

Positive to Negative Ground Conversion

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Introduction

Many older British cars (Spridgets included) had positive ground electrical systems. While leaving the car as a positive ground isn't an issue (some believe that it can decrease rust and corrosion) converting to negative ground is a fairly simple (and reversible process) that allows you to install modern electronics.

Why you want to consider doing this?

As stated above, it's all about the fact that almost all modern cars function on a 12 volt negative ground system. Consequently, if you want to install any accessories, you'll need to either find what you want in a positive ground configuration (believe it or not, you can still do this), isolate the accessory (easier said than done) or convert the entire car to positive ground. (Note: a section on proper isolation of accessories follows this document).

Some common accessories you might wish to add include:

1. Radio – probably the most common accessory added. While you can still find positive ground radios (eBay is a ready source), they tend to be older units, with few features. Radios from the 1950s and 1960s tend to be AM only and not FM. The higher end units may include some of the short-wave bands.

If you want to have some of the modern conveniences (CD-ROM, MP3 play capability, etc.) you really should convert to negative ground.

2. Electrical Fuel Pump – most everyone has a fuel pump disaster story. Early Sprites were fitted with a mechanical fuel pump which had a small lever operating off the camshaft that manipulated a rubber diaphragm. These units tended to be unreliable. They were prone to leaks, the diaphragm could easily be damaged, and the operating lever and its associated spring were vulnerable to wear. Even during the 1960's many Spridget owners removed these fuel pumps and fitted electrical units (typically SU positive ground fuel pumps). While an improvement over the mechanical units, the SUs were not without their faults, and are fairly unreliable by modern standards.

Fast forward to the present day, and you can find modern fuel pumps at a very reasonable cost. With solid-state electronics (no points like the old SUs) these are extremely reliable, and are generally a must have item if you venture very far from home with your classic.

3. **Electronic Ignition** –the standard “A-Series” distributor operates with an old-fashioned “points” system. While functional, the points require adjustment for the car to run its best, as well as periodic replacement. Installing an aftermarket electronic ignition solves most of these issues, and is a worthwhile investment. While positive ground electronic ignition systems are available, conversion to negative ground may make sense prior to upgrading your ignition system (as once you buy a positive ground electronic ignition, you won’t be able to easily convert to negative ground without buying another ignition unit).
4. **Alternators** – certainly an upgrade worth considering, most modern alternators require negative ground. Again, if you’re going to be upgrading, make the conversion.
5. **Cigar/Cigarette Lighter** – ever want to use common accessories via a cigarette lighter? On many such accessories, polarity will matter.

While these are the most common upgrades, I’m sure there are other modern accessories that would help tip the balance in favor of converting to negative ground. Unless you’re really interested in originality there really isn’t any reason not to convert.

Preparation

1. Find your copy of the wiring diagram for your particular car. It’s worth having around in case you run into any unexpected difficulties.
2. Check through your repair records to see if you’ve replaced any of the original equipment with electrical upgrades (for example, is there a positive ground radio already in the car?) Make a list of all the electrical components that might need attention.

If your car is basically stock, you should be set (as pretty much everything on the Sprite that’s electric (save the ignition system itself) will run equally well on positive or negative ground.) Things that are common “gotchas” are a radio and aftermarket fuel pump.

A short list of things you shouldn't have to worry about include:

- a. Lights (all, including turn signals)
- b. Wipers
- c. Heater blower motor (most Lucas electric motors are “field wound” and are not polarity sensitive—leave the wiring “as is”. However, if you've upgraded to any aftermarket equipment (like an electric radiator fan) then the motor may be of the “permanent magnet” type, and in this case you should reverse the wires. Check these aftermarket items after the conversion, and if any of them aren't spinning in the right direction, reverse the wires).
- d. Starter motor
- e. Generator
- f. Gauges (oil, fuel, temp, mechanical tachometer, speedometer, etc. are fine—no modifications are necessary)

Note: if you have an aftermarket electrical tachometer installed, this might be an issue. Check the back of the gauge (most are labeled either “positive ground” or “positive earth” or something similar).

Likewise if you have an aftermarket ammeter installed, you'll need to reverse the leads (no worries if you have a voltmeter, which is more likely to have been installed as a “period” accessory anyway.)

3. Make sure the ignition switch (key) is in the “off” position.
4. Disconnect the battery (since we'll be switching the terminals anyway, you'll need to do this, but it's wise to disconnect it before you start).

Conversion

1. Disconnect and remove all “polarity dependent” devices you've identified (radio, etc.) While you won't be able to use any of these components after the conversion, you won't want them damaged (as you can always sell them on eBay). While an expert may be able to convert a positive ground radio to negative ground, your best bet is to simply purchase a modern replacement.
2. Again, if you have an ammeter, reverse the wires on the meter. If you have a voltmeter, you're set (no changes necessary). (Remember though, Sprites didn't come with ammeters or voltmeters as standard equipment.)

3. If you have an aftermarket electrical tachometer, this will likely need conversion to negative ground, or replacement. I'd recommend installing the stock mechanical unit, or buying a negative ground unit rather than converting. While this isn't hard to do if you know your way around the tachometer's guts, for most folks, it's simply less aggravation to buy a new unit already configured for negative ground.

(Note: for those who are interested, conversion of the later electrical tachometer from positive to negative ground will be part of another technical "how-to" available on spritespot.com.)

4. Reverse the wires on the ignition coil (this is an important step, as it'll preserve the energy in the coil). One side is usually marked "SW" (for Switch) and the other marked "CB" (for Contact Breaker). Other common markings are "-" (instead of SW) and "+" (instead of CB).

If you're wondering why this is important, read on. If not, you can skip ahead to step #5 (Note: after the conversion is completed, you can check to see if you have the coil connected properly—see step "1c" under the "Road Test" section).

Here's the explanation:

While having the coil connected backwards will not prevent the car from running, you can end up with some "strange behavior" (misfiring, especially when hot, etc.)

The reason is that if the coil wiring is reversed, the coil's output will be decreased, thus giving the engine a weaker spark. In addition the polarity of the coil is reversed, and consequently the spark travels in the opposite direction from normal—in other words it goes from the spark plug arm to the center electrode, rather than from the center electrode out to the spark plug arm (the little thing you bend when you adjust the plug gap).

Furthermore, electrons flow better from a "hot" surface to a "cold" surface, and for a spark plug, that means from the center electrode out to the spark plug arm (which is more efficient at dissipating heat than the well-insulated center electrode).

One final issue is that the greatest erosion occurs at the source electrode (the place where the spark goes “from”). If the spark is traveling the wrong direction (from the spark plug arm to the center electrode) then you’ll experience greater erosion of the spark plug arm. (Manufacturers design the central electrode to resist this erosion, but not the spark plug arm.) Over a relatively short time, your plugs will erode and become less efficient (because the effective gap will have been increased), and the car will tend to misfire—especially with a weaker spark, having to jump an ever widening gap!

So everything works to your disadvantage if the coil is wired in reverse—the coil puts out a weaker spark, the spark is traveling in the wrong direction, with the heat of the engine making it more difficult for the spark to make it across, and as the engine runs, the gap is continuing to erode (and at an accelerated rate). Is it any wonder the car’s been misfiring? (I hope I’ve convinced you to be sure to check this step to be sure the coil is connected properly).

5. If you have a solid state fuel pump, and can reverse the connections, then do so. However, most fuel pumps have a single wire (relying on the metal pump case to act as ground). In this instance, you’ll be better off purchasing a new solid-state electronic fuel pump, than trying to electrically isolate the old unit.
6. Once you have taken care of all the electrical accessories that might be affected (by either removing or rewiring them as above) then:
 - a. Turn the battery around 180 degrees. (If you have really long battery cables, you may not have to turn the battery around, but it’ll likely be easier if you do so.)
 - b. Reconnect the positive battery terminal to the cable going to the starter (not to the cable going to the chassis ground).
 - c. Reconnect the negative battery terminal to the cable going to the chassis ground (not to the starter as it was originally connected).

Note the battery terminals are different sizes (the positive terminal post is larger). Most of the time you can manually spread the old terminals apart when you reconnect the battery. If this proves difficult, either purchase new cables, or purchase new terminal clamps and install them to your existing battery cables.

7. Convert the generator.
 - a. Disconnect the wire leading to the “F” terminal. (“F” stands for “Field”)
 - b. Use a small piece of wire to momentarily short the “B” terminal (usually connected to a large brown wire) to the “F” terminal. There should be some small sparks—don’t worry. This “polarizes” the generator to operate with negative ground. Do this momentary connection 2-3 times to be sure your generator is polarized

Note: don’t “connect” the “F” and “B” terminals together with the wire—you just have to touch them for only a second to change the polarity.

- c. Reconnect the wire removed in step a to the “F” terminal. That’s it!

Road Test

1. The car should start normally at this point. If not consider:
 - a. Are all connections tight and well connected?
 - b. Do you have a negative ground fuel pump installed? (Or have you reversed the wires on your fuel pump if it can run in either configuration?)
 - c. Did you remember to reverse the leads on the coil (you’ll have a weak spark if you’ve neglected this step, and the car may run poorly). Check this by following this procedure:
 - i. Turn the engine off.
 - ii. Remove any plug wire from its spark plug. Pull the plug boot back a bit so you can see the metal connector. Set it back so that it’s touching (but not “clipped” to) its associated spark plug.
 - iii. Get a sharp #2 lead pencil.
 - iv. Get an insulated pair of pliers (you’ll use these to hold the plug wire)
 - v. Start the engine.
 - vi. Holding the insulated pliers in one hand, slowly pull the loosened spark plug wire away from its plug. You should see a spark “jumping” from the end of the wire to the end of the spark plug. (This is easier to see in a garage than in bright sunlight)
 - vii. With your other hand, carefully insert the sharpened point of the lead pencil into the path of the spark. You’ll see one of two results:
 1. A “flare” of particles flying *from* the lead pencil *towards* the spark plug, or
 2. A “flare” of particles flying *from* the lead pencil *towards* the spark plug wire.

This indicates the “direction” of the spark flow. You want the spark going from the wire to the plug (not from the plug to the wire). Therefore if you see result #1 (the flare going from the pencil toward the plug) you’re ok. If you see result #2 (the flare going from the pencil toward the wire) your coil wires are hooked up in reverse. If so:

1. Turn off the car
 2. Reverse the wires on the coil (switch the wires from the “CB” (or “+”) terminal to the “SW” (or “-”) terminal, and vice versa).
 3. Redo the pencil test—you should be fine.
2. Check the ignition light – it should act as it did before (above 1,000 RPM or so it should be off, and it should be off when the ignition switch is off).
 - a. If the light does not go out above 1,000 RPM, try re-polarizing the generator.
 - b. If the ignition light is on when the ignition light is off, then **immediately** disconnect the battery and check your wiring (something is amiss).
 3. Check the heater blower (and any other aftermarket motors and/or fans you may have installed) to be sure it’s blowing in the right direction (if not, you’ll need to reverse the wires).
 4. Check all the gauges for proper operation:
 - a. Tachometer
 - b. Speedometer
 - c. Fuel gauge
 - d. Oil / Temp
 - e. Voltmeter / Ammeter
 5. Check other accessories
 - a. Windshield wipers
 - b. Windshield washers (if you have installed an electrical system instead of the stock rubber push button)
 - c. Lights / turn signals

At this point you’re set—go ahead and install your favorite negative ground (negative earth) accessories (like a new radio). Enjoy!

A final note: you may wish to get one of those stickers for your engine compartment that say something like “This vehicle is wired Negative Earth” (there’s a nice one the Jag folks use). While it should be fairly obvious to any mechanic which battery terminal is grounded, the truth is someone may not take the time to check, and make the assumption your car is positive ground when it’s not. The label can’t hurt.



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