HEADLAMP CIRCUIT ANALYSIS NOTES

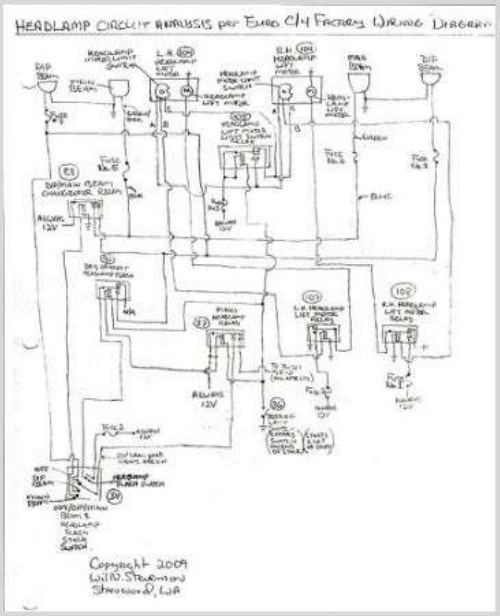
Disclaimer

THIS IS A WORK IN PROGRESS, AND PROBABLY CONTAINS ERRORS. TEST EVERYTHING YOU PLAN TO MODIFY OR REPAIR WITH AN OHMMETER BEFORE CONNECTING A BATTERY TO THE SYSTEM, OR YOU COULD BURN UP YOUR ELECTRICAL HARNESS OR YOUR CAR. USE THIS INFORMATION COMPLETELY AND ENTIRELY AT YOUR OWN RISK.

The C/4 electrical system is one of the most complicated pre-microprocessor, relay-based systems out there, but is in fact only a more involved version of simpler relay-based systems. Please use my drawing "Headlamp Circuit Analysis per Euro Wiring Diagram" with these notes. The numbers & letters used in this text are referred to in that wiring diagram. All relays are shown in their 'relaxed' or de-energized positions.

Overview

There are six relays (87, 88, 91, 105, 107, 108); five switches, consisting of two 104 limit switches in the headlamp motor/lights pods, the 36 Parking Lamp Switch, and the 34 Headlamp Stalk Switch which contains two switches, the Headlamp Flash Switch and the Headlamp Off/Dip/Main Switch; two 104 headlamp pod motors; and the obvious lights (headlamps, parking, etc.) involved in the headlamp system. They make up the heart of the overall wiring diagram complexity. If you understand this particular system, you have most of the C/4 wiring diagram licked. The other components are reasonably straight-forward, with the notable exception of the brake failure/pressure differential warning bulb test circuit, not the failure circuit itself, which is simple. The USA version brake failure/pressure differential warning bulb test circuit makes elegant sense -- it appears that when USA cars crank for start with the handbrake off, the brake warning light comes on until cranking ceases. Thus the brake failure bulb is tested even if one doesn't use the handbrake often. The Euro C/4 brake failure/pressure differential warning bulb test relay is a less kind creature altogether, and still under analysis.

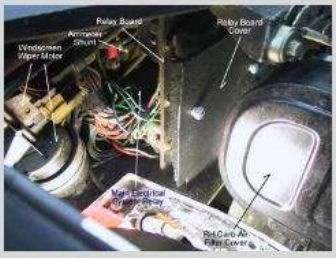


Until the headlamp motor limit switch/diodes circuitry in one of the 104 pods is disassembled and analyzed, an educated guess as to their function is all that can be done, their function is not shown in the factory wiring diagram.

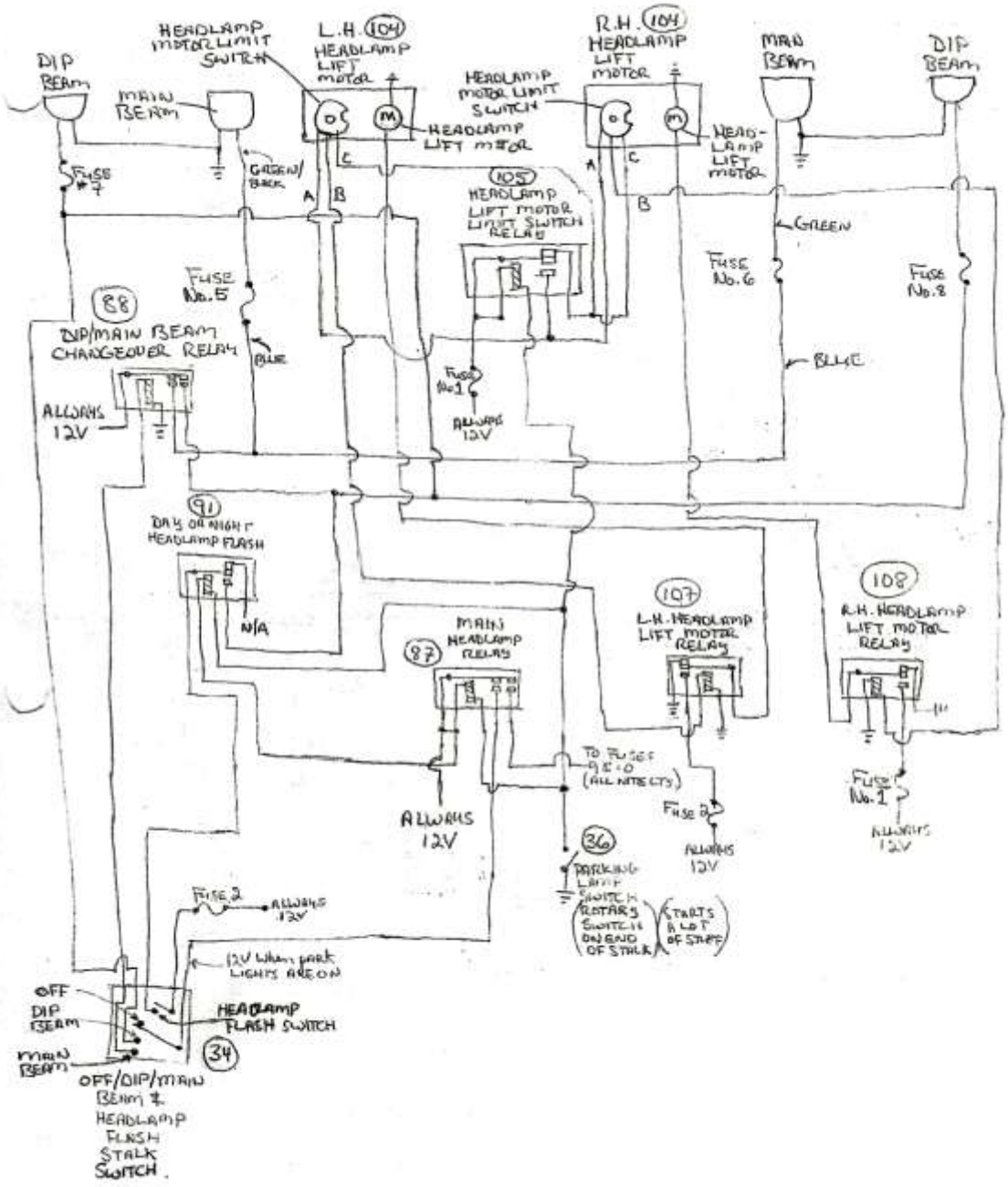
All the ground circuits have been simplified in the diagram compared to those depicted in the factory wiring diagram, but are functionally the same. A floating ground is not what's being depicted in the factory wiring diagram, it appears to be a function of the many fibreglass parts of the C/4.

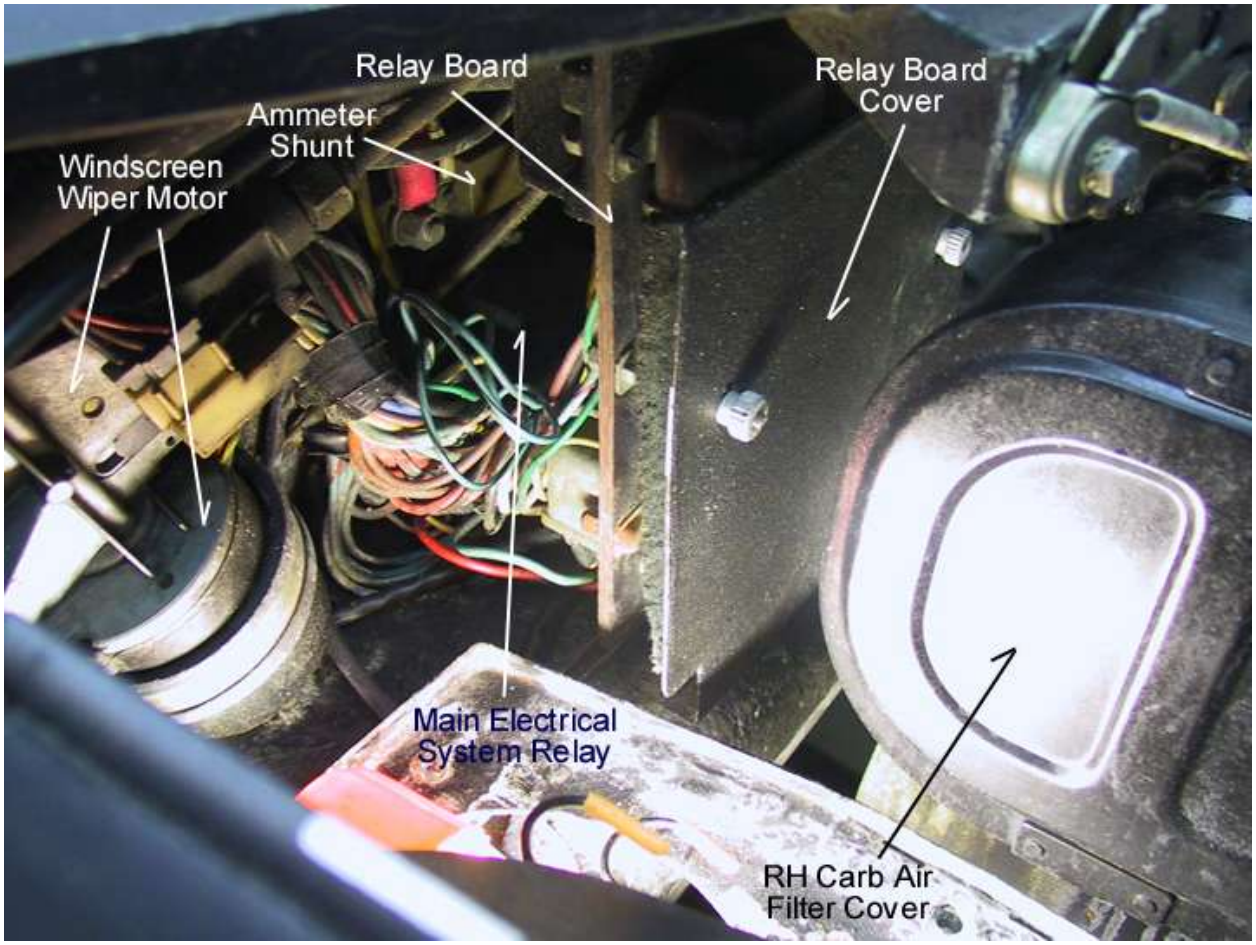
The "Always 12v" note in the diagram refers to the fact that this 12v source comes directly from the battery via the 106 Ammeter Shunt, a nice piece of design by the factory for safe monitoring of ampere charging & discharging.

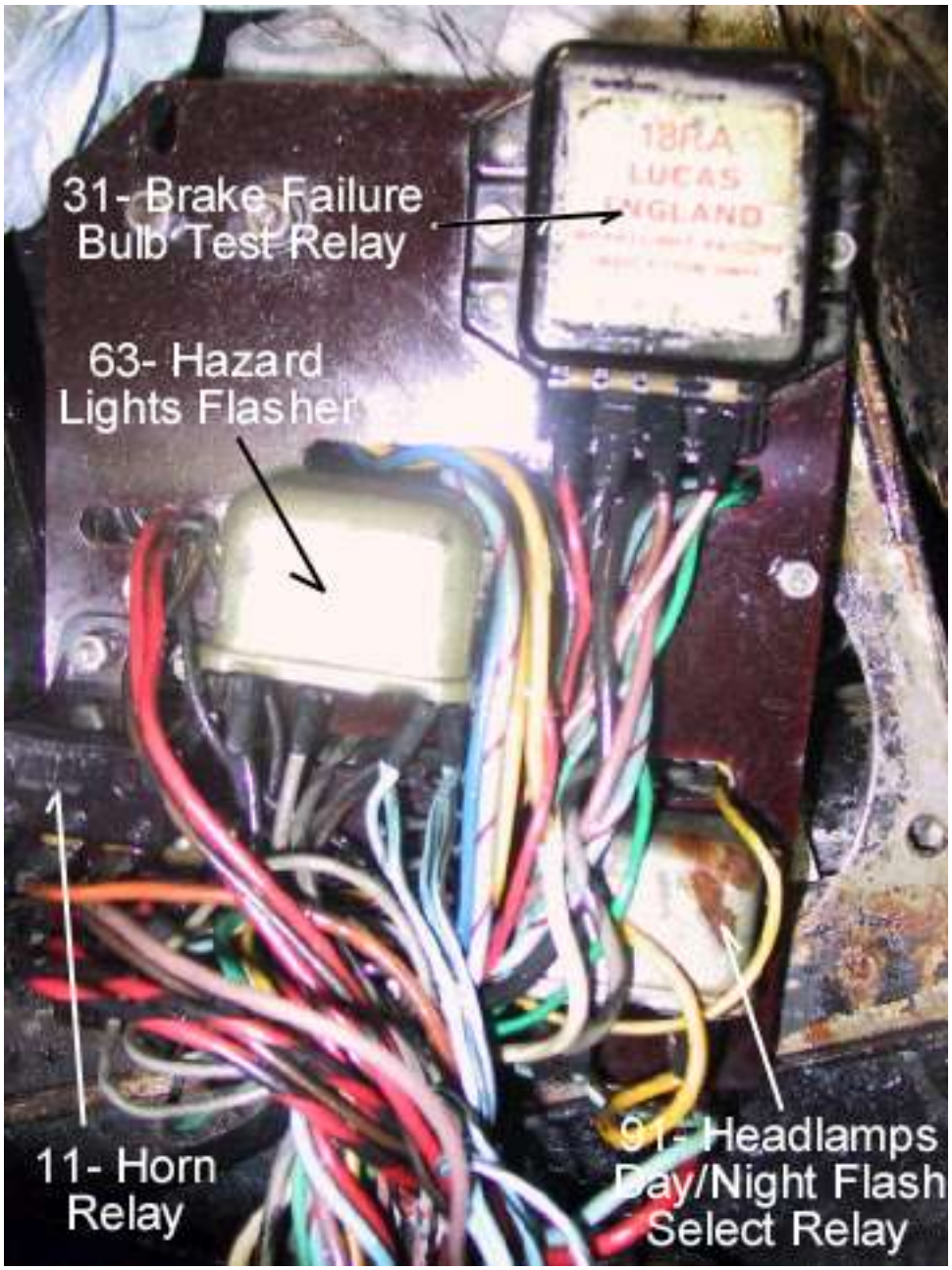
The relays are located on a bakelite board under the passenger side cowl, removed with two thumb screws.



HEADLAMP CIRCUIT ANALYSIS per Euro C/4 Factory Wiring Diagram




Relay Board
Ammeter Shunt
Windscreen Wiper Motor
Relay Board Cover
Main Electrical System Relay
RH Carb Air Filter Cover


31- Brake Failure
Bulb Test Relay
63- Hazard
Lights Flasher
11- Horn
Relay
91- Headlamps
Day/Night Flash
Select Relay


87- Main Headlamp Relay
88- Dip/Main Beam Changeover Relay
107- Left Headlamp Lift Motor Relay
E 224
30- R.H. Radiator Fan Motor Relay
99- A/C On R.H. Radiator Fan Relay
29- L.H. Radiator Fan Motor Relay
105- L.H./R.H. Headlamp Lift Motor Limit Switch Relay
108- Right Headlamp Lift Motor Relay

Summary of Relays & Switches and Their Function within Circuits

34 Headlamp Flash Switch & Headlamp Off/Dip/Main Beam Switch. Two switches in one, it is the longer stalk switch located on the steering column left side (LHD cars). Controls relay 88 when used in headlamp dip/main beam changeover function, provides 12v to dip beams when used in headlamp flash function. Also turns off headlamps.

36 Parking Lights Switch. Does a lot of stuff. Activates three relays- 87, 91, 105 by grounding their respective solenoids. See relay descriptions for these relay functions. It is a rotary switch located on end of switch 34.

87 Main Headlamp Relay. When 36 Parking Lights Switch is turned on, relay 87 is activated which powers up all night lights on Fuses 9 & 10, and relay 87 also powers up the Off/Main/Dip Beam Changeover portion of switch 34. Headlamp Flash portion of switch 34 is always powered.

88 Main Beam/Dip Beam Changeover Relay. Activated by the headlamp off/dip/main beam portion of switch 34. Provides dip & main beam changeover capability when driving at night. Removes current load from dip beam contacts portion of switch 34 when switched to main beams. When main beams are selected, both main & dip beams are turned on by, and all current is carried through, relay 88. When dip beams are selected, all current load for them goes through contacts in switch 34 –not so good.

91 Day or Night Headlamp Flash Relay. When this relay is activated by 36 Parking Lights Switch, it allows current from the headlamp flash portion of switch 34 to flow to the dip beam lights. When 36 Parking Lights Switch is turned off (i.e., headlamp pods are retracted), current is not allowed to the dip beams when headlamp flash portion of switch 34 is activated because relay 91 has been deactivated.

104 LH & RH Headlamp Motor Limit Switches & Motors -- (Educated guess, diode function unknown). Switches are located in the left and right headlamp pods and are mechanically activated by the headlamp pods as they travel up & down. They control the 105 Headlamp Motor Limit Switch Relay. Motors raise & lower the headlamp pods.

105 Headlamp Motor Limit Switch Relay. Activated by switch 36, this relay works with both the LH & RH Headlamp Motor Limit Switches and relays 107 & 108 to activate and provide the limits of travel to the headlamp pods when they are raised and lowered. This relay's main contacts are functional whether in the activated or relaxed positions.

107 Left Hand Headlamp Lifting Motor Relay. This relay carries the current load to the LH headlamp lifting motor when activated. Controlled by the LH headlamp limit switches, diodes, and relay 105.

108 Right Hand Headlamp Lifting Motor Relay. This relay carries the current load to the RH headlamp lifting motor when activated. Controlled by the RH headlamp limit switches, diodes, and relay 105.

Operational Steps to Turn On Headlamps

1. When 36 Parking Lamp Switch (rotary switch on end of headlamp stalk) is closed, relay solenoids 87, 91, & 105 are grounded, thus closing the contacts on these relays.
2. Relay 87 then energizes fuses 9 &10 (all the night lights -parking, ashtray, instruments, etc.), and puts power to the Off/Dip/Main Beam portion of 34 Headlamp Stalk Switch. Headlamp Flash portion of switch 34 is Always 12v (see note above).
3. When relay 91 is energized, 12v can go to the dip beams when headlamp flasher switch in switch 34 is activated.
4. It is difficult to make this step clear using text, here goes. When relay 105 is energized, the main contacts are pulled closed, thus conducting 12v from fuse no. 1 through the closed (in the down, activated position, not the relaxed, up position) contacts of relay 105 to both 104 headlamp motor limit switch circuits A and (because the limit switch contacts for circuit branches A& B are closed/connected when the headlamp pod is in the down position) 12v goes back down through headlamp motor limit switch circuit branches B (there are two branches, one for each motor) to the solenoids in relays 107 & 108, thus energizing relays 107 & 108. This allows 12v from fuse nos. 1&2 to flow through the closed contacts on relays 107 & 108 to the left and right headlamp lift motors 104, thus activating the motors and raising the headlamp pods. When the pods are fully raised, the lift motors are stopped abruptly by the headlamp motor limit switches opening the contacts in circuits A/B, and further also grounding the lift motor armatures (the relaxed position of the 107 & 108 relays ground the lift motor armatures), which quickly stops the 104 motors and thus the lift pods.
5. Now we have the headlamps raised and headlamp flash circuit and headlamp off/dip/main beams ready to be utilized by headlamp stalk switch 34. The dip beams can now be flashed by the always energized Headlamp Flash Switch portion of switch 34, through the previously mentioned closed contacts on relay 91 and fuses 7 & 8 to the dip beam lights. The headlamp off/dip/main beams can be turned on by the portion of switch 34 that controls these functions because the previously mentioned closed contacts in relay 87 have energized the input of the Headlamp Off/Dip/Main Beam control portion of switch 34. When dip beams are selected on switch 34, current flows directly through switch 34 dip beam contacts to the dip beams. When main beams are selected on switch 34, 12v is put on the solenoid of relay 88, thus closing its contacts. The relay 88 closed contacts allow 12v to flow from an unfused main 12v source through fuses 7 & 8 to the main beams and through fuses 5&6 to the dip beams. This removes the dip beam load from the contacts of Headlamp Off/Dip/Main Switch when in the dip beam position.

In my car, I need to slightly wiggle switch 34 when in the dip beams position in order to bring the dip beams on, perhaps a sign of contact burning from the high dip beam current over the years. A relay could be installed nearby using the same wiring that would remove the heavy current load from switch 34 dip beam contacts when in the dip beam position.

Headlamp Retraction, Turning the System Off

When rotary Parking Lamp Switch 36 is turned off (thus ground is removed), relay solenoids 87, 91, and 105 are deactivated, and their respective contacts move to their relaxed positions. This renders relays 87 & 91 completely inactive, but does something interesting to relay 105. When the contacts in relay 105 are in the relaxed position (as depicted on the wiring diagram), this routes 12v from fuse no. 1 through the relaxed contacts in relay 105 and onto headlamp motor limit switches circuit branches C (two, one for each lift motor) and closed headlamp limit switches contacts B&C; (they were closed when the headlamp pods raised to their full extent, which opened contacts A&B; and closed contacts B&C;), through headlamp limit switch circuit branches B (two, one for each lift motor limit switch) and activates the lift motor relay solenoids of relays 107 & 108. This energizes the lift motors and lowers the headlamp pods until the limit switches for both pods once again open up circuit B&C.; The headlamp motors continue running in the same direction to do this, but the circular headlamp pod drive gear is now retracting the headlamp pods, perhaps like how a windscreen wiper will move in one direction then the opposite direction on each revolution of the windscreen motor circular drive gear. No reversal of pod motor direction is needed.

Epilogue

Hopefully this is useful in troubleshooting C/4 headlamp system inop issues. A simple inop main headlamp beam (bulb was good) prompted this analysis. It turned out to be a bad connection on the back of fuse no.6 of the left-hand glovebox fuse block. A good idea is to turn all your electrical systems on with the car running and carefully feel the connections on the front and back of the two glovebox fuseblocks for excess heat. This will identify connections that need to be cleaned and tightened.

This represents a lot of work (three weeks of 2am, but that's what these cars do), so please treat it accordingly and respect the copyrighted content. I hope it is helpful to you, perhaps even enjoyable.

Having re-read and corrected this until numb-minded, if there are still areas that need clarification or correction, please send your welcome comments/suggestions to will at wavecable dot com.

Many thanks to Ian & Neil for their review of and suggestions for the analysis text & wiring diagram.

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