Adding I/O to the Raspberry Pi with a PIC32 Microcontroller and SPI

Matt Bennett

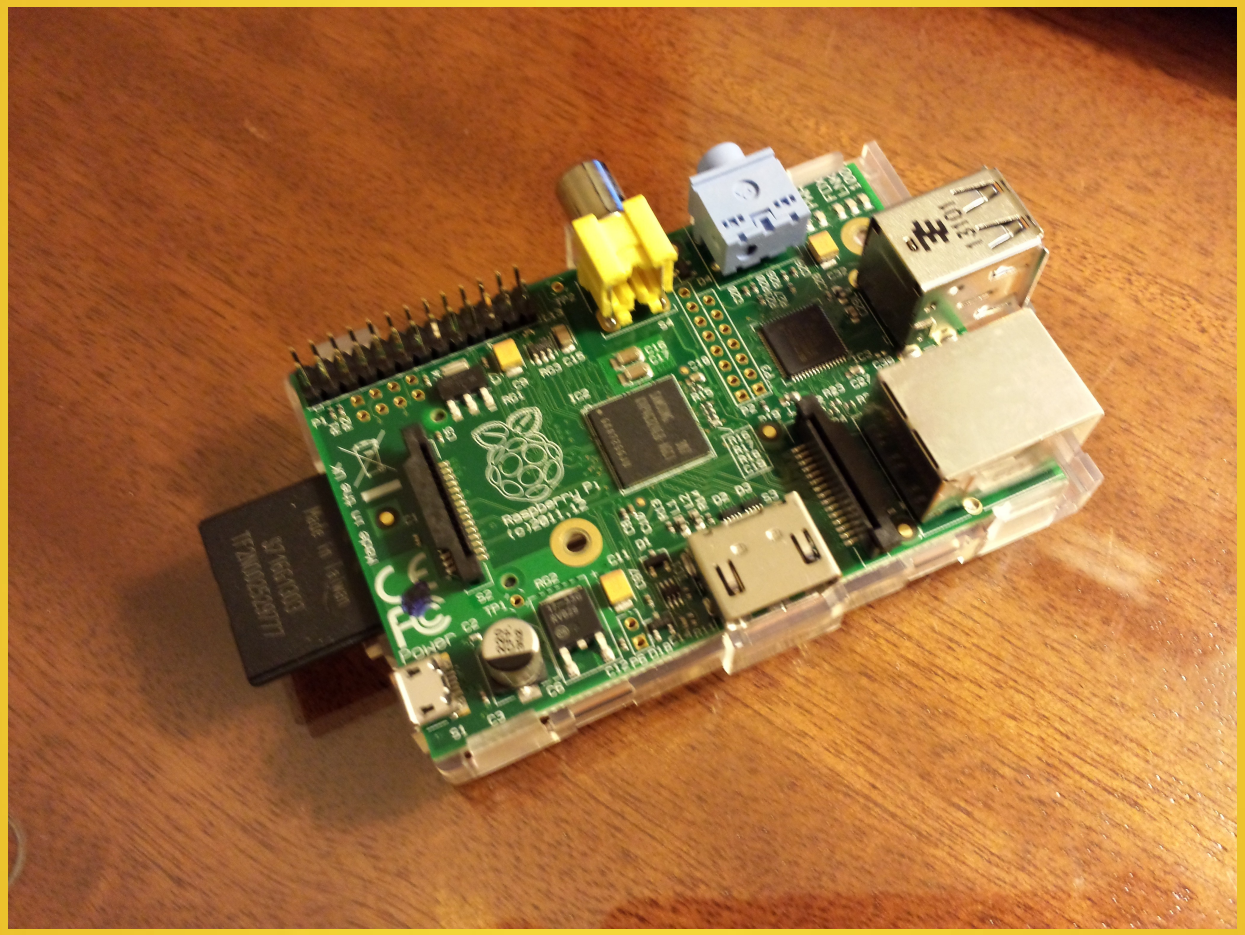
Who am I?

Who Am I?

- Matt Bennett
- FAE in Austin, Texas
- I play with electronics
- Not associated with the Raspberry Pi® Foundation

What is the Raspberry Pi®

Raspberry Pi®



Raspberry Pi is a trademark of the Raspberry Pi Foundation

Raspberry Pi®

- Credit card sized computer
  - Designed by Raspberry Pi Foundation
  - Teach basic computer science in schools
  - $35
  - Can run Linux
  - Programmed in Python, C

Raspberry Pi® Components

- Processor
  - Broadcom BCM2835 (ARM)
- 512K RAM (Current Model)
- USB & Ethernet
  - SMSC LAN9592 PHY

Raspberry Pi® Features

- 700 MHz Processor (overclockable)
- GPU
- SD Card filesystem
- HDMI or Composite Video Output
- Ethernet
- I/O Header
  - I2C
  - SPI
  - GPIO
- LOW COST

Introducing TRISThis

What is TRISThis

- A goofy name from years ago
- A Board that is designed to work with the Raspberry Pi®
- Open Source Hardware
- Open Source Software
- NOT FOR SALE
- Uses Microchip Parts, but not a Microchip Project

Why The TRISThis

- No mounting holes
- Not enough LEDs
- No Analog inputs
- Inputs not protected
- Power supply mechanism is poor

What does TRISThis DO?

- Powers the Raspberry Pi®
  - Standard 9V supply works (can use higher or lower voltage)
- Measures the input current
- Protected Digital I/O
- Analog Inputs
  - Buffered
  - Digipots used in signal conditioning

Why?

- I'm learning
- I'm sharing
- I'm learning how to do a open project in a collaborative manner
- Giving back to the community

How?

- Open source or low cost tools
  - (as much as possible)
- Linux
  - MPLAB X
- Design in Eagle freeware version (goal)
  - Single schematic sheet (2 sheets now)
  - 2 layer board
  - 4x3.2” max
- Git revision control
  - Free Project hosting for open source

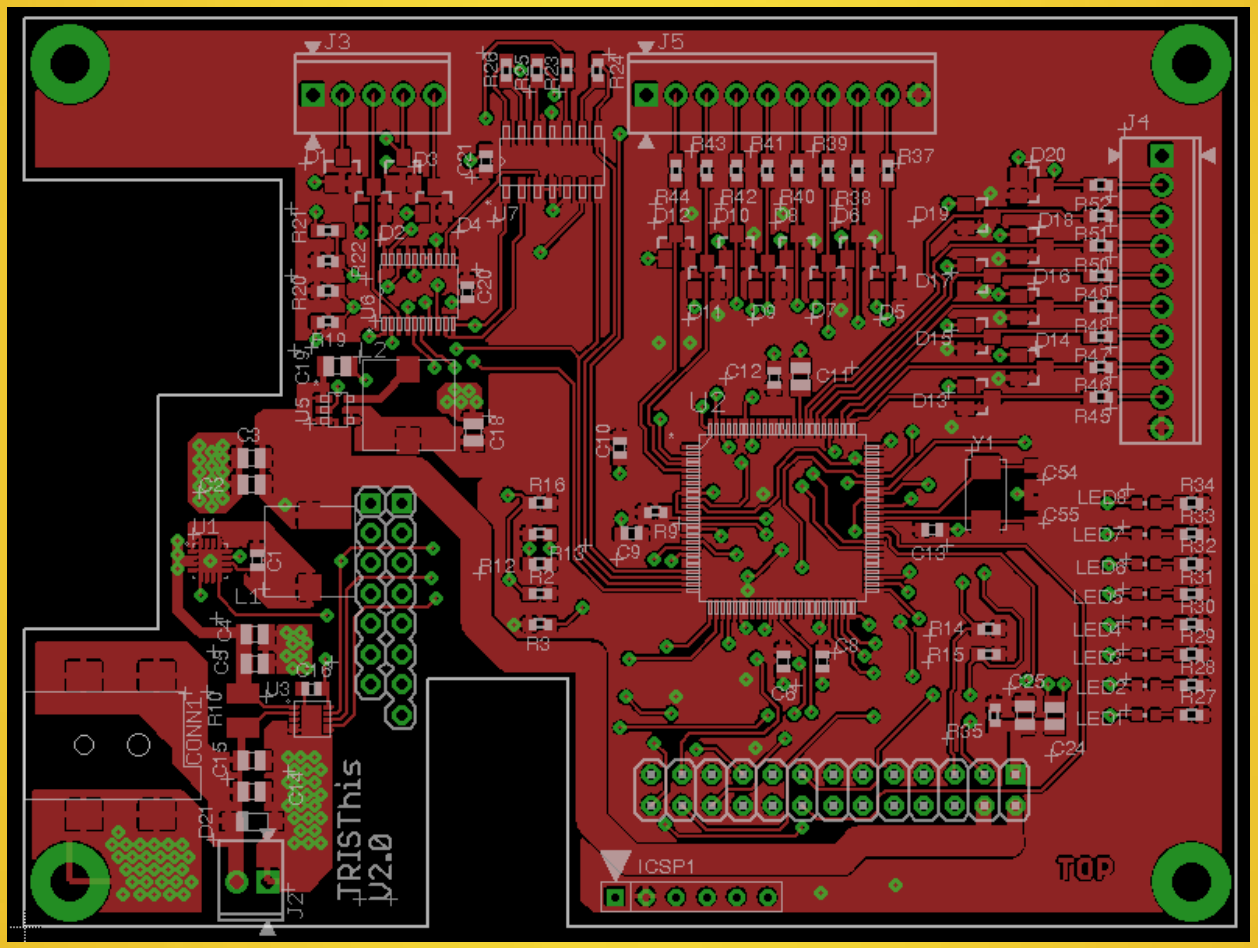
    https://github.com/MattAtHazmat/TRISThis

TRISThis Hardware

Gerbers available

- Used BatchPCB for original boards
  - Unfortunately, no longer around, but there are alternatives
  - Service would create non-rectangular boards

Latest Layout



What's TRISThis have?

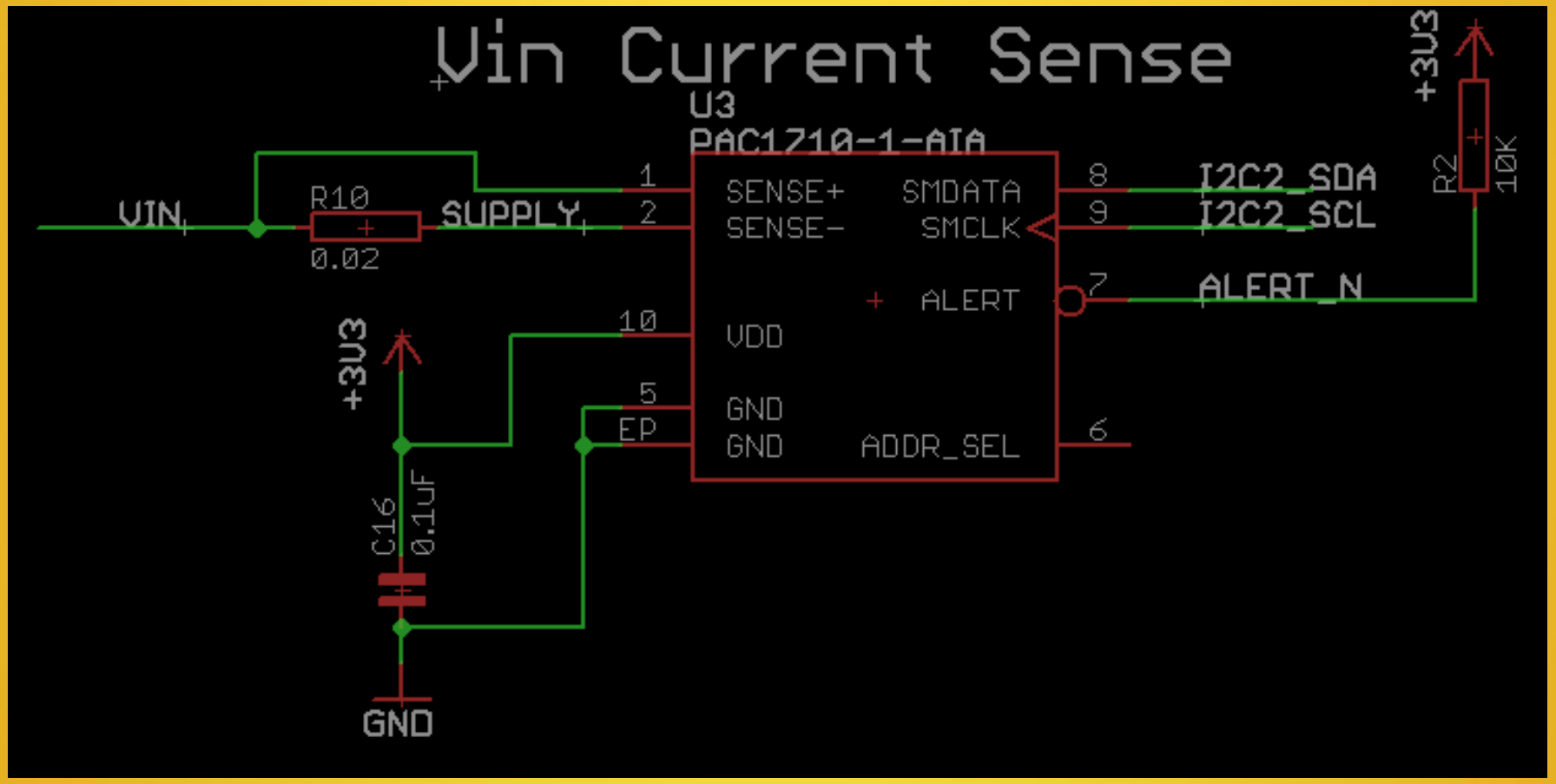
Processor

- PIC32MX795F512L
  - Way overkill
  - Large Memory
    - 128KB RAM
    - 512KB Program
    - 80 MIPs
  - Peripherals

Input Current Measurement

- PAC1710
  - High-Side Current Sense Monitor with Power Calculation
  - Measures input current across a shunt
  - I2C

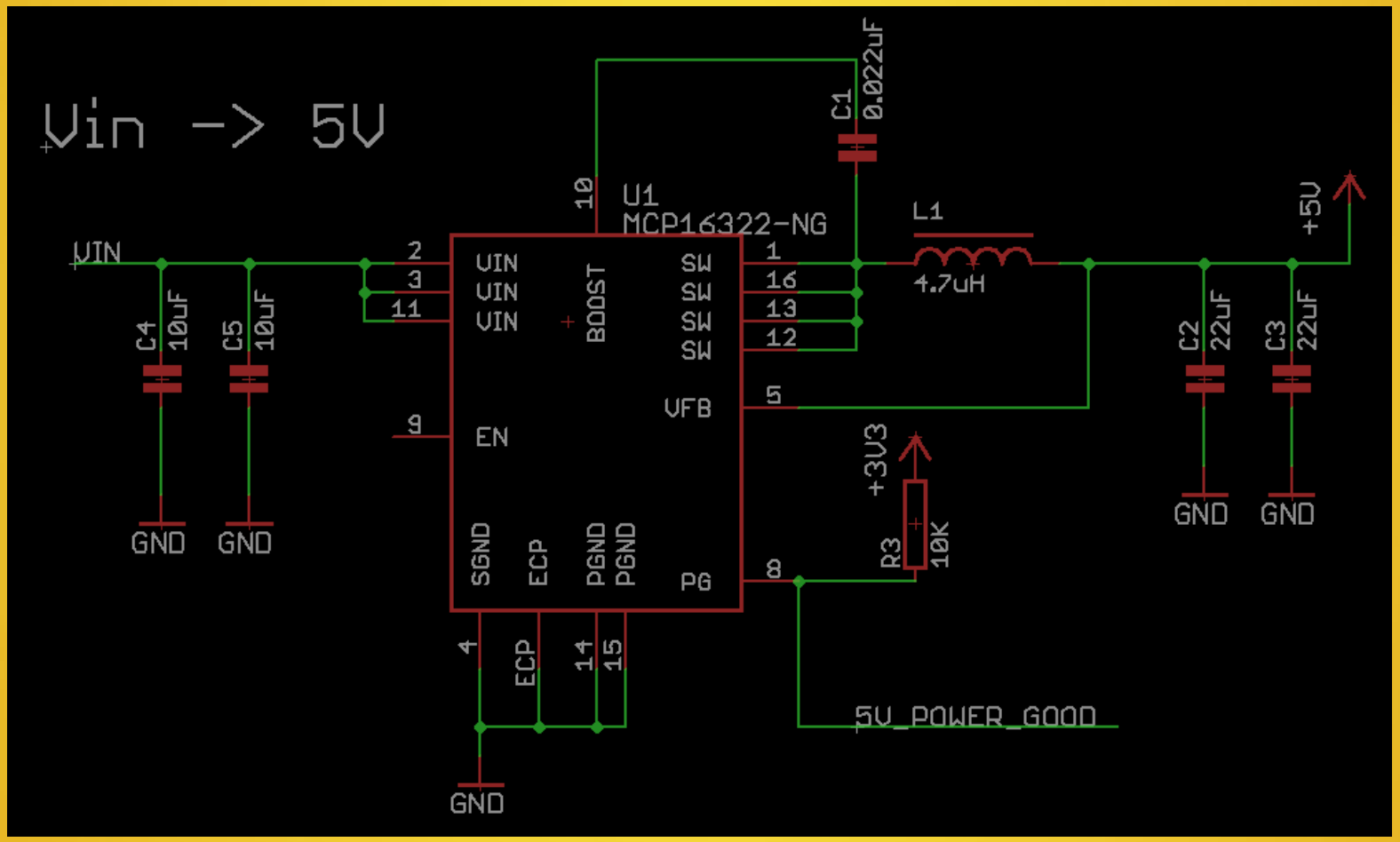
Input Current Measurement Schematic



Input Regulator

- MCP16322
  - 24V Input, 1A/2A Output, High Efficiency Synchronous Buck Regulator
- Input 6.0V to 24V
- Fixed 5V output
- Max 2A output

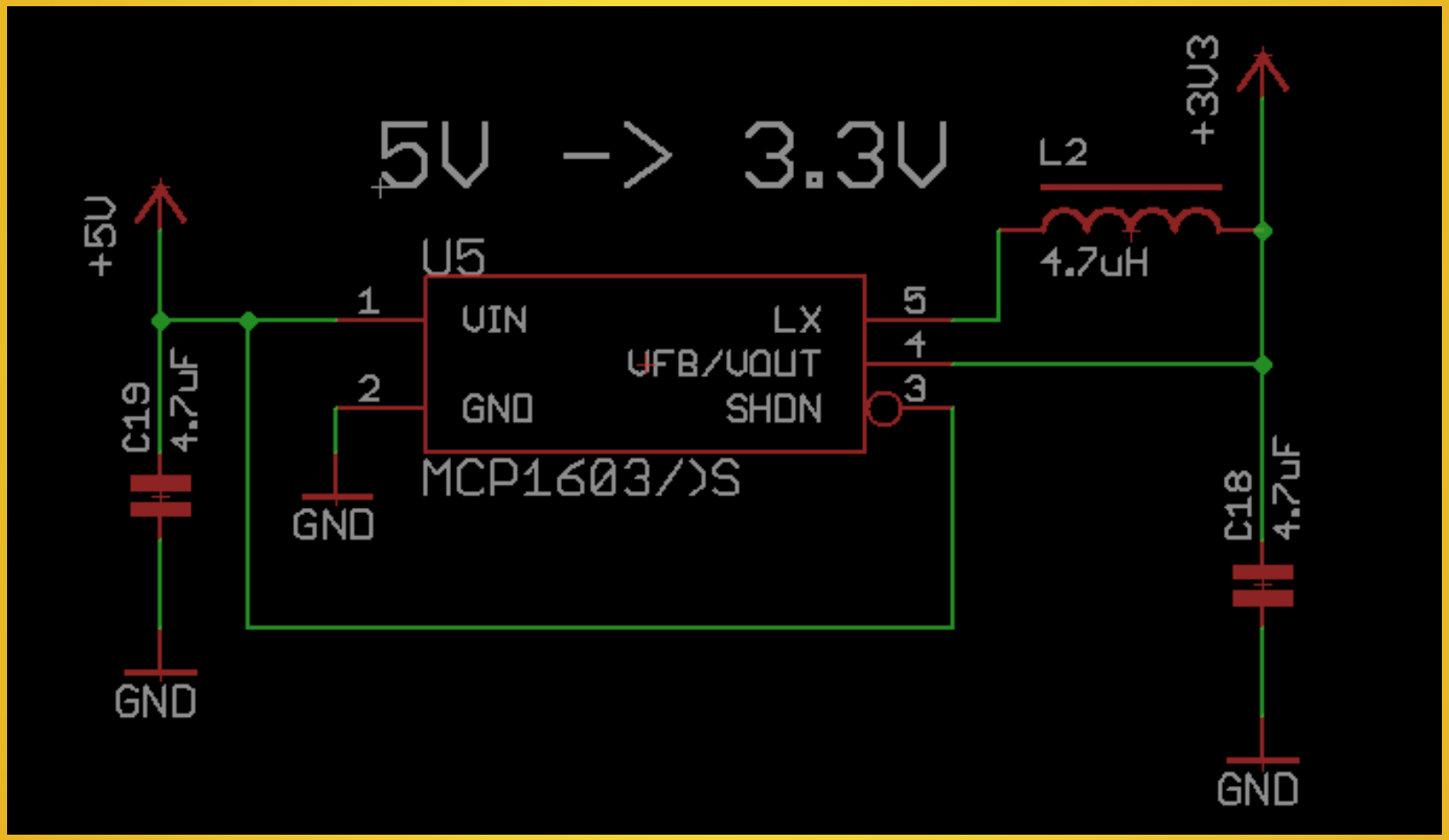
Input Regulator Schematic



5V to 3.3V Regulator

- MCP1603
  - 500 mA 2.0 MHz synchronous buck regul ator
- Powers TRISThis board
- Provision to replace 3.3V regulator on Raspberry Pi®

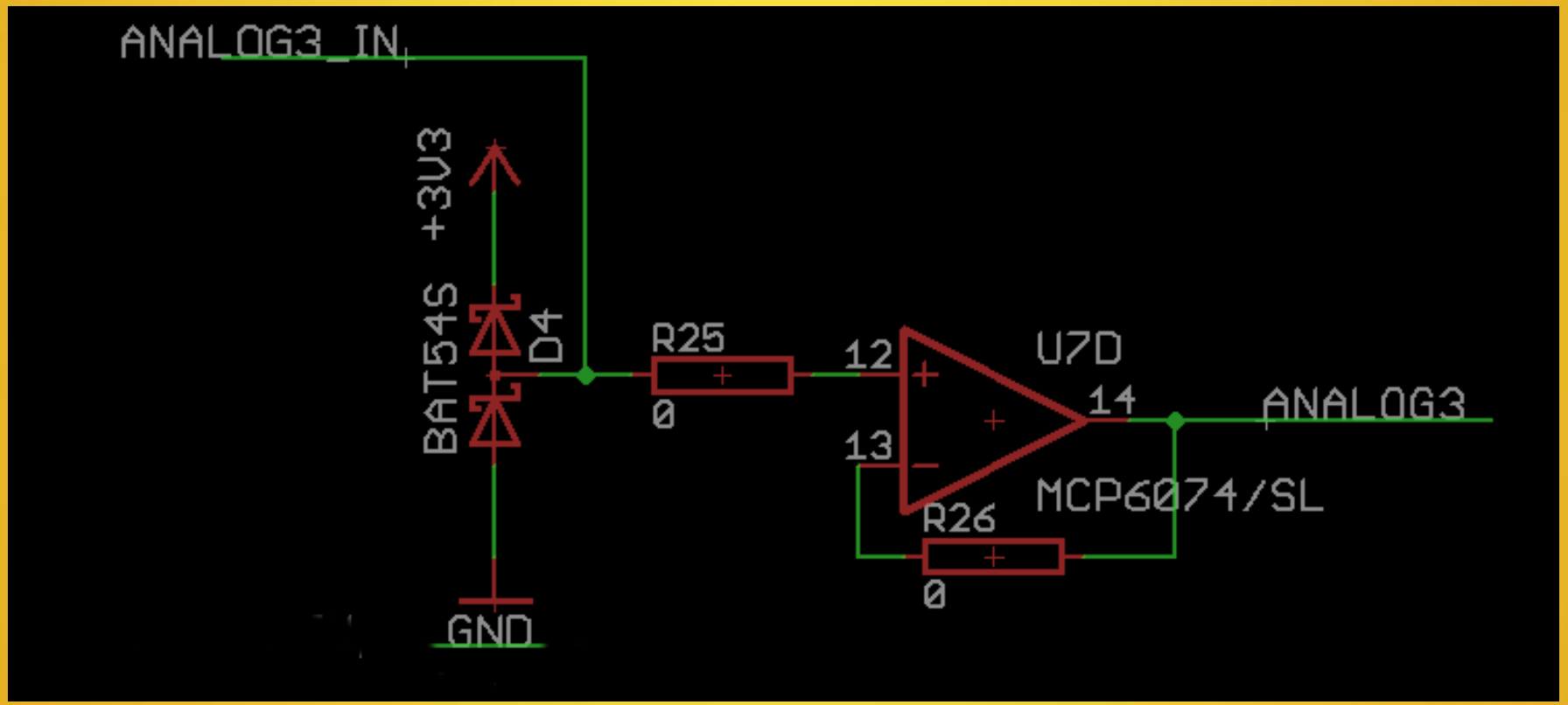
5V to 3.3V Regulator Schematic



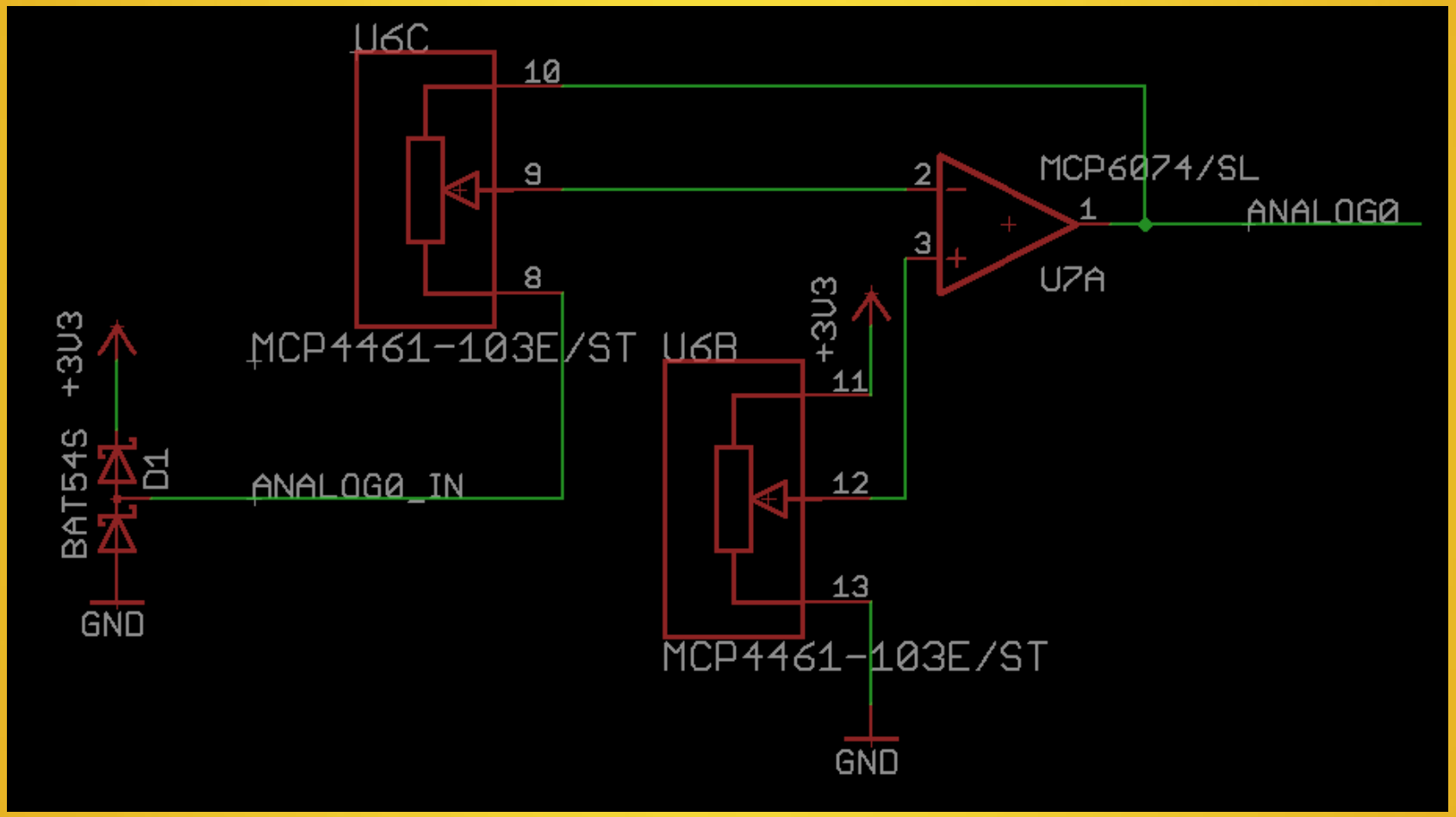
Analog Input Conditioning

- MCP6074
  - Op Amp
- MCP4461
  - I2C Digipot

Input Follower Schematic



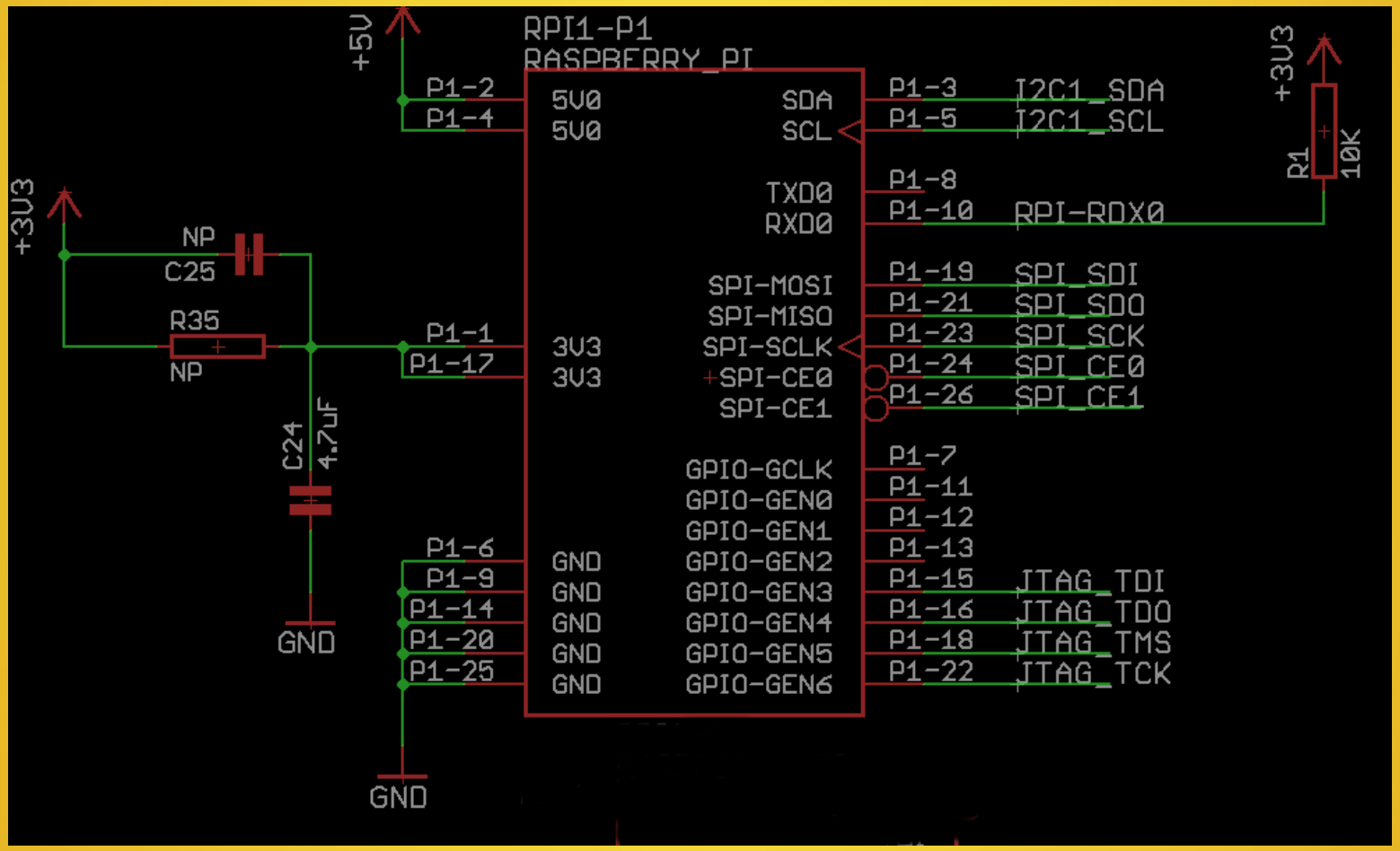
Adjustable Input Buffer Schematic



Interface to Raspberry Pi®

- Power
  - 5V to Raspberry Pi®
- SPI
- I2C
- JTAG
  - Raspberry Pi® has capability of programming/debugging PIC32 over JTAG

Interface to Raspberry Pi® Schematic



What's Working So Far?

Progress

- Power supplies
- LEDs
  - Blinking under full control!
- I2C
  - PIC32 Master talking to PAC1710 Slave
- SPI
  - Raspberry Pi® Communication to PIC32 via SPI *in development*
-

How about on the Raspberry Pi®?

Raspberry Pi® Code?

- Not much, so far
- SPI communication to PIC32 used for testing interface
- Hope to Implement FreeRTOS

Want to Help?

Join in!

- Follow TRISThis project on Github

  https://github.com/MattAtHazmat/TRISThis
- Build a board
  - Build/Customize/Sell- do what you want it is a non-restrictive open license
- Push contributions back to repository
  - **Share**
  - **Learn**
  - **Give**

Not associated!

- TRISThis is not an official Microchip Project
- TRISThis is not associated with the Raspberry Pi Foundation
  - Every effort is being made to work within trademarks and existing licenses. If there is anything overlooked, please inform Matt
- As this is not a Microchip project, for questions related to TRISThis, please contact me via my personal email, matt.bennett@gmail.comI will reply evenings/weekends.

TRISThis for Raspberry Pi®

- Power Supply
- PIC32 I/O Processor
  - 16 I/O
  - Analog Inputs
  - LEDs
- Mounting Holes!
- Open Source

Thank you!

KITTY!