Pixhawk Autopilot

PIXHAWK is a high-performance autopilot-on-module suitable for fixed wing, multi rotors, helicopters, cars, boats and any other robotic platform that can move. It is targeted towards high-end research, amateur and industry needs and combines the functionality of the PX4FMU + PX4IO.

Key Features

- 168 MHz / 252 MIPS Cortex-M4F (http://en.wikipedia.org/wiki/ARM_Cortex-M#Cortex-M4)

- 14 PWM / Servo outputs (8 with failsafe and manual override, 6 auxiliary, high-power compatible)
- Abundant connectivity options for additional peripherals (UART, I2C, CAN)
- Integrated backup system for in-flight recovery and manual override with dedicated processor and stand-alone power supply (fixed-wing use)
- Backup system integrates mixing, providing consistent autopilot and manual override mixing modes (fixed wing use)
- Redundant power supply inputs and automatic failover
- External safety switch

- Multicolor LED main visual indicator
- High-power, multi-tone piezo audio indicator
- microSD card for high-rate logging over extended periods of time

Where to Buy

Order this module from:

- **jDrones Store (http://store.jdrones.com/pixhawk_pixhawk_3dr_apm_flight_controller_p/pixhawkv1.htm)**
- **3D Robotics Store (https://store.3drobotics.com/products/3dr-pixhawk)**

United Kingdom:

- unmannedtechshop.co.uk (http://www.unmannedtechshop.co.uk/pixhawk-32bit-autopilot.html)
- buildyourowndrone.co.uk (http://www.buildyourowndrone.co.uk/3DR-Pixhawk-p/3dr-pixhawk.htm)

Germany:

- uav-store.de (http://www.uav-store.de/autopilot-1/pixhawk/)
- exp-tech.de (http://www.exp-tech.de/3dr-pixhawk-autopilotsystem-revision-2-4)
- synosystems.de (http://synosystems.de/de/home/85-3dr-pixhawk.html)

Switzerland:

- hobbytec.ch (http://hobbytec.ch/Multicopter/Flight-Control/3DR-Pixhawk-AutopilotGPS-Telemetrie-Sonar-OSD::733.html)
- eflight.ch (http://www.eflight.ch/pi/3DR-Pixhawk.html)
- koptershop.ch (http://www.koptershop.ch/product_info.php?products_id=383)

If out of stock the software-compatible but not connector-compatible versions can be used:

- HKPilot32 (http://www.hobbyking.com/hobbyking/store/__55561__HKPilot32_Autonomous_Vehicle_32Bit_Control_Set_w_Power_Module.html)

Specifications

Processor

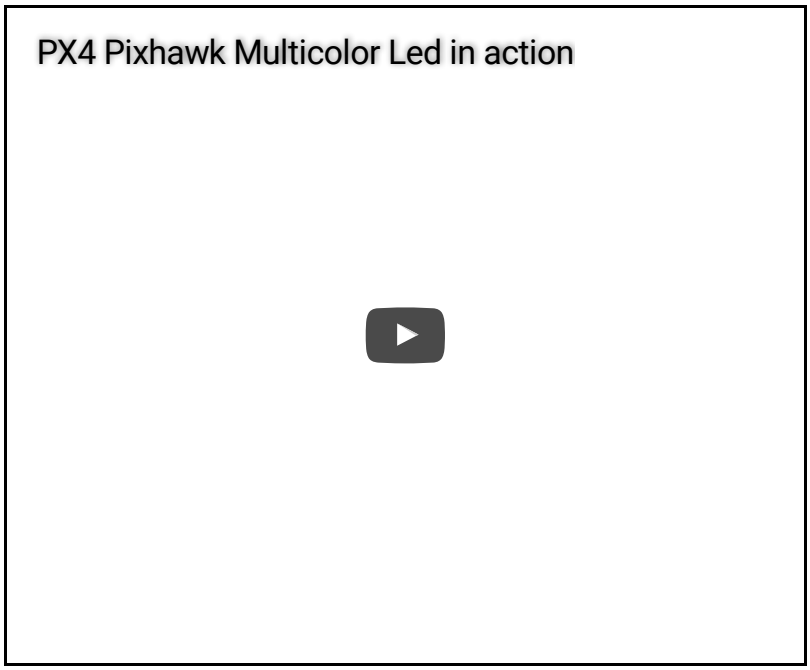
- 32bit STM32F427 Cortex M4 core with FPU
- 168 MHz
- 256 KB RAM
- 2 MB Flash
- 32 bit STM32F103 failsafe co-processor

Sensors

- ST Micro L3GD20H 16 bit gyroscope
- ST Micro LSM303D 14 bit accelerometer / magnetometer
- Invensense MPU 6000 3-axis accelerometer/gyroscope
- MEAS MS5611 barometer

Interfaces

- 5x UART (serial ports), one high-power capable, 2x with HW flow control
- 2x CAN (one with internal 3.3V transceiver, one on expansion connector)
- Spektrum DSM / DSM2 / DSM-X® Satellite compatible input
- Futaba S.BUS® compatible input and output
- PPM sum signal input
- RSSI (PWM or voltage) input
- I2C
- SPI
- 3.3 and 6.6V ADC inputs
- Internal microUSB port and external microUSB port extension



Power System and Protection

- Ideal diode controller with automatic failover
- Servo rail high-power (max. 10V) and high-current (10A+) ready
- All peripheral outputs over-current protected, all inputs ESD protected

Voltage Ratings

Pixhawk can be triple-redundant on the power supply if three power sources are supplied. The three rails are: Power module input, servo rail input, USB input.

Normal Operation Maximum Ratings

Under these conditions all power sources will be used in this order to power the system

1. Power module input (4.8V to 5.4V)
2. Servo rail input (4.8V to 5.4V) **UP TO 10V FOR MANUAL OVERRIDE, BUT AUTOPILOT PART WILL BE UNPOWERED ABOVE 5.7V IF POWER MODULE INPUT IS NOT PRESENT**
3. USB power input (4.8V to 5.4V)

Absolute Maximum Ratings

Under these conditions the system will not draw any power (will not be operational), but will remain intact.

1. Power module input (4.1V to 5.7V, 0V to 20V undamaged)
2. Servo rail input (4.1V to 5.7V, 0V to 20V)

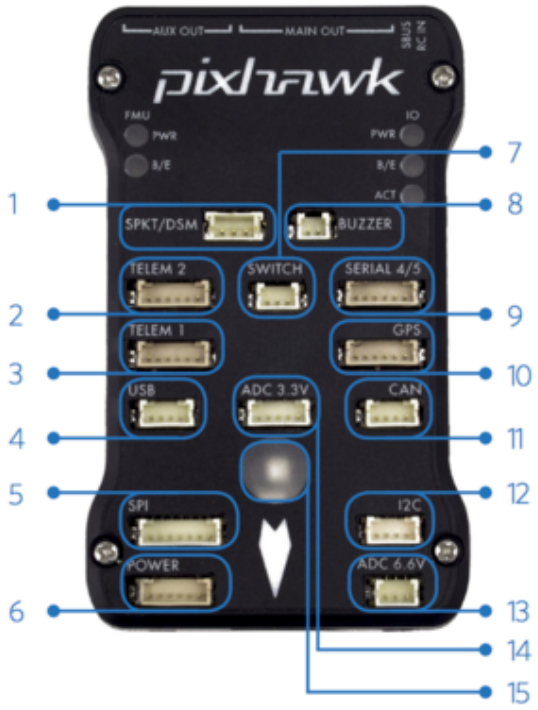
3. USB power input (4.1V to 5.7V, 0V to 6V)

Schematics

- FMUv2 + IOv2 schematic (https://github.com/PX4/Hardware/blob/master/FMUv2/PX4FMUv2.4.5.pdf) – Schematic and layout
- How-to guide: Pixhawk with 6S batteries (> 4S) – An How-to guide to power PixHawk with >4S LIPO batteries

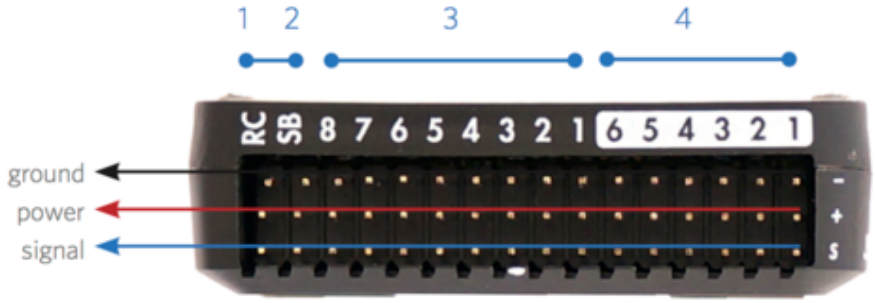
Connectors

The RC IN port is for RC receivers only and provides power. **NEVER** connect any servos, power supplies or batteries to it or to the receiver connected to it.



1 Spektrum DSM receiver
2 Telemetry (radio telemetry)
3 Telemetry (on-screen display)
4 USB
5 SPI (serial peripheral interface) bus
6 Power module
7 Safety switch button
8 Buzzer
9 Serial
10 GPS module
11 CAN (controller area network) bus
12 I²C splitter or compass module
13 Analog to digital converter 6.6 V
14 Analog to digital converter 3.3 V
15 LED indicator

1 Input/output reset button
2 SD card
3 Flight management reset button
4 Micro-USB port



Pinouts

TELEM1, TELEM2 ports

Pin	Signal	Volt
1 (red)	VCC	+5V
2 (blk)	TX (OUT)	+3.3V
3 (blk)	RX (IN)	+3.3V
4 (blk)	CTS (IN)	+3.3V
5 (blk)	RTS (OUT)	+3.3V
6 (blk)	GND	GND

GPS port

Pin	Signal	Volt
1 (red)	VCC	+5V
2 (blk)	TX (OUT)	+3.3V
3 (blk)	RX (IN)	+3.3V
4 (blk)	CAN2 TX	+3.3V
5 (blk)	CAN2 RX	+3.3V
6 (blk)	GND	GND

SERIAL 4/5 port - due to space constraints two ports are on one connector.

Pin	Signal	Volt
1 (red)	VCC	+5V
2 (blk)	TX (#4)	+3.3V
3 (blk)	RX (#4)	+3.3V
4 (blk)	TX (#5)	+3.3V
5 (blk)	RX (#5)	+3.3V
6 (blk)	GND	GND

ADC 6.6V

Pin	Signal	Volt
1 (red)	VCC	+5V
2 (blk)	ADC IN	up to +6.6V
3 (blk)	GND	GND

ADC 3.3V

Pin	Signal	Volt
1 (red)	VCC	+5V
2 (blk)	ADC IN	up to +3.3V
3 (blk)	GND	GND
4 (blk)	ADC IN	up to +3.3V
5 (blk)	GND	GND

I2C

Pin	Signal	Volt
1 (red)	VCC	+5V
2 (blk)	SCL	+3.3 (pullups)
3 (blk)	SDA	+3.3 (pullups)
4 (blk)	GND	GND

CAN

Pin	Signal	Volt
1 (red)	VCC	+5V
2 (blk)	CAN_H	+12V
3 (blk)	CAN_L	+12V
4 (blk)	GND	GND

SPI

Pin	Signal	Volt
1 (red)	VCC	+5V
2 (blk)	SPI_EXT_SCK	+3.3
3 (blk)	SPI_EXT_MISO	+3.3
4 (blk)	SPI_EXT_MOSI	+3.3
5 (blk)	!SPI_EXT_NSS	+3.3
6 (blk)	!GPIO_EXT	+3.3
7 (blk)	GND	GND

POWER

Pin	Signal	Volt

Pin	Signal	Volt
1 (red)	VCC	+5V
2 (blk)	VCC	+5V
3 (blk)	CURRENT	+3.3V
4 (blk)	VOLTAGE	+3.3V
5 (blk)	GND	GND
6 (blk)	GND	GND

SWITCH

Pin	Signal	Volt
1 (red)	VCC	+3.3V
2 (blk)	!IO_LED_SAFETY	GND
3 (blk)	SAFETY	GND

Console Port

The system's serial console runs on the port labeled SERIAL4/5. The pinout is standard serial pinout, to connect to a standard FTDI cable (3.3V, but its 5V tolerant).

Please refer to the wiring page for details how to wire up this port.

Parts / Housings

- **ARM MINI JTAG (J6**, *not populated per default***)**: 1.27 mm 10pos header (SHROUDED, for Black Magic Probe: FCI 20021521-00010D4LF (Distrelec (http://www.distrelec.ch/en/Pin-header-SMT-straight-for-IDC-1-27-mm-10-Minitek-127-Pin-header-for-IDC%2C-shrouded%2C-straight%2C-SMT-FCI-20021521-00010D4LF/p/14352308?q=20021521-00010D4LF&page=1&origPos=1&origPageSize=10&simi=99.4) , Digi-Key (http://www.digikey.com/product-detail/en/20021521-00010T1LF/609-4054-ND/2414951)) or Samtec FTSH-105-01-F-DV-K (untested) or Harwin M50-3600542 (Digikey (http://www.digikey.com/product-detail/en/M50-3600542/952-1389-ND/2264370) or Mouser (http://ch.mouser.com/ProductDetail/Harwin/M50-3600542/?qs=%2fha2pyFadujTt%2fIEz8xdzrYzHAVUnbxh8Ki%252bwWYPNeEa09PYvTkIOQ%3d%3d))
  - JTAG Adapter Option #1: BlackMagic Probe (http://www.blacksphere.co.nz/main/blackmagic) , comes without cables, needs the **Samtec FFSD-05-D-06.00-01-N** cable (Samtec sample service (http://www.samtec.com/suddenservice/samples/samples.aspx) or Digi-Key Link: SAM8218-ND (http://www.digikey.com/product-search/en?x=0&y=0&lang=en&site=us&KeyWords=FFSD-05-D-06.00-01-N)) or Tag Connect Ribbon (http://www.tag-connect.com/CORTEXRIBBON10) and a Mini-USB cable
  - JTAG Adapter Option #2: Digi-Key Link: ST-LINK/V2

(http://search.digikey.com/us/en/cat/programmers-development-systems/in-circuit-programmers-emulators-and-debuggers/2621880?k=st%20link%20v2) / ST USER MANUAL (http://www.st.com/internet/com/TECHNICAL_RESOURCES/TECHNICAL_LITERATURE/USER_MANUAL/DM00026748.pdf) , needs an ARM Mini JTAG to 20pos adapter: Digi-Key Link: 726-1193-ND (http://search.digikey.com/us/en/products/MDL-ADA2/726-1193-ND/1986451)
    - JTAG Adapter Option #3: SparkFun Link: Olimex ARM-TINY (http://www.sparkfun.com/products/8278) or any other OpenOCD-compatible ARM Cortex JTAG adapter, needs an ARM Mini JTAG to 20pos adapter: Digi-Key Link: 726-1193-ND (http://search.digikey.com/us/en/products/MDL-ADA2/726-1193-ND/1986451)
- **USARTs**: Hirose DF13 6 pos (Digi-Key Link: DF13A-6P-1.25H(20) (http://search.digikey.com/scripts/DkSearch/dksus.dll?WT.z_header=search_go&lang=en&site=us&keywords=DF13A-6P-1.25H%2820%29&x=0&y=0))
    - Mates: Hirose DF13 6 pos housing (Digi-Key Link: Hirose DF13-6S-1.25C (http://search.digikey.com/us/en/products/DF13-6S-1.25C/H2182-ND/241752))
- **I2C and CAN**: Hirose DF13 4 pos (Digi-Key Link: DF13A-4P-1.25H(20) (http://search.digikey.com/scripts/DkSearch/dksus.dll?WT.z_header=search_go&lang=en&site=us&keywords=DF13A-4P-1.25H%2820%29&x=0&y=0))
    - Mates: Hirose DF13 4 pos housing (Digi-Key Link: Hirose DF13-4S-1.25C (http://www.digikey.com/product-search/en?KeyWords=DF13-4S-1.25C))
- **USB (J5)**: Micro USB-B
    - Mates: Cell phone data / charger cables, e.g. Digi-Key Link: ASSMANN AK67421-0.5-R (http://search.digikey.com/us/en/products/AK67421-0.5-R/AE10418-ND/2263977)

Peripherals

- Digital airspeed sensor PX4AIRSPEED
- u-Blox GPS Module (https://store.3drobotics.com/products/3dr-gps-ublox-with-compass?taxon_id=34)
- External USB port
- External multicolor LED
- I2C splitter

Supported Platforms / Airframes

Any multicopter / airplane / rover or boat that can be controlled with normal RC servos or Futaba S-Bus servos. More details are available on the platforms page.