InPOWER
the systems people

Warning Lamp/ 8-Lamp Flasher System Technology

Overview

School bus warning lamp systems consist of red and amber warning lights on both the front and rear of the school bus as shown in Figure 1. The usual method of operating the warning lamps is for the driver to operate the Start Switch, which will start the amber lights on the front and rear to alternately flash (left, then right). The driver will initiate the amber light sequence when getting ready to stop the bus. When the bus has stopped and the door is opened, a switch on the door will automatically signal the flasher to stop the amber light flashing sequence and start the red light flashing sequence. If the bus is equipped with a stop arm and/or crossing gate these devices will activate when the red lights start to flash. When the driver closes the door, the door switch causes the red lights to stop flashing and the stop arm and crossing gate to deactivate. The sequence is now complete and ready to be repeated.

The above described operation is quite common, however, some state specifications require different types of operation. For example, Florida requires a three-position driver control switch (Amber-Off-Red) which allows direct control of when the red and amber light can be operated. Wisconsin requires only red warning lamps (two front and two rear). Other states require that when the door is opened the red lights will immediately start flashing without the need to first operate the amber lights. Another variation is to have a driver switch that can disable the operation of the crossing gate while the red warning lights are operating. It is beyond the scope of this document to describe all of these variations.

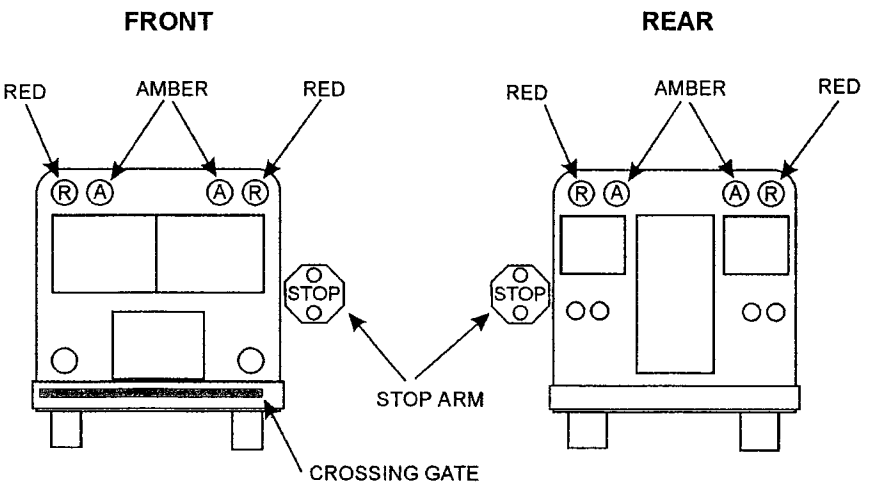

Figure 1
School Bus Diagram

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Warning Lamp Circuit

The red and amber lights are controlled by the warning lamp flasher module. A driver's operator panel containing control switches is connected to the flasher so that the driver can start the warning lamp sequence. These driver controls will vary to comply with the various state specifications.

Warning lights are seven inches in diameter, operate on 12 volts dc, and have red or amber lenses. There are two red lamps and two amber lamps on both the front and rear of the school bus. The earlier lights, drawing about 5.7 amps of current, were 80 watt sealed beam types. The newer halogen types are 55 watts and draw about 3.9 amps of current. The eight warning lamps are wired in parallel combinations so that the flasher requires only four output drivers to operate the eight lamps. See Figure 2.

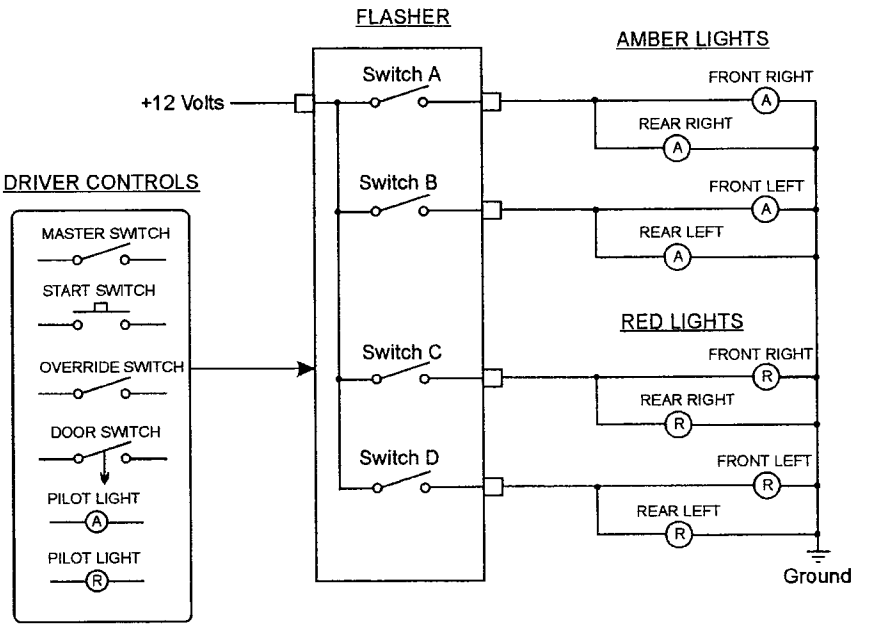

Figure 2
Warning Lamp Circuit

The flasher will alternately turn on the right lamps, then the left lamps, so that the power draw at any time is only that of two lamps. (The amber and red lamps will never flash at the same time.) The flash rate is in the range of 60 to 120 flashes per minute. On systems with the 80 watt lamps the flasher would supply 11.4 amps of current (2 x 5.7)

for each two-lamp set. Note that if the system contained warning lamps on the stop sign you would need to add that lamp's current draw to the 11.4 amps. Flashers such as the InPower SBF90 are rated to supply 16 amps of dc current for each of the lamp outputs.

LED Lights

LED lighting is a relatively new technology that utilizes a light-emitting diode (LED) to produce light rather than a metal filament. As this technology is a solid state semiconductor, the life expectancy is significantly longer than conventional lamps. Another factor is that LED lights require significantly less electrical power to operate than conventional lights, therefore the power consumption is much lower. The downside is that the costs are higher. However, many users find that LED lights can be justified over the long term due to lower maintenance costs (fewer lamp replacements). As the school bus industry is very specification oriented, purchasing entities will no doubt accept this new technology and upgrade their specifications accordingly.

Stop Arms

School bus stop arms are motor actuated stop signs mounted on the driver's side of the bus. A bus can be equipped with one or two stop arms. Stop arms usually contain two red warning lights on each side (four total) that are controlled by the warning light flasher. Typically these are two lights connected to the Right Red flasher output and two lights connected Left Red flasher output. These lights could be incandescent or LED types. An example of an incandescent lamp type stop arm is built by Specialty Manufacturing Co. This stop arm contains two red dual lens warning lamps. Each lamp utilizes only one bulb (2.1 amp current draw) that provides illumination to both the front and rear of the sign. Therefore there is only one additional 2.1 amp load of the stop arm on the flasher's red lamp outputs. Specialty Manufacturing Co. also produces LED and strobe based stop arms. Their LED unit contains four LED red warning lamps, each drawing one amp. The stop arm red lights may also be strobe types, which would be equipped with a strobe power supply. Stop arms usually contain a control relay, that when actuated, will operate the motor that will cause the stop arm to swing out, making it visible to other vehicles. By using a control relay (or solid state circuit), the power draw on the flasher is minimized to the current of the relay coil. Electronic warning lamp flashers contain a separate output driver to operate the stop arm. This output is typically rated at 3.0 amps (e.g., InPower SBF90 & SBF94).

Crossing Gates

School bus crossing gates are motor actuated hinged arms mounted on the front bumper. When actuated, they swing out in front of the bus. This causes children crossing in front of the bus to walk around the extended gate (further from the front of

the bus) allowing the driver to have a better view of the crossing children. The crossing gate is operated by the stop arm output of the warning lamp flasher (See Stop Arm Section). Like the stop arms, the crossing gates typically contains a control relay (or solid state circuit), that when actuated, will operate the motor causing the crossing gate to swing out.

Some bus specifications require a driver's switch that can disable the crossing gate operation for one warning light sequence. This is used in situations when the bus is parked close behind another vehicle so that when the red lights are actuated, the gate will not extend and contact the other vehicle.

Standard Warning Lamp Flashers (Eleven Faston Terminals)

The following is a functional description of the industry standard electronic warning lamp flasher that utilizes eleven 0.25 inch Faston blade terminals for the wiring terminations. Examples of this flasher type are the InPower SBF90, Weldon 7000 and Transpec 6500.

Functional Description of Inputs and Outputs:

Override Switch (Pin 1- Override)
An override switch may be used to function as a backup device as well as a means to immediately start the red lights flashing, bypassing the door switch and start button. The +12 volt power must be adequately fused. The override switch requires two contacts, one for Pin 1 and the second for Pin 10.

Master Switch (Pin 2 - Master)
This is the input for the 12 volt power, and must be adequately fused.

Right Amber Lights (Pin 3 - Right Amber)
This output provides the +12 volt power to flash the right front and right rear amber lights at a rate of 75 flashes per minute at a 50% duty cycle.

Right Red Lights (Pin 4 - Right Red)
This output provides the +12 volt power to flash the right front and right rear red lights at a rate of 75 flashes per minute at a 50% duty cycle.

Stop Arm (Pin 5 - Stop Arm)
This output supplies +12 volt power to actuate the stop arm device(s) when the red lights operate. If the load is more than 3 amps, a relay circuit should be used. Four lamp applications require different wiring.

Left Red Lights (Pin 6 - Left Red)

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This output provides the +12 volt power to flash the left front and left rear red lights at a rate of 75 flashes per minute at a 50% duty cycle.

Left Amber Lights (Pin 7 - Left Amber)
This output provides the +12 volt power to flash the left front and left rear amber lights at a rate of 75 flashes per minute at a 50% duty cycle.

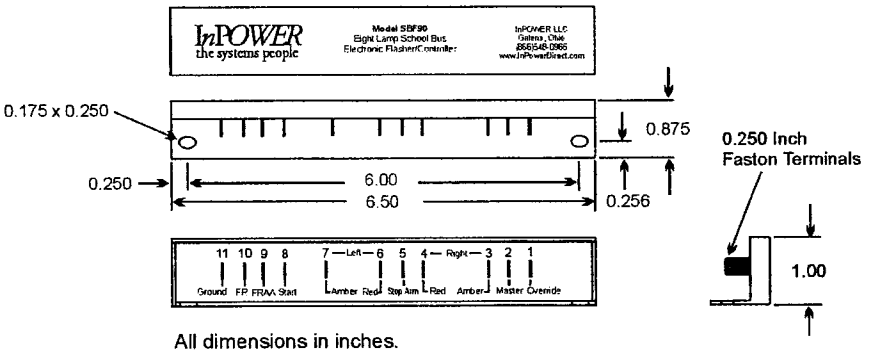
Start Switch (Pin 8 - Start)
This input is from a momentary contact closure that supplies +12 volts to start the flash sequence.

Flash Red ONLY After Amber (Pin 9 - FRAA)
This grounded input from the door switch will cause the red lights to flash after the start switch is activated and the amber lights are flashing.

Flash Red When Door is Opened (Pin 10 - FR)
This grounded input from the door switch will cause the red lights to flash anytime the door is opened (non-sequential operation).

Ground (Pin 11 - Ground)
Logic and power ground for the flasher/controller unit. This must be a good quality ground connection.

Wiring Terminations:



All dimensions in inches.

InPower SBF90 Warning Lamp Flasher

Standard Warning Lamp Flashers (Amp Connector Wiring Terminations)

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The following is a functional description of the industry standard electronic warning lamp flasher that utilizes an Amp Multilock 12-pin connector for its wiring terminations. Examples of this flasher type are the InPower SBF94 and Weldon 7000-1000.

Functional Description of Inputs and Outputs:

Start Switch (Pin 9)
This input is from a momentary contact closure that supplies +12 volts to start the flash sequence.

FRAA - Flash Red ONLY After Amber (Pin 10)
This grounded input from the door switch will cause the red lights to flash after the start switch is activated and the amber lights are flashing.

FR - Flash Red When Door is Opened (Pin 11)
This grounded input from the door switch will cause the red lights to flash anytime the door is opened (non-sequential operation).

Stop Arm (Pin 3)
This output supplies +12 volt power to actuate the stop arm device(s) when the red lights operate. If the load is more than 3 amps, a relay circuit should be used. Four lamp applications require different wiring.

Ground (Pin 12)
Logic and power ground for the flasher/controller unit. This must be a good quality ground connection.

Left Amber Lights (Pin 1)
This output provides the +12 volt power to flash the left front and left rear Amber lights at a rate of 75 flashes per minute at a 50% duty cycle.

Override Switch (Pin 8)
An override switch may be used to function as a backup device as well as a means to immediately start the red lights flashing, bypassing the door switch and start button. The +12 volt power must be adequately fused. The override switch requires two contacts, one for Pin 8 and the second for Pin 11.

Right Amber Lights (Pin 5)
This output provides the +12 volt power to flash the right front and right rear amber lights at a rate of 75 flashes per minute at a 50% duty cycle.

Left Red Lights (Pin 2)

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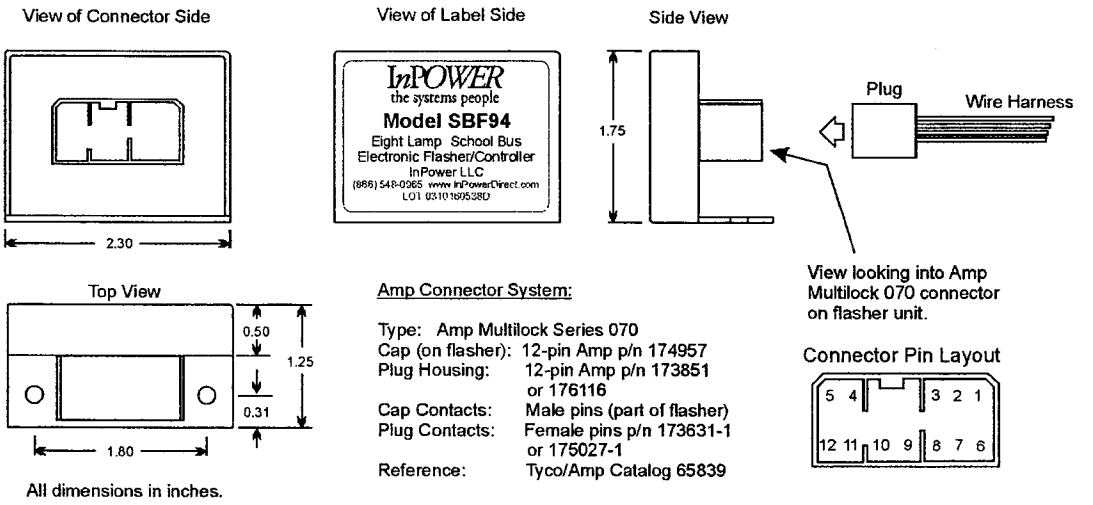
This output provides the +12 volt power to flash the left front and left rear red lights at a rate of 75 flashes per minute at a 50% duty cycle.

Master Switch (Pin 6, 7)
This is the input for the 12 volt power, and must be adequately fused.

Right Red Lights (Pin 4)
This output provides the +12 volt power to flash the right front and right rear red lights at a rate of 75 flashes per minute at a 50% duty cycle.

Wiring Terminations:



InPower SBF94 Warning Lamp Flasher

Sequential Operation Flasher Circuit

Warning lamp flashers are designed to provide the industry standard sequential and non-sequential operation. When wired for sequential operation the amber lights must be initiated before the red lights can be operated. See the Figure 3 for the sequential wiring diagram. The Master Switch must be On to provide +12 volt power to the flasher. When the Start Switch (momentary push button) is operated the flasher starts the amber lights flashing. The Door Switch is wired to the flasher FRAA (Flash Red After Amber) input so that when the door is opened a ground will be applied to the input. For

the duration of the FRAA input being at ground potential the red warning light will flash and the stop arm output will be activated. When the ground is removed from the FRAA input the red light sequence will terminate (red lights stop flashing and the stop arm output is turned off). Note that grounding the FRAA input will not cause the red light sequence to start unless the amber light sequence has first been started.

This wiring method will usually contain a two-pole Override Switch. When this switch is actuated, +12 volt power is applied to the flasher (the Master Switch does not need to be actuated) and a ground potential is applied to the FR (Flash Red) flasher input. This will cause the red lights and stop arm to be immediately started (without the amber light first being initiated).

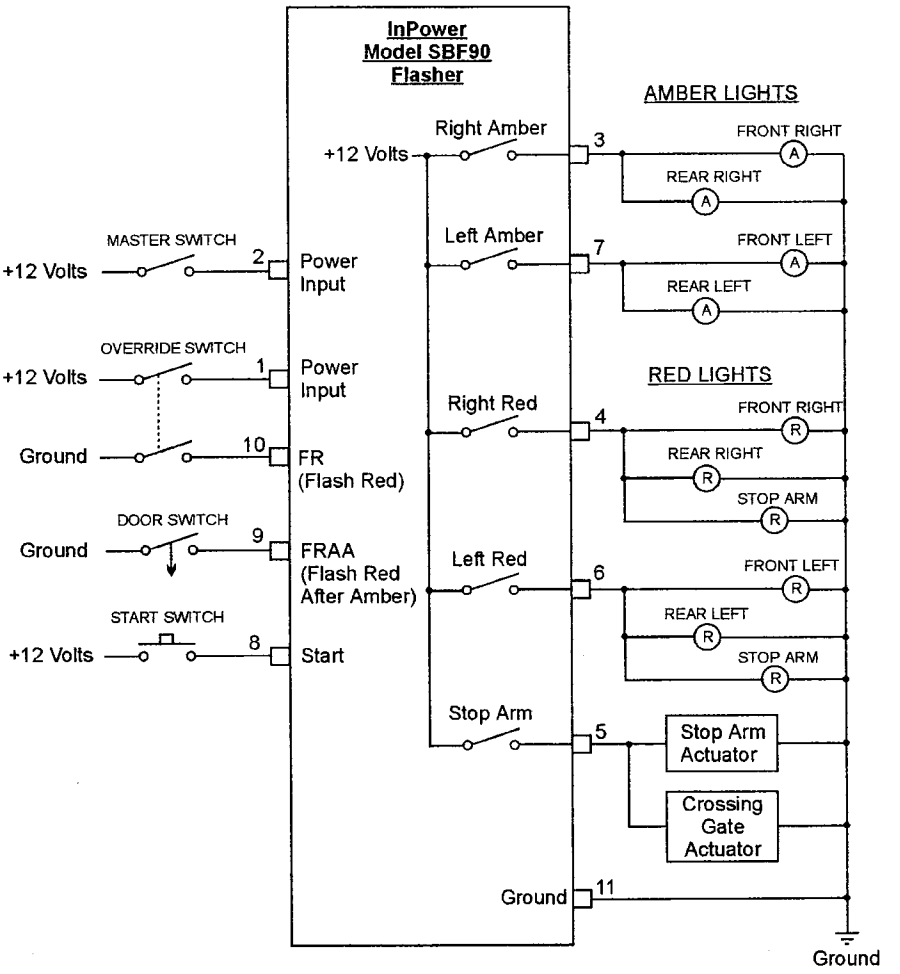


Figure 3
Sequential Flasher Wiring Diagram

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Non-Sequential Operation Flasher Circuit

Warning lamp flashers are designed to provide industry standard sequential and non-sequential operation. When wired for non-sequential operation, the red lights are initiated anytime that the Door Switch is actuated (the amber lights do not need to be operated first). See the Figure 4 for the non-sequential wiring diagram. The Master Switch must be On to provide +12 volt power to the flasher. When the Start Switch (momentary push button) is operated, the flasher starts the amber lights flashing. The Door Switch is wired to the flasher FR (Flash Red) input so that when the door is opened a ground will be applied to the input. For the duration of the FR input being at ground potential the red warning lights will flash and the stop arm output will be activated. When the ground is removed from the FR input the red light sequence will terminate (red lights stop flashing and the stop arm output is turned off. Note that it is not necessary to operate the amber lights first.

This wiring method may contain an Override Switch. When this switch is actuated, +12 volt power is applied to the flasher so that the Master Switch does not need to be actuated.

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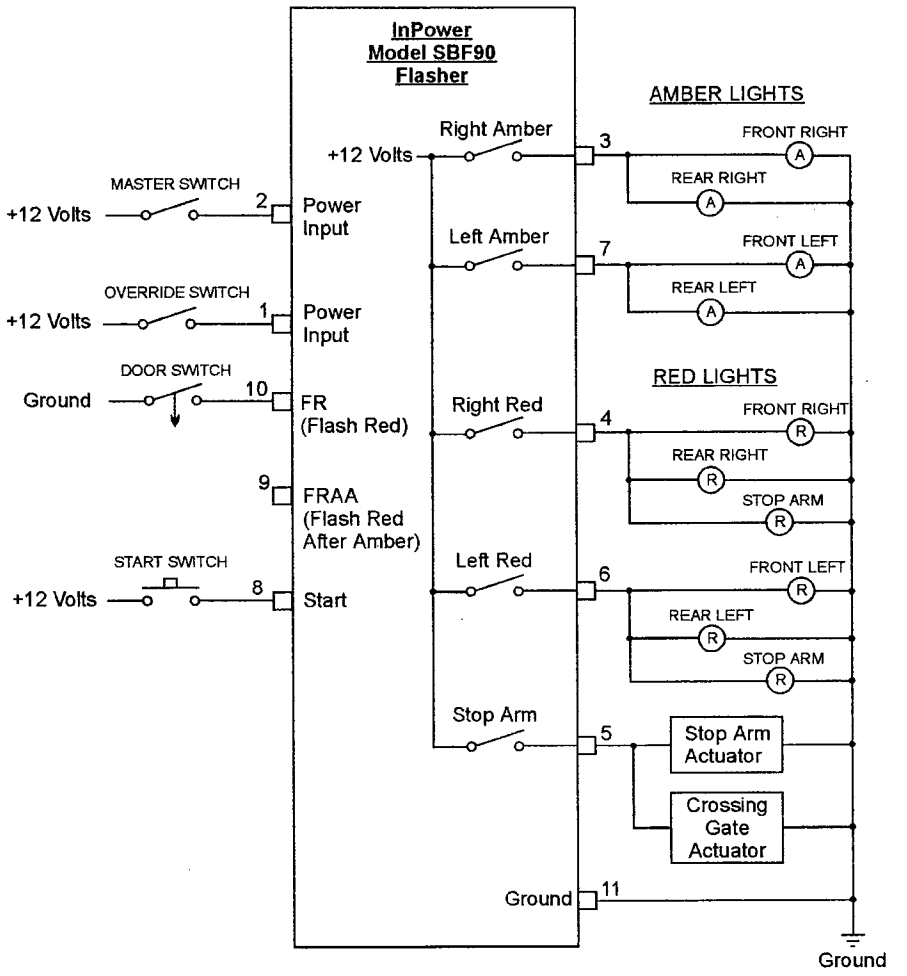

Figure 4
Non-Sequential Flasher Wiring Diagram

Lamp Monitoring

Lamp monitoring systems are used on school buses to determine if certain exterior lights are working. These devices measure the electrical current used by the individual lights. If a lamp fails (almost always an open circuit) the change in lamp current detected provides an indication of the problem to the driver. Most lamp monitors provide a small graphic panel with lights that mimic the front and rear of the school bus. Actually, these systems typically show that the lights are working, rather than directly indicating a failure. That is, the graphic panel lights will illuminate when the bus external light is on (drawing current). To determine if an external light has failed, the driver needs to observe that the graphic panel light is not working when it should.

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Lamp monitors systems are supplied by several companies, and are available to monitor just the red and amber warning lamps (eight-lamp monitors), or both the warning lamps plus the other eight lights on the rear of the bus (sixteen-lamp monitors). The graphic panels are mounted near the driver so that they can easily be seen by the driver. Like many bus features, lamp monitors are specified by the purchasing entity (state or school district).

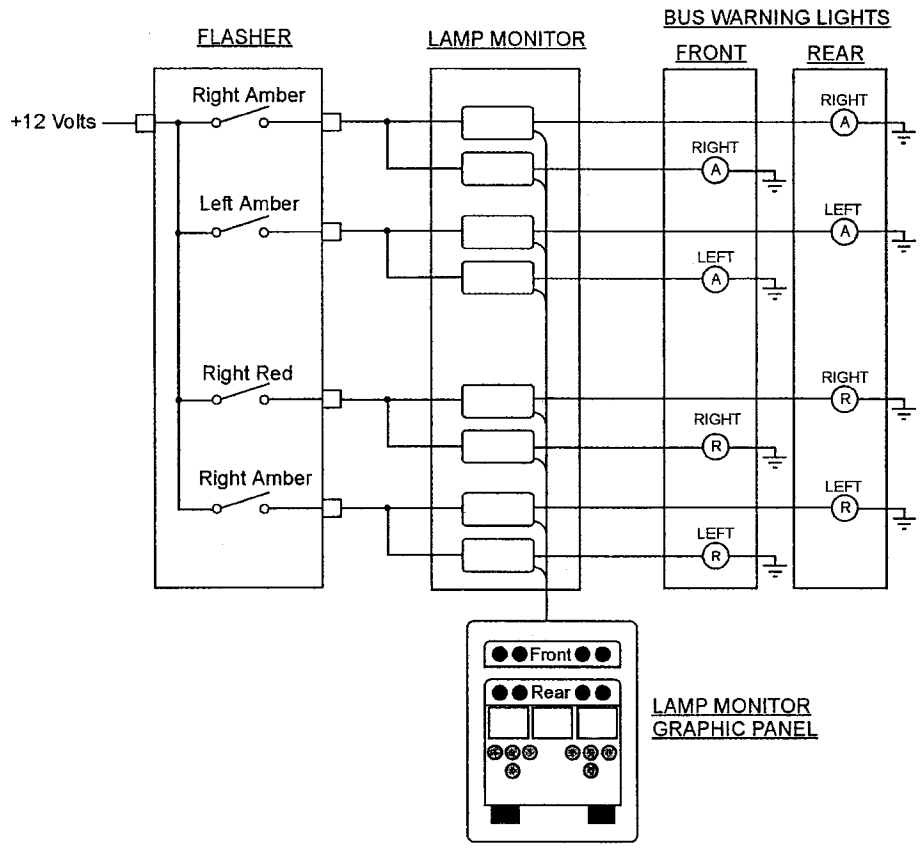

Figure 5
Eight-Lamp Monitor System