The Zero Labs Constant Current
Pulse Width Modulator v2.1

Specifications

Input voltage ..... +12 to +18 VDC
Max continuous output current 75A
Max repetitive peak current 250A
Operating temperature range ..... -25 to +85 *C
Current regulation ..... >100:1
Frequency Range (+/- 10%) 1KHz-10KHz

Introduction

First of all, thank you so much for your purchase. This PWM marks the first product I have designed that I personally am confident actually provides a benefit to HHO installations. So, what's the benefit?

Let's start with what a PWM is not. A PWM is not a magic device that is likely to provide any great gains in production over straight DC. It is not designed to provide resonant tuning such as Boyce or Meyer toyed with. While both of these devices use similar technology, there's much hocus-pocus in their designs. Personally, I have yet to see or hear of a working replication of either design that produces any amount of HHO close to what is claimed for them.

A true PWM is just an electronic switch that turns on and off at a very fast rate of speed varying the percentage of time on vs off. To the load it appears smooth because it's so fast, just like our vision can barely detect the flicker of a fluorescent bulb even though it goes completely off and back on again 120 times a second. The duty cycle of a PWM is the percentage of on-time vs. off-time.

HHO electrolyzers naturally draw more current as they warm up. All brute force electrolyzers will warm up, even the most efficient ones. At the end of a day current can be easily three times as much as what you started with at the beginning of the day. Without a PWM the problem becomes finding the correct electrolyte concentration for an entire day of driving. If you start out weak then production is very slow to start out with and you lose the benefits until much later in the day. If you start out strong enough to see benefits right away, by the end of the day you're blowing fuses or greatly stressing your alternator.

With a current limited PWM you set your electrolyte for the target operating current at the beginning of the day. To start the output duty cycle is nearly 100%. Half way through the day as the cell is getting warm it may want to draw twice as much current from straight DC. The PWM, sensing that twice as much current is flowing every time it switches on, rolls back the duty cycle to 50%, thus maintaining the same average current. At the end of day when the cell wants to draw three times as much current the PWM is operating at 33% duty cycle.

Presented here is my own design for a PWM with peak sensing current limiting. There is no other PWM design I have found that incorporates this feature, at least not at a price that anyone can afford.

It is my sincerest hope that you are able to realize a true return on your investment from what I have created.

Initial setup

The Zero Labs PWM v2 is capable of sustained current output far in excess of what can be delivered by most typical automotive alternators. Despite this fact, it's not impossible to exceed the 75 amp continuous, 250 amp peak impulse maximum limits of the device. It's easier than you may think.

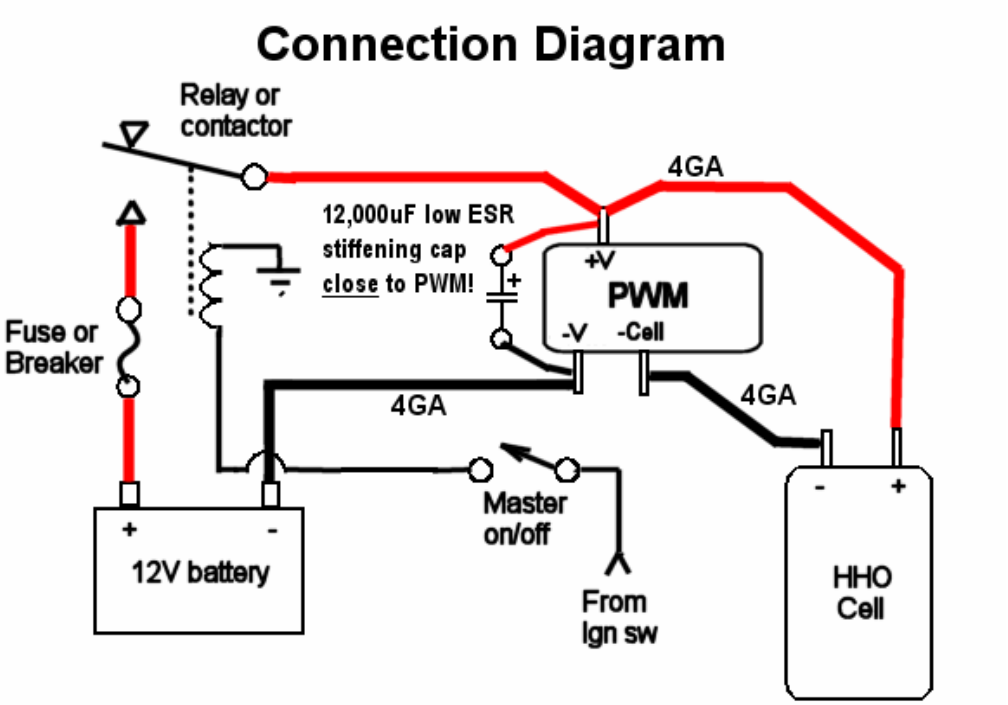
In the previous example I explained how the cell can draw as much as 3 times the amount of current if powered by straight DC once it gets hot. Let's say you set the PWM to regulate at 30 amps. If the cell wants to draw 60 amps from straight DC the PWM will throttle back to 50% duty cycle. If the cell wants to 120 amps the duty cycle drops to 25%. In all cases the average current remains at 30 amps, well below the 75 amp maximum. What changes is the peak impulse current. Even at 120 amps peak impulse, that too is also well within safe operational limits.

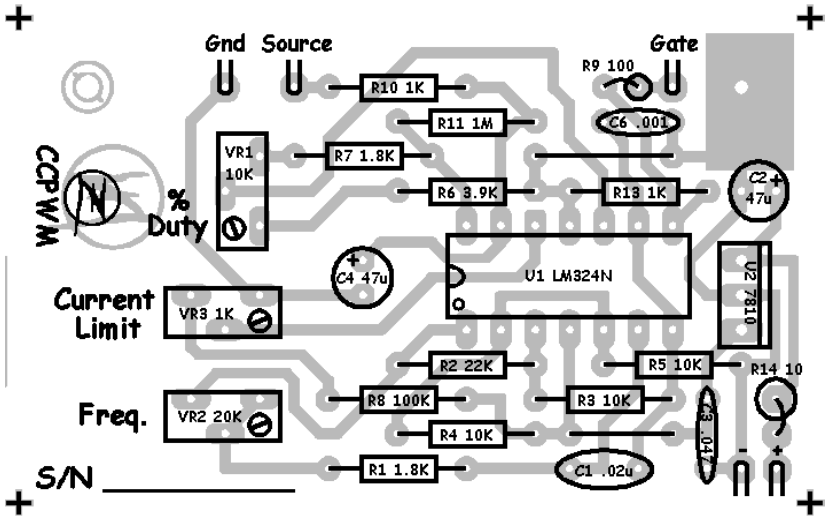
However, many builders like to use parallel plate designs (+-+-+-+-+-). This puts the full input voltage between every plate. It's very easy to add too much electrolyte to this type of cell and create a virtual dead short. No matter what, the PWM will limit the average current. But 30 amps average into a nearly dead short is impulses of nearly infinite current. 600 amps peak is still 30 amps average at 5% duty cycle but well in excess of the 250 peak impulse maximum of the PWM. Get it?

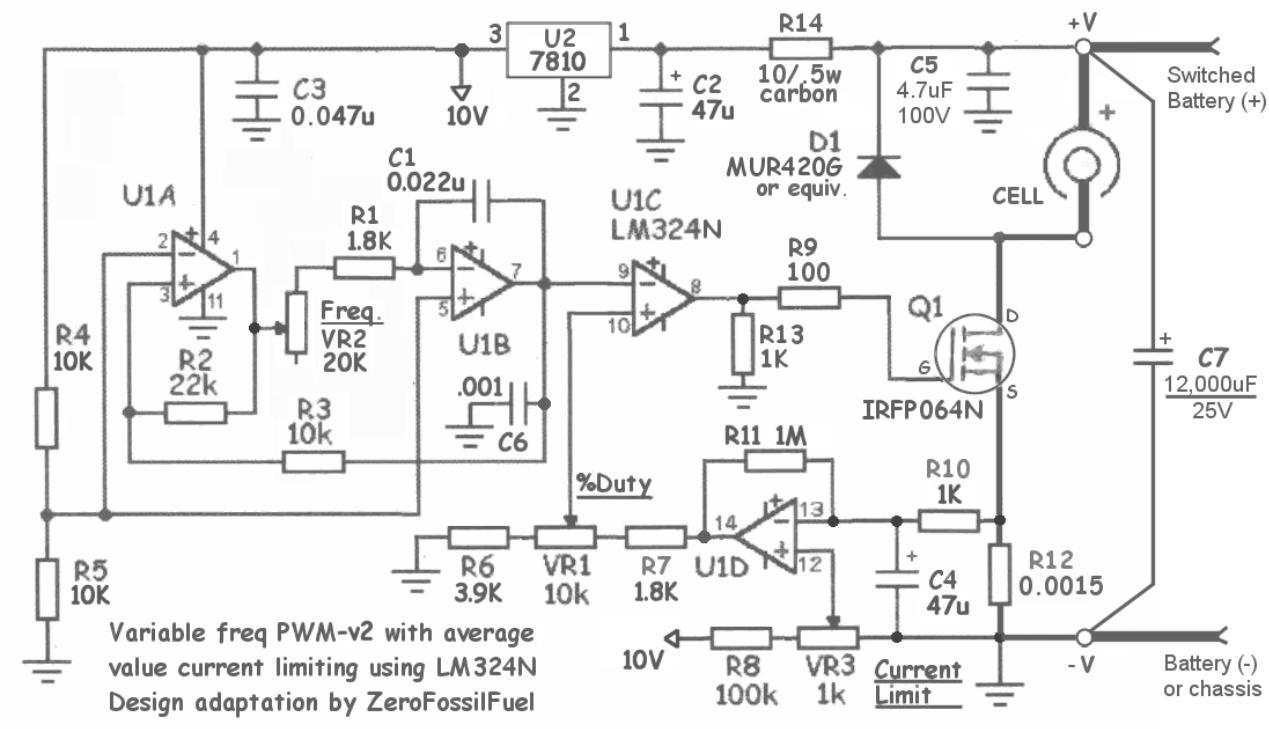
When you first get your PWM it will be calibrated for 25 amps at 2.5 Khz. This is a good baseline to start with for most installations. In order to make accurate adjustments you will need some way of measuring the large currents. I found a very good DMM with clamp-on DC ammeter on ebay for around $80. Other methods are analog panel meters with external shunts or of you have a DMM already you can make my poor man's shunt as shown in YouTube video #54.

REMEMBER, IT IS VITALLY IMPORTANT to adjust your initial startup current with electrolyte concentration first while the cell is cold from straight DC. Then use the PWM to limit current as the conditions of the cell changes with temp.

Frequency can literally be adjusted by ear. It's not that critical. If you need to know what the exact frequency is you'll need a frequency counter or oscilloscope. The % adjustment is used as a manual HHO throttle and can be extended to a throttle pot if desired.







Other uses for your CCPWM:

- Overload protected 12V EV motor speed controller
- High powered 12V Lamp Dimmer control
- Tesla Coil primary driver

Warranty: This PWM is warranted against defects in materials and workmanship. It is guaranteed not to be dead on arrival and to meet or exceed the published specifications. Liability is limited to repair or replacement at our discretion.

Warranty does not cover misuse including but not limited to miswiring, water damage or exceeding any published rating. Customer acknowledges that, as a still experimental field of study, devices such as this used in HHO experiments may be subjected to unexpected conditions causing premature failure for which the manufacturer will have no responsibility. Repair cost quotes based on time and materials plus return shipping.

HHO can be a dangerous field of study if not treated with the utmost respect. Zero Labs, it's owners, employees, etc. shall assume no responsibility for any harm to the customer, witnesses, neighbors or passersby, or any personal property owned by any of these, directly or indirectly through his/her use of this device.

Customer warrants that he/she shall use this device in compliance with local, state and federal laws, regulations.