

Brian Burgess demystifies Jaguar switching electronics as he applies the 'switchback' technique to fitting LEDs

HARNESSING THE POWER OF LED



LED lighting is commonplace on cars these days and the variety of applications we see them used in appears to be limited only by the imagination, with car manufacturers using them for exterior and interior lighting.

Apart from the visual benefits LEDs bring, they are also more energy efficient – with reduced heat generation – and considerably longer lasting. The familiar incandescent light bulbs traditionally used in cars tend to have a limited lifespan and are much less efficient, converting around five per cent of the energy they use into visible light, with the remaining energy lost as heat.

Many incandescent (filament) bulbs can now, thanks mainly to Chinese aftermarket parts manufacturers, be directly replaced with LED equivalents. However, LEDs can vary in quality, colour and light output, so a little research is recommended before you buy.

A rather natty use of automotive LED lighting that car producers have adopted is the 'switchback' technique, where two lighting functions are performed by a single unit. This can be seen on modern cars where the DRL (Daylight Running Lights) lamps on the front of the car are illuminated white by default but, when a turn signal indicator is operated, will illuminate yellow, then 'switch back' to white when the indicator is cancelled. To achieve this functionality some electronics are, of course, necessary.

DRL/turn-signal (white/yellow) switchback LED lamps are commercially available as an aftermarket upgrade and come with all the required electronic wizardry built into the lamp body. These can usually be purchased with a choice of two standard bulb-holder connectors. Each lamp has three wires of which one is a constant –ve (negative/ground) and the other two provide the white/yellow +ve (positive) switching connectivity. There is also a load resistor supplied, which is connected between +ve and -ve wires. This will make your CAN bus (electronic switching network) believe it is connecting to a filament bulb where the filament itself would normally provide the load. All this, hopefully, will become clearer when I outline the LED lighting conversion I performed on my 2005 S-Type 3.0 SE.

PLANNING THE DRL UPGRADE

My original plan was simply to add DRLs by replacing the existing halogen fogs with a recently acquired pair of high-intensity LED plug-and-play fogs. These would be connected so that they would come on automatically with the ignition. However, this would mean sacrificing the foglight feature, to say nothing of the redundant switch.

I had little idea at this point how I would connect the fogs as DRLs and even less idea how Jaguar switching electronics functioned. What I did know was that the electronic network on the S-Type is sensitive, so a bit of a learning curve lay ahead.

One evening, armed with the S-Type electrical manual in one hand, a pencil in the other, and a cup of strong coffee at the ready, I began to sketch out how I might connect in the DRL/fogs to the existing circuitry. It was late and progress was painfully slow so I decided to see if I could incorporate a set of switchback LEDs and kill two birds, etc. I could probably, with a bit of careful surgery, fit these LEDs along with the tiny control circuit PCB in the front turn signal holders and have the DRLs as part of the headlamp unit along with the turn indicators. The theory was sound, but the mechanics of the conversion would prove challenging.

JAGUAR SWITCHING

I'm not wishing to teach anyone's grandmother to suck eggs but, for those who are (as I was) unfamiliar with how Jaguar switching electronics work, I will attempt to explain.

Back in the good old days when a car lighting circuit was nothing more complicated than a switch, light bulb and a 12v dc power source, it was easy to determine which side of a bulb holder was connected to negative and which side was connected via the switch to positive. With the bulb removed and the switch in the 'OFF' position, there would be no reading on a voltmeter when connected across the bulb holder terminals. When the switch was in the 'ON' position, 12 volts (-ish) was shown on the voltmeter.

If you try the same thing on, for example, the S-Type interior light, when the bulb is removed and all the doors shut, i.e. light switched off, you will get the following result: setting the voltmeter to 20vdc range and measuring across the two terminals, the actual (and expected) result is 0 volts. With the same voltmeter setting and measuring between one terminal and a good ground point, the result is 12v. Measuring between the other terminal and ground returned 12v as well. How, I thought, can there be a 12v positive feed on both sides of the lamp holder when the light was switched off?

After a lot of head-scratching, disbelief and finally dismissing the fact that I could just be having another senior moment, I decided to read the S-Type electrical manual, which, by the way, is not for the faint-hearted!

When I did eventually find the appropriate pages and studied the circuit and its associated page cross-references, I finally had my Eureka moment.

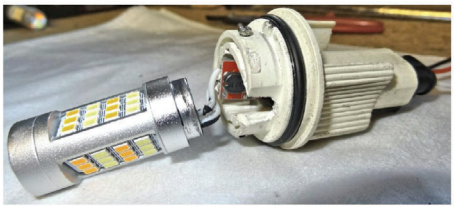
This is how it works: - A positive (+ve) feed is applied to both sides of a lamp holder when the switch that operates that lamp holder is in the 'OFF' position. Changing the switch state to 'ON' sends an instruction signal to a box of electronics e.g. the FEM (Front Electronics Module) or REM (Rear Electronics Module). The signal on receipt by the Electronics Module electronically switches one side of the receiving lamp holder to negative (-ve), which turns on the lamp. Simples!

At this point it became apparent that wiring in the switchback lamps would require switching relays and some carefully thought-out cabling to manage the needs of the switchback LEDs and the Jaguar REM. I won't attempt to explain the schematic and connectivity requirements of this project at this point but leave it to the documented schematics, installation guides and recommended component lists that are available to download via a link at the end of this article.

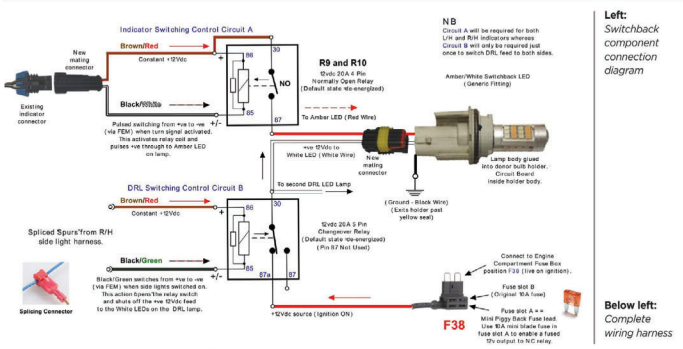
ON WITH THE PROJECT

From the outset I wanted this conversion to be reversible, i.e. to easily revert to factory standard in the event of failure during service. Worst-case scenario was switchback units failing and not being able to obtain replacements.

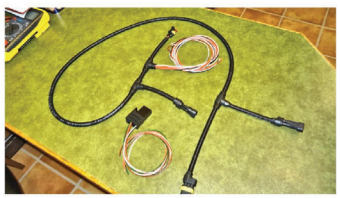




Facing page: *Switchback operational 'states'*
Above, top to bottom: *Aftermarket switchback LED lamp kit; fitting the LED lamp and circuit board to the donor lamp holder*



Left: *Switchback component connection diagram*



Below left: *Complete wiring harness*

My first task was to determine how to fit the switchback units along with their electronics into the existing turn signal lamp holder. This would require surgery on the lamp holders in order to house the switchback LED and circuit board assembly. As I wanted to retain the ability to revert to factory standard, I purchased two additional lamp holders and used these as donors for the project.

With the lamp holders sorted, I now needed (along with the aid of the electrical manual) to produce a wiring diagram and schematic to prove it all on paper. This showed me how many and what type of relays I would require and where I could pick up power and ground points. Fortunately, and because I was adding relays that have a resistive load in their switching coils, I didn't have to incorporate the large metal-clad load resistors supplied with the LED kit.

The next task was to determine physically what type of harness I needed and where the relays would be fitted. A visual check of the engine bay provided me with the solution, so I set about ordering all the necessary components. The most useful item I purchased was a fully fuse- and relay-populated front power distribution fuse box assembly with wiring attached from eBay. The fuse box was useful because it provided two of the correct type of donor relays, which are compatible with Jaguar switching, along with some wiring harness parts. All other components were purchased from an online automotive electrical store at *www.12voltplanet.co.uk*, apart from the two lamp holders, which were courtesy of the local car breakers.

I made up the harness and fitted two of the three relays in two empty bays in the existing front fuse box along with donor cables from the eBay acquisition. The third DRL switching relay I fitted to the side of the ABS motor housing. With some trepidation I connected it all up and it worked a treat.

LIGHTS: SWITCHING SEQUENCE

Daytime driving operation: when the ignition is switched on the DRLs will activate. When a turn signal (or hazards) is activated, the DRL will change from steady white to flashing yellow.

Night-time operation: initially, when the ignition is switched on, the DRL lamp will activate until the side or headlights are switched on. This action will disable the DRL lamp, but the yellow LED will function normally when a turn signal or hazards is switched on.

Switching on side or headlights activates the changeover relay which cuts power (via the changeover relay) to the white DRL lamp.

As the DRL/switchback conversion was successful, I decided on an upgrade variant for the reverse lights and rear turn signal lamps. I used the white switchback LED as an additional reverse lamp as well as replacing the existing reverse lamp bulbs with high-output LED equivalents. How it works is that when you select reverse gear, the white side of the switchback illuminates along with the new high-output LED reverse lamp, therefore doubling the reverse-light output. When a turn signal is activated, the yellow part of the LED illuminates and, of course, switches back to white when cancelled. I had to modify the rear lamp cluster housings to accommodate the switchback LEDs. However, and like the front DRLs, these were modified such that they would revert to factory standard if necessary.

My intention now, when time allows, is to include the two LED foglamps in the DRL switchback circuitry. I have completed the circuit mods for this, which incorporates the use of the existing foglamp relay. I have yet to test it but when I have, the downloadable diagrams will be updated to incorporate and reflect the changes.

For those interested in upgrading to the front switchback LEDs, the following files are available to download:

1) S-Type 2003 Elec Guide.pdf
2) S-Type 2005 Elec Guide.pdf VIN N13089 Onwards
3) Switchback LED DRL Upgrade V2.pdf (this includes my electrical schematic, wiring layout diagram, upgrade and installation guide and a recommended component list)
4) Video clips of finished upgrade.
5) Additional installation high-resolution images.

To download the upgrade information, email *jagtv.stype@gmail.com* quoting DRL Extra in the subject line. Gmail will auto-respond with a link to my Google Drive source folder where the shared files can be accessed and downloaded. All emails and files are scanned by AVG Avast Business anti-virus software.