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DS-016 Pixhawk Autopilot v6U Standard

Revision: 0.2.0
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Abstract

This document is the formal version of the Pixhawk industry standard that includes all aspects of the hardware standard required to build compatible autopilots.

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Document Revisions

Revision	Editor	Reviewer	Comments
0.1.0	Andrew C. Smith Gumstix (Altium)		Initial specification
0.2.0	Ramón Roche	Andrew C. Smith	Updated block diagram, verified the Sensor Set, updated the pinout, and the overview description

Contact and Public Developer Call

This standard is being developed on a public developer call.
For further questions, please contact the maintainer of the standard, lorenz@px4.io.

Trademark Guideline

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License and Disclaimer

Related Standards

- DS-009 Pixhawk Connector Standard
- DS-010 Pixhawk Autopilot Bus Standard

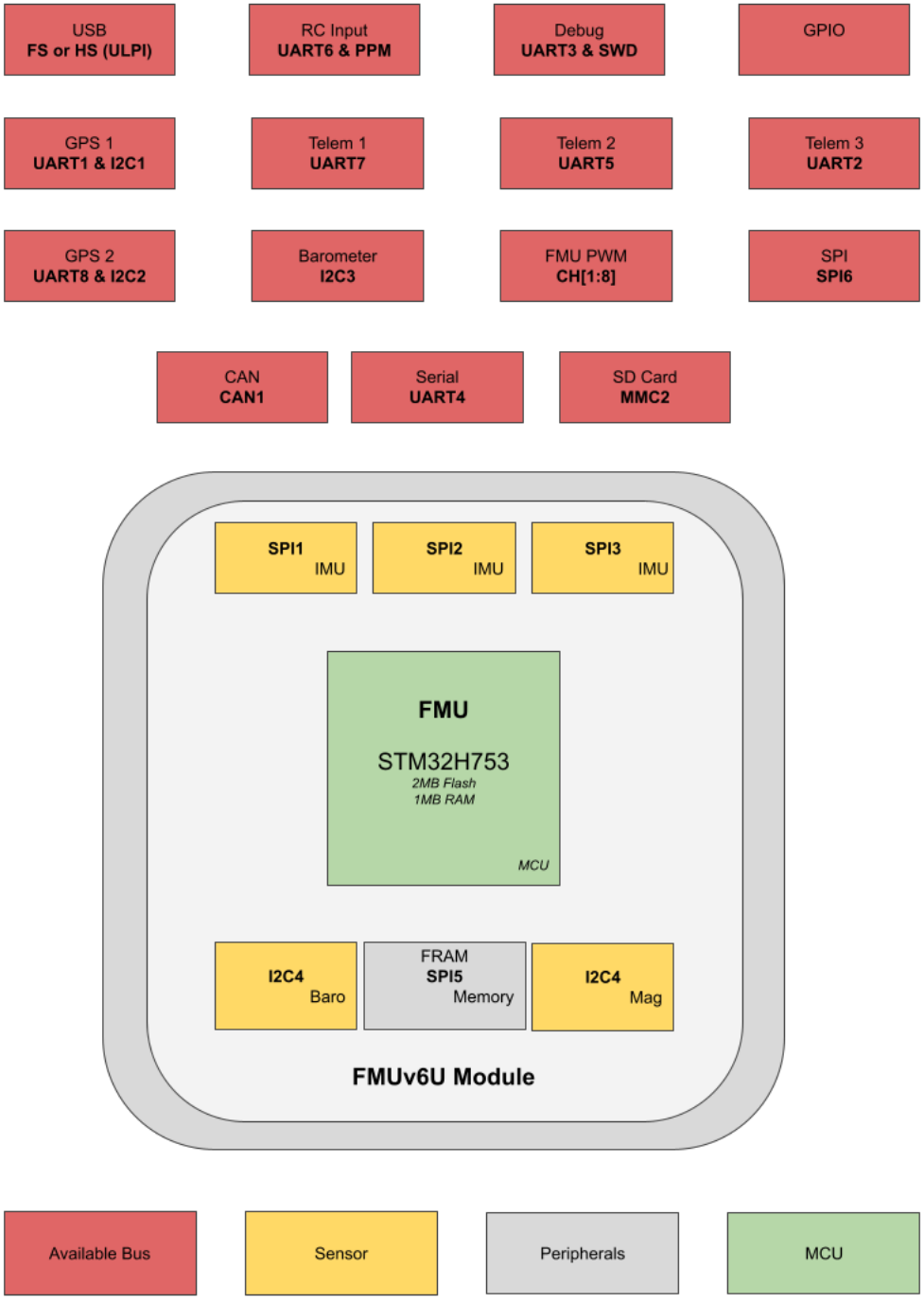
FMUv6U Summary

Overview

The FMUv6U generation builds on the functionality of the FMUv5 and FMUv5x and adds an increase in processing power and USB functionality.

- USB-HS Support
  - SMSC-USB2517 (ULPI)
- Redundant sensors on separate buses.
  - Bosch BMI088 (SPI3)
  - TDK Invensense ICM-42605 (SPI2)
  - TDK Invensense ICM-20602 (SPI1)
  - Bosch BMM150 compass (I2C4)
  - Bosch BMP388 pressure sensor (I2C4)
  - GPS external mag + baro #1
  - GPS external mag + baro #2
  - FRAM memory for configuration data (SPI5)
- Extensive power monitoring
  - 5V rail monitoring
  - 3.3V rail monitoring for CPU
  - 3.3V rail monitoring for sensor domain
- External sensor bus (SPI6)
- For NFC one external I2C port needs to have an additional GPIO line and 5V to supply the external NFC reader.

Block Diagram



Note: Please refer to the Sensor Set section for accurate sensor parts

Sensor Sets

There is currently only one sensor set available for FMUv6U, and we consider this one the "default" option.

Sensor Set (Rev 1)

FMU Board

Name	Sensor Type	Bus	Chip Select/ 7 Bit Addr	DRDY	Power Domain
U11 (IMU1)	ICM-20602	SPI1	CS1	DRDY1	
U7 (IMU2)	ICM-42605	SPI2	CS1	DRDY2	
U15 (IMU3)	BMI088 ACCEL	SPI3	CS1	DRDY1	
U15 (IMU3)	BMI088 GYRO	SPI3	CS2	DRDY2	
U108 (BARO)	BMP388	I2C4			
U108 (BARO)	~~MS5611~~ **~~DNP~~**	I2C3			
U106 (FRAM)	FM25V02A	SPI5	CS1		
U9 (MAG)	BMM150	I2C4			
U14 (USB)	SMSC-USB2517	ULPI			

Note: When referring to the pinout chart the CS Names are formed by BUS**n**_CS**n**_DEVICE: SPI**1**_nCS**1**_ICM20602
DRDY Names are formed by BUS**n**_DRDY**n**_DEVICE_INT**n**: SPI**2**_DRDY**2**_ISM330_INT**2**

Note device names may reflect legacy devices names. What matters is the BUSn,CSn,DRDYn and the INTn.

Full FMUv6U Pinout

At the time of the release of this document the reference pinout was version **RC02**. The current release of the reference pinout is found in this pinout sheet link.

FMUV6U_stm32_pinout - RC02

NOTE: The information contained below is for reference only. See the link above for the complete pinout reference.

			176-pin STM32H753IIK Signal		FMUV6 RC01 USAGE
0	PA	0	ADC1_IN16	A	SCALED_V5
1	PA	1	TIM15_CH1N	T	FMU_CAP2
2	PA	2	TIM2_CH3	T	HEATER
3	PA	3	OTG_HS_ULPI_D0	B	OTG_HS_ULPI_D0
4	PA	4	ADC1_INP18	A	ADC3_3V3
5	PA	5	OTG_HS_ULPI_CK	B	OTG_HS_ULPI_CK
6	PA	6	SPI6_MISO	S	SPI6_MISO_EXTERNAL1
7	PA	7	SPI1_MOSI	S	SPI1_MOSI_SENSOR1_ICM20602
8	PA	8	I2C3_SCL	I	I2C3_SCL_BASE_MS5611_BARBED_EXTERNAL1
9	PA	9	USB_OTG_FS_VBUS	B	VBUS_SENSE
10	PA	10	TIM1_CH3	T	SPI2_DRDY2_ISM330_INT2
11	PA	11	USB_OTG_FS_DM	B	USB_D_N
12	PA	12	USB_OTG_FS_DP	B	USB_D_P
13	PA	13	SWDIO	D	FMU_SWDIO
14	PA	14	SWCLK	D	FMU_SWCLK
15	PA	15	PA15	G	SPI6_nCS2_EXTERNAL1
16	PB	0	OTG_HS_ULPI_D1	B	OTG_HS_ULPI_D1
17	PB	1	OTG_HS_ULPI_D2	B	OTG_HS_ULPI_D2
18	PB	2	SPI3_MOSI	S	SPI3_MOSI_SENSOR3_BMI088
19	PB	3	SDMMC2_D2	SD	SDMMC2_D2
20	PB	4	SDMMC2_D3	SD	SDMMC2_D3
21	PB	5	OTG_HS_ULPI_D7	B	OTG_HS_ULPI_D7
22	PB	6	USART1_TX	U	USART1_TX_GPS1
23	PB	7	USART1_RX	U	USART1_RX_GPS1
24	PB	8	I2C1_SCL	I	I2C1_SCL_BASE_GPS1_MAG_LED_PM1
25	PB	9	I2C1_SDA	I	I2C1_SDA_BASE_GPS1_MAG_LED_PM1
26	PB	10	OTG_HS_ULPI_D3	B	OTG_HS_ULPI_D3
27	PB	11	OTG_HS_ULPI_D4	B	OTG_HS_ULPI_D4
28	PB	12	OTG_HS_ULPI_D5	B	OTG_HS_ULPI_D5_CAN2_RX

29	PB	13	OTG_HS_ULPI_D6	B	OTG_HS_ULPI_D6__CAN2_TX
30	PB	14	SDMMC2_D0	SD	SDMMC2_D0
31	PB	15	SDMMC2_D1	SD	SDMMC2_D1
32	PC	0	OTG_HS_ULPI_STP	B	OTG_HS_ULPI_STP
33	PC	1	SDMMC2_CLK	SD	SDMMC2_CLK
34	PC	2	ADC3_INP0	A	ADC3_6V6
35	PC	3	OTG_HS_ULPI_NXT	A	OTG_HS_ULPI_NXT
36	PC	4	ADC1_INP4	A	SCALED_VDD_3V3_SENSORS
37	PC	5	PC5	G	MUX_CTRL1
38	PC	6	USART6_TX	U	USART6_TX_TO_IO__NC
39	PC	7	USART6_RX	U	USART6_RX_FROM_IO__RC_INPUT
40	PC	8	UART5_RTS	V	UART5_RTS_TELEM2
41	PC	9	UART5_CTS	V	UART5_CTS_TELEM2
42	PC	10	SPI3_SCK	S	SPI3_SCK_SENSOR3_BMI088
43	PC	11	SPI3_MISO	S	SPI3_MISO_SENSOR3_BMI088
44	PC	12	UART5_TX	V	UART5_TX_TELEM2
45	PC	13	PC13	G	VDD_3V3_SD_CARD_EN
46	PC	14	OSC32_IN	X	32KHZ_IN
47	PC	15	OSC32_OUT	X	32KHZ_OUT
48	PD	0	FDCAN1_RX	C	CAN1_RX
49	PD	1	FDCAN1_TX	C	CAN1_TX
50	PD	2	UART5_RX	V	UART5_RX_TELEM2
51	PD	3	USART2_CTS	U	USART2_CTS_TELEM3
52	PD	4	USART2_RTS	U	USART2_RTS_TELEM3
53	PD	5	USART2_TX	U	USART2_TX_TELEM3
54	PD	6	USART2_RX	U	USART2_RX_TELEM3
55	PD	7	SDMMC2_CMD	SD	SDMMC2_CMD
56	PD	8	USART3_TX	U	USART3_TX_DEBUG
57	PD	9	USART3_RX	U	USART3_RX_DEBUG
58	PD	10	PD10	G	FMU_nSAFETY_SWITCH_LED_OUT
59	PD	11	PD11	G	SPI6_DRDY1_EXTERNAL1

60	PD	12	PD12	G	SPI6_DRDY2_EXTERNAL1
61	PD	13	TIM4_CH2	T	FMU_CH5
62	PD	14	TIM4_CH3	T	FMU_CH6
63	PD	15	PD15	G	PD15(PH11)
64	PE	0	UART8_RX	V	UART8_RX_GPS2
65	PE	1	UART8_TX	V	UART8_TX_GPS2
66	PE	2	PE2	D	TRACECLK
67	PE	3	PE3	G	nLED_RED
68	PE	4	PE4	G	nLED_GREEN
69	PE	5	PE5	G	nLED_BLUE
70	PE	6	PE6	G	nARMED
71	PE	7	PE7	G	MUX_CTRL2
72	PE	8	UART7_TX	V	UART7_TX_TELEM1
73	PE	9	TIM1_CH1	V	SPIX_SYNC
74	PE	10	UART7_CTS	V	UART7_CTS_TELEM1
75	PE	11	TIM1_CH2	T	FMU_CAP1
76	PE	12	SPI4_SCK	S	SPI4_SCK_SENSOR4_BMM150
77	PE	13	SPI4_MISO	S	SPI4_MISO_SENSOR4_BMM150
78	PE	14	SPI4_MOSI	S	SPI4_MOSI_SENSOR4_BMM150
79	PE	15	PE15	G	VDD_5V_PERIPH_nOC
80	PF	0	I2C2_SDA	I	I2C2_SDA_BASE_GPS2_MAG_LED_PM2
81	PF	1	I2C2_SCL	I	I2C2_SCL_BASE_GPS2_MAG_LED_PM2
82	PF	2	PF2	G	SPI1_DRDY1_ICM20602
83	PF	3	PF3	G	SPI4_DRDY1_BMM150_DRDY
84	PF	4	PF4	G	PF4
85	PF	5	PF5	G	FMU_SAFETY_SWITCH_IN
86	PF	6	UART7_RX	V	UART7_RX_TELEM1
87	PF	7	SPI5_SCK	S	SPI5_SCK_FRAM
88	PF	8	UART7_RTS	V	UART7_RTS_TELEM1
89	PF	9	TIM14_CH1	T	BUZZER_1
90	PF	10	PF10	G	SPI6_nRESET_EXTERNAL1
91	PF	11	SPI5_MOSI	S	SPI5_MOSI_FRAM
92	PF	12	PF12	G	NFC_GPIO
93	PF	13	PF13	G	VDD_5V_HIPOWER_nOC
94	PF	14	I2C4_SCL	I	I2C4_SCL_FMU
95	PF	15	I2C4_SDA	I	I2C4_SDA_FMU
96	PG	0	PG0	G	HW_VER_REV_DRIVE
97	PG	1	PG1	G	nPOWER_IN_A

98	PG	2	PG2	G	nPOWER_IN_B
99	PG	3	PG3	G	nPOWER_IN_C
100	PG	4	PG4	G	VDD_5V_PERIPH_nEN
101	PG	5	PG5	G	I2C2_DRDY1_BMP388
102	PG	6	PG6	G	PG6
103	PG	7	PG7	G	SPI5_nCS1_FRAM
104	PG	8	PG8	G	PG8
105	PG	9	SPI1_MISO	S	SPI1_MISO_SENSOR1_ICM20602
106	PG	10	PG10	G	VDD_5V_HIPOWER_nEN
107	PG	11	SPI1_SCK	S	SPI1_SCK_SENSOR1_ICM20602
108	PG	12	PG12	G	VDD_3V3_SENSORS_EN
109	PG	13	SPI6_SCK	S	SPI6_SCK_EXTERNAL1
110	PG	14	SPI6_MOSI	S	SPI6_MOSI_EXTERNAL1
111	PG	15	PG15	G	PG15
112	PH	0	OSC_IN	X	16_MHZ_IN
113	PH	1	OSC_OUT	X	16_MHZ_OUT
114	PH	2	PH2	G	VDD_3V3_SPEKTRUM_POWER_EN
115	PH	3	ADC3_INP14	A	HW_VER_SENSE
116	PH	4	ADC3_INP15	A	HW_REV_SENSE
117	PH	5	PH5	G	SPI2_nCS1_ISM330
118	PH	6	TIM12_CH1	T	FMU_CH7
119	PH	7	SPI5_MISO	S	SPI5_MISO_FRAM

120	PH	8	I2C3_SDA	I	I2C3_SDA_BASE_MS5611_BARBED_EXTERNAL1
121	PH	9	TIM12_CH2	T	FMU_CH8
122	PH	10	TIM5_CH1	T	FMU_CH4
123	PH	11	TIM5_CH2	T	FMU_CH3
124	PH	12	TIM5_CH3	T	FMU_CH2
125	PH	13	UART4_TX	V	UART4_TX
126	PH	14	UART4_RX	V	UART4_RX
127	PH	15	PH15	G	SPI4_nCS1_BMM150
128	PI	0	TIM5_CH4	T	FMU_CH1
129	PI	1	SPI2_SCK	S	SPI2_SCK_SENSOR2_ISM330
130	PI	2	SPI2_MISO	S	SPI2_MISO_SENSOR2_ISM330
131	PI	3	SPI2_MOSI	S	SPI2_MOSI_SENSOR2_ISM330
132	PI	4	PI4	G	SPI3_nCS1_BMI088_ACCEL
133	PI	5	TIM8_CH1_IN	T	FMU_PPM_INPUT
134	PI	6	PI6	G	SPI3_DRDY1_BMI088_INT1_ACCEL
135	PI	7	PI7	G	SPI3_DRDY2_BMI088_INT3_GYRO
136	PI	8	PI8	G	SPI3_nCS2_BMI088_GYRO
137	PI	9	PI9	G	SPI1_nCS1_ICM20602
138	PI	10	PI10	G	SPI6_nCS1_EXTERNAL1
139	PI	11	USB_OTG_HS_ULPI_DIR	B	OTG_HS_ULPI_DIR