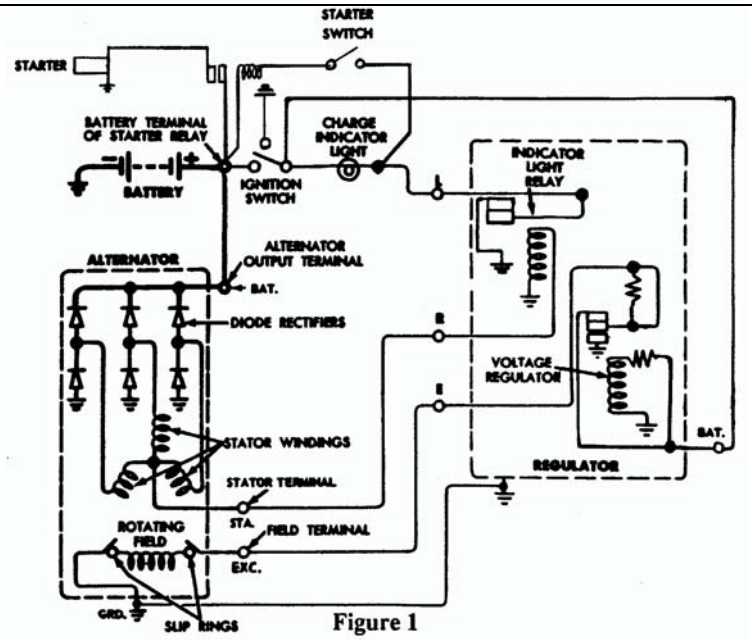
**Hiding a Ford Regulator in an Alternator Equipped Citroen D's and SM's**

By Mark L. Bardenwerper, Sr. January 3, 2007

Many of us have replaced the Ducellier voltage regulators on our alternator equipped Citroen D and SM models with electronic Ford regulators. The original voltage regulators have long ago passed their life expectancy and new ones are very difficult to find. Lights flicker and change intensity with shortened bulb life. Our batteries risk damage from overcharging. In 1985, John Titus wrote the definitive article on this subject in the Hollywood, California Citroen Club newsletter. In it he described how to install an electronic Ford voltage regulator such as NAPA part #MPEVR440SB to stabilize system voltage. Figure 1, from that article, shows the electrical circuit for the original system. Figure 2 shows the Ford regulator in place. This system works well. However, it uses a different method of controlling the charge indicator light. Instead of using a relay to disconnect the ground for the charge indicator lamp, it uses a current differential. This can cause charge light flicker.




First drawing from John Titus article showing the original circuitry used on alternator equipped D's. SM's should be similar. Besides controlling the charge indicator, the starter switch ground is attached to the L terminal of the regulator. When the engine is running, the points open, turning off the charge light and disabling the starter.

This same relay also disables the starter after the engine is running on some cars. The starter inhibitor feature must be bypassed in order to use the Ford regulator unless an extra relay is installed. To restore this function, Citroen owner and electronics expert Don Bennett has successfully added a relay and a resistor. I decided to go this one better and use the existing relay, which is already voltage matched to the system. This would not only make it unnecessary to modify the starter wiring, but it would also retain the original charge light function. I also didn't want to see an ugly, squat, silver Ford regulator where the tall black original once was. With a little measuring, I decided that it might be possible to hide the Ford voltage regulator inside the existing regulator and retain all of the original functions, with no further modifications.

I had the original Ducellier voltage regulator in my parts bin from my car. A used replacement was working no better. I first removed the cover of the old Citroen regulator, noting that when the three terminals faced me, the left-hand relay was the cutout relay and the right-hand one was the actual voltage regulator. I removed the right hand relay, which was held in place by a long machine screw and a few solder joints. Underneath were 2 wire wound resistors. These I simply cut off. I discovered that, with the regulator relay removed, the "EXC" terminal lost its support. I fixed this by applying some epoxy to steady it.

I was now ready to disassemble the Ford regulator. It was way too large to fit inside the Ducellier box unless stripped to the essential circuit board. I drilled out the rivets that attached the cover, then one that held the output transistor to the base. I then desoldered the electronics board from the terminal lugs. This had to be done carefully to avoid damaging the very fragile transistor and the printed circuit contacts. The board then was free from the base. I found that it just fit under the Ducellier cover if I turned it 90 degrees and tilted it so the solder points pointing to the right and the power transistor was at the left rear.


As purchased from the auto parts store, the replacement regulator was far too large to fit inside the Ducellier regulator can. The circuit board was a perfect fit, but all of its metal surroundings had to be removed.

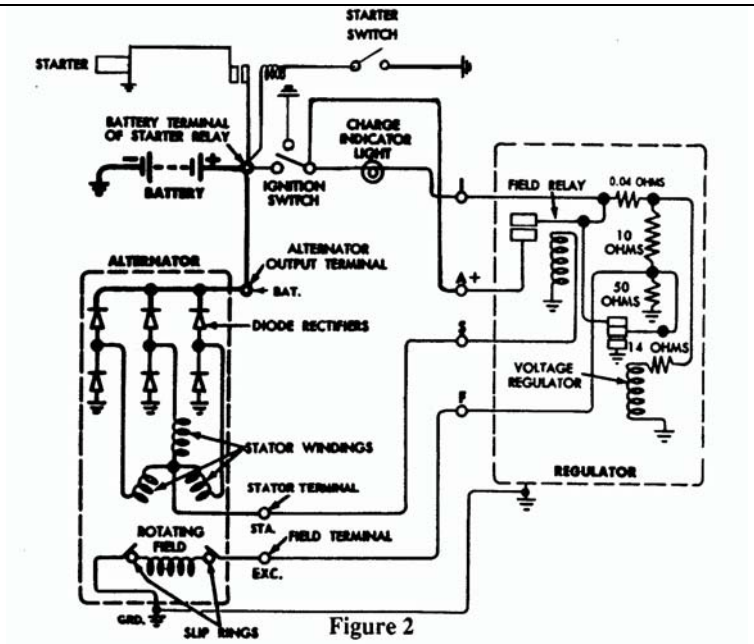



Figure 2 from John Tutus' article with the Ford regulator grafted in. Note the starter switch ground has been moved. This disables the starter inhibitor circuit. This change is not needed on all cars.

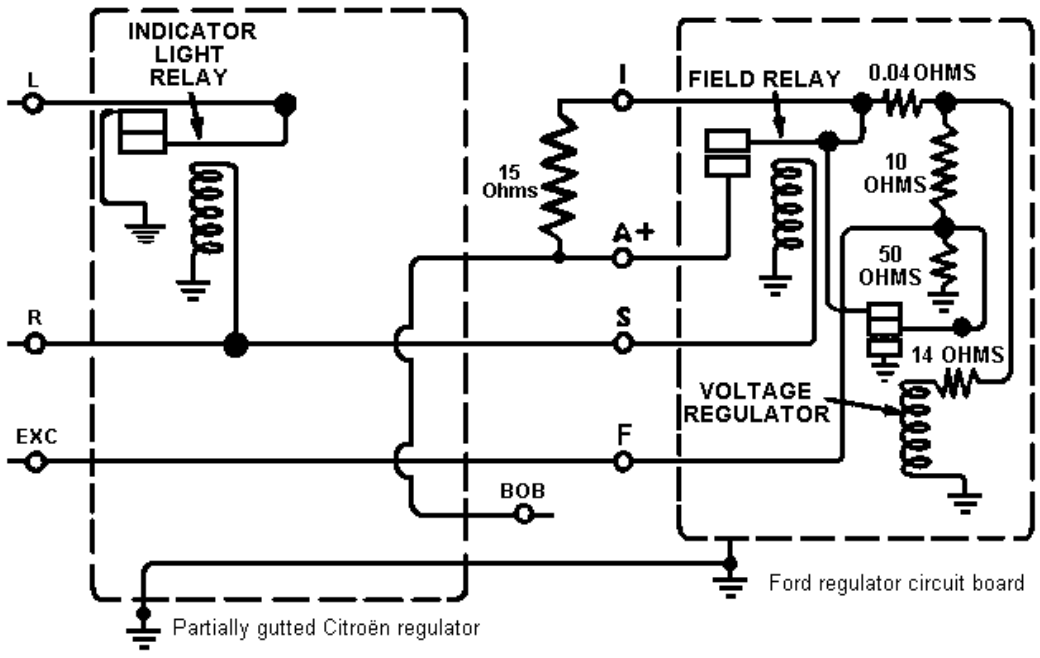
A few more details had to be worked out. First, the Ford regulator used the original base as a heat sink for the power transistor. Without a way for the heat from this transistor to dissipate, it would rapidly die. The solution was to pop rivet a copper strip to attach the transistor to the base of the old regulator, copper being an excellent conductor of heat. Luckily there was a rivet filling a hole which grounded the cutout relay exactly where it needed to be. I drilled it out and used a small bolt to attach the copper strip and the ground wire. Now the heat could travel down the copper strip through the regulator base. I added another tab of copper strip underneath for good measure. The thin strip attached to the heat sink bent readily to allow access to the bottom of the circuit board.

I then soldered all of the jumpers in place, leaving them long enough to allow me to press the board down to the proper angle for final attachment. First I tried a cardboard square, which you will see in my pictures. However, this proved not to be durable, though I tried various types of glue. The final solution there was to use a square of thin styrene plastic cut from the bottom of a small discarded box. High temperature silicone glue worked the best. It has not lost its grip since I fitted it. Again, I did not make this final attachment until all of the wiring was done.

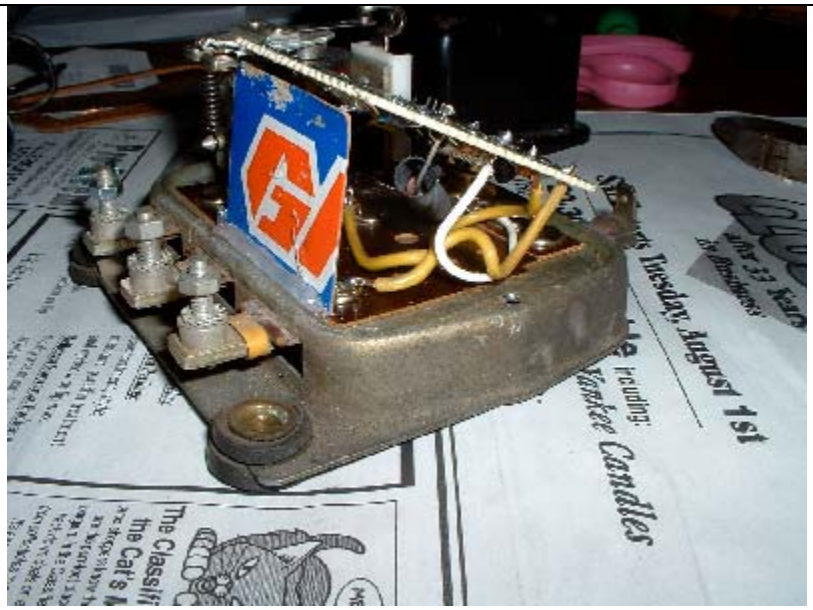
My first attempt at getting the regulator to work failed. The charge light on the dash stayed on and the alternator would not charge the battery. I had originally thought that the Ford regulator didn't need anything attached to the terminals that ran the charge light. I was wrong about this. The Ford voltage regulator actually uses the indicator light current to close a relay that supplies the full field current to the alternator (which is why the Ford regulator can wired directly to the battery rather than to the ignition switch). Bypassing the indicator light terminal on the Ford regulator prevented the alternator from receiving field current from the regulator.

In John Titus' article, he stated that the Ford voltage regulator, if mounted on a Citroen, needed to see a voltage coming from the charge light circuit to operate, but a backup circuit could be installed so that, should the light bulb fail, the charging system would still operate. Because I was not using the Ford regulator to operate the charge indicator light, I needed to add another jumper from the original "BOB" terminal to the "A+" on the board and a 15 ohm resistor from "BOB" to the "I" solder point. This time, it worked.

The regulator in my car is visually indistinguishable from the original, except for the screws that replace the rivets that hold the cover on. I have driven the car several hundred miles with and without lights and wipers and have not had any trouble. I did bring my old regulator along on my first few trips, particularly when I drove it all the way from Wisconsin to Detroit, Michigan for the 2006 Citroen Club of North America Fall Meet. Now it is in my spare parts bin and my battery charges a nice smooth 14.5 volts with no more flickering lights!




Circuitry for Ford regulator grafted to original Ducellier base, retaining the original cutout relay. The wiring and 15 ohm resistor fit under the board. In practice, the Ford board is turned so the circuitry points down. Solder connections at BOB and all others are all made internally on the appropriate rivet heads. This diagram shows the power transistor figuratively as a set of points.

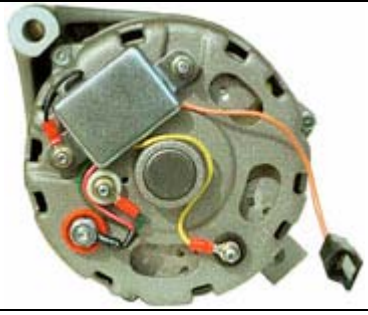



Nearly completed regulator conversion. The original terminal closest to you is epoxied in place underneath to keep it from turning. The cardboard was later replaced with a piece of thin styrene plastic sheet. Cover just fits over, with original rivets replaced by 2 sheet metal screws. The original cork gasket needed to be trimmed a little, but still seals the box just fine. Note the resistor has a shrink tube over it to protect it from short circuit. This may not be necessary, and could possibly prevent it from dissipating heat. I will leave this off if I make another.


The terminal coming off the back is the BOB terminal. Note the copper strip, pop riveted to the transistor heat sink. You can just see the screw that holds it to the base, with the relay ground. Solder joints are made at the shiny tops of rivets on the old regulator, which are insulated, yet provide electrical path to the terminals. Note extra black ground wire soldered to the relay and the board. I didn't trust the rivet, even though I wiped some dielectric grease on it to prevent corrosion. All external connections are identical to the originals in function. Once the cover is on, it is impossible to see the update.

Just after finishing this article, I came upon a product that could make this entire process much easier. Several web sites are selling a device that is designed to mount on the rear of a Ford alternator to convert it to one wire

operation. That is, it is a miniaturized voltage regulator! I found at least 2 sites that sell them. One is AMK Products (amkproducts.com), the other, Falcon Parts (falconparts.com). I haven't done any more research, but this little box should fit inside the Citroen regulator with room to spare. They cost $30-35.00.



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