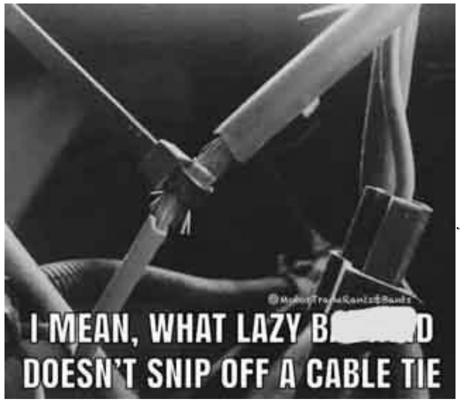
Electrical System

Last updated 05-Feb-2026

If you find the information here useful,
you may like to make a small contribution
to help offset the costs of providing it. Thank you.
Or just leave a comment in my visitor book.

Donate With PayPal

Automotive Electrics Basics - Part 1 - Terminology and Part 2 - Typical faults, symptoms, and diagnostic techniques



(Image posted by Geoff Hutton on the MGOC forum)

Probably more problems crop up with electrics than anything else, possibly everything else put together. Not surprising, considering the number of electrical components and connectors in the car. For those new to classic car electrics basic electrics terminology is covered here, and further generalised information including typical faults, symptoms, causes and diagnosis can be found here.

Bad connections are a frequent cause of problems in classic cars, and high-resistance connections can be the most confusing to deal with, small increases in resistance having a disproportionate effect on the circuits affected. The Lucas Fault Diagnosis Service Manual states:

> "The acceptable volt-drop figure for most circuits is 10% of system voltage (1-2v on a 12v system) but there are exceptions to this rule as in the case of the starter circuit where the maximum voltage drop is 0.5v."

The manual also states:

> "The majority of procedures involve circuit testing and the principle used will be that of checking for 'voltage drop' where a voltmeter is connected in parallel with the particular circuit to be tested.
>
> "As voltage drop exists only when current is flowing and varies according to the amount of current it is essential that the circuit is tested 'under load', i.e. whilst passing its normal current. In certain cases this current will be measured using a test ammeter."

That is exactly the principle that is followed in these pages. And as the Lucas manual says the majority will be using a voltmeter in parallel with a circuit to look for a volt-drop, which will indicate a bad connection or an open-circuit fault. About the only case where an ammeter will be used is for testing the LH overdrive circuit, as that is the only way of determining if current is passing through the solenoid or not, as well as whether it is to the correct level or not. Practically every other circuit has a visual (lighting, gauges) or audible (heater fan) indication that something is happening, even if it is not to the correct level, and a voltmeter on the device terminals will show whether the full voltage is reaching it or not. Similarly use of an ohmmeter is very rare - like for the D-type overdrive (this initially takes 17 amps which is beyond the capability of a typical automotive multi-meters), or testing the internal resistance of the two-speed heater assembly, although they can also be used for doing a simple go/no-go check of a condenser, and even checking the dwell/gap of points-based ignition systems.

Understanding how the circuit is wired and what it shares its supply and earth with will help immensely, and for that you will need the Workshop Manual, glovebox handbook, or Haynes wiring diagrams. The colour codes for your model and year are essential, but the factory diagrams can be difficult to follow as they generally place the components on the page as they are in the car, which means a lot of wiring snaking about. Where a component simply isn't working you can use either the individual circuit elements as here, or these Advance Autowire diagrams. But if you are getting strange interactions between various circuits you will need the factory diagrams to see how the supply and earths are shared, as bad connections in these are a frequent cause of problems.

The information that follows is mainly geared towards situations where the car has been working but now has a fault. Obviously, if there are faults when you buy the car, or after someone has been making changes, then absolutely anything could have happened, i.e. multiple faults and incorrect wiring, but the basic diagnosis techniques should allow you to resolve the problems.

Even in the case of your car where more than one fault has developed but especially where a car is new to you don't expect to find a 'magic bullet' that will fix all faults in one go. Investigate faulty circuits and fix them one at a time to gradually work through the problems, and if you find fixing one fault does clear more than one problem then it's a bonus.

I have created individual schematics of virtually every circuit in all variations of the MGB - hopefully you will find them a little clearer than the official diagrams. If you hover your cursor over a wire it should change shape to indicate a link, and then display a 'tool-tip' to confirm the wire colour. Where such a schematic exists you will see an icon  somewhere in the main text that talks about that circuit, click on this to see the schematic in a separate window. Clicking on the graphic here displays a list of available schematics.

Ammeters and Voltmeters

As John Twist has said: "Except in the RAREST of circumstances, the ignition warning light indicates any problem with the charging. AMMETERS properly connected into alternator circuits provide at least two more connections which can corrode and cause the alternator to fail. Buy some driving gloves instead." That presupposes that your warning light is working, of course ...

A car ammeter displays the current flowing into (charging) or out of (discharging, except cranking current) the battery hence has a centre zero and moves left of that to indicate a battery discharge and to the right of zero to indicate battery charging. Almost all need you to remove the brown wires from the starter solenoid and run two very heavy gauge wires capable of taking at least 45 amps from there to the ammeter. These wires, and the ammeter, are always live and unfused. As well as these two new connections which can corrode, those on the back of the gauge can come loose, and either wire can short to earth and being unfused could cause a fire. A conventional ammeter contains a very low resistance between the two terminals and this develops a voltage across it proportional to the current flowing - Ohm's Law, that voltage is then used to drive a meter. There are reputed to be 'remote shunt' ammeters around (although I've never seen one) where the current sensing shunt is at the solenoid or starter and two thinner, fused wires can then be used going to a gauge calibrated in amps. This does away with potential failures up at the gauge but still leaves those down by the solenoid and the risk of shorting-out. An conventional analogue ammeter needs a scale running from at least -45 amps to +45 amps, and is practice can be even higher, which means the 'normal' range of needle movement is compressed into a tiny section either side of zero. It will almost certainly be a moving-iron meter and be unstabilised i.e. have a trembling needle. Both these factors make it difficult to see whether it is showing a slight charge as it should, or a slight discharge which is bad. Under fault conditions the battery voltage could be reducing but an ammeter stills shows a slight charge, or conversely an overcharging fault could gradually be raising voltage higher and higher but still not be showing an excessive current. If you **really** want to connect an ammeter then see here.

A voltmeter avoids all these issues and is a much simpler proposition requiring just two light-gauge wires to an ignition switched source - ideally fused - and earth. I say 'switched' because the classic thermal (slow-acting) type can be drawing up to 160mA which while only equivalent to an instrument bulb will slowly discharge the battery on an infrequently used car, digital instruments take less current but I still wouldn't want to leave them powered all the time. Fused in case of shorts. However, unless you have an ignition relay and connect the voltmeter via an in-line fuse to that, the green circuit (fused ignition, which is probably the most obvious place to connect one) on most MGBs will show a voltage which can be significantly lower (up to 2v lower is classed as 'acceptable' by Lucas) than the alternator and battery voltages, even worse

with a digital gauge where owners get paranoid about tenths of a volt. I've also seen one digital gauge that displayed half a volt less than two other test meters connected to the same point! An alternative is the accessories circuit off the ignition switch on 1969 and later models, which has its own fuse on 71 to 74 models feeding the radio (bullet connection behind the centre console) wipers and heater fan. Beware of voltmeter vendor claims that the instrument will tell you the 'strength' of your battery, this type of 'slow-acting' gauge cannot.

The classic type above are rather expensive at around £50, there are some with modern internals at around £10, installation and use described by clicking the image. I'd never bothered about fitting one before but having recently bought a small digital unit to check the charging voltage in the A-Class but when no longer needed for that I thought I might as well use it on one of the MGBs. Fits in nicely beside the courtesy light on the roadster, but as Vee came to me with an unused gauge at the far right of the dash I decided to get one of the modern analogue type for there. This type is a fast-acting (but without the wobbling about of the early fuel gauge) stepper-motor type and shows cranking voltage i.e. the condition of your battery and its connections as well as ignition and charging voltages.

Under normal circumstances it is the charging circuit that is supplying all the electrical loads, even at idle in the case of an alternator, as well as trickle-charging the battery once the cranking losses have been replaced. Ordinarily a voltmeter will show something above 14v with a charged battery and a minimal electrical load, reducing as the current load goes up and gets towards the maximum capacity of the (say) alternator. When the current load exceeds the output of the alternator the voltage will drop below 12.5v and the battery will then be supplying part of the load, and hence discharging. This voltmeter has a coloured scale which is useful for showing at a glance if the voltage is in or out of limits. Up to 15.2v is shown as 'green' and dynamo-equipped cars can show this although an alternator should not get that high. At the lower end 11.5v is also shows as green but for me if it drops to 12v for any length of time I'd be concerned. The coloured scale (which not all instruments have) is particularly helpful as you can see at a glance whether it is correct or not instead of having to read the numbers and know what they mean

Voltage can drop for a number of reasons including an owner having added some high-current loads but not uprated the alternator, or the alternator is failing, or it could just be some iffy connections somewhere. In all cases a voltmeter will indicate these problems - also the problem of overcharging - much sooner and clearer than an ammeter will. The only added fault liability of a voltmeter is one of shorting of the 12v connection, but as long as this is fused even this is eliminated.

Both ammeter and voltmeter will tell you if the battery is being charged or not in their different ways, and a correctly operating warning light will do so as well. But none of them will tell you if the car is going to start next morning! You could say, if you are really desperate to win the argument, that the warning light **might** fail when you were driving along, and something else **might** happen to stop charging. But like I say, you would have to be desperate.

January 2015 Well, I said desperate, but Adam Liptrot did experience a situation where the warning light did NOT indicate a problem, where especially a voltmeter and possibly an ammeter would have, as recounted on the MGOC bulletin board. On a wet winter's night on country lanes over the Pennines he drove through a large puddle, and after that became aware that his indicators were slower, his lights were dimming, and about half an hour later he ground to a halt and had to be recovered home. A flat battery was diagnosed, but subsequent testing showed that whilst the system voltage was about 14v with the engine running with minimal electrical load, it dropped to 11.5v with the lights on. Turning them off again it climbed back to 14v. That is a symptom of a very weak alternator i.e. only able to put out a fraction of the current it is supposed to be capable of. A replacement alternator delivered 13.7v at idle with lights, fan and indicators all on, so somehow the water splash had damaged the alternator. Because it was still putting out some current, as indicated by the 14v with minimal electrical load, that was enough to keep the ignition warning light extinguished, even when the system voltage dropped to 11.5v. The reason the warning light didn't come on is because it is comparing the voltage at the alternator with the voltage at the rest of the cars electrical system. When these are both the same the light will not glow, and when both alternator and system voltages are low as in this case it still will not glow. In this case a voltmeter would have immediately and clearly shown the problem, but it has to be said that dimming lights and slowing indicators should also have alerted him. Unlikely to have enabled him to do anything about it at the time, but he would perhaps have been able to stop at a warm pub to ring his recovery organisation, rather than being stranded in the middle of nowhere. I've often wondered, if that happened to me on some of our jaunts around the country and Europe before I had a phone with sat nav, just how I would describe to the AA (in my case) exactly where I was!

Bulbs *Added July 2009*

Bulb holders

Part No.	Location	Type		Watts	Usage
GLU101	Headlamp	Sealed Beam		60/45	101-187210 RHD
GLU106	Headlamp	Sealed Beam		75/50	187211-360300 RHD and CB V8
BFS415	Headlamp	Bulb		50/40	101-360300 LHD except Europe and North America
GLB410	Headlamp	Bulb		45/40	101-360300 LHD Europe except

					France and Germany as below
GLB233	Headlamp pilot	Bayonet	BA9	4	57028-59462 Germany
GLB411	Headlamp	Yellow bulb		45/40	101-360300 France
17H9472	Headlamp	Sealed Beam		60/45	101-410000 North America
GLU123	Headlamp	Sealed Beam with pilot window		75/50	360301-410000 RHD and RB V8
GLB501	Headlamp pilot	Wedge	T10 Capless/Wedge	5	360301-410000 RHD and RB V8
GLU114	Headlamp	Sealed Beam		?	360301-410000 LHD except France, Germany and North America
GLB501	Headlamp pilot	Wedge	T10 Capless/Wedge	5	360301-410000 LHD except France, Germany and North America
GLB411	Headlamp	Yellow bulb		45/40	360301-410000 France
GLB233	Headlamp pilot	Bayonet	BA9	4	360301-410000 France
BHA5387	Headlamp	Sealed Beam		?	360301-410000 Germany
GLB233	Headlamp pilot	Bayonet	BA9	4	360301-410000 Germany
GLB472	Headlamp	Halogen	H4	60/55	410001 on RHD
GLB233	Headlamp pilot	Bayonet	BA9	4	410001 on RHD
17H9472	Headlamp	Sealed Beam		60/45	410001 on North America
GLB989	Front Parking	Bayonet	BA9	5	101-187170 North America 101-360300 Not North America
GLB382	Front Flasher	Bayonet	BA15	21	101-187170 North America All, not North America
GLB380	Front Parking/ Flasher	Offset bayonet	BA15	6/21	187170-on North America
GLB323	Front Fog	Bulb	P36s	48	101-187210
GLB185	Front Long-range	Bulb	P36s	48	101-187210

GLB380	Stop/tail	Offset bayonet	BA15	5/21	All
GLB207	Number plate	Bayonet	BA9	5	101-339964 and V8 to 1247 except as below
GLB501	Number plate	Wedge	T10 Capless/Wedge	5	187211-219000 North America
GLB989	Number plate	Bayonet	BA9	5	339965-360300 and V8 1247-2100 except North America
GLB233	Number plate	Bayonet	BA9	4	All RB except North America and Germany
GLB254	Number plate	Festoon	Festoon	6	339095 on North America
GLB233	Number plate	Bayonet	BA9	4	339095-410000 Germany
GLB382	Rear Fog	Bulb	BA15	21	1980 UK models
GLB987	Map light	Screw	MES E10	2.2	101-258000
GLB989	Gear light	Bayonet	BA9	5	Automatic only
GLB273	Reverse	Festoon	SU8, 5-8	21	101-410000 and V8 except as below
GLB270	Reverse	Festoon	SU8, 5-8	18	268698-410000 North America
37H 1547	Reverse	Festoon	SU8, 5-8	?	France, possibly yellow
GLB254	Load space	Festoon	Festoon	5	GT and V8
GLB239	Interior/Courtesy & Boot	Festoon	Festoon	5	219001-410000
GLB989	Side marker	Bayonet	BA9S	5	187211 on North America
GLB987	Instruments	Screw	MES E10	2.2	
GLB987	Ignition warning, main-beam and indicator tell-tale	Screw	MES E10	2.2	Tin dash, chrome bumper, not V8
GLB643	Indicator tell-tale	Bayonet	BA9S	2	Early padded dash, claw holder
GLB281	Ignition warning, main-beam and indicator tell-tale	Bayonet	BA7S	2	Other padded dash, all V8, all RB. Push-in holder with spade connectors
GLB921	Switches and controls	Screw	LES E5	1.2	410000 on, use GLB280
GLB643	Cigar lighter	Bayonet	BA9	2.2	

GLB280	Brake warning	Screw	LES E5	1.5	

Note 1: Unless otherwise indicated image are from Moss Europe.
Note 2: I have seen the dash harness for 77 and later UK models with capless/wedge-type bulb holders.
Note 3: Generally the 3-digit number following the GLB code is the industry code for the bulb style, fitting and output.
Note 4: It should be noted that LED bulbs are not always road-legal.
Note 5: RHD RB optional H4 headlamp - some suppliers describe this as 'flat glass', but whilst mine are shallower than the sealed beam, they are nowhere near flat.
Lucas Bulb Catalogue and Application Guide

Bulb Holders:

Bayonet:

Bayonet bulbs use two pins one either side of the bulb base to push down into channels in the bulb holder, then turn a few degrees clockwise and come back a little way to lock the bulb in position. Dual filament bulbs have offset pins to ensure the bulb can only be installed in one orientation and the correct filament illuminated. With these even though the bulb can be pushed into the holder either way round it takes a particularly ham-fisted or brutal person to turn it and lock it in position, which has been known! If it doesn't turn easily then withdraw, rotate 180 degrees, and try again.

MES/E10:

The bulbs can be a fiddle to fit as the claws get in the way of fingers trying to turn the small globe, but there is a technique to make it easier.

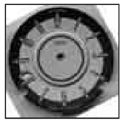
Clocks *February 2016*

A clock was standard equipment for the 77 and later models, powered from the purple circuit, in the centre console on UK cars but in the main instrument panel on export models. I don't know the 'technology' of the original clocks i.e. whether it is modern electronics taking a brief pulse of current every second, or the older escapement-style that wind themselves up with a motor every few seconds.

For both factory and after-market clocks, if you find it works with the lights off but not when the lights are on, then the earth supply to the clock is probably missing.

A PO had fitted a clock (electronic) to the V8 by cutting a hole in the extreme left hand end of the dash, which doesn't sound very convenient for the driver but is surprisingly easy to read. Originally powered from the purple circuit, when I fitted the battery cut-off switch I soon got fed-up with (not 'of' ...) having to reset the clock each time, so ran a wire from an in-line fuse attached to the battery cable connector direct to the clock, disconnecting the original purple feed. Why didn't I fit a switch with a bypass fuse? Because the switch was to prevent the alarm from flattening the battery when I stopped using the car every day. I did a similar thing when I fitted a cut-off switch to the ZS for the same reason.

I wouldn't contemplate cutting a hole in Bee's dash for a clock, nor wanted one in a separate bracket, and for years struggled with pushing my sleeve back - often being a coat and a jumper to see my watch. Eventually a pal with an interest in wood-turning mentioned he had made a holder for a watch insert and case that fits the cigar lighter socket, so I got him to make me one as well and get me an insert from Stiles and Bates (so he could make the holder a snug fit for the insert), which is a company he uses for wood-turning tools and materials, that just happens to sell clock and watch inserts! I chose one with a black face and bezel with bright hands as being most in keeping with the rest of the dashboard, and sprayed the 'holder' with several coats of satin black as well. £4.85 for the insert which isn't bad, but another £4.75 for delivery. However with the 'clock' installed I found that the bright hands reflected the black seat covers and I couldn't see the time! So I took the insert out of its case and painted the hands with a thin smear of Snopake. Much better, but having painted the seconds hand as well, I found I was having to look at it for two or three seconds, or several times in that time, in order to see where the other two hands were pointing to get the correct time! Also at about that time the insert stopped working, replacing the battery didn't help, which was very annoying. As well as having 'defaced' the insert if they wanted it back, I didn't want to put my pal to more trouble and expense in getting it replaced and posting it up to me, so ordered one direct at another £10, then complained that one didn't work. In the event they didn't want the old one back and sent me two more (one the same and one with a bright blue face in a bright surround) as well as two replacement batteries. So good service, but it would have been cheaper for my pal to complain then me pay him to send them up to me. Any road up, with a working clock, I painted just the hour and minute hands white, and finally I can see the time at a glance ... in the day time anyway.



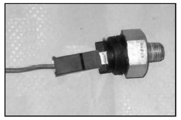
May 2020: Herb Adler has sent me some information on a classic Hillman clock that he tried to make use of, but in the end gave up. It's rather complex mechanically and electrically and the info document from the Hillman Car Club of South Australia recommends servicing one particular component every couple of years! No wonder Herb eventually installed an 80s VDO mechanism in the case.

Connectors and Terminals:

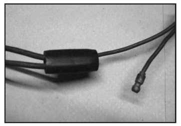
Spades
Bullets
Multiway
Sealed Wiring Junctions
Earth/ground Connections

When looking for electrical problems by doing voltage tests always leave the wires on the terminals. If you take them off to test for voltage then unless there is a full open-circuit back towards the supply you will always see 12v shown, because there is no current being drawn hence no voltage being 'lost' in the bad connection - see

Automotive Electrics Basics part 2 for more information. Looking for bad connections using an ohmmeter can be very misleading as in some cases like switch contacts it needs the full current to be flowing to make a good connection. OTOH the full current can make a weak connection worse due to the heat generated at the fault. By their very nature bad connections are likely to be variable over time and with various circumstances.



When checking voltages at components check the component terminal i.e. its spade as well as the terminal on the end of the wire that slides onto the spade as corrosion can develop between the two. Factory wires are usually spot-welded to the spade connectors so pretty robust and the least likely to fail.



Test the voltage on each side of bullet connectors as either bullet could be making a poor connection with the connector sleeve. Bullets are crimped onto the wires in factory harnesses, usually OK, but at the front of the car you can get corrosion running under the insulation for several inches. In one case I've had the conductor strands corrode right through where the insulation was damaged on an unsheathed headlight wire under the wing.

With PO wiring or re-terminations also check the connection between the wire and the connector if you can. With PO 'repairs' using dodgy components and techniques or if the car has been abandoned in a field for years bad connections can develop that don't occur in normal use. The fusebox often causes problems in a number of places. The most obvious is where the fuse ends are clipped into the holders, they don't grip very tightly and corrosion can burrow underneath. There are also the spade connections, and on the 4-fuse type a rivet underneath the fusebox that connects the spade terminals to the fuse holders can corrode. Last but not least the fuse itself can corrode internally, even though the element appears to be whole. Generally speaking (but see below) problems in the fusebox will only affect the circuits fed by it i.e. the purple, green and red circuits, note that nothing to do with the starter or ignition goes through any **fuses**. However the white feed from the ignition switch may go onto one fusebox spade then come off another one for some of the circuits, and those can be affected by corrosion on the spades. More information on fuseboxes here.

There are a couple of areas that can cause problems even in regularly used and cared for cars. Horns, lights and electric fans can all suffer from poor connections as their connectors tend to be exposed to the worst of the weather - spade connections of horns, bullet connectors for all the front lights, and two-pin connectors for electric fans. Chrome bumper indicator/parking light units earth through their physical fixings to the wing, and these are exposed to the worst that the front wheels can throw at them by way of water and salt. And even though rubber bumper indicators have a wired earth it comes via a rather flimsy bullet-type connection on the light unit that is also exposed to all the weather. Rear light clusters can also develop earthing problems as they also rely on the mechanical fixings, but being in the boot and protected from weather they **should** be less likely.

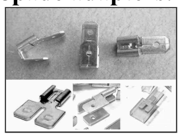
When adding any wiring I really don't like those blue ScotchLok connectors, I've found on a number of occasions that after a while even in the cabin the bifurcated blade loses tension on the copper strands and they start to cause problems. If you are near a bullet connection then substitute a 4-way for a 2-way and put a bullet on your new wire, or if there is already a 4-way with 4 wires in it I'd rather make up a couple of inch length with bullets and add a second 4-way, but you can get 6-way connectors. If you are near a spade connection then piggy-back spade connectors are a good way of tapping into these. But if you want to tap into a wire going into a multi-way connector then other than a ScotchLok there is nothing for it but to cut the wire, put two bullets on the end, and use a 4-way, or use these branching connectors. However with these as both ends have to be stripped then fed in from the same side of the connector it ends up making that wire shorter than the others which may put it under tension.

Spades:

The standard size of spade is 6.3mm width but the starter solenoid on rubber bumper cars has a coil boost contact which is smaller. Andrew Edwards asked if I knew what size it was, he had got a 2.8mm wire terminal but that was way too small. 12v Planet show 4.8mm (as well 2.8, 6.3 and 9.5mm used on alternator output terminals) but that was too big, it seems to be somewhere in between i.e. between 2.8 and 4.8mm. When I replaced the V8 starter (with coil boost system) with a rebuilt unit that came with two standard spades instead of one standard for the solenoid and one smaller for the ballast bypass, so I thought I had nothing to compare it with. But while writing this I remembered that later CB cars (i.e. Bee) have the same starter but the coil boost contact is unused, and that measures 0.187" which converts to 4.7498, or 4.8mm. So why Andrew's is smaller is a mystery. He's managed to pinch up a 4.8mm to fit, but it's not ideal. The spades on reversing light units are also 4.8mm but have a 2-pin connector on the harness, and the night-time illumination on the dash switches of 77-80 cars are the same size. I don't have the switches but the females from an old 1980 harness fit the reversing lights **and** the bypass spade on Bee's starter.

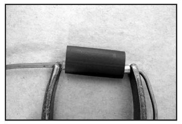
I don't trust the mechanical strength of crimped connections, even when using the proper tool and doing a double crimp, so I always solder as well as crimp, using the 'uninsulated' female crimp spades. Some claim that heat and solder wicking affects the strength of the copper conductors causing it to fracture about 1/4" from the end of the connector but you would have to leave a very hot iron on for way too long for that to happen. If you use an under-powered iron heat can travel to damage the insulation before the solder has run into the joint. I always use heat-shrink tubing over a soldered crimp connector for insulation, and about the first inch of wire to act as a strain-relief.

Spade adapters:



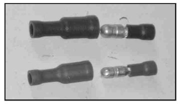
Piggy-back and branching adapters are very useful for wiring additions without cutting factory wires.

Bullets:



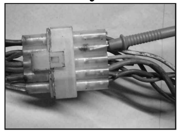
I always assemble bullet connectors and fan plugs/sockets at the front of the engine compartment using Vaseline which makes assembly easier as well as providing a seal against moisture. Even so it can take some force to push bullets right home into the

connectors, so I modified the handles of a pair of pliers. I subsequently discovered there is a specialised tool for this, but at £20 I'll stick with my modification, thank you very much. However replacement connectors seem to be rather inferior to the originals, not retaining bullets firmly enough, allowing one to be pushed in too far so it's opposite number isn't pushed in far enough, and plastic sleeves that slide all too easily to expose metal parts.



Sometimes it is necessary to replace electrical connectors, or you may be fitting additional electrical components. There are after-market, crimp-on bullets available, male and female in both cases, colour-coded for current carrying capacity - red (5amp), blue (15amp) and yellow in increasing capacity and conductor size, for one-to-one connections. The red males are too small for the standard bullet connector on the MGB and the blue ones are slightly too big. They can be forced in, but this distorts the connector and weakens it. Once a blue bullet has been forced in the connector will have opened up such that a standard bullet is now a loose fit, and crimping it tighter just weakens it still further. The brass bullets are the correct size for the standard connector, and are themselves too loose a fit in the blue females (confirming that the blue crimp type are the wrong size for the standard bullet connector).

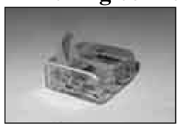
Multiway connectors:



Translucent multi-plugs can be tested by pushing a probe in along side the wires, again test both sides with the connector fully assembled. But moulded-on types can only be tested by parting the connector just enough to get a probe in, and even then only the pin-side.

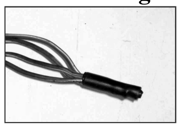
If not moulded-on the connector pins and sockets can be teased out of the connector blocks using a bit of tubing the right size. The pins and sockets have two little sprung tabs that stick out and latch behind a flange on the connector block as they are pushed in, I've used a piece of brake pipe to get them out. For projects or modifications Autosparks (and maybe others) sell plug, socket and connector kits in various sizes and shapes.

Branching connectors:

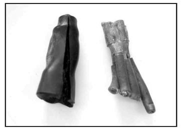


To connect several additional circuits to the some source i.e. 12v or earth these WAGO221 branching connectors are ideal.

Sealed Wiring Junctions *Added November 2009*



There are several junctions in wiring harnesses where a number of wires of the same colour come together in a sealed and permanent junction rather than a multi-way bullet connector. This seems to have started in the 1970 model years and these can be in the brown, black, green, red/white (instrument lighting) and maybe the green/orange of a late 1980 UK model. As far as I'm aware all are behind the dash i.e. where there are the greatest number of components in close proximity. Understandable in the brown circuit because of the high currents you can get and the need for low contact resistances, and where there are five or more wires coming together, but for other and lower current circuits where there are four or less wires in the junction it doesn't seem to make sense. Also 68 to 72 North American models were making use of 6-way bullet connectors in the white circuit (and the V8 at the front for lighting and cooling fan earth wires) at the same time as sealed junctions with six or less wires on other circuits - most odd.



The wires are crimped into a brass 'staple', for want of a better word, the wires and staple then being soldered. A heat-shrink end-cap is fitted over the junction first, then a length of conventional heat-shrink tubing over that, the two being shrunk over the soldered junction and that is all there is to it.

The chance of a fault developing inside one of these connections is highly unlikely bar severe abrasion of the insulation and hence shorting to metalwork, which is more likely to happen to a length of wire anyway.

An after-market version are these solder-sleeves, really intended for 'one to one' connections but you could probably get two slightly smaller wires in each end for branching, although they are 'permanent'.

Earth/ground connections:

by Felix Weschitz

Two types - a wired earth, and an earth derived from the physical mounting of the component. Although useful for other reasons the Dan Masters simplified drawings do not differentiate between the two and neither do they show which components share earths with other components, and some of those shared paths use bullet connections for branching. Earth faults can cause some very strange interactions between components and the Leyland/Haynes drawings will be essential to work out where the actual fault may lie.

Wired earths: From the Leyland schematics for the 62 to 64 MGB there seem to be quite a few wired earth points in various places:

- Headlights
- Wiper motor and instruments
- Dynamo control box
- Wiper motor switch and indicator switch (tell-tale contacts)
- Heater fan
- Fuel tank sender
- Fuel pump

After that there are generally only three covering all the above - one in the engine compartment for stuff at the front, one in the cabin above the wiper motor for stuff in the middle, and one (or two) on the rear panel for stuff at the back. Variations on this were:

- Early Mk2 and the 68 model year look like the engine compartment and cabin earth points were combined into one.
- Although the fan motor is in the engine compartment it always seems to have used the cabin earth point.

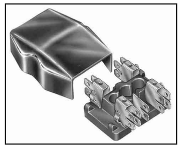
- North American Mk2 and rubber bumper cars use wired earths for the indicator tell-tales, prior to that it was picked up from their mountings.
- From around 1971 or 72 although there were only a couple of wires on the cabin earth point one of them fed a sealed junction behind the dash that could have many more wires, and some of those could be daisy-chained off various components and be branched in a series of 4-way bullet connectors with three or four wires.
- The schematic show that until 1972 models with the seat-belt warning the fuel tank sender used a wired earth abut picked up an earth from it's mounting to the tank and the tank to the body after that. RHD cars are shown as using a wired earth until the start of the 77 model year, but in fact all RB cars also used picked up an earth from its mounting even though the sender still had the earth terminal. Note that current stock plastic senders need a wired earth to a convenient point.
- From 1974 North American cars with the sequential seat-belt warning system used a wired earth for the number-plate lights on the number-plate backing panel, before that when they were in the overriders they picked it up from their mountings. This is via light unit - overrider - bumper - bumper iron - body and can fail to work with freshly painted components. RHD cars gained wired earths with rubber bumpers for the same reason.

Physical earths: A number of components pick up an earth for their electrical operation from their physical mounting:

- Starter motor and starter solenoid
- dynamo and alternator
- Distributor
- Chrome bumper front parking lights and indicators
- All rear light clusters
- Overrider-mounted number-plate lights
- CB (not V8) ignition, main-beam and indicator warning lights
- Horn button where it is wheel-mounted
- Overdrive solenoid
- Factory fog/driving lamps
- Early map light
- Instrument voltage stabiliser
- Courtesy light switches
- GT load space light
- Electric oil and temperature gauge senders
- Brake balance failure switch
- RB and all V8 fuel tank sender
- North American ignition switch with 'key in' warning
- North American anti-runon system oil pressure switch
- North American induction heater
- North American TCSA solenoid
- Horns 1977 on

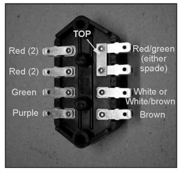
Fuses and Fusebox

Fusebox



Originally a 2-fuse unit was used, with one fuse protecting 'always powered' circuits like the interior light and horns and the other certain ignition-powered circuits. This fusebox is 'handed' in that one fuse has four spades at each end, and the other has four spades at one end and six at the other. It seems that the main harness for 1969 has five individual green wires at the fusebox, even though the Workshop Manual schematic only shows four, and in this case the fusebox needs to be orientated such that the six spades are pointing at the bulkhead and the five greens go on these, with the whites on the front of this fuse.

In 1968 and 69 in-line fuses were added to protect the parking lights - one for the front and one for the rear, simply added to the bullet connectors where the red wires came out of the main harness for the rear harness for the rear lights, and back into the main harness for the front lights.



In 1970 this was changed to a 4-fuse unit with the additional fuses protecting the parking lights, one fuse per side. This fusebox only has two spades per fuse end, and to accommodate additional wires two were sometimes put in one spade connector.

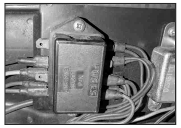
The 4-fuse fusebox is also 'handed' but in a different way to the 2-fuse, in that the front of the top two fuses are connected together as part of the splitting of the parking lights into two separate circuits with one fuse for each side. This link can only be seen from the rear, as shown here, but if you have some funny electrics and think you may have fitted it the wrong way round (which will put the linked pair at the bottom rear) you can check from the front by looking for the terminal numbers. These are quite small and easy to miss (circled on this image). In fact the Lucas Part No. and week of manufacture are easier to spot ('rectangled') and these should also be at the top of the fusebox when fitted to the car the correct way round.

Also shown are the riveted connections on the rear of the fusebox, which can suffer corrosion and bad connections. You may think that a solid connection here would be preferable, but the rivets allow the external spades to move from side to side while fitting the wiring connectors without twisting the fuse-holders, which would mis-align them with the end caps of the fuses. This could result in very small points of contact, so limiting current and resulting in volt-drops and hot-spots, which as well as affecting the performance of the electrics connected to that fuse this can also cause premature fuse failure. This image shows typical corrosion that can develop on the copper fuse holders.

The terminal numbers count from 1 at the top front to 8 at the bottom rear, slightly illogical when you consider that the bottom two fuses are the originals carried over from the 2-fuse fuseboxes. If you are wondering what the three circular holes in the fusebox are for and have lost your cover, then this image shows that the middle hole is for the cover locating peg and the two outer holes for spare fuses.

Fusebox connections: *April 2016* It's a common misconception that all wires at the fusebox are fused. Only the ones towards the rear are fused - outputs to the purple circuit (horns, interior lights etc.), green circuit (fused ignition stuff like instruments, brake lights, reversing lights etc.) and on fuseboxes with four fuses red circuits (parking lights one fuse per side). The ones towards the front are the unfused supplies to the fusebox - brown (powered all the time), white or white/brown (powered with the ignition on), and red/green (powered with the lights on).

It's also confusing as to why there can be two or more browns, whites or white/browns on the front of the fusebox. This is because the fusebox is being used as a branching point as an alternative to using a multi-way bullet connector with three or more wires. The power comes in on one of the wires, and goes out on the others as well as going through the fusebox. This happens elsewhere where there are two or more greens for example on a component - again one is bringing power in and the other is daisy-chaining it on to another component.



Where there are only two wires of a colour they will usually have separate spade connectors but on the four-fuse fusebox where there are three or more of the same colour two will share one spade connector as each end of each fuse only has two spades. An exception can be for the red wires which power the position markers (parking lights) where both wires feeding one side will share a connector even though there is an unused spade on each fuse.

Prior to 1977 a white wire from the ignition switch supplies power to the fusebox and there can be anything from none to three other wires of the same colour there. These other whites are feeding things the coil, fuel pump, overdrive and heated rear window at various times. But where there is only one white wire on the fusebox the ignition switch is feeding a bullet connector by the bulkhead and further wires in that bullet connector are then feeding the fusebox, coil and fuel pump. There are many subtle differences over the years, and you have to be looking at the right diagram for your car to work out what is going on for diagnostic purposes.

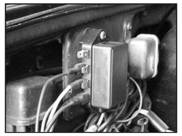
In the case of the white/brown on 77 and later cars with the ignition relay, the feed is from the ignition relay to the fusebox, but after that there are differences between 77 and 79, with the change being made some time in 78.

It started off with there being three other white/browns at the fusebox - one to the coil ballast, one to an in-line fuse for the cooling fan, and one to the usual bullet connector by the bulkhead for the fuel pump and overdrive - see this schematic.

After the change there were only two other white/browns on the fusebox - one to the in-line fuse for the cooling fan, and the other to the bulkhead bullet connector. Now the coil ballast is fed by the ignition switch, but using a white/brown wire on the same ignition relay terminal as the white wire! This goes to the coil ballast then branches off to a new in-line fuse under the fusebox, which feeds things like the heater fan, indicators, and heated rear window - see this schematic.

If that weren't enough both these in-line fuses have white/brown one side and green the other, making three separately fused green circuits in all. Not only that but the way the wires run and the fuse holders have been connected, it's possible to connect both the white/browns together, and both the greens together (as a new harness that came to me was), which makes things very confusing indeed.

Fusebox mounting: *June 2016* The first thing to say is make sure you fit the 4-fuse fusebox the right way up! These have a link between one end of two of the fuses, and this must go at the top and the front or when everything is connected up the ignition will be permanently powered.



Pondering replacement of Vee's fusebox as well as Bee's I thought I'd take it off and have a look at the back. However the lower screw was seized and the cross-head slots stripped. Eventually I cut a slot across the head with a junior hacksaw (space limited for drilling given the V8) which got it turning with a large flat-blade screwdriver, until it sheared. Fortunately it did so leaving a stub long enough to get a Mole wrench on, and with the previous application of WD40 and Shock and Unlock it unscrewed, so a new screw needed - and that's where the interesting bit started, in that the 73 roadster and the 75 V8 have quite different mounting arrangements, let alone earlier and later models.

The 73 roadster fusebox is screwed to a plinth, with nylon sockets pushed into it, and pan-head self-tappers.

The 75 V8 fusebox is screwed to welded nuts on the inner wing, with a sheet of insulating material under the fusebox, then spacers between that and the wing. I'm not sure why the insulating sheet or the spacers were felt necessary, there is nothing loose under the fusebox and the electrical parts are spaced away from the base. The roadster doesn't have either, and the surface of the plinth is solid just like the inner wing.

Moss Europe and MGOC say the screws are SE910201 (3/16" UNF x 3/4") up to chassis 456250 (Feb 78), with AB610081 (No.10 self-tapper pan head 1") and hence the nylon socket after that. Brown and Gammons says they are PMZ316 (3/16" UNF but 1" long) from 70 to 77, with AB610081 (as above) from 77 on. Note that my 73 has the self-tappers and nylon sockets despite the above saying these weren't used until 77 or 78, and whilst they are 1 1/4" from tip to top of the head, they project from the nylon socket by about 1/4", so a 1" should be OK. The screws on the V8 **are** 3/16" UNF, but they are 1 1/2" long rather than the 3/4" or 1" mentioned above. When fitted the end of the screw just reaches the far face of the nut so they are not over-size, a 1" would not allow the spacers to be used. Since a nylon socket was used in the 73 and avoids problems of corrosion either causing the screw to seize or the panel to rust, it seems odd that the 75 should have the less desirable arrangement. No mention of spacers or insulating sheets by the above three suppliers. The Parts Catalogue has no information at all on screws, nylon sockets, spacers, or insulating sheets.

Fusebox replacement: *May 2016* I decided to replace Bee's fusebox as prior to the MOT the horn seemed a bit iffy, the fuse holder springs were well tarnished, and it isn't easy to clean them. But the new one doesn't grip the fuses anywhere near as tightly as the old - I had to tweak the springs closer together, and the neither does the cover hold the spare fuses as tightly as the old. One of the spares does seem to be a little undersized and isn't gripped at all, but was held by the old cover. Never mind, I'll just use the old cover on the new fusebox ... only to find that the new fusebox is a couple of mm longer and the old covers won't fit! No 'Lucas' branding or part number on the cover, so obviously after-market despite the OE part number being used by suppliers.

As mentioned above I decided to replace Vee's fusebox as well (at £10 from Moss it's not worth trying to clean up corrosion) but one of the screws sheared as they go into welded nuts on the back of the inner wing and hence are open to water and salt from the wheel arch, and none of the usual suspects show the correct screws i.e. 3/16" UNF x 1.5". But I got a pair of stainless from Stig Fasteners at £3.12 shipped.

In-line Fuses:

- First used in 1968 and 1969 to fuse the parking lights before the 4-fuse fusebox, one for the front and one for the rear, with 10A fuses.
- None used in 1970, but in 1971 one was used in the 'accessories' circuit for the heater fan, wipers and radio where fitted. Positioned under the main fusebox between the white/green from the ignition switch and the green/pink on to the aforementioned components, with a 35A fuse. Deleted on rubber bumper cars when the heater fan and wipers were powered from the ignition green circuit again and only the radio was powered from the accessories circuit direct off the unfused white/green, presumably with it's own in-line fuse.
- One was added for the hazard warning lights in 1974 (North America for Mk2), very inconveniently located behind the centre console initially, subsequently moved to under the main fusebox, brown wires both sides, 35A.
- In 1977 the ignition green circuit was subdivided with an inline fuse feeding the electric cooling fans. Mounted under the main fusebox, white/brown on one side and green on the others, with a 35A fuse.
- In 1978 RHD cars gained a second subdivision feeding the tach, indicators, heater fan and GT HRW, white/brown to green and 35A as before. **Note** that these two have been arranged such that it's possible to connect green to green and white/brown to white/brown which will cause some head-scratching, a new harness came to me like that!

As well as for new circuits it's a very good idea to fuse the fuel pump and the overdrive circuits as shorts have occurred in both causing damage to the various harnesses. The V8 came to me with the cooling fans unfused - they were originally powered from the main green circuit as was the heated rear window but those two alone take 20 amps i.e. more than the 17A rated fuse. I powered the HRW from a fused relay off the brown circuit which boosted it's performance as well as taking load off the main green circuit and ignition switch. I suspect there was an official change to power the fans directly off the brown circuit which left them unfused. I didn't like that so added an in-line with a female spade one and and a male the other so it could be reversed at any time.

In-line fuse holder failures:

Good job as I did, as three times now fuse-holders have suffered heat damage and installing them how I had I was able to take the fuse out of circuit. The first one was a 'recovered' blade-type where the fuse had partially melted but still worked, only discovered by chance when for some reason I removed the cap! The second and third were new 20A eBay items that came complete with fuses, and both suffered heat damage in the holders where the ends of the fuses made contact with the holder terminals. After the second one I looked at these holders and fuses more closely, using an unused one from the same batch and made some interesting discoveries.

I opened up an unused one and the fuse stayed wedged inside, refitted the cap and realised the cap terminal wasn't in contact with the fuse. Trying different fuses they didn't jam, so I started measuring them and discovered that the included fuse end cap diameters were up to 0.2465" whereas the separately bought ones were slightly smaller at 0.242". Aha - too big for the holder? The larger ones the other way round, or twisted slightly, they didn't jam so it was really marginal. So was that the cause i.e. the fuse not free not making proper contact with the terminals? But then I compared the length and found the included fuses were 1.27" and the separately bought ones were 1.195" and a noticeable difference. Then I realised it was a separately bought i.e. shorter fuse in the second holder, so was it a case of the spring not pushing hard enough?

When I fitted headlamp relays and fuses to Vee I bought the bits from 12v Planet and have a spare fuse holder I can test the fuses with. These seem to have a larger internal diameter than the eBay ones as there is no sign of the larger fuse sticking, and it has a stronger spring which should mean even the shorter fuse is making a better contact. So buyer beware.

November 2023: Needing to pump a gallon out of Bee's tank using the on-board fuel pump I was surprised to find the fuse warm to the touch.

Fuses: As well as the two or four fuses in the fusebox there were a number of in-line fuses at various times. Unless otherwise stated these were always 17 amp rated, 35 amp blow.

- Firstly Mk2s prior to the 1970 model year had two in-line fuses where the rear harness joined the main harness for the parking lights - one 10A fuse for the front and one for the back. These were deleted at the fitting of the 4-fuse fusebox where the top two fuses are for the parking lights.
- From 1971 to the end of chrome bumper production the so-called 'accessories' circuit - so-called because it powers the wipers and heater fan (and North American screen washer) as well as the radio - had an in-line fuse under the fusebox with white/green one side and green/pink the other. All V8s i.e. both chrome and rubber bumper had this system, which also powered the electric washers.
- 1973 North American cars gained an anti-runon system utilising an electric valve and in-line under the fusebox.

- The 1974 models gained a hazard flasher and these are powered with an in-line with brown wires both sides. Originally behind the centre console (with the flasher unit - hardly convenient). The fuse moved to under the fusebox on rubber bumper 4-cylinder cars, remaining behind the console on V8s.
- For 1974 only North American spec cars had the sequential seat-belt system with its own 500mA line fuse with brown one side and brown/purple the other, location unknown.
- 1977 models had a second separately fused ignition circuit from an in-line under the fusebox with white/brown one side and green the other.
- At some time in 1978 RHD cars gained a third fused ignition circuit, from another inline under the fusebox and also having white/brown and green wires. Someone must have been having a laugh with these as the fuseholders and the wiring is such that you can connect the two white/browns together and the two greens together, which is how a new harness came to me.
- One of these seems to have been replaced by a thermal cut-out - probably the cooling fan fuse. Clausager says that between January and March 1978 "Thermal cut-out switch instead of line fuse to eliminate fuseholders overheating". He indicates RHD as well as LHD, but I've not heard of them being found in the UK, just a couple of occurrences from America. As North America had twin fans but the UK 4-cylinder only a single it does make more sense if it were LHD only. Certainly the first fuseholder I retro-fitted to the V8 (none from the factory twin fans) melted in normal use. And the 2nd, and the 3rd!

The tubular glass fuses used on the MGB usually show quite clearly when they are blown, especially if they have a slip of paper inside, and it can be confirmed with an ohmmeter. But it is not unknown for a bad connection to develop between the fuse wire or tape and the end cap, and appear to be sound. An ohmmeter may also show good continuity, but ohmmeters are not a reliable indication of a bad connection. The fuse needs to be in its holder, and the circuit powered and drawing current from one or more of the components it is supply, then to test both sides of the fuse with a voltmeter. There can also be bad connections at the fusebox between the end caps and the fuse holders, between the fuse holders and the spade terminals, and between the spade terminals and the spade connectors, so each of these points need testing as well, more info here.

With the exception of those specified in the above list MGB fuses are glass 17 amp continuous/hold rated, 35 amp blow rated, GFS3035. The Parts Catalogue specifies 35 amp i.e. the blow rating, and **some replacements are only described with one rating so you would have to be sure that relates to the blow rating and not the continuous rating or you could find that in a short-circuit situation the fuse wouldn't blow and the wiring would be damaged**. Most of the usual MG suppliers only give the 35A rating, Moss in some places gives the continuous rating as well but in others only the blow rating. One source (who I refuse to use anyway) states 35A but shows 25A! It's claimed that **generic** American fuses only state the continuous rating, so you would need to use a 15 amp or 17 amp, not a 30 or 35 amp. Also these generic American fuses are said to be physically slightly longer than UK fuses at 1.25" as opposed to 1.17" so at first glance look the same and will fit the fusebox, but could cause a problem with in-line fuseholders. However US MG parts suppliers such as Moss, Victoria British and LBCarCo do supply the correct 17 amp continuous/35 amp blow fuses. Fuses can come with a slip of paper inside giving the rating, or it is screen-printed on the outside of the glass, or stamped into one of the end-caps. The first two can give either one or both values, the third one only one of the values.

There has also been some unnecessary worriting about the voltage rating of MGB fuses. Automotive fuses seem to be rated for '32v', or 32 volts, even though our cars are 12v. This seems to be simply because some august body has decided every electrical component must have a voltage rating, and (presumably) because automotive applications don't usually go above 24v they have decided on 32v! An MGB owner was concerned that as his system was 12v, should he be fitting a lower rated 32v fuse instead of a 35 amp? The answer of course is 'no', amps are amps and depend on the voltage and resistance in the circuit they are testing, not some notional maximum safe voltage which is what the 32v represents. But even that notional safe voltage is ridiculous - voltage ratings are supposed to represent the maximum (plus a safety factor) voltage the fuse can break without arcing occurring between the end caps so allowing current to continue to flow. 250v fuses are half the length or less of MGB fuses, as are modern blade-type fuses. The concept of something higher than 32 volts jumping between the end caps of an MGB fuse when the fuse blows is ridiculous, even 20kv HT voltage wouldn't jump that, and 250v fuse are less than half the length. The bottom line is that as long as you fit a fuse with the correct **current** rating, ideally one specifically for British cars of the era i.e. 17 amp continuous/35 amp blow and not a modern generic item of a similar physical size that seem to be available in America, you will be fine.

You would be well advised to add fuses to the fuel pump and overdrive circuits, as both these have been known to short out and cause major harness damage. See Pump Fusing and Overdrive Fusing.

Blowing Fuses
This can be a bit of a beggar, especially if it's intermittent. Even if it is constant you don't want to keep blowing fuses while you are diagnosing the problem, and I'll deal with this first. Temporarily replace the fuse with a high-wattage bulb. You can get away with a 21w indicator or brake light bulb, but a headlamp bulb (e.g. one with one blown filament but one good one) is better. Why not use a meter? If you used an ammeter, that has a very low resistance to current flow, which will still allow a very large current to flow. If in series with a fuse the fuse will still blow, if not it could damage wiring, or the meter. Solder a couple of wires to the bulb, and use it to replace the blowing fuse. Then while switching things on and off, waggling wires around, or parting and joining connectors, watch the bulb. If the bulb glows at full brightness you know the short-circuit is present. If it's out, or just dim, you know the short-circuit is not present. On any of the fused circuits if only one circuit at a time is powered the test bulb - especially if it is a headlamp bulb - won't glow at full brightness. It will get closer to full brightness if you turn all the circuits on the fuse on at once, like brake lights, reversing lights, heater fan, wipers etc., but not otherwise. The bulb is limiting the current that can flow to a safe level, and you aren't shelling-out for dozens of fuses. However don't think you can operate the car like this, as in the case of an intermittent fuse blow, as the bulb will be taking some of the voltage away from the circuits normally fed by the fuse, so either they won't work properly or they won't work at all. It's simply a diagnostic tool. The fault could be on the wire leading from your test bulb, in which case the bulb will be bright even though all circuits fed by the

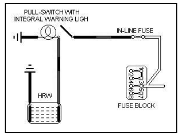
fuse might be switched off. In this case you will have to study the circuit diagrams and work out where the branches are, i.e. at bullet connectors, so you can isolate various branches to isolate the offending one. Unfortunately while pulling the wiring about to find, disconnect and reconnect these bullets you may well cause the fault to disappear, to appear again at the most inconvenient and inopportune moment. If the test bulb only goes bright when a particular circuit is switched on, then the fault is between that switch and the component it is powering - which should be easier to find.

For intermittent fuse blowing you have to be a bit cleverer. Get a couple of in-line fuseholders, with, say, 10 amp fuses in them, and use those to subdivide the fused circuit into separate sub-sections. It's then a matter of waiting until a fuse blows. As the factory fuses should all be 35 amp blow, your 10 amp sub-section fuse should blow first, leaving the main fuse intact. This does mean you will have to replace sub-section fuses as you go, but it's about the only way if waggling wires with the test bulb as above doesn't help by bringing the short on. If there is more than one spade used on the fused side of the fusebox (as is often the case), you can put one or more sub-section fuses on each of those first of all. Then by seeing which circuits work and which don't when the sub-section fuse is blown, and consulting the diagrams, you should be able to work out which 'branch' of the circuit has the problem, and so which parts of the branch to move the sub-section fuses to next, i.e. at bullet connectors. There are quite a few branches at bullet connectors in the green circuit, however some parts are daisy-chained, with two green wires in a single spade connector, meaning your sub-section fuse can isolate just one component or circuit at a time, and not a group of them. Hopefully, short of accident damage, only one circuit will be the cause, and it doesn't happen very often anyway.

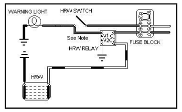
Heated Rear Window

Before the 1973 model year the heated rear window was always optional. For Mk1 North American spec and prior to the 1972 model year elsewhere a pull-switch with integral warning light was provided on a separate small panel somewhere. For Mk2 North American spec and 1972-on for other markets the switch and separate warning light moved to the centre console, and for 1977-on to the main switch panel. Clausager says that for the 1977 model year until December 77 the switch had a built-in warning lamp - quite why is unknown as there was a blank position for an external lamp beside it, and there is no reference to it in the Parts Catalogue. In December 77 the switch was changed to AAU3210 with an external warning lamp beside the switch, and the diagrams only show this arrangement. In 1980 there was now a rear fog lamp switch which took the place of the external warning lamp and the HRW switch was changed back (?) to one with an internal warning lamp. This switch does not appear in the Parts Catalogue, wiring diagrams or suppliers catalogues so I don't have a part number, however the Mini switch of the period YUF101680 may suffice although it has a yellow lens in the rocker whereas it looks like the original had a green lens.

Prior to 1971 (Mk2 for North America) a separate wire (green/black in the schematics) was run from the switch to the back of the car, after that it seems to have been part of both main and rear harnesses (white/black, including roadster main harnesses, it not being worth producing a separate harness minus that one relatively short wire), even though prior to 1973 the HRW was still optional on all cars. From 1973 on HRW was standard on UK cars although the Leyland schematics continue to show them as optional and Haynes only shows it as standard in the final 'later models' diagram. In December 1974 production of the GT for North America ceased, and for other LHD markets in June 1976.



Up to 1970 they were powered off the white circuit via their own in-line fuse - white to green/black (white/black Mk2 North America) - near the fusebox, the remainder of chrome-bumper cars were powered from the green circuit, sharing this with many other components.



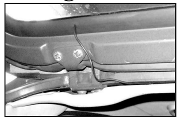
Rubber-bumper cars up to December 1977 (but not V8s) had a dedicated relay and powered the HRW from the purple (fused) circuit. After that it reverted to no relay and was powered from the green circuit again as there was now an ignition relay which took the load off the ignition switch. However that was only for one year, apparently there were problems with the relays sticking on and leaving all the ignition powered stuff running even with the key in your hand. So some time in 1978 on RHD cars things like the ignition, heated rear window, indicators and heater fan were moved back to the ignition switch, but the fuel pump was still left on the relay, see the ignition schematics for more info. At that point the HRW (plus indicators, heater fan and tach) were powered from one of two inline fuses under the fusebox that connected a white/brown wire to a green wire. One of these has thick wires but this is for the cooling fan, the HRW etc. are powered from the other one with the thinner wires.

When powered from the main green circuit not only does this have a tortuous route through many components and connectors in the brown, white and green circuits but because of the very heavy drain of the HRW it reduces the voltage to these other components and results in a low voltage at the rear screen, only about 7 volts in my case. Most of the other circuits aren't that bothered by the lower voltage but the indicators are very sensitive to it and use of the HRW can stop them flashing at idle if headlights, fans etc. are also on. Whilst this is usually due to one or more (probably several) bad connections, tired flasher unit, tired bulbs etc. even good connections result in low voltage at the rear screen. My flashers didn't stop with the use of the HRW but they did slow down so I decided to add a relay to remove the load from the green circuit and boost the voltage to the HRW at the same time

Updated September 2015: On my 75 V8 the window element measures about 1 ohm at the contacts on the sides of the glass, so from Ohm's Law with the engine running and the system voltage at about 14v one could expect about 14 amps to flow in the circuit. However as mentioned above taking its voltage from the green circuit, the

long run, and the ageing connectors I was getting about half that at the HRW connections, the rest being 'lost' en route.

Testing:



There often questions about the wiring and connections to the HRW on the tailgate itself. There were two types of HRW - the earlier embedded wire element type and the later surface-printed element type, I can only speak for the latter. On my V8 the wires exit from a hole in the rubber seal surrounding the glass very near the hinges, and terminate in bullets. The wires run down under the seal to the element connection points which are about mid-way down each side. The rubber seal is pretty hard to lift, and I don't want to damage the connections, so I've been unable to determine what lies beneath, but word is that it is a small spade connector (*October 2011:* it is, see here). You should be able to test at these points with a voltmeter to see if non-functioning of the HRW is due to a break in a wire feeding the element, or a problem with the elements themselves. If you have 12v on the right-hand side of the screen (the supply side) and see voltage on the left-hand side then there is a fault with the earth connection, it should be 0v or close to it.

Note that due to the high current drawn by a working screen some voltage drop in the long wiring run and connections from the front of the car is inevitable, and will result in something less than full system voltage being seen at the screen spade contacts. Bad connections will result in significantly higher volt-drops leaving progressively less voltage to be measured at the screen spade contacts. But the more horizontal tracks that have failed the lower the volt-drop will be, and if the screen itself has completely failed (as opposed to just one or two tracks), or the earth connection on the other side of the screen is missing, you will see full system voltage at the right-hand spade connection with respect to a good body earth.

As well as the connections at the front of the car, and above the rear cant rail, there is another connection by the right-hand rear light where a 2-wire sub-harness with white/black (HRW) and purple (load-space light) joins the main rear harness.

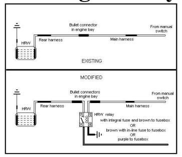
Note also that any bad connections in the earth connection will result in something higher than zero volts being measured at the spade connection in the middle of the left-hand side of the screen, with respect to a good body earth, as well as a higher voltage than normal at the spade connectors on the right-hand side.

For the earlier embedded element type that's about all you can do, but for the later surface-printed type you can go further, and should be able to measure voltage anywhere along the tracks. Connect the negative of your meter to a good body earth, then use the positive probe lightly (to prevent damage) on the exposed surface of the track. Right by the spade connectors at the side of the glass in the middle you should see the full voltage that is reaching the screen.

Assuming the screen is working, testing at various points up and down the main track at the right-hand side of the screen will show a small drop in voltage as you move away from the spade connections in the middle, in the order of a couple of tenths of a volt at the ends of the vertical track.

Moving along any horizontal track should show a gradual reduction from the voltage measured above, towards zero (but see above), being about half the voltage in the middle. Note that if you have a broken track, the voltage will NOT gradually reduce along that track, but will suddenly drop to zero as you cross the break.

Adding a Relay:

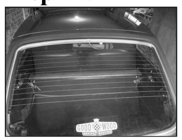


I added a fused relay direct off the brown circuit and that increased the voltage to 10 volts at the connections to the harness under the rear cant rail, 8v at the element contacts, and a measured 8 amps. Despite that being quite a bit less than the theoretical 14v it's still about 80 watts and has made a significant improvement to screen clearing.

It is convenient to interrupt the white/black at the bullet connector where the main harness joins the rear harness near where the firewall joins the right-hand inner wing. Mount the relay near the fusebox so there is a short run of thick brown wire between the two. Use a relay with an integral fuse or an in-line fuse close to the fusebox. Pick up the earth from the physical mounting, then run two wires from the relay - one to the existing bullet connector still on one of the wires and a new connector on the other. It would be preferable to use the new one on the wire to the rear harness as that carries the greatest current, and clean up the bullets. You could add a thick purple back to the fusebox instead of a fused relay or separate in-line fuse, although I used a brown as I was not aware of the factory relay arrangement at the time. Also make sure the connectors and earth at the back of the car are clean and sound.

The ignition, via the HRW switch as before, controls the relay which draws a very low current whereas the high current is carried by the relay and the short run of thick wire back to the purple (or brown) at the fusebox, and ensures that the HRW is only powered when the ignition is on. This increased the voltage at the rear screen from about 7 volts to about 10 volts. If you mount and insert the relay at the connector at the back of the car and run the thick brown direct to the battery you can get an even higher voltage, but even with my arrangement the screen clears noticeably quicker than before.

Repair:



Peter Ugle reports that after trying various repair paints for the surface tracks without much success he obtained a custom-made replacement kit from DS Demist which works really well. **The link I had for DS-Demist now displays a web page that will infect your computer if you click anything on it, and you have to force close the browser or shut down the computer. On no account click anything on a page like that. The same link is displayed on Citroen DS car sites, so take care there as well.** *April 2016:* One such paint is from Bare Conductive, but from their data sheet you can see a 70mm strip 3mm wide has a resistance of 473 ohms. Now this is much longer than one would hopefully need to repair a track, but even if it were only 1mm long it would have a resistance of nearly 7 ohms. And if one kept to the track width of about 0.75mm it goes up to 28 ohms, although increasing the thickness will reduce it. As my screen measures about 1 ohm, which represents 9 elements of 9 ohms each, you can see that even one 'repair' is going to leave the track virtually useless for screen clearing. There is also this HRW kit from Holdens, which consists

of lengths of self-adhesive foil that can be cut into narrow strips and stuck to the glass. Expensive at £60, it's intended for providing full HRW rather than a repair, and I don't think I could reasonably cut anything as narrow as my strips, and there is the problem of connecting the ends to the existing connectors. They say it is suitable for front screens as well, but getting it thin enough not to cause annoying if not dangerous obstructions would be difficult to say the least.

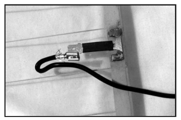
August 2016: The above paint is not aimed at HRWs, but another specifically for HRWs is Granville Electro Connector. They couldn't tell me the resistance of a typical bead of product, saying a typical repair is a 'thin bead to a preferred short length of 3-5mm although it is possible to mend longer breaks'. At the time of writing the typical price from Amazon and eBay is in the order of £15, but amazingly Halfords have it for £11.49! Mostly negative reviews, but one gave a detailed description of how he made a successful repair, so I thought it was worth a punt. The ZS has lost an element, testing with a meter located the fault but there is no visible break, so hopefully it is hairline and stands a chance of repair by bridging it. It took three goes ordering online before they managed to find it in the store, by which time they had reduced the price to about a tenner for my trouble! A single-coat test section about 1mm long and the same wide exhibits a resistance of about 1 ohm, which is significantly less than the other product. I had to wait until the weather was warmer and dryer before I could apply it, then wait for damp weather before I could test it! It didn't work, and despite re-testing and finding the break right at the end of the repair, and applying a longer repair, it still didn't work. Annoying, as I hate seeing that dead track in my rear-view mirror. Even more annoying is a second dead track a year later.

I also found this Loctite 'Rear Window Defogger Tab Adhesive', and a couple of other repair possibilities from Permatex.

Replace:

March 2019: Graham Moore bought an unused NOS screen that was 24 years old. However it measured about three times the resistance mine does and two of the tracks were defective, when tested using steam from a kettle. Close examination shows copper oxide on parts of the tracks, i.e. corrosion, so I suspect the tracks have 'thinned' making them higher resistance than they should be, to the point of going open-circuit altogether on the two defective tracks.

As well as the usual considerations for front and rear screen glass replacement there are the electrical considerations for the HRW. The original has two small spades on each side of the element, one pointing up and one pointing down, concealed under the rubber seal. Wires run from these under the rubber seal to exit at the top near the hinges, for connection to the vehicle wiring, which is very unobtrusive. However replacement screens seem to have a completely different connection arrangement that is very much less than ideal.



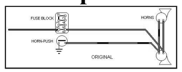
There is only one spade connection each side of the element which is fair enough, but it protrudes across the face of the glass in line with the elements, quite a long way. As the wire connector has to push onto this spade, the wire will protrude even further, and be quite unsightly. Anything catching on the wires could well rip the connection off the glass, and you would be back where you started. It might be possible to bend the spade back on itself so it is pointing at the seal instead and the wire could come out from the seal straight onto the spade, but great care would be need to hold the 'glass' end of the spade steady while you did so. Probably the best bet is to use a right-angle wiring connector instead, the wire making another right-angle from that to go under the seal. You will still need to take great care when pushing the wiring connector onto the spade, I'd advise trying it on another spade elsewhere several times to make sure it slides on easily.

But even better - and brave - is Joshua Taylor's approach which was to bend the spade over (while keeping the glass-end clamped to the screen top prevent it breaking off!) back on itself so the connector was under the seal.

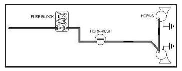
Another possibility is a fan heater - many different types, all more powerful than the screen, some several times more so. But don't go too mad or it could crack the glass!

Horns *Updated September 2013*

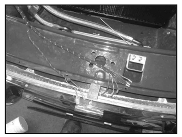
Description:



Originally the horn push put out an earth to one side of the horns, the other side being wired back to the purple fuse, these are known as '2-wire horns'. Apart from 1970, 77 and 78 the horn push was on the steering wheel picking up its earth from the steering column (which can be high-resistance resulting in poor horn operation), in the other years it was on the end of the indicator stalk and had a wired earth which avoided the problem of a poor earth from the steering column.



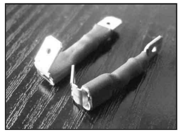
For the 1979 and 1980 model years the horn push (still on the indicator stalk) was fed with 12v from the purple fuse, and thence to one side of the horns, the horns picking up a local earth from their physical mountings. These are known as '1-wire horns' and as well as saving about 3 feet of wire they eliminate they also eliminated problem of the poor earth connection through the steering column mentioned below but corrosion can still result in a poor local earth at the horns. Clausager dates this change to chassis number 471001 in May 78 for the start of the 79 model year.



Also originally there was only one pair of wires for the horn as the second horn was optional. This came out by the right-hand headlight and went to the horn mounted on a flat bracket on the slam panel. This harness also only had one set of bullets for the front lights in the centre of the slam-panel, the tails from the light units reaching that point also. If you had the optional second horn there was a sub-

harness between the two. Later harnesses had one set of lighting wires by each headlight, the tails from the lighting units being shorter, and these seem to be the only ones available now so for the earlier harness you will need to make up extenders to reach the near-side lights units at least and coil up some slack in the main harness by the off-side light, or have extenders both sides to the middle.

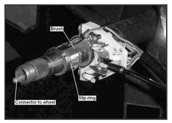
Clausager says the horns moved to the inner wing in 1963, and that from 1970 'all cars now had' twin horns, implying that some markets e.g. North America may have had them earlier. I've not found that itemised in his book, but the Workshop Manual schematics do show twin horns for North America with the start of the Mk2 in 1969.

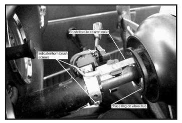


Note that with the early harness where a sub-harness is needed to power the second horn, you need a horn with two sets of spades on each terminal for the right-hand horn at least, these horns were BHA4514 and BHA4515. Later horns only have one spade per terminal, so there is nowhere to connect the sub-harness. On cars with twin horns from the factory the wiring to the right hand horn has two wires in each spade connector, so horns with only one spade per terminal can be used. You can use a male-male-female spade adapter on a later horn with the early harness.

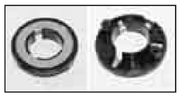
Originally the horn push was in the centre of the steering wheel. For North American MkII models and in 1970 for other markets it moved to the end of the indicator column stalk but was unpopular and reverted to the centre of the wheel for all markets in 1971. It remained there until the 77 model year when all markets moved back to the indicator column stalk until the end of production. (NB. Either arrangement is far preferable to that on the ZS, which has two little buttons at the edge of the large centre boss. This means that not only are they several inches away from fingers and thumbs when holding the wheel in the correct '10 to 2' position, but the buttons also move position as the wheel is turned. With their small size and changing position you have to look to see where they are before you can sound the horn, and you need to use a finger-tip rather than the palm of your hand, hardly ideal when you need to give an urgent warning of approach!

Wheel-centre horn push: *Updated October 2009*
Replacing a Moto-Lita steering wheel with an original





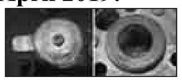
The various arrangements for connecting to the wheel-centre horn contacts can be seen by clicking the thumbnails to the left. Note that North American Mk2s, and other markets for the 1970 model year, moved the horn push to a column stalk. But this was not liked and it moved back to the horn centre for all markets for the 1971 model year. However it moved to a column stalk again for the 77 model year to the end of production.



The sprung wire (69 and earlier) and 'pencil'/sprung rod (71 to 76) that connects to the live side of the horn contact are often described as a 'brush' but that is incorrect. A brush is something that typically provides a rubbing contact between a fixed component and a rotating one, e.g. on the commutator of a dynamo or motor or the slip-rings of an alternator. The sprung wire/rod rotates with the wheel and column and don't rub on anything, they just provide a sprung contact to the horn push contact.

Wheel centre horn buttons **do** have a brush, but it is a contact fixed to the column outer and as the wheel and column turns either rubs on an insulated brass cylinder on the column (69 and earlier) or on a slip-ring on the back of the wheel (71 to 76). This brass cylinder and slip-ring are connected to the sprung wire or rod, which then connects to the horn push. Some think that the pencil rubs on the back of the brass ring that is on the rear face of the wheel as it is turned, but a moments thought and a turn of the wheel with the horn push removed will reveal that the wheel, sprung wire/pencil, and horn push all rotate as a unit. The sprung wire and the pencil simply sit between the horn contact and the column or wheel slip ring, under spring tension, but rubbing against neither. They are spring-loaded to absorb the movement of the wheel centre when the horn is sounded, as well as press on the slip-ring and horn switch to make a good connection between them. The pencil in particular seems quite a complicated component for what it does, the same thing could have been achieved (without detachability) by soldering a wire between the slip-ring and the horn contact. Detachability could have been achieved by having a pull-apart connector in this wire. Some after-market wheels dispense with the instant detachability of the factory 71-76 horn-push. The Moto-Lita wheel on my V8 has a wire soldered to the back of the slip-ring which connects to a threaded stud on the back of the wheel centre with a nut, removing this nut allows the horn-push to be detached from the wheel, and the fitting of pushes with different logos as required. The 71 to 76 pencils can be fitted either way round and the horn will function, but the correct way round is with the long hex brass rod pointing at the slip-ring on the back of the wheel and the end with the insulating sleeve facing the horn push. This way round means that the brass ends of the pencil can't come into contact with the frame of the horn push, which is at earth or earth potential (and would sound the horn) when any of the springs are touching the wheel, when refitting the push to the wheel or if the push is rotated once fitted. The factory horn push has four bosses which fit between the heads of the bolts securing the rim and spokes to the hub, and these only allow the horn button to be rotated a small amount in either direction which in practice keeps the pencil away from anything at earth potential even if it has been fitted the wrong way round, as well as keeping the logo centralised (once fitted correctly in the first place).

April 2019:

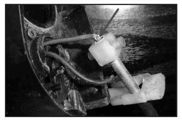


I discovered during a very rare need to sound the roadster horn that it needed to be pushed in a certain way, whereas pushing anywhere on its periphery (tilting it) or pushing it straight down should work, so an opportunity to inspect it. Three screws connect the earthed base to the rubber push via springs, and another screw attaches the 'live' contact to the rubber push, and both that and the copper ring round the hole in the earthed centre were pretty manky. A bit of fine wire wool cleaned both up, and reassembled and refitted it now works as it should.

August 2019: At least I thought it had. Something made me try it while driving, and again some positions worked and some didn't. Back home I tested the horn push with an ohmmeter (not ideal) and all the way round it was about a couple of ohms which shouldn't cause a problem with the relay I have fitted. That relay is powered from the

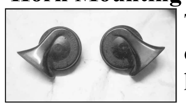
purple circuit behind the dash i.e. for the courtesy lights and headlamp flasher, whereas I discovered just the other day that of the three purple wires at the fusebox, two are standard-size in one spade connector and power the courtesy/boot lights and headlamp flasher, and a thicker wire is in it's own spade connector and goes direct to the horns. With that wire pulled off and the other two connected I realised I could hear the relay operating without the horns blaring out. And working round the edge of the horn push I could tell that the relay was operating better in some positions than others, and it varied if I turned the wheel a little. So this time use a voltmeter on the horn brush behind the wheel (after removing the cowl) and find the 12v is only dropping to 2 or 3v instead of zero volts. So off comes the wheel and I clean up the brass slip-ring on the back - which is pretty manky - with Solvol Autosol, and the stud on the brush. Peering into the horn-push pencil hole the back of the slip-ring looked pretty manky as well, so removed the slip-ring and its carrier from the wheel, and bent back the three tabs to remove the brass ring from the carrier. Tried cleaning that with Solvol Autosol but it is pretty pitted from having carried horn current for many years before I fitted a relay. So polished up another section and refitted it to the carrier rotated 120 degrees to use a 'new' area. At £17 for a new slip-ring (BHA5042) it was worth a few minutes of my time. Fitted the carrier to the wheel (has to go in one of two possible ways for the pencil holes to line up), the wheel to the column, and the horn-push to the wheel, tested the voltage on the brush and now it's dropping to zero volts all the way round and the relay sounds much 'stronger'. Checked the headlamp flasher and indicators to make sure I hadn't disturbed anything else, tightened the steering wheel nut and refitted the cowl - all hunky-dory now ... until the next time maybe. Used so infrequently - usually just at MOT-time, it's a good idea to occasionally test the horn with no traffic or people round just to check it still works.

Indicator Stalk Horn Push



Switch contacts concealed inside the moving end of the stalk so unlikely to be accessed non-destructively for a non-working horn. The wire to the horns that comes from the inside of the stalk tube can fray on the end of the tube which forms the other contact of the switch, if the two make contact the horns will sound when you don't want them to!

Horn Mounting *September 2013*



There were five different types of horns over the years and two different brackets. Originally a flat bracket (57H5309) mounted the horns vertically on the edge of the slam panel, before changing to an angled bracket (originally 17H8641, now GGE110) basically identical to the earlier flat bracket but with the bend, on the inner wing in January 1963 which positioned them horizontally. Also originally the harness only had one horn tail and there was a sub-harness to extend the wires across to the other side if you had the optional second horn. In late 69 dual horns and hence two tails in the main harness became standard. Both locations - when used with the appropriate brackets - position the horns horizontally, but going by the illustration in the Leyland Parts Catalogue you have very little choice about orientation - they have to point forwards or the spades will foul the top of the bracket. It's true that being horizontal water and dirt can't fall down inside the trumpet, but it will still be driven inside. However at least two horn types have the spades in a different position and so allow the horns to point across the car towards each other rather than forwards. Vee's are like this and it protects them to some extent from driving rain and dirt, whereas the position of the spades on at least one other type means they have to point forwards for the terminals to be accessible.

I bought new horns for Bee (why I forget) and as the existing ones didn't have brackets I bolted them direct to the inner wings as before, which positioned them vertically instead of horizontally. Originally I fitted them facing backwards to keep water and dirt out, and with the spades uppermost for accessibility. But they were never as loud as the ones I subsequently fitted to Vee (which needed a relay from the start or they didn't work at all), and thinking this was partly due to them facing backwards I turned them round to face forwards, which meant to keep the spades at the top again for accessibility they changed sides. Several years later and the horns seem to be getting worse if anything, so I do the voltage tests indicated below and find that whilst I'm only losing about 0.5v in the purple feed I'm losing about 3v in the earth feed i.e. the tortuous path back through the rack and steering column to the wheel centre button, so fitted a relay to Bee as well and that made a huge difference.

I had wondered whether I could 'tune' the horns to be louder, some have an adjuster screw and locknut in the centre of one side, so took one of mine off. Nothing as simple as a screw and locknut, just a plastic stud under a rubber cover, so I decided to leave that alone rather than risk damage. However while I was turning the horn over I became aware of a rustling noise, and when I tapped it on the bench all sorts of rubbish started falling out! Much tapping, shaking, turning, and poking a length of stiff copper wire up the trumpet of both horns extracted quite a pile of dead flies and debris that wouldn't have helped at all.

I then started thinking about the orientation of the trumpet, which curves around the edge of the horn body. My dual Mixo horns i.e. one high note and one low note are mirror images of each other. The construction is such that installed as mine were facing forwards with the spades uppermost, the curve of the trumpet is downwards and so any water, dirt, dead flies etc. that find their way in will remain lodged inside. They need to be mounted such that the curve of the trumpet points upwards, with the trumpet itself angled downwards to some extent, and both aspects will naturally resist stuff going in and getting stuck. The downside is that the spades now point downwards, but one can't have everything. The upshot is that my low note Mixo has to be installed on the left as you look at the front of the car, and the high note on the right.

Fault Diagnosis

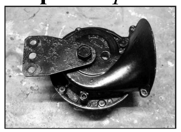
Two-wire horns:

- If the fuse is blowing or the horns sound continuously with the purple/black connection removed check for continuity between the horn terminals and the body. Any continuity here is a fault, as Steve Penkethman found in June 2021 with his 1970 which was blowing fuses but only when mounted.
- Check the voltage on the purple at the horns with the horn button both released and operated. If there is no 12v at all, or you see 12v with the button released but significantly less with the button pushed, then check the purple fuse (bottom in the 2- or 4-way fusebox) and the wiring back to it for broken or bad connections.

- Check the voltage on the purple/black with the horn-push released. If you don't see 12v at all then the horn itself is bad.
- If you see 12v then measure again with the button pushed. This should drop to almost 0 volts (earth). If it does but the horn doesn't sound then again the horn is bad.
- If the voltage doesn't drop, or doesn't drop very far, check the wiring back towards the horn button for broken or bad connections, and test on the connector going to the brush, the brush itself, and the brass ring on the back of the wheel. If you get the same 'less than zero' voltage at the body of the wheel then the column earth is bad, fit a relay.
- *(Updated May 2008)*If the wheel shows zero volts, but the voltage on the brass ring on the back of the wheel is higher than this, then there is a problem inside the wheel and horn push. There are several possible places this could happen - the pressure contact between the back of the brass ring on the wheel and one end of the pencil, the braided wire between the two brass ends of the pencil, the pressure contact between the end of the pencil and the brass contact inside the horn push, the connection between the brass contact and the copper ring attached to the horn push frame (this is the operative part of the horn switch), the copper ring where it is attached to the horn push frame, where the springs are attached to the horn push frame, and these springs and the wheel when the push is fitted. Unless these springs have been bent and are slack this last is very unlikely unless the wheel is badly corroded.

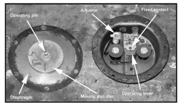
One-wire horns: Check the voltage on the purple/black spade with the horn button pushed. If there is no 12v or something less than 12v check the wiring and connectors back to the horn button for broken and bad connections the horn button itself, and 12v on the purple wire feeding the button. If there is a good 12v on the purple/black measure the voltage on the horn body. If you see more than 0v then the horn earth is bad. If you see 0v (earth) then the horn is bad.

Repair *September 2014*



This horn is from a TR4, but the principle should be the same for the MGB as the originals were electro-mechanical as this is. This horn was completely dead, but another fault could be that it just clicks when power is applied. Both could be down to adjustment, so before opening the horn up try twiddling the adjuster screw that is usually present. On this horn just a quarter-turn of the screw is enough to change the fault from 'completely dead', through sounding to some degree, to 'just clicking'. If adjusting the screw doesn't bring it back to sounding normally then you might as well open it up and see if it can be fixed, you have nothing to lose. Note that if it just clicks, leaving the power connected for any length of time will probably burn the internal coils out, the horn will get very hot in the process.

The casing is usually in two halves, with the 'trumpet' in one half and the active stuff in the other, with a diaphragm clamped between them. The two halves are usually riveted together, in this case with six rivets, one side usually being easier to get at all six than the other as some may be in the mouth of the trumpet. Use a drill the next size up from the head of the rivet and drill the head off - it may be easier to start with a small drill to drill a pilot hole part way through first, then use a nail punch to punch the remainder of the rivet out. If the two halves haven't parted by now, carefully lever them. This horn had a paper gasket either side of the diaphragm, you may be able to separate the halves and remove the diaphragm without ripping the gasket as I did, if not it's no big deal to cut new ones out of thin paper.



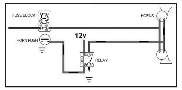
Inside you should find a couple of electromagnet coils, and some kind of interrupter contact, in series with the two spades (or the single spade and the body of the horn in the case of 77 and later MGB horns). The principle of operation is that current flows through the coils and attracts the diaphragm towards it. This diaphragm has a 'crinkle' in it, which means that rather than it moving gradually as the magnetic field builds up (electromagnet coils are effectively inductors and there is a finite period over which the magnetic field builds to its maximum, it is not instantaneous) the field has to reach a certain level before the diaphragm starts to move, then it moves suddenly as the force overcomes the resistance of the crinkle. This is exactly the principle used in the 'D-Day Cricket' used by paratroopers in WW2 to tell friend from foe when they couldn't see someone, rather than risk showing themselves. The crinkle makes the diaphragm move further and faster with a snap action than it otherwise would, which greatly amplifies the sound over a simple flat diaphragm. However, unlike the Cricket, as soon as the diaphragm has moved it's operating pin moves a lever which opens a contact, which breaks the electrical circuit through the coils, so the diaphragm is released, again with a snap action. As soon as it has released the diaphragm the operating pin releases the lever, so the contacts close again, re-energising the electromagnet, attracting the diaphragm again, and so on, vibrating the diaphragm.

The adjuster screw acts on the assembly that holds the contacts, moving the contact lever closer to or further away from the operating pin of the diaphragm, to get the most effective movement of the diaphragm, and hence the loudest noise! Whilst there is some pitch change as adjustment is made, the primary difference between high-note and low-note horns is in other aspects of the design.

With the innards exposed the first thing to do is check the continuity of the coils, because if one of those is open-circuit you may not be able to go any further, it should be easy to see where the ends of the coils are terminated. If those test OK - typically 4 or 5 ohms - then test the continuity of the contact. This one was open-circuit, possibly through oxidisation during a long restoration of the car. A little bit of wiggling and manually opening and closing the contact was enough to restore continuity in this case.

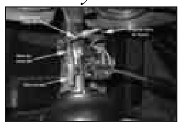
The only real way to test is to clamp the two halves together again, as the diaphragm has to be held firmly and at the correct distance from the coils and the contact lever in order to function properly. I used three nuts and bolts in case I had to take it apart again, although I intended to re-rivet when I was happy with the repair. This is when I discovered just how small the operating range of the adjuster screw is - just a quarter turn. With that I was happy with the sound, so fitted three pop-rivets and backing-washers in the so-far unused holes before removing the three temporary nuts and bolts, as I didn't want to disturb the alignment of the two halves and the diaphragm, then fitted the remaining three rivets and backing-washers. Retested, final tweak of the adjuster screw, and returned it to the very satisfied owner.

Adding a Relay: One fairly common problem with the earlier 2-wire horns, particularly with collapsible columns, is a weak or non-operating horn even though you have 12v at the horns. This can be caused by a bad earth to the column itself - it relies on its mechanical fixings between the chassis rails, crossmember, rack, UJ and the upper and lower halves of the later collapsible steering columns for this and not a dedicated earth wire. I've even had one where the bad connection was where the UJ clamped onto the shaft at one of the splined joints! This earth path is only a problem with the earlier 2-wire horns prior to 1977, but not on cars with the horn push on the column stalk (1970 model year) as these have a wired earth. I used a relay to 'boost' the earth to operate the horns, but I have heard of others connecting an earth-strap between chassis and rack although that won't overcome problems at the UJ or column. Before going to the bother of adding a relay or earth strap check the other connections first.



Note that this circuit will only get round a poor earth from the column through the switch and onto the purple/black. I opted to install the relay as the column on my V8 had a low-grade earth that would not even operate one horn (I wondered why it came to me with what looked like a moped horn!)let alone two. I mounted it behind the dash on the firewall close by the indicator flasher and voltage stabiliser where all the wires that are needed are close by (on an RHD, at least). The purple/black is cut between the column multi-way connector and the main harness, and will need short extensions to the relay, I opted to use a 2-way 'chocolate block' connector rather than solder bullets or spades. Inside the cabin is also a better environment than under the bonnet. Subsequently when I found the roadster would benefit from a relay as well as it was losing about 3v in the earth path, to avoid cutting this wire I did think about fitting it behind the radiator diaphragm, diverting and extending the purple/black from the right-hand horn back to the relay winding, then extending the relay contact to the horn. However that would only have helped the right-hand horn, I would need to extend the new purple/black to the left-hand horn to benefit both. So I decided to put that one in Bee's cabin as well.

February 2021:



Even more subsequently I realised that for 1970 to 76 inclusive there is a spade connection to the horn brush under the cowl, so with a relay by the column the existing wire can be removed and extended down to the relay contact, and a new wire run from the brush to the relay coil, although on CB cars at least the cowl is pretty snug round the column and harness.

The relay spades are shown with modern markings and the diagram also shows which pair are the winding and which are the contacts. If you use an older-style Lucas relay the 'W1' and 'W2' spades are the winding and the 'C1' and 'C2' are the contacts. It doesn't matter (on either type of relay) if you reverse the winding pair or reverse the contacts pair, as long as you don't get any of the winding wires on the contact spades and vice-versa.

The relay is operated from the earth from the horn-push and 12v from the purple (the purple is always hot and fused for safety) and will operate reliably even with quite large resistances in the horn-push circuitry. The contacts push out a good earth, taken from a tag secured under the relay lug, onto the purple/black to the horns themselves.

Footnote: Some time later I decided to see just where the high resistance connection on Vee was and the results were interesting. I was losing 0.5v between the body and the outer column despite all the fixing bolts, and another 0.5v between the outer column and the inner column. But the greatest loss was inside the horn button itself. As this was a Moto-Lita wheel and the two halves of the switch casing were held together with spire clips on three small plastic pins that always break when you try to remove them, discretion was the better part of valour. Given that, there didn't seem much point in making a better connection between the outer column and the body, even less trying to fabricate another brush to get a good connection between outer and inner columns. The relay has been working perfectly well for a number of years so I left well alone. Subsequently I replaced the Moto-Lita wheel with an original but left the relay in place.

September 2013: Bee's horns have never seemed as loud as Vee's with the relay, and yet more testing showed an iffy earth through the column. So without any more messing about I fitted a relay to Bee as well, and a noticeable improvement.

August 2014: I've been helping a pal finish off the restoration of a TR3 and one of the last things is to deal with some electrical problems to get it ready for the MOT. One of those is the horns not working - "should be easy" I thought. The principle is the same as on the MGB i.e. an earth up the column, through the horn button in the centre of the wheel, out to the horns, then back via a fuse to the 12v supply. The TR3 has two steering column UJs, and they are rubber doughnuts, so there is an earthing wire from one yoke to the other, around the doughnut. There is also an earthing wire going direct from the rack to the chassis, even though the rack is bolted to brackets on the chassis and not a removable cross-member like in the MGB. The rack earth wire was broken, the lower UJ earth wire seemed to be missing altogether, and the upper one was iffy being a bodge of wire strands wrapped round the UJ clamp bolt. First job was to replace the rack and lower UJ earth wires. Still didn't work. Must be that iffy upper earth wire, but did some testing, and to our amazement the earth wire was fine, the fault was where the upper yoke was clamped onto the steering column at the splined joint! Removed both UJ clamp bolts with the intention of tapping the yokes up and down the shafts to clean the splines, but the upper one didn't move. Nothing for it but to remove the UJ and the column. Four bolts and the doughnut comes out, and we found bolt-through terminals under one bolt-head each side - for the original but missing earth wire! We'd put the earth wire on the lower UJ between the two UJ clamp bolt heads, as the bodged wire on the upper UJ had been, thinking that was the correct position, but we aren't going to move the lower one now. Also the four yoke bolts screw into the opposite yoke, no nuts, but have locking-wire through the ends of the bolts. There is also a weird clamp with two bolts and an Allen screw and lock-nut on the column shaft. Another difference to the MGB is there is no outer tube as part of the column, it is part of the bulkhead. So the column needs to be removed via the engine compartment as the yoke was stuck on the lower end, but it can only go forwards along the line of the column as the outer tube is fixed. Would there be enough room? We removed the steering wheel, but didn't get very far as something was stopping it going forwards, possibly the indicator cancelling cam hitting the fixed outer tube. But then we found that the column was in two halves - a long section that withdrew into the cabin leaving just a short section to withdraw into the engine compartment, so easier than feared. It took some pounding with hammer and drift to get the shaft out of the yoke, so we could clean up the splines with wire brushes. With

it all apart we could see that the clamp with the Allen screw clamps the two halves of the column together, a) to get a good earth going all the way up, b) to position the upper part and the steering wheel correctly in relation to the indicator switch cowl, and c) to set the fore and aft free play of the column shaft in the outer tube that is part of the bulkhead. The clamp with the two bolts goes around the upper half of the column, which has the lower half of the column sliding inside it, and the Allen screw tightens through a slot in the upper column onto the lower column. We weren't sure if the Allen screw had been adjusted correctly before so went to slacken the lock-nut but it was stuck fast, and needed heat before it would shift.

After that it was 'just' a matter of putting it all back together again. I'd decided to fit the new earth wire to where we had found the original bolt-through terminals, and not where the bodge had been or where we had put it on the lower UJ. That meant the wire could run through the middle of the doughnut rather than being round the outside, and so not scrape on the shelf or various tubes and pipes nearby. Also when removing the UJ it was apparent that because the column and intermediate rack shaft were not directly in line, the doughnut would have to be 'bent' to get at least two of the bolts to line up correctly with the opposite yoke when refitting it. So I decided to assemble the UJ off the shafts, but even that needed the doughnut to be squashed a bit in a vice to get the fourth bolt started. By leaving the Allen screw clamp off I was able to slide the lower half of the column up out of the way enough to get the two sets of splines engaged, then fitted the Allen clamp, setting the fore and aft free-play in the process. Time for a test ... and we have a horn! Actually we should have two as there are twin horns, but one isn't working. More voltage tests on the horn spades and it is apparent that horn itself is faulty, but one is good enough for the MOT. That's taken all morning, so the wipers will have to wait for another day.

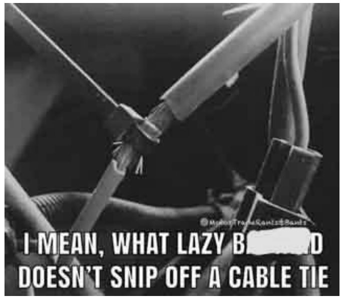
© Copyright - 1999 to 2026
I.T. Answers

Electrical System

Last updated 27-Jan-2026

If you find the information here useful,
you may like to make a small contribution
to help offset the costs of providing it. Thank you.
Or just leave a comment in my visitor book.

Automotive Electrics Basics - Part 1 - Terminology and Part 2 - Typical faults, symptoms, and diagnostic techniques



(Image posted by Geoff Hutton on the MGOC forum)

Lighter Socket *November 2018*

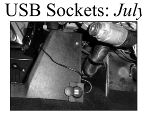
Schematics
USB Sockets

Going by the Leyland Workshop Manual schematics it was optional in all markets until the 1973 model year when it became standard, although Clausager says it was standard on North American Mk2. It was always illuminated with the parking lights, under the control of the panel light dimmer rheostat/switch.

When dealer-fitted it was powered from the white circuit on the ignition switch on Mk1 cars, i.e. unfused and only available with the ignition on. On the first year of RHD and non-North American LHD Mk2 models it was powered from the brown circuit at the ignition switch i.e. now available at any time but still unfused. 1969 and 70 RHD and non-North American LHD models were powered from the accessories position of the ignition switch but still unfused. 1971 RHD and non-North American LHD models were powered from the accessories position of the ignition switch, but were now fused from the 'accessories' fuse that powered the wipers and heater fan. All Mk2 North American spec cars, and from 1972 onwards all other models, were powered from the purple circuit i.e. fused and always available. When dealer-fitted it may or may not have needed a dedicated earth wire, but when mounted in the various plastic centre consoles it will.

There are many different types - some where the whole of the removable part is pushed into the socket against spring pressure and locks in position to heat it up, then pops out when hot. Others with a smaller 'push-button' inside the removable part that is pushed in and pops out. When pushing in to start heating the centre connection which is a circular disc gets pushed into a spring clip that retains it. This clip is bi-metallic so as the element heats up so does the clip, which starts opening up, and eventually releases the disc to pop out. Typically they are retained in the bracket or console by a large sleeve that screws onto the lighter from the back. This may have a large slot on one side for the bulb holder to clip in to, by pinching the sides of the holder.

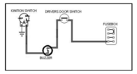
USB Sockets: *July 2023*



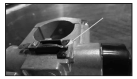
In this day and age of phone sat-nav it's probably better to have the phone powered and recharging rather than run the battery down on a long journey and get stranded later. For a while I've been using a charger that plugs into the cigar lighters but as well as having a couple fail I've had to replace it for different phones whereas probably all phones these days come with a charging cable with a standard USB plug on the end so a USB socket in the car makes more sense. I didn't want to replace the lighter

with a USB socket, I'd used a USB adapter that plugged into the socket but that also failed, so something needed to be added. I don't like drilling holes and wanted it to be unobtrusive but there should be plenty of places to position one under the dash and on the side of the centre-console without catching it with one's legs and the Navigator's bags. Looking around some rectangular very low profile sockets would seem to fit the bill, so one was purchased. The obvious place to me was flat on the sides of the centre-console - in my footwell as I don't want to get my face slapped by said Navigator. One of the securing screws for the centre console seems to be the most obvious, and although the (dual) socket comes with fixing screws and only one would be needed it would have to go through the centre-console and existing spire clip so needed to be longer - no problem given my stock of nuts, screws washers and bolts. Bee would be my first candidate as she is used more for touring than Vee and as a CB I have to bear in mind access to the rubber plug in the tunnel for the gearbox dipstick, and it can mount vertically only intruding into the space slightly. Vee has the alarm controller in that position so it has to be mounted horizontally projecting across the space behind the console, but being an RB with the side-fill and level plug on the gearbox the tunnel plug is never accessed. The mounting screw where it goes through the spire-clip behind the console also offers a convenient point to pick up an earth for the sockets. 12v ideally picked up from the fused accessories circuit i.e. the green/pink behind the centre-console feeding the radio (and heater fan and wipers) from 72 to the end of CB production and all V8s which means it can remain powered when the ignition is off but the key still in. Otherwise from the fused purple circuit to be powered all the time, or the fused green circuit just for when the ignition is on. Of course you can add your own in-line fuse and power it from wherever you want - certainly safer to have it fused.

North American 'Key In' Warning *June 2013*



For the 1970 model year North American gained a warning buzzer that sounded whenever the drivers door opened if the key was still in the ignition. This used an additional contact on the ignition switch to send an earth to the buzzer when the key was in, and an additional drivers door switch. This door switch (BHA4984) differs from the courtesy light switches in that it is insulated from the body and has two wires - a purple (always on, fused) supplying 12v to the switch and a purple/green going to the buzzer. Both switches have to be 'closed' to sound the buzzer, i.e. either the door being closed, or the key being out, will stop it. It stayed the same for the 1971 model year and the first four months of the 1972 model year, but when these cars got the seat-belt warning system in December 1971 it was combined with that.



The ignition switch contact. Examination indicates that this contact is only closed with the key inserted and the switch in the 'OFF' position. However one would have expected it to also be closed in the 'ACCESSORIES' position, if not in the 'RUN' position as well in case the engine has stalled with the ignition still on. The Leyland Workshop Manual has a test procedure for the sequential seatbelt system including this warning feature, however it does not give different conditions for any of the possible ignition switch positions. Furthermore it says "Test 10 Warning buzzer: Requirements: (l) Warning buzzer operates - ignition key removed: Remarks: If the warning buzzer does not operate in (l), either the warning buzzer or the circuit wiring is faulty". This seems to be incorrect, as the warning buzzer should NOT operate when the key is removed, only when it is inserted, and the driver's door should be open as well. The Austin MG Technical Service Bulletin gives even less information, just saying "Connect wire (between) pins 5 and 7, Warning buzzer on" without saying anything about the ignition key or switch or drivers door.

June 2020:

Arthur Taylor writes that he has been working on two 1973 models where the warning buzzer sounds when the key has been removed but the steering is not yet locked. Looking at the Parts Catalogue and Clausager there were three different ignition switches for the USA, Canada, Sweden and Germany 1973 model year - at the start in September 72 and chassis number 296000, chassis numbers 324942 and 325855, and it changed again at the start of the 74 model year at chassis number 328800.

Polarity

What polarity is my car!?
Which battery terminal is which?
Polarity Conversion
Dynamo polarity
Coil polarity
Tachometer polarity
Fuel pump polarity
Heater fan motor polarity
Instrument stabiliser polarity

First, a history lesson: Why was the MGB positive earth to begin with, and why are some even older cars negative earth? Originally negative earth was the norm as on the low-output HT systems of the day a positive HT pulse gave a better spark at the plug than a negative one. Wired negative return was also originally used, but it was soon realised that chassis return was cheaper and easier. Before plastic-insulated wire all sorts of other materials were used, but all had a certain amount of leakage where they touched metal parts, which were now at earth potential. It was then discovered that the leakage from wires at positive potential to the chassis at negative potential was causing the wires to corrode and fail, hence the change to positive earth. Battery terminals also suffer from corrosion, particularly with the proximity of acid, and it was found that positive earth reduced this as well. This now meant that any leakage caused corrosion at that point on the chassis, which wasn't ideal, but the chassis is a lot more substantial than the wiring. By this time modern coil design meant a positive HT pulse could be produced from a negative supply, so the spark wasn't adversely affected by the change in polarity. Post WW2 most wiring was plastic insulated, which has negligible to zero leakage, so the polarity issue went away. No point in changing back to negative earth just for that, but with the advent of television post-war, interference from the ignition systems of passing cars became an issue, and negative-earth system are easier to suppress. Nevertheless, the MGB and presumably other marques and models in the BMC stable, didn't switch back until the fitting of alternators in 1968, but certainly had adequate suppression systems before that. Electronic components in cars - transistor radios being the first - can be instantly destroyed by the wrong polarity, unlike simple electric components like bulbs and coils. Early radios usually had a polarity switch on the back, but with the growing use of electronics it was decided that polarity switches on everything would be costly, so a standard polarity need to be adopted by all manufacturers, and negative earth - for its suppression benefits - it was.

Whilst there is no safety benefit with one polarity over another, whichever polarity you have it is very important to observe the same rule when disconnecting or reconnecting the battery, and that is to remove the earth connection from the battery first, and reconnect it last. This is regardless of whether the car is negative earth/ground or positive earth/ground, and the reason for this is that if your spanner should happen to touch the body whilst it is also touching the earth/ground post of the battery nothing will happen. Once the earth/ground connection is removed it is now safe to undo the 12v (aka 'hot' or 'live') connection, because if your spanner should happen to touch the body while it is on the hot post still nothing will happen because the earth/ground connection has already been removed. If you work on the 12v post with the earth still connected, and your spanner should happen to touch the body which on the MGB with its batteries in a hole in the rear shelf is very easy to do. This has the effect of shorting out the battery, generating a large arc which could cause any battery gases in the locality to explode, which can itself cause the battery to explode, and your face is quite likely to be right above it. Modern automotive advice sources often say to remove the negative cable first, but they are talking about modern cars which are all negative earth, and are not taking into account the many classic and older cars that are still positive earth. It's **earth** cable off first and on last, regardless of polarity.

What Polarity is my Car!? *July 2014*

Someone recently bought a 1965 MGB which came without a battery i.e. was a non-runner, and as these were originally positive earth, but many have been converted to negative earth, he was quite rightly concerned as to which way round he should connect the battery.

The first thing to say is that if it has an alternator it has almost certainly been converted to negative earth, and very probably so if it contains any after-market electronic equipment like electronic ignition or a modern radio. Period radios often had a polarity changing connector, so this can be a clue. If it has a dynamo then it could be either polarity, according to which way it has been polarised.

Another possible way to determine polarity is to examine the battery connectors. Are these marked + and -? If not, then on UK batteries at least, the +ve and -ve posts on the batteries are different sizes, and the connectors are similarly different sizes. The posts typically measure 0.756" for the positive and 0.690 for the negative, i.e. the positive is bigger. Try connecting them **one at a time** and see if that indicates anything by one way fitting better than the other. The original cup-type connectors will be obvious, but bear in mind that the bolt-up type can be bodged to fit either post.

If it's a 62 to 64 i.e. with a mechanical rev counter instead of a tachometer, and if there is no aftermarket electronic equipment, then with one exception connecting the battery either way round won't hurt anything. The exception is fuel pumps. The original pump was capacitor quenched and can be used on either polarity. Later pumps were diode-resistor and are polarity sensitive. Connecting these the wrong way round still won't do any harm, but will cause the pump to take about 1 amp more current than normal. Later versions still have transient voltage suppression devices which again are polarity independent. You may have to take the end-cap off the pump to see if it has the diode-resistor, and if so which way round it is connected. However bear in mind that someone could have fitted a positive earth pump, then someone else reversed the polarity. Or indeed someone simply fitted the wrong type!

As a 65 to 67 Mk1 (Mk2 cars were negative earth from the factory) it should have the electronic tach, which is polarity sensitive. I'm not aware of reverse connection blowing these up, but can't promise. Tachometers were marked with the **original** polarity - positive and negative - from inception, at least until they changed from chrome bezels to plastic for the 1977 model year. But bear in mind that a PO may have changed the internal wiring of a positive earth tach and not changed the legend on the dial. Short of removing that and opening it up and working out whether it has been modified or not, really you need to remove the white 12v supply wire from the spade connection on the back to protect the electronics while you work out what the polarity actually is. But it's complicated by having three white wires, the other two being the ignition feed, usually as a single loop of white going through the external pickup. And even if you do open up the tach, there is nothing to say that it is the original tach and was working before the car came to you.

I would **not** recommend simply firing it up and seeing what happens to the battery voltage i.e. to see if the dynamo is charging or not. The dynamo will generate it's output voltage according to its polarisation, independently of the battery voltage. If the polarity of one is opposite to the other and the control box cut-out relay operates the voltages will be added together and a very high current will flow. This could well burn wiring and damage the dynamo and control box. Disconnect the wiring from the F and D terminals of the dynamo. Connect the battery using your best guess as to polarity, switch on, and start up. Then with the engine running at less than 1000rpm, link the F and D terminals of the dynamo together, and connect a voltmeter between that link and a good earth on the engine. Assuming you get a voltage reading, the polarity of that will tell you which way the dynamo is polarised, i.e. if you see the F and D are negative with respect to earth, then it hasn't been converted. But if the voltage is positive with respect to the earth, then it has been converted. Remember that the battery polarity will be opposite to this, i.e. if you see a negative voltage on the F and D terminals the battery needs to be connected for positive earth, and vice-versa. However with a car new to you and a non-runner there is nothing to say that the previous owner fitted a dynamo of the opposite polarity in an effort to correct a charging problem, and when it didn't gave up and sold the car. You can connect the battery according to the dynamo polarity, but that still might be wrong for the tach electronics.

If you do see a voltage, and slowly raising the revs towards 1000rpm increases the voltage towards 20v (do not exceed 20v), then you know the dynamo at least is working. However if you get no voltage, you are no further forwards without diagnosing what is wrong with the dynamo.

Which Terminal is Which? *July 2009:*

Modern 12v batteries usually have the polarity symbols + and - moulded into the battery top by the respective posts, as well as being supplied with colour-coded caps (red for +ve and blue or black for -ve) over the post (discarded on fitting), and possibly coloured rings around the base of the posts (permanent). But some 6v batteries don't seem to have markings, even current supply. These seem to be the ones with the individual screw caps for the cells of which there are least two designs - the original tar-tops with black caps as well as a more modern smooth-topped battery with coloured caps. My present 6v batteries have a single rectangular cover (red) over all three cells and do have + and - markings. There is a possibility that some makes may have a distinct vertical groove in the negative post (no + or - markings), but this remains to be confirmed. Easy to use a meter to determine polarity - as long as you are sighted and the battery has some charge in it! Other than that all the batteries and cars in my experience have had the posts and connectors of different sizes - positive larger than negative. It's not much by sight or touch, only about 1/20" in diameter, but it makes a big difference if you try to put the negative connector on the positive post (it won't fit) or the positive connector on the negative post (it drops on and is loose). If you do need to test-fit the connectors, make sure you only do one at a time, and only one battery at a time, to avoid reverse connection and the risk of shorts from the loose end of the link cable. When changing polarity **always** change the connectors as well, junking the cup-shaped type (if you still have them) for bolt-up type, as whilst the bolt-up type can be made to fit the wrong posts it would be rather short-sighted. I've seen a couple of comments from people who have flattened the battery, then charged it up in reverse, which seems a really iffy process to me, if not downright dangerous if someone else should go by any + and - markings for reconnection, boosting or even charging. Also some sources stating that +ve and -ve plates are made of slightly different materials which aid battery performance, which would work against you if the polarity is reversed.

Polarity Conversion

As far as the actual conversion goes I've not had to do this myself so what follows is what I've gleaned from elsewhere. The usual reason for converting is that the owner also wants to replace the dynamo with an alternator for its higher output, or fit modern electronic devices. It's possible to connect a positive earth radio in a negative earth car of course but the case has to be insulated from the car body, and if any exposed part of the radio is at (radio) earth potential there is always the risk that this will be bridged to some other part of the car that is at car earth, which will result in a short-circuit and a blown fuse at best. You can also get inverters which convert polarity, but will need a pretty big output for anything but a basic radio. Of course, if you already have a positive earth radio, you will not be able to use it after the conversion.

The first consideration is the batteries. **Before doing anything else make sure the battery earth connection is the first thing you remove, and the last thing to reconnect at the end.** All the batteries I have seen have different-sized posts for +ve and -ve so in theory you cannot connect them the wrong way round, therefore the connectors will have to be swapped over or replaced. The original 'helmet' type that completely cover the post and are secured with a small screw that goes into the post expand and get loose with age and repeated removal and replacement, giving poor connections, and some resort to using silver paper to get a tight fit. Seeing as you are changing the polarity originality is not an issue, so if you haven't already then replace these with the bolt-up type which give a much better connection. The other thing with the helmet type is that they are usually moulded on, these have to be cut off and replaced with the clamp on type, which usually have two large screws to secure the cable. This results in shortening each cable by about an inch but that shouldn't be a problem. If it is, then you will have to replace the cable(s) and get ones with moulded-on clamps. If you already have clamp-up type connectors remove these from the 12v and earth cables and swap them over. Unless you have already replaced the twin-6v with a single-12v you will also have to deal with the interconnecting cable in the same way, and unless it can be physically removed from the car and reversed you will have to cut off and replace moulded-on helmet-type connectors, or remove and swap over the clamp-up type.

If you are retaining the dynamo this has to be repolarised so that it generates the correct polarity voltage. Disconnect the wires from the F and D terminals of the dynamo and with the batteries connected take a jumper lead and connect it briefly between the brown at the fusebox and the F terminal of the dynamo so as you see a small spark. Just one flash is enough, then reconnect the dynamo.

Cars after 64 had the electronic tach and this has to be converted too. You have to get into the case, find the supply and earth wires from the case to the circuit board, and reverse the connections. But note that some cars (e.g. a 67 B belonging to John Schroeder) have the circuit board screwed to the case and pick up the earth connection this way. In this case you have to isolate the circuit board from the case, move the original 12v supply wire from the terminal on the case to the body of the case, and provide a new wire from the earth connection on the circuit board to the 12v supply terminal on the case. John intends to publish notes and pictures of this on the Chicagoland MG Club website. In all cases you have to reverse the direction of the current pulse through the pickup and this also varies. Originally positive-earth cars had a tach with an external pickup and a continuous white wire comes out of the harness, through the pickup twice (i.e. one turn) then back into the harness. With these carefully note the route the wire takes now, remove it, and reverse the direction of the wire through the pickup, but keeping everything else the same e.g. the position of the loop. However there seems to be another variant with a short flying lead through the external pickup, terminated with two male bullets. In this case the harness should have two female bullet connectors, making it very easy to do this part of the switch. Tachs for negative-earth cars up to 1972 all have the pickup inside the case, with male and female bullets on the back of the case, and female (from the ignition switch) and male (to the coil) bullets on the ends of the harness wires.

Added December 2009: It's frequently stated that when changing the car's polarity you should also reverse the coil connections to keep the polarity of that and the HT spark the same. I usually mention it when the subject comes up, but you do end up with slightly less HT voltage than before either way, replacing the coil with one intended for negative earth cars would be preferable, see Ignition Coil polarity.

If you have the heater fan motor with black and green/brown wires these may have to be reversed at the connectors by the motor. If in doubt try them both ways (you can't do any harm) and if one way blows more air than the other that is how to connect it. More detail here.

Fuel pumps: Original pumps used capacitor quenching to reduce points burning and these pumps work on either polarity. Towards the end of production diode quenching was used which gives improved quenching, and these pumps are polarity sensitive. They will work on the 'other' polarity, but quenching will be reduced and hence points burning will increase. These can be converted quite easily. More recently the quenching component used is bi-directional, and these pumps will work correctly on either polarity. 'Pointless' electronic pumps may not work at all on the 'other' polarity, or may be destroyed. More detail here.

Finally, whereas the original instrument voltage regulators works on either polarity many replacements contain electronics, and most of these will only work on the correct polarity. They may be destroyed, or not work, on the 'other' polarity. More detail here.

That's it, unless you have any other electronic devices, which will be aftermarket and so up to you. The only possible other thing might be that the wipers now park in a slightly different place. If it bugs you then move the arms on the spindles. Start the car, check the tach is working, and measure the voltage on the brown at 3000rpm with minimal load. With a dynamo you should see in the order of 14.3v to 15.5v depending on ambient temperature (lower volts at higher temps), with an alternator you should see 14.3v to 14.7v.

Radio *August 2009*

Aerial in front wing
Speakers
Interference suppression

This is not intended to be a dissertation on all the different types of radio or 'in car entertainment' and how to install them, but touches on one aspect of improving security that might not be immediately obvious.

As the V8 was my daily driver I installed an 'el-cheapo' radio-cassette from Halfords that had a removable face-plate, and was always diligent about removing this from the car when parked up. At that time the car was parked under a car port in front of my house, and despite there being a security light under the porch and a street lamp right outside I came down one morning to find the screen rubber partially cut away and the glass cracked from top to bottom in two places where 'they' had tried to lever it out. Obviously an attempt to break in, and thinking it was an attempt at theft I bought a wheel clamp. A couple of weeks later I came down to find the 1/4-light levered open, window wound down, glovebox and arm-rest cubby open, and the radio missing. So **that** was what they were after! The trouble is that so many people are lazy that although they remove the face-plate from the radio they leave it somewhere in the car, so it worth these peoples time to break in as more often than not they will find it (but not mine which was in the house), totally destroying

the objective of a removable face-plate! I was very lucky, after the first attack the screen was replaced without loss of NCD, and the second time the only damage was a small tear in the shoulder rail under the 1/4-light where they had levered it open, and a broken 1/4-light hinge. They hadn't even scratched the paint levering the glovebox open. MGBs being what they are I was able to purchase just the broken half of the hinge and replaced that, and glued the tear down. I didn't bother claiming for the radio as it would have affected the NCD.

I still wanted a radio-cassette, so got another el-cheapo from Halfords, but this time a fully removable one where only the chassis is left in the car. This leaves a gaping hole in the console, and so might still attract attention from people expecting it to be left in the car somewhere, but I had another idea up my sleeve! I still had the blanking plate from before I fitted the original radio, which fixes in the console with two flattish clips attached to the back of the blanking plate, that can swivel round to lock behind the back of the console. I bent these into a sort of U-shape so instead of locating behind the console they now fit into the chassis, gripping it top and bottom to hold the blanking plate in place. Even though it is only a friction fit it has never come loose. So now, if anyone does peek in to check out the radio, to all intents there isn't one installed (despite the aerial) so it isn't worth breaking in to look for it. You may well be able to fit one over the top of a radio where only the face-plate is removed, but I'll leave that up to you. I also had an all-singing, all-dancing alarm installed with the usual ultrasonic and perimetric (door, bonnet and boot to you and me) sensing plus a dual-zone microwave unit which will set off the main alarm if anyone gets in the car, and also sounds a warning beeper if anyone gets too close to the outside. But that is another story.

Quite apart from the security issue technology moves on, and although the quality of tapes was perfectly adequate for the noisy driving environment of the MGB it was a fiddle copying CDs to tapes so I bought a portable CD player with cassette attachment slot that allowed me to play direct from CD via the radio. fast-forward another few years, and it's all about MP3 now, and the ability to get hundreds of tracks onto a single device and so not even have to change CDs. I was given a hard-disk MP3 player that is usually used as a personal player i.e. with headphones, but I found the cassette adapter from the CD player fitted the MP3 player as well so that could be played through the radio. That left the original problem with the cassette attachment that although the transfer of the signal is from an electro-magnetic device sitting in front of the playback head rather than tape, there was still an endless loop of tape driven by the capstan wheel to keep the spool wheels turning. This is nothing to do with playback per se, but some cassette players will stop or go into reverse if one or other of the spool wheels stops during playback. No problem with that, but it was very noisy. I tried opening it up and lubricating the moving parts with powdered graphite but it made little difference. Not knowing whether mine was one of these auto-reverse or stop players I decided to remove the tape altogether, and bingo, it just plays as it should with no added noise.

Relays *Expanded March 2009*

Plug-in Relays

Relays were used at various times in various places on the MGB:

- The first usage was as part of the D-type overdrive circuit, until 67 and the MkII and 4-synch gearbox.
- From 1970 until the end of production a starter relay was used between the ignition switch and the starter solenoid on all models.
- On all V8s (73 to 76) a relay was used in the cooling fan circuit.
- On rubber bumper GTs up to 76 a relay was used in the heated rear window circuit.
- From 77 (but see below) to the end of production an ignition relay was provided. Originally this powered all the ignition circuits on UK cars, and everything bar the fuel pump, overdrive and ignition warning light on North American spec cars. In 1978 a number of circuits on RHD cars such as the ignition and heated rear window were moved back to the ignition switch, possibly after problems with the relays sticking closed and draining the battery. Although why this included the heater fan and indicators when it should have been obvious if they were still running after the ignition had been turned off, while leaving the cooling fan (which may only come on a short time after parking the car) and the fuel pump on the relay, is a bit of a mystery. Click the link for ignition schematics .
- One as-yet unresolved oddity concerns MGBs for North America. The Parts Catalogue and other sources show a 'battery cut-off' relay for the 1976 year on, Part No. 13H9475 and also an 'ignition switch' relay Part No. AAU 3334 for the 1977 year on (when all models got one). However no schematics I have seen show both these relays, and none are shown for the 76 model year in North America as they no longer had the GT so no HRW relay. For 1977 and later the catalogue lists no less than four relays, including an HRW relay and an ignition relay apparently for all versions but when the ignition relay was provided the HRW was deleted. This catalogue again shows the 13H9747 'battery cut-off relay' for North America, which suppliers show as a cooling fan relay, but 4-cylinder cars never had a relay controlling the fans.

Originally the Lucas 6RA rectangular metal can type, but you need to be careful with these if replacing them as there are many different types, and in some cases you need to make sure you get the correct replacement. Basically the starter relay is designed for intermittent usage with a low contact resistance to supply the high current required by the pre-engaged starter solenoid, and has a winding resistance of about 40 ohms. The others are designed for continuous operation with a winding of 75 ohms resistance. If you use an intermittent-type relay in a continuous application it will overheat. Using a continuous relay for the starter is less of an issue but may eventually burn its contacts, which will eventually go high-resistance and cause starting problems. Note that when relays get old their contact resistance increases, and on high-current applications like the twin V8 cooling fans this will also cause the relay to get hot. An important thing to note is that if you replace your inertia starter with a pre-engaged you should also consider installing a relay at the same time to protect the ignition switch against the higher solenoid current. One way of doing this is to leave the original solenoid in place and use that as the relay, as per the relevant schematic here.

As I say there are very many Lucas 6RA relays - 6v, 12v and 24v as well as many different 12v types in addition to the ones mentioned above, you need to compare reference numbers **and** voltage when replacing, don't just go by the '6RA' and the terminals. Having said that many types **are** suitable for a number of applications, but you need to check the terminal labelling carefully and change wires over by terminal designation and not physical position. These are the MGB variants:

Part No.	Lucas Nos.		Configuration	Resistance	Current rating	Usage rating	Notes
563417	33243J	SRB113	4 terminal/spade	40 ohm	20 amps	intermittent	Starter relay see note
BMK685	33302B	SRB111	4 terminal, 5 spade	76 ohm	20 amps	continuous	D-type Overdrive, HRW
UKC5146	33188H	SRB102	3 terminal, 4 spade	?	?	continuous	V8 cooling fan

Note: Some starter relays are shown as being Lucas number 33231 which are type SRB111 and may have the higher resistance winding and be less suitable for starter solenoid current.

At the time of writing (September 2021) suppliers are showing starter relay 142169A and some images show this as having a double-spade on C1 i.e. for the brown wire. This makes it an SRB111 for continuous operation rather than SRB113 for intermittent operation. The difference is that SRB111 has a higher resistance winding so won't close the contacts as quickly and as hard as the SRB113, which with the high current of the starter solenoid (an initial 30 amps) may cause some contact burning over time.

4 terminal 5 spade types have a double spade on C1 which is useful for daisy-chaining a circuit to another component without cutting into the wiring.

The V8 cooling fan relay is an oddity with only three terminals, one being common to both the winding and the contacts, with the missing W2 terminal being connected internally to C2. The idea is that the temp sensor is used to send an earth to W1, with 12v on C2, and the output to the fan motors on C1. Browsing it seems this relay was commonly used as a horn relay on motorbikes, but also on classic Ferrari, Daimler/Jaguar and Rover. There are a few NOS versions around (£130 from a Ferrari supplier, anyone?) indicating it was designated SRB102, but it doesn't seem to be in current production, all the new relays I have seen advertised with the 33188 number are actually four and five terminal relays. These can be used with the existing three-wire harness connections by jumpering W2 to C2, then connecting the harness wires as before. However that would need a piggy-back connector on C2, so better to get a five-terminal relay with two spades on C1 with one jumpered to W2, and reverse the original C1 and C2 connections i.e. the wire that went to C2 now goes to the second spade on C1, and what was on C1 goes to C2.

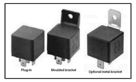
However I suspect the V8 relay was replaced by a more conventional 4-terminal relay during production. The reason being the 12v to C2 came from the green circuit fuse, which meant that circuit was powering all the fused ignition circuits including the HRW and the fan relays. This puts a huge current on that fuse and I suspect it suffered from overheating, so they substituted a 4-terminal type with 12v from the brown at the fusebox connected to C2. The drawback with that is that it makes the fan circuit unfused, so I have added an inline in that brown wire. North American cars didn't have a relay despite having the same twin cooling fans, but in that case the fuse was replaced by a self-resetting thermal cut-out, so I suspect they had the same overheating problems there as well.

More info on Lucas relays here.

The starter and OD/HRW types have the same configuration of two winding terminals (W1 and W2) and two contact terminals (C1 and C2). The V8 cooling fan relay is a one-off in that it only has three terminals, W2 being connected internally to the C2 terminal hence no W2 terminal. Unlike the other types, in which the winding wires can be reversed, or the contact wires reversed (but winding wires can't be swapped around with contact wires!) on the V8 cooling fan relay the green wire must be connected to C2 and the black/green wire to C1 or the relay won't operate. See also the schematics in electric cooling fans for how to use a conventional 4-terminal relay in place of the original V8 3-terminal cooling fan relay.

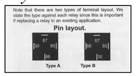
From January 1976 Part No. CHM68, Lucas 26RA 12v 20A cylindrical relay SRB402 with bracket, was used for the starter relay, and AAU3334 for the ignition relay on UK cars from the start of the 77

model year. These use the modern terminal numbering, see below. There only seem to be four variants of this relay, the others being 12v 20A double-normally open, a 12v 20A changeover, and a 24v 10A changeover. The 77 and later Parts Catalogue shows 'Relay - battery cut-off' 13H9475 for the USA and Canada, how this differed from the ignition relay for other markets I don't know, currently suppliers show it as the Bosch cube-type, i.e. it could be the Lucas SRB520 28RA type.



Lucas 28RA 12v 30A SRB520 cube-type were also factory fitment on late cars, and this style are what is commonly available from after-market sources for accessory switching. No less than 26 different types, just one applicable to the MGB, suitable for both starter and ignition. However as the starter solenoid initially takes a calculated 30 amps it might be better to go for the 40 amp SRB537 for the starter relay.

July 2015:



Note: Be aware that there are two pin layouts for these relays, pins 30 and 86 can swap positions. This is significant as 86 is one side of the operate winding and 30 is usually the 12v source to the load. Reversing these can cause weird results. Initially I only found one reference to this - by Vehicle Wiring Products, although it is only detailed in its printed catalogue. However although their web site allows you to order Type A or Type B only Type B shows the terminal layout. The choice is only available with their basic four-terminal 12v relay, their other types (e.g. fused, dioded) are to the Type B layout which is said to be a more logical arrangement. Maybe only the basic 4-terminal type were available before it had been decided that Type B was preferable, so these later types were never made in Type A and are all Type B. I got caught out by this when buying a replacement relay for a commercial headlamp relay system where one dip didn't work, swapped the relays over (which plugged into wired sockets) and the fault moved with the relay so decided the relay was faulty, but the new relay didn't work either! Testing with first principles with a voltmeter, and connecting the 12v source direct to the output wire all indicated the wiring was correct. In desperation I looked at the relay numbering on the base, and spotted the difference. Mentioned it to a pal who had the Vehicle Wiring Products catalogue, he looked it up and found the reference to the two types. I altered the wiring on the one relay socket, but it offends me as the two sides or beams are now different. Checked some eight relays I have dotted around various places and find I have a mix of types. However none are in sockets, so I've always connected the wiring to them directly i.e. looking at the terminals numbers. It's something you would have to be very careful about when replacing plug-in relays anywhere, on modern cars for example.

Subsequently I came across this from 12 Volt Planet which covers it along with much other information about these Bosch-type relays, saying that the change was made to put the operate terminals on one pair of opposite sides, and the contact terminals on the other two opposite sides, to make visualisation of the connections easier.

If you don't want to keep with the 6RA and 26RA types for originality the modern black cube relays will be at least as good if not better, 12v items are rated from 20A to 70A. Cube relays come in a variety of contact configurations as well as the basic single-pole normally-open type which is used in all MGB applications except the V8 cooling fan relay. If using an alternative 6RA or modern relay in place of the V8 cooling fan relay at the very minimum you will need to connect the green wire to one of the winding terminals as well as one of the contact terminals. Some types of these modern relays also have integral fuses, which can be no bad thing for accessories on the lightly-fused MGB. However it is no advantage on the HRW or V8 cooling fan relays as the supply to these is fused already (the green circuit). Another variation includes a diode across the winding (see 50 amp Sealed Automotive Relay With Diode) which will protect the circuit operating it. Present stock brake light switches are said to be so poor that as well as not being man enough to operate the lights they need this diode or they still fail from the back emf generated by the relay. With this type you need to connect the power to the winding the correct way round or it will present a short to the operating circuit, although there is a variant of this with a second diode in series with the winding protecting the parallel diode from reverse connection! Yet another variant has a resistor across the winding, these aren't polarity sensitive but don't give as much quenching of back emf as the diode type. Some have a plastic mounting bracket moulded into the casing, some have a slot for an optional metal mounting bracket, and some have no provision for mounting and these are usually plugged into sockets on modern cars. The mounting bracket bolt can be used to provide an earth for the relay where this is required.

The contact numbering of modern relays is different from the originals. On the originals W1 and W2 are the Lucas winding connections, C1 and C2 the contact connections, on all bar the V8 cooling fan relay as described above. The equivalents on late MGB cylindrical relays and modern cube relays are 85 and 86 for the winding, and 30 and 87 for the contacts. On the basic single-pole, on-off relays as used on the ignition and starter circuits it doesn't matter which way round the two winding connections go, or which way round the two contact connections go, but you mustn't mix up the winding and contact connections. Having said that the convention is that terminal 30 is where the 12v (brown) supply is usually connected to, and 87 feeds whatever the relay controls. Some cube relays have five terminals, the additional terminal in the centre being a normally closed contact 87a, or an additional normally open contact also 87, in which case it will be important to get the three contact wires on the correct terminals. Les common are relays that have diode protection on the winding, to prevent damaging voltage spikes being reflected back into whatever has operated the relay. With these it is important to get the winding terminals the correct way round as well as the relay is polarity dependant. Failure to do this could well damage the relay, and/or whatever is operating the relay, and/or blow a fuse, or the relay may not operate at all.

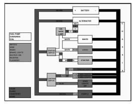
You may well wonder at the weird numbering instead of the more logical W1 and W2 for the winding and C1 and C2 for the contacts, but it is part of international standard DIN72552 for automotive components ('DIN' stands for 'Deutsches

Institut für Normungstandard' or German Institute for Standardisation), but only relays are likely to be applicable to MGBs. Even then, you will see the format has been changed for relays, with 87 replacing 30 or 51 as the common contact and 87b replacing 87 as the normally open contact. 87a remains as the normally closed contact, where provided. However all the relays I have bought in recent years still use the 30 and 87 convention for 'common' and 'normally open'.

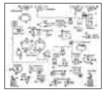
References:

> http://www.lucaselectrical.co.uk/catalogues/LucasSwitchgearXCB634_Full.pdf Comprehensive Lucas switchgear catalogue containing information on switches, relays, flashers, both classic and modern, 136 pages, 7MB.
> http://www.lucaselectrical.co.uk/downloads/lucas-switchgear.pdf Another Lucas relay and switchgear catalogue but including fuseboxes, some duplication with the above, but only 43 pages, 2.8MB.

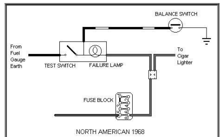
Schematics 

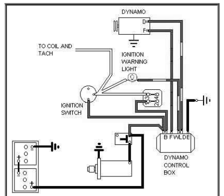


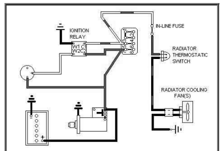
This block diagram originally drawn by Graham Moore gives a simple but clear overview of the main parts of the MGB electrical system. There were some 18 variations over the years this being probably the most common arrangement with relatively minor variations for year and market, however North America diverged significantly from 'other' markets starting with the Mk2. For details of a particular circuit refer to the sections below.

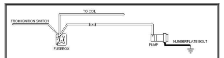


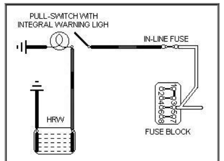
Many components share wired earths going back to a handful of common body earthing points as well as many branching points including bullet connections. Earth faults can cause some very strange interactions and knowing which components share earths can help track down the source of a problem. Earth paths are not depicted on the simplified Autowire drawings so I have started extracting them from the Leyland drawings and including them at the end of each page that lists the wire colours and functions for each year.

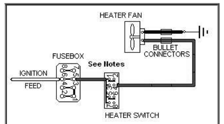

Brake Balance and Handbrake Warning

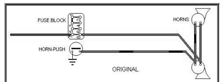

Dynamo and Alternator

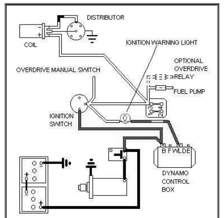

Cooling Fans

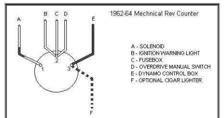

Fuel Pumps

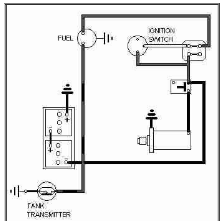

Heated Rear Window

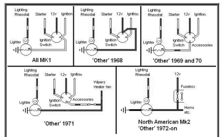

Heater Fan

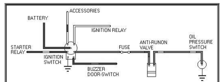

Horns

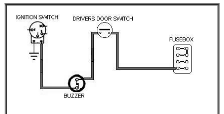

Ignition

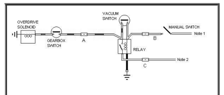

Ignition Switch

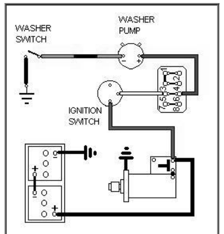

Instruments

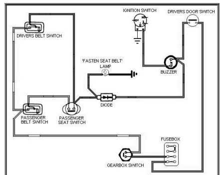

Lighter Socket

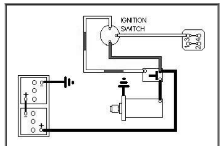

North American Anti-Runon Valve

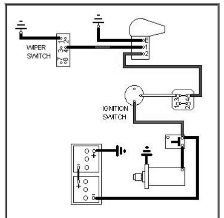

North American Key-in Warning


Overdrive

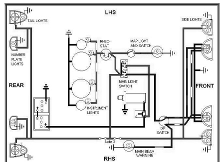

Screen Washer

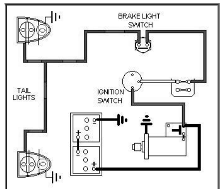

Seat-belt Warning

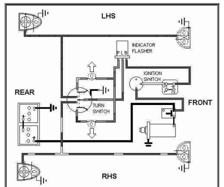

Starter

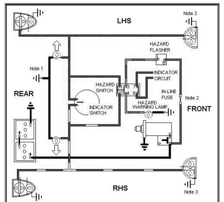

Wipers

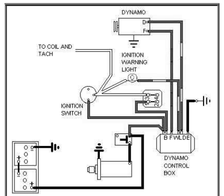
Lighting:

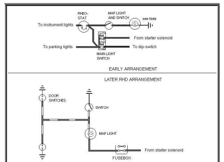

Main Lights

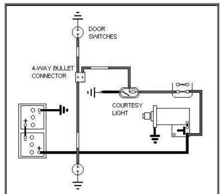

Brake Lights

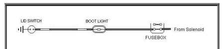

Indicators

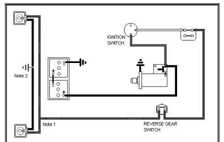

Hazard Warning

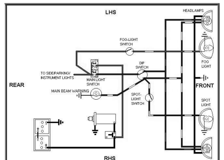

Ignition Warning Light

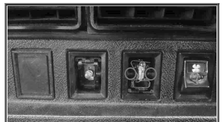

Map Light


Courtesy Light


Boot/Loadspace Light


Reversing Lights


Fog/Spot Lights


Switch Illumination

Lamps/Bulbs

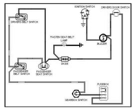
See also these redrawn schematics from Dan Masters. Capable of being enlarged by several times, they are also laid out so that generally the circuit elements are physically closer together and not placed more or less where they would be on the car. This results in much less wiring snaking all over the place and so are easier to 'read'. They are based on the Workshop Manual, Bentley and Haynes diagrams and so have the same limitations of particularly the later diagrams in Haynes where several slightly different eras of circuitry diagrams are combined into a single diagram, and some of the minor and late changes seem to have been missed altogether. However because the Workshop Manual and Haynes also act as 'layout' drawings they have all the branching and common connection points which are great help in locating wiring faults, including showing earth connections that come from the physical mounting of a component and wired earths, something the Masters simplifications don't have. OTOH the factory drawings are not without errors such as showing early rubber bumper cars having the front parking lights and the indicators in the same housing whereas by that time the parking lights had moved into the headlights, and even when showing that correctly for 1977 cars it doesn't show that the front indicators had wired earths, which all rubber bumper types did.

The Masters drawings are also confusing because the first batch are numbered as in the Workshop Manual but don't have the index so it's not obvious which market (North America or UK) each is applicable to, you have to look for subtleties like whether it has a brake balance test and warning circuit or not. It's only towards the end that the title box tells you the market, but there is another batch in the middle that doesn't have either! However every one has a sheet number, so the following table lists all three types of designation and confirms which market it is for. Clicking the link for the model will show the diagram full-screen. You should notice the cursor displays a magnifying glass with a plus symbol - position this over a part of the circuit you want to examine more closely, left-click, and it will zoom in to more than double size for even greater clarity. Use the scroll bars to move around.

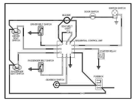
Model	Drawing	Sheet	Market	Note
62-64 MGB	1	1	All	Not 62/64 as shown
64-67 MGB	2	2	All	Not 64/67 as shown
67/68 MGB	3	3	UK	I.e. includes 68 models built in 67, ditto other drawings
68/69 MGB	4	4	UK	
69/70 MGB	5	5	UK	Not 68/70 as shown
70/71 MGB	6	6	UK	
71/72 MGB	11	11	UK	
72/73 MGB	14	14	UK	
73/74 MGB	16	16	UK	
73/74 UK MARKET MGB		29	UK	Electrically identical to Sheet 16
74 1/2 - 76 MGB	18	18	UK	Not 75/76 as shown
75/76 UK MARKET MGB		31	UK	Functionally identical to Sheet 18
LATE UK MARKET MGB		33	UK	This is a Haynes amalgam of 77, 78, 79 and 1980 models and not all changes in those years are shown.
MGC - UK MARKET		26	UK	
MGBGTV8		28	UK	
67/68 MGB	7	7	North America	
68/69 MGB	8	8	North America	
69/70 MGB	9	9	North America	Not 69/71 as shown
71/72 MGB	12	12	North America	Without seat belt warning
71/72 MGB	13	13	North America	With seat belt warning
72/73 MGB	15	15	North America	
73/74 MGB	17	17	North America	
73/74 US MARKET MGB		30	North America	Functionally identical to Sheet 17
1975 MGB W/PERIOD WARNING		19	North America	
1975 MGB W/SEQUENTIAL SEAT BELT WARNING		20	North America	
1976 MGB W/CAT CONV		21	North America	
1976 MGB W/O CAT CONV		22	North America	
1977 MGB W/CAT CONV		23	North America	Omits the ignition relay
1977 MGB W/O CAT CONV		24	North America	Omits the ignition relay
1978 & LATER MGB		25	North America	Shows the coil powered from the fusebox when it should be with the white on the ignition relay
LATE US MARKET MGB		32	North America	This is a Haynes amalgam of 77, 78, 79 and 1980 models and not all changes in those years are shown.
MGC - US MARKET		27	North America	

Seat Belt Warning

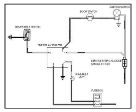
A fairly straightforward system was used on North American cars in late 1972 and 73 covering both driver and passenger seat belts. A very much more complicated system was used for just one year in 1974, reverting to a simpler system, covering drivers belt only in 1975 for the remainder of production. UK cars got a slightly simpler version in 1977 for the remainder of production, also covering just the drivers belt. The American system included an audible warning if the keys were left in the ignition with the drivers door open.



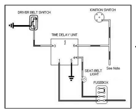
North American 1972-73: If the ignition was on, the car in any gear, and the drivers seat belt was **not** fastened, there was a continual audible and visual warning. Additionally if the passenger seat was occupied and their seat-belt not fastened the same warnings applied. Independently of this if the drivers door was opened with the keys in the ignition, in any position including completely off, there was the same audible warning but no visual.



North American 1974: A rather complex interlock system requiring a box of electronics with no less than 12 connections plus 10 other components was installed at the behest of the American authorities. One of these components was a 500mA fuse feeding the electronics. This lasted just one year as reputedly American manufacturers complained that the requirements were too complex to implement! With this system there was a drivers seat switch as well as the passengers. Much as before under the appropriate conditions the audible and visual warnings would sound, but additionally the starter circuit was interrupted to prevent starting of the car. There was the same gearbox switch as before, which probably means you can only start the car in neutral, so preventing it leaping forward if inadvertently left in gear. Additionally one has to sit in the seat, then fasten the appropriate belt, then turn the key to crank before the starter will operate, to prevent people leaving the belt fastened behind the seat. If you stall the engine it can be restarted immediately, **unless** you have switched the ignition off, in which case you must get out of the car and repeat the sit, buckle, start sequence! However there is also a timing delay function, which apparently allows the starter to be operated under any seat-belt conditions i.e. fastened or unfastened, after the drivers seat has been vacated, for a period of three minutes. Which conflicts a bit with the previous sentence. Also if neither seat is occupied one can start the engine by leaning in and turning the key, which would help with manoeuvring the car in and out of the garage. However in this case it seems that the gearbox switch is ignored as the instructions warn that gearbox must be in neutral and the handbrake applied. More information on this system can be found here. Although it shares the buzzer with the seat-belt system the 'key in, door open' warning operates independently.



North American February 1975-on: A very much simplified system, even more so than the original 72-73 system as the only sensor was on the drivers seat belt (presumably passengers are now expendable). This also had a box of electronics but the main purpose of this was to give a limited period audible warning. The electronics didn't have their own fuse any more, but picked up a 12v supply from the purple circuit instead. This time the 'key in, door open' circuit is connected in to the electronics, which contained the buzzer, but whether this circuit operates the buzzer continually as before or again on a timer as with the seat-belt I don't know. There was no starter inhibition, but there was still a connection from the start circuit to the electronics. This is to trigger the warning if the car is **started** without the drivers belt being fastened, rather than as soon as the ignition was turned on as previously, as there is no direct connection to an ignition circuit. There was no gearbox switch. The same starter connection was used to test the warning light for the EGR valve service indicator, fitted in 1975 only (Canada) and 1975 and 76 (rest of North America) but may not have been fitted to all cars.



UK 1977-on: Much like the later American system but even simpler - no 'key in, door open' function, just a seat-belt warning. It includes a 'timer module' but it's not clear what this is supposed to do.

Switches in General *Added May 2009*

There has been quite a bit of comment on mailing lists and bulletin boards for a few years about the poor quality of replacement switches. Probably one of the earliest related to replacement brake light switches failing very soon after fitting. The only 'cure' for this seems to be to install a relief relay, but back EMF from that still causes the problem so protection has to be added in the form of diode or capacitor quenching (see Brake Lights). Adding relays (and fuses) to the headlight circuit is a must when uprating the headlights (see Uprated Headlights), and these will take the load off both the main lighting switch and the dip-switch and their associated connections. They may even be necessary with standard lighting system if you have to replace the switch, I have just found my main lighting switch intermittently failing to power the headlights. This is a 'new' switch from when I restored Bee, and although that was 20 years ago use of lighting has been minimal since.

Another common problem is with the hazard switch. Not so much with replacement quality this time, as hardening of the internal lubricating grease after many years and little use so that it tends to insulate the contacts. Sometimes flipping the switch back and fore will sort it out, but sometimes only temporarily. I had to dismantle Vee's (in a poly bag to catch all the bits), dig out the old grease and put in some fresh some years ago and it has worked fine ever since. That is with the original style of rocker switch, a friends 78 with the later smaller switches had intermittent heater and hazard switches. I tried dismantling these and cleaning them but the bits inside are so small, fiddly and delicate it wasn't successful and we had to resort to buying new.

Another quite common problem concerns the overdrive lockout switch on the gearbox. In this case it isn't the contacts that go faulty but mechanical wear in the linkages between gear-lever and the button on the switch causing the switch to be pushed not quite far enough to close and engage OD. With this often by pulling the gear lever around in 4th gear you can make OD engage and disengage at will. This can usually be corrected by an 'adjustment' at the switch. The switch was originally fitted with two fibre spacer washers, and removing one of these usually cures the problem. Unfortunately the switch is awkward to reach, particularly on 4-synch cars which only have a small removable panel on top of the transmission tunnel. Remove the centre arm-rest, remove the screws from the centre console, pull back the tunnel carpet, and remove the small access panel. But even then it isn't easy to get at the switch. You can get a bit more space by undoing the rear crossmember bolts and allowing the tail of the OD to rest on the fixed crossmember, being careful not to damage the speedo cable.

One thing to be aware of is that testing switches with an ohmmeter is not good enough. Ohmmeters only pass a minute current through a circuit - especially digital meters, MGB switches don't have gold contact surfaces, and so they will oxidise especially if not used for a while, which presents a resistance to an ohmmeter. However when carrying their normal current this will burn through any slight surface film, and the circuit will usually work as they should. Because of this the only valid test for detecting bad connections is looking for volt-drops where there shouldn't be any when the circuit is carrying it's design current. *April 2017:* Even overnight can be enough for the switch resistance to start getting erratic. When Bee's OD started dropping out after a few miles the first thing I did when back home was to check the current by inserting an ammeter at the manual switch, which was correct at about 800mA, and double-checked by measuring the solenoid resistance at about 15 ohms which is also correct. After leaving it overnight I went straight for the resistance check and was surprised to see it varying all over the place as I moved the gear lever round, anywhere between 15 ohms and over 200 ohms. But powering the solenoid with an ammeter in series I got the correct 800mA, and when testing the resistance again I got a consistent 15 ohms. Passing normal current through the switch had 'cleaned' its contacts.

Screen Washers

Washers schematic 
Nozzles and valves
Convert manual to electric
Washer bottle decals

Originally a manually operated pump, utilising a rubber 'bulb' in an alloy housing which was compressed by a plunger. The back of the rubber bulb has a plastic end-cap with two ports for the tubing. No valves here, it relies on the valve(s) in the bottle and tubing to push fluid to the screen when the plunger is operated and pull it from the bottle when released to recharge the bulb.

Electric washers were provided on North American models from the 1968 model year and UK models from 1974 1/2 i.e. the start of rubber bumper production. The exception is the V8 which had electric from inception in 1972. The controlling switch is on a column stalk with the wipers being a push-button on the end, the motor is mounted by the water bottle. The motor is polarity sensitive so needs to be connected the right way round to pump. For some reason the factory decided to connect this 'the other way round' i.e. instead of the switch controlling the 12v supply to the component which is permanently connected to earth, the switch controls the earth and the motor is permanently connected to the green (fused ignition) supply. Thinking about it this probably avoids having two wires going up inside the stalk. A earth can be picked up from the body of the stalk if it is metal, so only one wire is needed. Funnily enough they went the **other** way with the horns in 1977 - they had always been backed by 12v and a switched earth sounded them until then, after that the horn button put out 12v and the horns were backed by a earth from their physical mounting. So that needs two wires up the stalk but saves a long-ish run of (purple) wire from the fusebox to the horns.

Note that from 1971 for the remainder of chrome bumper production and all V8s the electric washers (and wipers and heater fan) were powered from the accessories position of the ignition switch via a white/green to an in-line fuse under the fusebox, and then via a green/pink.

Update January 2010: Karl from Ohio reports that he found the black earth wire with a stripped end hanging loose at the base of the stalk, and eventually that the stalk itself (which is a tube with the green/black running up inside) can be pulled out of the main body of the switch, has a groove in the splined end of the stalk tube which the earth wire conductors can be laid in, then stalk with earth wire pushed back into the body of the switch.

The nozzles were different between roadster and GT until 1978 - separate single nozzles for right and left on roadsters, a single item with two nozzles on GTs, then two plastic nozzles on all cars form 1978. The Parts Catalogue shows 'filter' 13H 7846 for all cars, which one supplier converts to GWW601, which several suppliers show as a 'foot, filter and valve' which goes in the washer bottle. However the catalogue also shows 'valve-line' 13H6501 which is an in-line valve i.e. a second valve, which some have found behind the dash right up by the nozzles, possibly only GTs with the dual nozzle item. *Update Nov 2021:* Further research and it all becomes clear (no pun intended ...). Cars with two separate jets need a tee of course, and originally this included the valve (13H6472). But cars with a single jet with two nozzles don't need the tee, so they have the in-line valve instead (13H6501). However some suppliers show a tee plus an inline valve and a short connecting piece instead of the combined tee and valve.

August 2021: Prepping Bee for the MOT I found the (manual) screen washer didn't work - some gurgling but no spray. This is something that gets used as regular as clockwork - once a year for the MOT! Wondered if the bottle had developed a leak but no, still some fluid in there and no gunge. Had another more vigorous go and no better, but this time when I stopped I noticed water in the pipe going back towards the bottle. What about the one-way valve(s)? There

is a component on the end of the pipe in the bottle that looks like a valve, and looking at the business end the bit that contained the two flaps was at an angle in the housing. Pressed that back into place ... and Bingo! I replaced the bottle over 30 years ago and replaced the plain water with screenwash fluid probably in 1995, but other than that it's not been touched and always worked - weird!

Convert manual to electric

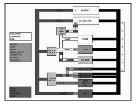
The details of the washer bottle end will depend on what pump or pump kit you get, and on the face of it the switch can be positioned anywhere including in place of the manual pump. But David Birkby wanted to keep the appearance of the dash the same so modified the manual pump to accept a simple 'push for on, release for off' switch. Since then I have done the same for Bee following a problem with the 'foot valve' in the bottle even though that was easily resolved.

Wires and Terminal Numbering

Wire Colours
Wired Earths
Joining (and adding) wires
Wire Size and Current-carrying Capacity
Terminal Numbering

Wire Colours. The most important colours to remember are:

- Brown - always live, unfused, feeds everything except the starter either directly or via the purple, white and green circuits
- Purple - always live, fused (top fuse where there are two fuses, bottom where there are four), typically horns and interior lights
- White - ignition, unfused, typically coil, fuel pump, overdrive
- Green - ignition, fused (bottom fuse where there are two fuses, second one up where there are four), typically instruments, brake lights, reverse lights, indicators, wipers, washers and heater fan
- Black - earth



This block diagram originally drawn by Graham Moore gives a simple but clear overview of the main parts of the MGB electrical system and wiring colours. There were some 18 variations over the years this being probably the most common arrangement with relatively minor variations for year and market, however North America diverged significantly from 'other' markets starting with the Mk2. For details of a particular circuit see Schematics.

The following links display tables showing all the colours and wiring variations I am aware of and have been extracted from no less than 21 schematics in the Leyland Workshop Manual and Haynes and the 'changes by car and body number' tables in Clausager. I say 'all' but with the best will in the world I may have missed some or got some wrong, and there is less detailed information for the later variations than for earlier. The tables can only as good as the source material, and there are one or two where I suspect the published information may be wrong, but I have used them anyway.

Note 1: The years are approximate, mostly coinciding with the model year changes which occurred from the start of MkII production in November 1967 i.e. at various points shortly before the end of the calendar year. As well as major changes at model year change points there were a succession of small changes throughout the year, these I have included as if they dated from the start of the model year.

Note 2: 'North America' refers to the USA and Canada for all years plus Japan from September 1977. 'UK' refers to everywhere else. Note all LHD cars were to North American spec from 1977 on, and only roadsters were produced.

Note 3: There are a number of cases where two electrically separate circuits appear to share the same colour wire at the same time, these I have denoted 'green/black 1' and 'green/black 2' e.g. in the case of the fuel tank sender to fuel gauge and heated rear window switch to the heated rear window in UK cars from 1968 to 1970. Other examples are the brown that goes to the hazards flasher via an in-line fuse and the green that goes to the indicator flasher via the hazards switch both of which should strictly speaking have changed colour. Some wires changed colour a number of times over the years like the wire from the starter relay to the solenoid: white/brown from 1970 to 1976, changing to brown/white for North American cars when white/brown was used for the ignition relay output, and white/red for UK cars with the ignition relay even though the wire from the ignition switch to the starter relay was already white/red!

Note 4: The wire colours are listed in alphabetical order, main colour first, any tracer second.

Note 5: 'Fuse' indicates which fuse, if any, protects the wire. In the case of the indicators wires this can either be the hazards fuse or the green fuse, depending on whether the hazards or the indicators are being used, there are other examples of this situation.

Note 6: 'Component' indicates which items are connected together by the relevant wire, which may go through several bullet and multi-way connectors.

1962 - 1964, all markets	GHN3-101 to 48756 Tourer only
1964 - 1967, all markets	GHN3-48766 to 138800 Tourer, GHD3-71933 to 139823 GT
1968 model year, UK	GHN4-138801 to 158370 Tourer, GHD4-139824 to 158230 GT
1968 model year, North America	GHN4-138401 to 158232 Tourer, GHD4-139472 to 158370 GT
1969 model year, UK	GHN4-158371 to 187169 Tourer, GHD4-158231 to 187840 GT
1969 model year, North America	GHN4-158233 to 187169 Tourer, GHD4-158371 to 187840 GT
1970 model year, UK	GHN5-187170 to 219000 Tourer, GHD5-187841 to 219000 GT
1970 model year, North America	GHN5-187170 to 219000 Tourer, GHD5-187841 to 219000 GT
1971 model year, UK	GHN5-219001 to 258000 Tourer, GHD5-219002 to 258003 GT
1971 model year, North America	GHN5-219001 to 258000 Tourer, GHD5-219001 to 258003 GT
1972 model year, UK	GHN5-258001 to 294250 Tourer, GHD5-258004 to 296000 GT
1972 model year, North America, without seat-belt warning	GHN5-258001 to 276579 Tourer, GHD5-258004 to 268280 GT
1972 model year, North America, with seat-belt warning	GHN5-267580 to 294240 Tourer, GHD5-268281 to 296000 GT
1973 model year, UK	GHN5-294251 to 328100 Tourer, GHD5-296001 to 328800 GT
1973 model year, North America	GHN5-294241 to 328100 Tourer, GHD5-296001 to 328800 GT
1974 model year (chrome bumper), UK	GHN5-328101 to 360300 Tourer, GHD5-328801 to 361000 GT
1974 model year (chrome bumper), North America	GHN5-328101 to 360300 Tourer, GHD5-328801 to 361000 GT
1974 1/2 (rubber bumper) - 1976, UK	GHN5-360301 to 410000 Tourer, GHD5-361001 to 410350 GT
1974 1/2 (rubber bumper) - 1976, North America	GHN5-360301 to 410000 Tourer, GHD5-361001 to 367803 GT
1977 model year, UK	GHN5-410001 to 447000 Tourer, GHD5-410351 to 447035 GT
1977 model year on, North America	GHN5-410001 to 523002 Tourer
1978 model year on, UK	GHN5-447001 to 523001 Tourer, GHD5-447036 to 523002 GT

V8	G-D2D1-101 to 2903

September 2010: See also this British Standard BS-AU7 listing of colour codes, sent to me by Stephen Strange and based on an original layout and format by Marcel Chichak, I believe. And this history of BS-AU7. And this scan of a Rists Wires and Cables document sent to me by Dave O'Neill.

Joining (and adding) wires: *January 2020* Over the years wiring can deteriorate from heat and oil causing the insulation to harden, and crack with normal flexing, as well as from short-circuits and mechanical action causing more extensive damage. Short of replacing the complete harness it may be necessary to 'piece-out' or replace damaged sections. But first, a short section where the insulation has been damaged could be 'repaired' or at least protected with a length of heat-shrink to both strengthen the wire as well as cover exposed conductors. Getting the right size to slide over bullets is easy, less so where spade connectors are involved but still possible, although to fit over factory spades would need the rubber or plastic covers to be removed, and replaced with heat-shrink as well as over the damaged section. This method may not be adequate if any of the conductor strands have parted as that will reduce the current-carrying capacity of the wire.

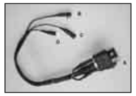
Where a section has to be replaced there are supplies of single and two-colour wire out there, although there are not many two-colour options available in 17 amp as there are in 8 amp, and that gauge won't be adequate for all circuits. To

piece out, the existing wire will have to be traced back, possibly under the harness wrapping, to a sound section, then cut, stripped, and spliced with an appropriate length of new wire. There are very many ways of splicing - just Google 'hand splicing wires' or similar. Laying the two wires side by side and twisting the conductors will not get a neat result for piecing-out, it's only advantage is that you can fit heat-shrink **after** making the join if you forget to fit it beforehand! Splay the conductors out into at least two forks, partially interlace them, then twist the cut ends of each set of conductors around the base of the other wires conductors. This forms a good mechanical joint as well as electrical. The same techniques are used when adding circuits and wires.

Soldering is the trickiest part. You need a soldering iron of sufficient power, and only hold it on long enough for the solder to flow into the joint. An under-powered iron will start damaging the insulation before the joint has got hot enough to flow the solder, and holding a higher powered iron on for too long will do the same. It should only take about a second for the right iron to flow the solder into the joint, and for automotive wiring you should need less than 1/4" of solder per joint. Never carry molten solder to a joint on the iron as per James May, the flux will have burnt off and it will not flow into the joint. If you have a good mechanical joint and the wire is self-supporting, or supported in some way, you only need two hands - one to hold the iron and the other to feed in the solder. Don't disturb the joint until the solder has solidified, this is usually visible as a slight change in appearance from 'silvery' to matt. If it goes a very dull grey you could have a 'dry' joint (the solder is not bridging conductor strands, the joint could move with vibration, oxidise, and develop a bad connection), either from a poor mechanical joint having moved as it solidifies, or the flux having burnt off for some reason. The conductors must be clean and bright or the solder will not flow, but stay in lumps on parts of the joint. Do not leave the iron on so long that the solder flows all the way through the joint and into the untwisted strands. When the joint has cooled slide a section of heat-shrink just slightly bigger than the joint over the joint, and apply heat to shrink it to typically half its diameter. A heat gun is best, blowing from both sides. You can use a soldering iron using the side of the heated tip, not the very end that you use for soldering or that may compromise the next joint you make.

The other end of the wire will almost certainly go to a bullet or a spade connector.

- For bullets strip only as much as is needed for the insulation to butt up against the back of the bullet, and the strands of the conductor to just poke through. Use a bullet with a hole in the end just big enough for all the strands to go through. Support the wire vertically so the bullet sits on it, wrap a piece of wet paper or cloth round the wire just at the base of the bullet, and touch iron and solder to the tip of the bullet, remove the solder as soon as some has melted, and leave the iron on just long enough to see the solder flow into the strands and onto the tip of the bullet. A bullet shouldn't need any heat-shrink unless you have overheated the insulation, or allowed solder to run down that far.
- For spades use uninsulated connectors, or if they are crimp connectors use the type that only have insulation over the base tube where the wire goes, not over the spade. For non-crimp which are completely uninsulated there should be two pairs of tabs - one to fold down onto the conductors, and another to fold down onto the insulation for mechanical support. I only ever use crimp connectors, and never rely on crimp alone even using a ratchet crimp tool. There are those that talk about crimps being good enough for aerospace, and if you can get aerospace wire and crimps to fit our cars and a calibrated tool, then go for it. They claim soldering crimps will damage insulation and cause the wire to go stiff with solder and so make a weak point - and so it will if you use the wrong iron and/or use it for the wrong length of time. If the conductor strands are thin enough to fit into the spade when doubled, then I do. I also crimp in two places slightly apart, with the end of the conductors just visible at the base of the spade part. Again support the wire with the spade uppermost, and touch iron and solder to the tip of the conductors, remove the solder as soon as some has melted, and leave the iron on just long enough to see the solder flow into the strands and the connector tube. You will need a larger diameter heat-shrink to just fit over the spade, and long enough to extend at least 1/2" over the insulation, which will act as a strain-relief.



The above information for bullets and spade connectors applies to adding wires for additional circuits of course, the attached shows this method used for male, female and piggy-back spade connectors.

Wire Size and Current-carrying Capacity: *Updated December 2025* Wire gauge is often mentioned when people are asking what size they should use which seems to be the American way of specifying and leads to the abbreviation AWG (American Wire Gauge). In the UK it's more likely to be numbers of strands and cross-sectional area of each strand e.g. 14/0.30 which might seem more complicated, but a few strands of thick conductor won't be as flexible as many strands of thinner with the same overall current carrying capacity, and some wiring needs to be more flexible than others.

All wire and cable has a finite resistance which results in a volt-drop or 'lost' voltage when carrying current, and the greater the current in that wire or cable the greater the volt-drop. Also the longer the wire or cable the greater the volt-drop so thicker wire is needed for longer runs to reduce that 'lost' voltage which reduces the voltage at the component being supplied. This chart from Offroaders.com shows what gauge should be used for various currents over various lengths, and this chart from AES converts AWG to diameter and cross-sectional area in mm.

On the MGB it may well be that a component takes a low current and a thin wire would be suitable, but if it's a fused circuit then you have to consider the rating of the fuse as well. Of the few fused circuits in an MGB most are rated at 17 amps with 35 amp blow, so in theory to cope with a partial short-circuit fault the wire should be capable of carrying at least 17 amps which would need wire with 28 strands of 0.30mm each i.e. 2.0 sq mm total conductor area which is a lot thicker than most of the wire in an MGB - fused or unfused. Whilst a full short will blow the fuse pretty-well instantly, with no risk of wiring damage a partial short could draw quite a bit of excess current before the fuse actually blows potentially causing insulation damage. For that reason an 'M-effect' fuse might be better, where a blob of low melting-point solder is in the current path and a low overload will cause that to melt over a short period of time, but a large overload will cause the fusewire to melt instantly as normal. I have seen fuses like this with an internal spring at one end and a short length of fuse wire at the other, joined by this blob of solder. MGB fuses have the wire soldered into the end-cap, but I don't think there is any mechanism where the wire is retracted from the cap if the solder melts, the solder would have to run away from the joint and leave the wire suspended and isolated which seems unlikely, so these fuses are dependent on a high level of excess current to melt the fuse wire itself.

Modern cars have wiring gauge **and** fuse ratings according to the current in the circuit for every circuit in the car bar the starter motor which results in a lighter harness - very necessary given the sheer volume of wiring these days. The whole harness is like a tree with each successive branch being of thinner wire and lower rated fuse so components taking very little current could well have two or more fuses between them and the battery or alternator. However there is a lot of unfused wiring in an MGB or equivalent classic, and no matter what gauge you use on those circuits it is going to burn if a full short-circuit occurs.

AES has some useful information on wire sizes.

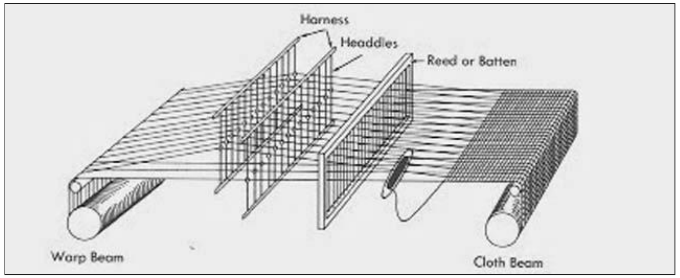
- For the majority of MGB wiring 14/0.30 rated at 8.75A should be enough for the current in normal usage, available in no less than 48 different colours which is hopefully enough from that aspect.
- As the top of that page indicates headlights should have 28/0.30 rated at 17.5A and that is probably enough for electric cooling fan(s) as well, available in 39 colours. That should go for those earths as well, for some inexplicable reason MGBs can have the thicker wire feeding 12v to the headlights and cooling fans but standard gauge for the earth wires.
- For a dynamo that is probably enough but for an alternator the brown wires from the alternator to the solenoid and from there up to the rest of the cars electrics would benefit from being the next one up i.e. 44/0.30 available in six colours. It depends on how the brown circuit runs round things like ignition switch, headlight switch, fusebox, starter relay, ignition relay but from 1970 there is a sealed multi-way connection in the brown wire coming up from the starter solenoid and 44/0.30 would be good for that wire, with 28/0.30 from there to each component.
- Fuel pump and sender can also be standard gauge, where AWS indicate it should be thicker would be for fuel injection pumps.

For battery 12v and earth cables it's usual for the 12v cable in an MGB to be thicker than the earth because it is significantly longer. If replacing cables then keep to the same sizes as best you can, thicker is better especially for the battery cable but bear in mind it will have to fit in the channels under the floor. I've used Halfords ready-made short lengths with through-hole terminals for modifications in the past. The usual suspects i.e. MGB parts houses don't give any current or sizing information for off-the-shelf cables i.e. direct replacement but I think one can assume they are 'adequate'. AES sell battery cable by the metre but you have to add terminals. Whilst attaching battery clamps is easy enough where the clamps have two screws going into the conductors, through-hole terminals as at the starter solenoid are a different matter needing heavy-duty crimping and/or soldering.

Terminal Numbering: *Added January 2007* Very hit and miss with original MGB components as terminal numbering changed from time to time. In more recent years DIN (the German Institute for Standardisation) published Standard 72552 covering terminal numbering for pretty-well every electrical component in an automobile. The numbering seems to have been adopted world-wide and is most likely to crop up in connection with MGBs for additional and replacement relays, flasher units etc. Wikipedia DIN 72552 lists the numbers and their meaning, broken down into circuit areas, however 'Standard' is stretching the definition as several of the numbers have multiple applications.

Wiring Harness Replacement

Yes, 'HARNESS', not 'loom' as many call it.



The terminology comes from weaving where 'loom' is machine that weaves the cloth. Alternate threads of yarn - the warp threads - are lifted up and the shuttle with the weft thread is passed under them, and above the remainder of the warp threads. Then those threads are lowered and the others raised and the shuttle passed back, so weaving the weft thread in and out of the warp threads. Each warp thread is lifted by a special wire with a loop in it, known as a 'heddle'. So there are many wires, the upper end of each of them being attached to one of at least two bars running the width of the loom. Each bar is called a HARNESS, and each HARNESS carries many WIRES. So there you have it - Harness, not loom.

February 2024: Brian Wall raises this on the MGOC MGB forum, referencing (but not linking ...) my reasoning for harness, instead providing a link to a Live Electronics page headed "Cable Assemblies, Wiring Harnesses and Wiring Looms: What is the difference?". Which camp Brian falls into he doesn't mention even though he asks others for comments. You can read the explanations of 'harness' and 'loom' for yourselves in that link, but the only significant difference I can see is the use of the term 'more complex' for 'loom'. What isn't given is the point at which that distinction is made. Compared to a fighter jet or airliner the MGB can hardly be described as 'complex'.

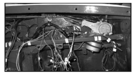
Googling 'harness or loom' I was surprised at just how many wiring product manufacturers have a page on the subject, and even more surprised at how similar they are, as if there has been a concerted campaign (who would do that and why?) to make everyone use 'loom'. Clare McGarrey at Interconnect Wiring writes "In the last 23 years I have only thought of InterConnect as a manufacturer of F-35 wiring **harnesses**, B-1B cable assembles, F-16 fiber optic cables, V-22 **harnesses**, UH-60 circuit breaker panels, and F-15 power panels." She goes on to say:

> "In the dictionary it says that the word loom means: “An apparatus for making thread or yarn into cloth by weaving strands together at right angles.”
>
> "Well that now makes perfect sense. At InterConnect Wiring or incredible assemblers weave together hundreds of wires creating one large beautiful electrical tapestry. Therefore, a wire loom is a well-crafted work of art that InterConnect creates from multiple wires, contacts, and connectors weaved together and bound by braid or lacing tape."

Her second paragraph makes no sense as wires are collected into parallel bundles not woven 'together at right angles', neither do they make a 'tapestry', and she has completely missed the point of the dictionary definition. The loom 'is an apparatus for making' an article or product. That article or product is not called a 'loom' otherwise we would be walking on looms, lying in bed under looms, draping looms round our necks, and Scots would be dancing in looms all of which would be ridiculous. If you take that further restaurant menus would simply list the utensils with which the dishes were made, not the names of the dishes themselves. Some say the use of 'loom' for automotive wiring dates back to the fifties - American companies, so another example of Americans mistreating the **English** language, and another example of creeping Americanisation over here. A pet hate is American use of the term 'dove' as the past tense of 'dive' instead of 'dived', or 'pled' instead of 'pleaded'. And how about 'lucked out' vs 'lucked in'? Which one is good luck and which bad? Even Americans can't agree on that, I asked a pal who runs an insurance brokers in Philadelphia and to him 'lucked in' is good luck, but he asked a younger person in the office and for them 'lucked out' was good luck! And how about 'double-up' vs 'double-down'? To bring it back to the automotive world where on earth did 'rocker panel' come from for 'sill'?

My 1976 copy of the Leyland Parts Catalogue uses 'harness', I have a 2016 Moss printed catalogue that uses 'harness', an undated (but post-2005) Rimmer's that uses 'harness', and a 2005 Brown & Gammons that uses 'loom'. Moss now uses 'loom' on its website, Rimmer's still uses 'harness', and Brown & Gammons still use 'loom'.

Use whichever term you like, I know which I will continue to use. Back to the MGOC forum post only two dismissive comments other than my reply seems to show what a burning issue it isn't ... but back to replacement.



For Mk1 cars all markets used the same main harness, designed to reach right across the car for LHD, turned back on itself behind the dash for RHD. For Mk2 and later cars even though there were separate North American harnesses this was more to do with additional circuitry for that market rather than differences between LHD and RHD, other LHD markets and the UK seem to have continued to use the same 'LHD' harness turned back for RHD cars. It wasn't until the 77 model year that all LHD roadsters (LHD GTs having ended by this time) conformed to the North American spec, at which point there was a RHD-only harness, a LHD for Canada, and another LHD for America and the rest of the LHD world. The V8 also had an RHD harness as it was never **marketed** in LHD form, even though seven were built for Federal testing in the USA so either hand an LHD harness or a modified RHD. These may or may not have had all the North American parts as they were never offered for sale there, a Dutch LHD GT V8 which may have been one of the returned North American cars doesn't have dual-circuit brakes which were mandatory for North America by that time.

For removal/fitting split a length of thin cable sheathing or tubing up one side and put it over the edges of the two holes that go through the firewall to avoid damaging the harness tape or cloth as you work them through.

For removal pull the old one back into the cabin, and for fitting do the reverse i.e. pull it into the engine compartment from the cabin.

As time went by more and more wires were contained in the main harness, so for later ones in particular it will be necessary to tape the tails in the engine compartment to the main part, some facing forwards and some back, to avoid a thick wodge at one point as you are pulling it through.

The main, rear and gearbox harnesses joined together in more or less the same place, albeit lower on the 77 RHD and later with the long master cylinder and servo, and also for some reason on early cars when there was no similar space restriction. Interconnecting harnesses should be straight forward as in the vast majority of cases they are the same colour both sides of the bullet connector. Exceptions are the indicators where the tail from the light unit is green (one part number for both side) whereas the harness wires will be green/white or green/red. Another is the 4-synch LH overdrive circuit prior to 1977 where yellow coming out of the main harness goes to yellow/red in the gearbox harness.

In general spurs with their own harness wrap come out of the main harness adjacent to the component they feed which reduces the confusion of what goes where. After that the Autowire diagrams are going to be more helpful than the WSM or Haynes as to exactly which wires go to which component. On the original web site they only show up as full screen, but the ones linked here should allow you to expand them and be even clearer by clicking on it when you get the cursor with a + symbol in a magnifying glass.

As time went by various sub assemblies connect to the main harness with multi-plugs which makes life easier, commencing with the indicator/dip/main/flasher switch, then the ignition switch and column wiper switch, and eventually the dash had it's own sub-harness with three (RHD) or two (others) multi-plugs for interconnection.

Fusebox has brown wires on the lowest front spades and purple on the back. White on the next one up front and green on the back. for the 'four-fuse' fusebox red/green goes to either of the top two at the front and red on the back. Strictly speaking the red wires should be one fuse for one side and one for the other, they can be cross-connected between front and back, but it doesn't matter. The important thing if you've had the fusebox off is to fit it the right way up - the top two fuses are linked together at the front, which is why it doesn't matter which spade the red/green goes on.

The ignition coil has a preferred connection with white on the SW or + terminal or two white/light-greens on the + terminal, and one or two white/blacks on the CB or - terminal.

The earlier square wiper motor has separate spades and getting the connections the wrong way round can blow the fuse. The later 2-speed wiper motor is straightforward as that has a multi-plug and socket.

The biggest problems are individual spades on things like the ignition switch and switches for the lighting and wipers, more info by clicking the links. Later rocker switches have multi-way connectors.

Courtesy lights with manual switches such as for the GT load space also have to be connected the right way round or you will get a short-circuit when turning them on manually. The centre console courtesy light is connected using bullet connectors so as long as you match up the colours it should be fine.

For dynamo and earlier 16AC alternator with the external control boxes/regulators terminals will be labelled. For later alternators multi-way plugs are used.

Starter and ignition relay (where provided) should have marked terminals and the diagrams shows which wire goes where, ditto for solenoids and starters.

The single-speed heater fan and overdrive switches and the later fuel and electric temp gauges only have two connections each so it doesn't matter which way round they go. The single-speed heater fan only has two connections but these do have to be round the right way as otherwise it blows very poorly. The 2-wire horns and the hydraulic brake light switch can also be connected either way round.

The instrument voltage stabiliser only has two connections but those do have to be the right way round. Originally the arrangement of male and female spades meant that the wires would only connect one way, but more recent stabilisers may allow you to connect them either way round. In all cases they should have the terminals labelled B(attery) for the green wire with a female spade, and I(nstruments) for the light-green/green wire with a male spade.

The later 2-terminal indicator flasher unit also has two connections labelled B(attery) for the green wire and L(amps) for the light-green/brown but can be connected either way round, as with the hazard flasher.

For any additional wiring (for which you may not have any diagrams) make absolutely sure you have very detailed notes or pictures, or cut them taking a little bit of the original harness, so you know where it all has to go back to.

Bullets are only crimped on, unlike the spades which are spot-welded, and can pull off as well as corrode internally. With all the lighting bullets at the front of the car drill a conical depression in the end so it shows both shiny brass from the bullet and shiny copper from the wire, and fill the depression with solder making sure you get the bullet hot enough for the solder to run, but not so hot as to damage the insulation. A high-power iron used briefly is best. Make sure the outside of the bullet is clean (no flux) and shiny after soldering. Do this to the old wires from the lights too.

Use all new bullet connectors (particularly at the front) and put Vaseline inside them and on the bullets before assembling which makes them easy to assemble as well as protecting against moisture. Make sure both bullets are pushed home inside the connector, and ends of bullets or the end of the metal connector are not poking out of the insulating sleeve.

When reassembling the multi-plugs for the column switches and the later dash make sure all of the pins are pushed fully home, and not pushed partly out the back of the connector so only the tips are touching.

Note: On rewiring a UK 1980 I had some really curious issues with the fused ignition i.e. green circuit components, until I discovered that the two additional in-line fuses for some of these circuits (under the fusebox) had been cross-connected i.e. brown to brown and green to green. Reversing these corrected the problem. This had come about because one circuit has the brown coming from the front and the green going towards the rear, and the other circuit the other way round, but both circuits had the fuse holders installed in the same orientation instead of one facing one way and the other facing the other way. Had both fuse holders been connected with the short cap on the brown and the main body on the green, for example, it wouldn't have been possible. Murphy's Law - if something can be fitted more than one way but only one way is right, someone somewhere will eventually fit it the wrong way.

The body/boot harness can be a real pain, unless damaged leave it alone. The mass of bullets form a diameter greater than the some of the support brackets, and whilst you will be able to get some of the bullets through in one go you will have to thread the remainder through one at a time. However on 67 and later cars with the solenoid on the starter, unless you can remove the fixing nuts for the brackets down the inner wing (a real challenge with a V8, even more to replace them) you may **have** to remove the body harness in order to get the thick wires that go to the starter together with their big lugs through the brackets first. In the case of a 1980 with a V8 conversion I had to tape up the end of the body harness, with the bullets slightly staggered to reduce the maximum width, then I could pull it through from above using a pulling wire also taped on.

The main rear and chrome bumper front parking/flasher lighting units do not have earth wires but rely on the mechanical fixings. Consider adding earth wires from a fixing screw. Later cars should have bullet connectors nearby, early cars will have to go back to the number-plate fixing bolt earthing point.

If you have any additional wiring do not rely on crimp connections alone, they simply are not good enough. Get the semi-insulated spade terminals that allow you to solder after crimping, using heat-shrink to cover the whole connector afterwards. Do not use those tubular crimp wire extenders as they cannot be soldered at all. Use a male and a female spade, soldered as well as crimped, assemble with Vaseline and put heat-shrink over the lot. Crimp-type bullets do not fit the original bullet connectors without distorting them.

Clean up all the body earth points and use Vaseline when bolting the earth wires to them.

Before reconnecting the battery for the first time make sure everything else is connected as you think it should be, and turn everything off, including any interior and boot/trunk lights, clocks, radio etc. Connect the thick starter cable to the battery but not the earth strap. Connect a meter set to display 12v between the battery earth post and the car body. If it shows 12v then some circuit is drawing power (if you have an alternator you should see a few volts, this is OK). I also have an old headlamp bulb with two flying leads, if this lights up at full brightness when used in place of the meter you have a full short to earth from somewhere. Don't reconnect the battery earth strap until you are sure there are no shorts. Start with everything switched off, and the bulb should be out. Then switch each circuit on in turn, one at a time, and the test bulb should glow to some extent. You should be able to test everything except turning the ignition key to the crank position. The more powerful the circuit being tested, the brighter the test bulb will glow. The brighter it is glowing, the higher the voltage will be across the test bulb, and the lower it will be across the circuit being tested. This means that low-current circuits may well appear to be working normally, but higher current circuits will only work weakly or not at all. Turning on headlights (the next highest current circuit after the starter) will make the test bulb glow pretty brightly, but there should still be some glow from the parking lamps at least. If you do happen to turn the key to the crank position, the test bulb will glow at full brilliance, as the solenoid takes a very high current, and it won't operate. In fact if you have a starter relay, you will probably find this chatters and the test bulb flickers. This is because there is enough current through the test bulb to operate the relay, but as soon as the relay contacts close, and connect the high-current circuit of the solenoid to the battery, the test bulb glows brightly, which means it is taking all the voltage. There will be little or none left to keep the relay operated, which will release. As its contacts open the current will drop, meaning that the test bulb dims, the voltage available for the relay goes up again, so it operates again, and so on.

Won't Start

This could mean several things like:

"It isn't turning over when I turn the key" or
"The solenoid is chattering" or
"It just clicks as I turn and release the key" or
"It spins the starter but not the engine" or
"It cranks very slowly" or
"It turns over normally but won't fire" or
"It fires occasionally but not enough to run" or
"It only fires up as I release the ignition key" or
"It starts but cuts out again when I release the ignition key" etc.

On the other hand, you could have the "It starts cranking as soon as I turn the ignition on and won't stop until I release the handbrake or disconnect the battery!!" problem.

The diagnostics below relate to points and coil systems, not electronic systems either factory or aftermarket.

"It isn't turning over when I turn the key"

Circuit chain: battery - heavy current circuit - brown circuit - ignition switch - white/red circuit - starter relay (1970 on, inner wing) - white/brown circuit - solenoid - starter body - engine - engine earth strap - body - battery. Click the link for .

Note 1: Until the 1970 year the ignition switch was connected direct to the solenoid, even when the alternator and pre-engaged starter was fitted to Mk2 cars. From 1970-on the relay was between the ignition switch and the solenoid.

Note 2: *Updated May 2006* Note that on the V8 there is an insulated stud mounted under the RHS toe-board by the chassis member where the browns, long cable back to the battery, and a short cable forward to the starter motor, all join together, which is an additional point where bad connections can develop.

If you normally have the ignition light glowing between turning on the ignition and starting the car, is it on now?

No - check battery, heavy current cable, brown circuit to ignition switch, white circuit from ignition switch. Click the link .

Yes - does it go out or nearly out when you turn the key to the start position?

Yes - could be insufficient charge in the battery (check by putting a known fully charged battery on the car) or bad connections in the heavy current cables and engine earth strap, check these with this method. It could also be the starter jammed in mesh with the flywheel. This usually only affects inertia starters i.e. those with a remote solenoid. Try putting the car into 4th and rocking it back and fore to free it.

No - can you hear a clicking when you turn the key to the start position?

No - is there 12v on the white/red wire at the ignition switch?
No - possible faulty ignition switch.

Yes - is there 12v on the red/white terminal of the starter relay and earth on the black terminal?

Yes - possible faulty relay winding or contacts jammed open.
No - check white/red and earth wiring at ignition switch and relay.

Yes - is it the relay or the solenoid?

Relay only - check that 12v is coming out of the relay onto the white/brown wire and getting to the solenoid terminal. If it is, possible faulty solenoid otherwise possible faulty relay contacts or wiring between them.

Solenoid - possible bad contacts on solenoid, or brushes/windings on starter motor, or connections between solenoid and starter (some pre-engaged starters have the connection from the solenoid to the starter exposed, check here as well).

"The solenoid is chattering"

Is the engine turning?
No - either the battery is flat or there is a bad connection in the heavy current circuit. Continue as for "It isn't turning over when I turn the key".

Yes - probable bad connection in the solenoid operate circuit. With the key turned to 'start' check the voltage on brown and white/brown connections at the starter relay, and at the white/brown spade on the solenoid. Any sudden voltage drops indicate a bad connection. If the voltage on the relay brown spade is good but on the white/brown spade is low then the relay is bad. If you still have 9v or so at the white/brown spade on the solenoid then the solenoid/starter is suspect.

"It spins the starter but not the engine"

This usually only affects inertia starters (i.e. remote solenoid) and can be caused by a dirty or sticky pinion. This pinion is on a spiral 'thread' with a very coarse pitch. When the starter starts to spin it tries to spin the pinion, but the 'inertia' of the pinion and the direction of the spiral means that it slides up the spiral into engagement with the flywheel, and only then starts turning. If this spiral is dirty the pinion doesn't move into engagement with the flywheel, it just spins where it is. Most books tell you not to oil the pinion and spiral, and it is true that oil will hold dirt and cause the problem. But I have also found that a 'too clean' pinion and spiral will also stick. After several bouts of 'remove, clean, refit, wait, stick' many years ago an old hand told me to put a drop (literally) of oil on the pinion and after that the problem never came back.

"It cranks very slowly"

Could be insufficient charge in the battery, or bad connections. The first check is to look at the ignition warning light, or turn the headlights on, then crank. If the lights dim right down then either the battery is flat, or its connections or the battery cable connection to the starter is bad. Check by putting a known fully charged battery on the car, and check the connections as described here. Note that V8s have an additional connection in the battery cable under the driver's toe-board. If the lights stay bright then the problem may be in the starter or solenoid.

Update December 2008: Brian Smith on the Bulletin Board had this problem and mentioned his ignition warning light dimmed significantly while cranking. It suddenly struck me that as well as indicating a low battery or bad connections at the battery or solenoid, it will do the same if the engine/gearbox earth strap is bad as well. How does that get us any further forward? Well, the ignition warning light gets its earth from the engine when it isn't running, but all the other lights on the car get their earths from the body. So if, say, the **interior** light doesn't dim at all or only very slightly during cranking when the warning light dims a lot, that is probably an indication of a bad engine earth strap, and that was indeed what was happening on Brian's car, jumping from another battery and cleaning up the battery earths having had no effect. Connecting a voltmeter between the engine (+ve probe) and a known good body earth (-ve probe) would reveal this by showing some voltage during cranking. Ideally it should only show 1 or 2 tenths of a volt, if it shows any more it is probably worth cleaning up the engine earth strap, and this did the job on Brian's car.

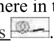
"It fires occasionally but not enough to run", and **"It only fires up as I release the key"**

Do you get a good and regular spark at each plug lead?
No - follow "It turns over but won't fire" above.

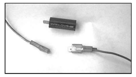
Yes - check fuel delivery and carbs; check timing and order of leads from dizzie to plugs.

September 2019: A pal with a TR4 spluttered to a halt shortly after leaving home having not used the car for a while. Since then it would make an occasional cough then cut out, but only as he released the key while cranking, which apparently was what normally happened. He said the spark looked weak so with that and only trying to fire as he released the key suggested a bad condenser. Tried one of my known good spares from the points wire on the coil to earth but no different. Checked the plugs and the front pair were soaked, the back pair less so. Peering in the carb intakes while cranking I could see fuel pulsing up the jet, so flooding, i.e. float valve stuck open. These are Strombergs with no overflow pipe to the floor and engine-driven pump so no clicking. That fixed, the spark was still weak, but also intermittent. Checked the points volt-drop and that showed they were high-resistance so cleaned them, but other than that they were opening and closing as they should. Maybe a bit better spark but still intermittent, then no spark at all. Check the coil and the secondary had gone open-circuit. Fitted my spare coil and spark again, but still intermittent. Checked the HT leads and two were open-circuit - silicon cores not trapped under the crimp in the plug caps - new cap and leads to be obtained but in the meantime I fit my cap and leads. Spark now better but still intermittent. A couple of days later fitted his new cap and leads, and new rotor, but still intermittent sparking, confirmed from two Colortunes and a timing light on a third plug lead. By now I'm beginning to tear what's left of my hair, and pal says to fit new points and condenser which he'd got at the same time as the other stuff, from Powerspark. The first problem with those was that the condenser and spade connections had been attached to the points incorrectly so the tags and leads would have been trapped under the cap, and the condenser didn't reach its slot on the points plate. Corrected that, but couldn't close the gap enough as the end of the points spring was sticking out and pressed against the fixing screw - shorting the points out! After bending that out of the way, and discarding the large washer that had been under a spring washer and looked to me like it was also up against the points spring, the screw still looked very close to the spring. So I slackened the nut and pressed the spring out of the way and retightened the nut. Finally we could adjust the new points! Switched on, cranked, and it burst into life - and before he had released the key, and did so several times! On a test drive pal said it was going better than it ever had before. I reckon it **was** a weak spark originally from the two bad leads, which was causing it to only fire as he released the key and the ignition voltage went back up, also causing the HT voltage to rise much higher than normal as it struggled to jump the increased gaps, which sapped power, and eventually took the coil. The float valve was probably because of a period of idleness, and caused the initial problem. When first looking for the problem pal had reset the points gap which I reckon had put the points screw or washer too close to the points spring, and the 200v or so that appears across the points was enough to jump that gap, which killed the spark. Comparing with mine after the event I'm sure his screw has a larger head, but presumably the same thread, and the washer was definitely bigger than mine.

"It starts but cuts out again when I release the ignition key"

This problem usually only affects cars equipped with a 6v coil and an external ballast resistor. The coil normally runs at 6v and is fed from the white circuit via the ballast resistor, usually a length of resistance wire contained within the harness with a white wire at the ignition switch end and a white/light-green at the coil end. The coil is boosted to 12v during cranking by the white/light-green circuit from the solenoid which effectively bypasses the ballast resistor. The fault is caused by a disconnection somewhere in the white circuit - ballast resistor - white/light-green circuit - coil chain. Click the link for ignition schematics .

"It starts cranking as soon as I turn the ignition on and won't stop until I release the handbrake or disconnect the battery!!"



This problem affects late-model cars to both North American and UK spec and is caused by the brake-warning diode going short-circuit. More information here.

Won't Switch Off!!

For North American spec cars with the ignition relay i.e. 1977 on, where the ignition warning light is working normally, and the engine runs normally when the ignition is turned off, see here. In all other cases where the engine continues to run normally see here. For the rocking and rolling Dieseling-type run-on see here.

© Copyright - 1999 to 2026
I.T. Answers