



And Now for Something Completely Different ... USB Connectors!

Paul Ireland has been working out how to charge modern computer technology in a 70 year old car

Writing an article about electronics and USB connectors in a magazine dedicated to 70 year old cars appears to be a little off-the-mark. My reason is to share a problem that can occur with USB connectors and the associated possible fire risk.

In the 1930's and 40's the only 'computers' were telex machines and the famous Colossus. However we are now in the 21st century and it's common to have devices such as mobile phones, satnavs and dash cams even in our 70 year old cars, all of which need power supplied by a USB cable. Needless to say, when our cars were made, the concept of USB connectors was 'pie in the sky'.

One of these modern devices my wife and I find very useful is the satnav. While my wife is a fantastic navigator, a satnav relieves her of the hassles of trying to refold a large OS map in the tiny cockpit of an open car as we inevitably travel along roads that regularly cross over the fold in the map. We now plan the route before leaving and programme it into the satnav using waypoints. The satnav also gives a significant benefit for the driver: it warns of sharp corners on the road ahead - almost as good as a professional rally navigator! Additionally with the ever present dangers of speed cameras, it gives an accurate measure of your speed.

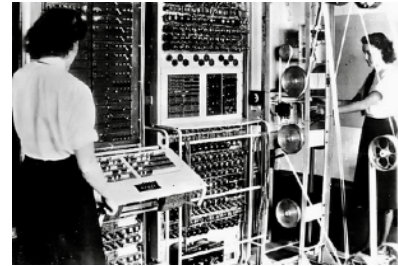
Unfortunately, satnavs need a source of power supplied by a 5 volt USB socket. There are two ways to fit these to our cars, you can either fit a cigarette lighter with a USB adapter plug or, my preference, a dual USB socket.

Fitting either of these and powering them from the car's 12 volt supply is relatively easy, **providing you buy one with a plastic body**. In my TC I have installed a scuttle board under the dash which provides a convenient and discrete mounting for the USB socket.

Why a plastic body? Originally the earth, or the body of cars, was positive (called a Positive Earth). One reason for this is the polarity of the spark plug central electrode is then made negative, which results in improved spark plug performance and longer service life of the spark plugs and the HT cables.

Unfortunately this arrangement has the effect of causing more electrolytic corrosion on the light fittings and body and as a result this convention was changed around the mid 1950's to make the earth or car bodies negative (Negative Earth) - a convention that has been widely adopted. And, guess what, it is also used in cigarette lighter sockets and USB connectors.

In practice this causes no problems with plastic bodied sockets which have two connectors +ve and -ve. As the body of the socket is plastic and therefore insulated, they can be mounted



Cigarette lighter



Cigarette lighter - USB adapter



Dual USB socket

anywhere, but the problems start when you plug something into them. Both the connecting cable and device are Negative Earth, the car is Positive Earth. **If an uninsulated part of the cable or the device contacts any part of the car body, there is a short.** As cigarette lighter sockets can supply 20-30 amps, a short can be quite damaging, with melting wire or components or even starting a fire.



The negative polarity of the device end of a USB cable

Again, practically this creates very little problems as satnavs, mobile phones etc. do not expose any conducting parts. The exception as I found, is the USB cable. The metal (device) end is at Negative Earth potential (-12 volts) and if it touches any part of the car – bang! You can see what part of the cable I mean from the picture on the left.

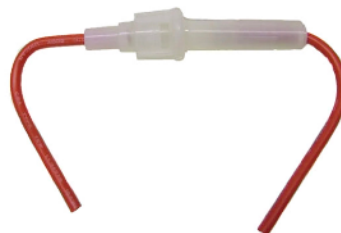
Fortunately, as a precaution I had fitted an inline 5 amp fuse. Needless to say, it was behind the scuttle board so changing the fuse was **not** easy. At first I could not understand why it kept blowing, until I realised the problem with the polarity of the USB sheath. (BTW I have now fitted a cartridge fuse which is much easier to change - you can see this in the picture below).

Many USB sockets are fitted with circuits to protect them from a short. This works on the positive (or power line) and are ineffective in protecting against a short to a Positive Earth vehicle. Why is this? Because the current flows through the chassis and not through the protection circuit.

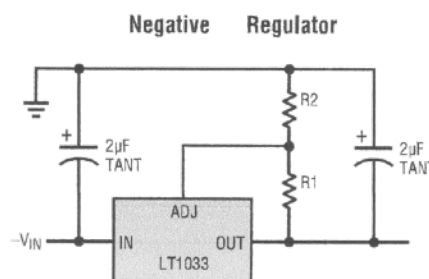
The solution

If you have fitted or plan to fit a cigarette lighter or USB socket to power your modern devices, there are some steps you can take to mitigate or resolve this problem.

1. **Change the Earth on the car.** It is possible to convert Positive Earth cars to Negative Earth. This means if the USB connector touches the body of the car, they are now both at the same potential, -12 volts - so no short.
2. **Fit a low current fuse.** If you do nothing else you should fit a low current fuse, e.g. 5 amp, into the -ve connection to the cigarette lighter or USB connector. Just put it somewhere it is easy to get at and change. If you have nowhere to mount a fuse holder, you can use an inline fuse. This will, at least, protect against any major short should a wayward USB cable touch any part of the car's body. If you do fit a fuse to a cigarette lighter socket, check on the current rating of any other devices you may plug in, e.g. a battery charger
3. **Fit a negative supply protection circuit.** For the more electronically minded owner, it is relatively easy to fit a -ve supply protection circuit. It sounds complicated but it is not. It is a circuit that works in the same way as those already fitted to USB sockets, except it works on the negative supply. If a USB cable shorts, the power is turned off until that short is removed. No more replacing blow fuses!



An inline fuse



Negative supply protection circuit

Expressing interest

Should you be interested buying a USB fitting kit for a Positive Earth T Type please let Paul Ireland know.

Estimated cost will be around £60.00. and depending on interest, he will look into manufacturing a batch.

You can contact him by emailing him at

tregister@ireland-family.org

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