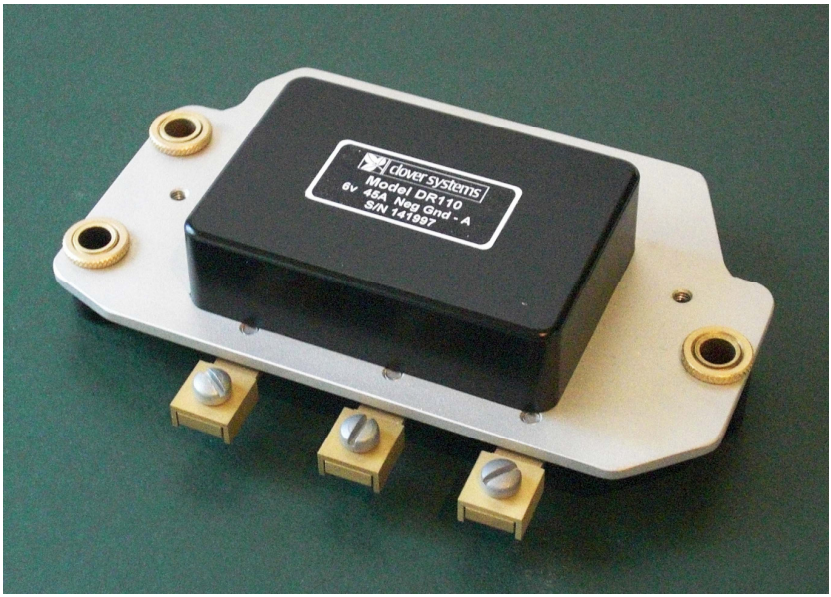
clover systems

DR110™



Electronic Dynamo Regulator

INSTRUCTION MANUAL

INTRODUCTION

The Clover Systems DR110 is an all-electronic voltage and current regulator for DC generators used in vintage cars, trucks, motorcycles, tractors and boats. This regulator never requires cleaning or adjustment, and will be trouble-free for the life of your vehicle. It is more efficient than mechanical regulators, and is impervious to shock and vibration,

Figure 1 – With Delco Cover

INSTALLATION

1) First, be sure that you have the correct model DR110 for your vehicle (Positive or Negative Earth, 6, 12, or 24 volts, A-circuit or B-circuit and correct current limit to match your dynamo). Although DR110 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.

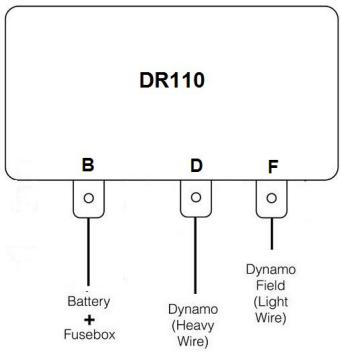


Figure 2 - Connections

   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: The connectors are labeled D (Dynamo Armature), F (Field Coil), and B (Battery). Attach the wires to the DR110, and mount the DR110 using the three stainless steel machine screws provided.

6) The DR110 is grounded to the chassis via the brass mounting spacers. Be sure that a good ground connection is obtained, as the regulator will not function properly if it is not grounded.

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

8) 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 800 RPM (depending on generator model). You should also be able to see charging of the battery on the ammeter.

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

10) Installing the cover: DR110 does not include the Delco/Autolite/Bosch/Ford metal cover. You can however, use your existing cover, or find a used one. The original cover screws are sheet metal screws. Do not use these; use the included #8 machine screws instead. Some aftermarket covers have different dimensions from the original covers and may require new holes.

Caution

Although the DR110 is protected against most everything that can go wrong, there are some things that can damage the DR110 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) *A-circuit regulators (Autolite, Bosch, Delco)*: If the F wire is shorted to ground, the dynamo will run at full output without any voltage or current limiting. As a result, your dynamo and wiring could be damaged.

   B-circuit regulators (Ford & Lucas): 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.

4) If the ground wire is not connected to the regulator, the regulator will not function correctly. The regulator ground is connected to the back plate, and then to the vehicle's chassis via the brass mounting spacer.

5) *Note on Mounting:* Mechanical regulators are typically mounted on rubber bushings to provide some isolation from vibration and shock, but since DR110 is immune to vibration and shock, the regulator can be rigidly mounted.

TESTING & CALIBRATION

The DR110 voltage and current limits are set at the factory to match your dynamo, and normally, no adjustment is required. 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. Voltage can be adjusted from 5v to 17v, and the current limit is adjustable from 7A to 30A. The HP version is adjustable 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 (0-50A) plus a very small flat-blade screwdriver.

Note: Use only analog moving-coil voltage and current meters for these tests. Digital meters will 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:

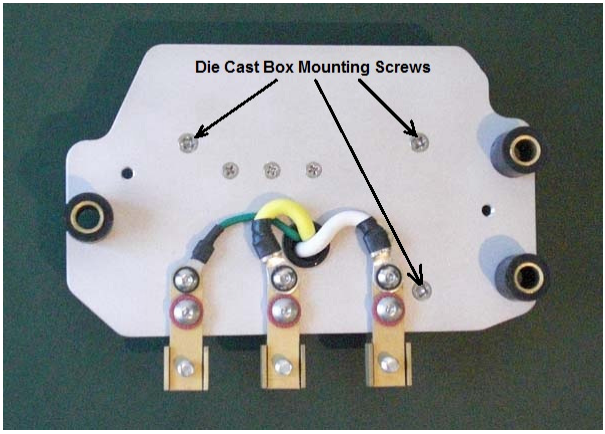


Figure 3 - Cover Mounting Screws

2) Remove the wires from the B terminal. If there is more than one, connect them together with a clip lead. This will provide power from the battery to the vehicle's 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.

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

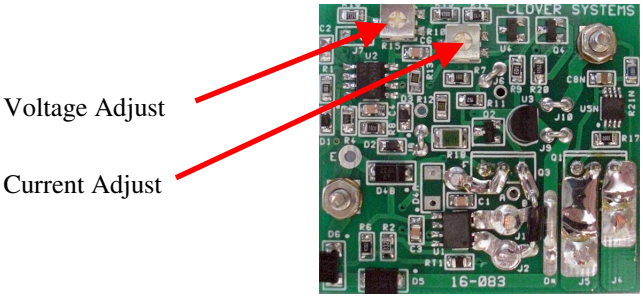


Figure 4 – Location of Pots

The correct voltage limit also depends on they type of your 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 14.3V 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.

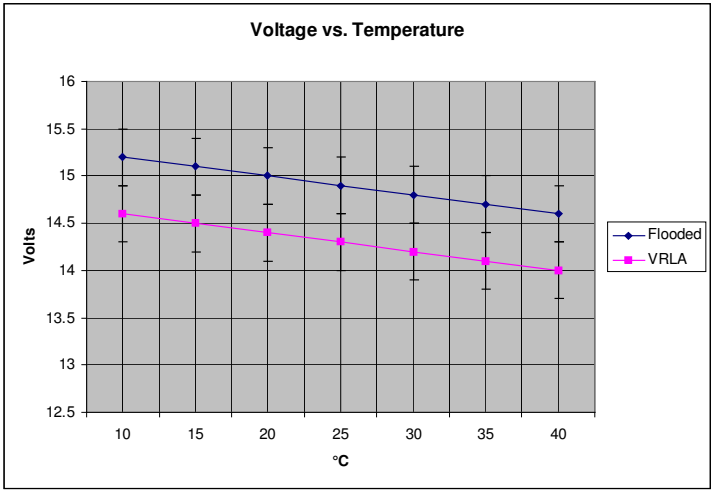


Figure 5 - Voltage vs. Temperature

If the car has been running with substantial electrical load, the regulator may 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 DR110, and connected together, connect a 0-50A 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.

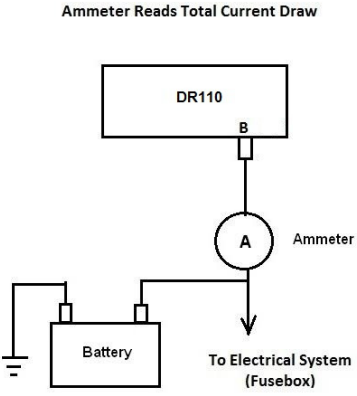


Figure 6 - Ammeter Hookup

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 the pot 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.

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 adjusting 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 DR110, 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 and armature, 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, DR110 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 from the field coils.

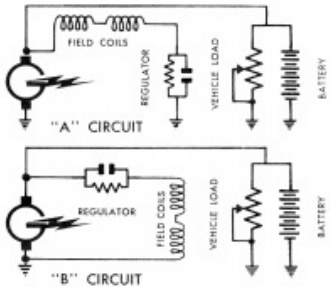


Figure 7 - A and B circuits

Ford and Lucas dynamos are B-circuit. Autolite, Bosch, and Delco standard generators used on autos are generally A-circuit, but there are some exceptions.

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. Also, the Clover Systems regulator does not need to be polarized, as there are no magnetic components.

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:

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 terminal is not connected to the dynamo output terminal
2) F terminal is not connected to the dynamo field terminal
3) Backplate is not connected to ground
4) Dynamo armature is shorted or open
5) Dynamo field coils are shorted or open
6) D, or F 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.