CANSAT FLIGHT COMPUTER USER'S AND MANUFACTURER'S MANUAL



Picture 1: 3D renders of the board

Introduction:

The CANSAT flight computer is an all-in-one, multi-purpose, model rocket flight computer, it can be used to deploy recovery mechanisms, perform measurements, and conduct experiments.

Capabilities:

Processor: STM32F405RGT6 Sensors: MPU6050, BMP180, HMC5883l, L80 GPS 8x PWM ports 4x High current DC ports rated at 10A momentary Spare GPIO ports SD card interface

Size: 51.4096mm x 38.1mm

Pinouts and features:



BLUE: Spare GPIO BOOT1, BOOT0, SWCLK, PA10, PA9, PC3, PA2, PC1, PC0, PB5, PB4, PB3, +3.3V, +5V, +12V GND, +3.3V, GND, PB11, PB10, PA13, PA3, PA5, PA6, PA7, PC4, PC5, PB0, PB1,PA8

Picture 2: Pinouts

Note: x denotes pins that are not connected to anything

Important safety information:

- 1. Only connect power to the device you are using it, NEVER leave it unattended with the power connected
- 2. Nichrome wire can heat up to dangerous temperatures, DO NOT touch the wire in any circumstances when power is connected
- 3. The length of the nichrome wire should be similar to the width of the board
- 4. The firmware must drive all High current channels to low at startup, as the MOSFETs are defaulted to ON
- 5. Since the MOSFETs are defaulted to the ON state, the microcontroller needs to be powered on whenever the high current channels are powered. See table below for acceptable power situations

Microcontroller	High current channels	Is this situation safe
Off	On	Unsafe
On	Off	Safe
On	On	Safe
Off	Off	Safe

(Rule 4, and 5, only applies to hardware versions prior to v1.0, devices with hardware version v1.0 and later have the MOSFETs defaulted to OFF)

Firmware development:

This board is compatible with Arduino[®] ecosystem, the prefer tool for firmware development is stm32duino [1], follow the stm32duino documentation to install it in Arduino[®] IDE.

To turn on a nichrome wire connected to a specific high current DC channel, use digitalWrite(<PIN_NAME>, HIGH). E.g. to turn on the channel closest to the battery terminals (see picture 2), use digitalWrite(PA8, HIGH). Use digitalWrite(<PIN_NAME>, LOW) to turn it off.

Recommended 3rd party libraries, these libraries have extensive documentation and easy to understand examples:

https://docs.arduino.cc/libraries/mpu6050_light/

https://docs.arduino.cc/libraries/bmp180mi/

https://docs.arduino.cc/libraries/tinygpsplus/

https://docs.arduino.cc/libraries/rf24/

If the BMP180MI library is used, a temperature reading must be taken prior to taking a pressure reading, even if the temperature reading is discarded.

If the RF24 library is used, there is an in-house developed helper library(rf24_transeiver.h) that can be used alongside if desired.

- 1. Copy the rf24_transeiver.h into your project directory
- 2. Setup the radio transceiver using radioSetup(), returns 0 on success
- 3. To send a piece of text, use sendStringRadio(<text>, <length_of_text>), <text> must be in char, max length is 32 characters each call, <length_of_text> must match the actual length of the text, and must be int
- 4. Calling pollRadio() will return all the text the radio has received so far, in order to retrieve all the data continuously, and send it over the serial terminal, use while(radio.available()) {

Serial.print(pollRadio);

}

Power supply requirements:

It is highly recommended to use 2 separate batteries to power the product, with one being used to power the computer system (system battery), and the other being used to power the high current nichrome wire (wire battery). The system battery need to be around 5v +- 1v, and the wire battery need to be able to deliver around 3A of current continuously. Typically, a 1s lipo is sufficient for the system battery, and a 1s – 2s should be sufficient for the wire battery. Alternatively, a 9v battery can be used to provide power to the nichrome wire.

The nichrome wire needs to be at minimum 50mm long, and it is not recommended to turn on the wire for more than a few seconds. The wire can be turned on by applying a high signal to the microcontroller pin whose name is next to the port with in which the nichrome wire is connected.

The system battery is labelled with +5v- under the screw terminals, and the +12v- is the wire battery. The positive wire should be connected to the terminal closest to the + sign, the negative wire should be connected to the terminal closest to the – sign.

For manufacturers, hardware developers / contributors, and advanced users

The product is exclusively designed in KICAD and already have JLCPCB part numbers pre-populated. JLCPCB seems to be a good manufacturer, they offers a high quality manufacturing service, while keeping the prices low in comparison to other manufactures. However, they are not the only manufacturer capable of producing these boards.

1. Adding of parts: To add additional parts, it is preferred if it can be assembled by JLCPCB SMT service. To inform JLCPCB on what part to place it is necessary to

add another field called "LCSC" and input the JLCPCB part number, see images below for examples

	ssembly Parts Lib or PCBA Only	Search by Part # / Keyword						
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Components / Embedded Processors 8	& Controllers / Microcontrollers (M	ICUIMPU/SOC) / STM32F405RGT6						
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$\wedge \wedge \wedge$	Manufacturer	STMicroelectronics						
	MFR.Part #	STM32F405RGT6						
	JLCPCB Part #	C15742						
X Mar and X	Package	LQFP-64(10x10)						
	Description	1MB 1.8V~3.6V ARM-M4 1 (MCU/MPU/SOC) ROHS	92KB 16	8MHz FLASH	151 LQFP	-64(10x10)	Microco	ontrol
A COL	Datasheet	Download						
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	ECCN	3A991A2						
	Source	JLCPCB						
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- 2. Generating fabrication files: To have the boards manufactured by JLCPCB gerber files, BOM(bill of material), and placement file needed to be provided, please use the following instructions for generating these files. These instructions are based on JLCPCBs recommendation for KICAD 7 [2] [3], but has been updated for KICAD 8
  - a. Gerber: PCB editor > File > Fabrication output > Gerber



b. Drill: PCB editor > File > Fabrication output > Drill

Output folder: jicpcb/ Drill File Format © Excellon   Mirror Y axis   Mirror Maxis   PTH and NPTH in single file   Oval Holes Drill Mode   Use route command (recommended)   @ Use alternate drill mode   Gerber X2 Map File Format   PostScript   @ Gerber X2	Drill Origin Absolute Drill/place file origin Drill Units Millimeters Inches Zeros Format Decimal format (recommended) Suppress leading zeros Suppress trailing zeros Suppress trailing zeros	Hole Counts Plated pads: Non-plated pads: Through vias: Micro vias: Buried vias:	83 2 137 0 0
O DXF SVG PDF	Precision: 3:3		
Messages			^
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- c. Zip all the outputs from the above steps into a .zip archive, store it for use later
- d. Generating BOM: Schematics Editor > Tools > Generate bill of materials

ield	Label	Show	Group By	Q Filter		0	clude DNP
eference	Designator			Comment	Designator	Footprint	LCSC
alue	Comment			AB\$05W-32.768KHZ-D-2-T	Y2	Crystal:Crystal_SMD_MicroCrystal_CM9V-T1A-2Pin_1.6x1.0mm	C1985550
ootprint	Footprint			SG2016CAN 8.000000 MHz TJGA	X1	Crystal:Crystal_SMD_2016-4Pin_2.0x1.6mm	C881716
itasheet	Datasheet			~	UB	flight_computer_parts:flight_computer_gps	
scription	Description			LD 1086D TSOTR	U7	Package_TO_SOT_SMD:TO-252-2	C164853
	- Caty			~	U6	flight_computer_parts:flight_computer_mini_nrf24	
EW_NUMBER/	LCSC		H	L80-R	U4	RF_GPS:Quectel_L80-R	C3029061
Device	Sim Device		H I	~	U3	flight_computer_partsflight_computer_GY-87	
Pins	Sim.Pins	ň	- i	NCP1117-3.3_SOT223	U2	Package_TO_SOT_SMD:SOT-223-3_TabPin2	C26537
.Type	Sim.Type		-	STM32F405RGTx	U1	Package_QFP:LQFP-64_10x10mm_P0.5mm	C15742
NP)	DNP			200 ohm	R6	Resistor_SMD:R_0603_1608Metric_Pad0.98x0.95mm_HandSolder	C8218
				200 ohm	R5	Resistor_SMD:R_0603_1608Metric_Pad0.98x0.95mm_HandSolder	C8218
				5.1k	R4	Resistor_SMD:R_0402_1005Metric_Pad0.72x0.64mm_HandSolder	C25905
				5.1k	R3	Resistor_SMD:R_0402_1005Metric_Pad0.72x0.64mm_HandSolder	C25905
× u				5.1k	R2	Resistor_SMD:R_0402_1005Metric_Pad0.72x0.64mm_HandSolder	C25905
v presets:				Scope:  Entire project	O Current sheet or	W O Recursive	
					-		

e. Generate component placement: PCB editor > File > Fabrication output > Component placement:

enerate Placeme	nt Files				
)utput directory:	jlcsmt\				
Format		Units		Files	
		OInches		Separate files f	or front, back
CSV		Millimeters		◯ Single file for b	oard
⊖ Gerber X3					
✓ Include only S	SMD footprints				
Exclude all fo	otprints with throu	igh hole pads			
Exclude all fo	otprints with the D	o Not Populate flag s	et		
Include board	l edge layer				
Use drill/place	e file origin				
Use negative	X coordinates for f	ootprints on bottom	ayer		
Output Message	es				
Show: 🗌 All	Errors 0	Warnings 🕕	Actions	Infos	Save

f. Open the component placement file, and change the first line to match the example below



g. By now you should have 1x zip file containing gerber and drill files, 1x
BOM, 2x position .csv files, collect all these files and submit to JLCPCB for manufacturing

Alternatively use <u>https://github.com/Bouni/kicad-jlcpcb-tools</u> after you have finished the design of the board, with this extension, it allows you to check the parts are available at JLCPCB, and allows for one-click compilation without disruption to your workflow.

Sometimes, JLCPCB will fail to process the board placement and BOM files, in this case, open the file in LibreOffice or Microsoft Excel, and delete all empty rows.

### References

- [1] STMicroelectronics, "GitHub stm32duino/Arduino_Core_STM32: STM32 core support for Arduino," 23 1 2025. [Online]. Available: https://github.com/stm32duino/Arduino_Core_STM32. [Accessed 23 1 2025].
- [2] JLCPCB, "How to generate Gerber and Drill files in KiCad 7," JLCPCB, 2025. [Online]. Available: https://jlcpcb.com/help/article/how-to-generate-gerber-and-drill-filesin-kicad-7. [Accessed 13 2 2025].
- [3] JLCPCB, "How to generate the BOM and Centroid file from KiCAD," JLCPCB, 2025. [Online]. [Accessed 13 2 2025].