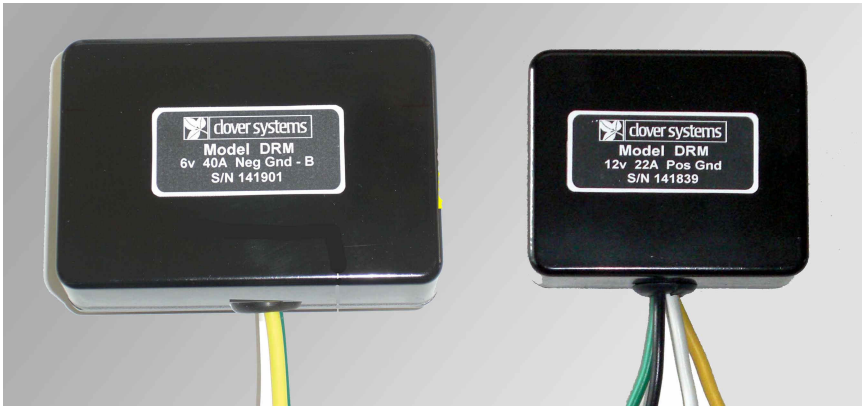
clover systems

DRM™

DRM-HP™



Electronic Dynamo Regulator

INSTRUCTION MANUAL

INTRODUCTION

The Clover Systems DRM is a state-of-the art all-electronic voltage and current regulator for dynamos[1] used in vintage cars, trucks, motorcycles, tractors and boats. DRM comes in two sizes: The standard DRM has dimensions of 2.4″ x 2.2″ x 1.2″ (60mm x 55mm x 31mm), and controls dynamos up to 30A. For higher currents up to 55A, DRM-HP comes in a slightly larger case: 3.2″ x 2.2″ x 1.0″ (80mm x 55mm x 25mm).

Figure 1 - DRM

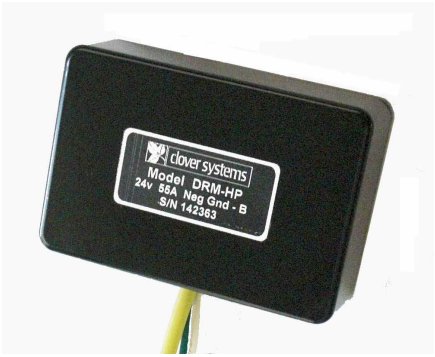


Figure 2- DRM-HP

APLICATIONS

DRM can be used to upgrade or replace most any mechanical regulator made for DC generators. It can be used as is, or mounted inside the case of an original mechanical regulator.

INSTALLATION

1) First, be sure that you have the correct model DRM 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 DRM 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) Disconnect the battery at the ground cable to prevent any mishaps.

3) 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.

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[1] A Dynamo is a type of DC generator that uses electromagnets to generate the magnetic field, and is self-energizing.

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.

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 DRM wires are:

DRM Wire	Goes To:
Black	Earth
Yellow	Dynamo Output
Green	Dynamo Field Coil
White	Battery and Ignition

6) If you have an Ignition Warning Light, connect it to the Yellow wire (Dynamo Output).

7) In some cases, the output (white wire) will go through fuses, or a fuse box.

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

Mounting

You will need to devise a means of mounting the DRM. One solution is to mount it inside the original regulator case. This will require removing the mechanical relays and connections. Also be sure to remove the wire-wound resistors that are typically mounted on the back of the regulator.

You can use two or more of the four screws holding the DRM cover in place to mount it.

IMPORTANT --- The DRM cover mounting screws are metric: M3.5.

Alternatively, you can drill additional holes in the DRM cover for mounting. Just be sure that your mounting screws don't interfere with the circuitry.

WARNING --- The DRM cover must be installed, as it provides heat sinking for the power transistors.

Here are some examples of installation in an original regulator housing:

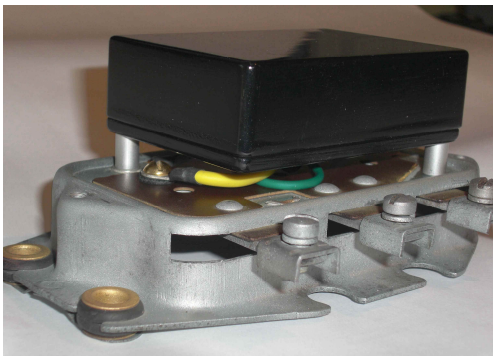

Figure 3 - RB 310 Installation

Figure 4 - RB 106 Installation

In the left photo, the DRM is mounted on two M3.5 x 25mm screws with 3/8" spacers. For regulators with current limit greater than 30A, be sure to keep the yellow and white wires as short as possible.

TESTING

1) If there is no output from the generator, and it passed the above tests, it may need to be polarized. A new generator may have no residual magnetization of the field pole pieces. In this case, no voltage will be generated. See the appendix for instructions.

2) 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). You should also be able to see charging of the battery on the ammeter.

Caution

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

1) If the ground (black) wire is not connected to ground, the regulator will not work properly. The regulator ground is connected to the case, but the case may be insulated from the chassis ground. Therefore, the black wire must be connected to ground (usually the chassis).

2) 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.

3) Reversing the Yellow and White wires will create a direct path from the battery to the dynamo's armature, which could damage your dynamo.

4) *B-circuit regulators*: If the Green wire is shorted to the Yellow wire (dynamo armature), the dynamo will run at full output without any voltage or current limiting.
A-circuit regulators: If the Green 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.

CALIBRATION

The DRM 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. Variations in field coil impedance, resistance of the wiring, and other factors can affect the calibration, so, for most accurate results, adjustments should be made on the vehicle.

Both voltage and current limit are user adjustable, but within limits. In the standard configuration, voltage limit is adjustable from 5 to 16V. and the current limit is adjustable from 7A to 30A. DRM-HP is adjustable 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 all connections to the White wire, but make sure that the ignition circuit is connected to the battery so that the engine can be run.

2) Connect an analog voltmeter capable of measuring 0-20 volts between the Yellow wire and ground. 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).

3) Now 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.

4) When finished, remove the voltmeter and re-attach the battery and ignitions wires to the DRM white wire.

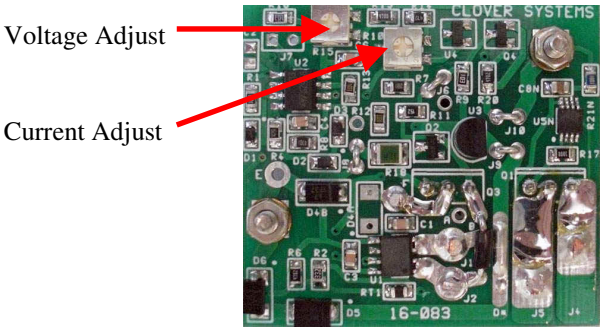

Figure 5- Location of Pots

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.

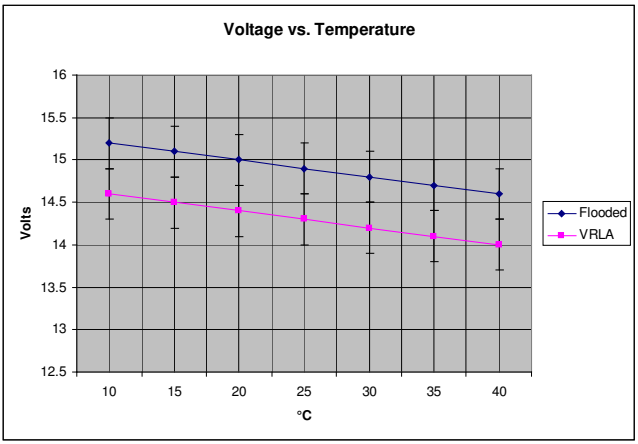

Figure 6 - Voltage vs. Temperature

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.

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.

Current Limit Test:

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

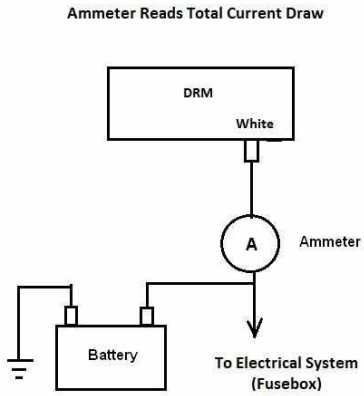

Figure 7 - Ammeter Hookup

2) Start the engine and turn on all loads such as headlights, 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) Now you can turn the potentiometer to adjust the current limit. Turning clockwise increases the limit, and counter-clockwise decreases the limit.

4) When finished, remove the ammeter and re-attach the battery and ignition wires to the DRM white wire.

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 typically is more. To measure total generator output, you need to connect an ammeter as described above.

. 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

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 DRM, 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, DRM 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.

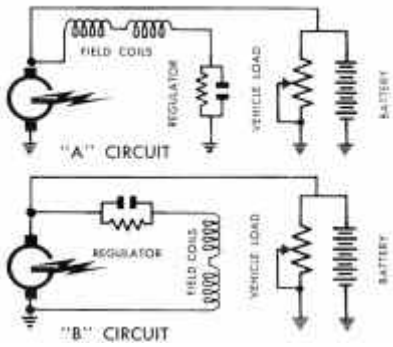

Figure 8 - A & B Circuits

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:

B-Circuit: While the car is not running, connect a lead from the battery (or white wire of the regulator) to the dynamo's field coil terminal (or the green wire) 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.*

Troubleshooting

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

1) Yellow wire is not connected to the dynamo output terminal
2) Green wire is not connected to the dynamo field terminal
3) Black wire is not connected to ground
4) Dynamo armature is shorted or open
5) Dynamo field coils are shorted or open
6) Yellow or Green wires 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.

DRM FINAL TEST

SERIAL NO. _____

☐ Voltage Cal ☐ Negative Ground ☐ Threadlocker

☐ Current Cal ☐ Positive Ground ☐ Side Exit

☐ A-Circuit ☐ Burn-In ☐ Bottom Exit

☐ B-Circuit

CALIBRATION

Open Circuit Voltage Limit _____ V

Current Limit _____ A

☐ TEST COMPLETED ☐ READY FOR SHIPPING

CHECKED BY: _____ DATE: _____