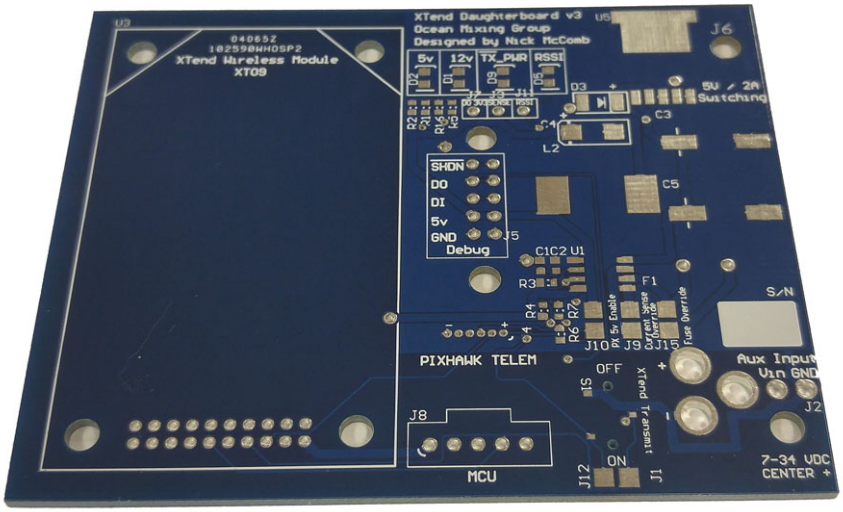
XTend Daughterboard v3 Documentation



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Documentation v1 Released 2015/12/21

Ocean Mixing Group
Oregon State University

Additional documentation can be found at
http://nickmccomb.net/printed-circuit-boards/xtend-daughterboard

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Section 1 | Board Summary

This board was originally designed for the ROSS project.

The Daughterboard was created as a breakout for the Digi 9XTend Wireless module, as it requires a breakout board to function properly. Modifications were also made to enable compatibility with the 3v3 Pixhawk Flight Management Unit by 3D Robotics.

It's features are summarized below:

- Breaks out the XTend's 2mm (not the standard .1" spacing) pins and routes signal and power appropriately.
- Provides 2A @ 5v directly to the XTend from any source between 7v and 16v (designed for a 12v SLA battery pack).
- Preforms Logic Level Conversion of the 5v Serial signal coming out of the XTend to be received by the Pixhawk (or any other 3v3 device).
- Provides current sensing, RSSI, and XTend interface to a 5v serial device (uC, RasPi, etc) via a Molex Connector.

This documentation is for **Hardware v3**.

Section 2 | Technical Specifications

	MIN	TYP	MAX	UNIT
Normal Conditions				
Supply Voltage	7	12	16	V
Output Voltage		5		V
Output Current			2	A
DO (TX)		5		V
DO (3v3) (3v3 TX)		3.3		V
DI (RX)	3.3		5	V
Absolute Maximum Conditions				
Sustained Input Current (10 seconds)			1.35	A
Instantaneous Input Current			2.7	A

Figure 1: Technical Specifications for the XTend Daughterboard

Section 3 | Board Pinouts

3.1 | DF 13 Connector (Pixhawk)

The DF13 (Pixhawk) connector on the board is designed to work with the Pixhawk "TELEM" ports. Note: This documents the pinout from the XTend's perspective. It's pinout is as follows:

Pin	Signal	Voltage
1 (red)	Vcc	+5v
2 (blk)	Rx (IN)	+3v3
3 (blk)	Tx (OUT)	+3v3
4 (blk)	N/C	N/A
5 (blk)	N/C	N/A
6 (blk)	GND	GND

Figure 2: XTend DB DF13 (Pixhawk Connector) Pinout

Please note, Pin 1 is marked "+" and is on the "right" (farthest from the XTend).

3.2 | MCU Connection

The port labeled "MCU" or "MCU Conn" is designed to interface with a 5v serial device. This can be anything from a AVR Microcontroller (Ardiuno) to a USB to UART device. The connector on the board is DigiKey part no. WM4803-ND, and it's pinout is as follows:

Pin	Signal	Voltage
1	GND	GND
2	XT DO	+5v
3	XT DI	+3v3-5v
4	RSSI	+2.8v PWM
5	Current Sense	Analog

Figure 3: XTend DB MCU Molex Connector Pinout

There are a couple of notes that need to be associated with Figure 3.2. They follow:

- Pin 1 is marked, and on the "left" (closest to the XTend).
- The XTend's DO and DI signals stand for "Data Out" and "Data In", these are equivalents to "TX" and "RX". They were used because that's what Digi uses in it's documentation.
- The XTend DI input has been tested to be 5v and 3v3 tolerant.

- If you want to use a 3v3 output from the DB, then use the test point labeled "DO 3v3" or the pin for the Pixhawk DF 13 connector.

3.2.1 | RSSI

RSSI stands for Return Signal Strength Indicator, and it can be used to determine the strength of the signal that the XTend Module is receiving.

The RSSI pin is calibrated to show the difference between received signal strength and the sensitivity level of the RF module. It outputs 2.8v PWM Pulses that vary from a zero to a 95% duty-cycle. The following table shows dB levels above sensitivity and PWM values (The total time period of the PWM output is 8.32ms. PWM Output consists of 40 steps and therefore the minimum step size is 0.208ms.):

dBm above sensitivity	PWM percentage (high/total)
10	20%
20	35%
30	50%

Figure 4: RSSI PWM Values

A non-zero value references the last received RF packet. After a time when no RF packets are received, PWM output is set low until another RF packet is received. The delay is set by the parameter "RP" on the XTend, and it's default value is 3.2 seconds. See XTend Documentation for more.

3.2.2 | Current Sensing

The Current Sensing on the board is provided by an Allegro ACS711 in-line current sensing device. The device itself can measure from -12.5A to +12.5A and outputs a corresponding analog voltage. It is placed to measure the main system input, before any voltage regulation.

In its current configuration, the device is powered with 5v Vcc, so it outputs 2.5v with no current flowing and has an output sensitivity of 167mv/A in either direction (less implying negative current flow).

Note for application with ROSS: The Microcontroller on the Power Distribution board is a 3v3 device, which means it cannot receive a 5v signal. This is not inherently a problem, it just means that you cannot measure more than about 4.5A through the current sense chip without any sort of filtering (such as an OpAmp), but this in turn is not a problem because the circuit is fused to ensure that absolutely no more than 2.7A is drawn at any time. Typical current draw should be less than 1A.

3.3 | Barrel Jack

The Barrel Jack is a standard 2.1mm ID, 5.5mm OD center positive Barrel Jack. For reference, it's DigiKey part number is CP-002A-ND. It is only rated to 16v, contrary to what the label next to it says.

Section 4 | Hardware Options

When using this board, there are 3 hardware "switches" that can be soldered to create a permanent switch. Their functions are described below:

4.1 | PX 5v Enable

This switch controls whether 5v is outputted over pin 1 on the DF13 connector. By default, this pin is not connected to 5v because the Pixhawk has its own internal 5v rail and should not be connected to the XTend's power source. This could be useful if you want to reference the XTend's 5v supply externally.

NOTE: This 5v connection should be used for reference only. The XTend uses all of the available power on the board, so this cannot be used to power anything else.

4.2 | Current Sense Override

This switch bypasses the Current Sense device, which is useful if this is not a desired feature, or if you do not have the proper chip.

4.3 | Fuse Override

This switch Bypasses the PTC fuse (F1) on the board.

Section 5 | Downloads

For downloads, please visit:

http://nickmccomb.net/printed-circuit-boards/xtend-daughterboard

At that site, you can find:

- Photos
- Full Schematic
- Bill of Materials
- Design Files (Altium Designer)
- Legacy Schematics
- Legacy Design Files

Section 6 | Assembly Notes

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

- J9, J10, and J15 are "SMT Jumpers", and should be connected only if the labeled option is desired. See "Hardware Options" (section 4) for more details.

- D3 should be placed with the cathode of the diode facing towards the "+" on the board (as labeled).
- C3 and C5's negative terminals are marked on the board.
- (as of version 3) C1 and C2 are poorly labeled, they should be vertical with respect to the rest of the board.
- (as of version 3) U1 is poorly labeled, it's pin one is closest to the "F1" label on the PCB (bottom right).
- The Debug Header should remain unpopulated.
- Make sure you install S1 before J1, as the Barrel Jack can get in the way when installing the switch.

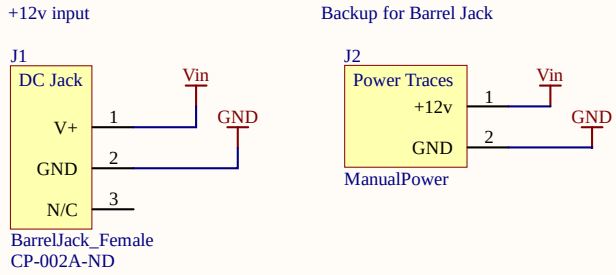
Section 7 | Schematic Diagram Notes

The Schematic Diagram has been included in the following pages. For a full version, please refer to the "Downloads" section (section 5).

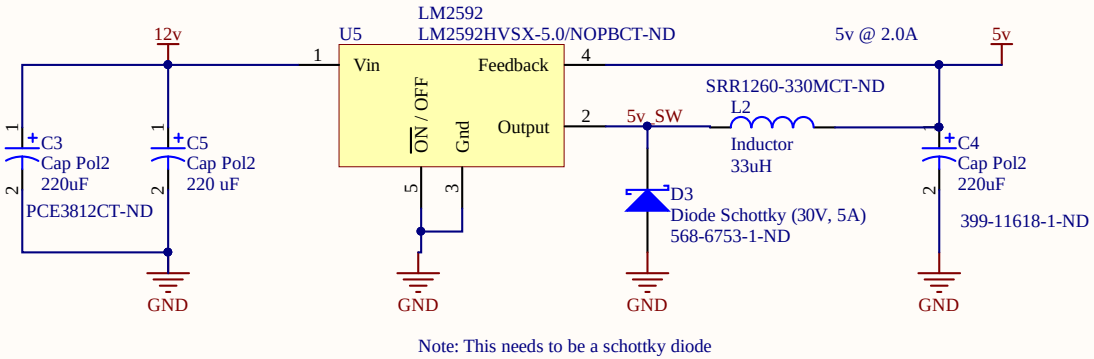
Section 8 | Documentation Revision History

Version 1	December 2015	Initial Documentation Release for Hardware v3. This was the first version of documentation released.

Power Input

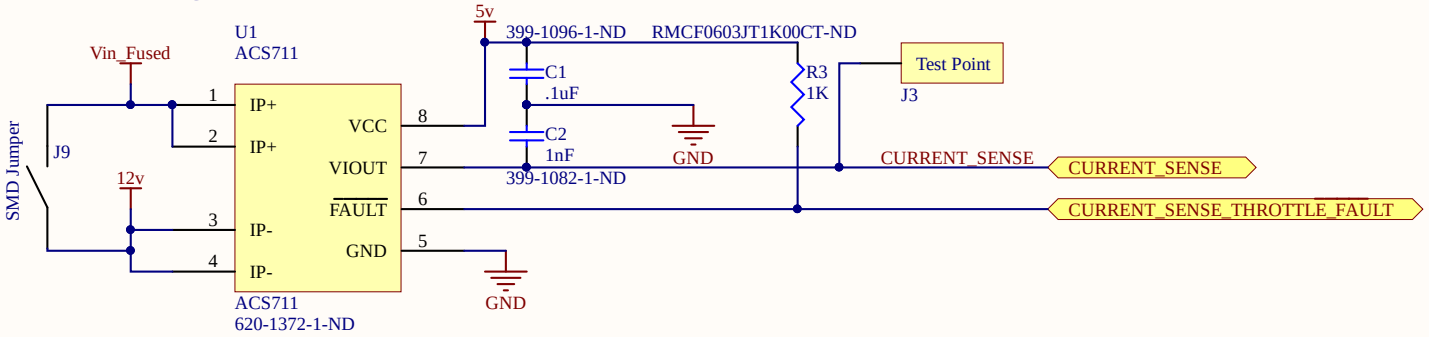


Voltage Regulation

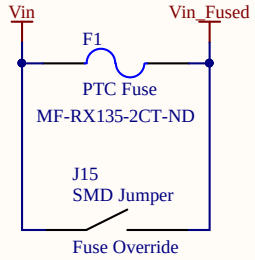


Note: This needs to be a schottky diode

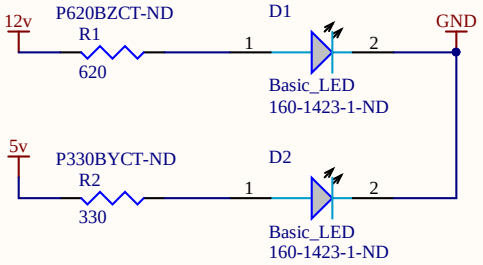
Current Sensing



Fusing



Power LEDs



Miscellaneous Hardware

J6 Mounting Holes

J13 Mounting Holes

J14 Mounting Holes

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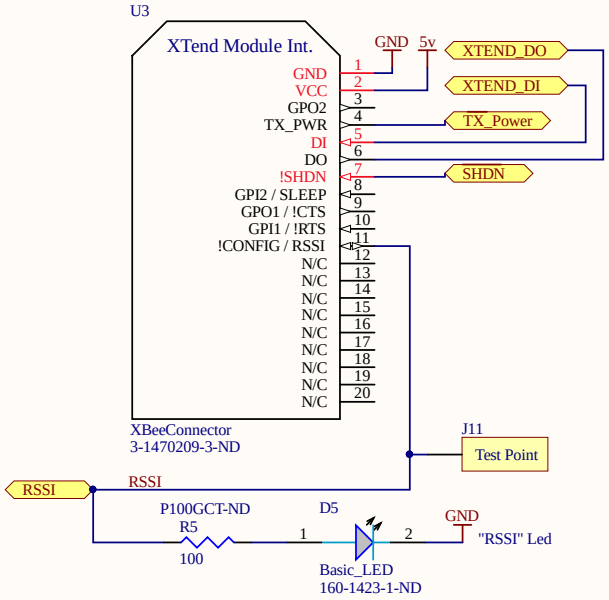
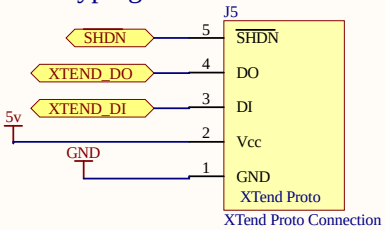
Ocean Mixing Group
Oregon State University
Corvallis, OR

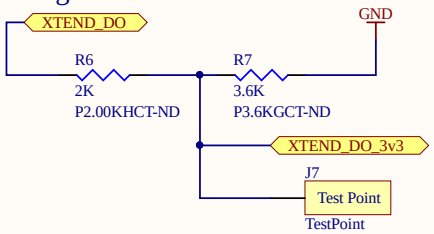
XTend Connection



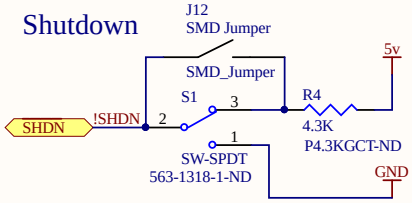
"Prototyping" Connection



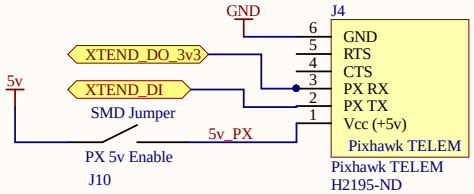
Logic Level Conversion



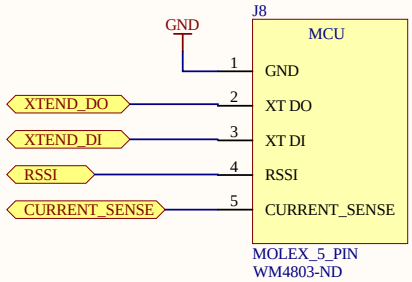
Shutdown



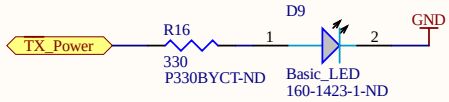
Pixhawk CONN



MCU CONN



TX LED



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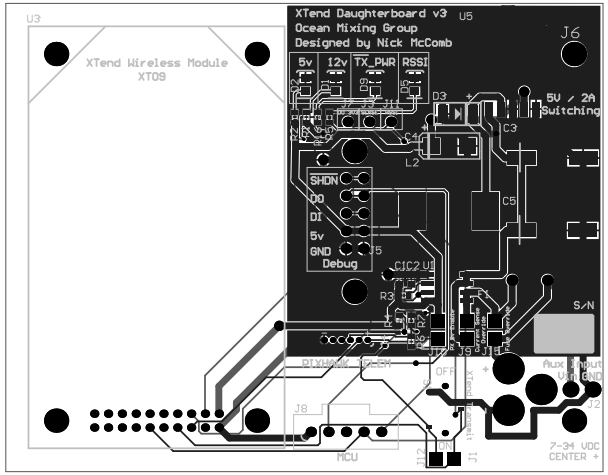
XTend Daughterboard v3
Ocean Mixing Group
Designed by Nick McComb
XTend Wireless Module
XT09
5v
12v
TX_PWR
RSSI
5V / 2A
Switching
SHDN
DO
DI
5v
GND
Debug
S/N
MCU
7-34 VDC
CENTER +