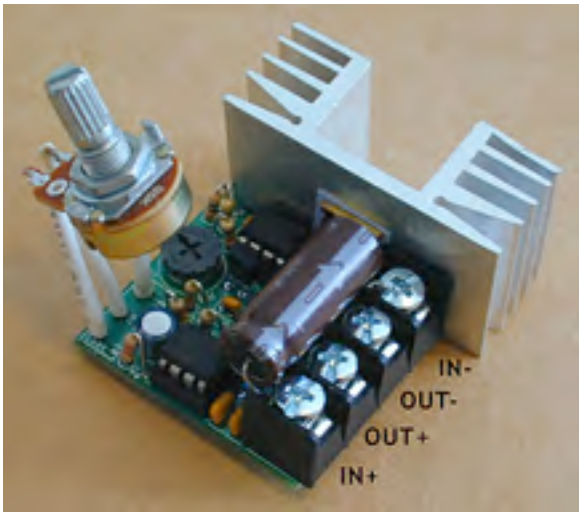
Instructions for Building the Pulsed Width Modulation Circuit

MC-12 *(DC Motor Controller or PWM)*
From Electronic Light Inc. (**revised 4/08)**

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.)



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 parts list below is for the 5K potentiometer.

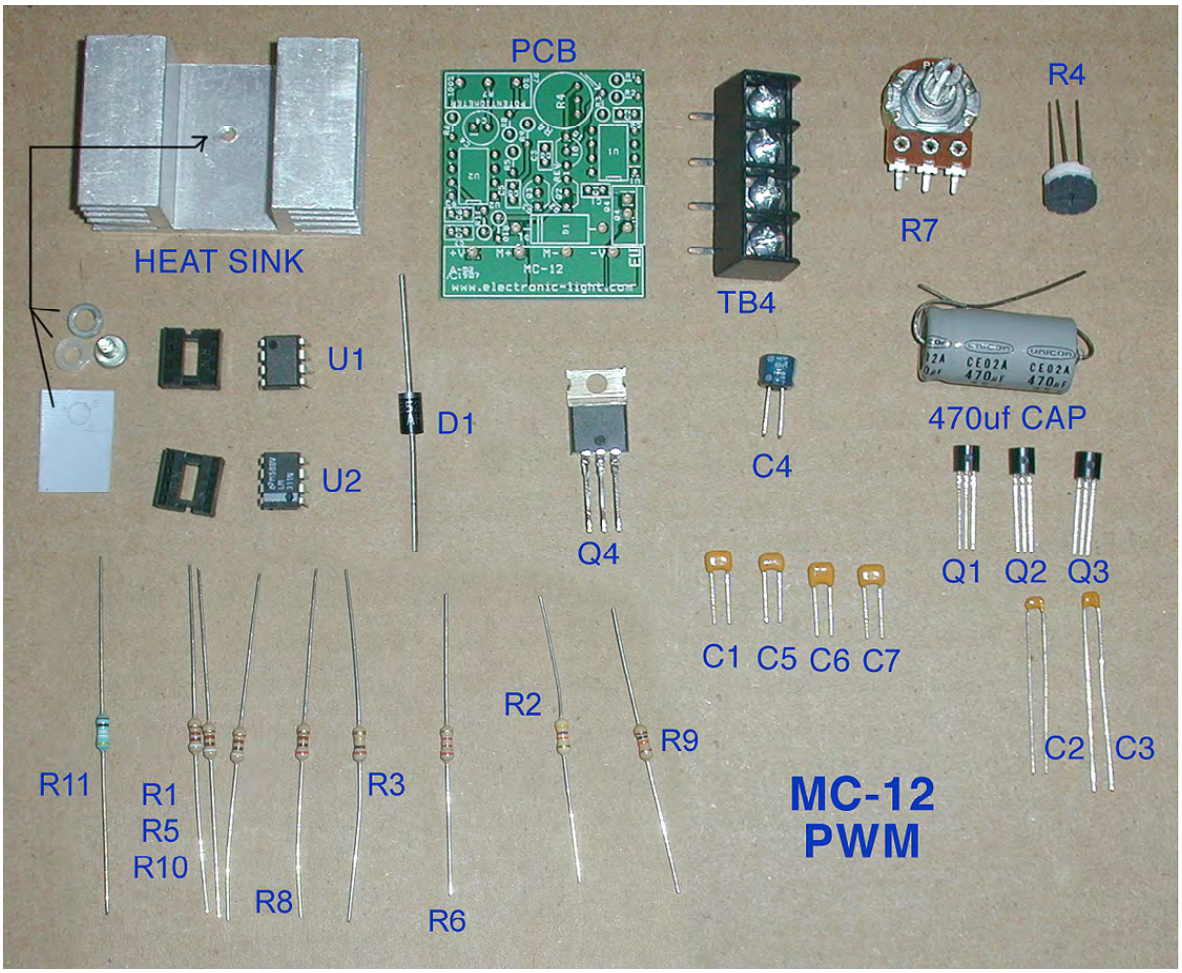
Parts List

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	SB520
2	Q1, Q3	2N3906	2N3906
1	Q2	2N3904	2N3904
1	Q4	IRL3803 (MOSFET)	IRL7833
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	2.2k_	GREEN-BROWN-RED
1	R7, POTENTIOMETER	5 k_ (throttle potentiometer)	B5K
1	R8	180 _	BLUE-GREY-RED
1	R9	10 K_	BRN-BLK-ORN
1	R11	510 _	YEL-VLT-BLK-BLK-BRN
2	U1, U2	8 pin DIP sockets	RN
1	U1 (socket)	LM555 or NE555	UA555TC
1	U2 (socket)	LM311	LM311
1	+V, M+, M-, -V	TB4 - In 2 pieces.	tyco electronics

1	---	470 _F, 35V filter capacitor	35V 470_F - BROWN
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	---

If your kit came with a 15K potentiometer (R7), you will have 4 resistor changes below :

1	R6	5.1 k	GRN-BRN-RED
1	R7, POTENTIOMETER	15 k_ (throttle potentiometer)	25A15K
1	R8	6.8k_	BLU-GRY-RED
1	R11	470	YEL-VLT-BL-BLK-BRN



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 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 1. Insert the resistors in their respective places on the PCB in the up-right position and bend the leads outward to hold the resistor in place. Solder each of the resistor leads and trim the excess lengths with a flush cutter or diagonal cutter.

Step 2 ***Placing the Capacitors***
Place capacitors C1, C5, C6, & C7 into their respective locations. Bend the leads outward to hold them in place and solder and trim the leads. Repeat with capacitors C2 & C3. Capacitor C4 is polarized. The negative lead is indicated as shown in Figure 2 as the lead nearest the white stripe on the capacitor body. Place the capacitor with the negative lead inserted into square-padded hole labeled "-".

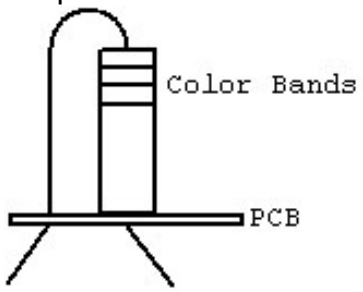


Figure 1 Up-right resistor mounting

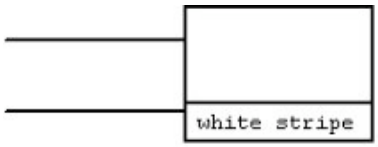


Figure 2 Negative lead of capacitor C4, white stripe to negative square hole. .

Step 3 ***Placing the Frequency Adjustment Potentiometer***
Insert the 100 k_ potentiometer into Position R4. Solder and trim the leads.

Step 4 ***Placing the IC Sockets and Inserting the ICs***
Place an IC socket with the notch aligned with the small rectangular outline for U1 on the silk screen as shown in Figure 3. Solder the socket into place. Repeat with the other IC socket in position U2. Pin 1 is indicated on the IC package by a small circular impression. Pin 1 must coincide with the small rectangular outlines as indicated in Figure 3. Insert U1 (LM555) into socket U1. Repeat with U2. It may be necessary to bend the IC leads slightly inward in order to insert the part.

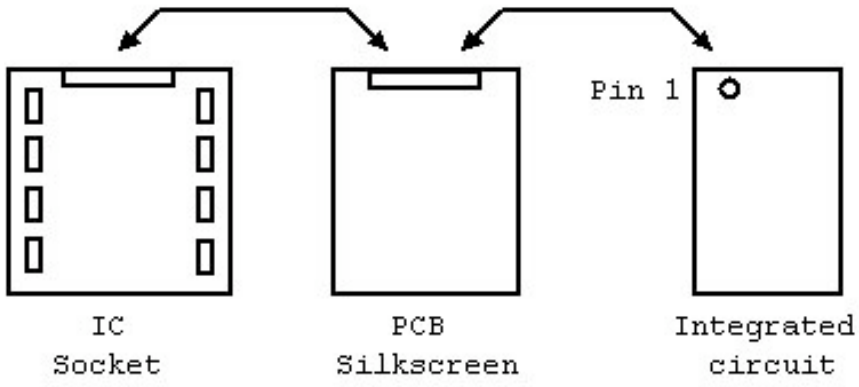


Figure 3 IC socket placement and IC Orientation

Step 5 ***Placing the Diode***
Place diode D1 into the PCB with the lead on the white-banded side of the diode package inserted into the square-padded hole. Solder into place and trim the leads.

Step 6 ***Placing the Transistors***
Place transistor Q1 so that the flat side of the transistor package coincides with the flat edge of the PCB silkscreen outline. Repeat with transistors Q2 and Q3. Solder and trim the leads.

Step 7 ***Placing the Terminal Block***
The terminak Block is now in 2 pieces and the back fins need to be nipped off to allow room for the diode and other compontents that are cloe to the 2 piece terminal block. Place and fit before soldering into place. Insert the leads of the terminal block into the pads labeled "+V M+ M- -V" from the under side of the PCB. Solder the terminal block into place.

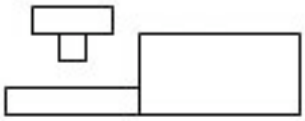


Figure 4 Inserting the Shoulder Washer into the MOSFET.

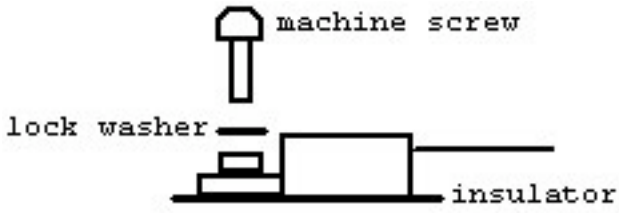
Step 8 ***Placing the MOSFET***
Insert the nylon shoulder washer into the MOSFET as shown in Figure 4. If necessary, round the edges of the screw hole with a larger Philips screw driver.

DO NOT solder in the MOSFET into location Q4, we will be adding 3 jumper wires instead. 3 – 16 gauge stranded copper wire about 1 inch long jumpers to the mosfet on the heat sink detached from the pcb board. Make sure you have the 3 leads from the mosfet face the same direction as the mount on the board! Trim the leads on the mosfet and solder in the 3 jumper wires (see photo at end of document).

Step 9 ***Attaching the Heatsink to the Cheap Plastic 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.

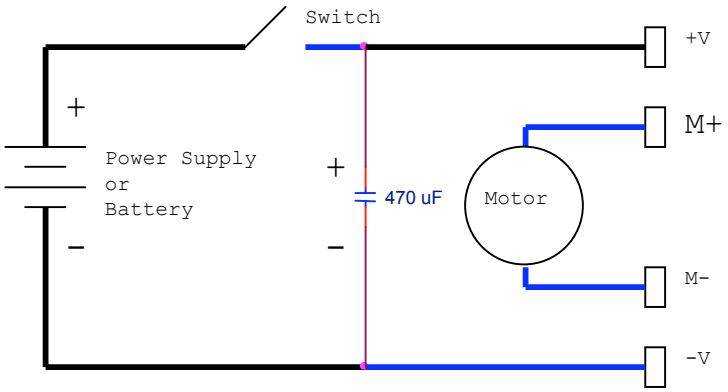
We also drill 2 holes on top of the box to allow the throttle pot. To fasten to the box and a 3/8" hole to access the Freq. Trimmer (potentiometer) that is on the pcb board. Access through the hole with a Phillips small screwdriver, to turn the pot. See photos at end of this .pdf

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.



Step 10 ***Placing the Throttle Potentiometer***
Insert the 5k_ throttle potentiometer into Position R7. Solder the potentiometer into place.

Step 11 ***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 between the power supply and the motor controller is recommended.



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 soild 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 monoatomic 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).

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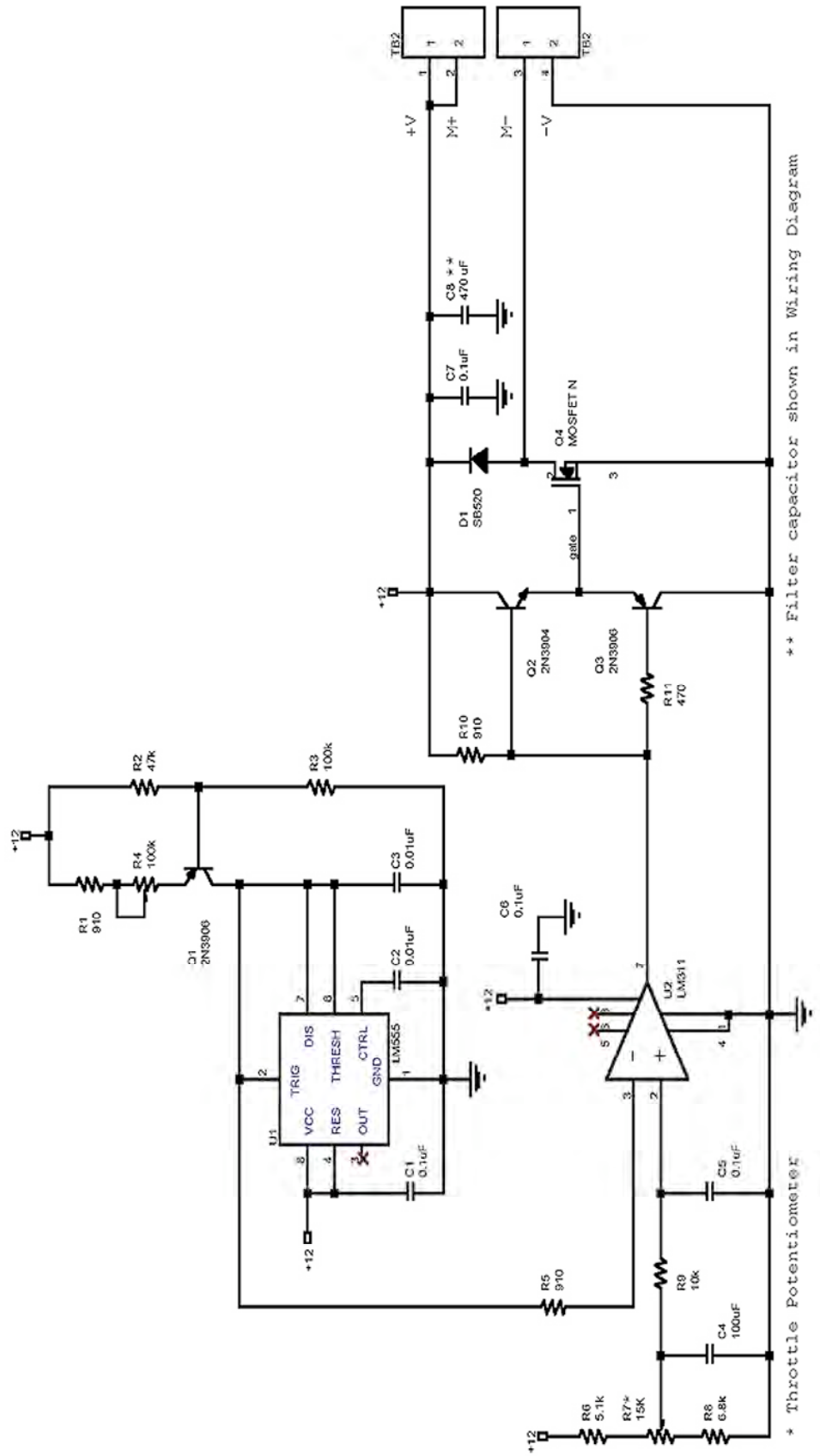
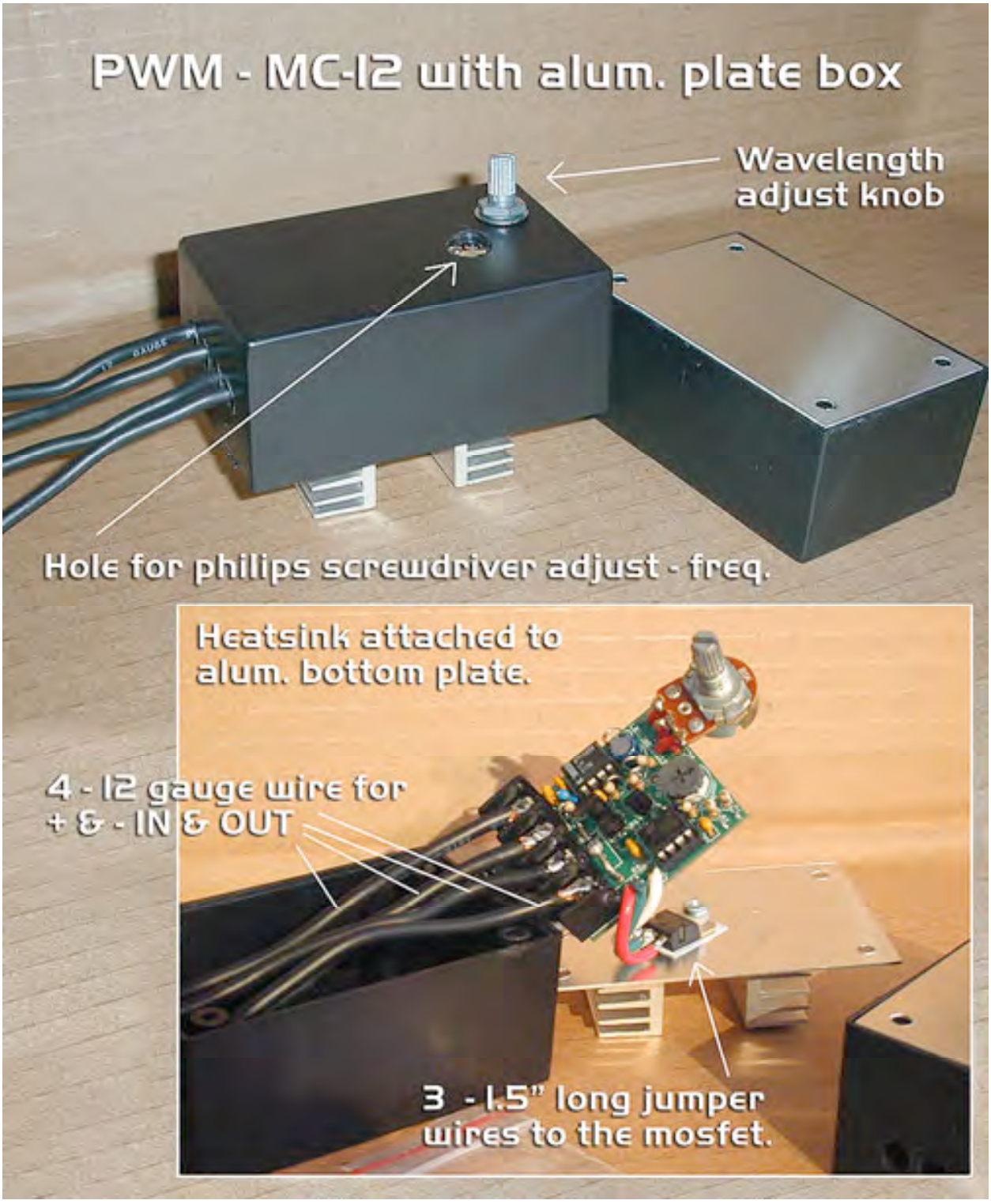
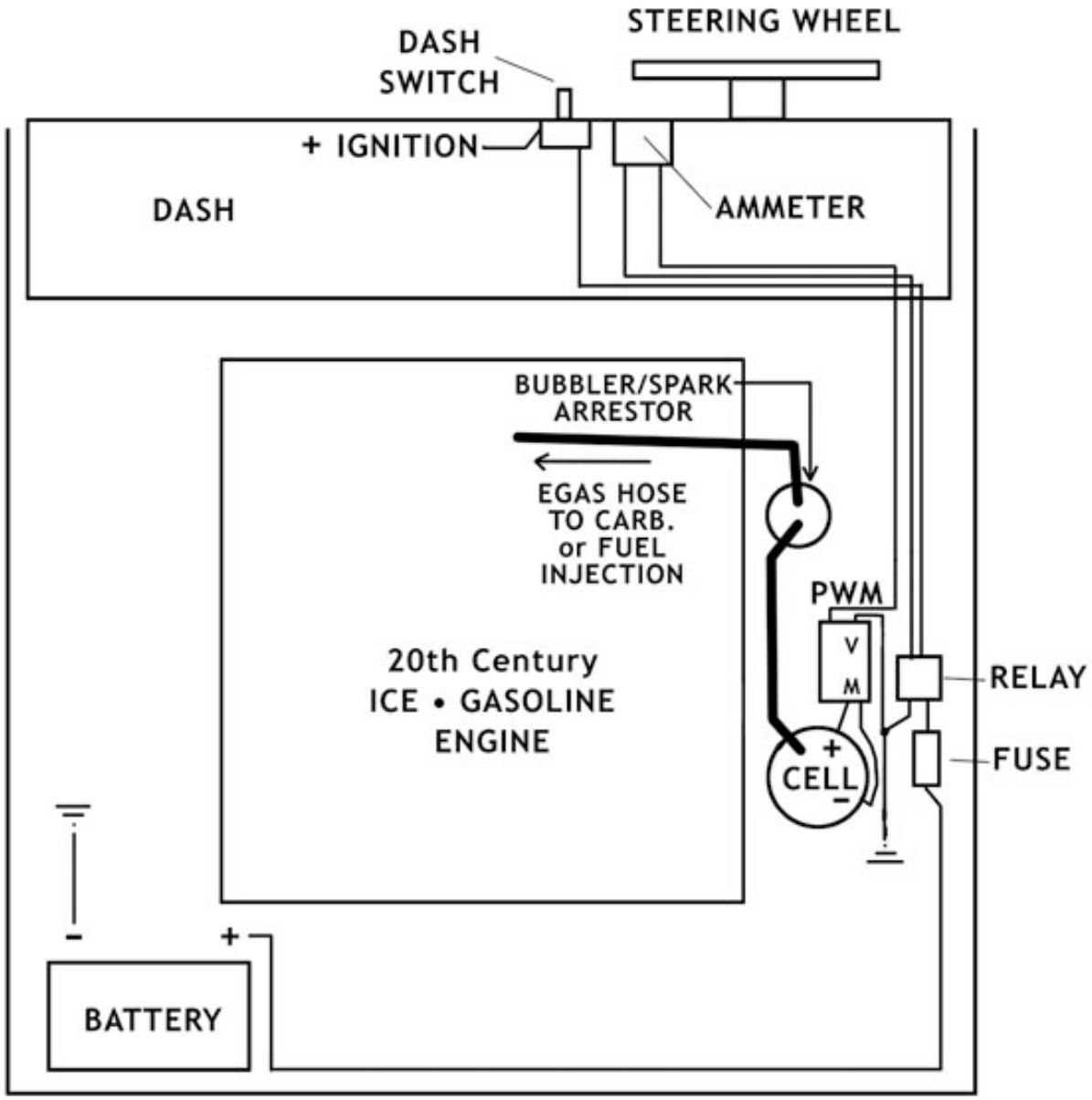
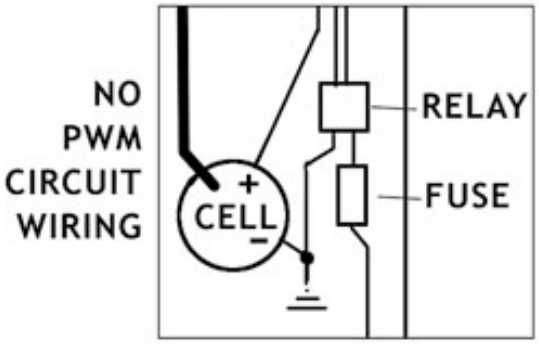
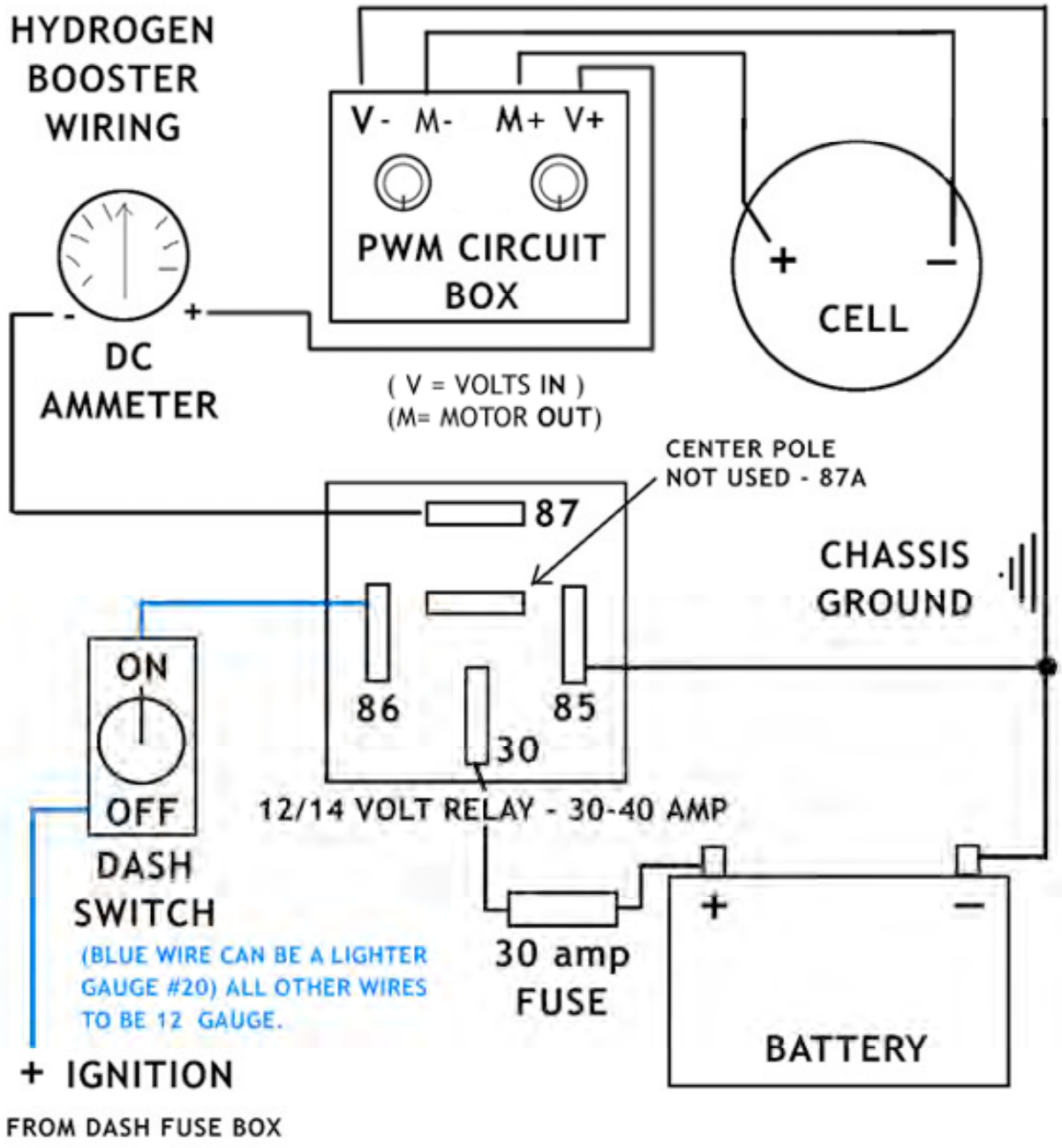

TB2
+V
M+
M-
-V
C8 **
470 uF
C7
0.1uF
Q4
MOSFET N
D1
SB520
gate
+12
Q2
2N3904
Q3
2N3906
R10
910
R11
470
** Filter capacitor shown in Wiring Diagram
R2
47k
R3
100k
R4
100k
R1
910
Q1
2N3906
C3
0.01uF
C2
0.01uF
C6
0.1uF
U2
LM311
U1
LM555
TRIG
DIS
THRESH
CTRL
GND
VCC
RES
OUT
C1
0.1uF
C5
0.1uF
R5
910
R9
10k
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