clover systems

DR310™

Electronic Dynamo Regulator

INSTRUCTION MANUAL

INTRODUCTION

The Clover Systems DR310 is an all-electronic voltage and current regulator for dynamos used in vintage cars, trucks, tractors, motorcycles, and boats.

It is designed to be used with Lucas dynamos, although it can work with other dynamos as well.

Figure 1 – With Lucas Cover

INSTALLATION

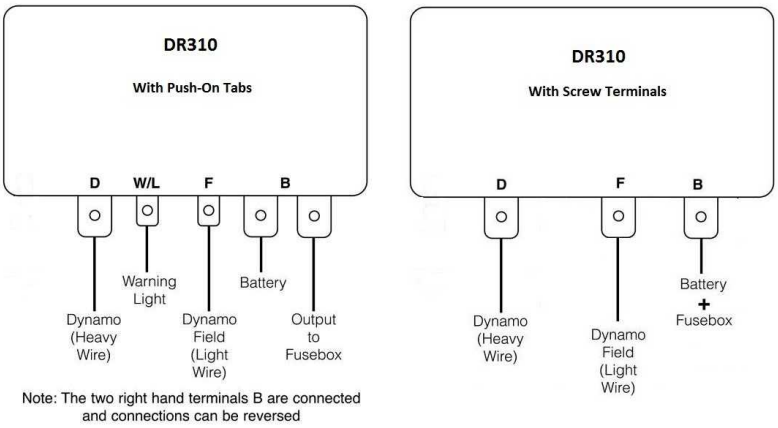

Figure 2 - Connections

1) First, be sure that you have the correct model DR310 for your vehicle (Positive or Negative Earth, 6 or 12 volts, and correct current limit to match your dynamo). Although DR310 is protected against most every possible problem, it is possible to damage the unit and/or your generator if for instance, the battery is hooked up backward (see below).

2) You should make sure that the dynamo is in good working order before installing the new regulator. If there is a problem with the dynamo, the regulator could be damaged.

   If you are installing a new generator, or your existing one is in unknown condition, you can perform some simple tests to verify that it is workable:

   a. With an ohm-meter, you should measure resistance of ~ 2 ohms from terminal D to ground. If the resistance is infinite, then either the wire

from D to the generator is not connected, or the generator's armature is open.

b. Similarly, you should measure resistance of ~ 5-6 ohms from terminal F to ground. Infinite resistance indicates the wire from terminal F to the generator's field coil is not connected, or the field coils are open. A low resistance indicates partial shorting of the field coils to ground.

3) Disconnect the battery ground cable to prevent any mishaps.

4) Next, label all wires connected to your existing regulator. If you do not already have a regulator connected, you may need to trace the wires to see exactly where they go.

5) Wire Connections:

a) For DR310 with screw terminals, the connectors are labeled D (Dynamo Armature), F (Field Coil), and B (Battery).

b) For DR310 with Lucar Tabs, the terminals are (left to right, viewed from the front) D (Dynamo Armature), WL (Warning Light), F (Field Coil), B (Battery1), and B (Battery2). The two B terminals are connected together. One goes to the battery, and the other goes to the vehicle's ignition switch and lights. Since they are connected together, it doesn't matter which wire goes on which terminal.

The WL terminal is connected directly to the D terminal. If your vehicle doesn't have a warning light connection, it can be left open. On the Lucas regulator, the WL terminal is to the left of the D terminal, but on ours, it is to the right.

6) The DR310 (like the Lucas RB 310) is grounded to the chassis via the right-hand mounting bolt.

Warning: Be sure that the right hand mounting bolt is making good connection to the chassis. Ideally, you should check the connection with an ohmmeter. If the DR310 is not grounded, the dynamo output will not be properly regulated and the regulator could be damaged.

7) Attach the wires to the DR310, and mount the DR310 using the three stainless steel hex cap screws provided.

8) Reconnect the battery ground. If there is excessive sparking, there may be a wiring mistake.

9) If everything seems to be in order, start the engine and observe the ammeter and ignition warning light. If everything is working correctly, the warning light should go out at around 900 RPM (depending on

generator model and condition). You should also be able to see charging of the battery on the ammeter.

10) If there is no output from the generator, and it passed the above tests, see the troubleshooting section in the appendix.

11) Installing the cover. DR310 does not include the Lucas cover. You can however, use your existing cover, or find a used one. There are two styles of RB 310 cover: One has a flange and is held by two short screws. The other has no flange and is held by two long screws. In the case of the cover with the flange, use the two #8-32 machine screws included. If yours uses the long screws, you will have to use your original screws. DR310 has mounting holes for both styles of cover.

12) DR310 with screw terminals comes with the screws and wire clamps, but you can also use your originals if you prefer.

Figure 3- DR310 with Lucar Tabs

Caution

Although the DR310 is protected against most everything that can go wrong, there are some things that can damage the DR310 and/or your dynamo:

1) Connecting the battery backward. Be sure that you have the correct polarity regulator. If there is any doubt, check the battery connections to see which battery terminal is connected to the vehicle's chassis.

2) Reversing the D and B wires will create a direct path from the battery to the dynamo's armature, which could damage your dynamo.

3) If the F wire is shorted to the D wire (dynamo armature), the dynamo will run at full output without any voltage or current limiting. Lucas RB310 regulators with Lucar tabs and wiring are made so that you cannot connect the F wire to the WL terminal (which is connected to the D terminal). We have copied this scheme, but if your wiring is not original, it may be possible to accidentally connect the F wire to the WL terminal.

4) If the DR310 is not connected to chassis ground with the right-hand mounting bolt, the regulator will not work properly.

TESTING & CALIBRATION

The DR310 voltage and current limits are set at the factory to match your dynamo, so normally, no adjustment is required. Test and calibration results are printed at the back of this manual. You may however, wish to confirm that everything is working properly, or change the settings to accommodate your needs.

Both voltage and current limit are user adjustable. In the standard configuration, Voltage limit is adjustable from 5v to 17v, and current limit is adjustable from 7A to 30A. In other configurations, current limit can be up to 55A.

Adjustment to the voltage or current limit must be carried out on the car. For these adjustments, you will need an analog moving-coil voltmeter (0-20V) and/or analog moving-coil ammeter (0-40A) plus a very small flat-blade screwdriver.

Note: Use only analog moving-coil voltage and current meters for these tests. Digital meters may or may not read correctly because of rapid variations and noise in the dynamo output.

Voltage Limit Test (open circuit):

1) Remove the die-cast cover by removing the three screws from the back of the unit:

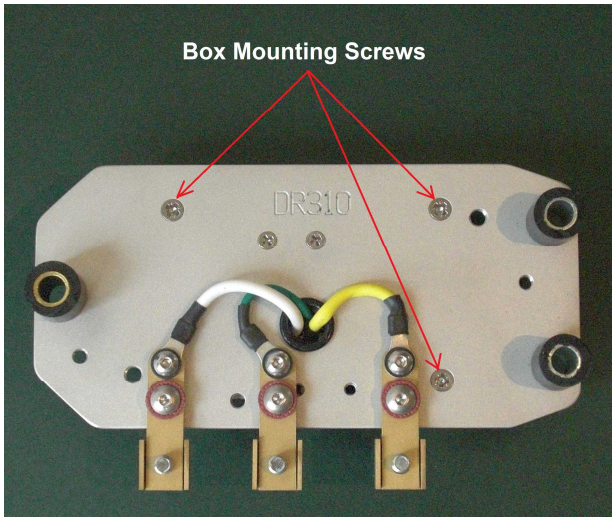

Figure 4 - Cover Mounting Screws

2) Remove both wires from the B terminals, and connect them together with a clip lead. This will provide power from the battery to the vehicles electrical system so the engine can run.

3) Connect an analog voltmeter capable of measuring 0-20 volts between the B terminal of the regulator and ground.

4) Now start the engine. As you increase the engine speed, you should see an increase in the voltage on the meter. Run up the engine speed, and you should see the voltage rise with engine RPM, until it reaches it's preset limit (See the *Final Test* Sheet at the end of this manual for the proper voltage).

5) If necessary, adjust the voltage limit control to get the desired output voltage limit. Turn the pot clockwise to increase the limit, and counter-clockwise to lower the voltage limit. You should be able to reach the voltage limit at no more than 3000 or 4000 RPM.

6) When finished, remove the voltmeter and re-attach the wires to the B terminals.

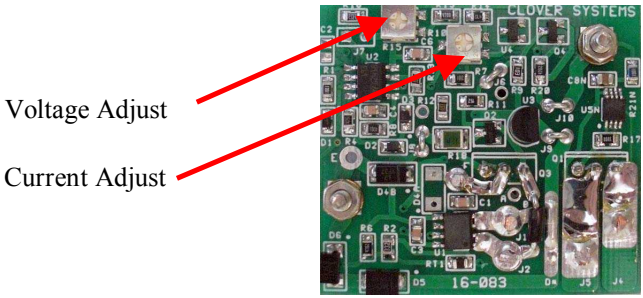

Figure 5 – Location of Pots

The correct voltage limit also depends on they type of battery. The requirements for "flooded" type batteries, where you can add water are different than for sealed, "Maintenance Free" batteries, also known as VRLA, AGM, or Gel batteries, which require a lower charging voltage. The chart below shows optimal settings for the two types of batteries, depending on the battery temperature. For 6v applications, divide by 2.

We normally set the voltage at 14.4V at 25°C for 12v dynamos, and 7.2v for 6v dynamos, which is safe for all batteries. Since there are many types and models of batteries, you may wish to consult the battery specs for the optimum charging voltage.

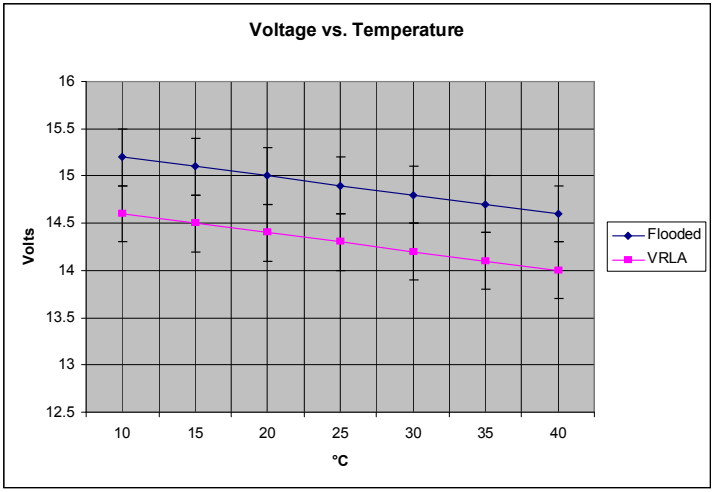

Figure 6 - Voltage vs. Temperature

If the car has been running with substantial electrical load, the regulator will be hotter than ambient temperature. Therefore, it is best to perform the test with the regulator at ambient temperature.

Current Limit Test:

1) With the two B wires disconnected from the DR310, and connected together, connect a 0-40A ammeter between the B terminal of the regulator and the two B wires connected together. If your vehicle is negative ground, then connect the + terminal of the ammeter to the B terminal of the regulator, and the – terminal of the ammeter to the two wires. For positive ground, reverse these connections.

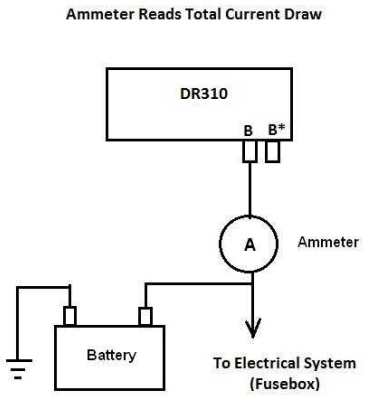

Figure 7 - Ammeter Hookup

2) Start the engine and turn on all loads such as headlights, fans, etc. As you increase the engine RPM, you should see the current flow increase until it reaches the preset limit. You may need to add additional loads to reach the desired limit.

3) Turning clockwise increases the limit, and counter-clockwise decreases the limit.

4) When finished, remove the ammeter and re-attach the wires to the B terminals.

Warning: Do not adjust the current limit higher than the rated output of your dynamo, as this may overload the generator and reduce it's life.

Warning: The adjustment pots are made from soft plastic, so be careful not to exert too much force with the screwdriver, as the slots may be damaged.

Note: Typically, the ammeter in your vehicle only measures current to and from the battery. It does not measure the total output of the generator, which could be more. To measure total generator output, you need to connect an ammeter as described above.

APPENDIX

How the regulator works

All generators work by rotating a loop of wire in a magnetic field. In a dynamo, the magnetic field is created by electromagnets (field coils). Voltage and current are controlled by controlling the current to the field coils. The current through the field coils determines the strength of the magnetic field that the armature rotates in, and thus the output of the generator.

In the DR310, the output voltage of the generator is compared to a precision voltage reference. When the generator output exceeds this reference, the current to the field coils is cut off. This causes the generator output to fall. When the output falls below the reference voltage, the field current is turned back on. In this way, the field current is modulated at a rate of 50 – 125 Hz. These rapid changes are smoothed out by the inductance of the field coils, thus maintaining a constant output voltage.

Current limiting is accomplished in the same way. Output current is sensed with a Hall-Effect device that detects the magnetic field created by the output current. When the output current exceeds a preset limit, the field current is turned off. Just as with the voltage regulation, the field current is modulated to maintain a constant output current.

Instead of a cut-out relay, DR310 uses a MOSFET "ideal diode", which is much more efficient than Schottky diodes. Power is supplied whenever the dynamo output voltage is greater than the battery voltage, rather than a pre-set voltage as in the mechanical regulator.

A-Circuit and B-Circuit

There are two types of shunt-wound dynamos: A and B. The only difference is in the way that the field coils are wired. In an A-circuit dynamo, one end of the field coils is internally connected to the dynamo output. In a B-circuit dynamo, one end of the field coils is internally connected to ground. So in the B-circuit case, the regulator supplies current to the field coils, and in the A-circuit, the regulator sinks current.

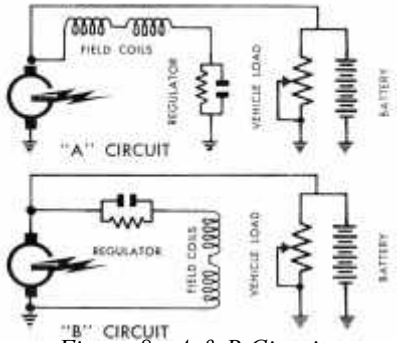

Figure 8 - A & B Circuits

Autolite, Bosch, and Delco generators used on automobiles are A-Circuit. Ford and Lucas generators are B-Circuit. There are some exceptions to this rule (for instance Autolite and Delco "Heavy Duty" generators), so it's always good to check.

How to polarize a new generator

Your generator only needs to be polarized if it is new, has been rebuilt, or you have changed ground polarity. A generator that has already been working does not need to be polarized.

A dynamo uses electromagnets to generate the magnetic field for the armature to rotate in. But when starting up, there is no field current to create this magnetic field. In order to get the process started, some permanent magnetism is required to provide this field. This is provided by iron pole pieces that can be permanently magnetized.

Magnetizing the pole pieces is easy, but is different for A-circuit and B-circuit dynamos. In both cases, first disconnect all wires to the regulator.

B-Circuit: While the car is not running, connect a lead from the battery to the dynamo's field coil terminal for one or two seconds. *Connecting them for a long period could overheat and damage the field coils.*

A-Circuit: Disconnect the output wire from the dynamo (usually labeled D or A). Then connect the field terminal of the dynamo (usually labeled F) to ground with a jumper lead. Now using another jumper lead, briefly connect the battery output to the dynamo output for a second. *Connecting them for a long period could overheat and damage the dynamo.*

The pole pieces will now be permanently magnetized, and the dynamo will start up. If the dynamo is properly polarized, it will produce ~3 volts with the field coils disconnected.

Troubleshooting

In case there is no output from the dynamo, check the following:

1) D connector is not connected to the dynamo output terminal
2) F connector is not connected to the dynamo field terminal
3) DR310 is not grounded via right hand mounting bolt
4) Dynamo armature is shorted or open
5) Dynamo field coils are shorted or open
6) D, F, or WL are shorted to ground
7) Dynamo is not polarized
8) Regulator is not the correct A or B circuit model

Service

If you need service or have questions, you can contact us at +1 949-598-0700 or support@cloversystems.com.

Warranty

All Clover Systems products are guaranteed against original defects for one year. Any products returned within the warranty period will be repaired or replaced at no charge except for return shipping.

DR310 FINAL TEST

SERIAL NO. _____

☐ Voltage Cal ☐ Negative Ground ☐ A-Circuit

☐ Current Cal ☐ Positive Ground ☐ B-Circuit

☐ Burn-In ☐ Mounting Hdwr ☐ Cover Hdwr

☐ Lucar Tabs ☐ Screw Terminals

CALIBRATION

Open Circuit Voltage Limit _____ V

Current Limit _____ A

☐ TEST COMPLETED ☐ READY FOR SHIPPING

CHECKED BY: _____ DATE: _____