Bus to Trailer/Toad Wiring Conversion System Using Standard Relays

By Jim Shepherd, RV Safety Systems

Most buses have separate brake and turn lights, while virtually all towed vehicles and trailers have combined brake and turn lights. This condition requires some sort of conversion system that is commonly called a 5 to 4 wire converter. Fig. 1 shows a commercial unit where five wires from the bus are connected to one side of the converter and 4 wires from the converter are connected to the trailer connector.

The five wires from the bus are:

1. Ground
2. Tail Light
3. Left Turn
4. Right Turn
5. Brake

The wires exiting the converter are:

1. Ground
2. Tail Light
3. Left Turn/Brake
4. Right Turn/Brake

My experience with commercially made converters is that they are not very reliable. I have just experienced my second failed unit in less than three years and 50K miles. They are not expensive, but it is still a pain to find one and replace it when you are on the road.

Figure 1: Commercial 5 wire to 4 wire converter.

There are other issues when wiring a bus for towing. First is the fact that buses were not designed for towing and the wiring might have marginal current capacity to handle the additional trailer/toad lights. Second, some buses are 24-volt and conversion to 12-volts must be accomplished. A properly designed relay conversion system address both issues.

On the Bus Conversion Bulletin Board, there have been several threads discussing the 5 to 4 wire conversion issues. I recalled that some folks had accomplished the conversion with standard relays. Relays are used extensively in our buses for a large number of applications. They are very reliable and relatively easy to obtain. The converter system made with these relays is easy to repair – simply replace one of the relays.

In my fire suppression system, I use the same Bosch-type automotive relay that is used in Eagle buses (perhaps others) and many over-the-road trucks. I decided to design my system around these relays. My electronic skills are a bit limited, so I searched for ideas after spending a few hours designing the system only to find that it did not function properly for all conditions. The first site I went to was: http://www.gumpydog.com/bus/MC9_WIP/Electrical/Tail_Light_Converter/tail_light_converter.htm. Craig Shepard has documented a system that does the 5 to 4 conversion and the 24-volt to 12-volt conversion using MCI relays. **Fig. 2** is Craig's wiring diagram. Craig has built some of these systems for other bus folks who did not feel comfortable building their own. If you would like to contact Craig, his email address is craig@gumpydog.com. As a side note, Craig's bus project pages contain a huge amount of great ideas for the conversion process.

I worked my way through Craig's schematic and built my own using four Bosch-type relays and the system works very well. **Fig. 3** is a wiring diagram furnished by Sean Welsh. Many of you know Sean from the Bus Conversion board, since he is the resident electrical expert who has bailed many of us out. I found Sean's diagram after I spent hours making a complex drawing for my system. His is very straight forward and much easier to visualize. Again, as a side note, Sean and Louise publish a fabulous blog about full-timing life on the road in their very unique Neoplan bus (http://ourodyssey.blogspot.com/)

Before we talk about the relay based converter system, let's talk about the Bosch-type automotive-type relay. It is a standard relay used extensively in the bus and heavy truck market. Several manufacturers make this relay and most rate them for a one million mechanical cycle life, minimum. The relay is typically described as an ISO standard automotive relay. They are very

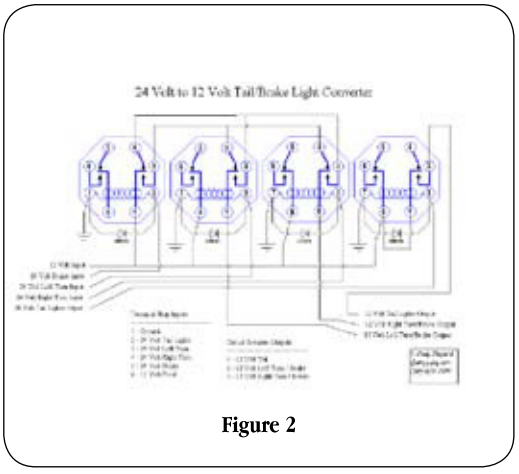

Figure 2

inexpensive and readily available. These relays come in many versions including weatherproof, with diodes across the coil, with/without mounting tabs, etc. Some sources are:

Digi-Key (www.digikey.com)
Tyco, part number PB682-ND (12V with diode)
Tyco, part number PB684-ND (24V with diode)

Del City (www.delcity.net)
73986 (12V with diode)
73570 wired socket only

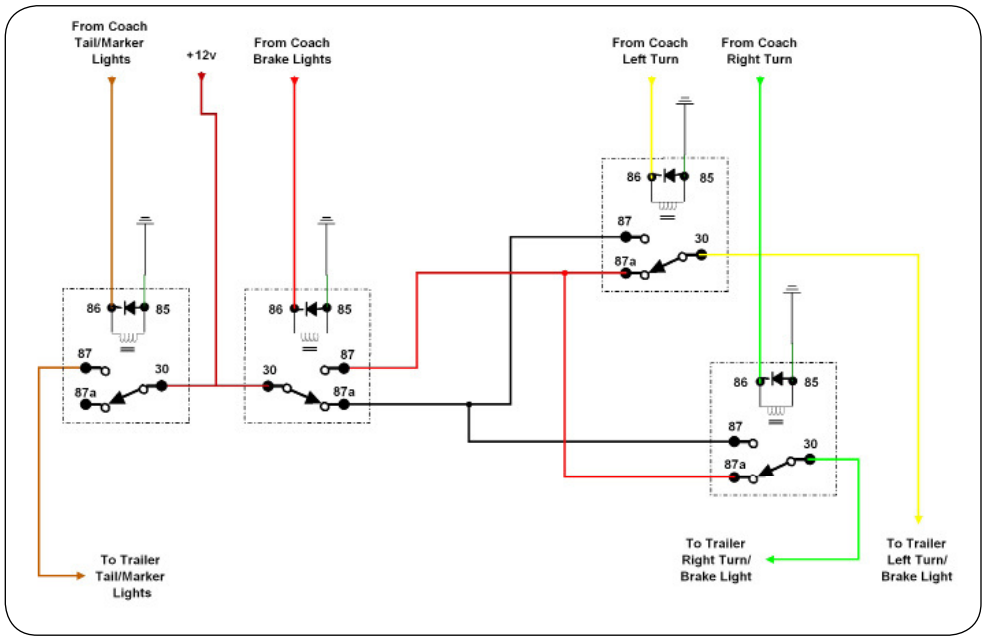

Figure 3: Trailer converter wiring schematic using Bosch-type automotive relays

I have listed relays that have built-in diodes connected to the coil terminals. The diodes prevent voltage spikes when the relay coil is de-energized. For this application, that would probably not be an issue, but the added cost is negligible. Relays with diodes are polarity sensitive. The coil connections must be wired so that terminal 85 is the ground terminal and terminal 86 is the signal. These relays are not weatherproof, so they should be mounted in an enclosure or an area not subjected to significant amounts of fluids. The relays are less than $5.

In addition to the relays, I listed a wired socket that makes wiring the relays very simple. It is possible to connect the wires to the relays using female spade connectors, but that makes replacing the relay a bit tedious and can result in loose connections. The sockets are less than $2.

A bus with a 12V system could be designed with three relays. However, I recommend that a four-relay system be utilized. One relay will be activated by the brake signal, one activated by the right turn signal, one activated by the left turn signal and the fourth relay will be activated by the tail light signal. The ground will be connected directly to the trailer connector. Using a four-relay system will assure that the bus wiring will not be overloaded. The bus wires will only be used to trigger the relays (negligible current) and the power for the trailer/toad lights will be supplied by a auxiliary 12-volt source.

For a 24V bus, the wiring will be the same as the 4-relay, 12-volt system, but 24-volt relays will be used. The 24-volt signals will trigger the relays, which will then connect the 12-volt power source to the proper output terminal.

Both Sean and Craig suggest that each trailer/toad circuit have a circuit breaker wired into the system. That is not the norm for most trailer wiring, but it would offer maximum protection.

The best way to connect the relay system components is to use either a screw or stud terminal block (see **Fig. 4**). The number of connections will require a 12 terminal connection block. Del City part numbers for these are 70022 (screw type) or 70005 (stud type). Using these blocks will provide a clean installation and allow easy troubleshooting.

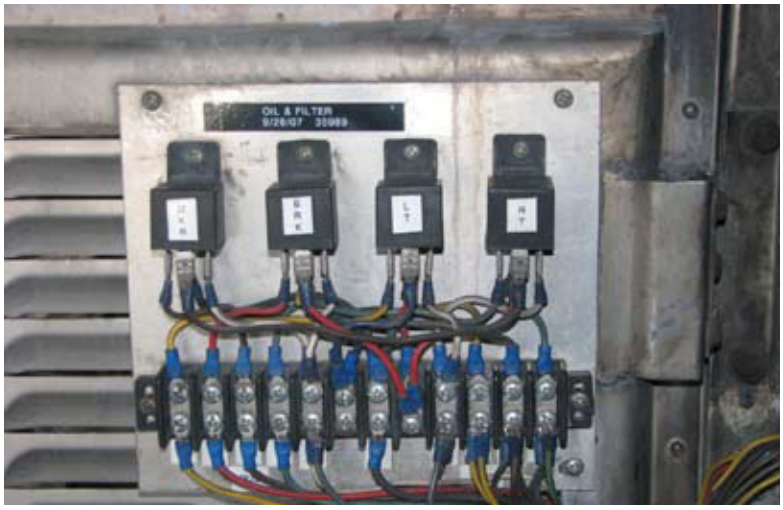

Figure 4: Shepherd installation

I would like to acknowledge the assistance and guidance that Sean Welsh and Craig Shepard offered for this article.