



**MATEKSYS**

# **FLIGHT CONTROLLER F405-WTE**

## **QUICK START GUIDE**

MCU: STM32F405RGT6, 168MHz , 1MB Flash

IMU: ICM42688-P

Baro: SPL06-001

OSD: AT7456E

Blackbox: MicroSD card slot

ESP WiFi Telemetry(MAVLink) or ExpressLRS 2.4G receiver(CRSF protocol)

6x UARTs, 1x Softserial1\_Tx option(INAV)

12x PWM outputs

1x I2C

4x ADC (VBAT, Current, RSSI, Airspeed)

USB/Beep Extender with Type-C(USB2.0)

Dual Camera Inputs switch

9V(12V) for VTX power switch

6.8~30V DC IN (2~6S LiPo)

90A continuous, 220A peak Current Sense

BEC 5V 2A for FC

BEC 9V 2A for camera/VTX, 12V option

BEC Vx 8A cont. 10A Peak for servos, 5V, 6V or 7.2V option

LDO 3.3V 200mA

ArduPilot: MatekF405-TE

INAV: MATEKF405TE\_SD

# LAYOUT

	INAV AirPlane	INAV Multirotor	ArduPilot
S1	Motor	Motor	PWM1
S2	Motor	Motor	PWM2
S3	Servo	Motor	PWM3
S4	Servo	Motor	PWM4
S5	Servo	Motor	PWM5
S6	Servo	Motor	PWM6
S7	Servo	Motor	PWM7
S8	Servo	Motor	PWM8
S9	Servo	Servo	PWM9
S10	Servo	Servo	PWM10
S11	Servo	Servo	PWM11
LED	2812 LED	2812 LED	PWM12

AirS: Analog Airspeed sensor (0-3.3V)  
no voltage divider built-in  
Rssi: Analog RSSI ADC, 0-3.3V

Tx1/Rx1: UART1\_Tx/Rx  
ETx / ERx: ESP8285 UART\_Tx/Rx

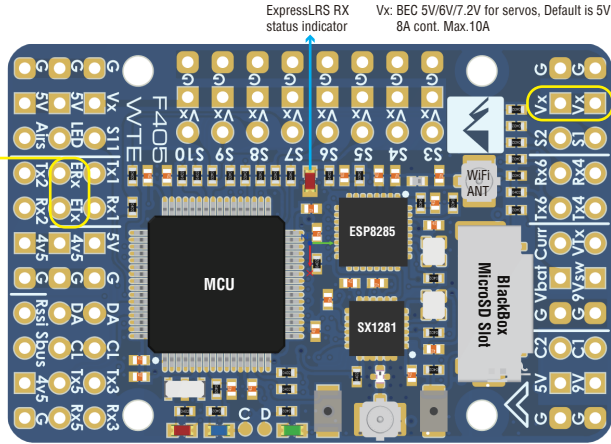
Rx2: UART2-RX for Serial\_RX by default  
\*PPM is not supported by INAV

Tx2: UART2-TX  
\*softserial1\_tx is an alternative on Tx2 pad in INAV

Sbus: UART2\_RX + inverter for SBus receiver

Tx3/Rx3: UART3\_Tx/Rx  
Tx5/Rx5: UART5\_Tx/Rx  
DA & CL: I2C\_SDA, SCL  
for compass/digital Airspeed

5V: onboard BEC 5V 2A cont.  
\*\*\* 5V is not supplied by USB  
4V5: 4.4-4.8V, Max.800mA,  
\*\*\* 4V5 is also supplied when connecting via USB.  
G: Ground



LED 0: Blue, FC Status  
LED 1: Green, FC Status  
LED 3.3: Red, 3.3V Status

F405: ELRS RX  
DFU: 2.4G ANT  
bottom

ESP: Boot  
IPEX MHF-1 button

C: SWCLK  
D: SWDIO

**DO NOT connect the ESC BEC output (Red wire in middle of connector) to Vx pad  
If Vx rail is powered from bottom PDB.**

TX6/RX6: UART6\_Tx/Rx  
TX4/RX4: UART4\_Tx/Rx

Vbat: Battery voltage  
onboard battery voltage sense: BATT\_VOLT\_PIN 14, BATT\_VOLT\_MULT 21  
INAV scale 2100

Curr: Current signal (0-3.3V)  
onboard current sense: BATT\_CURR\_PIN 15, BATT\_AMP\_PERVLT 66.7  
INAV scale 150

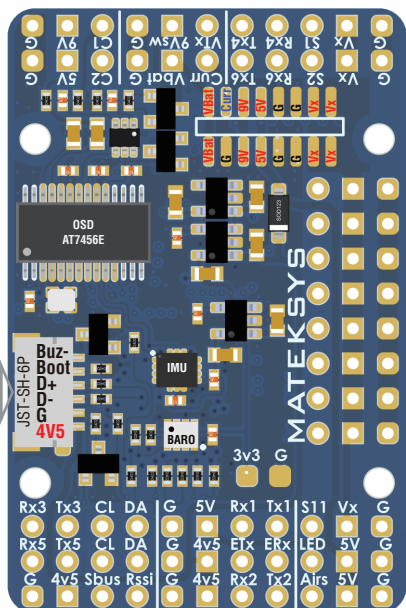
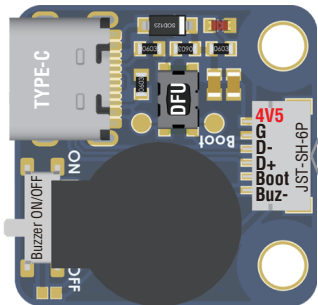
9V: 9V output, 9V will increase to 12V if "12V" jumper on bottom PDB is bridged.  
9Vsw: 9V ON/OFF can be switched via ArduPilot Relay or Modes/USER1 (INAV)  
Max.2A load on this pad. (Default ON)

5V: onboard BEC 5V 2A cont. Max.3A

G: Ground  
VTX: Video OUT for Video Transmitter  
C1: Camera-1 video IN (Default)  
C2: Camera-2 video IN  
\*\*\* C1/C2 can be switched via ArduPilot Relay or Modes/USER2 (INAV)  
\*\*\* Two cameras should be set with identical video format, both PAL or both NTSC

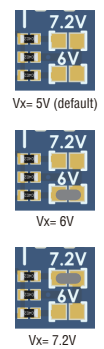
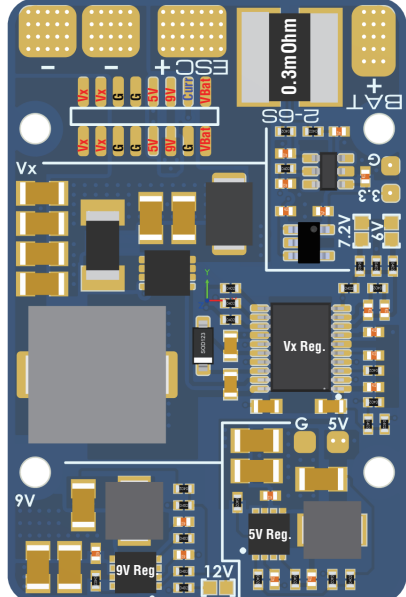
DFU Button: F405 DFU mode, same function as the button on FC board.  
Connect USB to the PC While holding the boot button in.

Red LED, USB power indicator



Size: 44x29x12.7mm  
Weight: 22g w/ USB extender  
Holes: Ø2mm, 25mm mounting

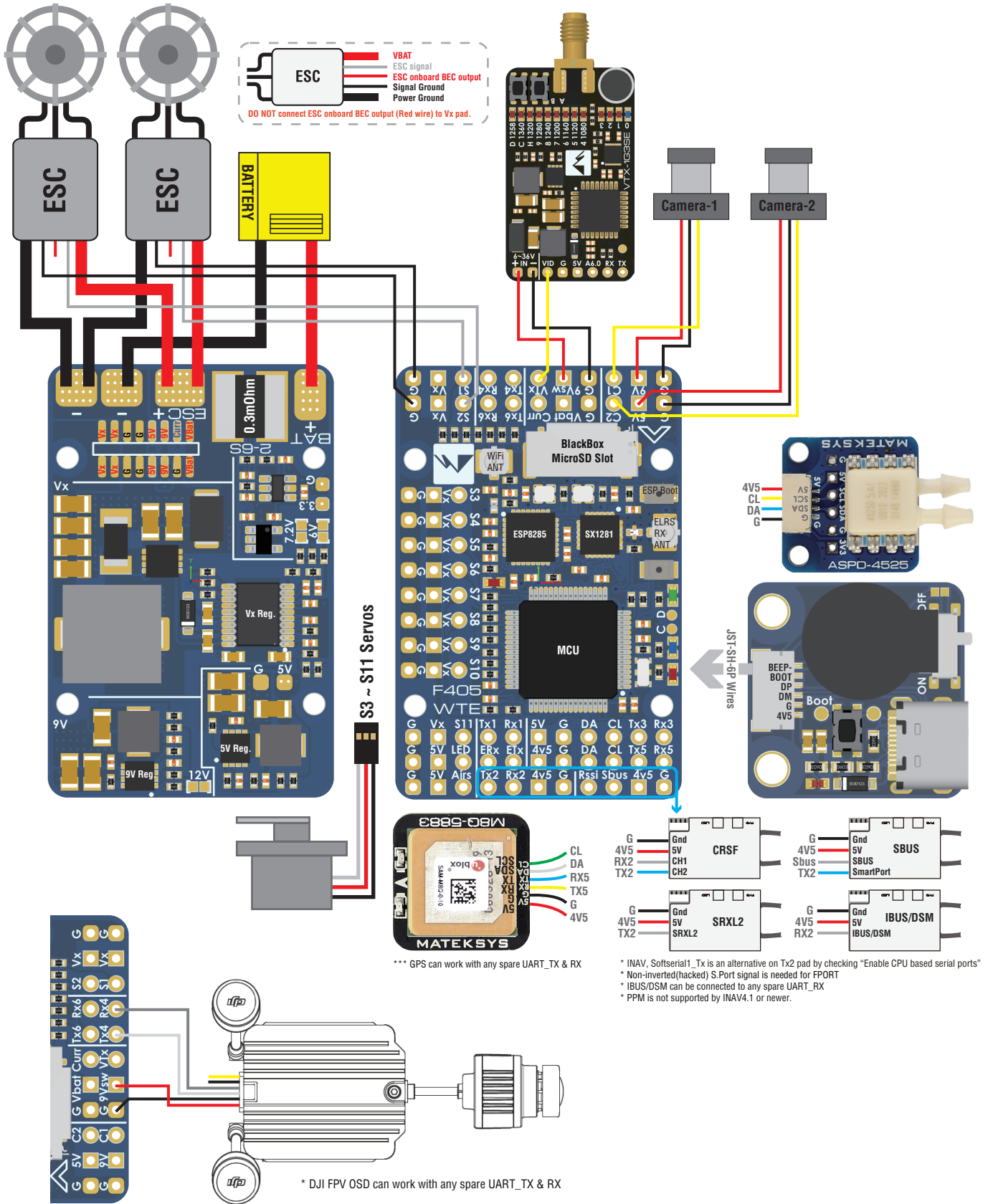
Battery & ESC -      ESC +      Current Sense resistor  
90A continuous  
220A peak      Battery + 6.8V-30V



**12V**  
9V increase to 12V

# Wiring

INAV fw: MATEKF405TE\_SD  
 ArduPilot fw: MATEKF405-TE

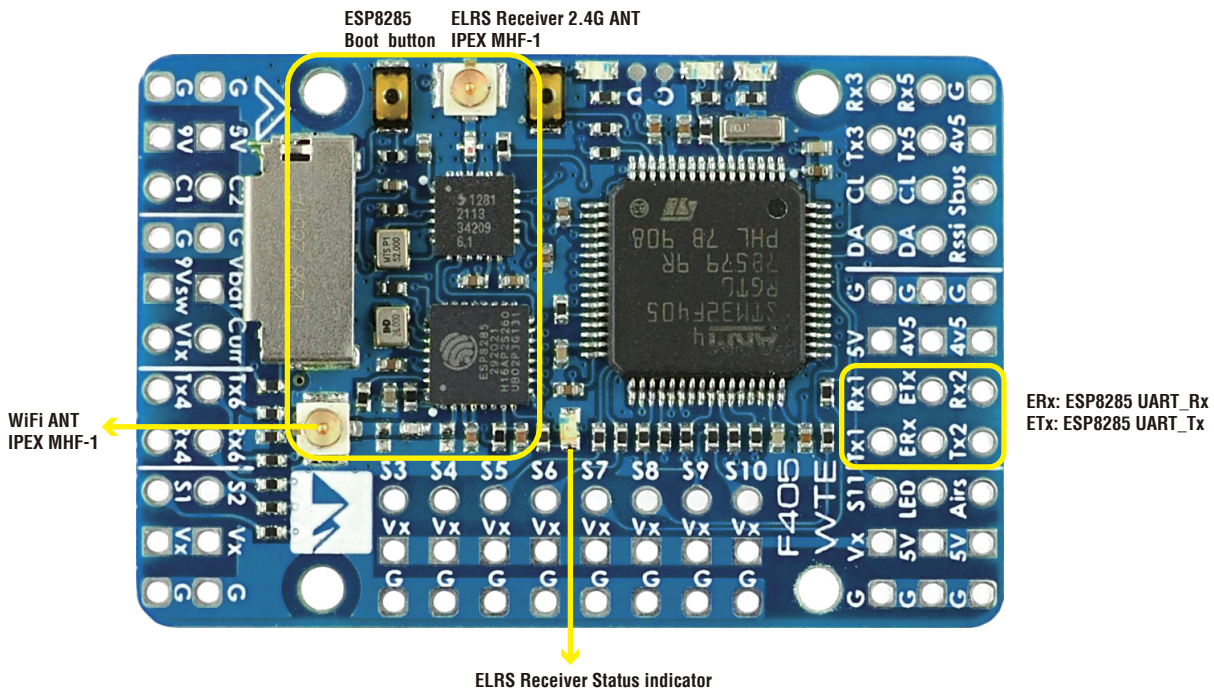


## 9Vsw Power / Camera switch

USER1	No USER1 definition 9Vsw ON by default
USER2	No USER2 definition C1 (Camera-1) ON by default

The screenshot shows the INAV configuration interface with the following settings:

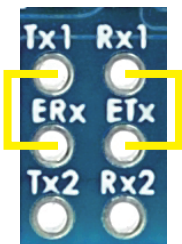
- USER1:** Channel 8, 9Vsw OFF (slider at 1500), 9Vsw ON (slider at 1500).
- USER2:** Channel 5, C1 ON & C2 OFF (slider at 1500), C2 ON & C1 OFF (slider at 1500).



### ESP WIFI Telemetry

Fw: ArduPilot MAVESP8266 (firmware-esp01\_1m)

\*\*\* Red LED for ELRS receiver will not turn on if MAVESP8266 firmware is flashed in.



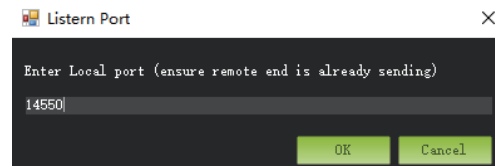
Bridge TX1 to ERx, RX1 to ETx

ArduPilot Parameters  
 SERIAL1\_PROTOCOL = 2 (MAVLink2) or 1  
 SERIAL1\_BAUD = 921 (921600 baud)

SERIAL1_BAUD	921
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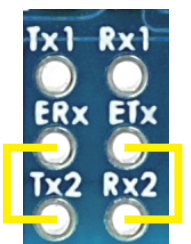
WiFi SSID "ArduPilot"  
 Password "ardupilot"

Connect to Mission Planner or QGC over WiFi



### ExpressLRS 2.4G Receiver

Fw: DIY 2.4GHz / DIY\_2400\_RX\_ESP8285\_SX1280



Bridge TX2 to ERx, RX2 to ETx

ArduPilot Parameters  
 BRD\_ALT\_CONFIG = 1  
 SERIAL6\_PROTOCOL = 23 (RCIN)  
 SERIAL6\_OPTIONS = 0  
 SERIAL6\_BAUD = 115 (115200)  
 RSSI\_TYPE = 3 (ReceiverProtocol)  
 RC\_OPTIONS enable "Suppress CRSF mode/rate message for ELRS systems".

INAV  
 Serial receiver is enabled on UART2 by default  
 CRSF Protocol is enabled for Serial receiver by default

## I/O Mapping

ArduPilot					
PWM 5V tolerant I/O	S1	PWM1 GPIO50	TIM8_CH4	DMA/DShot	Group1
	S2	PWM2 GPIO51	TIM8_CH3	DMA/DShot	
	S3	PWM3 GPIO52	TIM1_CH3N	DMA/DShot	Group2
	S4	PWM4 GPIO53	TIM1_CH1	DMA/DShot	
	S5	PWM5 GPIO54	TIM2_CH4	DMA/DShot	Group3
	S6	PWM6 GPIO55	TIM2_CH3	DMA/DShot	
	S7	PWM7 GPIO56	TIM2_CH2	DMA/DShot	
	S8	PWM8 GPIO57	TIM2_CH1	DMA/DShot	Group4
	S9	PWM9 GPIO58	TIM12_CH1	NO DMA	
	S10	PWM10 GPIO59	TIM13_CH1	NO DMA	Group5
	S11	PWM11 GPIO60	TIM4_CH1	NO DMA	Group6
LED pad	PWM12 GPIO61	TIM3_CH4	DMA/DShot	Group7	
	SERVO12_FUNCTION 120, NTF_LED_TYPES neopixel				

Mixing Dshot and normal PWM operation for outputs is restricted into groups, ie. enabling Dshot for an output in a group requires that ALL outputs in that group be configured and used as Dshot, rather than PWM outputs.  
If servo and motor are mixed in same group, make sure this group run lowest PWM frequency according to the servo specification. ie. Servo supports Max. 50Hz, ESC must run at 50Hz in this group.

ADC	Vbat Pad	1K:20K divider builtin 0-30V	Vbat ADC onboard battery voltage	BATT_VOLT_PIN BATT_VOLT_MULT	14 21.0
	Curr pad	0-3.3V	current sensor ADC onboard current sense	BATT_CURR_PIN BATT_AMP_PERVLT	15 66.7
	RSSI Pad	0-3.3V	RSSI ADC Analog RSSI	RSSI_ANA_PIN RSSI_TYPE	8 2
	AirS /PC0 Pad	no divider builtin 0-3.3V	AirS ADC Analog Airspeed	ARSPD_PIN ARSPD_TYPE	10 2

I2C	I2C1	5V tolerant I/O	Compass	COMPASS_AUTODEC	1
			onboard Baro SPL06-001	Address	0x76
			Digital Airspeed I2C MS4525	ARSPD_BUS ARSPD_TYPE	1 1
			DLVR-L10D	ARSPD_TYPE	9

UART 5V tolerant I/O	USB	USB		console	SERIAL0
	TX1 RX1	USART1	with DMA	telem1	SERIAL1
	TX3 RX3	USART3	NO DMA	telem2	SERIAL2
	TX5 RX5	UART5	NO DMA	GPS1	SERIAL3
	TX4 RX4	UART4	NO DMA	GPS2/DJI OSD	SERIAL4
	TX6 RX6	USART6	TX6 with DMA	USER	SERIAL5
	TX2 RX2 SBUS	USART2	with DMA	RC input/Receiver	SERIAL6
		RX2	IBUS/DSM/PPM	BRD_ALT_CONFIG 0 Default	
		Sbus pad	SBUS	BRD_ALT_CONFIG 1	SERIAL6_OPTIONS 0
		TX2 & RX2	CRSF	SERIAL6_PROTOCOL 23	SERIAL6_OPTIONS 4
TX2		uninverted FPort (hacked)		SERIAL6_OPTIONS 4	
TX2	SRXL2			SERIAL6_OPTIONS 4	

INAV					
PWM	S1	5 V tolerant I/O	TIM8 CH4	INAV MultiRotor	INAV Plane
	S2	5 V tolerant I/O	TIM8 CH3	Motor	Motor
	S3	5 V tolerant I/O	TIM1 CH3N	Motor	Servo
	S4	5 V tolerant I/O	TIM1 CH1	Motor	Servo
	S5	5 V tolerant I/O	TIM2 CH4	Motor	Servo
	S6	5 V tolerant I/O	TIM2 CH3	Motor	Servo
	S7	5 V tolerant I/O	TIM2 CH2	Motor	Servo
	S8	5 V tolerant I/O	TIM2 CH1	Motor	Servo
	S9	5 V tolerant I/O	TIM12 CH1	Servo	Servo
	S10	5 V tolerant I/O	TIM13 CH1	Servo	Servo
	S11	5 V tolerant I/O	TIM4 CH1	Servo	Servo
LED	5 V tolerant I/O	TIM3 CH4	2812LED	2812LED	

ADC	Vbat Pad	1K:20K divider builtin 0-30V	Vbat ADC ADC CHANNEL 1	BF scale 210, INAV scale 2100
	Curr pad	0-3.3V	Current ADC ADC CHANNEL 2	scale 150
	RSSI Pad	0-3.3V	RSSI ADC ADC CHANNEL 3	Analog RSSI
	AirS /PC0 Pad	no divider builtin 0-3.3V	AirS ADC ADC CHANNEL 4	Analog Airspeed

I2C	I2C1	5V tolerant I/O	Compass	QMC5883 / HMC5883 / MAG3110 / LIS3MDL
			OLED	0.96"
			onboard Barometer	SPL06-001
			Digital Airspeed sensor	MS4525
			Temperature sensor	

UART 5V tolerant I/O	USB	USB		
	TX1 RX1	5V tolerant I/O	UART1	USER
	TX3 RX3		UART3	USER
	TX4 RX4		UART4	USER
	TX5 RX5		UART5	USER
	TX6 RX6		UART6	USER
	TX2 RX2 SBUS	5V tolerant I/O	UART2	RC input/Receiver
			Sbus pad	for SBUS receiver, Sbus pad = RX2+inverter
			RX2 pad	IBUS/DSM
			TX2 & RX2	CRSF
TX2 pad			SmartPort Telemetry   enable Softserial Tx1	
TX2 pad		uninverted FPort (hacked)		
TX2 pad		SRXL2		