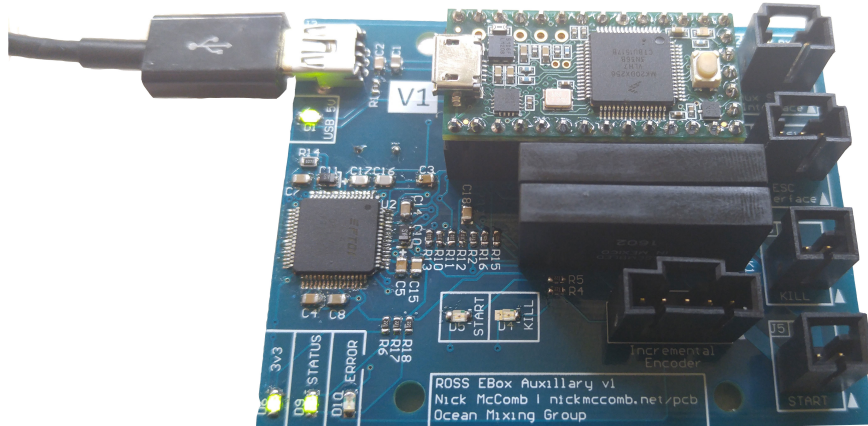


EBox Auxillary v1 PCB Documentation



PCB Design: Nick McComb
Sch Design: Robert Shannon, Corwin Perren
Documentation v1.0 Released 2016/04/08

Ocean Mixing Group
Oregon State University

Additional documentation can be found at
<http://nickmccomb.net/printed-circuit-boards/ross-ebox-auxillary>

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Section 1 | Board Summary

This board was originally designed for the ROSS project.

The Auxillary Board was created as a "catch all" to support kayak operations. It preforms functions that were otherwise left out of other systems designed into the Electronics Box on the kayak. The board preforms 3 primary operations: kayak winch control (optional), "Remote Start" and "Remote Kill" functionality, is a "USB to Serial" bridge for the Flight Management Unit (FMU) (or any other single device that requires it).

The board is powered by a Teensy 3.2 (or a Teensy 3.1)

This documentation is for **Hardware v1**.

Section 2 | Technical Specifications

	MIN	TYP	MAX	UNIT
Normal Conditions				
Supply Voltage	4.4	5	5.25	V
Output Voltage		5		V
uC I/O voltage		3.3		V
Absolute Maximum Conditions				
UART I/O voltage (Aux)	3.3		5	v
START/KILL current			3	A

Figure 1: Technical Specifications for the EBox Auxillary PCB

Section 3 | Board Pinouts

Please note, for all **Molex Connectors**, the triangle (Δ) on the PCB signifies 'pin 1'. This is also (by definition) typically represented by the "red" conductor on the flat flex cable used.

Also note, as of hw version 1, internal schematic notation for pin numbers is backwards from the rest of the documentation. Please use this document (with exclusion of the attached schematic) and the website (see Section 6) as your reference.

3.1 | Incremental Encoder

This connector interfaces with the incremental encoder on the winch. The pinout is as follows:

Pin	Signal	Voltage	uC Pin
1 (red)	Z	5v	D4
2 (blk)	B	5v	D2
3 (blk)	A	5v	D3
4 (blk)	V+	5v	
5 (blk)	GND	GND	

Figure 2: Auxillary Incremental Encoder Connection

3.2 | ESC Interface

This port is for interfacing with an "Electronic Speed Controller" via PWM. This ESC needs to be powered internally because this interface only provides a signal and ground reference.

Pin	Signal	Voltage	uC Pin
1 (red)	PWM	+3v3	D9
2 (blk)	N/C	N/C	
3 (blk)	GND	GND	

Figure 3: Auxillary ESC Output Connection

3.3 | Aux Serial Interface

This connection is provided for the main "flight controller" in the Electronics Box. Currently the Pixhawk needs it's own dedicated USB to UART, and this connection provides it.

The connections are from the perspective of the client device. This means that the FMU (e.g. Pixhawk) TX line needs to **connect to** the TX that is labeled

on the PCB. This can be analogous to thinking that the labels show where you should put the signals on the PCB.

Note: This is different than that is labeled on the schematic. Please reference this documentation and the website.

Pin	Signal	Voltage
1 (red)	Computer RX	5v tolerant
2 (blk)	Computer TX	+3v3
3 (blk)	GND	GND

Figure 4: Aux Serial Connection

3.4 | START/KILL Interface

These interfaces connect to the relays on the board that are controlled by the Teensy to facilitate remote starting and stopping of the engine on the Kayak. Please note that for these applications, the relays have the appropriate resistors "pulling" their values to the appropriate 'initial values', so that the kayak doesn't accidentally try to start the engine on power-up.

The microcontroller interface is described immediately after this paragraph, while the wiring interfaces are described immediately after that.

Signal	uC Pin
AUTO START	D5
AUTO KILL	D6

Figure 5: Remote Start uC interface definition

3.4.1 | KILL

Pin	Signal	Voltage
1 (red)	REAR GND	GND
2 (blk)	REAR KILL	(spark plugs)

Figure 6: KILL connection

When dealing with the Autoboat™ style wiring harness (e.g. the C6343 Alphawire Cable), the start cable colors are as follows: REAR KILL = Green and REAR GND = Blue.

3.4.2 | START

Pin	Signal	Voltage
1 (red)	REAR START	
2 (blk)	REAR BATT	12v

Figure 7: START connection

When dealing with the Autoboat™ style wiring harness (e.g. the C6343 Alphawire Cable), the start cable colors are as follows: REAR START = Orange and REAR BATT = Brown.

3.5 | USB

This board's main interface to the computer is through USB. It employs an FTDI 2232 Dual Uart to USB serial device to achieve this. This allows multiple hardware serial connections through one USB port.

The FTDI device achieves this by emulating either multiple COM ports (on Windows) or multiple hardware ports on linux ("/dev/ttyUSB*"). Once emulated, these devices maintain a consistent order.

Device	Serial Converter "ID"
Teensy 3.X	A
FMU (Aux Serial)	B

Figure 8: FTDI Allocation

Please note that Serial Converter A is always listed before Serial Converter B (e.g. Converter A is COM12 and Converter B is COM13).

3.5.1 | Serial Number

This particular method of USB connection allows for the developer programming of serial numbers. Please note that all devices designed by Nick shall contain a "NM" prefix to their serial number, while the rest remains randomly generated. Example serial number: NMAHQUJ.

Section 4 | Microcontroller Interface Definition

This section describes the interface that the microcontroller has with peripherals on the PCB.

uC Pin	Signal	I/O
D0	Serial RX	I
D1	Serial TX	O
D2	INC_B	I
D3	INC_A	I
D4	INC_Z	I
D5	AUTO START	O
D6	AUTO KILL	O
D7	AUTO START LED	O
D8	AUTO KILL LED	O
D9	ESC SIGNAL	O
D10	n/c	
D11	n/c	
D12	n/c	
D13	n/c	
D14	STATUS LED	O
D15	ERROR LED	O

Figure 9: Microcontroller interface

Note: All of the rest of the pins on the Teensy 3.X are unallocated.

Section 5 | Hardware Options

5.1 | USB Connector

The only option available to the assembler for this product is which USB connector to populate. There are two (J3 and J13), and you should *only* populate one, as well as their associated capacitors. The primary difference is that one connector is horizontal, and the other is vertical, allowing for different mounting methodologies.

Section 6 | Downloads

For downloads, please visit:

<http://nickmccomb.net/printed-circuit-boards/ross-ebox-auxillary>

At that site, you can find:

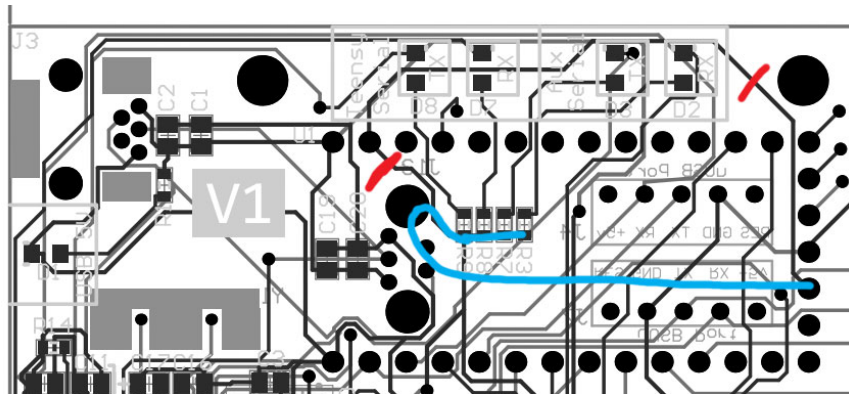
- Photos
- Full Schematic Download
- Bill of Materials

- Design Files (Altium Designer)
- Legacy Schematics (if applicable)
- Legacy Design Files (if applicable)

Section 7 | Assembly Notes

There are a few miscellaneous notes to heed when assembling these boards by hand. They follow:

- In error, the AGND and 3v3 out pins on the Teensy were connected during the design process. This is a relatively simple fix to make. Refer to the following schematic extraction, and cut the traces in the 2 (two) places where it is marked red, then used red wire to connect the bottom of the row of resistors with the appropriate pin (marked on the diagram, it's the 3v3 output pin). This last connection is marked in blue on the diagram below.



- Ensure you reference Section 5.1 to ensure you connect the USB connector correctly.
- This particular FTDI chip requires it's external EEPROM to be programmed. This is a relatively simple process that is supported by an FTDI program called FT Prog. It can be found here: http://www.ftdichip.com/Support/Utilities.htm#FT_PROG

When programming, use the template file "FTDI RS2232 EBox Auxillary Template.xml", available in the appropriate "Hardware" folder, or on the downloads page found in Section 6.

This template file is configured to randomly generate a new serial number, and this feature should be maintained.

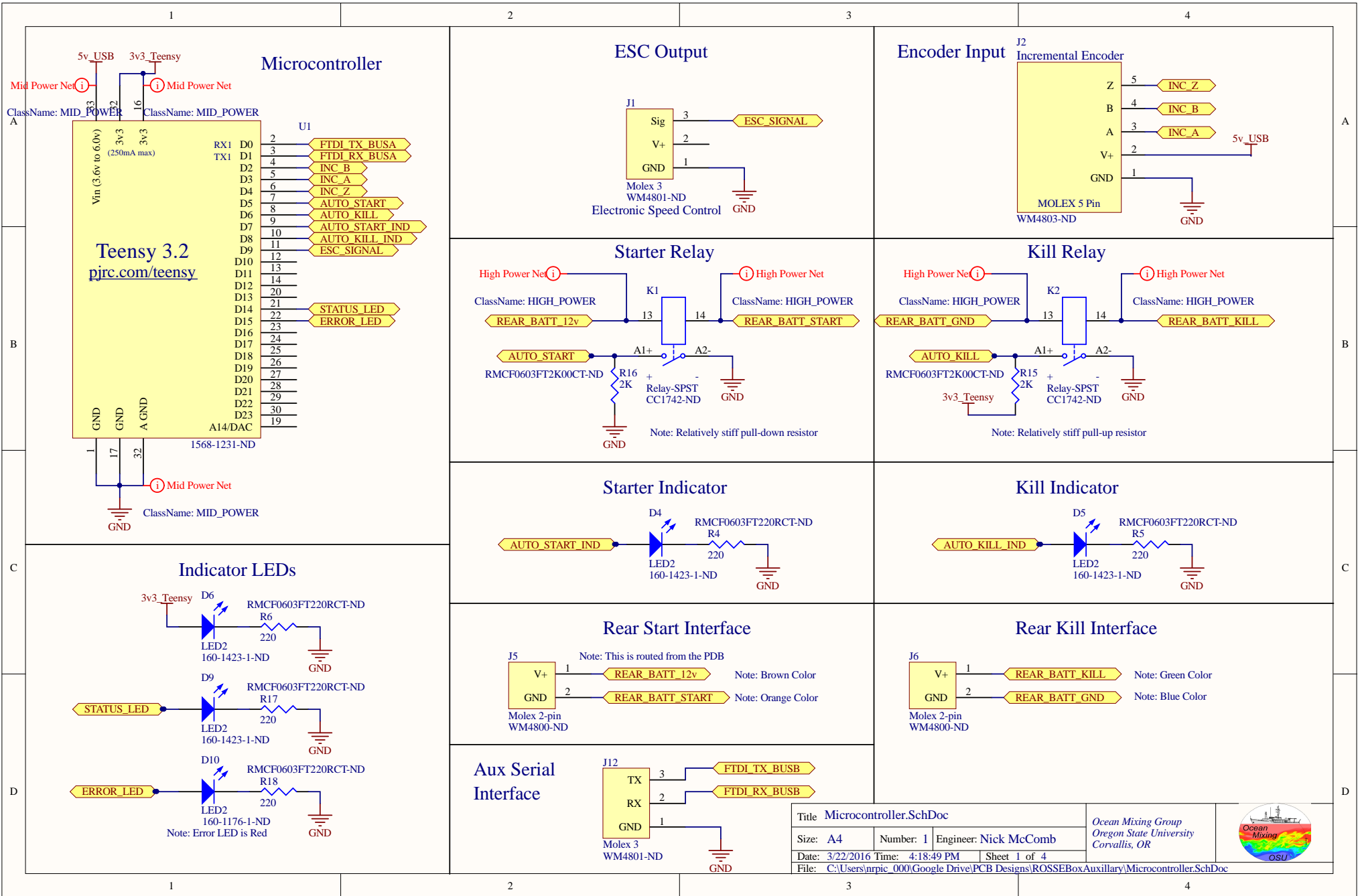
Operation of the program is fairly intuitive, so it will not be described here. It works directly over the USB connection.

Section 8 | Schematic Diagram Notes

The Schematic Diagram has been included in the following pages. For an individual file, please refer to the "Downloads" section (section 6).

Section 9 | Documentation Revision History

Version 1	April 2016	Initial Documentation Release for Hardware v1. This was the first version of documentation released.
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Microcontroller

ESC Output

Encoder Input

Starter Relay

Kill Relay

Starter Indicator

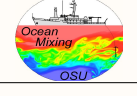
Kill Indicator

Indicator LEDs

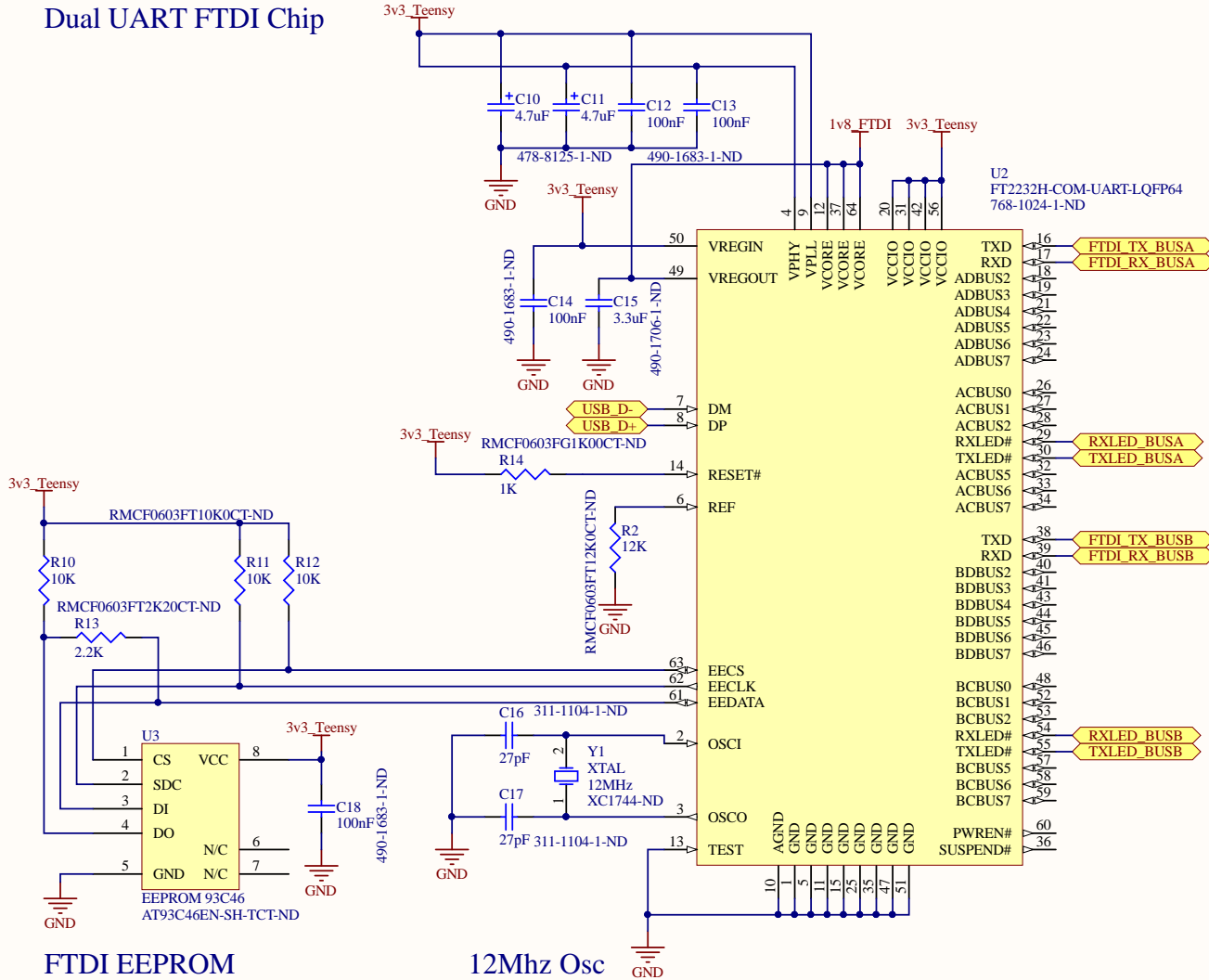
Rear Start Interface

Rear Kill Interface

Aux Serial Interface

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File: C:\Users\nrpic_000\Google Drive\PCB Designs\ROSSEBoxAuxiliary\Microcontroller.SchDoc			

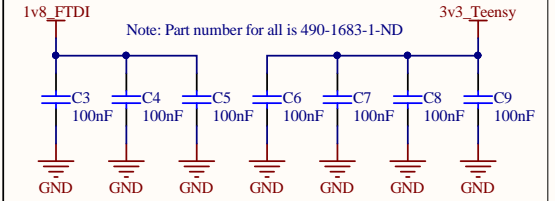
Dual UART FTDI Chip



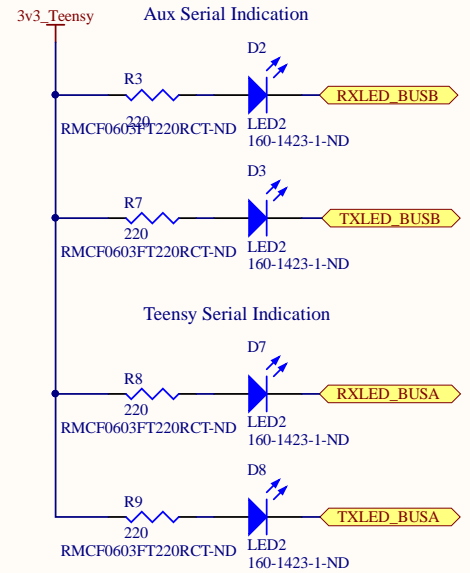
FTDI EEPROM

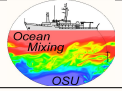
12Mhz Osc

Filtering Caps

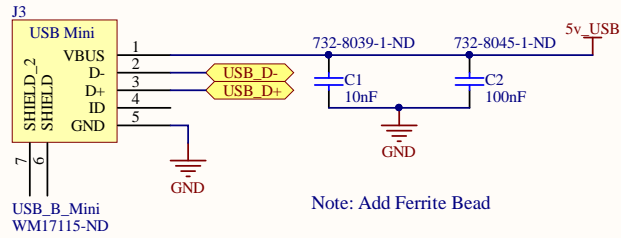


Status LEDs

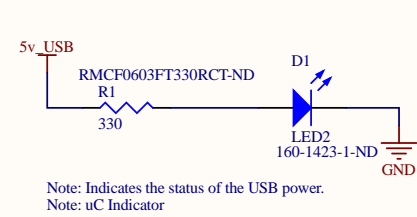


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Microcontroller USB Connection



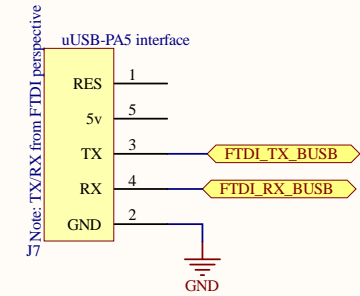
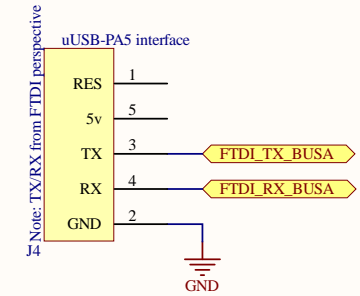
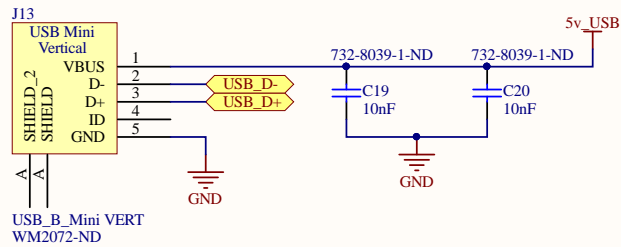
FTDI Status Indicators

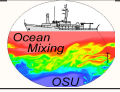


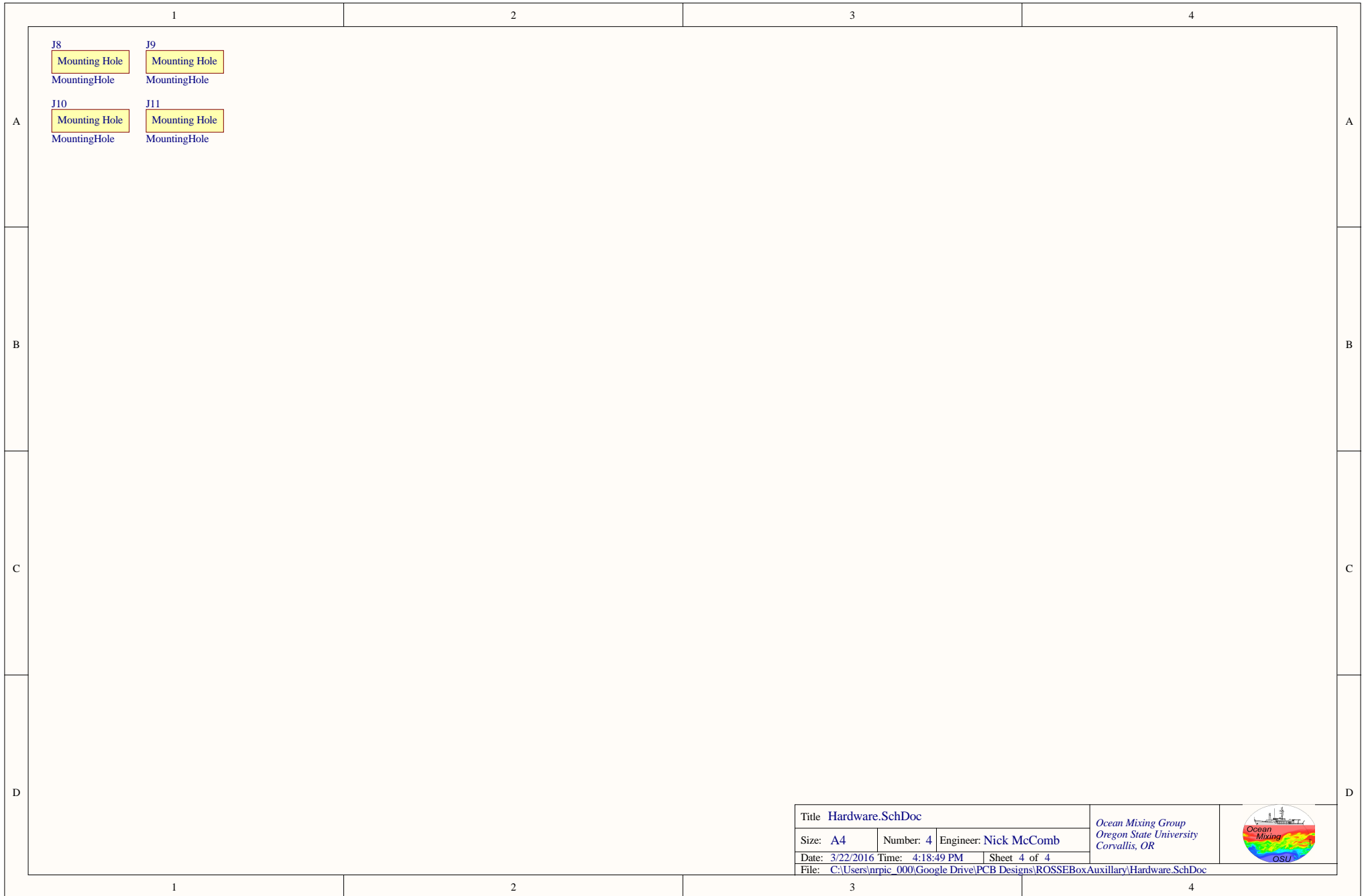
USB To Serial Backup

Note: Backup, do not populate unless onboard FTDI chips do not work

Vertical USB Port



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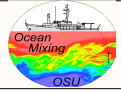


J8
Mounting Hole
MountingHole

J9
Mounting Hole
MountingHole

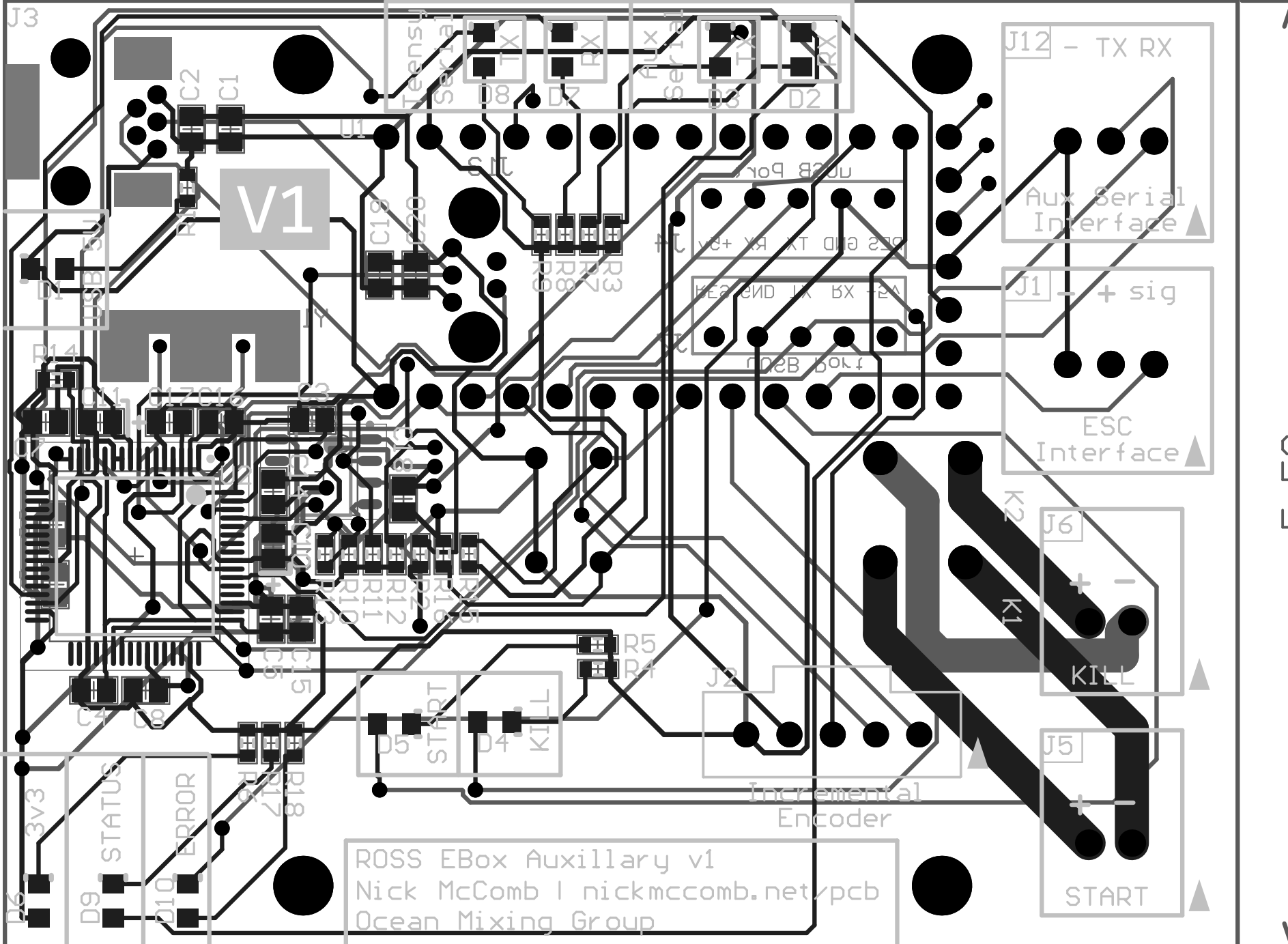
J10
Mounting Hole
MountingHole

J11
Mounting Hole
MountingHole

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7.24

5.58



ROSS EBox Auxillary v1
 Nick McComb | nickmccomb.net/pcb
 Ocean Mixing Group

J3
 P6
 D9 STATUS
 D10 ERROR
 R18
 R17
 R15
 R14
 R13
 R12
 R11
 R10
 R9
 R8
 R7
 R6
 R5
 R4
 R3
 R2
 R1
 C18
 C17
 C16
 C15
 C14
 C13
 C12
 C11
 C10
 C9
 C8
 C7
 C6
 C5
 C4
 C3
 C2
 C1
 D8 TX
 D7 RX
 D6 TX
 D5 START
 D4 KILL
 J12 - TX RX
 J1 - + sig
 J6 + -
 K1
 J5 + -
 START
 KILL
 Incremental Encoder

V1

Aux Serial Interface ▲
 ESC Interface ▲
 KILL ▲
 START ▲