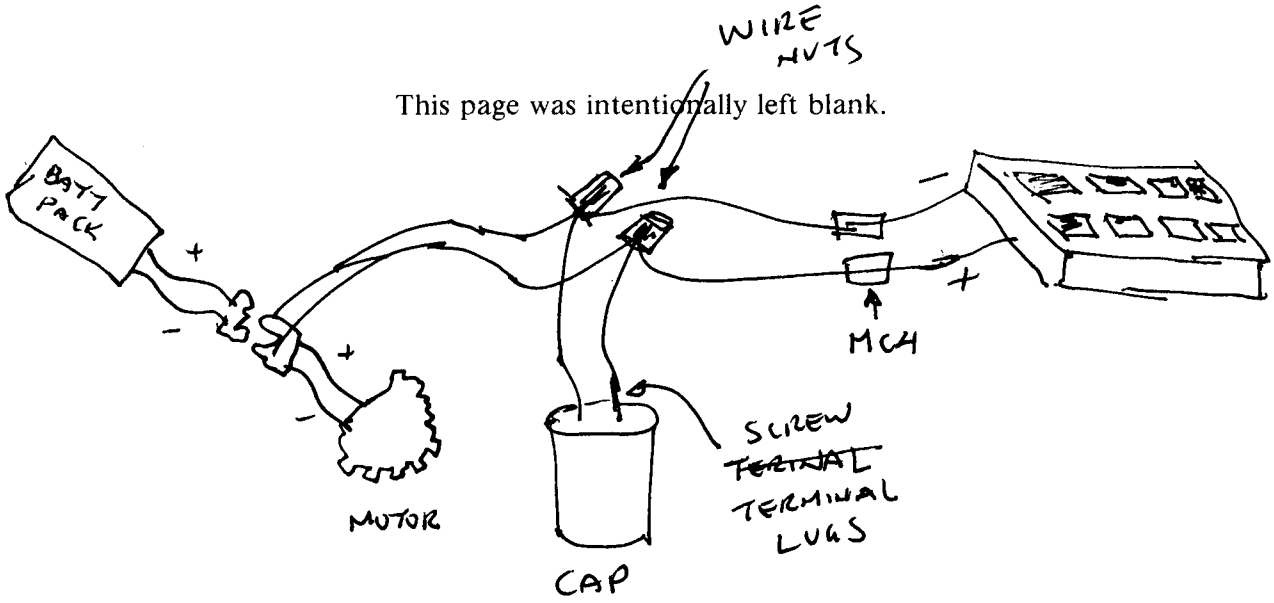
11-MAY-2014; Roderick. MOTHER'S DAY.

Vanguard®

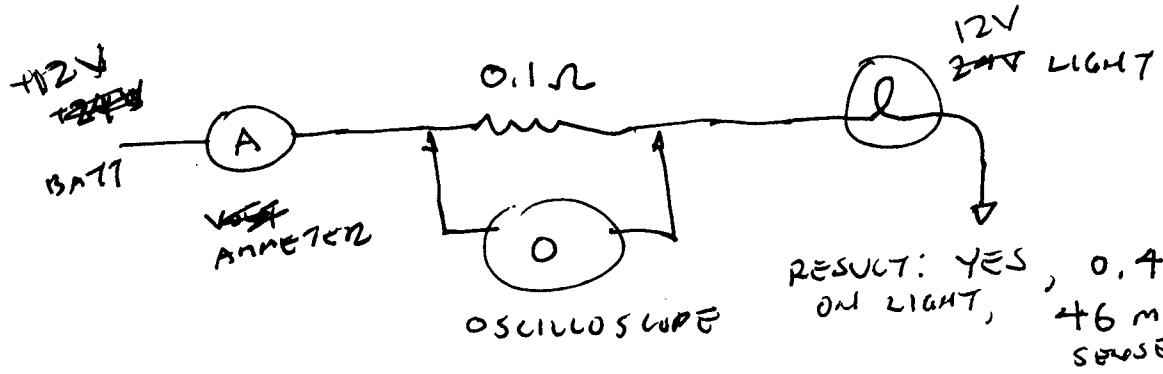
BIKE MOTOR WON'T RUN OFF SOLAR PANEL DIRECTLY - IT JUST TWITCHES. MAYBE PANEL DOESN'T HAVE THE SURGE CURRENT NEEDED TO START THE MOTOR? WILL TRY PARALLELING A CAPACITOR WITH THE PANEL. GOT 5 ELECTROLYTIC CAPS AT ELECTRONIC FLEA MARKET, 5/$1. GOT ANOTHER, 20,000μF @ 40V, FOR $1.



MAKE TERMINAL LUGS + WIRE

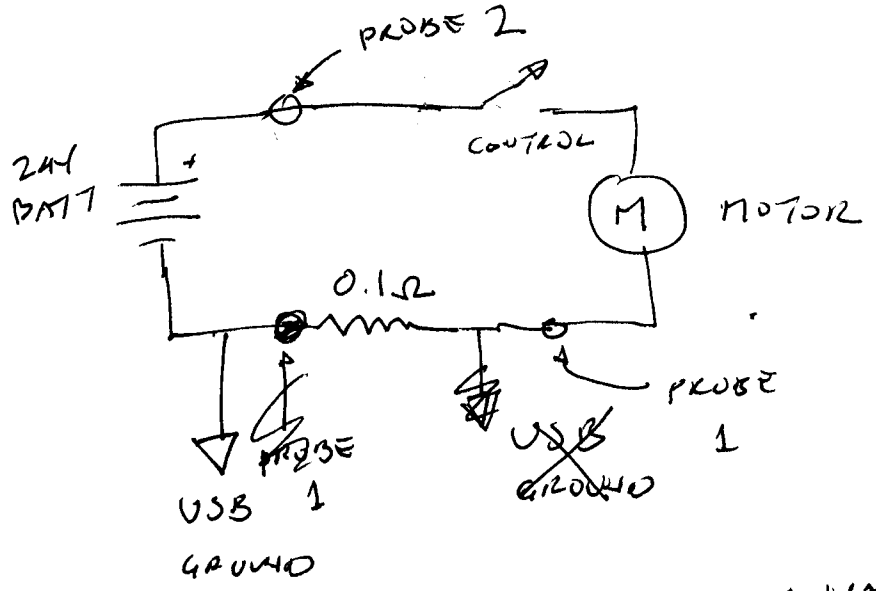
12MAY14; Roderick.

HOOKED UP 20,000nF CAP IN PARALLEL W/ SOLAR PANEL. WHEEL GIVES A LITTLE STRONGER KICK, BUT WON'T START. ABOUT 30V ACROSS CAPACITOR. FROM ~~PLOTS BEFOR~~ SCOPE TRACES BEFORE, DIP IN VOLTAGE APPEARS TO LAST A FEW SECONDS WHEN MOTOR STARTS UP FROM BATTERY. WILL HAVE TO PUT SMALL SERIES RESISTOR TO MEASURE CURRENT.



RESULT: YES, 0.47A DRAW ON LIGHT, 46 mV ACROSS SENSE R.

10A = 1V DROP TO CALIBRATE SENSE RESISTOR.



CAN TAKE VOLTAGE & CURRENT TRACE TO DETERMINE STARTUP POWER NEEDS W/ RESPECT TO TIME.

THEN CAN SEE WHAT CAPACITANCE IS NEEDED.

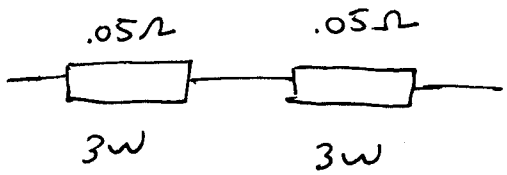
RESULT: ALMOST 50A SURGE WHEN MOTOR FIRST STARTS.

→ SHOULD TRY VOLTMETER ACROSS SENSE RESISTOR TO SEE RUNNING CURRENT UNDER ACTUAL ROAD CONDITIONS.

15 MAY 14; Roderick,

CLEARLY, 50F ULTRACAPACITOR WOULD BE ENOUGH TO START MOTOR. BUT NOW I'M STARTING TO WONDER WHETHER THE PANEL CAN SUSTAIN ~~P~~ AVERAGE POWER TO THE MOTOR ON ITS OWN. THAT WOULD BE A REQUIREMENT TO RUN BATTERYLESS.

ON STAND, MEASURED 164 mV AT TERMINAL VELOCITY ⇒ 1.64 A



THE SENSE RESISTOR I MADE TO MEASURE START-UP ~~S~~ SURGE BURNED UP UNDER ACTUAL ROAD CONDITIONS.

SUPPOSE 50A DRAWN.

$P = I^2R = 50^2 \times 0.1 = 250\ W$

NO WONDER ONE SIDE LITERALLY EXPLODED. I HAVE MORE OF THESE RESISTORS - COULD PUT 3 IN PARALLEL, FOR 0.017 Ω, 9W. WOULD STILL HAVE 42.5 WATTS THROUGH IT AT 50A.

CAN USE PLAIN #12 WIRE: 0.00159 Ω/FT. IF USE 2 FEET, THAT'S 3.2 mΩ. AT 50A, 8W. CHECKED W/ CRUISING CURRENT ON STAND, CONSISTENT W/ 3.2mΩ CAN'T MEASURE ON METER.

RESULTS; NO TRAILER, UPHILL (SLIGHT) ON RAINBOW DR.

START: 128 mV → 40A (NO PEDALING)

5 SEC: 100 mV → 31 A

7 SEC: 75 mV → 23A

10 SEC: 50 mV → 16A

EQUILIBRIUM: 42 mV → 13A

DOWNHILL ON RAINBOW - SAME STARTUP CURRENT, FINAL EQUILIBRIUM 35 mV → 11A

15MAY14; Roderick,

ROAD EXPERIMENTS CONTINUED POWER DRAW

RAINBOW DR - UPHILL NO TRAILER - WITH PEDALING -

TERMINAL VELOCITY IN 5 SECONDS

PEDAL WHILE CRUISING - 10mV

DOWNHILL -

TERMINAL VELOCITY IN 3 SECONDS.

PEDAL WHILE CRUISING - 5-10 mV

↳ SAME AS ON STAND.

WITH TRAILER ON RAINBOW (NO PEDALING)

UPHILL - LONG ACCELERATION AT 110 mV

TERMINAL VELOCITY @ 56mV

WITH TRAILER DOWNHILL (NO PEDALING)

TERMINAL VELOCITY @ 30 mV REACHED FAIRLY QUICKLY.

17MAY14. LOOKS LIKE PANEL CANNOT SUSTAIN MOTOR EVEN AT CRUISING VELOCITY. LET'S SAY 43mV, AVERAGE OF UPHILL/DOWNHILL, IS DRAWN.

$\frac{.043}{.0032} = 13.4A$ IF THAT'S AT 23 VOLTS, THAT'S 308 WATTS. PANEL IS 215 AT BEST, NOT COUNTING LOSS IN CONVERTER.

IF I GO WITH ULTRACAPACITOR SOLUTION, WILL STILL HAVE TO PEDAL. IN FACT, IF GO WITH BATTERY, WILL NOT BE ABLE TO CHARGE WHILE RIDING.

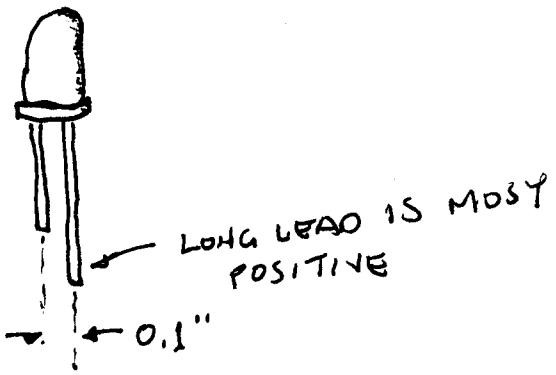
MIGHT BE ABLE TO GET MORE EFFICIENT HUB MOTOR? EVEN IF GO SLOW, COULD SUSTAIN MOTION.

19MAY14; Roderick.

LED FOR FLASHERS.

GOT LS33-NEUSC-8D 12 cd LED'S FROM HALTED, 99¢ EACH, RED.

MEASURED
$V_F = 2.02V$
@ $I_F = 12.7mA$



USE PUSH-ON CONNECTOR, SO CAN CHANGE BURNED-OUT LED IF NEEDED.

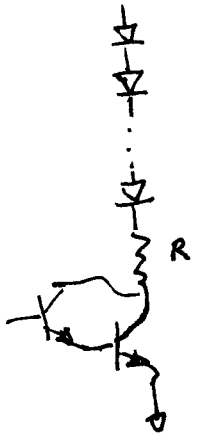
AIM FOR WORST-CASE $I_F = 20mA$

8 LED'S IN SERIES : $8 \times 2.0 = 16V$

USING DARLINGTON DRIVER, SATURATION VOLTAGE = 1.0V

FULLY CHARGED BATTERY = 30V

30 - 16 - 1 = 13 VOLTS ACROSS DROPPING RESISTOR.



$R = \frac{E}{I} = \frac{13}{.02} = 650\Omega$

POWER = $13 \cdot .02 = .26 W$

USE $4 \times \frac{1}{8} W$ (1206) RESISTOR IN PARALLEL (MORE FAIL SAFE)

2.61 kΩ EACH.

ACTUALLY, FLASHER DUTY CYCLE IS 50%, SO POWER IS LESS, BUT NEVER KNOW, MIGHT WANT TO HAVE LIGHTS GO SOLID ON.