Improving Bus Headlights

By Jim Shepherd

I began writing this article in February, 2011. As you will see, I will emphasize the use of relays in this article to help resolve some of the problems with our headlights. As I worked on explaining relays, it became obvious that relays deserved their own article. That article was published in the May, 2011, issue of Bus Conversions Magazines.

In this article we will discuss modifications to our headlight wiring circuit and explore headlight technology available for our buses that will allow us to drive safely at night.

Most of us drive older buses with very marginal headlights. Like many folks, I try not to drive at night, but once in a while, we don't have a choice. Several years ago, we pulled into a campground on the Utah/Colorado boarder on US 40. It was very hot and we were glad to get checked in and looked forward to relaxing with the air conditioners blasting out cool air.

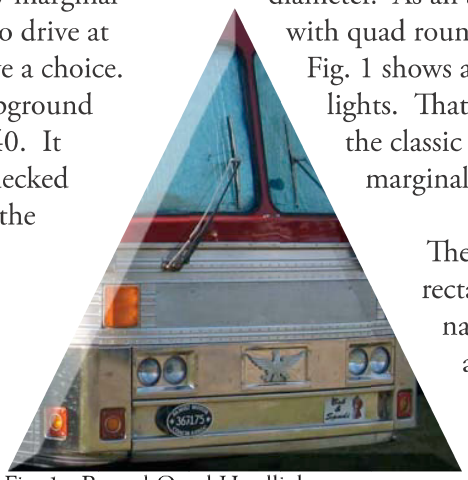

Fig. 1 - Round Quad Headlights

As soon as we turned the AC on, the campground breaker opened. We tried several more times and it was obvious the campground wiring was very marginal. We considered running the generator, but when we looked around, it looked like a migrant worker camp. We quickly pulled up stake and headed down the mountain road to the next campground. Not long after we left, it got dark and we could barely see the road. We ended up driving about 75 miles with Pat watching the strip on her side of the road and I watched the center line.

It was a miserable trip and bordered on being very dangerous. Fortunately, there was no traffic on the road. After that trip I began to research methods of improving our headlights.

Headlight Size/Shape

First, let's talk about headlight sizes and shapes that are typical for our older buses. For this article we will limit our discussion to "conventional" headlights as opposed to modern, shaped headlights.

Some of the early buses have a single round headlight on each side. Typically those will be 7 inches in diameter. As an alternative, many older buses came with quad round 5 ¾ inch diameter headlights. Fig. 1 shows an Eagle with these quad round lights. That is what we have and I really like the classic look. Problem is, they are really marginal using standard technology.

The next headlight option was quad rectangular headlights. These are nominally 4 X 6 inches (Fig. 2). By most accounts, these quad rectangular headlights are not much improvement over quad round headlights using the same technology.

The last of the conventional headlights was a single rectangular headlight (nominally 6 X 8 inches – see Fig. 3).

Table 1 shows the various sizes and shapes of headlights typically used on our older buses.

Fig. 2 - Single Rectangular

Fig. 3 - Quad Rectangular

Headlight Technology History

Domestic conventional headlight construction is sealed beam. Sealed beam technology was introduced in 1940. In 1978 sealed beam technology changed to quartz halogen construction. Today's over-the-counter, conventional, DOT approved headlight technology has not changed much since 1978. In recent years, some manufacturers have offered premium versions of the sealed beam halogen that are rated at up to 35% percent more "brightness" for some of the sizes shown in Table 1.

Later in this article we will discuss headlight technology that can vastly improve night vision.

Upgrade Your Bus Wiring

Without question, this should be the first step in improving your headlight system. The process is pretty simple and not all that costly: add headlight relays. As noted previously, I wrote a detailed article on relays that was published in the May, 2011, issue of Bus Conversions Magazine.

Simply stated, relays allow a very small current source to trigger a high current circuit. They are used extensively in modern cars, trucks and buses.

Our headlights draw current through a multitude of components including fuse/breaker, headlight switch, dimmer switch and aging wiring. While the original components were pretty robust, they have seen a lot of use by the time most of us buy our buses and their ability to transmit the current needed to maintain full voltage at the headlights is often compromised.

The concept of using a relay is very simple: you use your standard headlight wiring system to trigger a relay with a very low current (about one half amp for each relay) and then let the relay transmit the high current (3-6 amps for each headlight element). The old bus components (breaker/switch/dimmer/etc.) can very easily transmit the very low current needed to trigger the relay but may have problems that cause resistance at the higher current required by the headlights. This makes "life a bit easier" on the tired components since they only carry a very low current.

The high current side of the relay is supplied from a main power feed on the bus via large gauge wire (and, of course, the proper size fuse/breaker). All of that assures that the headlight element will see full system voltage.

To illustrate the concept, I will use my system as an example. The first point I want to make is the stock Eagle circuit protection system is a joke. It is possible that other makes also have the same type of circuit protection. Fig. 4 shows the type of breaker that the OEM system used.

The breaker connection is made with spring-loaded clips on each end. It probably worked well for the first few years, but after time the tabs just do not have enough clamping force to make a good high current connection. In addition, the clips become a bit corroded and that makes the situation worse. The other aging circuit

Fig. 4 - Eagle Headlight Breaker

Table 1: Conventional Headlight Bulbs

Part No.	Shape	Size	Wattage	Application
5006	round	5 ¾ inch	35W/35W	low/high beam
5001	round	5 ¾ inch	50W	high beam
6024	round	7 inch	60W/35W	low/high beam
4656	rectangular	4x6 inch nominal	35W/35W	low/high beam
4651	rectangular	4x6 inch nominal	50W	high beam
6054	rectangular	6x8 inch nominal	65W/35W	low/high beam

components can result in a significant voltage drop at the headlight. Low voltage means poor night vision.

The wiring schematic for the typical headlight relay system is shown in Fig. 5. In this schematic, terminals 86 and 85 are the low current "trigger" terminals, while terminals 30 and 87 are the high current terminals. When terminal 86 is energized by the existing headlight circuit, the connection between the high current supply (terminal 30) is connected to terminal 87 and the headlight elements received their power. Terminal 30 receives the power from a battery source. While the schematic suggests 16-gauge fusible link, I would use a 15-20 amp breaker and at least 12-gauge wire (or larger) wire. It is easy to see that the wire from the beam select switch (dimmer switch) is cut with one end connected to the relay trigger (terminal 86) and one end connected to the high-current side of the relay (terminal 87). This is done for both the low beam and high beam circuits.

The installation is very simple. As noted above, you simply cut the wires that feed the headlight (via the breaker/switch/dimmer) and use them to trigger the relay. The output of the relay is then connected to the headlight connector. In my case, I mounted a terminal strip behind the front bumper and attached my relay connections to the terminal strip.

I used Mini ISO cube relays which are available at most truck supply and electronic supply houses. In the relay article I listed sources for variations of that type of relay (repeated here as Table 2). One lesson I quickly learned, is that they make a sealed ("weather proof") relay for a reason. The water splash in a rain storm wreaked havoc with my wiring system. I ended up using two weather proof relays (Z983-ND from Table 2) – one for the low beam and one for the high beam.

My headlights now get full voltage and produce all of the light that they are capable of producing. The relay modification made a significant difference.

Upgrade Headlight Technology

Modern headlight technology makes use of a non-sealed housing and a replaceable bulb. This technology is used in the "styled" headlights that are shaped to fit the design of the vehicle. The most popular applications use the H4 bulb technology that "plugs" into the housing. Updating our headlights to this technology

requires that the sealed beam headlight be replaced with a housing that accommodates a replaceable bulb.

Unfortunately, there is not a DOT approved headlight housing for the non-styled headlights listed in Table 1. However, there is an excellent option: European E-Code headlight housings. The biggest issue with E-Code lights is that they are not DOT rated and are not "legal" in the United States. That said, many folks, including several Bus Conversion Forum members, have run them on their vehicles for many years without being stopped. The main reason these housings are far superior to DOT headlights is that they have far superior optics that focus the light on the road and not in the eyes of the oncoming traffic.

There is a huge amount of documentation on the Internet about E-Code technology. One of the best sites is: http://www.danielsternlighting.com. Universally, all of the information on this technology raves about the superior optics/focus of the housing. I have done a considerable amount of reading on the subject and I have not seen one negative comment about housings manufactured by the leaders in the industry: Cibie and Hella. These housings (without bulbs) cost about $75 each. If you have quad lights, that can cost around $300 plus bulbs. The overwhelming opinion is that the conversion was well worth the money.

In recent years there have been a growing number of vendors that offer sealed beam conversion kits with housings that do not appear to meet either DOT or E-Code specifications. They are perhaps 60% of the cost of Cibie or Hella housings. I have not been able to find one vendor of these housings that offer technical data. In my opinion, the extra cost of the proven E-Code technology is worth the extra dollars.

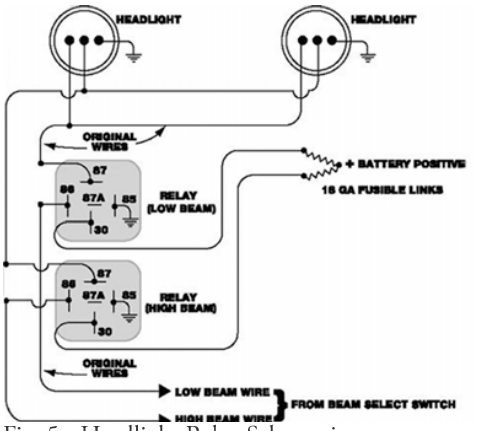

Fig. 5 - Headlight Relay Schematic

If a person makes the decision to purchase a sealed beam conversion housing, the next decision involves what 9003/H4 bulb technology to select. Daniel Stern makes a strong argument for a standard H4 replacement bulb. His thesis is that the great optics of the reflectors in the E-Code housings are so superior, that higher wattage and/or special technology is not required. The typical standard 9003/H4 bulb (60W/55W) costs about $10 and can be obtained at any automotive parts store. In addition there are many sites that list very high wattage bulbs and/or super duper technology. My take, is that anything more than a standard 9003/H4 bulb would risk attention from law enforcement. This is especially true when the experts seem to agree that the E-Code housing with a standard 9003/H4 combination yield fantastic results.

There are other technologies available such as Xenon HID and LED. We will not discuss these technologies in this article. I will offer my personal opinion that some of these bulb technologies have a very bright blue hue and are very offensive to oncoming drivers.

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Table 2: Mini ISO Cube Relays Part Numbers and Sources

Part	Manufacturer	Part No.	Supplier	Product No.
Basic 12V	Omron	G8JN-1C7T-DC12	www.digikey.com	Z981-ND
12 V with diode	Tyco	1432790-1	www.digikey.com	PB682-ND
12V sealed/shield	Omron	G8JN-1C6T-DC12	www.digikey.com	Z983-ND
Basic 24V			Source not found	
24V with diode	Tyco	1432795-1	www.digikey.com	PB684-ND
24V diode sealed	Panasonic	CB1-D-24V	www.digikey.com	255-2160-ND
Socket with wires	NA	NA	www.delcity.net	73570