efabless Raven test board User Manual

Circuit board rev v1.0.

DUT isolation points and power connections:

A	B	C		
			1 3 5 7	2 4 6 8

Jumper A to power entire board from USB 5.0V (recommended) (pins 1–2)

Jumper B to power DUT 3.3V (normal operation). May be used as current measurement point (pins 3–4).

Jumper C to power DUT 1.8V. Normally DUT generates its own 1.8V output. Use this only as a backup or voltage test measurement point (pins 5–6).

To program, connect pins 4 and 8 with a jumper wire. It may be preferable to solder a wire on the back between pins 4 and 7 (7 is N/C on the board) so that a jumper from 7 to 7 can be used instead.

J2: Flash CS select

Jumpered at top: FTDI accesses flash (program mode) — 1 2

Jumpered at bottom: Raven accesses flash (run-time mode) — 2 3

1 3 5 7
2 4 6 8

UART display: Connect to display.
Pin 1 = 3.3V, Pin 2 = GND, Pin 3 = Rx

Due to a board layout error, the intended functions are not as labeled.

J12 left is 8MHz CMOS clock

J3 left is 8MHz CMOS disable (ground to disable clock. Runs when open)

J3 center pin is Raven Extclk input

J3 right pin goes to J10 ext. clk pin.

J12 right is Raven IRQ input.

Wire J12 left to J3 center to enable 8MHz clock to Raven Extclk input.

Wire J12 center to J3 left to silence the CMOS clock signal.

1
2
3

GPIO termination. When GPIO lines are connected across J9, each GPIO drives an LED.

3
2 — Connected at top, disables LEDs for current measurements.

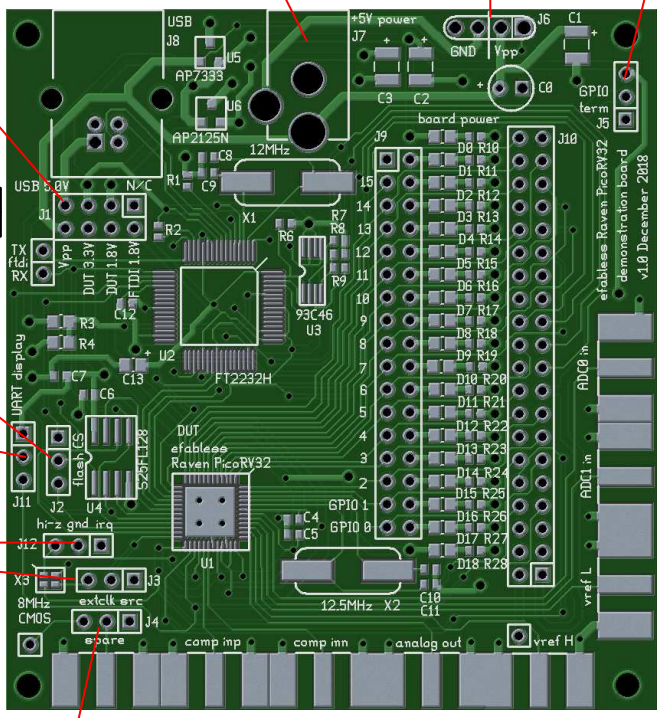
2
1 — Connected at bottom, LED lights when GPIO output is low (normal position).

Board power indicators only function when this is jumpered in the bottom position.

Only use one of these three power sources: Power jack, 4-pin power post, or USB 5V.

Power jack: 5 to 6V input (regulated)

4-pin power post: 5V input (regulated).



Spare: Middle pin is spare SMA

1 2 3

May be used with jumper wire to connect any GPIO pin to the spare SMA connector.

Board power indicators:

D0 : Indicates board has 3.3V power.
D18: Indicates Raven chip has 3.3V power.

Board rev v1.0 errata:

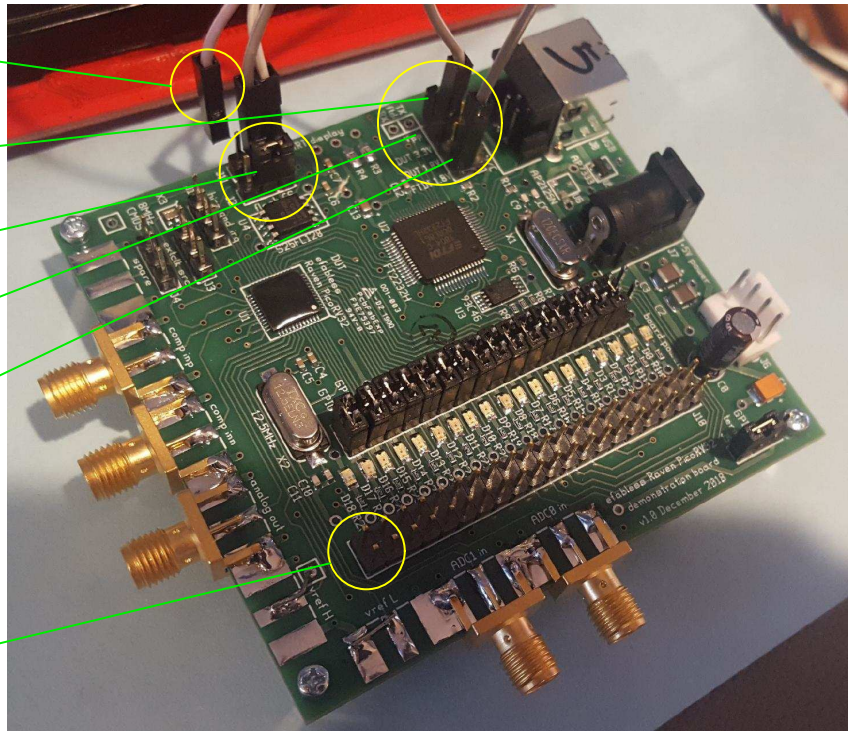
1. Accidental therm put on 4-pin header pin 1, ties Vpp to ground. Therm should be reamed out from ground on the board bottom side.
2. Device AP2125N has the wrong pinout. Device AP7333-18 should be used instead for U6. Device marked AP7333 (U5) is an AP7333-33 (3.3V output).
3. 8MHz CMOS footprint is inverted. Device was rotated to match the power and ground pins. The other two pins (clock and disable) are connected only through jumpers, so the only consequence is that the silkscreen names do not match.

Additional notes:

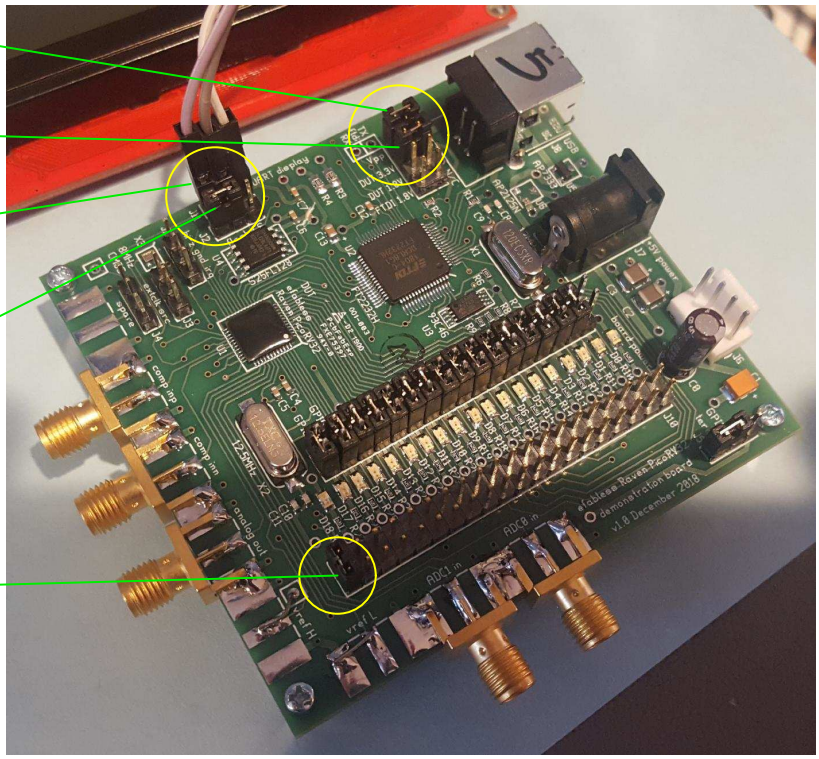
1. Device U6 is optional and should not be installed (Raven does not need additional 1.8V external supply).
2. Device U3 is optional. It can be used to prevent the board from appearing to the host computer as a serial device.
3. Due to lack of disable signals on the flash SPI pins during reset, the Raven chip must be put in a semi-powered-down state to access the flash from a host computer for flash programming. This is accomplished by powering the Raven chip at 1.8V from the FTDI 1.8V output.

Board configurations:

1. *Programming mode*



2. *Run-time mode*



Programming the Raven:

Getting the driver software:

Driver software is tclftdi-1.0. Obtain from http://opencircuitdesign.com/tclftdi

Git repo: use `git clone git://opencircuitdesign.com/tclftdi-1.0`

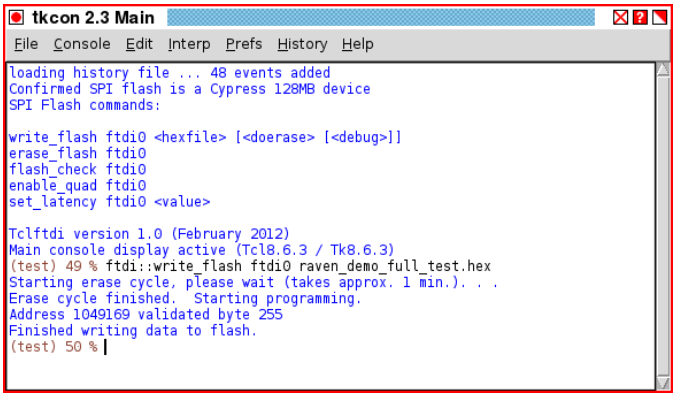
Install according to instructions. Prerequisite packages are tcl-dev, tk-dev, and libftdi-dev (for Ubuntu apt-get; yum equivalents are tcl-devel, tk-devel, and libftdi-devel).

Obtain tclftdi scripts from the Raven standalone repo on github:

```
git clone https://github.com/efabless/raven-picorv32
```

The tclftdi scripts can be found in the `test/` subdirectory.

Script `startup_flash.tcl` is for programming the SPI flash device:



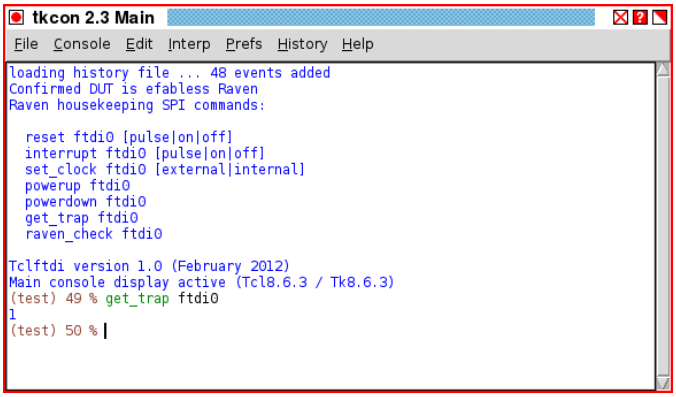
The board must be configured to programming mode (see last page).

Misconfiguration will result in failure to confirm the device, and immediate exit from tclftdi.

Available commands are printed on startup. The main command needed is "write_flash" to write a hex file to the SPI flash.

The file raven_demo_full_test.hex is an example demonstration program. For the source, see the git repo directory `verilog/raven_demo/`

Script `startup_raven.tcl` is for accessing the Raven housekeeping SPI:



The board must be configured to run-time mode (see last page).

Misconfiguration will result in failure to confirm the device, and immediate exit from tclftdi.

Available commands are printed on startup. These commands are not necessary to run a program on the Raven but may be used for testing reset, external IRQ, setting the system clock to the external clock source, adjusting the PLL frequency (trim), enabling and disabling the crystal oscillator and voltage regulators, and reading the state of the PicoRV32 "trap" signal.

Raven external connector:

The Raven test board is equipped with an external connector that matches the Raspberry Pi connector pinout, and allows the Raven chip to be used with Raspberry Pi compatible daughterboards.

Note that some functions are not precisely equivalent to the Raspberry Pi functions. There is no I^2C module on the Raven, so the I^2C pins are no-connects. There is no I^2C-compatible non-volatile memory on the Raven test board, so the EEPROM pins are no-connects. The 5V supply is also a no-connect but can be wired to the USB power supply if needed (note that the rev 1.0 test boards were all modified to use the 5V pin to connect to the VrefH analog input to VDD3V3 to avoid the need for external supplies to set the ADC and DAC reference voltages, so these pins are unavailable for use as a 5V supply connection). The SPI signals connect to the Raven housekeeping SPI and so are not available for use as an SPI master. The TX and RX lines connect to the Raven UART.

The lack of I^2C means that some Raspberry Pi modules like the RTC cannot be used.

Raspberry-Pi compatibility GPIO header (3.3V)

NOTES:
Generally, the GPIO line up with similar channels on the Raspberry Pi board. The GCLK on the Pi is connected to the Raven external clock input. The I^2C lines are not connected. The Raven SPI is connected to the Pi SPI lines.

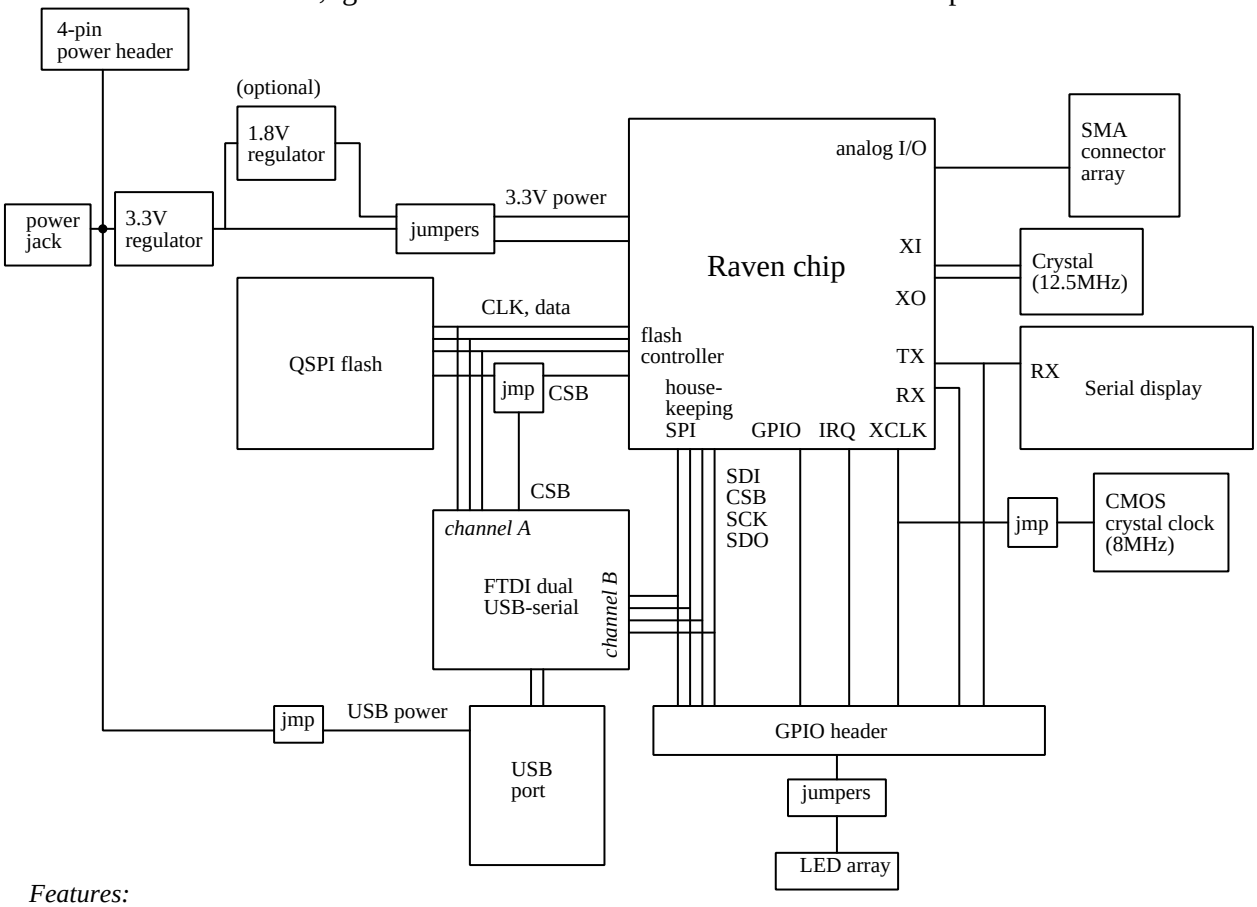
VDD3V3	1	2	5V (From USB or power jack)
N/C (I2C)	3	4	5V
N/C (I2C)	5	6	Ground
EXTCLK	7	8	TX
Ground	9	10	RX
GPIO0	11	12	GPIO1
GPIO2	13	14	Ground
GPIO3	15	16	GPIO4
VDD3V3	17	18	GPIO5
SDI	19	20	Ground
SDO	21	22	GPIO6
SCK	23	24	CSB (Raven)
Ground	25	26	N/C (2nd SPI CSB)
N/C (I2C EEPROM)	27	28	N/C (I2C EEPROM)
GPIO7	29	30	Ground
GPIO8	31	32	GPIO12
GPIO9	33	34	Ground
GPIO10	35	36	GPIO13
GPIO11	37	38	GPIO14
Ground	39	40	GPIO15

Raven demonstration board, block diagram

Obtain PCB layout from the Raven standalone repo on github:

```
git clone https://github.com/efabless/raven-picorv32
```

The layout can be found in the `pcb/` subdirectory. Layout is in gEDA "pcb" format; gerber files are also available. See BOM for complete bill of materials.



Features:

1. Can be powered from external supplies, power jack, or USB.
2. Split supplies if external 1.8V needed; otherwise chip is powered from 3.3V only.
3. Flash chip programmed through FTDI via USB or from SPI header*
4. Raven SPI programmed through FTDI via USB
5. Serial display for text I/O from Raven chip
6. Clock from crystal (100MHz onboard), external (8MHz) or data line (slow)
7. Match Raspberry Pi header pins with GPIO header pins

SPI flash: Cypress S25FL128 or similar (available from Digi-Key).
Use the 8-pin SOIC (4 data + clock, select, power, and ground). 3.3V.

Serial display: Use a SparkFun serial-enabled 16x2 LCD, 3.3V, or the 20x4 SerLCD (available from Digi-Key). Or the 20x2 SerLCD.

FTDI: Use FT2232H (LQFP package)