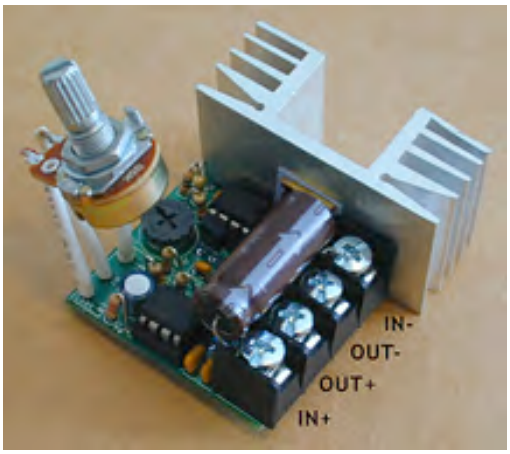
Instructions for Building the Pulsed Width Modulation Circuit

MC-12 *(DC Motor Controller or PWM)*
From Electronic Light Inc. (**revised kit 8/08)**

Using this circuit for a pulsed DC current to your cell. Do NOT solder the mosfet : (Q4) to the board, just yet. You will be attaching the mosfet & heatsink to the outside of a box.
(See photo at the end of this document.)
** NEW Heatsink is bigger and better and price increase.*
(the photo below is the smaller heatsink, with old price, still works fin,e away from the pcb board as described at the end of this .pdf file)



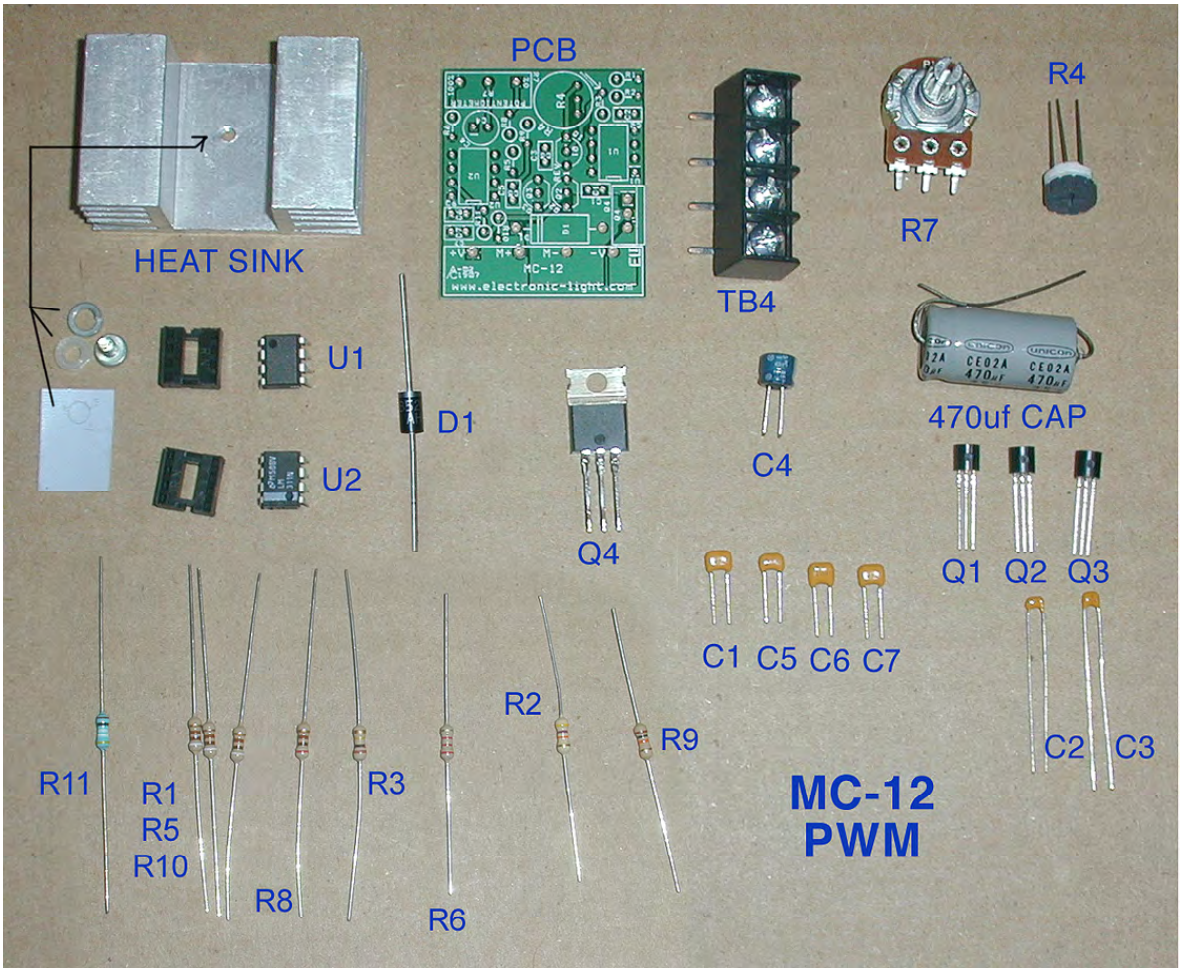
First check to see if your kit came with a 5k or a 15k metal (R7) potentiometer. The larger metal pot is R7, look on the back for 5K or 15K. The Revised kit is for the 15k pot. If you have the 5k pot. Kit, please download previous versions. Sorry we keep improving the circuit, as we go. Parts list below is for the 15K potentiometer. This,revision has a new improved mosfet (Revised kit - 7/08)

Parts List

Qty	Location on PCB	Part Value/Number	Part Marking
4	C1, C5, C6, C7	0.1 _F	104
2	C2, C3	0.01 _F	103
1	C4	100 _F	16V 47 _F
1	D1	SB520 (free wheeling diode)	SB520
2	Q1, Q3	2N3906	2N3906
1	Q2	2N3904	2N3904
1	Q4	SUP75N08 (MOSFET)	SUP75N08
3	R1, R5, R10	910 _	WHT-BRN-BRN
1	R2	47 k_	YEL-VLT-ORN
1	R3	100 k_	BRN-BLK-YEL
1	R4	100 k_ (potentiometer)	100K
1	R6	8.2k_	GRAY-RED-RED
1	R7, POTENTIOMETER	15 k_ (throttle potentiometer)	25A15K
1	R8	3.9 k _	ORG-WHT-RED
1	R9	10 K_	BRN-BLK-ORN
1	R11	510 _	GRN-BRN-BRN
2	U1, U2	8 pin DIP sockets	RN
1	U1 (socket)	555 TIMER - NE555	NE555
1	U2 (socket)	Comparator	LM311
1	+V, M+, M-, -V	TB4	-

1	---	1000 uF, 25V filter capacitor	1000 uF, 25v
1	---	Heatsink	---
1	---	Printed Circuit Board (PCB)	MC-12
1	---	#M3-30 machine screw	---
1	---	#4 lock washer	---
1	---	#4 nylon shoulder washer	---
1	---	Thermally conductive insulator	---

35 total parts.



*(Please note the photo above is from an earlier version of the kit, so values of parts may be different than the photo.)

Congratulations on your purchase of *MC-12* from Electronic Light, via Hydrogen Garage LLC.
Please read the entire instructions first before proceeding.

Follow the recommended steps below to facilitate the assembly your kit.

Step 1 ***Placing the non-polarized capacitors***
Place capacitors C6, C7, and C1 into their respective locations. Bend the leads outward to hold them in place. Repeat with capacitors C2 & C3. Solder the components in place and trim the excess lead lengths with flush cutters or wire cutters. Repeat with Capacitor C5.

Step 2 ***Placing the IC Sockets***
Place an IC socket with the notch aligned with the small rectangular outline for U1 on the silk screen as shown in Figure 1. Solder the socket into place. Repeat with the other IC socket in position U2. Trim the excess lead lengths.

Step 3 ***Inserting the ICs***
Pin 1 is indicated on an IC package by a small circular impression. Pin 1 must coincide with the small rectangular outlines as indicated in Figure 1. Insert U1 (NE555) into socket U1 and U2 (LM311) into socket U2. It may be necessary to bend the IC leads slightly inward in order to insert the parts.

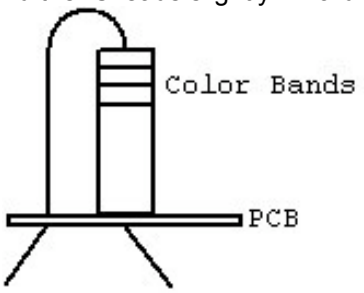


Figure 1 Up-right resistor mounting

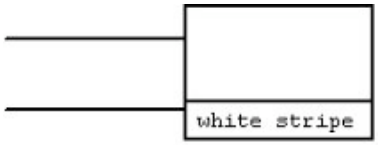


Figure 2 Negative lead of capacitor C4, white stripe to negative square hole. .

Step 4 ***Placing the Frequency Adjustment Potentiometer***
Insert the 100 k_ potentiometer into Position R4. Solder and trim the leads.

Step 5 ***Placing the Diode***
The cathode side of the free-wheeling diode is indicated by a silver ring on the diode package and by a thin rectangle on the PCB next to the square-padded hole. Bend the diode leads at right angles and insert it into the PCB with the cathode lead in the square-padded hole. Solder D1 into place and trim the leads.

Step 6 ***Placing the Resistors***
Identify resistors R1 – R3, R5, R6, R8 – R11. Bend the lead of each resistor that is closest to the color bands down toward the body of the resistor as indicated in Figure 2. Insert the resistors in their respective places on the PCB in the up-right position. With the exceptions of resistors R1, R2, and R8, align the body of the resistor with the round circle on the silkscreen. Bend the leads outward to hold the resistor in place. Solder each of the resistor leads and trim the excess lengths.

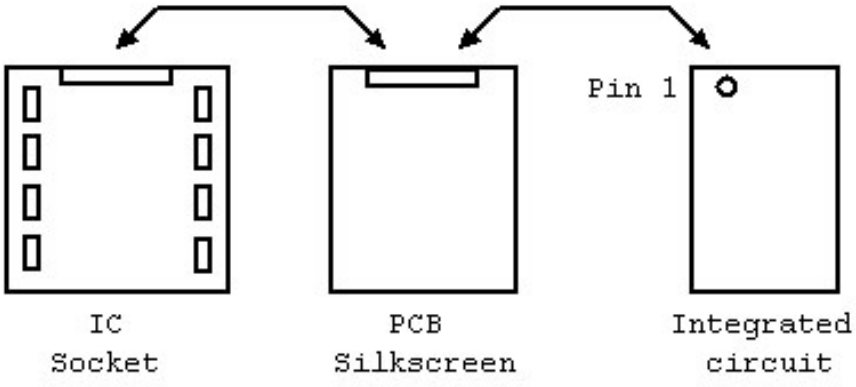


Figure 3 IC socket placement and IC Orientation

Step 7 ***Placing the polarized capacitor***
Capacitor C4 is polarized. The negative lead is indicated as shown in Figure 3 as the lead nearest the white stripe on the capacitor body. Place the capacitor with the negative lead inserted into the square-padded hole labeled "-".

Step 8 ***Placing the Transistors***
Place transistors Q1 and Q2 so that the flat side of the transistor package coincides with the flat edge of the PCB silkscreen outline. Note that Q2 has part number 2N3904 and Q3 has part number 2N3906. Solder the transistors into place and trim the leads. Repeat with transistor Q1 (also a 2N3906).

Step 9 ***Placing the MOSFET***
Insert the nylon shoulder washer into the MOSFET as shown in Figure 4. If necessary, round the edges of the screw hole with a larger Philips screw driver.

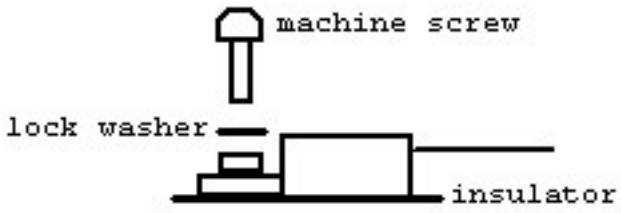


Figure 4 Inserting the Shoulder Washer into the MOSFET.

Step 10 ***Placing the Terminal Block***
Insert the leads of the terminal blocks into the pads labeled "+V", "M+", "M-", and "-V" from the *under side* of the PCB. Push the terminals firmly into place. Solder the leads on the upper side of the PCB.

Step 11 ***Attaching the Heatsink***
Place the thermally-conductive insulator between the MOSFET and the heatsink. Attach the heatsink to the MOSFET with the machine screw and lock washer as indicated in Figure 5. Tighten the screw firmly.
(You may skip this step and place the mosfet and heatsink off the pcb board, we use 3 1" long coated coper wire 20 gauge to do this. The Mosfet is the main heat generator and needs to be cooled, especially if you be be running 25 amps for hours under the hood of your car. Attaching the mosfet to the board like the first photo in this doc., it may not last long and burn up the board, or melt it.

Step 12 ***Placing the Throttle Potentiometer***

Insert the 15k_ throttle potentiometer into Position R7. Solder the potentiometer into place and trim the excess lead lengths.

Step 13 ***Wiring the Motor, Controller, Filter Capacitor, and Power Supply***
Wire the motor, power supply, and filter capacitor to the terminal block as shown in the Wiring Diagram. Use #12 AWG or heavier wire. Make certain that the negative lead of the capacitor is connected to the -V terminal and the positive lead is connected to the +V terminal. The negative lead of the capacitor is indicated by the white arrows on the capacitor package. A power switch and fuse between the power supply and the motor controller are recommended. If used in an automobile, a fused 12-volt line that is powered by the ignition switch is suitable.

CAUTION
- **Do not attempt to operate the circuit without the 1000 uF filter capacitor**
- **Make absolutely certain that the power supply is connected with the correct polarity. A reverse polarity connection will destroy the unit**
- **If this controller is used to power an electric vehicle, make certain that the throttle is turned all the way to the 0% position before power is applied**

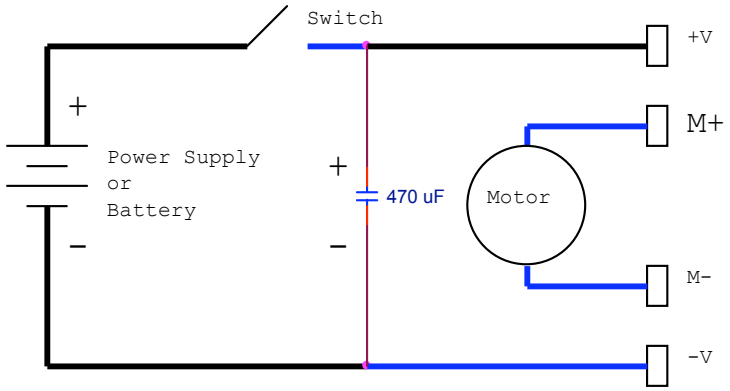
Step 12 ***Adjusting the Pulse-Width-Modulation Frequency.***
Adjust the frequency to the desired setting with R4. The lower frequencies reduce the power losses in the MOSFET but create audible noise. The higher frequencies result in tighter control over the motor current and allows for silent operation.

Questions? Send email to info@electronic-light.com

Step 13 ***Attaching the Heatsink to the Cheap Plastic box or Aluminum box.***
Changes to the heatsink mount for using pass 25 amps under the hood of your car or truck. Attach the heatsink to the aluminum plate on the bottom of the box.. Drill a hole to allow the heat sink to be in the center of the alum. plate. Drill 4 - .25" holes in the side of the black plastic box, to allow the 2 IN (V+ & V-) and 2 out wires (M+ & M-) to enter the box. We make 4 – 12" long , 12 gauge stranded copper wire leads, 2 will go to the cell – M+ and M- (M = motor, in our case we are not powering a motor, rather to our cell. V = volts IN) We used to solder right to the terminal block, but that creates too much heat and fries the already soldered in components. We now use electrical connectors that fit in the terminal block and are screwed down. The other end of these 4 leads have 2 round connectors that fit our .25" threaded rods or .25" bolts. The other 2 ends that are the IN+ and IN- have electrical spade connectors solder onto the ends of the 12" long wires. One end goes to the chassis ground and the other goes to our nearby auto relay, See under the hood connections at the end of this .pdf file.

We also drill 2 holes on top of the box to allow the throttle pot. To fasten to the box and a 3/8" hole to access the Freq. Trimmer (potentiometer) that is on the pcb board. Access through the hole with a Phillips small screwdriver, to turn the pot. See photos at end of this .pdf

Place the thermally-conductive insulator between the MOSFET and the heatsink. Attach the heatsink to the MOSFET with the machine screw and lock washer. Tighten the screw firmly.



Wiring Diagram

CAUTION

- **Do not attempt to operate the circuit without the filter capacitor.**
- **Make certain that the throttle is turned all the way to the 0% position before power is applied.**

Step 12 ***Adjusting the Pulse-Width-Modulation Frequency.***
Adjust the frequency to the desired setting. The lower frequencies reduce the power losses in the MOSFET but create audible noise. The higher frequencies result in tighter control over the motor current and allows for silent operation.

The, **output frequency is adjustable from 1,250 Hz to 120,000 hz with R4 (100k).** The side-mounted 5k pot adjusts the duty ratio.

Hooking the circuit up to a electrolysis pulsed generator cell :

- 1) Wire both (-) and (+) into the PWM –MC-12 circuit from battery or relay. And both wire outs to cell (+) and (-), using 10 or 12 gauge wire. If you use the black plastic box, drill 4 separate holes so if you get the wires hot (25 amps range) they will not melt together and short. I say bench test them first. Also when bench testing use a battery, not a battery recharger, most new battery chargers are solid state and have the PWM already built into the charger and makes the circuit misbehave and maybe short. Always put a 25 amp fuse after the battery from your power source or from your relay. I mix my electrolyte and distilled water to about 10 amps to start. When warmed up after about 10 minutes of driving it will heat up slightly and the amps will go up to about 15 amps. That will produce a good amount of egas for a hydrogen booster. I believe this circuit creates Brown's egas, ortho hydrogen or monatomic hydrogen and oxygen, a more powerful hydrogen gas, so less is needed. The bubbles will appear smaller and more uniform than a direct DC hook up. Ortho hydrogen will build and collect to each other in a molecular state. It can build up pressure more easily than regular HHO egas. You can also tune the cell, if you listen carefully you can hear a humm and can dial in the loudest humm, or dial in the sweet spot that delivers the most amount of bubbles. Or tune into the frequency of your desire.

The frequency of the square rectangular wave form of this circuit can be adjusted rate of 1200 Hz. To 120,000hz, by adjusting the 5k pot. (R4) The 100K pot (R6) adjusts the square wave length or throttle control for an electric motor.

Any more questions on this circuit contact Electronic Lights. (auctions@electronic-light.com) Thanks to Dr, Shaffer for working up this design for us to use as pulsed square wave DC for our hydrogen generator cells.

Wiring diagrams for under the hood and dashboard wiring, photos of the cheap plastic box and schematic are on the next, last pages of this .pdf document (Next 4 pages).
(info@hydrogengarage.com)

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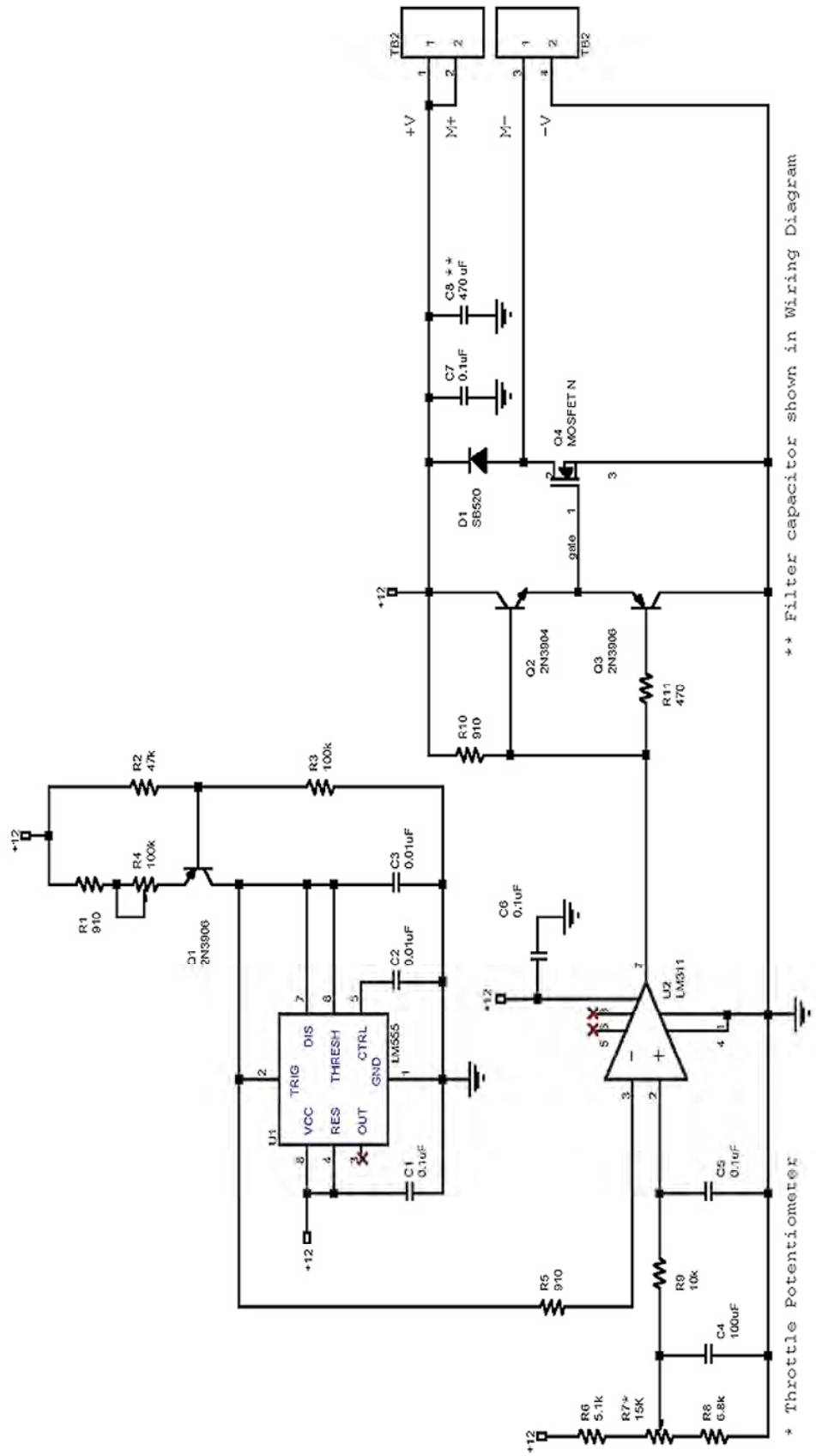
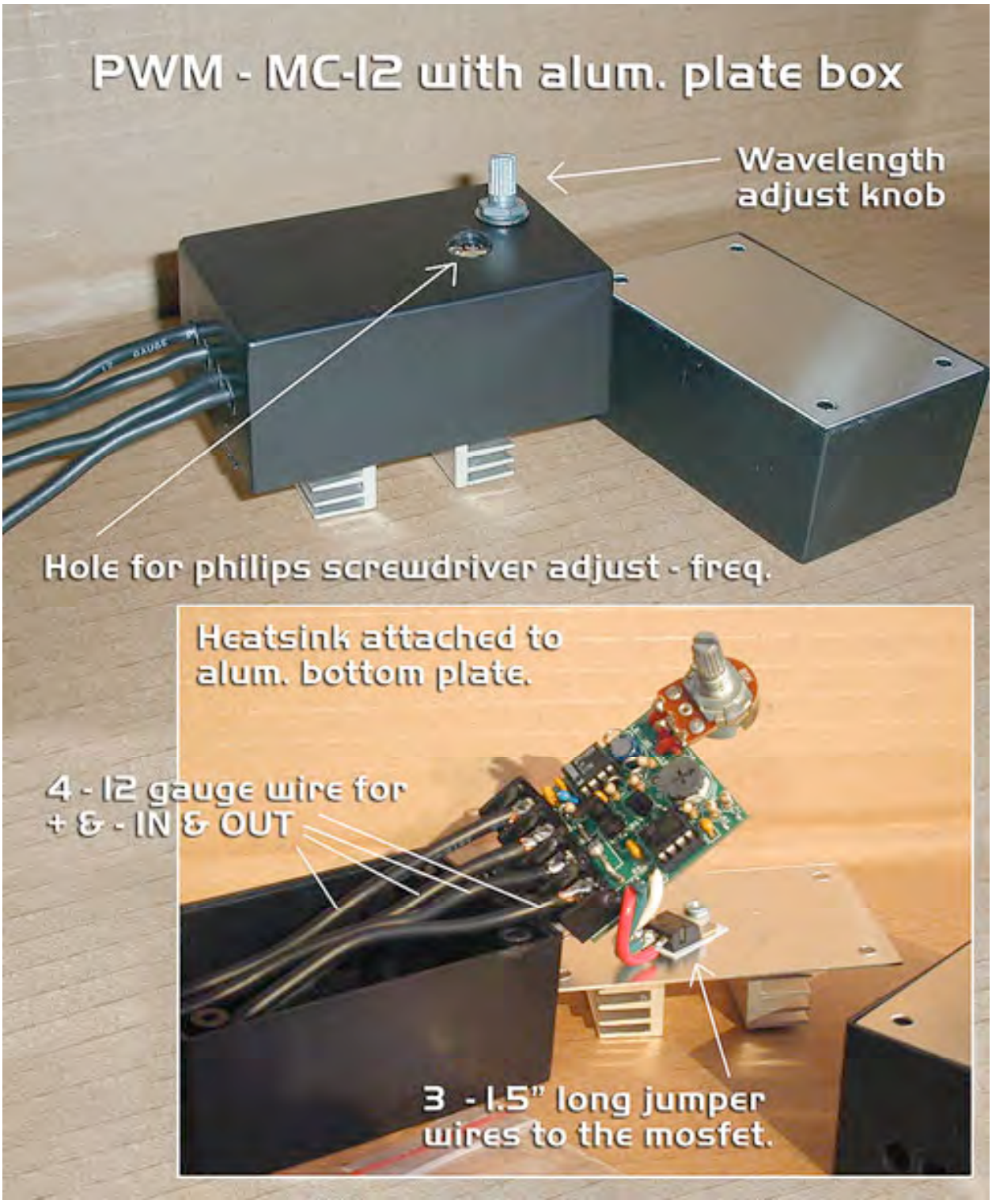
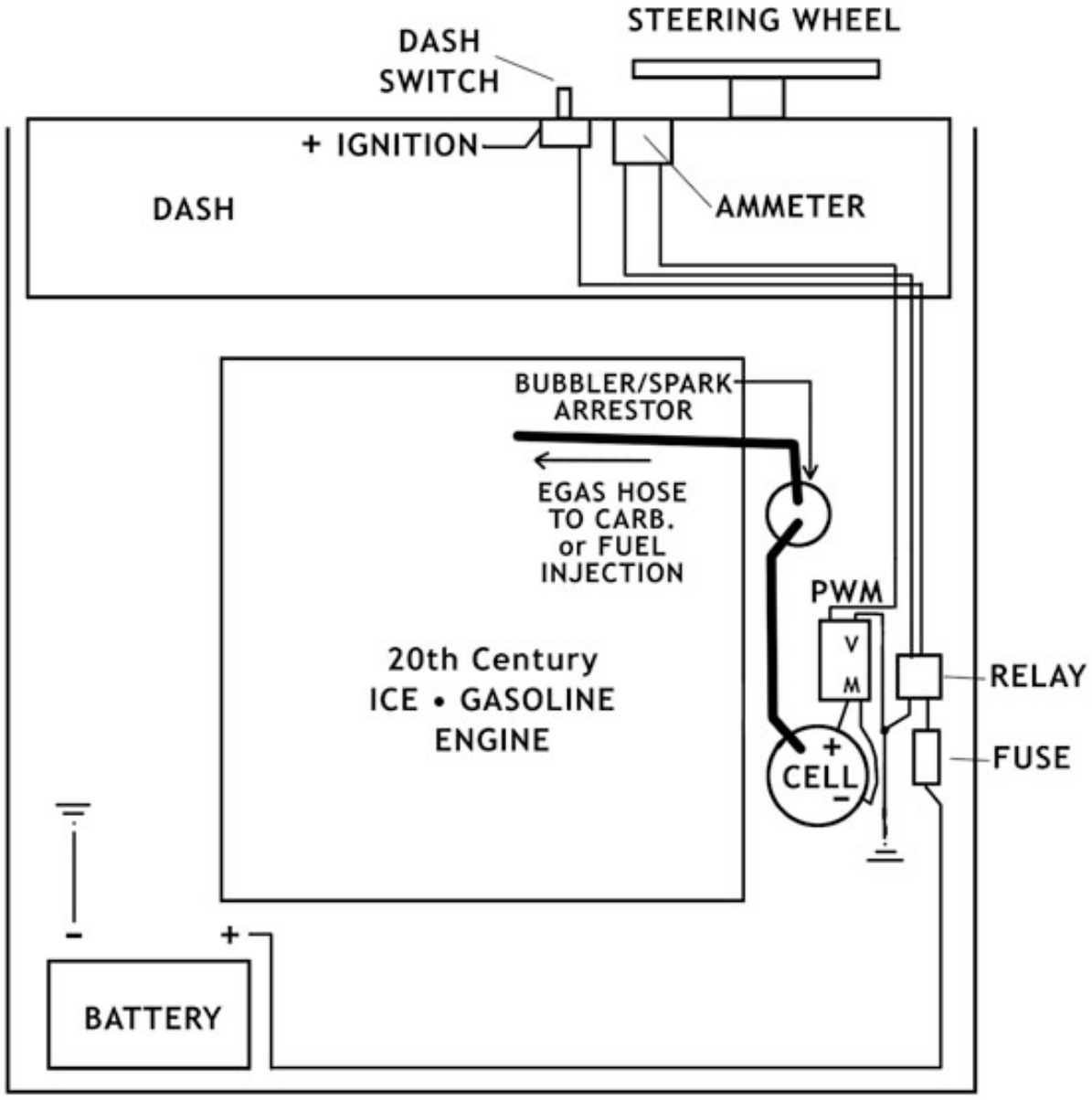
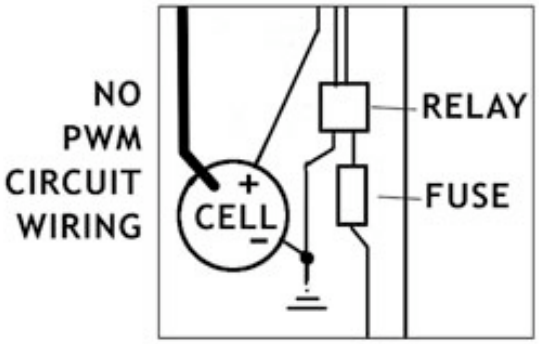
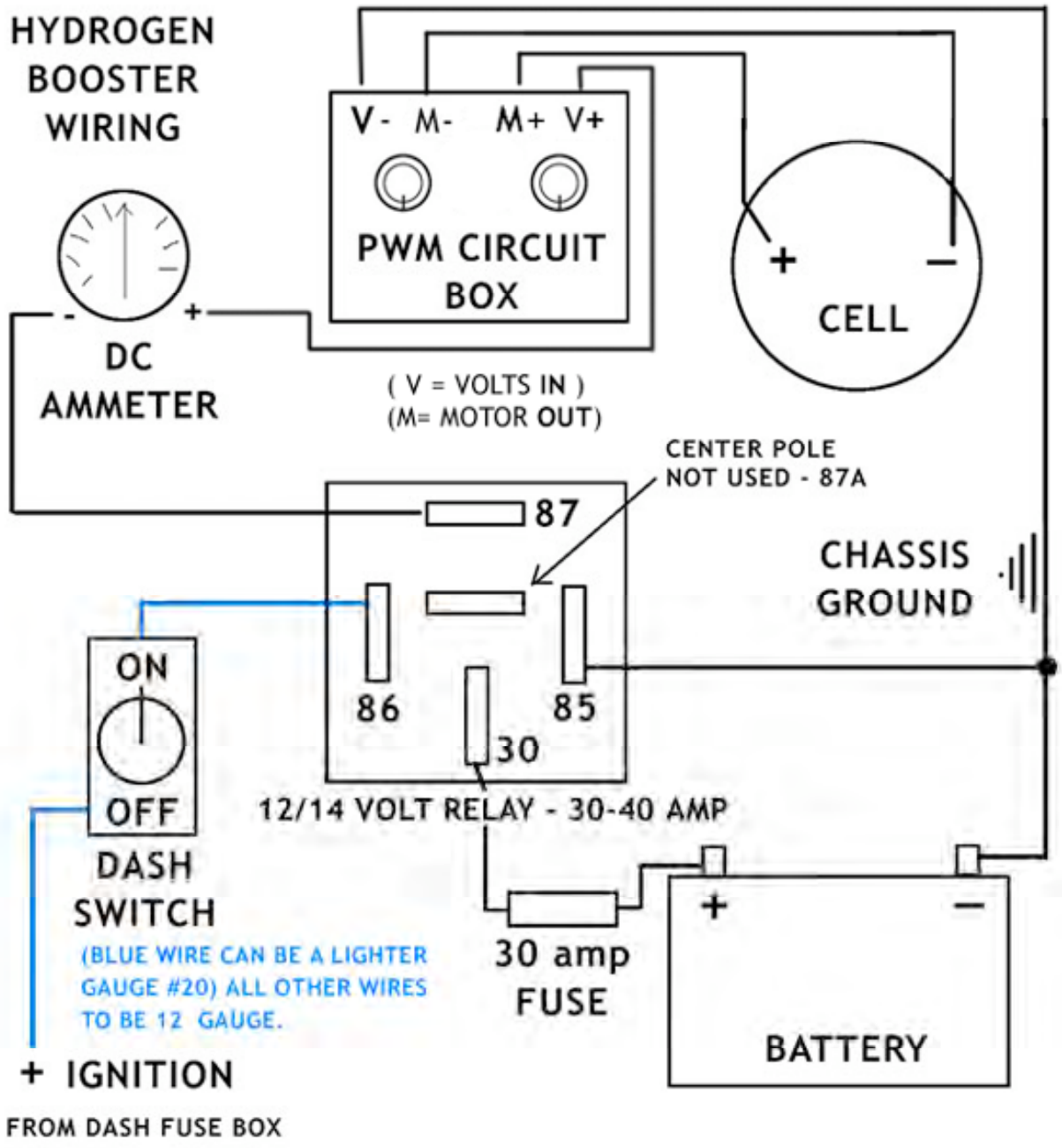

TB2
+V
M+
M-
-V
C8 **
470 uF
C7
0.1uF
Q4
MOSFET N
D1
SB520
gate
+12
Q2
2N3904
Q3
2N3906
R10
910
R11
470
** Filter capacitor shown in Wiring Diagram
R2
47k
R3
100k
R4
100k
R1
910
Q1
2N3906
C3
0.01uF
C2
0.01uF
C8
0.1uF
U1
TRIG
DIS
THRESH
CTRL
GND
VCC
RES
OUT
LM555
U2
LM311
C1
0.1uF
C5
0.1uF
R5
910
R9
10k
C4
100uF
R6
5.1K
R7*
15K
R8
6.8k
* Throttle Potentiometer


PWM - MC-12 with alum. plate box
Wavelength adjust knob
Hole for philips screwdriver adjust - freq.
Heatsink attached to alum. bottom plate.
4 - 12 gauge wire for + & - IN & OUT
3 - 1.5" long jumper wires to the mosfet.

UNDER THE HOOD SIMPLE WIRING






HYDROGEN
BOOSTER
WIRING
V- M- M+ V+
PWM CIRCUIT
BOX
CELL
DC
AMMETER
(V = VOLTS IN)
(M= MOTOR OUT)
CENTER POLE
NOT USED - 87A
87
CHASSIS
GROUND
ON
OFF
86
85
30
12/14 VOLT RELAY - 30-40 AMP
DASH
SWITCH
(BLUE WIRE CAN BE A LIGHTER
GAUGE #20) ALL OTHER WIRES
TO BE 12 GAUGE.
30 amp
FUSE
BATTERY
+ IGNITION
FROM DASH FUSE BOX