E30 Fog Light Wiring Instructions

Conversions Allowing for Independent Fog Light Operation in Sealed Beam and Ellipsoid Style Headlight Systems

X Mon™

Revision A
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This document details the steps required to convert the headlight dependent fog lights of the E30 chassis BMW to an array of user configurable options, none of which require the illumination of the headlights. Additionally, a brief discussion of the variations in frontal light wiring and headlight switch design are covered as a basis for the modifications contained here within. This document is the second in a series of three publications describing modifications typically preformed to the headlight, high beam and fog light systems of the second generation 3 Series BMW.

The "Legal" Mumbo Jumbo

I'm human, I fuck up, my brain gets ahead of my fingers. If you find errors in anything written, let me know. I will correct them. Of course anything you do on YOUR car is at YOUR OWN risk. I cannot, will not, and refuse to be held responsible for any damage you may inflict, or any adverse performance you may encounter.

Written solely from my own experience on installations in an '89 and a '90 325iX

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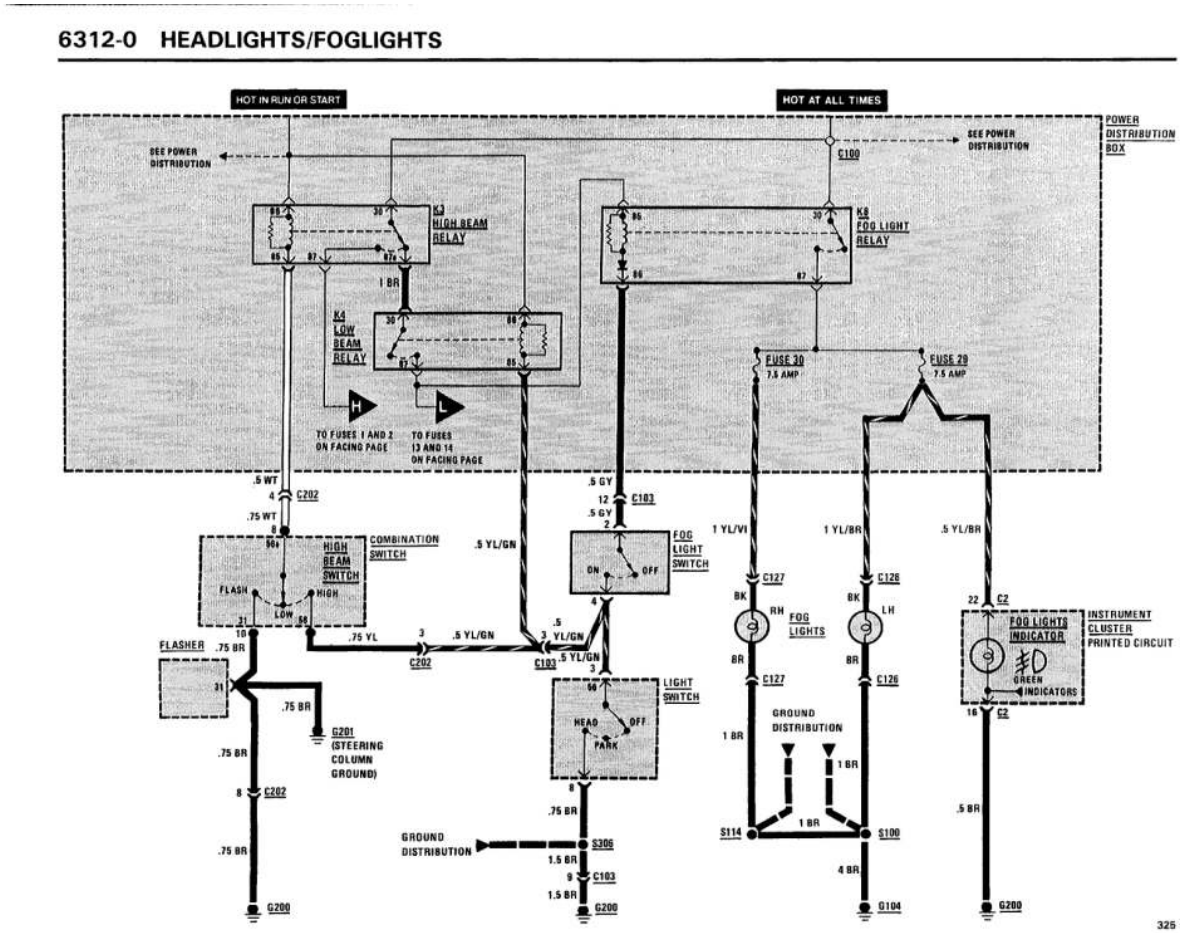
The Background

The US specification E30 head light wiring circuit utilized 3 different headlight/fog light configurations during its production run. BMW utilized three variants, Figure 1, an early sealed beam system that was utilized between 1984 and 1987, a late sealed beam configuration that was used from 1990 through the end of production, and an ellipsoid system during 1988 and 1989. It is interesting to note that the only difference between the early and late sealed beam wiring configurations is the difference in the headlight switch. This variance is show in the ground path of the fog light switch. It will come to head during the discussion of the modifications to be preformed.

Fig 1a: 1984-1987 Early Sealed Beam Wiring



Figures 1a,b,c ©1998 BMW of North America, Full Scale Figures at End of Document

Fig 1b: 1990 on Late Sealed Beam Wiring

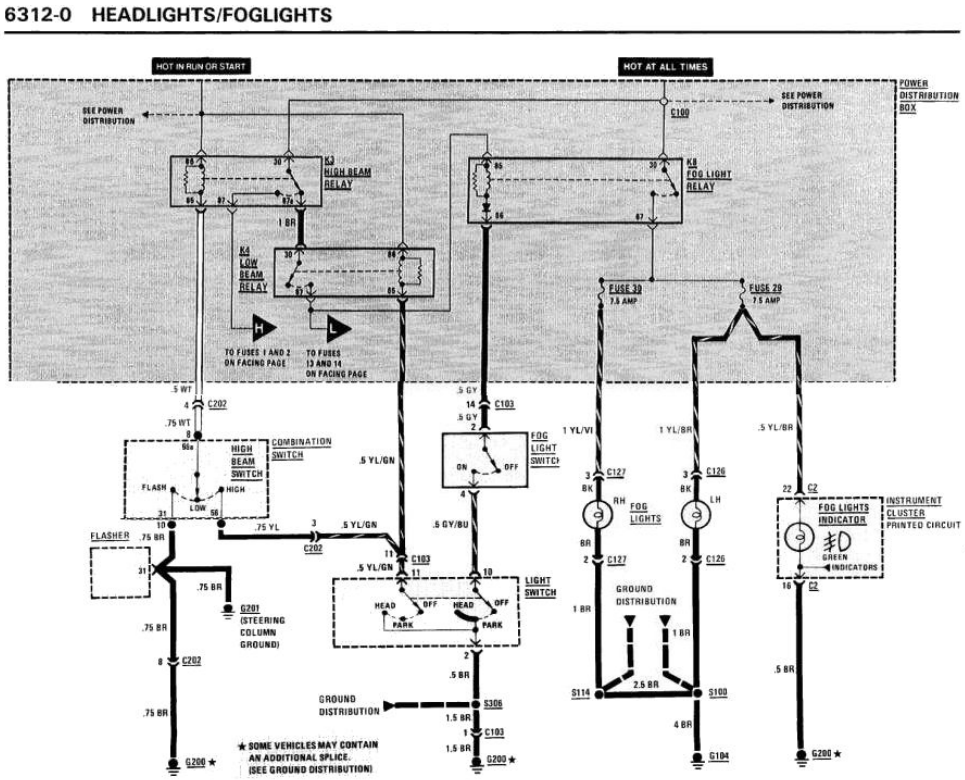
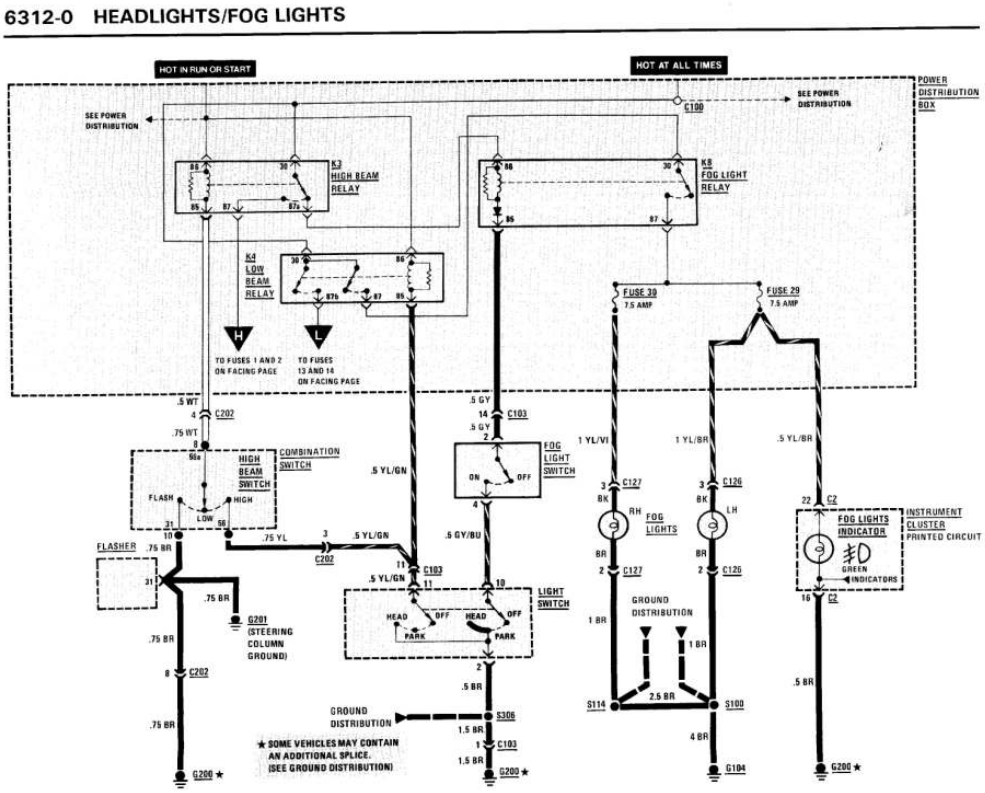


Fig 1c: 1988 and 1989 Ellipsoid Wiring



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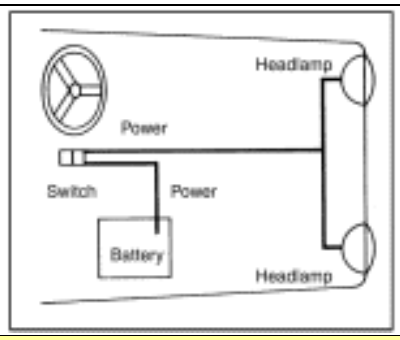
A Brief Note about Relays

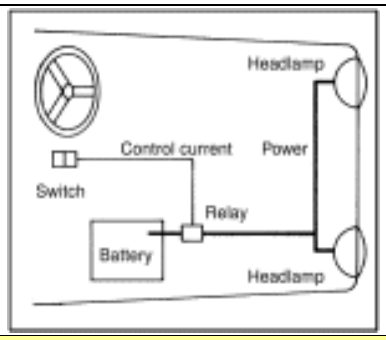
Relays are used to control electrical loads and are elementary components of modern vehicle control units. A relay is a remote-controlled switch operated by electrical current for switching circuits on, off or over. In an electro-mechanical relay, an iron armature is attracted by the current flow in the electro-magnetic coil. Through its movement, the iron armature makes or breaks one or more contacts, which in turn makes, breaks or switches over a load circuit. The current intensity and electrical voltage in the load circuit can be much greater than that in the coil. This allows extremely high voltages and/ or currents to be switched using comparatively small relays [1].

The need for a relay stems from the fact that wiring in itself is a resistive load. Resistances cause voltage drop, which means that consumer performance is reduced. One of the basic rules of electricity states that the electrical resistance of a lead depends on its length and cross-sectional area. The longer and thinner it is, the greater the resistance will be. Higher resistance means less voltage at the far end of the lead, i.e. where the power user is. If the power user is a bulb, a little less voltage means a lot less light, as illustrated in Table 1 [2].

Operating voltage*		Luminous intensity
100%	=	100%
95%	=	83%
90%	=	67%
85%	=	53%

* 100% = 6,75V
or 100% = 13,5V
or 100% = 27,0V





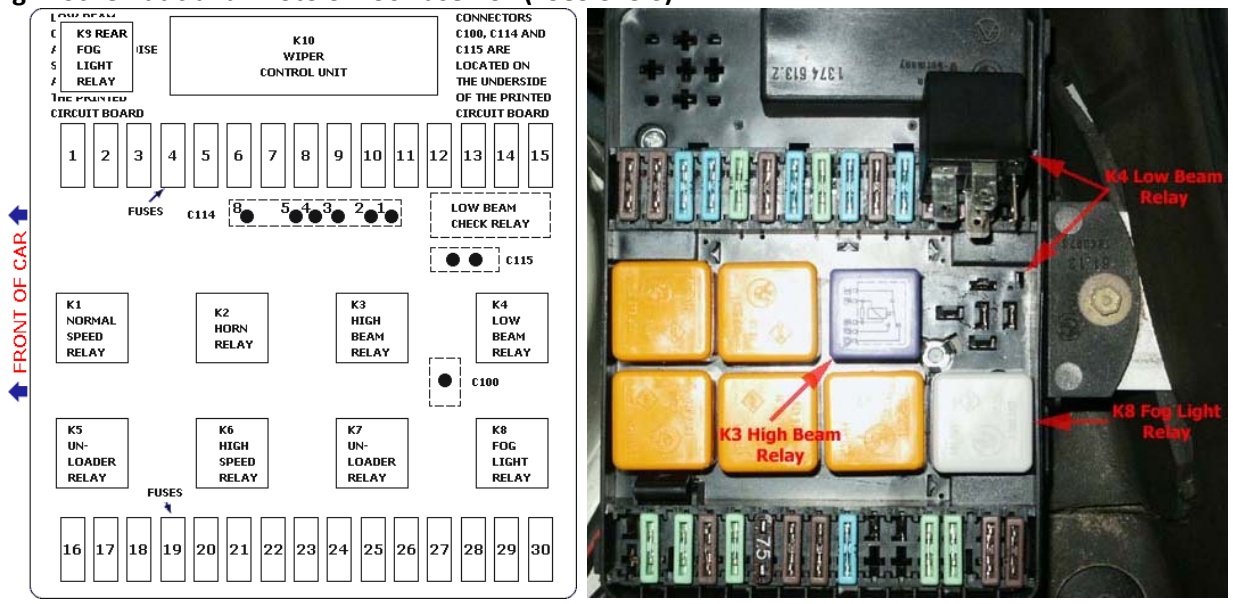
Important	Not Good	The Best Solution
The importance of optimum operating current and the negative effect voltage drop can have, on the luminous intensity of a bulb, can be seen from the table above.	Power current must travel from battery to headlamps - via the dashboard switch using a large gauge cable. Result: A voltage drop causing reduction in headlamp performance. Possible overloading of switch.	The power current is routed over the shortest distance between battery and headlamp via the relay. A control current lead of only 0.75 sq. mm (current consumption for this lead less than 150 mA!) is required between dashboard switch and relay.

Fortunately, as shown in Figure 2, BMW already uses relay based circuitry for all of the frontal lighting as well as many other high load requirements throughout the vehicle. For the purposes of modifying the fog lights, we will be concerned with the High Beam, Low Beam and Fog Light Relays, K3, K4 and K8 respectively, as labeled in the right hand image.

[1]: http://www.hella.com/produktion/HellaUSA/WebSite/MiscContent/Download/AutoIndustry/Electronics/TIRelais_GB_TT_14.pdf

[2]: http://www.rallylights.com/hella/Relays.asp

Fig 2: Schematic and Photo of E30 Fuse Box (1989 325iS)



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Sealed Beam Systems

Taking a look at the sealed beam diagrams, Figures 1a and 1b above, one finds that Pin 85 of the Fog Light Relay (K8) is powered via pin 87 of the Low Beam Relay (K4). This of course requires that the low beam circuit is active for the fog lights to be on. Moreover, in looking at K4, ones finds that the power for Pin 87 is provided via Pin 30 which is attached to Pin 87a of the High Beam Relay (K3). Therefore K3 functions not only as switched power for the high beam lights, but also to "unload" or turn off the low beam filament of the dual filament outer headlight bulbs, as well as the fog light circuit. This is an important point to note; as many US states only allow for the illumination of four total frontal light sources at any given time during on-road operation of a vehicle.

Thus, attention also needs to be given to the headlight switch wiring to account for the differences between the early and late sealed beam style wiring. If one carefully examines the headlight switch portion of Figures 1a and 1b it can be seen that the early sealed beam system utilizes a light switch that provides a COMMON ground. This common ground provides the ground circuit for both the headlight relay and the fog light switch on pin 3 that is only active when the headlight switch is pulled out fully, position II. The ellipsoid headlight circuit and late sealed beam headlight switch share a revised switch. The later switch provides separate grounding circuits for the fog light switch, position I or position II, and the headlight switch, position II, on pins 10 and 11 respectively. Figure 3, overleaf, depicts the two headlight switches utilized.

Fig 3: Early (Top) and Late E30 Headlight Switches

Using a mutlimeter to trace the connections inside the early switch, it can be found that pin 4, which his unutilized, is connected to ground with the switch in positions I and II. This result will be utilized later in the conversion.

One possible solution would connect Pin 87a of K3 to Pin 85 of K8 thus maintaining the unloader circuit. Unfortunately, due to the solder trace connection of Pin 87 of K4 to Pin 85 of K8, this result would cause the headlights to illuminate at all times, even with the key removed from the ignition. This also presents an issue with the fog light wiring, as they would remain on as long as the fog light switch was depressed, regardless of key position. Obviously such functionality is less than desirable, as it leads to multiple issues with proper light function. With the lack of accessibility a different stratagem must be employed to gain access to Pin 85 of K8.

Therefore the suggested solution here is 2 fold in an effort to address these issues. K8 is replaced with a jumper, which is created inside the shell of a hallowed out relay. Then a new unloader relay is created in the position of K9 to shut the fog lights off whenever the high beams are illuminated. In the case of the early sealed beam system, the ground path of the fog light switch is modified to permit headlight independent use, while preventing accidental fog light illumination.

Ellipsoid Systems

Returning to the ellipsoid lighting diagram of Figure 1c of page 3, one finds that Pin 85 of the Fog Light Relay (K8) is connected directly to Pin 87a of the High Beam Relay (K3). Thus the stock configuration already provides for a direct unloader circuit for the fog lights, thus simplifying the required modifications. Additionally, one finds that the power for the illumination of the fog lights is sourced

directly from Pin 87 of the Low Beam Relay (K4). Taking a closer look at the wiring for K3 provides the basis for a simple solution with the additional caveat of easily incorporating Daytime Running Lights (DRL).

The only modification required is that Pin 30 of K8 is connected within the fuse box to the switched power circuit of C114 at Pin 4. It is important to note that the OEM relay utilized in K4 is a single pole single throw relay with dual outputs 87 and 87b. This relay differs from the typical dual 87 relay in that the 87, 87b relay has contacts that are independent until the relay is closed; whereas the contacts of the dual 87 are linked internally. This means that the external pins of K4 and K8 can remain unchanged. At the same time, if one does place a dual 87 relay in K4, the headlights will illuminate as soon as the ignition is placed in key position II, effectively creating a DRL system.

The Conversion

1. Begin by removing the negative lead from the battery
2. Remove the fuse box cover, and remove K8

3. Remove the two (2) screws INSIDE the fuse box and the single screw on the outside near the fender
4. Carefully pry open the fuse box


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Sealed Beam Systems

Supplies Required for Wiring Conversion

Step I - Modification of the Fog Light Relay

- 16 Gauge Wire
- Solder
- 61 36 8 373 700 SPST BMW Relay (Orange Relay for Fogs, Unloader, Fan, etc) It can be non-functioning

Step II - Recreation of the Unloader Circuit

- 16 and 18 Gauge Wire
- Solder
- 14-16 Gauge Ring or Spade Terminal 
- 14-16 Gauge Splice Tap 
- 1 to 3 61 13 1 376 460 (Hella HL87272) 6.3mm Female Blade Connector(s) w/ Barb for Relay Blocks
- 2- 61 13 1 370 691 .5-1mm Female Blade Connectors w/Barb for Fuse Block
- 2- 61 13 1 370 692 1.5-2mm Female Blade Connectors w/Barb for Fuse Block
- 61 36 8 373 700 SPST BMW Relay (Orange Relay for Fogs, Unloader, Fan, etc)

Early sealed beam REQUIRED modification

- 1- 61 13 1 350 848 Right Angle Female Blade Connector for fog light switch socket
- 1- Right Angle Female Blade Connector for headlight switch socket

The majority of the parts above can most easily be sourced from a parts car.

Additional Steps

5. **Step I - Modification of the Fog Light Relay**
   a. Using K8 which you've removed or a dead plastic relay, take a small screw driver and gently pry the two "tabs", located on the bottom of the housing, open and remove the cover.
   b. Use a Dremel® or similar tool to carefully remove the internal components of the relay.
   c. Solder a flexible piece of 16 gauge wire inside the relay to connect Pin 86 to Pin 87, in essence creating a glorified jumper.
   d. Replace the cover of the relay, making sure it does not pinch the newly added wire.
   e. Reinstall the relay in K8.

6. **Step II - Recreating the unloader circuit**
   In European E30s with the REAR fog light setup installed, there is an additional Rear Fog Light Relay (K9), shown in Figure 2 of page 4, which is utilized to provide the unloader circuit for the REAR fog. We can emulate this setup somewhat and at the same time provide a means to run the rear fog light should you decide you want to install it at a later date.

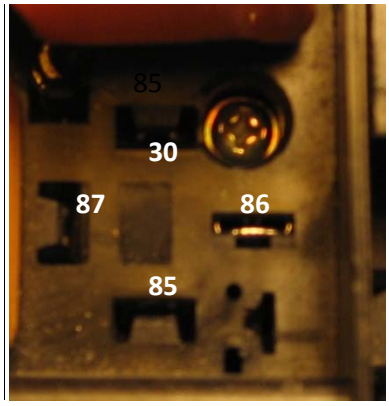
a. Take a paper clip, a pin or a stiff piece of wire, and gently pry back the locking tabs on the following pins of the following relay sockets:

1. 86 of the Fog Light Relay (.5mm Gray Wire) [Relay K8]
2. 87a of the High Beam Relay (1mm Brown Wire)[Relay K3]

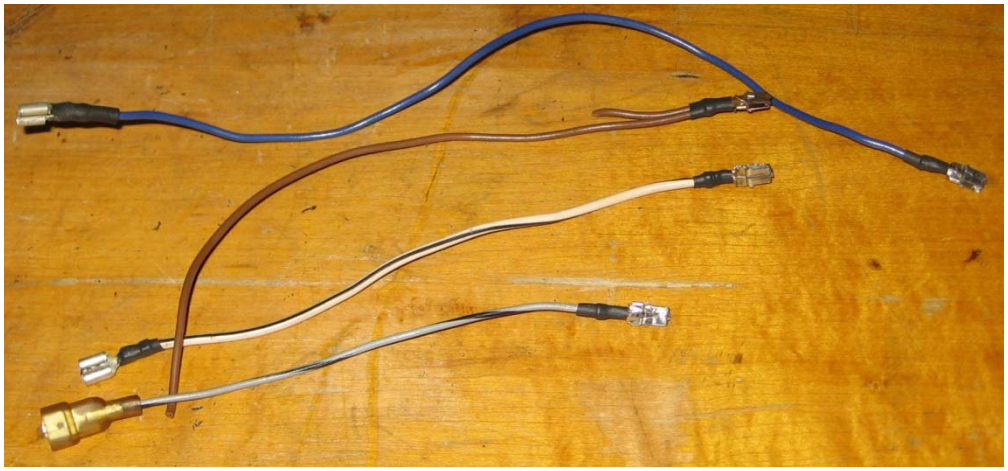
IF YOU ARE ALSO INSTALLING SINGLE FILAMENT LOW BEAM LIGHTS

3. 30 of the Low Beam Relay (1mm Brown Wire) [Relay K4]

To pry back the lock tab, stick the wire in parallel to the pin, and pull away from the pin. Pushing up from the bottom side sometimes helps. The pin orientation looking down into the fuse box should be:



b. Create four or five new sections of wire that will allow for the following:
   1. Connect the .5mm Gray Wire you removed from the fog light relay socket to PIN 86 of K9. (Use a spade connector to keep the original wiring intact)
   2. Make a new 16 gauge wire connection and connect Pin 87 of K9 to pin 86 of K8
   3. Using 16 gauge wire, connect Pin 30 of K9 to Pin 4 of C114 (2.5mm green wire)
   4. Make a splice connection and connect Pin 85 of K9 to pin 87a of K3



IF YOU ARE ALSO INSTALLING SINGLE FILAMENT LOW BEAM LIGHTS

4. Make a new connection and connect pin 85 of K9 to pin 87a of K3
5. Connect pin 30 of K4 to C100 using 16 gauge wire and a spade or ring terminal (Gently loosen the Allen bolt going through the fuse box under K3/4)

7. **Early sealed beam REQUIRED modification**
   a. Remove the lower left trim panel above the driver's side of the dash.
   b. Disconnect the fog light switch connector from the switch.
   c. Carefully pry the back of the connector open, and gently remove the Pin 4 (dual .5mm yellow/green wires). Tape or heat shrink over the metal part of the connector.
   d. Create a new jumper wire to connect Pin 4 of the fog light connector to Pin 4 of the headlight connector.
   e. Carefully remove and pry open the headlight switch connector.
   f. Install the new jumper, close the connectors and reinstall.

Conversions Allowing for Independent Fog Light Operation in Sealed Beam and Ellipsoid Style Headlight Systems

Ellipsoid Systems

Supplies Required for Wiring Conversion (Fuse Box):

- 1x 14-16 Gauge Splice Tap 
- 14 or 16 Gauge Wire
- Solder
- Zip Tie

Additional Steps

5. Solder a 1mm (16 gauge) or heavier wire to terminal 30 on the bottom of the fuse box circuit (Zip tie the wire to another nearby wire as a means of stress relief)
6. Using a 14-16 gauge butt splice, tap into the 2.5mm GREEN wire at Pin 4 of C114


Final Steps

1. Re-connect the battery and test the system for the desired operation. Disconnect the Battery.
2. Replace the screws holding the fuse box together, being careful not to pinch any wires.


3. Replace any relays removed during the preceding work and replace the fuse box cover
4. Reconnect the grounding strap of the battery.


For Sealed Beam Conversions

5. Replace the under dash trim and reinstall the associated fasteners

A note about further wiring modifications:

The fog light wiring in the E30 is sufficient to handle up to twice its sock current, 15 amp fuse versus the stock 7.5 amp, WITHOUT any risk of damaging the wire. This would allow you to run up to at least a 110 Watt bulb without having issues with the lighting, and the voltage drop at the light should be minimal. That said, due to the limited area of the fog light, a 110 Watt bulb does not have enough air space to properly dissipate heat, and it has been found that bulb life is greatly diminished. Moreover, as most of the traces between the relays and fuses are within the fuse box, the only real area for improvement would be in new runs between the fuse itself and the fog light connector, yet the wiring can already handle twice the current. Thus it is highly discouraged that wiring modifications be made.