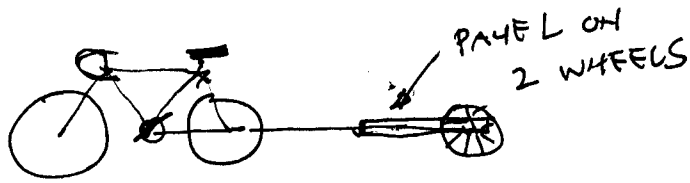
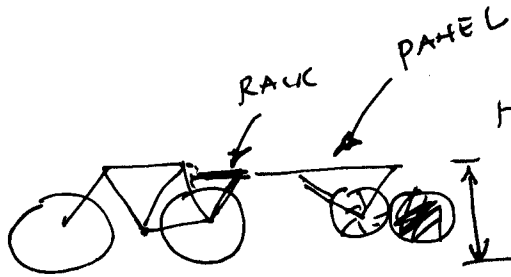


05-APR-13



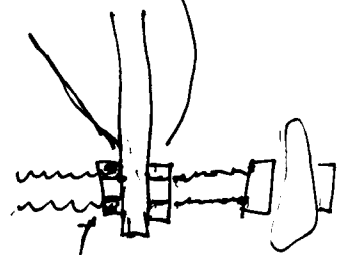
FAR FROM BIKE  
TO AVOID  
SHADOWS

CAN GET ALUMINUM  
ANGLE STOCK @  
HARDWARE STORE  
FOR TRAILER



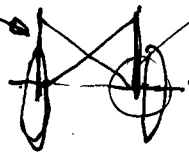
HIGH OFF GROUND  
TO AVOID  
SHADOWS

NOTES &  
LOCKWASHERS



ROD SHOULD  
NOT SPIN -  
WOULD WEAR  
AWAY HOLE

ANTI-SWAY  
BRACING



STEEL THREADED ROD  
ALL THE WAY THROUGH

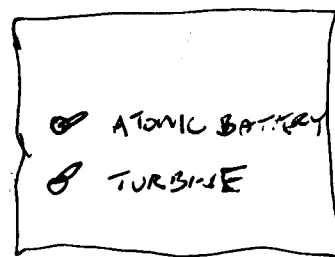
SUDDEN DROP IN  $V_{BAT}$   $\rightarrow$  ENTER CONSTANT VOLTAGE OUTPUT

SUDDEN SPIKE IN  $V_{BAT}$   $\rightarrow$  EXIT CONSTANT VOLTAGE OUTPUT

$V_{BAT} > V_{FLOAT}$   $\rightarrow$  100mA TRICKLE (50mA?)

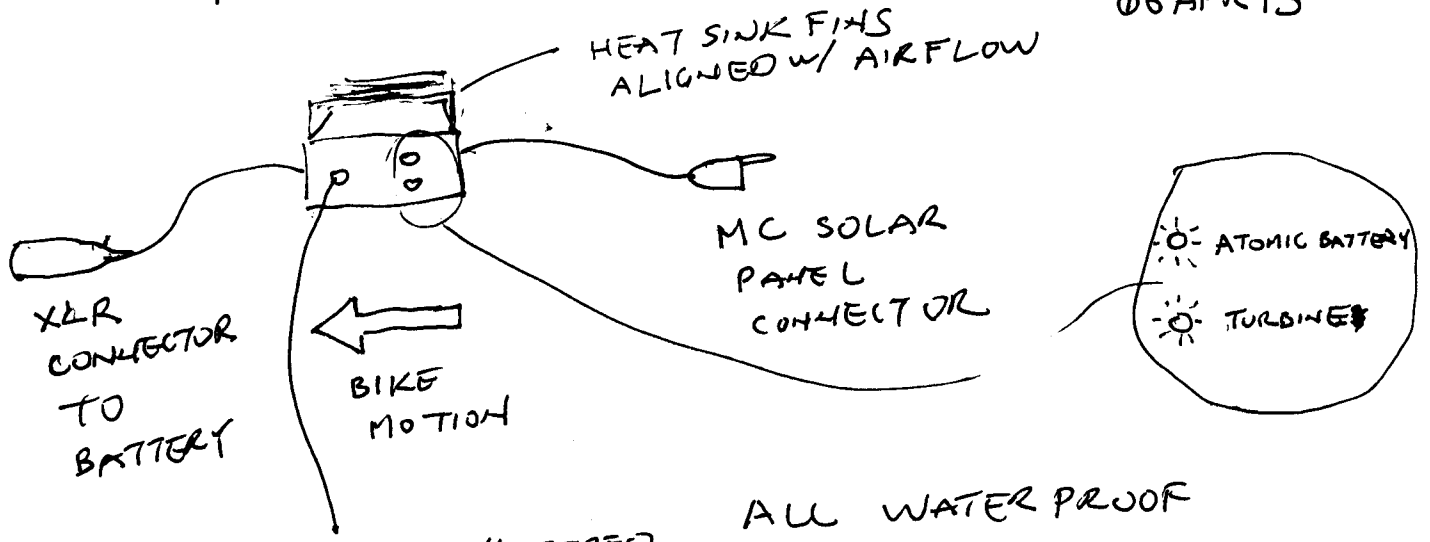
$V_{BAT} < V_{FLOAT}$   $\rightarrow$  2A

BUTTON - FORCE MPPT OUT  
"TURBO"



# POWER TRANSFER CONTROLLER

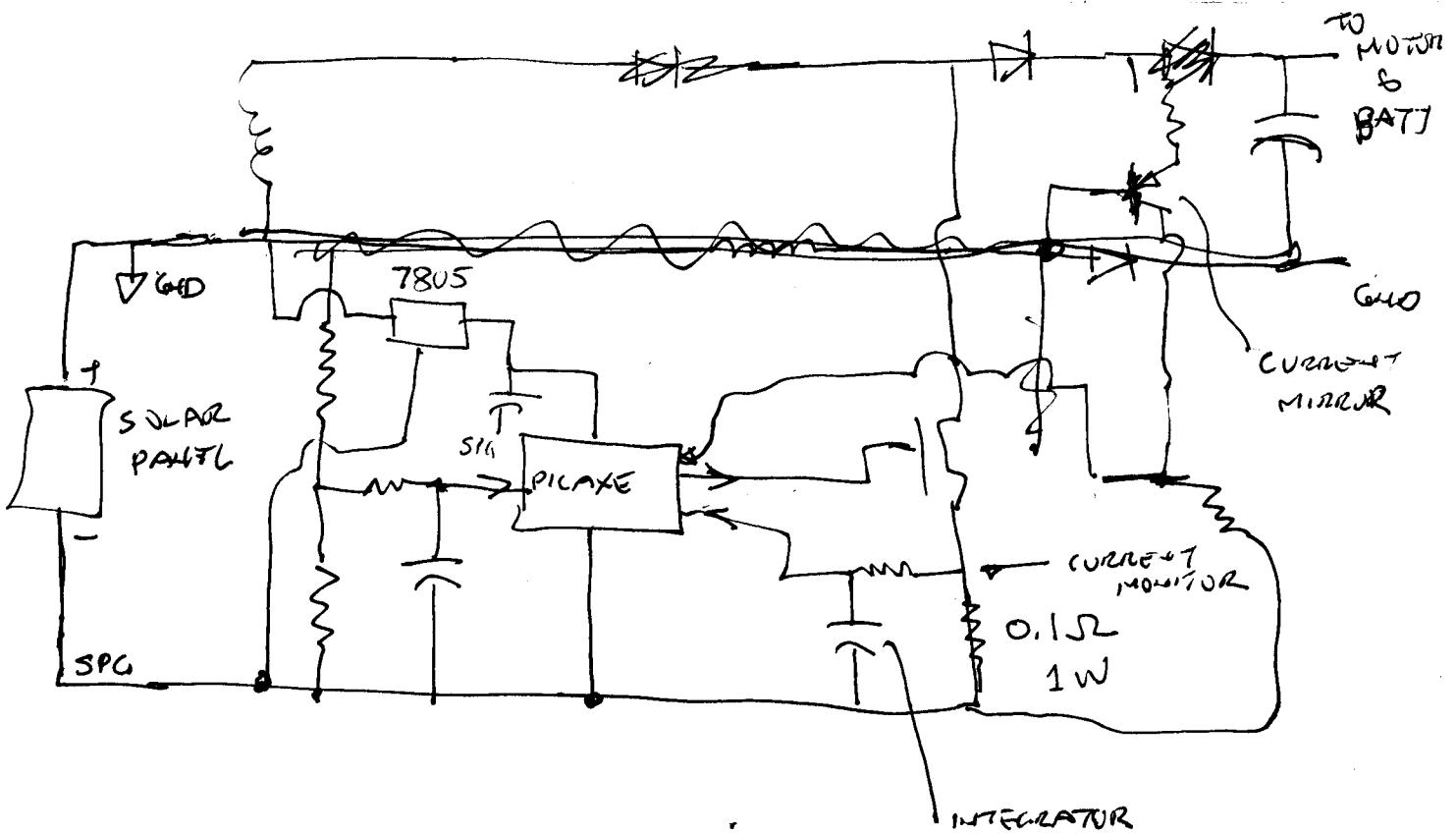
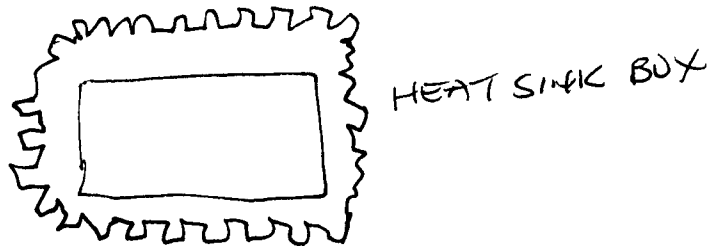
06 APR 13



BIKE MOTION

ALL WATER PROOF

5 SECOND DELAY AFTER POWERUP  
TO ALLOW POSSIBLE RESET &  
REPROGRAMMING



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### PICAXE

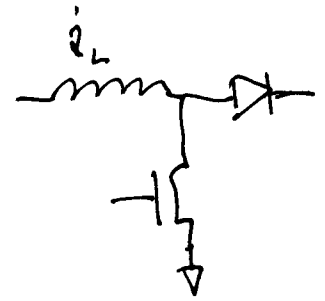
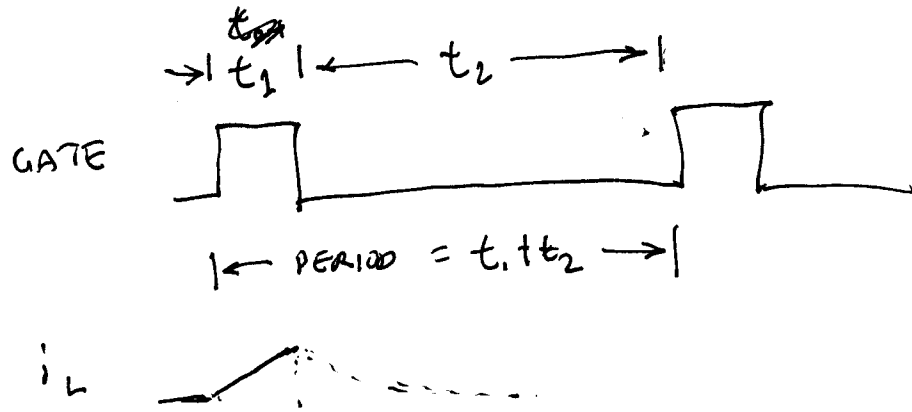
IN - SP CURRENT  
 SP VOLTAGE  
 BATT - MOTOR VOLTAGE

OUT - PWM  
 SERIAL DISPLAY?

SP VOLT BELOW MINIMUM  
 FOR PICAXE SUPPLY,  
 STOP DRAWING POWER.

07-APR-13

Roderick.



$$V = L \frac{di}{dt}$$

$$i_L = \frac{V}{L} t_1$$

ENERGY =  $\frac{1}{2} L i^2 = \frac{1}{2} L \frac{V^2}{L^2} t_1^2 = \frac{1}{2} \frac{V^2}{L} t_1^2$

PER PULSE

POWER =  $\frac{1}{2} \frac{V^2}{L} t_1^2 \cdot \frac{1}{t_1} \cdot \frac{t_1}{t_1 + t_2}$

↑  
DUTY CYCLE

↑  
FREQUENCY

↑  
DUTY CYCLE

IF  $t_1$  IS SMALL COMPARED TO  $t_2$ , SIMPLIFY TO

$$\text{POWER} = \frac{1}{2} \frac{V^2}{L} \frac{t_1^2}{t_2}$$

→ BEST CONTROL OF POWER IS BY TUNING  $t_2$ , SINCE  $t_1$  OBEYS SQUARE LAW.

BUT PULSAR CAN'T DIRECTLY CONTROL  $t_1, t_2$  -  
 CAN ONLY CONTROL PERIOD  $(t_1 + t_2)$  & DUTY CYCLE. AT TIME  $t_1$ ,  
 SO BEST CONTROL IS TO PRESERVE DUTY CYCLE & AT TIME  
 ALTER PERIOD. FOR 50% DUTY CYCLE, EXCEPT TRICKLE CHARGE.

07 APR 2013

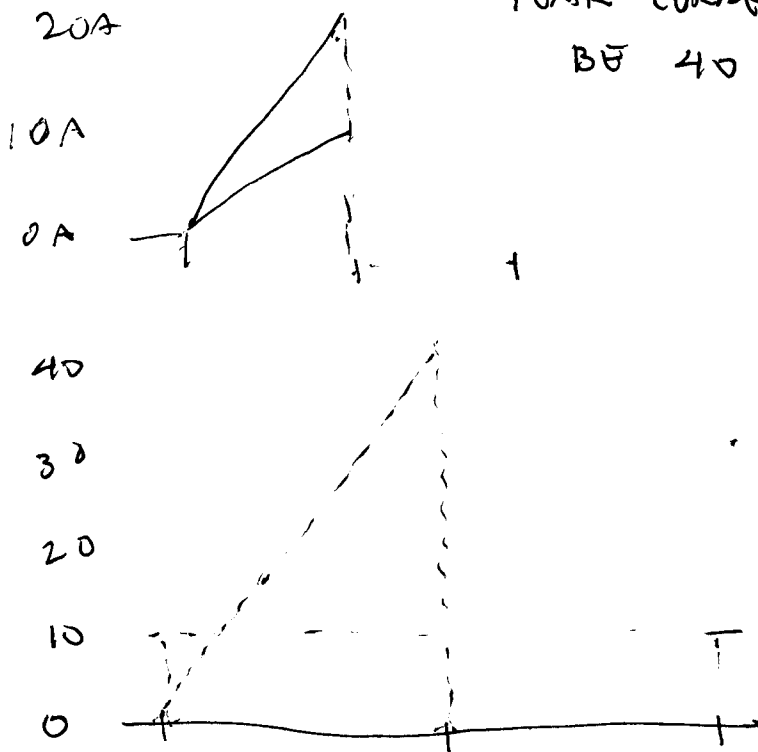
Roderick.

SHOULD CHOOSE  $L$  FOR POWER TRANSFER SO THAT  
~~200~~ 250W POWER RATE POSSIBLE AT 50%  
DUTY CYCLE, MODERATE FREQUENCY.

FREQUENCY SHOULD NOT BE SO HIGH THAT DO  
NOT HAVE 1% CONTROL OVER PERIOD. IDEALLY,  
PERIOD SHOULD BE HALF-SCALE FOR PARAMETER,  
I.E. IF IT'S 0..255, CHOOSE 128, 0..1023,  
CHOOSE 512.

IF SOLAR PANEL CAN SUPPLY 10A (HIGH ESTIMATE)

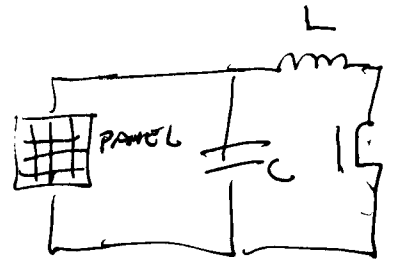
PEAK CURRENT IN INDUCTOR WILL  
BE 40A. NEED HEAVY TRACES



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pwmout pin, 199, 400.  
~~period~~ period p (0..255)  
 duty cycle d (0..1023)

32 MHz = 40 kHz FREQ,  
 50% DUTY  
 PERIOD = 25 μS



period = (p+1) × 4 × resonator period  
 duty cycle = d × resonator period

MEANS INDUCTOR MUST DEVELOP 40A CURRENT IN  
 12.5 μS WITH (SAY) 25 VOLTS ACROSS IT.

~~i~~  $V = L \frac{di}{dt}$        $25 = L \frac{40}{12.5 \times 10^{-6}}$

$$L = \frac{25}{40} \times 12.5 \times 10^{-6}$$

$$= \frac{25 \times 100}{40 \times 8} \times 10^{-6}$$

$$\approx 8 \mu H$$

```

      7.8
32)250
  224
  ---
   26
   25.6
   ---
    .4
  
```

WANT FREQUENCY AS HIGH AS POSSIBLE + THEORETICALLY -  
 STILL NEED SAME WIRE GAUGE TO CARRY CURRENT,  
 BUT LESS TURNS MEANS SMALLER INDUCTOR PHYSICALLY,  
 MAYBE WANT MULTIPLE INDUCTORS IN PARALLEL.

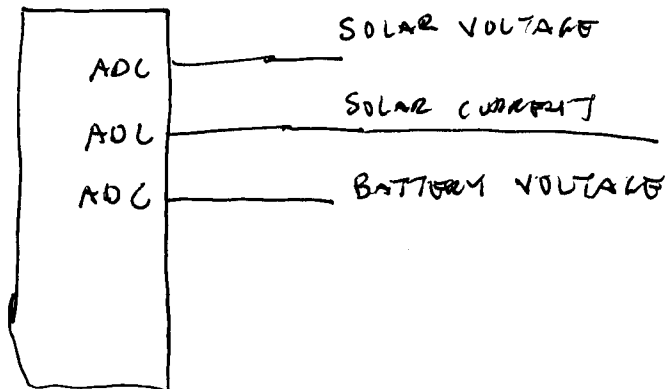
STIFFENING CAP, C. WANT DROP OF 0.1V WITH  
 AVG (30A/2) CURRENT, BECAUSE PANEL PROVIDES 10A

$i = C \frac{dv}{dt}$        $15 = C \frac{0.1}{12.5 \times 10^{-6}}$

$C = 15 \times 12.5 \times 10^{-6} = 1875 \mu F$   
 w/ 50V RATING

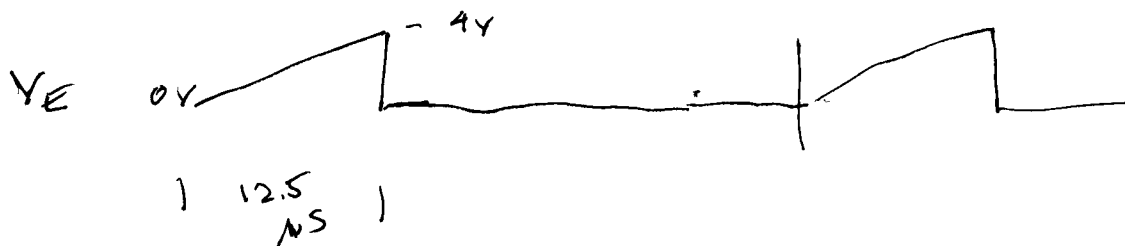
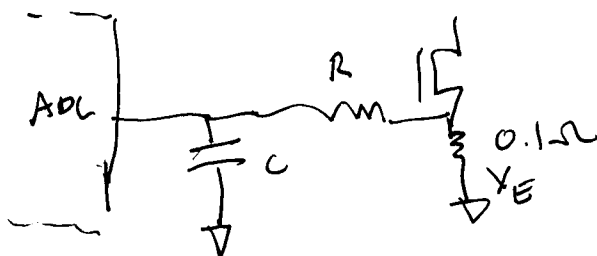
```

  125
 62.5
 ---
187.5
  
```



PIC

SOLAR CURRENT - WORST CASE  $0 \rightarrow 0 \rightarrow 4$  VOLTS  
 IF  $0.1 \Omega$  SENSE RESISTOR, AT  $40 \text{ KHz}$

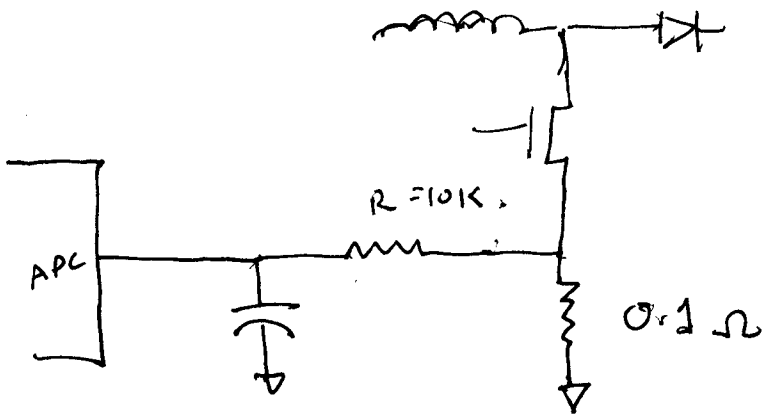


$R = 10 \text{ K}$  FOR ADC IMPEDANCE.

EXPECT TYPICAL VOLTAGE ON ADC TO BE  $0.5 \text{ V}$  AVG.  
 IF FULL-SCALE =  $4,096 \text{ V}$ ,  $4 \text{ mV}$  PER BIT.  
 COUNT = 125 FOR  $0.5 \text{ VOLT}$ .



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IF ADC = 4.096 VOLTS FULL SCALE, 10 BITS,  
MEANS 4mV / ~~count~~ COUNT. = ~~0.04A~~ 0.04A

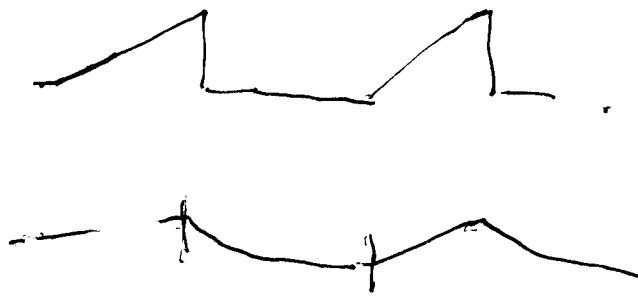
5A TYPICAL AVERAGE CURRENT  
COUNT OF 125. GRANULARITY

$$.04 \frac{125}{500} = \text{COUNT OF } 125 \quad \text{GOOD FOR 8-BIT VALUE}$$

© COUNT OF 255, CURRENT =  $\frac{255}{1020} \times 10.2 \text{ AMPS}$  NOT LIKELY.

IDEALLY WOULD LIKE TO CHOOSE R SO THAT RIPPLE AT ADC IS LESS THAN 2mV (HALF A COUNT)

~~Worst case~~ TYPICAL CASE, CAPACITOR VOLTAGE IS 0.5V, OUTPUT SWINGS FROM 2V TO 0V SUDDENLY FOR 12.5μS



$$e^{-\frac{t}{RC}} = \frac{1.98}{2.0}$$

$$-\frac{t}{RC} = \ln\left(\frac{1.98}{2.0}\right)$$

$$\frac{-12.5 \times 10^{-6}}{10^4 C} = \ln\left(\frac{1.98}{2.0}\right)$$

$$V = 2.0 e^{-t/RC} = 1.98$$

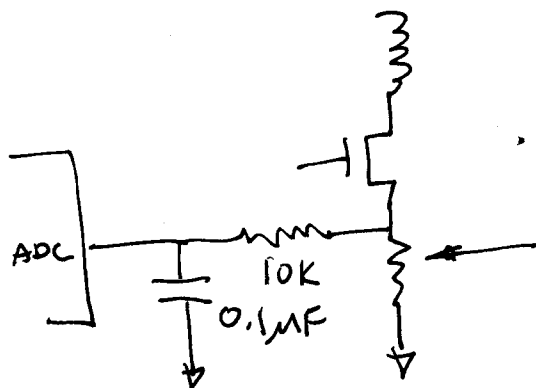
$$C = 12.5 \times 10^{-8}$$

$$= 0.125 \times 10^{-6}$$

$$= 0.1 \mu\text{F}$$

$$0.1 = \frac{12.5 \times 10^{-6}}{\ln(2/1.98)} = C$$

08 APR 13



MAY HAVE TO GO  
w/ 1.024V OR 2.048V  
REFERENCE ON ADC,  
HOPE NOISE ISN'T AN ISSUE

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WAS GOING TO USE  $0.1\Omega$ , BUT  
AT 10A AVERAGE CURRENT, THAT'S  
10 WATTS. CAN CERTAINLY GET  
POWER RESISTOR TO DISSIPATE  
THAT, BUT WHY THROW AWAY  
10 WATTS, + INCR HEAT LOAD, TOO?  
GO WITH  $0.05\Omega$ , THEN  
MUST DISSIPATE 5 WATTS,  
USE 2 X  $0.1\Omega$  FOR BETTER  
CURRENT CARRYING ABILITY. 17

09 APR 13

## 5V REGULATOR FOR SOLAR BIKE

LM340T HAS MAX 35V INPUT. DOES NOT SPECIFY DURATION.

LM2930, 2940 HAS MAX 60V INPUT, BUT AS 100ms TRANSIENT, ONLY ~~SPEC~~ SPECIFIES OPERATING VOLTAGE AS 26V. MAYBE IT ACTUALLY WOULD RUN OFF 35V.

HOW MUCH POWER WOULD BE DRAWN BY PICAXE?

SUPPOSE 100mA.

AT 35V INPUT, MEANS REGULATOR DISSIPATES

$$30V(35-5) \times 0.1 = 3W \quad \text{ONLY A SMALL HEAT SINK.}$$

SHOULD TRY PICAXE DRIVING PWMOUT AT

4MHz, 32MHz CLOCK, AND SEE ~~PICAXE~~ CURRENT DRAW

09 APR 13, IN ~~POWER~~ PCB, BE SURE TO ADD HF & LF BYPASS  
TO PICAXE.

IN GENERAL, PARALLEL DEVICES FOR BETTER CURRENT  
HANDLING CAPABILITY. PARALLEL INPUT CAPS, OUTPUT  
CAPS (MAYBE NOT), DIODES, CURRENT SENSE RESISTORS  
MAYBE MANY INDUCTORS

LOW ESR CAPS FOR INPUT FILTER