A Polarity Converter for Interfacing to Common-Positive Dashboard Illumination
by
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Overview

This document describes how to interface common-ground aftermarket gauge illumination to cars and trucks with common-positive dashboard illumination.

Background

I was installing a cheap ($14 U.S.) aftermarket voltmeter gauge in a car when I discovered that the gauge manufacturer's installation instructions were wrong. The instructions showed how to connect the gauge illumination to the car's dashboard illumination wiring. But they didn't account for the fact that the bulb socket was grounded to the car frame through the chrome mounting bracket! After stewing over this for a few minutes, I had an idea to build a polarity converter.

Many cars made since the early 1980's use a Pulse-Width Modulation (PWM) dimmer, which is an electronic circuit that switches the voltage to the lamps on and off thousands of times per second. The ratio of on-time to off-time determines how bright the lamps are (more on-time is brighter). PWM dimmers can be either common-ground or common-positive. How do you tell which one you have? Find the positive side of a dashboard bulb and measure it's voltage as you vary the dimmer. If the voltage stays the same (at or near 12V), it is a common-positive dimmer, and you need to build this circuit.

Theory of Operation

Fig. 1 shows an equivalent circuit of a typical common-positive PWM dimmer, and dashboard bulbs. The polarity converter circuit works by inverting the polarity of the switched ground input, thereby switching the positive side of the gauge bulb. When the PWM circuit switches the ground on, current flows through the base of the PNP transistor, turning it on. It then allows current to flow through the gauge bulb. When the PWM switches off, the current stops flowing through the base of the transistor, turning it off. This stops current flow to the gauge bulb. Because of the switching action of the PWM, the brightness of the gauge bulbs will follow that of the dashboard bulbs. For a single gauge bulb, a 2N3906 transistor is sufficient. For multiple gauges, more bulb current is needed (about 0.2 A per bulb), so you can either build several of these polarity converters, or use a single larger transistor (TIP32 or similar) and scale the resistor values down for more base current (i.e., 75 and 330 ohm ½-watt resistors, for 3 bulbs). Don't omit the diode – it is needed to protect the transistor from harmful voltage spikes in the car's electrical system. Any 1N4000 series diode will do (1N4001, 1N4003, etc.).

Results

I designed and built this circuit in about 20 minutes, from parts in my junk box. It worked very well. If you don't have a well-stocked junk box, you should be able to buy the necessary parts at Radio Shack. The component values are not too critical. If they don't have the exact resistor values you need, you can substitute something close i.e., a 270 ohm instead of 220 ohm.

Enjoy your new gauges!

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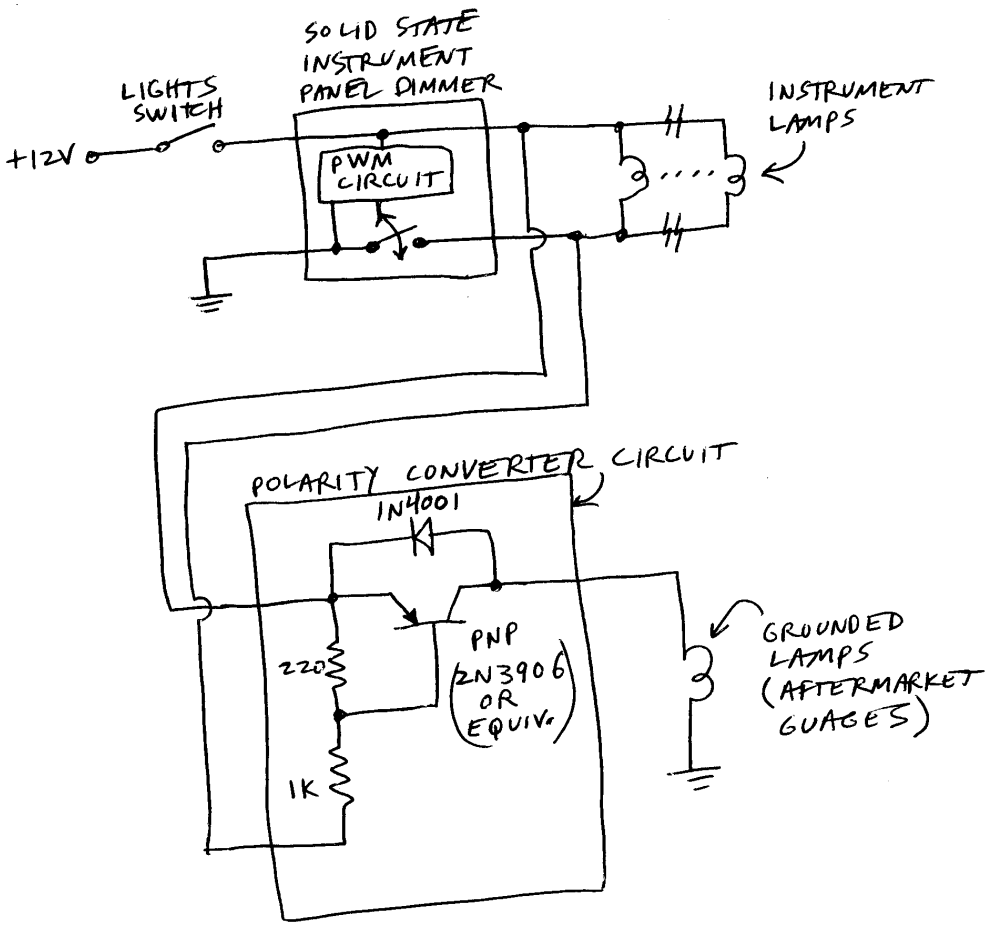

Figure 1