

Bike Tracker

- GPS
- Connection to upload data
 - ↳ 3G (GSM), LTE, WiFi, Satellite, others?
- Connection to PC
 - ↳ USB?
 - ↳ Bluetooth, Zigbee wireless std
- Charging
 - ↳ wall, solar, wind?
- * hobby project, NOT for biz
 - ↳ build it, see what happens
- Idea
 - ↳ hard to track bike routes accurately
 - ↳ Map My Ride, phone, others not as effective
 - ↳ could use for mass transit, walking, other routes
 - ↳ turn on, tracks your route via GPS, uploads data to net when in range (live tracking), saves to storage when not in range for later upload

- Idea (con.)

- ↳ easy to carry, long batt life, cheap
 - ↳ subscription to cell service?

- What method to upload?

- ① GSM (3G)

- established, dev kits available
 - cheaper
 - more coverage than 4G, but not satellite
 - slower?

- ② LTE (4G)

- faster, newer technology
 - less coverage
 - more expensive
 - less availability (modules avail, no easy interface) → Ask Sparkfun if modules exist 

- ③ WiFi

- fast, cheap
 - very little coverage
 - * good alt. (like cell phones)

- ④ Satellite

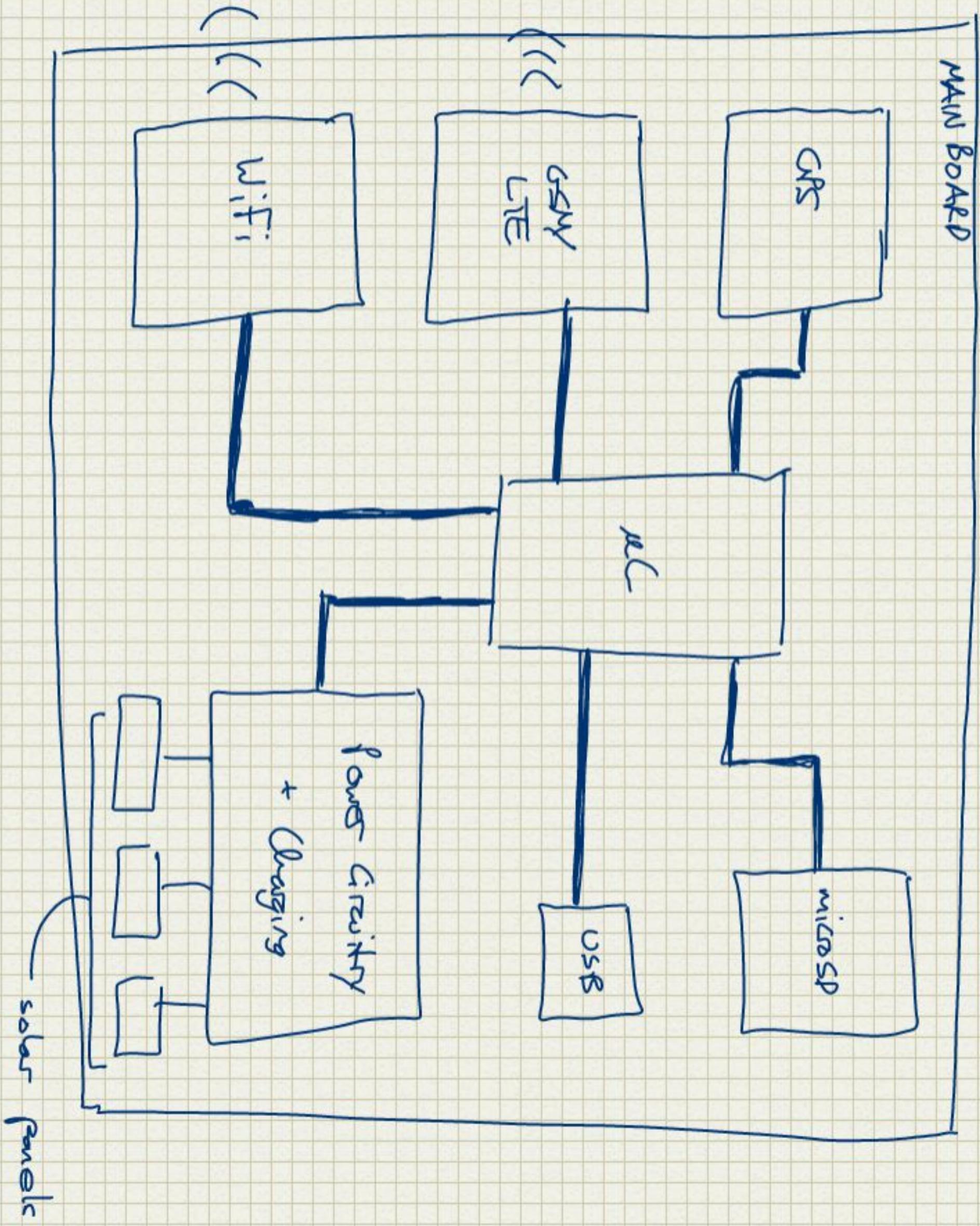
- VERY expensive, need subscription (SPOT)

④ Satellite (con.)

- best coverage by far
- could do const. live tracking 

⑤ WiMAX

- needs to research



GSM/GPS Selection

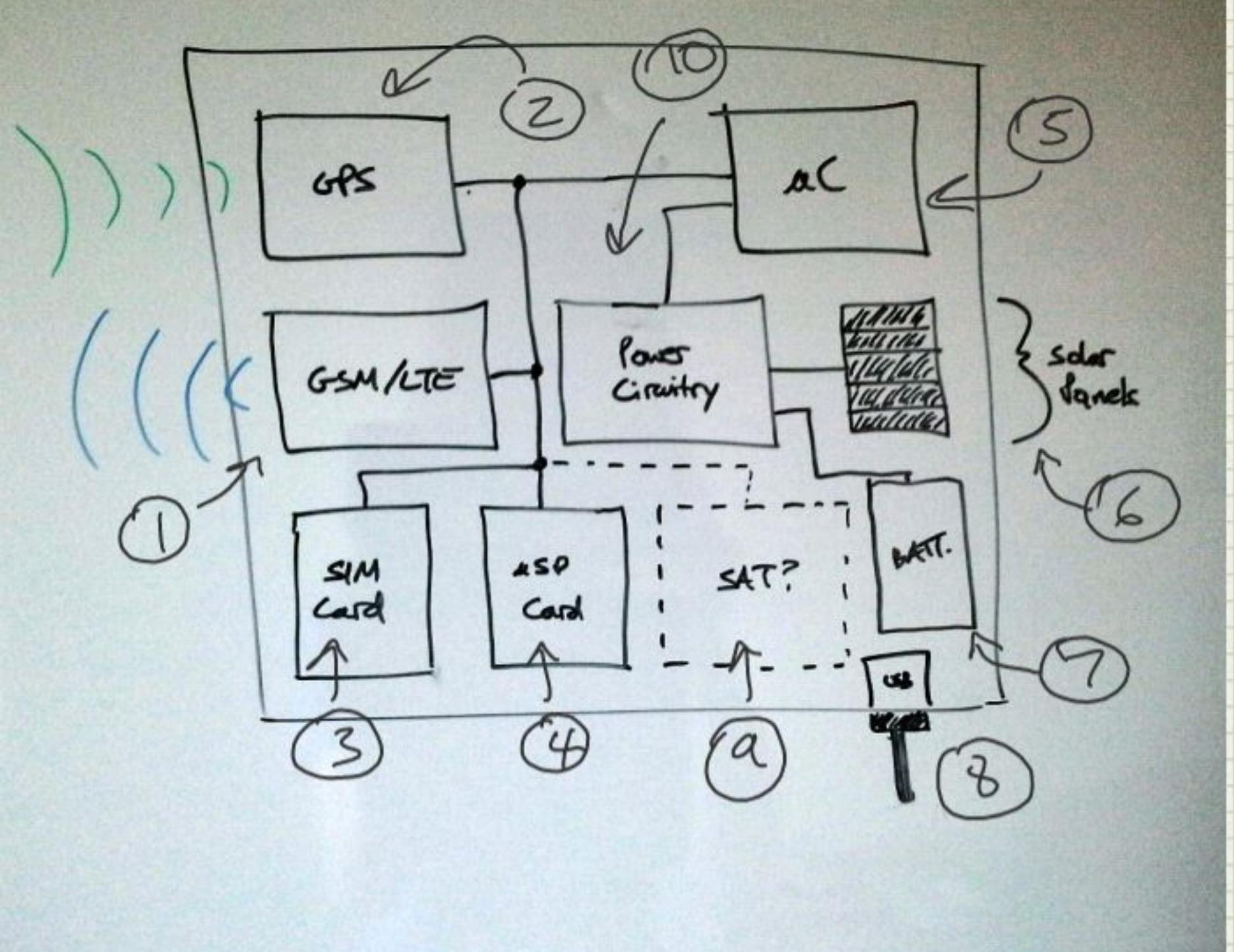
- * See Google Doc
 - ↳ power vs. function vs. cost

Project Name

- ① "Beagle", tracking app
 - ↳ "BGL" (Bike GPS Locator)
 - issues w/ domain names ("BEAGL" more free)

9/8/2012

- * Updated diagram, see next pg



Parts Needed:

- ① GSM module + Antenna
- ② GPS module + Antenna
- ③ SIM Card Holder
- ④ uSD Card Holder
- ⑤ uC
- ⑥ Energy Harvesting
- ⑦ Battery
- ⑧ USB
- ⑨ SAT Uplink (optional)
- ⑩ Power Circuity

USB

- * PLCKit 3 comes w/ prog interf (6-pin)
 - ↳ no need for USB for programmer
- used to get data fr. uC → PC
 - ↳ can be used for debug + final version for downloading data
- * need USB to serial interf.
 - ↳ both SFE, Adafruit have board w/ FT232RL
 - SFE board mainly for Arduino
 - Ada lets you pick RTS vs. DTS (reg. cable vs. Arduino) → use theirs
 - ⊗ needs 4-5.25V w/o ext osc!

SD Card

- * use microSD to save space, lower power?
 - ↳ Ada has best one, breakout + shifting, LEDs
 - ↳ SD card : Amazon 8GB Class 10 card ordered

uC

- Interfaces : USB : 1.8 - 5.25V IOs, need 4 pins to uC (min)
(Spec, p. 30) : UART (Tx/Rx)
- μSD : 3.3 - 5V, need 4 pins to uC :
SPI (use HW pins)
- GSM : * need 3.7V Li-Ion battery for charging! *

batt charge?



GSM: (con) 6 sigs for GPIOs, 6 sigs for UARTo,
2 sigs for UART1, 3 AUX sigs; 5 sigs
for SPI LCD (or GPIO), 10 sigs for key pad
(or GPIO); 3.3 - 4.2^V

GPS: 3.0 - 4.3^V, need 5 sigs for UART

uC Characteristics

- Voltage: 3.3 - 4.2^V
- IOs: 45
 - ↳ 4x UART
 - ↳ 2x SPI (1 for LCD)
- Needs processing power for GPS

September 12, 2012

uC Choices

- TI (430)
 - Microchip
 - ↳ check out low pwr (XLP) versions
- ② What arch? (8/16/32b)
- ↳ AN1373, uses PIC32 MCU to dev. GPS, GSM (PIC32MX..)
 - ↳ in conjunction w/ M2M daughter board, also 32
 - use u-blox parts! (\$200)
 - ↳ some forum posts using 16-bit

Candidates

- ① PIC24F
- ② ~~MSP430F5xx~~ (skip TI)
- ③ PIC32MX
- ④ PICXL PIC24F

Criteria

- # IOs
- Voltage Range
- Power Consumed
- Price
- Core Size / Speed
- 4 UARTs, 2 SPI intfs
- RAM Size
- Flash Memory Size
- Plug

* See MCU Selection in Google Docs

- NOTE: PIC32 doesn't support > 2 UARTs!
- MSP430 F5xx also doesn't support > 2 (some 3)
- dsPICs also don't support > 2 (+ 24H)

UART issues

- 2 needed for sure (GSM, GPS)
- 1 for USB → UART intf
 - ↳ bit borg? have integrated USB
- 1 for 2nd intf on GSM → mainly for debug, simple intf → can get away w/ 



Other Notes

- RAM size not a concern, copy data off to SD card (time hit?)

* Check prog mem size when compile code

↳ Conclusion: for now, go w/ reg PIC24F series!

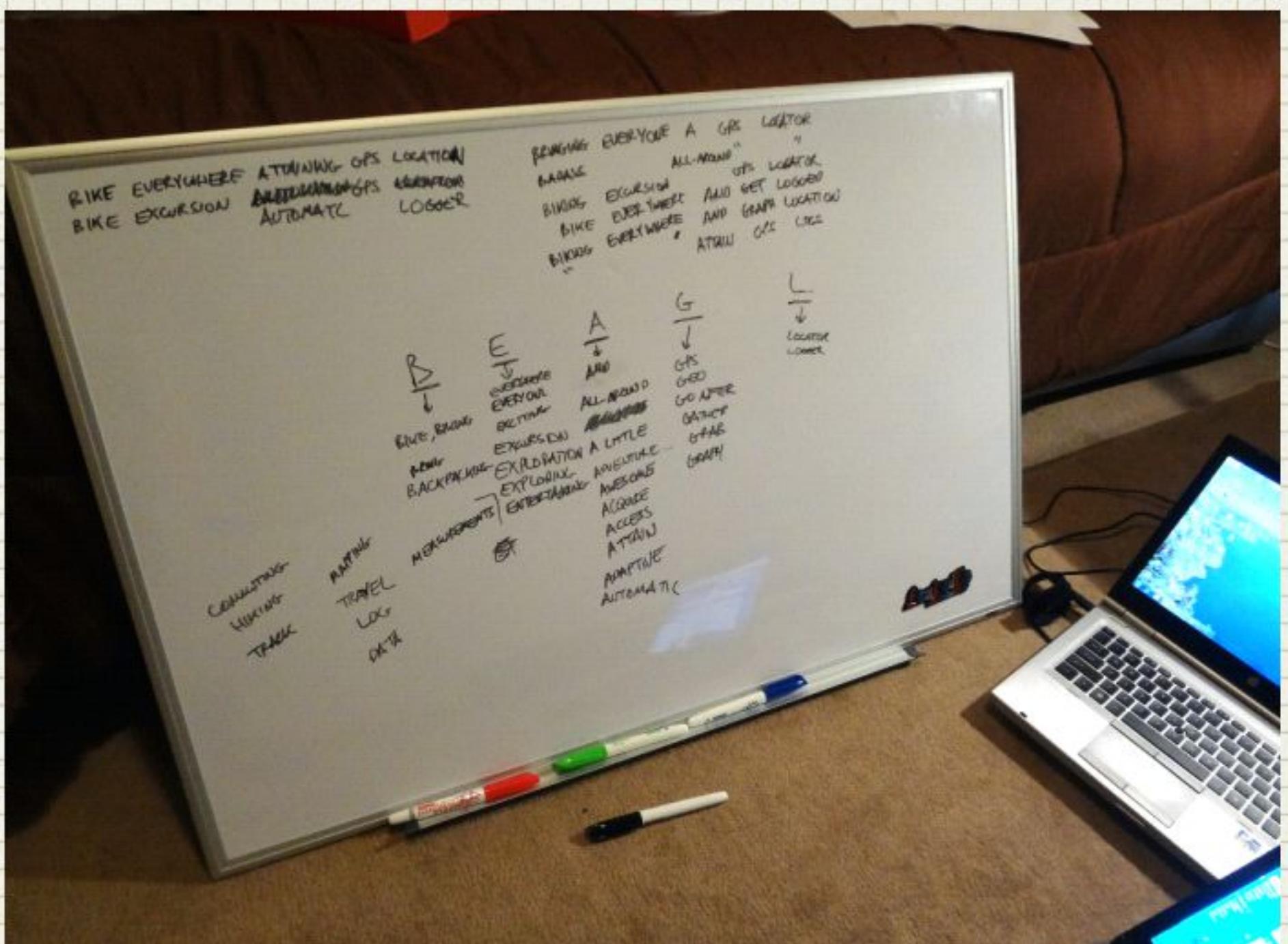
Converter Board: 64-TQFP → DIP (PA 0096)

September 14, 2012

Name

Bike Excursion Automatic GPS Logger

↳ after lots of brainstorming:



Next up

- ① Battery
- ② Charging - solar, etc?
- ③ Power Control/Supply

- once all main components selected, read specs for pwr, discrete req's
 - ⌚ fully understand, wire; test each sys one at a time for running all.

September 16, 2012

Discrete Parts

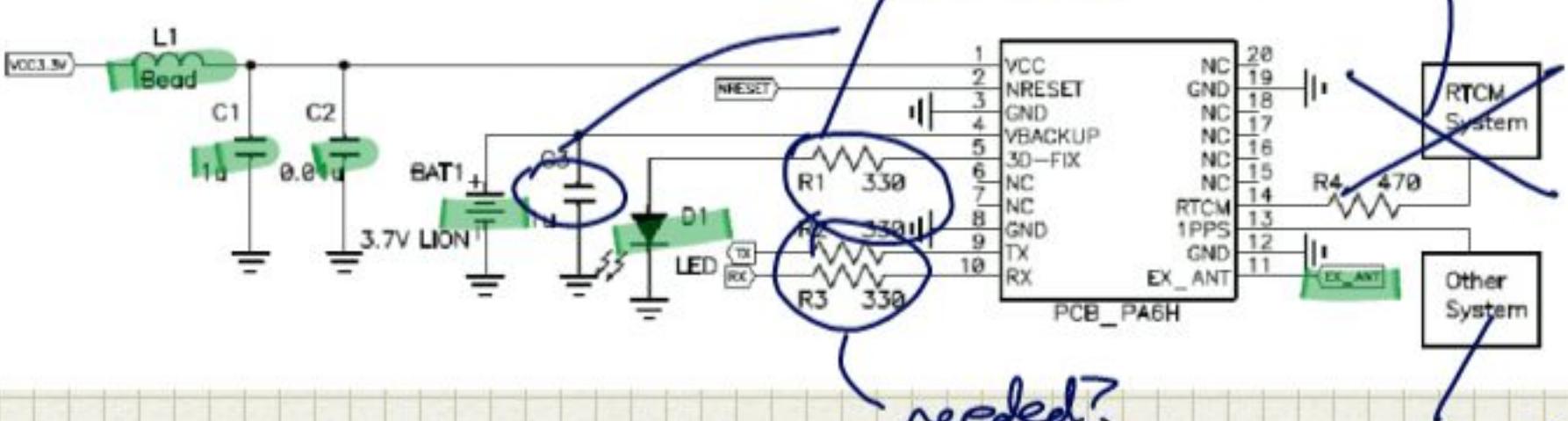
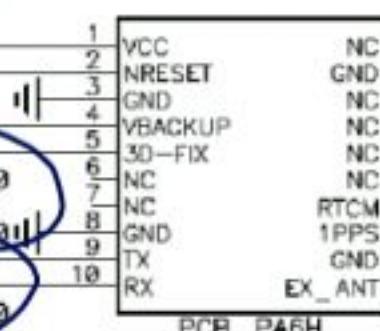
- ea dev req's add'l parts

① GPS

↳ Reference design, spec p. 26

↳ w/ breakout board, don't need everything

not incl'd by default



↳ Parts: 2x 330Ω R's, 1x 1uF Cap, LED

② GSM

↳ Reference design, spec (HW and datasheet)

→ keypad not conn'd, SIM all wired

→ mic avail, not using

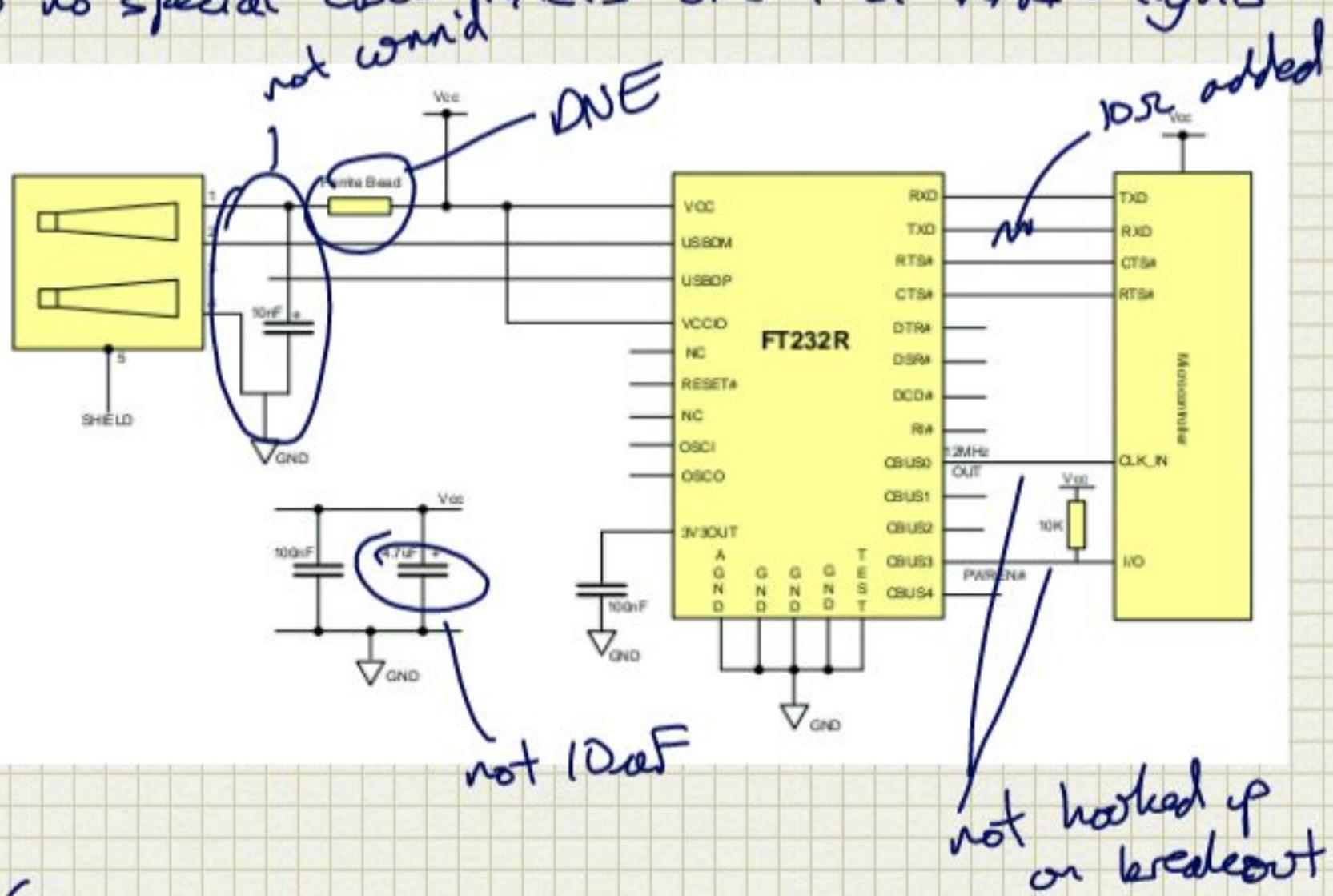
- RTC batt not hooked up; neither is VCHG
- ⌚ looking at components needed now (not w/ real version)
- no VBAT, NETLIGHT (GPIO26)
- fancier SW circuit, not using w/ breakout

③ μSD

- ↳ good to go (see tutorial site)
- ↳ use sch for final proj

④ USB

- ↳ using it as UART (Spec, p. 30 for uC com's)
- ↳ no special CBUS funct's other than TX/RX lights
not weird



⑤ μC

- ↳ see diag, p. 31
- ↳ need: 6x 0.1μF, 20V ceramic, 10μF 63V ceramic, 10k, 100-470R
- * section 2

↳ MCLR: 1x 10k (or less), 1x 470R (or less), jumper (for prog modes)

↳ ENVREG: will be using pin ($3.3 \rightarrow 1.8^{\circ}$)
→ needs a $10\mu F$ 6.3V ceramic

Parts List

2x 330 Ω Resistor

= should have in SCA

1x 1uF Capacitor

1x UEP

6x 0.1uF, 20 $^{\circ}$ ceramic capacitor

1x 10uF, 6.3 $^{\circ}$ ceramic capacitor

1x 10k Ω Resistor

1x 100-470R Resistor

1x jumper

→ use wire on breadboard

1x 10uF, 6.3 $^{\circ}$ Ceramic Capacitor

Final Order

① uC

② converter board

* Next up: power!

September 25, 2012

Solder Paste

- See instructable on Porkbot
 - ↳ solder paste : Stencils Unlimited, Pb-free no clean → used card to apply
 - ↳ stencils : Pololu w/ Eagle gerbers
 - ↳ hotplate : std fr. store
→ might want temp ctrl or dev own sys
- * Article : extreme SMT soldering
- for TQFP, need to run header pins on bot first OR order new board
- use TQFP for Microchip uC, need to use Ultra Lilorian (win tool) to gen for Eagle
 - ↳ PIC24FJ256GB206-I/P
- use book to do Gerber output in Eagle, verify by viewing online (Circuit People)
- * APX portland, tutorial on making board there
- * make a generic stencil based on SMT parts, order:
 - ① TQFP - 32, 44, 64, 100 — see specs
 - ② SOIC - 8, 10, 14, 16, 18, 28
 - ③ SSOP 24, 28
 - ④ TSSOP 16, 20, 28
 - ⑤ MLCF 32
 - ⑥ QFN 20, 24, 28, 32, 36, 64

μ C: TQFP-64 ✓ (Microchip lib)

USB: SSOP-28 ✓ (SF lib)

GPS: custom ✓ (Adafruit lib)

GSM: custom 60-pin conn ✓ (SF lib)

September 27, 2012

Power Distribution

GSM: 3.3° - 4.2° @ $\geq 1A$ MAX (3.6° typ)

↳ must guarantee 3.3° min during lowest ($+50\text{mV}$ drop)

→ cellular shield regulates to 3.8°

GPS: 3.0° - 4.3° (ripple below 50mVpp) (3.3° typ)

@ $\geq 5\text{mA}$

→ breakout regulates to 3.3°

μ C: 2.0° - 3.6° @ $\geq 0.05\text{mA}$ MAX

* do not use Vout of GSM as pwr input to μ C,
 $I_p = 50\text{mA}$ max!

USB: $V_{CC10} = \underline{1.3^{\circ}} - \underline{5.25^{\circ}}$ for int'l pins (μ C)

$V_{CC} = \underline{3.3^{\circ}} - \underline{5.25^{\circ}}$ @ $24\text{ mA}/IO (\times 13)$

* V_{CC} must be 4.0° when using int'l clk gen!

→ breakout switches to 3.3° or 5°

→ uses $V_{CC} = 5^{\circ}$ from USB port!

μSP : card operates at $2.7^\circ - 3.6^\circ$ @ 500mA

Summary

$$3.6^\circ \text{ @ } 2\text{A} \rightarrow 3.8^\circ \text{ @ } \underline{x} \quad 3.8x = 3.6(2)$$

$$x = \underline{1.89\text{A}}$$

(V_{reg}) 3.3° @ 25mA

$2.0 - 3.6^\circ$ @ 200mA (3.3° typ)

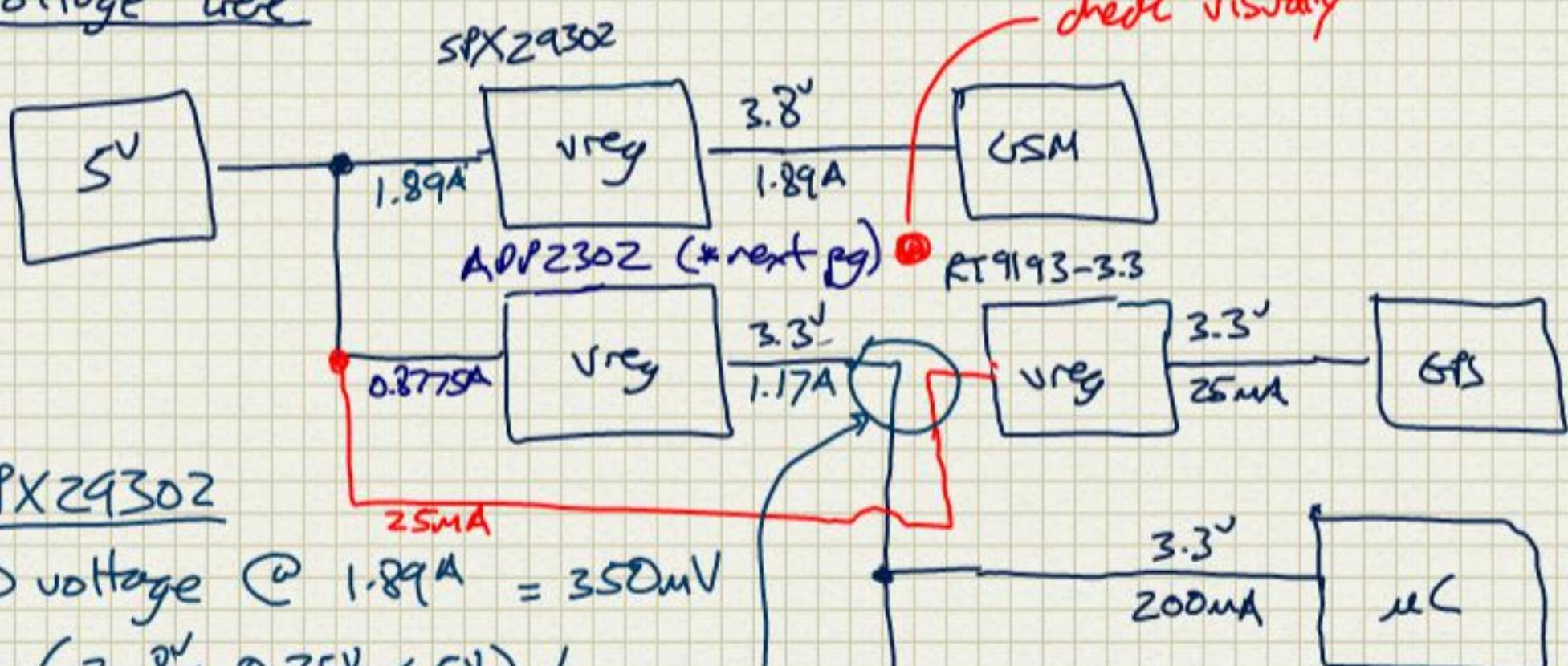
$$5^\circ (312\text{mA}) = 3.3^\circ y$$

$$y = 473\text{mA}$$

5° @ $312\text{mA} \rightarrow 3.3^\circ$ @ 473mA

3.3° @ 500mA

Voltage Tree



SPX29302

DD voltage @ $1.89\text{A} = 350\text{mV}$

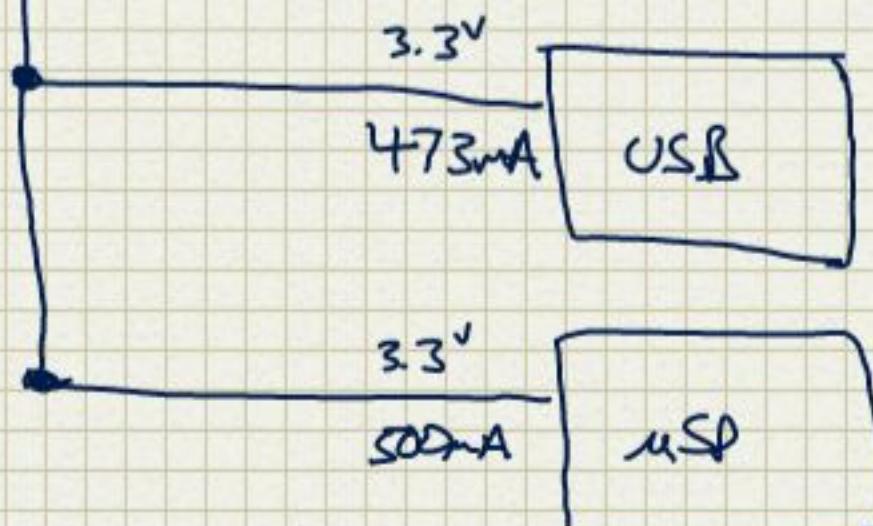
$$(3.8^\circ + 0.35^\circ < 5^\circ) \checkmark$$

RTL9193

DD voltage @ $25\text{mA} = 25\text{mV}$

~~$$(3.3^\circ + 0.025^\circ) > 3.3^\circ$$~~

$$(3.3^\circ + 0.025^\circ) < 5^\circ \checkmark$$



2A 5^v - 3.3^v Vreg

• Linear

↳ Fairchild KA278R3SC

↳ Maxim MAX85C7 (SMT)

no linear (Christie),
not efficient

• Switching

↳ Ntesemi LM2592HVT-3.3

Efficiency @ 1.17A

67% (effic.)

↳ STM A5973D

88% (comp)

↳ Semtech SC4C24C

85% (effic.)

↳ Intersil ISL8012

93% (plug)

↳ TI TPS54218

93% (comp)

↳ Fairchild FA118301

88% (comp)

↳ Rohm RPS222A33

89% (plug)

↳ Empirion EN5322QI (SMT) 92% (plug)

↳ Diodes Inc. AP15D9

78% (effic.)

↳ Analog APP2362

88%

↳ Maxim MAX1951

92% (comp)

fixed Vout, less comp's



Efficiency:

$$\eta = 38\%$$

$$V_{in} = 5^v$$

$$V_{out} = 3.3^v$$

$$I_{in} = ?$$

$$I_{out} = 1.17^A$$

$P_{out} = \eta P_{in}$

$$V_{out} \cdot I_{out} = \eta V_{in} \cdot I_{in} \rightarrow I_{in} = \frac{V_{out} \cdot I_{out}}{\eta V_{in}}$$

$$I_{in} = \frac{(3.3^v)(1.17^A)}{(0.38)(5^v)} = \underline{\underline{0.8775^A}}$$

AC Adapter:

$$5^v, I = 0.8775^A + 1.89^A + 0.025^A = \underline{\underline{2.7925^A}}$$

Need: 5^v, 3^A AC Adapter

* BATT'S! *

* ADP Parts Selection, see notes or spec!

October 2, 2012

ADP Design (use Design Ex in spec)

① Catch Diode

② Inductor

③ Input Cap

④ Output Cap

} spec part choices in spec!

Parameter	Specification
V _{IN}	5V ± 0.075V (1.5%) ← AC adapts spec, p. 1
V _{OUT}	3.3V, 2A, 1% ripple
Programmable UVLO	Connect to V _{IN}

① Diode

use Schottky, V_D = 0.45V
(spec)

$$I_{D(AN6)} = \left(1 - \frac{V_{OUT} + V_D}{V_{IN} + V_D} \right) \cdot I_{LOAD(MAX)}$$

$$= \left(1 - \frac{3.3V + 0.45V}{5V - 0.45V} \right) \cdot 2A = \underline{\underline{352mA}}$$

Choice: ANY diode in Table 7 (p. 18) would work

↳ for proto (PTH), use:

Fairchild 1N5817FSCT

② Inductor

$$L = \frac{(V_{IN} - V_{OUT})}{0.3 \cdot I_{LOAD(MAX)} \cdot f_{SW}} \cdot \left(\frac{V_{OUT} + V_D}{V_{IN} + V_D} \right)$$

$$V_D = 0.45V$$

$$f_{SW} = 700\text{kHz}$$

$$L = \frac{(5V - 3.3V)}{0.3 \cdot 2A \cdot (700 \times 10^3 \text{Hz})} \cdot \left(\frac{\frac{3.3V + 0.45V}{5V + 0.45V}}{} \right)$$

$$L = (4.05 \times 10^{-6} \text{H}) \cdot (0.683) = \underline{\underline{2.79 \mu\text{H}}}$$

Choice: ANY 2.5 - 3.5uH part in Table 8 (p.18)

↳ w/ $L = 2.8\text{uH}$,



w/ $I_{SAT} > I_{peak}$

$$\Delta I_{RIPPLE} = \frac{(V_{IN} - V_{OUT})}{L \cdot f_{SW}} \cdot \left(\frac{V_{OUT} + V_0}{V_{IN} + V_0} \right)$$

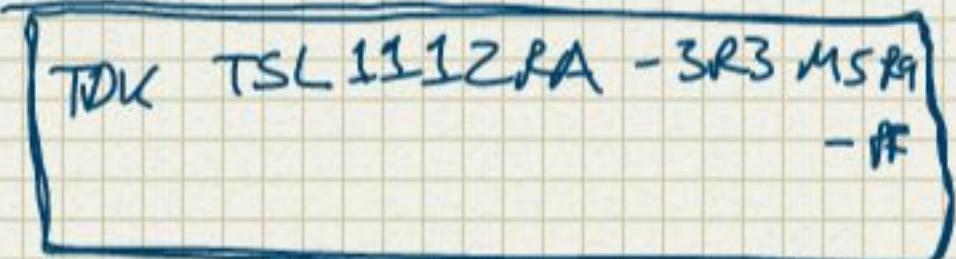
$$= \frac{5^v - 3.3^v}{2.8\text{uH} \cdot 700 \times 10^3 \text{Hz}} \cdot \left(\frac{3.3^v + 0.45^v}{5^v + 0.45^v} \right)$$

$$= \underline{\underline{597\text{mA}}}$$

$$I_{peak} = I_{LOAD(MAX)} + \frac{\Delta I_{RIPPLE}}{2} = 2\text{A} + \frac{597\text{mA}}{2}$$

$$= \underline{\underline{2.30\text{A}}}$$

↳ for proto (PTH), use:



$$\rightarrow L = 3.3\text{uH}$$

$$\Delta I_{RIPPLE} = \underline{\underline{506\text{mA}}}$$

$$I_{peak} = \underline{\underline{2.25\text{A}}} \text{ or } \sqrt{}$$

③ Input Cap

- needs to w/stand $I_{IN rms}$) as its max I_{LOAD} and max V; X5R or X7R; 10uF usu good



$$I_{W(\text{rms})} = I_{\text{LOAD(max)}} \cdot \sqrt{D \cdot (1-D)}$$

$$D = \frac{V_{\text{out}} + V_0}{V_{\text{in}} + V_0} = \frac{(3.3^v + 0.45^v)}{(5^v + 0.45^v)} = \underline{0.688}$$

$$I_{W(\text{rms})} = 2^A \cdot \sqrt{0.688(1-0.688)} = \underline{0.927^A}$$

Need: 5^v, 1^A rated cap

↳ For proto (PTH), use:

TDK FUC20X7R1C106K

④ Output Cap

$$\Delta V_{\text{RIPPLE}} = \Delta I_{\text{RIPPLE}} \left(\frac{1}{8 \cdot f_{\text{sw}} \cdot C_{\text{out}}} + ESR \right)$$

w/ L = 3.3uH :

$$\Delta I_{\text{RIPPLE}} = 506\text{mA}$$

$$\Delta V_{\text{RIPPLE}} = 33\text{mV} \quad (1\% \text{ of } V_{\text{out}})$$

$$f_{\text{sw}} = 700\text{ kHz}$$

Choose ESR = 3mΩ (spec chose, same type caps)

$$0.033^v = 0.506^A \left(\frac{1}{8 \cdot 700 \times 10^3 \text{Hz} \cdot C_{\text{out}}} + 3 \times 10^{-3} \Omega \right)$$

$$C_{\text{out}} = 2.87\text{uF}$$

Based on Table 11 (p-21), use 2x 22uF

For proto (PTH), use:

TDK FK22X7R1C226M

Cost Comparison

EVAL Board = \$60

Parts (vreg + L + in/out caps + diode)

$$\begin{aligned} &= \$2.90 + \$0.90 + 2 \cdot \$1.57 + \$0.63 + \$0.50 \\ &= \$8.07 \end{aligned}$$

$$\% \text{ difference} = \frac{\$60 - \$8.07}{\$8.07} \times 100 = \underline{\underline{644\%}}$$

(big savings ☺)

October 3, 2012

Interfacing

① Micro SD

↳ see Adafruit, generic spec

- 5^V = 3.3^V rail (3-5^V tolerant)
- SPI I/F, use HW pins (not bit banging)

"CK" → SCK

"DO" → MISO

"PI" → MOSI

"CS" → SS

- PIC, use following pins: (Ch 15 of Manual)

↳ mapped based on gPS (Section 10.4)

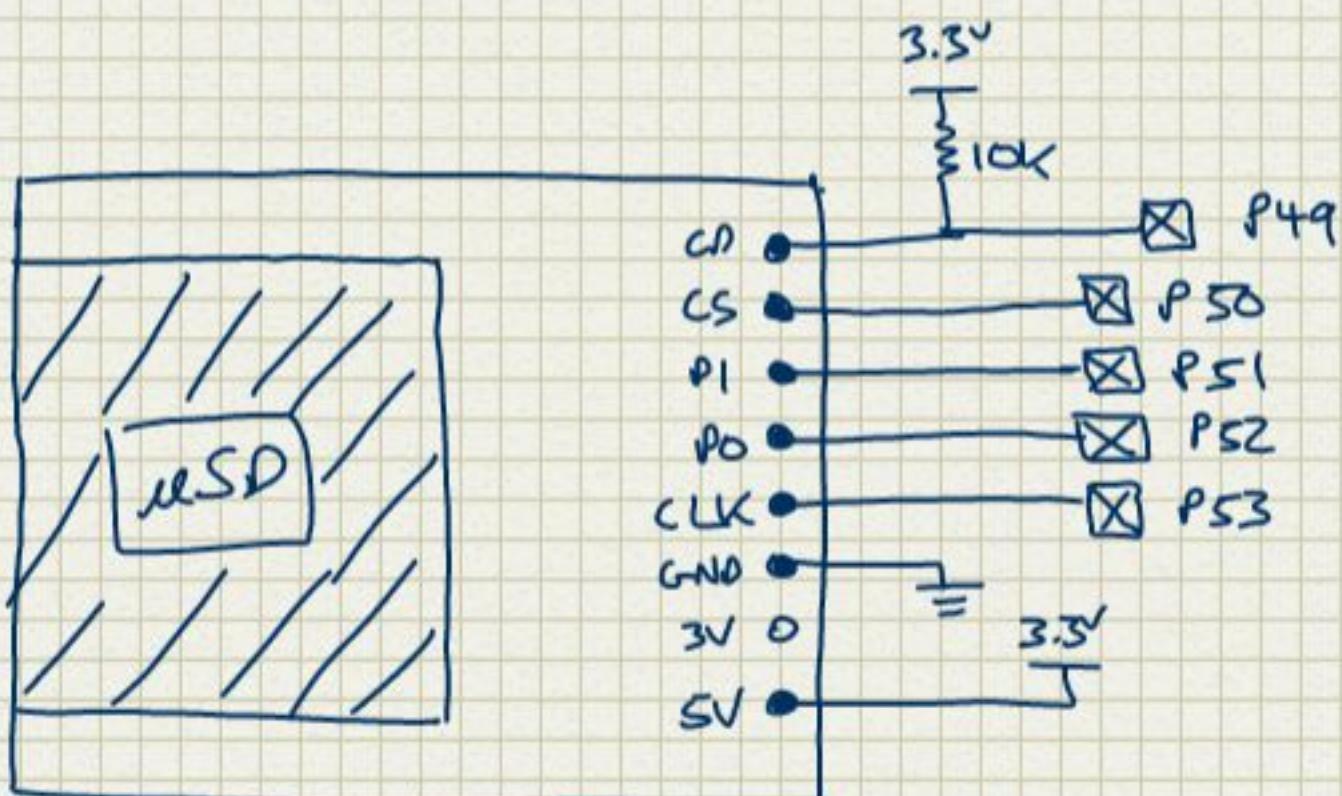
"CLK" = RP20 (P53)

"DO" = RP25 (P52)

"PI" = RP22 (P51)

"CS" = RP23 (P50)

"CD" = card detect (PO w/ short to GND
when card in) RP24 (P49)



② USB

↳ USB to uC JUART I/F (spec, p.30)

- RXD → TXD
- TXD → RXD
- RTS# → CTS#
- CTS# → RTS#
- 5 CBOS pins, conn to I/Os for extra functionality
- $V_{CC} = 3.3V$ (5V tolerant)

*not avail
for proto*

- PIC, use the following pins:
 - ↳ map based on PPS (10.4)
 - * already has USB OTG, but can use ext'l
 - * See Section 27.3 of PIC24F User Manual

↳ Fig 27.9

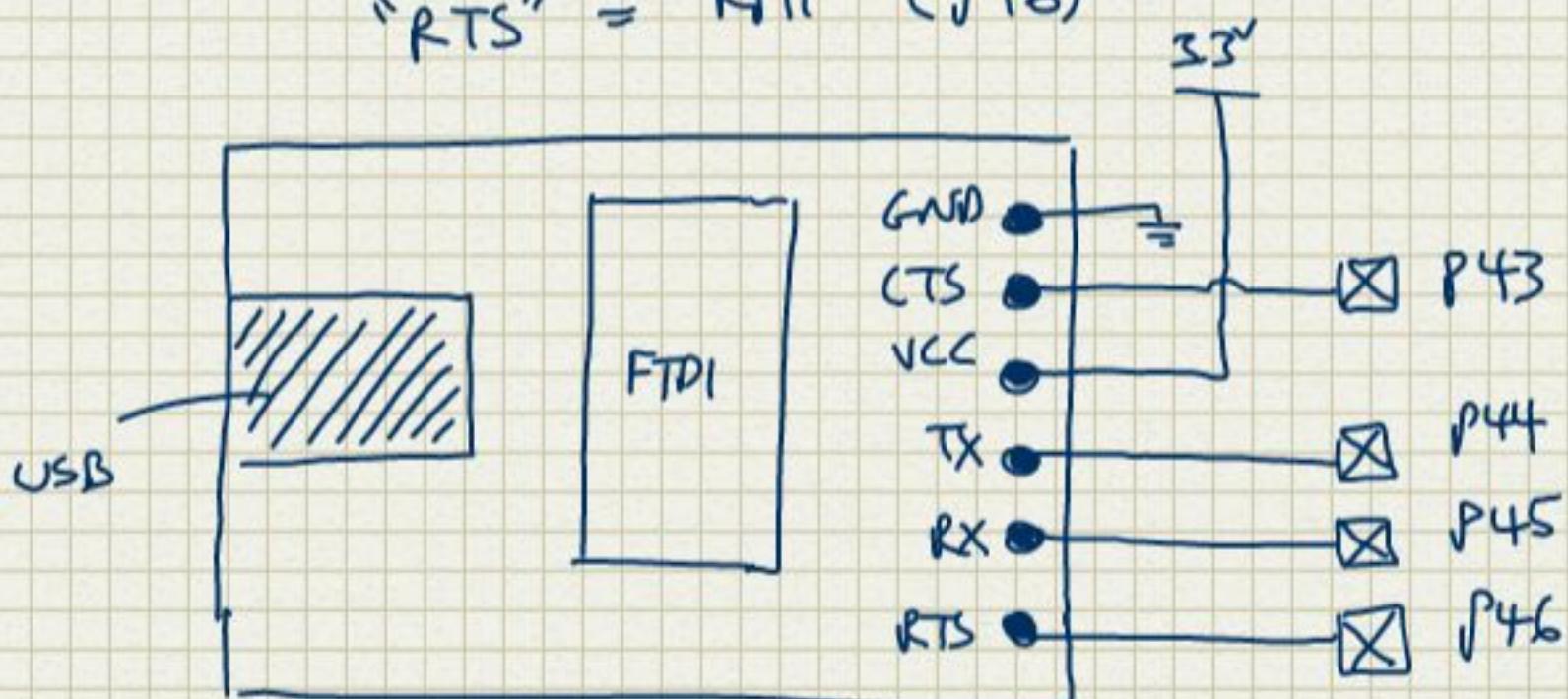
→ using USB → UART w/ UART (NOT USB)

"CTS" = RP4 (P45)

"TX" = RP3 (P44)

"RX" = RP12 (P45)

"RTS" = RP11 (P46)



→ PIC incl's CTS/RTS!

October 4, 2012

③ GSM

- proto board lacks 2nd UART, keypad, GPIOs
- SW serial or UART (jumper's)
- RESET attached to SW on shield
- conn's to UART0 TXD/RXD

* non-proto, need to re-review the doc'n !

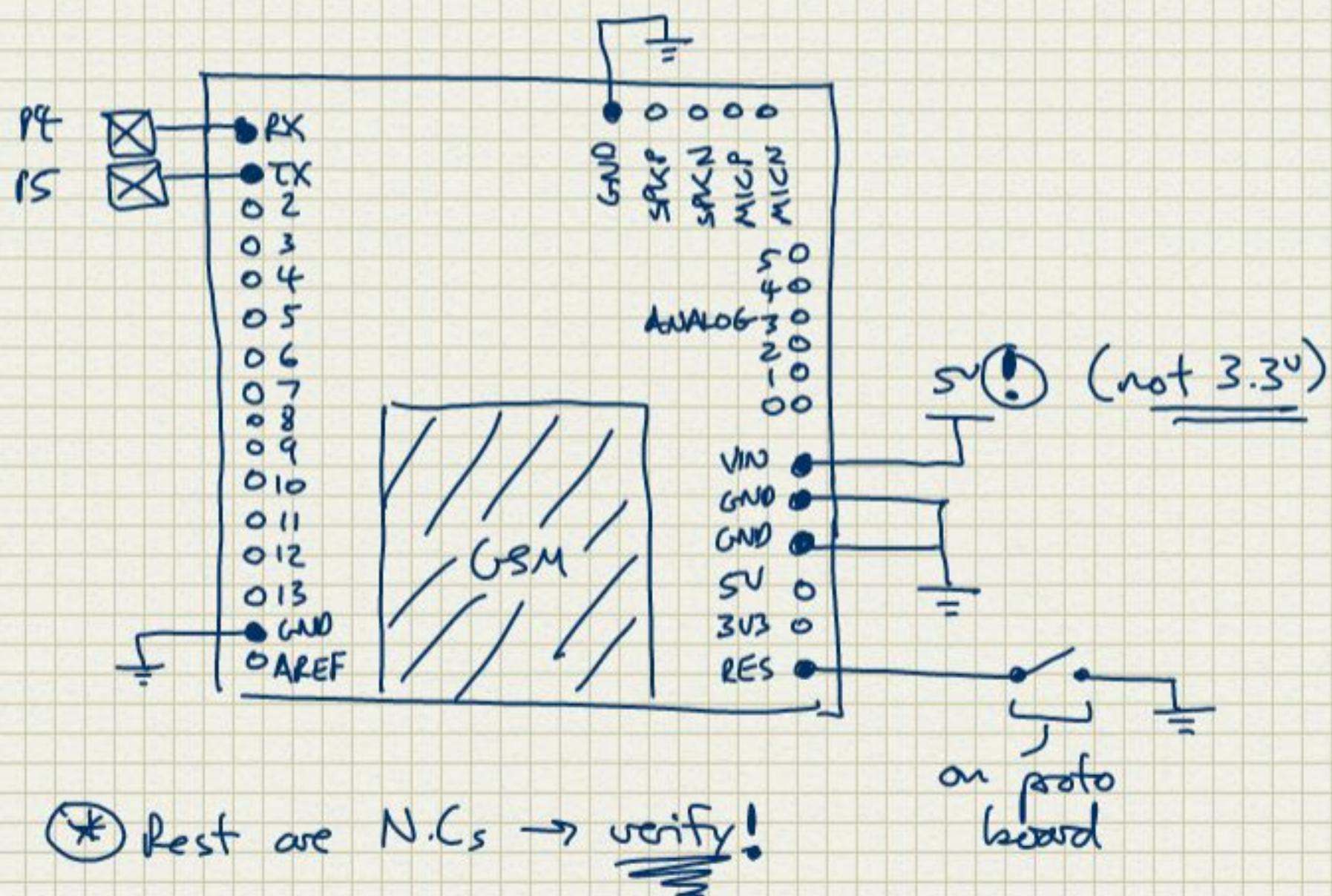
- Not using UART as 6-wire, but 3-wire (incl GND)
- future, add more funcs

| → Q What are other header pins for?

- PIC, use following pins (based on PPS, IQ4) :

"RX" = RP21 (P4)

"TX" = RP26 (P5)

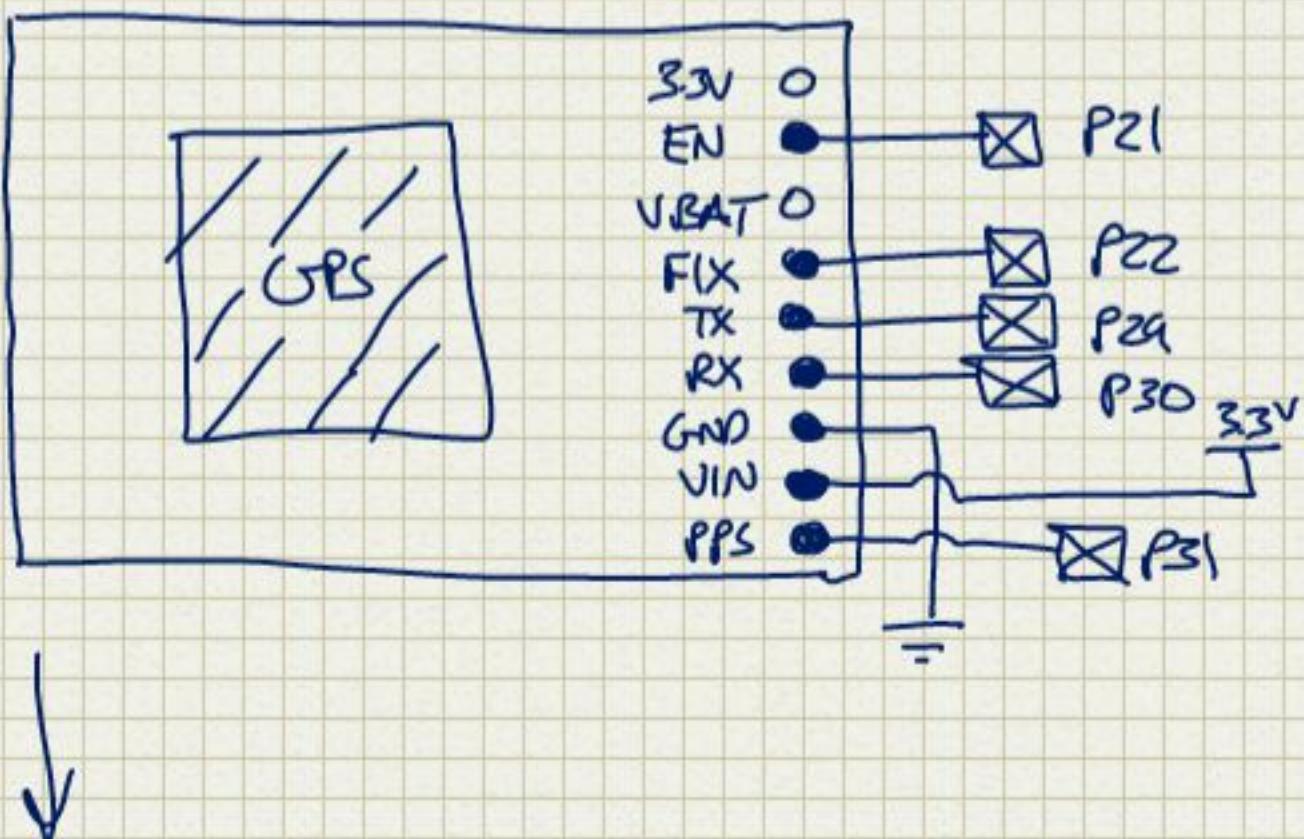


* Rest are N.C.s → verify!

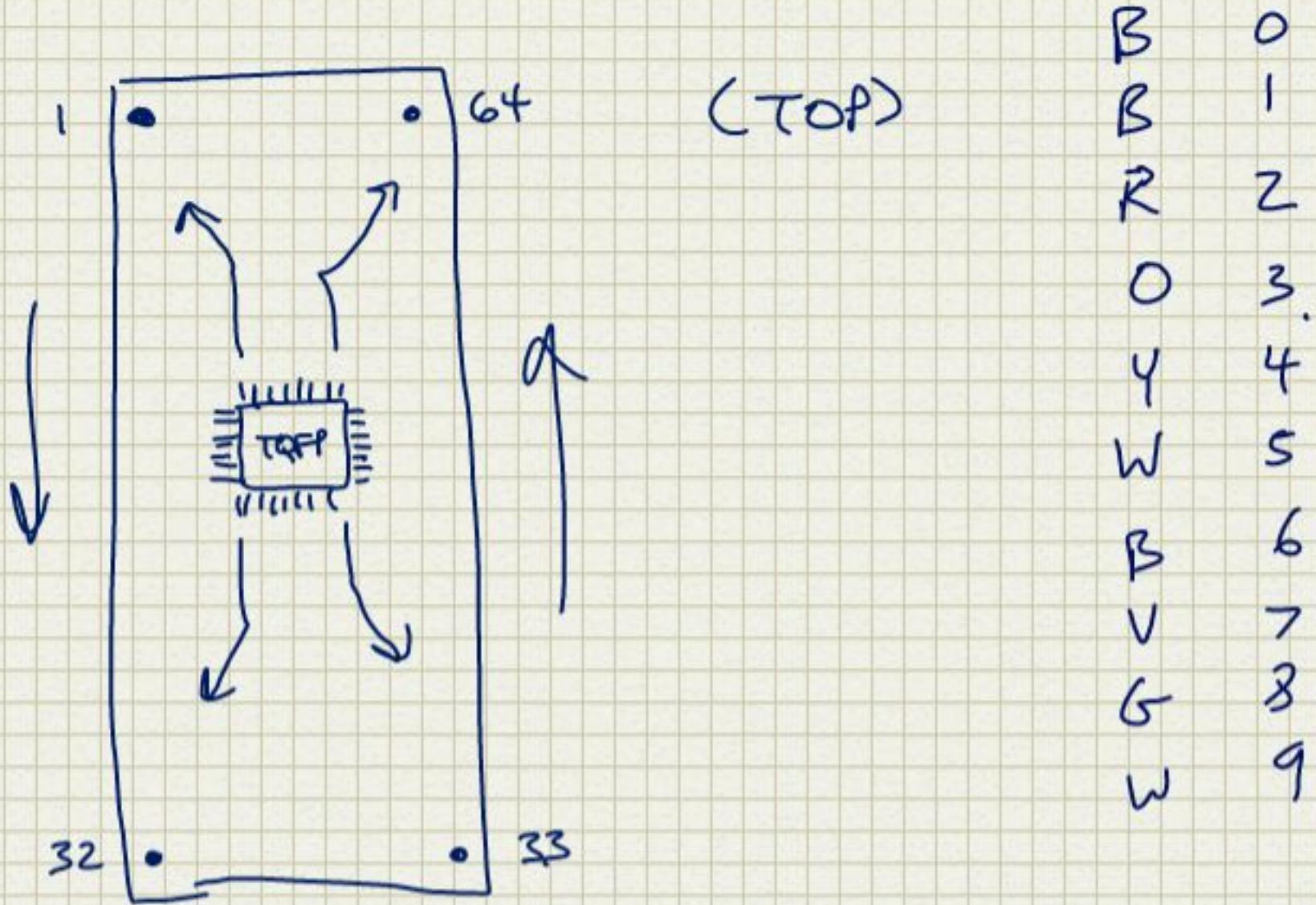
④ GPS

- Adafruit tutorial, use Arduino wiring
- $V_{IN} = 3.3V$, $FIX =$ input to uC for sig lock
- V_{BAT} not used in proto until have batt. backup

- EN pulled ↑ via 10k (already), tie to uC and pull to GND to disable GPS
- 3.3V output ONLY 100mA, don't use!
- PPS is uC sync sig
- uses UART (TX/RX) for xfer
- PIC, use following pins (PPS, 10.4)
 - "EN" = RP8 (P21)
 - "FIX" = RP9 (P22)
 - "TX" = RP14 (P29)
 - "RX" = RP29 (P30)
 - "PPS" = RP10 (P31)



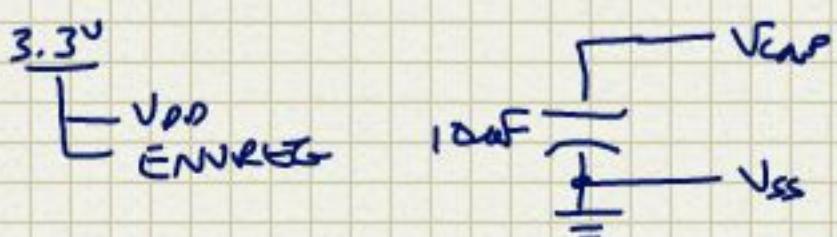
Proto TQFP-64 Layout:



October 8, 2012

PIC Hookups

- See Fig 2.1 , p. 31
 - ↳ connect all V_{DD}, V_{SS} pins (AV_{DD}, AV_{SS} too)
 - ↳ MCLR (Section 2.3) → jumper for 1 when prog'g
 - ↳ ENVREG, V_{CAP}
- *ISP, need pins (Section 2.5)
 - need int'l reg for 3.3V → 1.8V conversion (Fig 26-1)



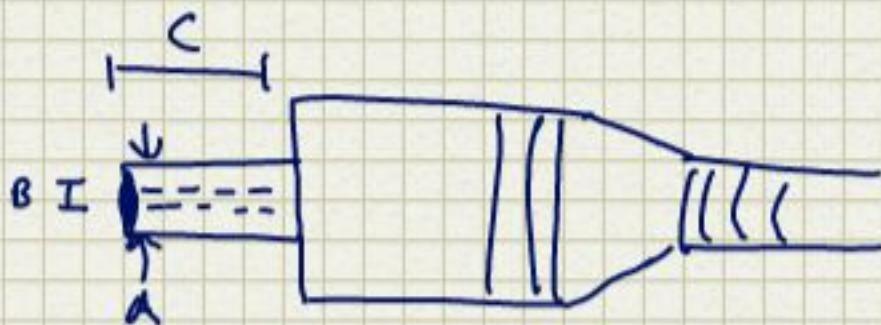
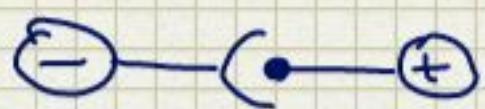
AC Adapter

October 9, 2012

... - P S P - ...



Center Positive



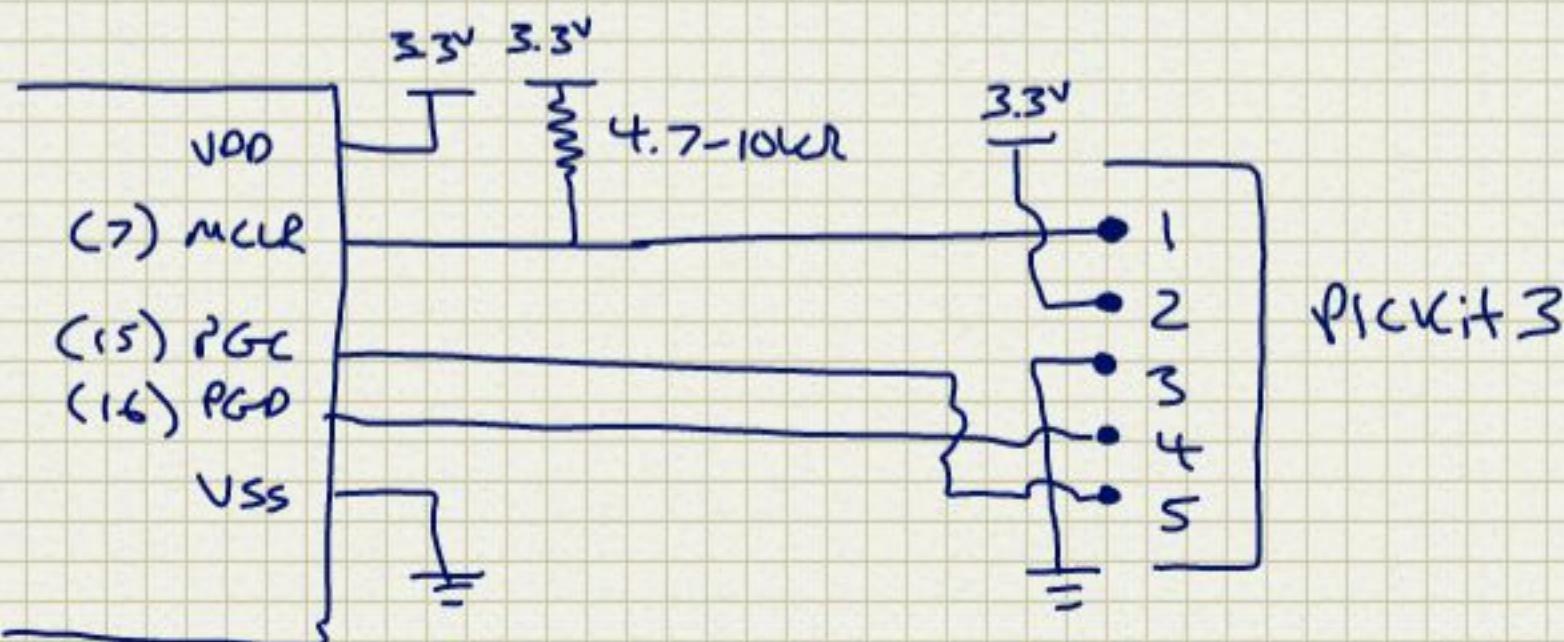
$$A = 5.5\text{mm}$$

$$B = 2.1\text{mm}$$

$$C = 9.5\text{mm}$$

PICKIT 3

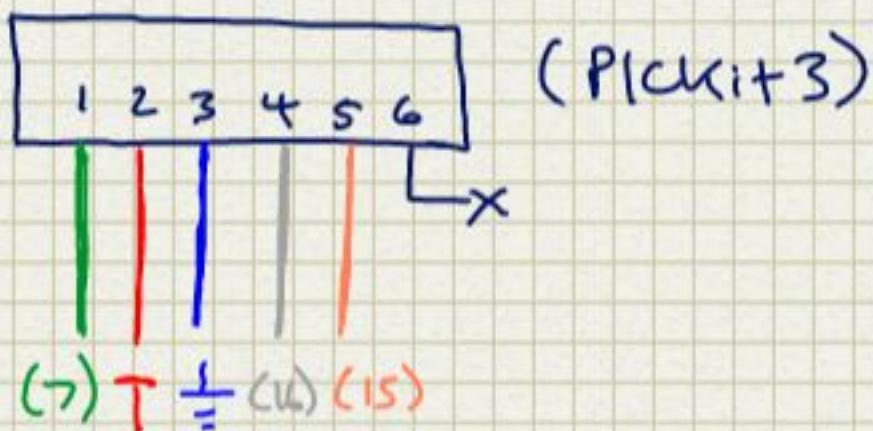
- ICSP req's wiring of PGEx/PGExD pins
 - ↳ Section 27.0 → see PICKIT 3 Manual
 - ↳ use board (NOT debugger) to provide pins
- Standard connections w/ PICKIT:



- * DO NOT :
 - ① pull-up PGC, PGD
 - ② use caps on PGC, PGD
 - ③ use caps on MCLR
 - ④ use diodes on PGC, PGD

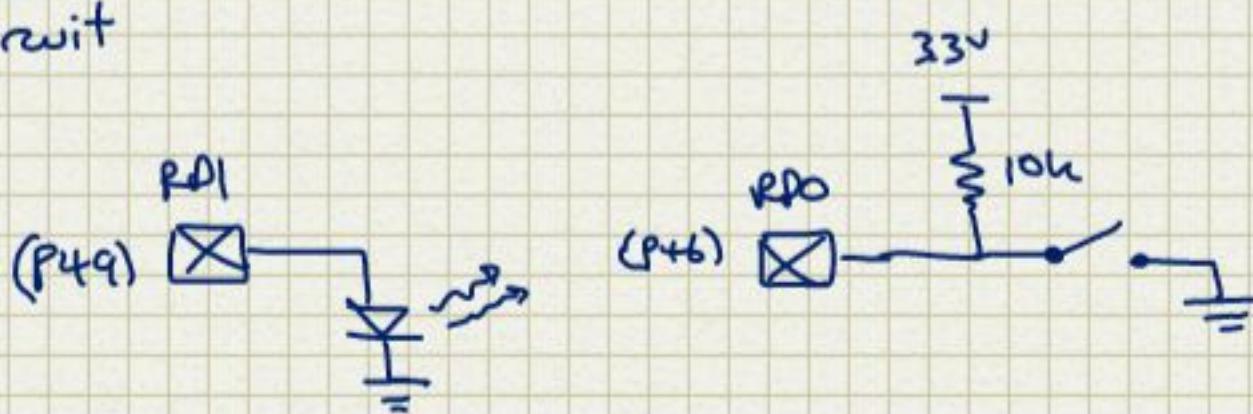
↳ need to revise MCLR based on this

- using PGEC/PGEDI, config correctly
(ICs configuration bits)
→ see Ch 4 of PICKit 3 Guide
- wire coloring:



October 15, 2012

Test Circuit



* no ANSEL needed for these bits!

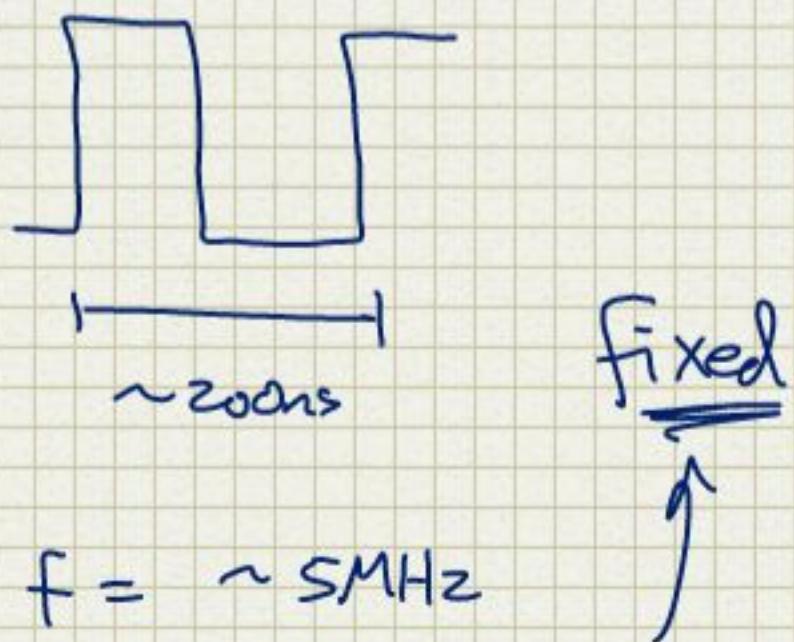
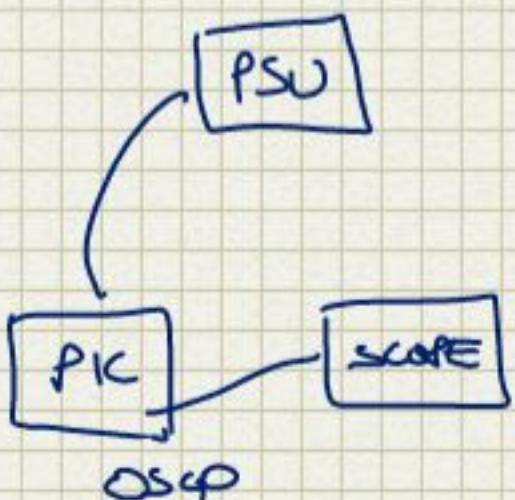
PROGRAM, PORTD reg's → use my 478 code as ex

Oscillator Settings

October 18, 2012

- 8MHz internal, 32 MHz external osc
- overall layout, see Fig. 8-1 (p. 137)
 - ↳ use Primary Oscillator (Posc) on OSC1/OSCO
 - ↳ internal, use FRC
- Default: FRC w/ no post scalers
 - ↳ POSCMD = <11>, FNOSC = <000>
- OSCO pin determined by OSC10 FCN bit
 - ↳ defaults to OSCO
- EC OSC w/ no PLL
 - ↳ POSCMD = <00>, FNOSC = <010>
- OSCON reg, leave alone for now (dyn clk changes)
- Internal
 - ↳ set RCDIV = <000>
- OSCO = P40

Test Circuit



* expect $\frac{2\text{MHz}}{2} = 4\text{MHz} \rightarrow 250\text{ns}$ (calibration error)

Result

+ w/ updated code, works! → light blinks!

October 19, 2012

USB Friend

- no driver needed for Linux; just plug in!
- verify COM / driver install
 - ↳ appears as "/dev/ttyUSB#" in Terminal
- PIC uses TX/RX w/ RTS/CTS for ctrl (see p. 24)
- Baud Rate
 - ↳ BRGH = 0 (low-speed), = 1 (high-speed)
 - ↳ F_{CY} = F_{osc}/2 (choose F_{osc} = 32MHz)
 - ↳ FTDI req's baud rate : 183 baud - 3Mbaud
 - Baud rate = $\frac{3000000}{(n+x)}$
 - n = 2 to 16,384
 - x = 0-1 decimals
 - ↳ PIC, w/ BRGH = 1, max is

$$\text{Baud} = \frac{F_{CY}}{4 \cdot (\overset{\rightarrow}{U_x BRG} + 1)} = \frac{16 \text{MHz}}{4} = \underline{\underline{4 \text{Mbaud}}}$$

(choose: U_x BRG = 1, F_{CY} = 16MHz)

$$\text{Baud} = \frac{16 \text{MHz}}{4 \cdot 2} = \boxed{2 \text{Mbaud}}$$

(PIC)

$$2000000 = \frac{3000000}{(n+x)} \rightarrow (n+x) = \frac{3}{2} = 1.5$$

can't do values b4 1 and 2

Try: Baud rate = 1Mbaud

$\text{UxBRG} = 4, \text{BRGH} = 1, \text{Fosc} = 32\text{MHz}$:

PIIC: Baud = $\frac{(32\text{MHz}/2)}{4 \cdot 4} = 1 \underline{\text{Mbaud}}$ ✓

FTDI Baud = $\frac{(3000000)}{(n+x)} = 1 \text{ Mbaud}$

* 2Mbaud OK according to FTDI app note

AN232B-05

↳ Divisor = 1

- need to "pass" non-standard rate to driver

↳ Q how in Linux?

• TX in 8-bit data mode (also 9 bit)

↳ write date, pty, stop bits

↳ set baud rate in UxBRG reg

↳ set up TX/RX int en/priority bits

↳ en UART

↳ set UTXEN bit

↳ write data byte to lower byte of $UxTXREG$
→ can also set data byte, then $UTXEN = 1$

↳ TX int ctrl bit gen'd based on $UTXISEL_x$

* Break and Sync TX Sequence (p.227)

- RX in either mode

↳ set up UART (like TX)

↳ enable UART

↳ RX int gen'd when get data based on $URXISEL_x$

↳ Read OERL for overrun err

↳ Read $UxRXREG$

- use $UEN<1:0>$ bits to ctrl \overline{CTS} , \overline{RTS}

- $UxMODE$ Reg

↳ UARTEN (b15) = 1 (UART enabled)

↳ RTSMD (b11) = 0 (flow ctrl mode)

↳ UEN (b9:8) = 10 (Tx, Rx, \overline{CTS} , \overline{RTS} enabled)

③ ↳ LPBACK (b6) = 1 (enable loopback)

↳ ABAUD (b5) = 1 (auto baud measurement)

↳ BRGH (b3) = 1 (high speed mode)

↳ PRSEL (b2:1) = 01 (8-bit data, even parity)

4.10.4

- $UxSTA$ Reg

↳ UTXEN (b10) = 1 (TX enabled)

Port Remapping:

- use UART3 for USB ($0 = \text{GSM}, 1 = \text{GPS}$)

- use regs

↳ IN → set function to pin #

↳ OUT → set pin # to function # $\xrightarrow{\text{U3TX} = 28}$ $\xrightarrow{\text{U3RTS} = 29}$

• REGS

↳ RPINR17 - 0x0300 (RP3)

$$28 = 16 + 8 + +$$

↳ RPINR21 - 0x0B00 (RP11)

$$29 = 16 + 8 + + +$$

↳ RPOR6 - 0x001C (RP12)

$$11100 = 1C$$

↳ RPOR2 - 0x001D (RP4)

$$11101 = 1D$$

October 23, 2012

- try std baud rate, got no response from chip

↳ bad soldering?

② Disconnect 3.3V out \rightarrow main board?

Choose Baud = 115200

$$\text{UXBRG} = \frac{\text{FCK}}{4 \cdot \text{Baud}} - 1 = \frac{(16 \times 10^6 \text{ Hz})}{4(115200)} - 1 \\ = 34.72 \rightarrow \text{choose } 35$$

$$\text{Baud} = \frac{(16 \times 10^6 \text{ Hz})}{4 \cdot (35)} = 114285 \text{ baud}$$

$$\% \text{ error} = \frac{114285 - 115200}{115200} \times 100\% = \underline{\underline{-0.79\%}}$$

$$\text{BFG} = 35d = 32 + 2 + 1 = \underline{\underline{0x100011}} = \underline{\underline{0x23}}$$

October 23, 2012

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Priority Issues

- pin functions listed in terms of priority

P46 = DMH \rightarrow USB PU control output, digital 0

P44 = SCL1

P43 = DPLN/SDA1 \rightarrow USB PD

\hookrightarrow need to set TRISx correctly or fixed peripheral

\hookrightarrow needs to be configured in digital mode

- disable USB, SPI1?

\hookrightarrow USB disabled by default

\hookrightarrow SPI disabled by default

I/O dirs and settings

P46 = RDO \rightarrow INPUT

TRISD bits. TRISD11 = 0;

P45 = RP11 \rightarrow OUTPUT

" " TRISD10 = 1;

P44 = RP10 \rightarrow INPUT

" " . TRISD9 = 0;

P43 = RD9 \rightarrow OUTPUT

" " . TRISD8 = 1;

- no ANSEL worries on PORTD!

LATD = 0 \rightarrow bring all outputs low (BEFORE setting TRIS!)

TOP: fix baud rate (Fosc setting)
get oscillator!

FIX: using 8MHz Fosc (SRC) for now, NOT 32MHz!

$$F_{CY} = \frac{8\text{MHz}}{2} = 4\text{MHz}$$

$$\begin{aligned} U_{xBRG} &= \frac{F_{CY} \cdot}{4 \cdot \text{baud}} - 1 \\ &= \frac{(4 \times 10^6 \text{Hz})}{4(115200)} - 1 = 7.68 \rightarrow \underline{\underline{8}} \end{aligned}$$

$$\text{Baud} = \frac{F_{CY}}{4 \cdot U_{xBRG}} = \frac{(4 \times 10^6 \text{Hz})}{4(8)} = 125000 \text{ baud}$$

$$\begin{aligned} \% \text{ error} &= \frac{125000 - 115200}{115200} \times 100 \\ &= \underline{\underline{8.51\%}} \end{aligned}$$

works!

issues, driver?

Fastest:

$$\text{Baud} = \frac{F_{CY}}{4} = \underline{\underline{1MBaud}}$$

*UART → watch AND-OR settings!

November 1, 2012

GPS Settings

P21 = RB8 → OUTPUT

TRISB bits. TRISB 8 = 0;

P22 = RB9 → INPUT

" ". TRISB9 = 1;

P29 = RB14 → INPUT

" ". TRISB14 = 1;

P30 = RB15 → OUTPUT

" ". TRISB15 = 0;

P31 = RF4 → INPUT

TRISF bits. TRISF4 = 1;

LATB = 0x0000; } before TRIS settings!
LATF = 0x0000; }

* no ANSEL worries on PORT F!

ANSELB = 0x 0000; turn off analog pins

U2RX → RP14

U2TX → RP29

UART Reg Settings (different from POR values):

Ux Mode

↳ UART_EN = 1

data? parity?

16bit, even parity

↳ UTXEN = 1

↳ PR = 7, INTs on



- Based on Adafruit, using 9600 baud to start w/
B.RGH = '0':

$$U2BRG = \frac{Fcy}{16 \cdot \text{Baud}} - 1 = \frac{(4,000,000 \text{ Hz})}{16 \cdot 9600} - 1 \\ = 25.04 \approx \boxed{25}$$

(* Read through libs

Adafruit Notes

November 2, 2012

- on board Data logger (Locus), stores up to 16 hrs of data
 - ↳ uC can start it, go to sleep

- usual GPS seq's used: \$GPRMC, \$GPGLL

↳ see ext' site for details

↳ GGA = current fix data; RMC = min GPS sentences info,

~~GSA~~ = satellite status info

GGA = LAT/LONG, ALT

Google Maps can provide

RMC = LAT/LONG, GROUND SPEED

* NOTE: GPS sends data, regardless of Fix!

↳ parse, look for empty sentences

↳ RMC, use Active ('A') flag

* GPS → gMaps translation

ex: 40 42.6142 N (Lat 40°, 42.6142' N)

07400.4168 W (LONG 74°, 0.4168' W) ↓

- Google, N/E are (+) and S/W are (-)

Type into Google : +40° 42.6142', -74° 00.4168'

GMT	Active/Void	LAT	LONG	Speed (knots)
1	A	4042.6142, N	07400.4168, W	2.03,
EGPRMC, 194509.000, A, 4042.6142, N, 07400.4168, W, 2.03,				
22.11, 160412,, A*77				
tracking	data (DDMMYY)	checksum		

- example code, "echo", sends GPS data to USB on Arduino

↳ need my own custom version

④ * Modify echo() code for my use!
(see code)

→ Serial Setups? ④ Asked Forum

GPS Updates

January 21, 2013

- needed to add <<R><LF> (\\r\\n) to all PNTK sentences to successfully send data to GPS
- if want to parse/checksum data, looks like can't output to USB before hard (empties data and messes up structure)
 - ↳ just print parsed data

January 24, 2013

LOWS

- logging works!
- for dump, use straight WriteUART3 in ISR, NOT display GPS data!

January 28, 2013

GSM Setup (from previous)

RP21 (RG6) \rightarrow P4 \rightarrow "RX" or module (TX fr. PIC)

↳ set TRISG6 = 0 (output)

↳ set ANSG6 = 0 (Digital I/O)

↳ set RP21 to U1TX output

RP26 (RG7) \rightarrow PS \rightarrow "TX" or module (RX for PIC)

↳ set TRISG7 = 1 (input)

↳ set ANSG7 = 0 (Digital I/O)

↳ set RP26 to USRX input