows down due to either an overload on the alternator or a mechanical fault in the engine, the exciter field voltage will increase. The same applies if the engine speed remains constant whilst the alternator is overloaded due to excessive current being drawn, or a very low power factor load.

The SCOOP feature of the regulator is built in to protect the alternator against such overloads. It senses the average voltage being applied to the alternator exciter winding, and if this applied voltage exceeds a pre-set safe maximum value, the SCOOP inhibits the triggering of the thyristor which controls the current supply to the exciter winding. The result is the alternator output voltage falls to approximately 50 volts.

Allowance is made for temporary overloads, such as those encountered when starting electric motors, by the addition of a built-in delay. This factory pre-set, non-adjustable, feature delays the operation of the SCOOP function for approximately 20 seconds.

If the alternator output voltage is lost due to the operation of SCOOP the voltage will remain at its SCOOP level until the generating set is shut down. Stopping the set will automatically reset the function. If the reason for the operation of SCOOP is not immediately obvious, it is advisable that an investigation is carried out before any attempt to restart is made. If the cause of the failure has not been determined and rectified, the set will again lose output voltage approximately 30 seconds after restart.

The operation of SCOOP and/or certain short circuit conditions may result in the loss of residual magnetism in the alternator exciter field. In such cases, refer to the section entitled "Repolarisation". **Under no circumstances must any voltage from an outside source be applied to the voltage regulator field terminals.** Failure to observe this point may result in permanent damage to the regulator.

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CONTROLS (cont' d)

#### 3. **SCOOP** (cont'd)

##### **SCOOP Adjustment**

As previously stated, the point at which this function operates is pre-set at the factory so as to limit, to a safe maximum value, the voltage applied to the exciter field. This voltage varies according to the particular size and type of alternator and should not normally require adjustment. If, however, under operational conditions it is found that the SCOOP function is frequently resulting in loss of alternator output, without any apparent cause, it may be necessary to adjust the voltage at which SCOOP operates. In such cases, it will be necessary to contact the factory to determine the normal cut-out voltage and then carry out the tests detailed below.

(Note: To avoid any delay in obtaining this information, please specify both the type and serial numbers of the generating set when making enquiry.)

1. Connect a high impedance 0-50 volts DC voltmeter across the field supply terminals positive and negative.
2. Run the generating set and apply the full rated load and note the voltage being applied to the exciter field.
3. On engines incorporating a hand throttle, adjust the speed of the prime mover until the field voltage equals the SCOOP cut-out voltage recommended by the factory.
4. Adjust the SCOOP control until the red SCOOP indicator LED starts to illuminate.
5. Return the hand throttle setting to normal after the final adjustment has been made.

On engines which do not incorporate a hand throttle, the load should be increased to achieve the field volts as specified by the factory.

**DO NOT** run the set on overload for extended periods when carrying out these tests, or the alternator may sustain permanent damage, and **UNDER NO CIRCUMSTANCES ALLOW THE SET TO RUN WITH THE FIELD VOLTS IN EXCESS OF THE MAXIMUM VALUE SPECIFIED BY THE FACTORY.**

It is possible to adjust the SCOOP to operate at a lower voltage, thereby reducing the tolerable degree of overload; however, when doing so account must be taken of the increase in field volts required to cover low power factor loads and high ambient temperatures.

The SCOOP indicator will illuminate as soon as an overload or low speed condition arises and will remain illuminated after the SCOOP has de-energised the alternator.

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#### SCOOP REMOTE INDICATION S+ S- (Later models)

S+ and S- terminals are used for remote indication of the SCOOP operation. The output is an optically coupled silicon NPN phototransistor. The output is connected via the alternator terminal box to a Series 2000 control which has the necessary interface.

If SCOOP trips as per normal overload protection etc. the opto coupled transistor will switch and shut the engine down. (See operating manual Series 2000 MK III).

#### Connection details SCOOP S+ S-

To No. 7 engine terminal  
Series 2000 control cubicle

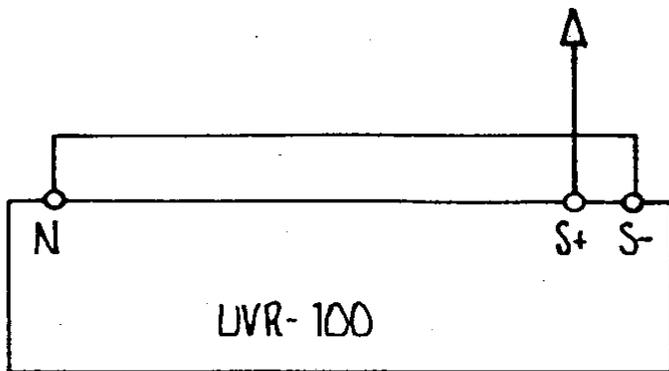


Figure 1

Connect as for Figure 1 when neutral and battery negative are common to earth.

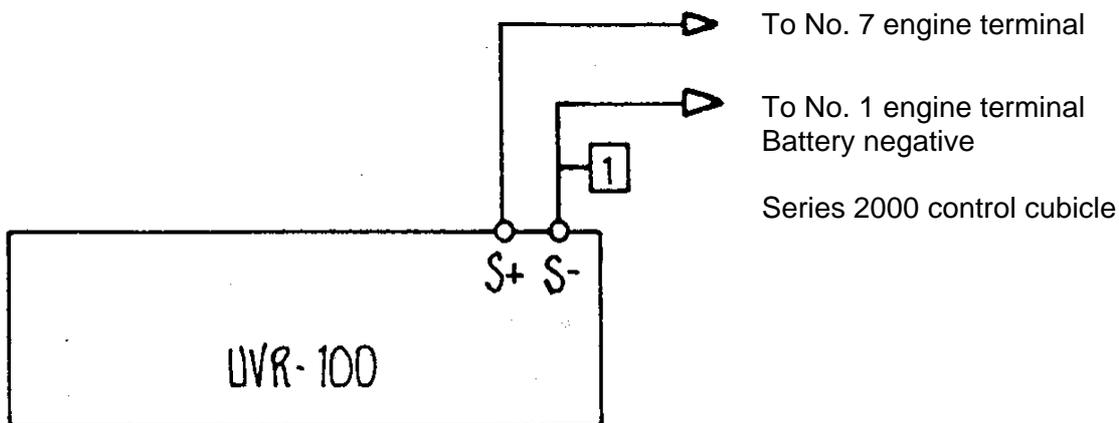


Figure 2

Connect as for Figure 2 when separate neutral and battery negative is required. Battery negative is earthed.

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#### REMOTE VOLTAGE CONTROL

##### Terminals PP

The UVR100 regulator has remote voltage facilities where the voltage range can be varied up to 10%.

Remove bridge from PP and fit an external 5K 2W potentiometer. Turn RV1 voltage adjusting potentiometer on the regulator fully clockwise so as to have full voltage range adjustment on the external potentiometer.

It is advisable to use screen cable for the remote potentiometer connection as this will prevent noise from being transmitted to the AVR and causing voltage stability problems.  
See Figure 3.

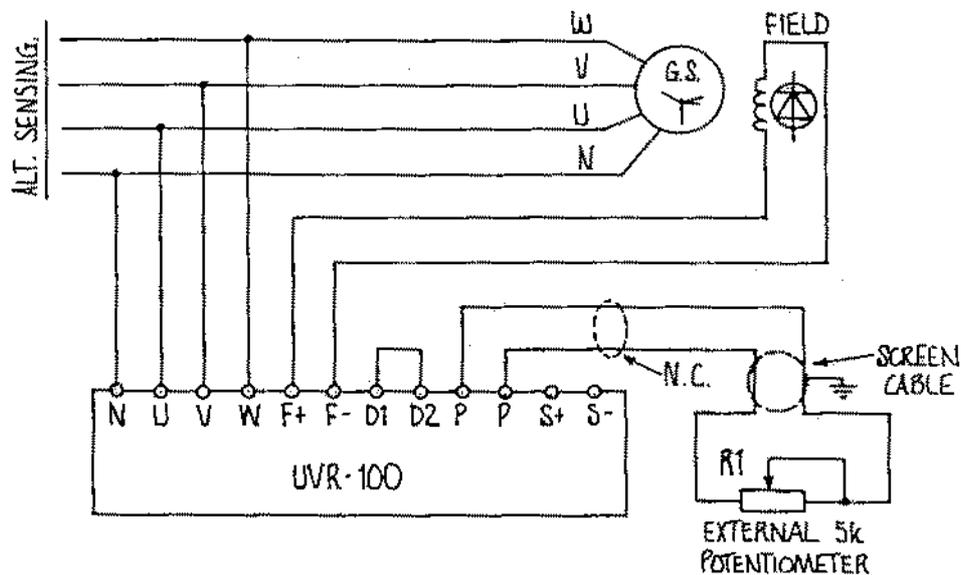


Figure 3

## POWER DRIVE SYSTEMS

### DUNLITE UVR100 AUTOMATIC VOLTAGE REGULATOR

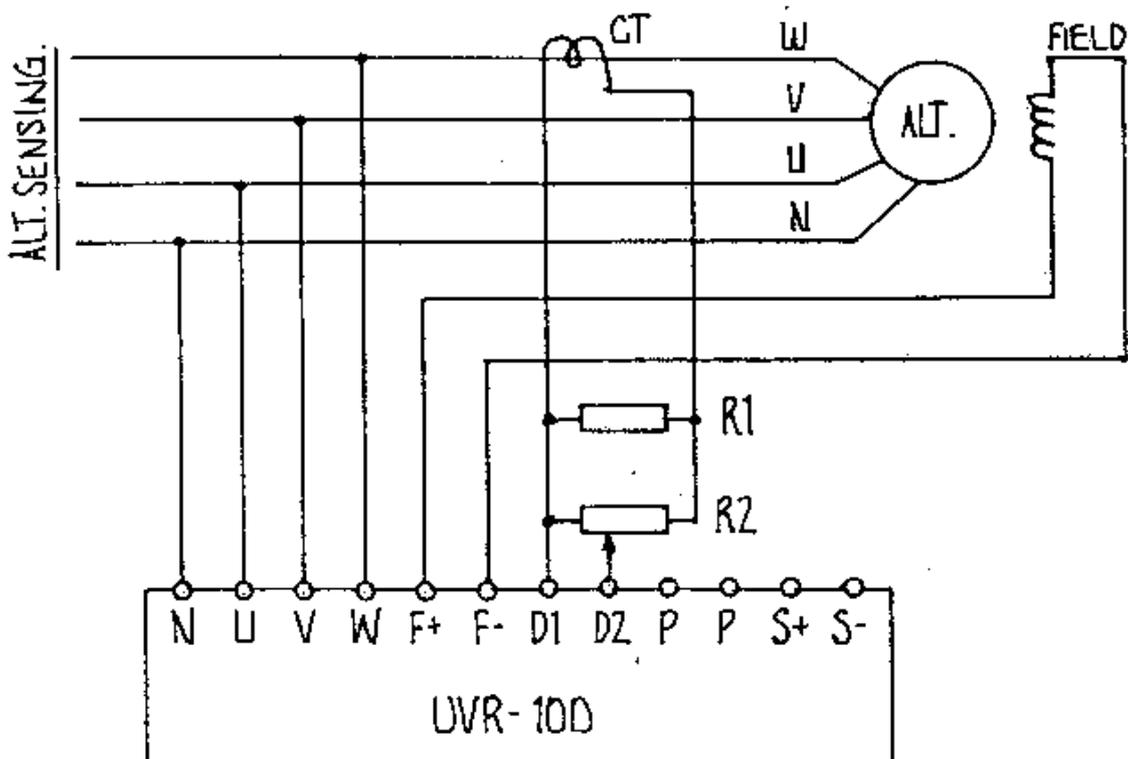
#### DROOP FACILITY

##### Terminals D1 D2

The UVR100 regulator has quadrature droop facilities for parallel operation. The addition of a drooping kit will make the UVR100 suitable for parallel operation.

Quadrature droop allows load sharing of reactive load (kVAR) only, since kW load sharing is a function of the prime mover.

Part of the droop kit will be a class 2.0 (Australian Standard C388) ring current transformer, with 5A 10 (ten) VA secondary rating and ratio to suit twice the alternator output. This current transformer must be placed in the Blue phase. It is to be noted that the UVR100 senses Red and White phase voltage and to achieve quadrature droop, current must be sensed in the Blue phase. See diagram.



Nominal value of fixed resistor 'R1' is 1 ohm 20W and of adjustable potentiometer 'R2' 30 ohm 2W. These values are subject to change, dependant on the number of alternators to be paralleled, and advice should be obtained from the factory in this regard.

R2 must be adjusted on both plants for kVAR load sharing.

See 'Parallel Operation' Appendix C.

## POWER DRIVE SYSTEMS

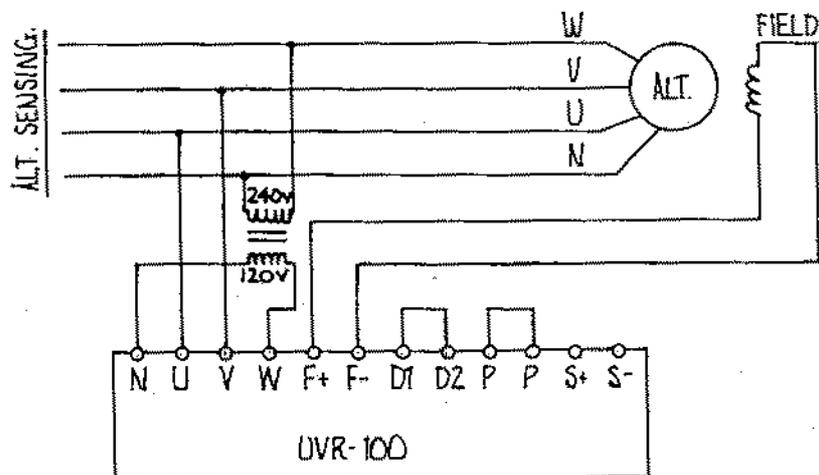
### DUNLITE UVR100 AUTOMATIC VOLTAGE REGULATOR

#### OPERATING UNDER EXTREME ADVERSE CONDITIONS

For operation under extreme adverse conditions (ie. lightning strikes etc.) the regulator may be used without additions, provided the power terminal (B) is connected to a centre tap of the alternator (ie. on 240 volt machine, connect terminal B to a 120 volt tap).

Where a centre tap is not available, an isolation step down transformer may be used to supply power to terminal B – see diagram. Contact the factory for VA rating of transformer, stating alternator serial number.

Where severe transients may be induced by direct lightning strikes, lightning suppressors should be used on alternator outputs.



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#### **FAULT LOCATION**

If the generating set runs at the correct speed, but will not generate, check as follows -

1. Shut down the set.
2. Check all wiring between the alternator, distribution board and load.
3. Check the external potentiometer terminals PP are bridged. If an external potentiometer is being used, check it and its connecting leads for continuity. Check droop terminals DI, D2 are bridged if not in use.
4. Isolate the main stator windings and exciter field windings and check for continuity and the insulation resistance to earth and between the windings. (Contact Dunlite for specific ohmic values, stating alternator serial number.)

**Note** Before testing insulation resistance with any high voltage test equipment, make certain the main alternator voltage regulator and the battery charging voltage regulator leads are disconnected and insulated to prevent damage to solid state components.

5. Disconnect the exciter field leads from the regulator F+ and F-, carefully noting the respective lead/terminal positions (grey lead to F+, white lead to F-). Connect the white lead to the negative of the starter battery. Place a 0-5 amp DC ammeter in series with the grey lead, and connect to the lowest battery tap. Start up the alternator and note alternator output voltage. Increase the tapping voltage until the alternator voltage is approximately 240 voltage.

**Note** Do not connect any voltage from any source to these leads whilst they are connected to the regulator, or permanent damage to the regulator may occur.

Check the current with the 0-5 ammeter, and if this is in excess of the factory recommended limit of the alternator, the fault probably lies within the alternator.

The fault could have caused the regulator to fail, hence regulator fault finding procedure must be carried out.

#### **REPOLARISATION**

It is possible, after prolonged periods of storage, or as a result of certain fault conditions, that the alternator will not have sufficient residual magnetic field for initial excitation. In such circumstances, the following procedure will re-establish the residual field -

1. Shut down the set.
2. Disconnect the exciter field leads from the regulator (Field Supply positive and negative) carefully noting the respective lead/terminal positions.
3. Momentarily, connect the leads from the exciter field across the starter battery with the lead from the positive terminal being taken to the positive battery terminal and the lead from the negative terminal to the negative battery terminal .

(The starter battery may be either 12 or 24 volt.)

Take care not to connect the starter battery to these leads whilst they are connected to the regulator, or, permanent damage to the regulator may occur.

4. Reconnect the exciter field leads to the regulator.

If the alternator still fails to excite, the fault may be in the regulator.

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#### UVR100 REGULATOR FAULT FINDING CHART

Instrument: Multimeter 20K Sensitivity.

Ref: Drg. No. 0212-J-03

#### Fault

**High Voltage**  
300V AC

#### Diagnose

**(Danger – run for periods of 1-2 mins. only to avoid excess field current and disconnect all load)**

1. Check correct transformer tap to suit alternator sensing for three phase or single phase operation.
2. Check all leads to regulator are secure.
3. Check D1, D2 terminals are bridged or connected to correct burden resistor-as for parallel operation.
4. Check printed circuit board for fractured track or loose component.
5. Check transformer secondary voltage at BI 32 volts AC plus or minus 2 volts.
6. Check DC output voltage across CI  
39 volts DC plus or minus 1 volt.
7. Check transistor TR2 for open circuit.
8. Check D5 for short circuit.

#### Fault

**Low Voltage**  
50V AC

#### Diagnose

1. Check correct transformer tap to suit alternator sensing for three phase or single phase operation.
2. Check all leads to regulator are secure.
3. Check PP terminals are bridged or connected to correct 5K external potentiometer.
4. Check printed circuit board for fractured track or loose component.
5. Check for short circuit flywheel diode 04 across F+ F-.
6. Check for short circuit or open circuit main thyristor D5.
7. Check residual voltage and repolarise if necessary as per "repolarisation" procedure.  
(Note: Residual ranges from 10-50V AC approx.)
8. Check transistor TR2 for short circuit.
9. Check SCOOP operation.

#### Fault

**Continually losing voltage output.**

#### Diagnose

1. Check all leads are secure.
2. Check SCOOP setting as per SCOOP adjustment procedure.
3. Ensure that alternator is not overloaded.
4. Check that engine speed is constant.

#### Fault

**Unstable voltage.**

#### Diagnose

1. Check all leads are secure.
2. Check stability potentiometer as per stability adjustment procedure.
3. Check transistor TR1 for open or short circuit.
4. Check diode D1 for open or short circuit.
5. Check printed circuit board for fractured track or loose component.

Note: If unable to find fault, return to Dunlite for repairs, with brief history of type of failure.

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#### **Mains Check of the UVR100**

Connect the UVR100 for 240 volt single phase operation.

Connect a 40 watt globe between F+ F-.

Bridge out terminals D1,D2 and PP separately.

Set voltage control potentiometer RV1 fully anti-clockwise.

Connect the N and U terminals to the neutral of the mains.

Connect the V and W terminals to the active of the mains via a 1 amp fuse.

Switch on the mains.

The 40 watt globe should not illuminate.

Turn the potentiometer RV1 fully clockwise and the globe should illuminate.

At the same time the red SCOOP indicator LED will also illuminate.

After a period of 15-20 seconds, the 40 watt globe will turn off.

Switch mains off immediately after globe turns off otherwise damage will occur to SCOOP circuit.

Under these conditions the UVR100 is functioning correctly.