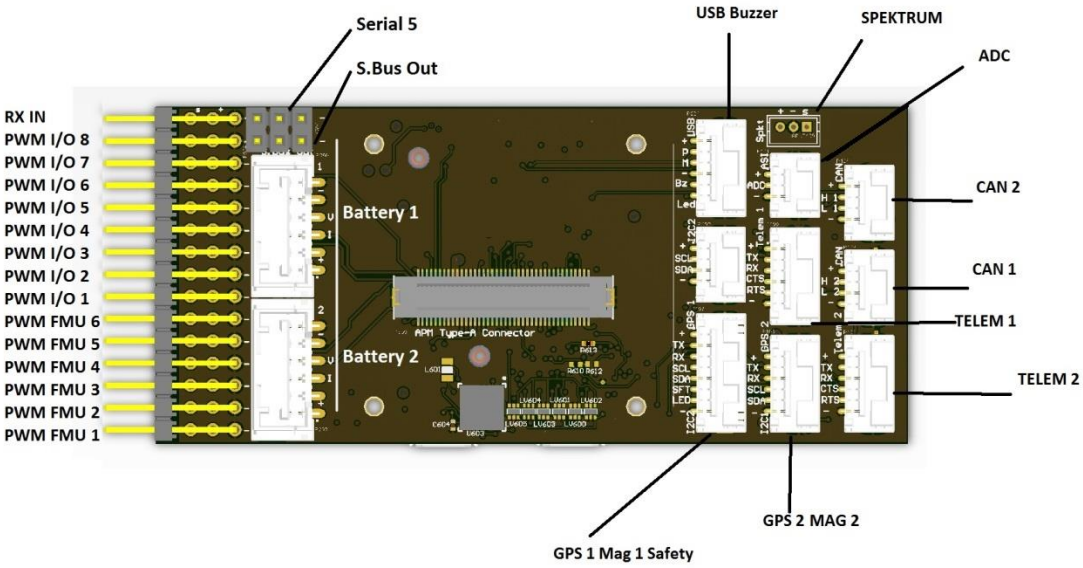
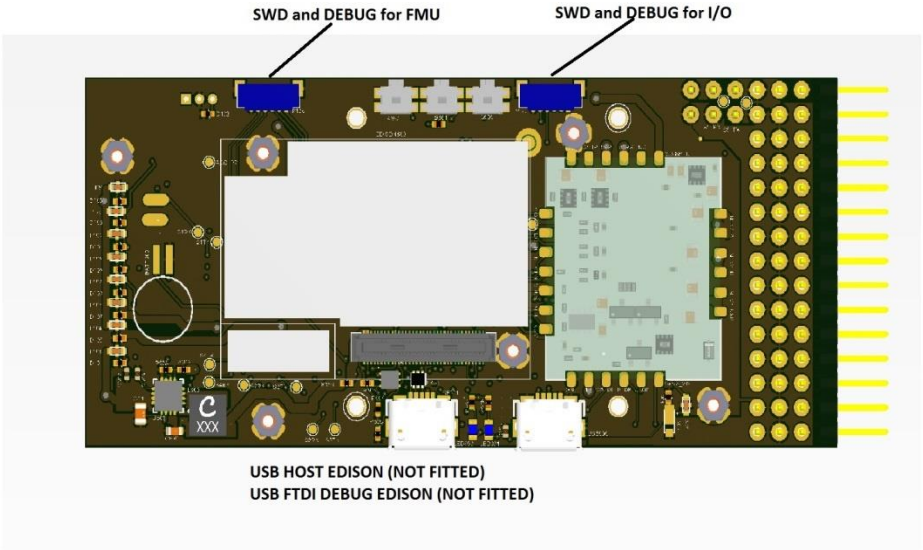
Pixhawk v2 Feature Overview

Note: This document is derived from the specification of the Px4-V2 (Pixhawk)





Contents

Goals for this iteration of the platform are:

• An integrated, single board / box flight controller.
• Sufficient I/O for most applications without expansion.
• Improved ease-of-use.
• Improved sensor performance.
• Improved microcontroller resources.
• Increased reliability and reduced integration complexity.
• Reduced BoM and manufacturing costs.

Key design points

• All-in-one design with integrated FMU and IO and lots of I/O ports.
• Improved manufacturability, designed for simpler mounting and case design.
• Separate power supplies for FMU and IO (see power architecture section).
• On-board battery backup for FMU and IO SRAM / RTC.
• Integration with the standard power brick.

Pixhawk FMU Main Board

• STM32F427; flash 2MiB, RAM 256KiB.
• On-board 16KiB SPI FRAM
• MPU9250 or ICM 20xxx integrated accelerometer / gyro.
• MS5611 Baro
• All sensors connected via SPI.
• Micro SD interfaces via SDIO.

Vibration Damped IMU board

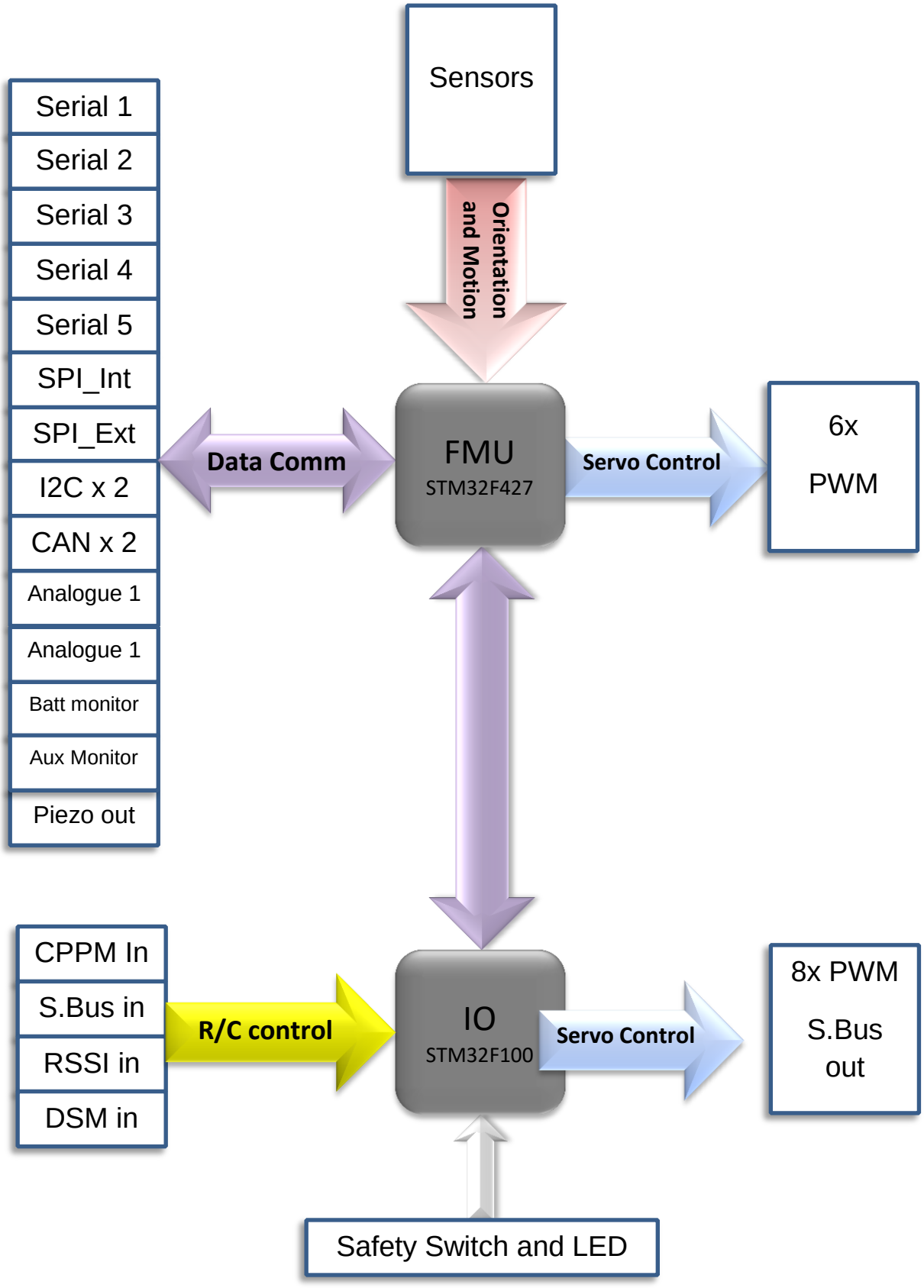
• LSM303D integrated accelerometer / magnetometer.
• L3GD20 gyro.
• MPU9250 or ICM 20xxx Gyro / Accel
• MS5611 Baro
• All sensors connected via SPI.

I/O ports

• 14 PWM servo outputs (8 from IO, 6 from FMU).
• R/C inputs for CPPM, Spektrum / DSM and S.Bus.
• Analogue / PWM RSSI input.
• S.Bus servo output.
• 5 general purpose serial ports, 2 with full flow control
• Two I2C ports
• One SPI port (un-buffered, for short cables only not recommended for use).
• Two CAN Bus interface.
• 3 Analogue inputs
• High-powered piezo buzzer driver. (On expansion board)
• High-power RGB LED. (I2C driver compatible Connected externally only)
• Safety switch / LED.

System architecture

Pixhawk V2 continues with the PX4FMU+PX4IO architecture from the previous generation, incorporating the two functional blocks in a single physical module.



PWM Outputs

Pixhawk V2 has eight PWM outputs that are connected to IO and can be controlled by IO directly via R/C input and on-board mixing even if FMU is not active (failsafe / manual mode). Multiple update rates can be supported on these outputs in three groups; one group of four and two groups of two. PWM signal rates up to 400Hz can be supported.

Six PWM outputs are connected to FMU and feature reduced update latency. These outputs cannot be controlled by IO in failsafe conditions. Multiple update rates can be supported on these outputs in two groups; one group of four and one group of two. PWM signal rates up to 400Hz can be supported.

All PWM outputs are ESD-protected, and they are designed to survive accidental misconnection of servos without being damaged. The servo drivers are specified to drive a 50pF servo input load over 2m of 26AWG servo cable.

PWM outputs can also be configured as individual GPIOs. Note that these are not high-power outputs – the PWM drivers are designed for driving servos and similar logic inputs only, not relays or LEDs.

Peripheral Ports

Pixhawk V2 Differs from Pixhawk V1 in that all peripherals are connected through a single 80 pin connector, and the peripherals are connected via a baseboard that can be customised for each application

Base Board

The initial base board features separate connectors for each of the peripheral ports (with a few exceptions.

Five serial ports are provided. Serial 1 and 2 feature full flow control. Serial 3 is recommended as the GPS port and has the safety button and (possibly the safety led) as well as I2C for the compass and RGB LED. Serial 4 also has I2C, but on the second bus, thus allowing two compass modules to be connected at the same time. Serial 5 is available as a header underneath the board. Serial ports are 3.3V CMOS logic level, 5V tolerant, buffered and ESD-protected.

The SPI port is not buffered; it should only be used with short cable runs. Signals are 3.3V CMOS logic level, but 5V tolerant. SPI is only available to test points on the first base board, along with a CS and INT pin.

Analogue 1-3 are protected against inputs up to 12V, but scaled for 0-3.3V inputs.

The RSSI input supports either PWM or analogue RSSI. This input shares a pin with S.Bus output - only one may be connected at a time.

CPPM, S.Bus and DSM/Spektrum input are unchanged from Pixhawk

The CAN ports are standard CAN-Bus; termination for one end of the bus is fixed on-board. Drivers are on-board the FMU

The piezo port will drive most piezo elements in the 5 - 300nF range at up to 35V. it is intended to be *extremely loud*, with the achievable sound pressure level limited by the sensitivity of the piezo element being driven.

I2C is direct driven, un-buffered, and pulled up to 3.3v on-board the FMU

Sensors

All flight sensors in Pixhawk V2 are connected via SPI.
On-board we have an MPU9250 or ICM 20xxx Gyro and Accelerometer, and a MS5611 used in SPI mode.
On the ***vibration isolated board,*** we have the L3GD20 gyro, the LSM303D Accelerometer and magnetometer, another MPU9250 or ICM 20xxx, and MS5611 also used in SPI mode.
The board mounted sensors run on a separate bus to the Vibration isolated sensors.

Data-ready signals from all sensors are **NO LONGER ROUTED**

Power Architecture

The Pixhawk V2 removes the power management from the FMU, it instead grows on the Pixhawk power by removing the Servo rail as the primary source of backup power for the FMU, and it leaves it there for the IO last chance failsafe.
The supply of 3.3v remain the same as Pixhawk 1
• Split digital and analogue power domains for FMU and sensors.
• Backup power for IO in the case of FMU power supply failure.

Power management module (separate from the FMU)

Key features of the Pixhawk V2 power architecture:
• Single, independent 5V supply for the flight controller and peripherals.
• Integration with 2 power bricks or compatible alternative, including current and voltage sensing.
• Low power consumption and heat dissipation.
• Power distribution and monitoring for peripheral devices.
• Protection against common wiring faults; under/over-voltage protection, overcurrent protection, thermal protection.
• Brown-out resilience and detection.

FMU and IO Power Supplies

Both FMU and IO operate at 3.3V, and each has its own private dual-channel regulator. As in Pixhawk v1, each regulator features a power-on reset output tied to the regulator's internal power-up and drop-out sequencing.

Power Sources

Power may be supplied to Pixhawk V2 via USB, via the power brick port, or the second brick port. Each power source is protected against reverse-polarity connections and back-powering from other sources.
The FMU + IO power budget is 250mA, including all LEDs and the Piezo buzzer. Peripheral power is limited to 2.5A total.

Power Brick Port

The brick port is the preferred power source for Pixhawk V2, and brick power will always be selected if it is available.

Servo Power

Pixhawk V2 supports both standard (5V) and high-voltage (up to 10V) servo power with some restrictions.
IO will accept power from the servo connector up to 10V. This allows IO to failover to servo power in all cases if the main power supply is lost or interrupted.

FMU and peripherals will NO LONGER accept power from the servo connector.

Aux Power

Pixhawk V2 introduces a backup power port; this is set up the same as the primary power input.
At input voltages over 5.7V power is locked out.

Pixhawk V2 and peripherals combined may draw up to 2.75A total when operating on Aux power, provided that the Brick or other power source can supply the required current.

Power is never supplied by Pixhawk V2 to servos.

Servo rail

The I/O chip takes power up to 10.5v from the servo rail; this is used to revert to manual mode in the unfortunate event that the other two main sources of power fail. This is only useful for plane, and only useful if the I/O chip has been mapped correctly.

USB Power

Power from USB is supported for software update, testing and development purposes. USB power is supplied to the peripheral ports for testing purposes, however total current consumption must typically be limited to 500mA, including peripherals, to avoid overloading the host USB port.

Multiple Power Sources

When more than one power source is connected, power will be drawn from the highest-priority source with a valid input voltage.
In most cases, FMU should be powered via the power brick or a compatible off board regulator via the brick port or auxiliary power rail.
In desktop testing scenarios, taking power from USB avoids the need for a BEC or similar servo power source (though servos themselves will still need external power).

Summary

For each of the components listed, the input voltage ranges over which the device can be powered from each input is shown.

	Brick port	Aux port	USB port	Servo rail
FMU	4 - 5.7V	4 - 5.7V	4 - 5.7V	NIL
IO	4 - 5.7V	4 – 5.7V	4 - 5.7V	4-10.5V
Peripherals	4 - 5.7V, 2.5A max	4 - 5.7V 2.5A max	4 - 5.7V 250mA max	NIL

Peripherals

Peripheral Power (on power module)

Pixhawk V2 provides power routing, over/under voltage detection and protection, filtering, switching, current-limiting and transient suppression for peripherals. Power outputs to peripherals feature ESD and EMI filtering, and the power supply protection scheme ensures that no more than 5.5V is presented to peripheral devices. Power is disconnected from the peripherals when the available supply voltage falls below 2.7V, or rises above approximately 5.7V.

Peripheral power is split into two groups:
• Serial 1 has a private 1.5A current limit, intended for powering a telemetry radio. This output is separately EMI filtered and draws directly from the USB / Brick inputs. Peak power draw on this port should not exceed 2A, which should be sufficient for a 30dBm transmitter of reasonable efficiency.
• All other peripherals share a 1A current limit and a single power switch. Peak power draw on this port should not exceed 1.5A.

Each group is individually switched under software control.
The Spektrum / DSM R/C interface draws power from its own regulator, rather than from either of the groups above. This port is switched under software control so that Spektrum / DSM binding can be implemented. Spektrum receivers generally draw ~25mA.
S.Bus and CPPM receivers powered directly from the servo rail, and must support the servo supply voltage.

Battery Backup

Both the FMU and IO microcontrollers feature battery-backed real-time clocks and SRAM. The on-board backup battery has capacity sufficient for the intended use of the clock and SRAM, which is to provide storage to permit orderly recovery from unintended power loss or other causes of in-air restarts.
The capacitors are recharged from the FMU 3.3V rail.
this will only function in the event of software existing to support this feature.

Voltage, Current and Fault Sensing

The battery voltage and current reported by both bricks can be measured by the FMU. In addition, the 5V unregulated supply rail can be measured (to detect brown-out conditions). IO can measure the servo power rail voltage. Over-current conditions on the peripheral power ports can be detected by the FMU. Hardware lock-out prevents damage due to persistent short-circuits on these ports. The lock-out can be reset by FMU software.

The under/over voltage supervisor for FMU provides an output that is used to hold FMU in reset during brown-out events.

EMI Filtering and Transient Protection (on the normal Base Board, must be specified for externally supplied base boards.)

EMI filtering is provided at key points in the system using high-insertion-loss pass-through filters. These filters are paired with TVS diodes at the peripheral connectors to suppress power transients.

Reverse polarity protection is provided at each of the power inputs.
USB signals are filtered and terminated with a combined termination/TVS array.
Most digital peripheral signals (all PWM outputs, serial ports, I2C port) are driven using ESD-enhanced buffers and feature series blocking resistors to reduce the risk of damage due to transients or accidental misconnections.

PIXHAWK 2 Series Interface Spec

Scope of this Document

This document covers the complete interface standard and core mechanical, electrical and external connection options of the Pixhawk 2 module series. Sections marked as LT (long term) are intended to be kept stable to isolate vehicle from autopilot revisions.

Interface Standard

Connector Series

- Low density: 0.1” over mould Futaba keyed servo connectors (Mfg. to be identified)
    - Cabling: AWG24, ribbon or round, iconic colour scheme
- Stack: Hirose DF17, 80pos, 4 mm stacking height, 0.5 mm pitch, drop-proof
- High density: JST-GH 1.25 mm
    - Cabling: AWG28, ribbon, iconic colour scheme
- Power Module: Molex Clik-Mate 2 mm for both main and backup power (on bottom of board?)

Pixhawk 2

Mechanical: 30x30 mm M3 mounting hole pattern, 35x35 mm footprint
80 position DF17 connector. Carries *all* autopilot interface connections.

- Minimal (read: really minimal) electrical protection
- No power management
- 3.8 to 5.7V operation (absolute maximum ratings)
- 4.0 to 5.5V operation (compliant rating)

Pixhawk 2IO

Total connectivity

- I2C2
- 2x CAN: CAN1 and CAN2
- 4x UART: TELEM1, TELEM2, GPS (I2C 1 embedded), SERIAL4(I2C 2 embedded)
- 1x Console: CONSOLE (SERIAL5)
- 1x HMI: USB extender

Power 6 pos (ClikMate 6 pos 2.0mm)

Pin #	Name	Dir	Wire Color	Description
1	VDD 5V Brick	in	red / gray	Supply from Brick to AP
2	VDD 5V Brick	in	red / gray	Supply from Brick to AP
3	BATT_VOLTAGE_SENS_PROT	in	black	Battery voltage connector
4	BATT_CURRENT	in	black	Battery current connector

	_SENS_PROT			
5	GND	-	black	GND connection
6	GND	-	black	GND connection

Backup Power 6 pos

Pin #	Name	Dir	Wire Color	Description
1	VDD 5V Brick	in	red / gray	Supply from Brick to AP
2	VDD 5V Brick	in	red / gray	Supply from Brick to AP
3	AUX_BATT_VOLTAGE_SENS			Aux Battery voltage connector
4	AUX_BATT_CURRENT_SENS	in	black	Aux Battery current connector
5	GND	-	black	GND connection
6	GND	-	black	GND connection

I2C - 4 pos (1 fitted as a stand alone, I2C_2, (old internal)

1 connector: I2C2 bus

Pin #	Name	Dir	Wire Color	Description
1	VCC_5V	out	red / gray	Supply to peripheral from AP
2	SCL	in/out	blue / black	SCL, 5V level, pull-up on AP
3	SDA	in/out	green / black	SDA, 5V level, pull-up on AP
4	GND	-	black	GND connection

CAN (2 fitted)

2 connectors: CAN1 and CAN2 buses

Pin #	Name	Dir	Wire Color	Description
1	VCC_5V	out	red / gray	Supply to peripheral from AP
2	CAN_H	in/out	yellow / black	12V
3	CAN_L	in/out	green / black	12V
4	GND	-	black	GND connection

UART GENERIC (autopilot side)

2 connectors: TELEM1, TELEM2

Pin #	Name	Dir	Wire Color	Description
1	VCC_5V	out	red / gray	Supply to GPS from AP
2	MCU_TX	out	yellow / black	3.3V-5.0V TTL level, TX of AP
3	MCU_RX	in	green / black	3.3V-5.0V TTL level, RX of AP
4	MCU_CTS (TX)	out	gray / black	3.3V-5.0V TTL level or TX of AP
5	MCU_RTS (RX)	in	gray / black	3.3V-5.0V TTL level or RX of AP
6	GND	-	black	GND connection

UART GPS (autopilot side, I2C is the original "External" bus)

1 connector: GPS

Pin #	Name	Dir	Wire Color	Description
1	VCC_5V	in	red	Supply to GPS from AP
2	GPS_RX	in	black	3.3V-5.0V TTL level, TX of AP
3	GPS_TX	out	black	3.3V-5.0V TTL level, RX of AP
4	SCL	in	black	3.3V-5.0V I2C1
5	SDA	in/out	black	3.3V-5.0V I2C1
6	BUTTON	out	black	Signal shorted to GND on press
7	BUTTON_LED	out	black	LED Driver for Safety Button
8	GND	-	black	GND connection

UART 4 (I2C 2, the original "Internal" bus)

1 connector: GPS

Pin #	Name	Dir	Wire Color	Description
1	VCC_5V	out	red / gray	Supply to GPS from AP
2	MCU_TX	out	yellow / black	3.3V-5.0V TTL level, TX of AP

3	MCU_RX	in	green / black	3.3V-5.0V TTL level, RX of AP
4	SCL	out	gray / black	3.3V-5.0V I2C2
5	SDA	in	gray / black	3.3V-5.0V I2C2
6	GND	-	black	GND connection

UART 5(Debug) and S.Bus out

1 connector: FR-SKY TELEM? or Debug

Pin #	Name	Dir	Wire Color	Description
1	S.Bus Out	out		3.3V-5.0V TTL level, TX of AP
2	MCU_TX	out		3.3V-5.0V TTL level, TX of AP
3	VDD_Servo	OUT		Servo rail voltage
4	MCU_RX	in		3.3V-5.0V TTL level, RX of AP
5	GND	out		GND
6	GND	out		GND

Debug (New Standard Debug) (Digikey PN for housing SM06B-SURS-TF(LF)(SN)-ND)

IO DEBUG

Pin #	Name	Dir	Wire Color	Description
1	VDD 5V PEIPH	OUT		5V
2	IO_TX	out		3.3V-5.0V TTL level, TX of AP IO_uart1 TX
3	IO_RX	in		3.3V-5.0V TTL level, RX of AP IO_uart1 RX
4	IO-SWDIO	I/O		Serial wire debug I/O
5	IO-SWCLK	I/O		Serial wire Clock
6	GND	out		GND

FMU DEBUG

Pin #	Name	Dir	Wire Color	Description
1	VDD 5V PEIPH	OUT		5V
2	FMU_TX (SERIAL 5)	out		3.3V-5.0V TTL level, TX of AP FMU_uart5 TX
3	FMU_RX (SERIAL 5)	in		3.3V-5.0V TTL level, RX of AP FMU_uart5 RX
4	FMU-SWDIO	I/O		Serial wire debug I/O
5	FMU-SWCLK	I/O		Serial wire Clock
6	GND	out		GND

Analogue

Pin #	Name	Dir	Wire Color	Description
1	VDD_5V_Periph	out		
2	Pressure sense in	in		
3	GND	out		GND

Spektrum

Pin #	Name	Dir	Wire Color	Description
1	VDD_3v3_spektrum	out		Independent supply 3v3.
2	IO_USART1_RX	in		
3	GND	out		GND

HMI (Buzzer, USB, LEDs)

Pin #	Name	Dir	Wire Color	Description
1	VCC_5V	out	red / gray	Supply to GPS from AP
2	D_PLUS	in/out	green / black	3.3V
3	D_MINUS	in/out	red / black	3.3V
4	GND	-	black	GND connection
5	BE_LED	out	black	Boot / Error Led (FW updates)
6	BUZZER	out	gray / black	VBAT (8.4 - 42V)

Back Edge (may rearrange to suit PCB layout)

SERVO HEADER (0.1", 1/1/15 power layout)

Position	Name	Dir	Wire Color	Description
15	RC / SBUS IN	in/out	black	3.3V (4..5V powered)
14	MAIN_OUT_8	out	black	3.3V servo signal, servo rail power
13	MAIN_OUT_7	out	black	3.3V servo signal, servo rail power
12	MAIN_OUT_6	out	black	3.3V servo signal, servo rail power
11	MAIN_OUT_5	out	black	3.3V servo signal, servo rail power
10	MAIN_OUT_4	out	black	3.3V servo signal, servo rail power
9	MAIN_OUT_3	out	black	3.3V servo signal, servo rail power
8	MAIN_OUT_2	out	black	3.3V servo signal, servo rail power

7	MAIN_OUT_1	out	black	3.3V servo signal, servo rail power
6	AUX_OUT_6	out	black	3.3V servo signal, servo rail power
5	AUX_OUT_5	out	black	3.3V servo signal, servo rail power
4	AUX_OUT_4	out	black	3.3V servo signal, servo rail power
3	AUX_OUT_3	out	black	3.3V servo signal, servo rail power
2	AUX_OUT_2	out	black	3.3V servo signal, servo rail power
1	AUX_OUT_1	out	black	3.3V servo signal, servo rail power

80 pin header (LONG TERM STANDARD!)

Pin #	Name	Dir	Description
1	FMU-SWDIO	i/o	Single wire debug io
2	!FMU-LED_AMBER	o	Boot error LED (drive only, use Fet to control led)
3	FMU-SWCLK	o	single wire debug clock
4	I2C_2_SDA	i/o	I2C data io
5	!EXTERN_CS	o	chip select for external SPI (NC, just for debugging)
6	I2C_2_SCL	o	i2c clock
7	FMU-!RESET	i	reset pin for the FMU
8	CAN_L_3		Future compatibility
9	VDD_SERVO_IN	i	power for last resort i/o failsafe
10	CAN_H_3		Future compatibility
11	EXTERN_DRDY	i	interrupt pin for external SPI (NC, just for debugging)
12	SERIAL_5_RX	i	
13	GND		System GND
14	SERIAL_5_TX	o	
15	GND		System GND
16	SERIAL_4_RX	i	
17	SAFETY		Safety button input
18	SERIAL_4_TX	o	
19	vdd_3V3_SPECTRUM_EN	o	enable for the spectrum voltage regulator
20	SERIAL_3_RX	i	
21	PREASSURE_SENS_IN	a i	Analogue port, for pressure sensor, or Laser range finder, or Sonar
22	SERIAL_3_TX	o	
23	AUX_BATT_VOLTAGE_SENS	a i	Voltage sense for Aux battery input
24	ALARM	o	Buzzer PWM signal
25	AUX_BATT_CUR	a i	Current sense for Aux battery input

	RENT_SENS		
26	IO-VDD_3V3	i	IO chip power, pinned through for debug
27	!VDD_5V_PERIPH_EN	o	enable signal for Peripherals
28	!IO-LED_SAFETY_PROT	o	IO-LED_SAFETY pinned out for IRIS
29	VBUS	i	vbus, voltage from USB plug
30	SERIAL2_RTS		
31	OTG_DP1	i/o	DATA P from USB
32	SERIAL2_CTS		
33	OTG_DM1	i/o	DATA M from USB
34	SERIAL2_RX	i	
35	I2C_1_SDA	i/o	I2C data i/o
36	SERIAL2_TX	o	
37	I2C_1_SCL	o	I2C clock
38	SERIAL1_RX	i	
39	CAN_L_2	i/o	Canbus Low signal driver on FMU
40	SERIAL1_TX	o	
41	CAN_H_2	i/o	Canbus High signal driver on FMU
42	SERIAL1_RTS		
43	!VDD_5V_PERIPH_OC	i	error state message from Periph power supply
44	SERIAL1_CTS		
45	!VDD_5V_HIPOWER_OC	i	error state message from High power Periph power supply
46	IO-USART1_TX	o	
47	BATT_VOLTAGE_SENS_PROT	a i	Voltage sense from main battery
48	IO-USART1_RX_SPECTRUM_DSM	o	signal from Spectrum receiver
49	BATT_CURRENT	a i	Current sense from main battery

	_SENS_PROT		
50	FMU-CH1-PROT	o	
51	SPI_EXT_MOSI	o	External SPI, for debug only
52	FMU-CH2-PROT	o	
53	VDD_SERVO	i	VDD_Servo, for monitoring servo bus
54	FMU-CH3-PROT	o	
55	!VDD_BRICK_VALID	i	main power valid signal
56	FMU-CH4-PROT	o	
57	!VDD_BACKUP_VALID	i	backup power valid signal
58	FMU-CH5-PROT	o	
59	!VBUS_VALID	i	USB bus valid signal
60	FMU-CH6-PROT	o	
61	VDD_5V_IN	i	main power into FMU from power selection
62	PPM-SBUS-PROT	i	
63	VDD_5V_IN	i	main power into FMU from power selection
64	S.BUS_OUT	o	
65	IO-VDD_5V5	o	power to RX
66	IO-CH8-PROT	o	
67	SPI_EXT_MISO	i	External SPI, for debug only
68	IO-CH7-PROT	o	
69	IO-SWDIO	i/o	IO single wire debug i/o
70	IO-CH6-PROT	o	
71	IO-SWCLK	o	IO single wire debug clock
72	IO-CH5-PROT	o	
73	SPI_EXT_SCK	o	External SPI, for debug only
74	IO-CH4-PROT	o	
75	IO-!RESET	i	IO reset pin

76	IO-CH3-PROT	o	
77	CAN_L_1	i/o	Canbus Low signal driver on FMU
78	IO-CH2-PROT	o	
79	CAN_H_1	i/o	Canbus High signal driver on FMU
80	IO-CH1-PROT	o	

Pin Changes from Pixhawk

FMU	Pixhawk 1	Pixhawk2	Reason for change
PA0	FMU-UART4_TX		
PA1	FMU-UART4_RX		
PA2	BATT_VOLTAGE_SENS		
PA3	BATT_CURRENT_SENS		
PA4	VDD_5V_SENS		
PA5	SPI_INT_SCK		
PA6	SPI_INT_MISO		
PA7	SPI_INT_MOSI		
FMU	Pixhawk 1	Pixhawk2	Reason for change
PA8	!VDD_5V_PERIPH_EN		
PA9	VBUS		
PA10	IO-USART1_TX		
PA11	OTG_FS_DM		
PA12	OTG_FS_DP		
PA13	FMU-SWDIO		
PA14	FMU-SWCLK		
PA15	ALARM		
FMU	Pixhawk 1	Pixhawk2	Reason for change
PB0	GYRO_DRDY	EXTERN_DRDY	Added Dev SPI to 80 pin
PB1	MAG_DRDY	!EXTERN_CS	Added Dev SPI to 80 pin
PB2	10k TO GROUND		
PB3	FMU-SWO		
PB4	ACCEL_DRDY	NC	Data ready pin not used
PB5	!VDD_BRICK_VALID		
PB6	CAN2_TX		
PB7	!VDD_SERVO_VALID	!VDD_BACKUP_VALID	Backup now comes from Aux plug, NOT SERVO
FMU	Pixhawk 1	Pixhawk2	Reason for change
PB8	FMU-I2C1_SCL (OLD_EXT)	FMU-I2C1_SCL	All External now, there is no internal I2C
PB9	FMU-I2C1_SDA (OLD_EXT)	FMU-I2C1_SDA	All External now, there is no internal I2C
PB10	FMU-I2C2_SCL (OLD-INT)	FMU-I2C2_SCL	All External now, there is no internal I2C
PB11	FMU-I2C2_SDA (OLD-INT)	FMU-I2C2_SDA	All External now, there is no internal I2C
PB12	CAN2_RX		
PB13	FRAM_SCK		
PB14	FRAM_MISO		
PB15	FRAM_MOSI		
FMU	Pixhawk 1	Pixhawk2	Reason for change
PC0	!VBUS_VALID		
PC1		SPI_INT_MAG_!CS	On-board HMC5983 Mag (NC on 2.1)

PC2	!MPU_CS		
PC3	FMU_AUX_ADC1	AUX_BATT_VOLTAGE_SENS	Added Aux Power brick
PC4	FMU_AUX_ADC2	AUX_BATT_CURRENT_SENS	Added Aux Power brick
PC5	PRESSURE_SENS		
PC6	SERIAL_FMU_TO_IO		
PC7	SERIAL_IO_TO_FMU		
FMU	Pixhawk 1	Pixhawk2	Reason for change
PC8	SDIO_D0		
PC9	SDIO_D1		
PC10	SDIO_D2		
PC11	SDIO_D3		
PC12	SDIO_CK		
PC13	!GYRO_CS	!GYRO_EXT_CS	IMU L3GD20 Gyro
PC14	GPIO_EXT_1	!BARO_EXT_CS	IMU MS5611 Baro
PC15	!ACCEL_MAG_CS	!ACCEL_MAG_EXT_CS	IMU LSM303D Mag Accel
FMU	Pixhawk 1	Pixhawk2	Reason for change
PD0	CAN1_RX		
PD1	CAN1_TX		
PD2	SDIO_CMD		
PD3	FMU-USART2_CTS		
PD4	FMU-USART2_RTS		
PD5	FMU-USART2_TX		
PD6	FMU-USART2_RX		
PD7	!BARO_CS		
FMU	Pixhawk 1	Pixhawk2	Reason for change
PD8	FMU-USART3_TX		
PD9	FMU-USART3_RX		
PD10	!FRAM_CS		
PD11	FMU-USART3_CTS		
PD12	FMU-USART3_RTS		
PD13	FMU-CH5		
PD14	FMU-CH6		
PD15	MPU_DRDY	Still connected….	
FMU	Pixhawk 1	Pixhawk2	Reason for change
PE0	FMU-UART8_RX		
PE1	FMU-UART8_TX		
PE2	SPI_EXT_SCK		
PE3	VDD_3V3_SENSORS_EN		
PE4	!SPI_EXT_NSS	!MPU_EXT_CS	IMU MPU9250 or ICM 20xxx CS
PE5	SPI_EXT_MISO		
PE6	SPI_EXT_MOSI		
PE7	FMU-UART7_RX		
FMU	Pixhawk 1	Pixhawk2	Reason for change
PE8	FMU-UART7_TX		
PE9	FMU-CH4		
PE10	!VDD_5V_HIPOWER_OC		

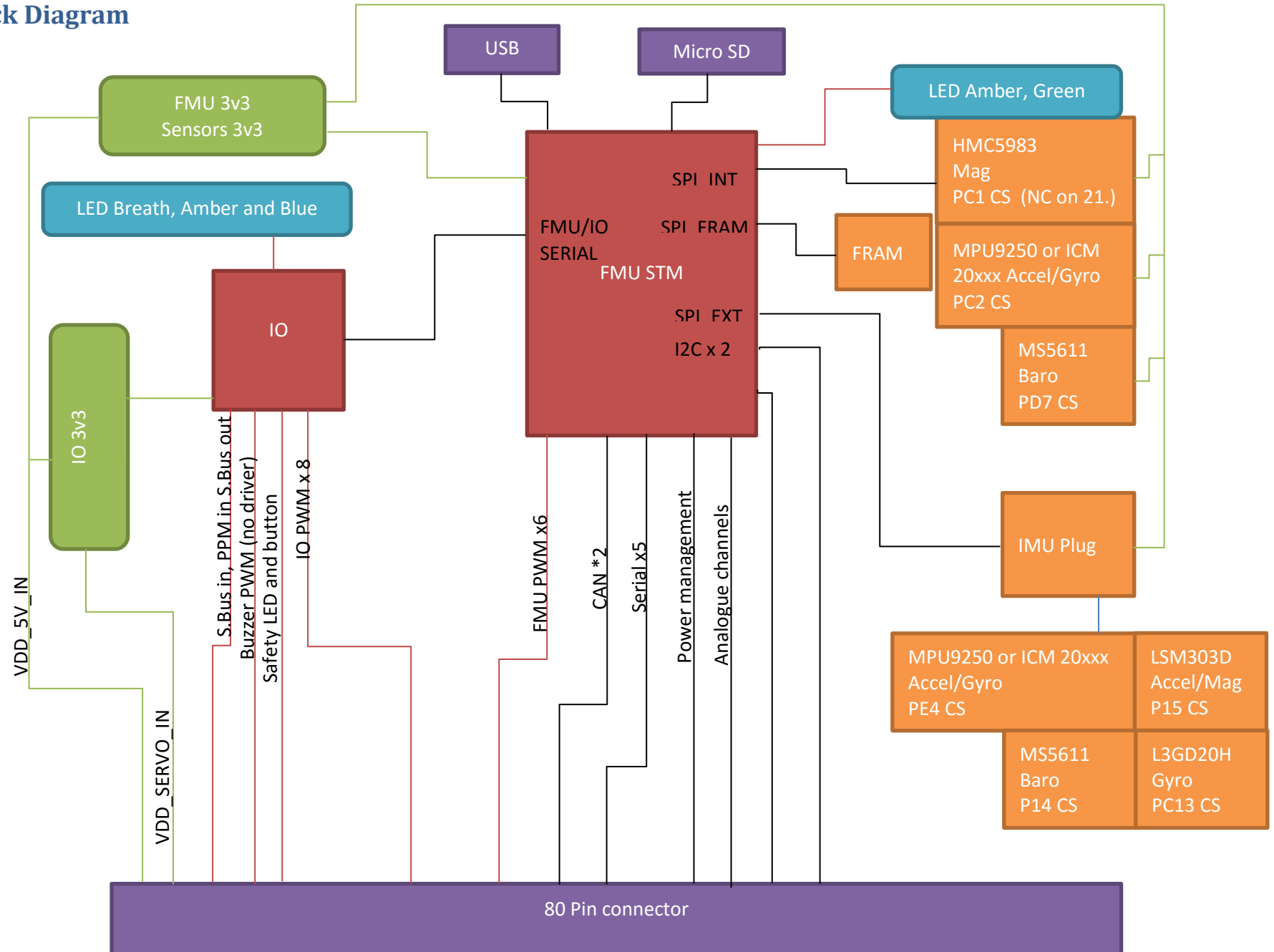
PE11	FMU-CH3		
PE12	!FMU-LED_AMBER		
PE13	FMU-CH2		
PE14	FMU-CH1		
PE15	!VDD_5V_PERIPH_OC		
IO	Pixhawk 1	Pixhawk2	Reason for change
PA0	IO-CH1		
PA1	IO-CH2		
PA2	SERIAL_IO_TO_FMU		
PA3	SERIAL_FMU_TO_IO		
PA4	VDD_SERVO_SENS		
PA5	RSSI_IN		
PA6	IO-CH5		
PA7	IO-CH6		
IO	Pixhawk 1	Pixhawk2	Reason for change
PA8	PPM_INPUT		
PA9	IO-USART1_TX		
PA10	IO-USART1_RX	IO-USART1_RX_SPECTRUM_DSM	Just renamed. Same function
PA11		I/O_POWER_BREATHING	Added breathing LED to IO PWM
PA12	RSSI_IN		
PA13	IO-SWDIO		
PA14	IO-SWCLK		
PA15	IO-!VDD_SERVO_IN_FAULT		
IO	Pixhawk 1	Pixhawk2	Reason for change
PB0	IO-CH7		
PB1	IO-CH8		
PB2	Via 10k to ground		
PB3	IO-SWO		
PB4	!SBUS_OUTPUT_EN		
PB5	SAFETY		
PB6		!VDD_BRICK_VALID	Added to monitor power during an inflight reboot
PB7		!VDD_BACKUP_VALID	Added to monitor power during an inflight reboot
IO	Pixhawk 1	Pixhawk2	Reason for change
PB8	IO-CH3		
PB9	IO-CH4		
PB10	SBUS_OUTPUT		
PB11	SBUS_INPUT		
PB12		FMU-VDD_3V3	Added to monitor power during an inflight reboot
PB13	!IO-LED_SAFETY		
PB14	!IO-LED_BLUE		
PB15	!IO-LED_AMBER		
IO	Pixhawk 1	Pixhawk2	Reason for change

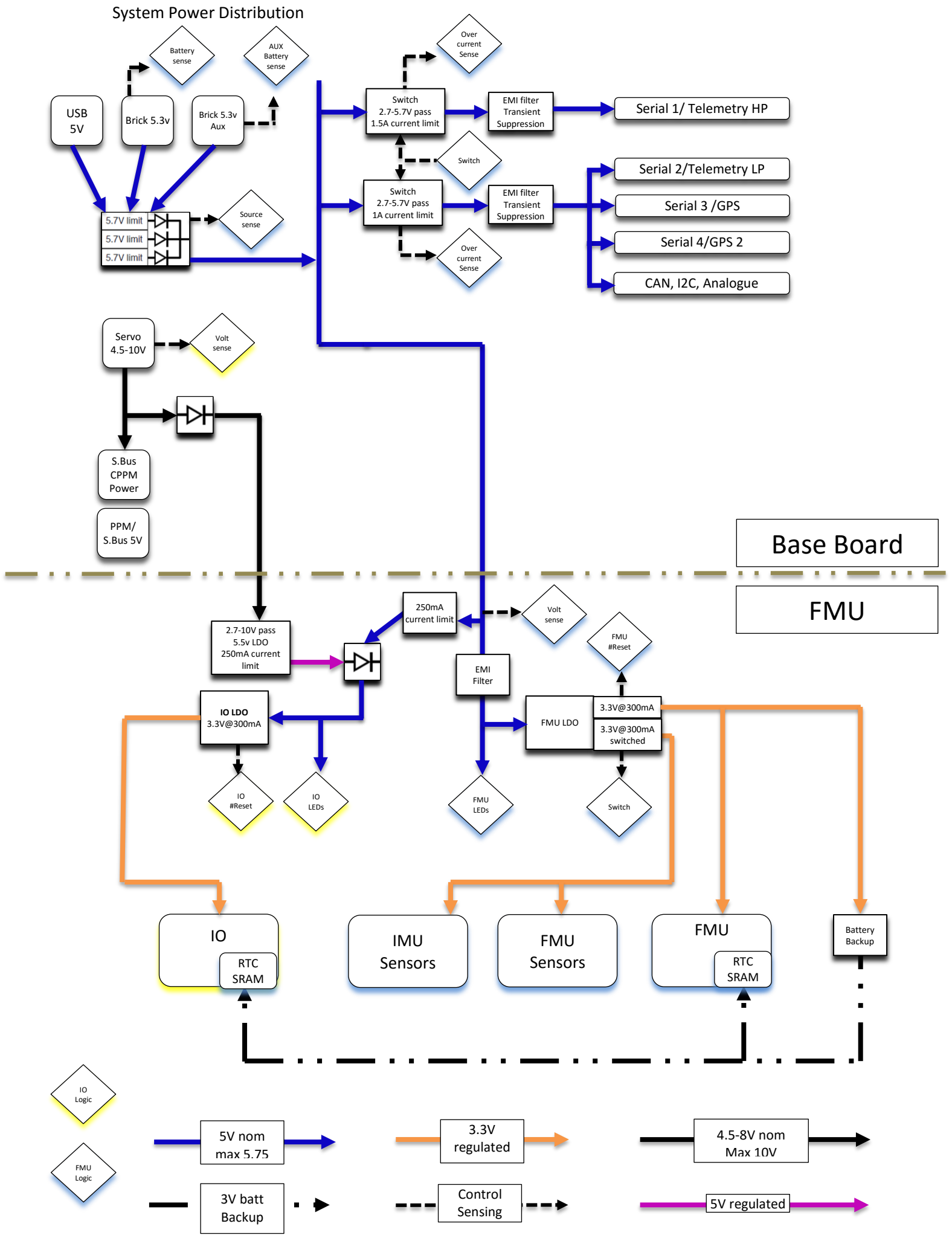
PC13	VDD_3V3_SPEKTRUM_EN		
PC14		Pulled to 3.3v	To ID the hardware change 0x01
PC15		Pulled to ground	To ID the hardware change 0x01

List of features changed on Pixhawk 2 from Pixhawk 1

- three IMU's
  - these consist of 2 on the IMU board
  - 1 fixed to the FMU
- two onboard compasses
  - these consist of 1 on the IMU board
  - 1 Fixed on the FMU
- two Baros
  - 1 on the IMU (this Baro will most likely be removed in favour of a dedicated external Barometer.
  - 1 Fixed on the FMU
- Dual Power input
  - This removes the option of redundancy from the Servo rail and replaces it with a dedicated second power plug
  - A dedicated power protection Zener diode and Fet have been added to protect from voltages over 5.6v being applied to Aux input 2
  - This is only on the "PRO" carrier board mini carrier board still draws the backup from the servo rail.
- only 2 FMU PWM out channels on the Mini carrier board. (10 PWM total)
- Dual external I2C
  - This allows for connection of items to either I2C port, potentially allowing two GPS / Mag units to be plugged in without the Mags conflicting.
- GPS_Puck with Safety and LED
  - a single unit GPS / Mag / RGB / Safety button
- Pixhawk 2 Hardware ID
  - I physical Hardware ID has been added to the I/O of the Pixhawk 2. This needs software to identify the board for debug purposes. This is the only non-software method to tell the two Pixhawks apart.
- Breathing LED on cube. Comes on solid with default settings on the pin. Is connected to a PWM pin, and as such could be made to Breath,
- Power monitoring pins are now routed to the I/O chip, these will allow for the logging of power events during an inflight reboot.
  - Brick OK, Backup OK, and FMU 3.3V are all connected to a digital pin on the I/O via a 220Ohm resister.

Block Diagram




System Power Distribution
Battery sense
AUX Battery sense
USB 5V
Brick 5.3v
Brick 5.3v Aux
5.7V limit
5.7V limit
5.7V limit
Source sense
Over current Sense
Switch 2.7-5.7V pass 1.5A current limit
EMI filter Transient Suppression
Serial 1/ Telemetry HP
Switch
Switch 2.7-5.7V pass 1A current limit
EMI filter Transient Suppression
Serial 2/Telemetry LP
Serial 3 /GPS
Serial 4/GPS 2
CAN, I2C, Analogue
Over current Sense
Servo 4.5-10V
Volt sense
S.Bus CPPM Power
PPM/ S.Bus 5V
Base Board
FMU
2.7-10V pass 5.5v LDO 250mA current limit
250mA current limit
Volt sense
FMU #Reset
EMI Filter
IO LDO 3.3V@300mA
FMU LDO
3.3V@300mA
3.3V@300mA switched
IO #Reset
IO LEDs
FMU LEDs
Switch
IO
RTC SRAM
IMU Sensors
FMU Sensors
FMU
RTC SRAM
Battery Backup
IO Logic
FMU Logic
5V nom max 5.75
3.3V regulated
4.5-8V nom Max 10V
3V batt Backup
Control Sensing
5V regulated