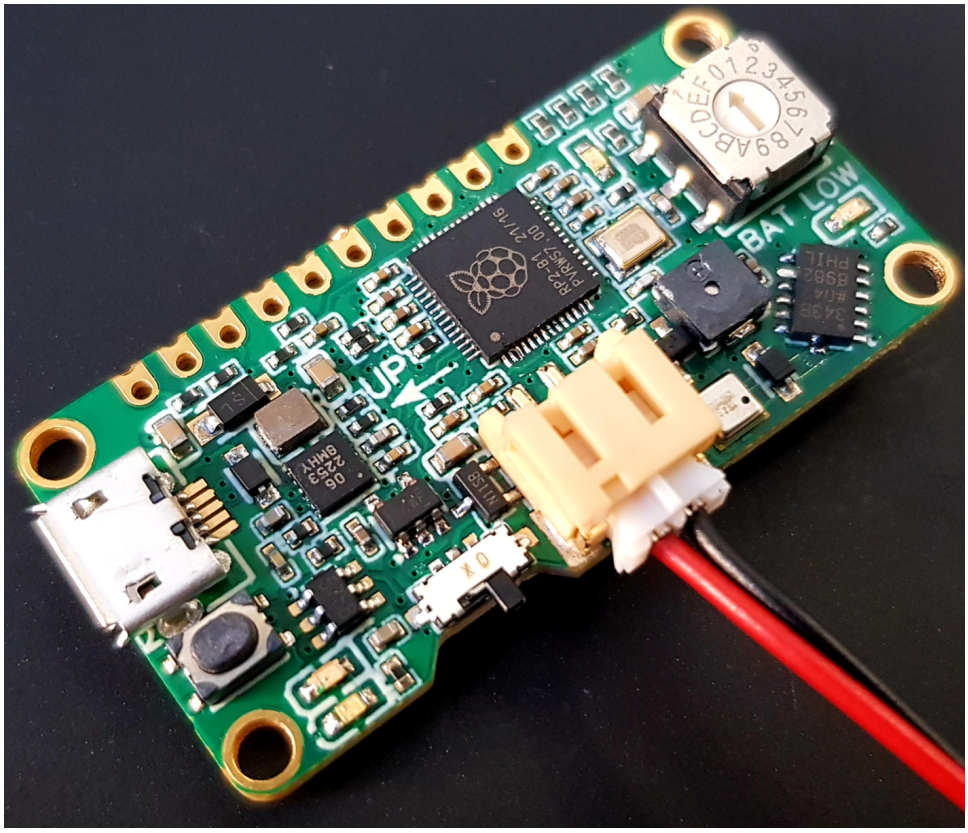
Rockit rev.1 user manual

Version 1.3



DanInvents

May 17, 2022

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1 Disclaimer

In no respect shall DanInvents be accountable for any liabilities, claims, demands, damages or suits resulting from the use of Rockit and/or its related firmware. By using this circuit, you assume all risks associated with this product and its associated features. While the circuitry and firmware have been tested, they should be considered experimental and handled with caution.

2 Introduction

Rockit or Rocket Operation Computing Kit is a flight controller designed with rocketeers in mind. In a small package, it delivers accurate altitude and acceleration data, dual parachute deployment capabilities, and battery charging as well as fast data processing speed and data logging to a micro-SD card. Neat!

	Specs
Dimensions (length, width, height) in mm	44, 22, 9
Mass in grams	5
Working voltage*	2.3 to 5.6 V
Current draw when idle	70 mA
Current draw when logging data	80 mA (200mA when beeping)
Current draw when moving a servo motor	400 mA
Maximum current output from 5V	2A (continuous)
Battery charging current	500 mA
Sampling rate	100 Hz
Altimeter range	Up to 9160 m
Accelerometer range (adjustable)	22.6 g
Maximum number of files	100
Maximum data logging time	5 min

Table 1: The lower limit of the voltage range is set by the protection circuit of your lithium polymer battery. The battery power is typically cut off below 3V.

3 Layout

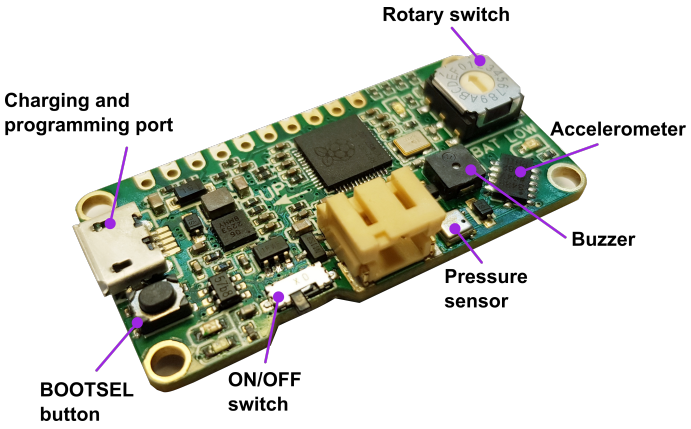

Fig.1. Top Rockit layout, the I2C pins as well as the servo signal pins operate at 3.3 V. Connecting these pins to a 5V signal source will destroy the microcontroller. For best data logging speed, use a class-10 microSD card.

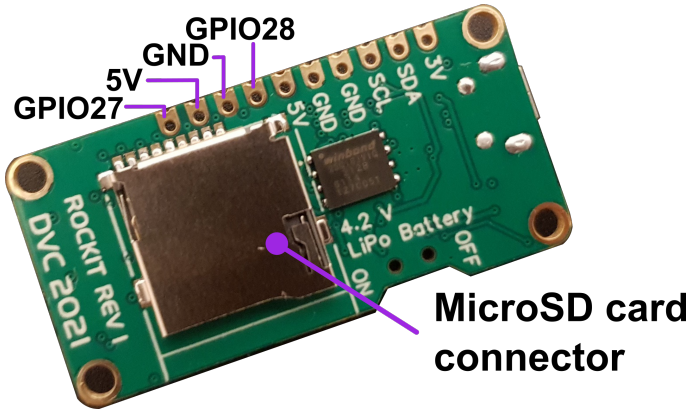

Fig.2. Bottom Rockit layout the general-purpose input/output pins (GPIO) 28 and 27 are used in the firmware to control servo motors 1 and 2 respectively. The I2C pins SDA and SCL corresponds to GPIO pins 10 and 11.

4 How does Rockit work?

4.1 Launch detection

In version 1.0 of the firmware, Rockit detects launch when the longitudinal acceleration is zero. This requires an acceleration transient, which might or might not occur.

Version 1.1 of the firmware solves this issue by setting an acceleration threshold of 1.5 g. This means that to detect launch Rockit must experience an upward acceleration of 1.5 g.

4.2 Apogee detection

To detect apogee (position A of the rotary switch) the firmware constantly computes the difference between the current and the previous filtered altitude values. When the difference in altitude is negative four times in a row, a countdown starts to activate the servos.

5 How to use Rockit

5.1 Effect of sunlight on altitude readings

To avoid sunlight from interfering with altitude data, protect the pressure sensor from direct sunlight. One way to do it is by placing your Rockit in a container with opaque walls. Alternatively you can cover the circuit with tape or foam, just be careful not to cover the vent hole that there is on the surface of the pressure sensor.

5.2 Rockit power source

To work properly, Rockit needs an input voltage ranging from 2.3 to 5.6 V. The battery charging functionality is only safe to use with 1s (3.7 V nominal voltage) lithium-ion or lithium-polymer batteries.

Lithium-polymer batteries typically incorporate a protection circuit. When driving servo motors current spikes can trigger the overcurrent protection of your battery thus disabling it. To prevent this from happening at start up, Rockit includes soft-start circuitry. You can avoid this problem altogether

by carefully choosing your servo motors and battery. Before a flight, test your Rockit to make sure that it can actuate the servo motors without the battery-protection circuit cutting off the power.

When connecting a battery, the polarity of the JST connector must be the same as indicated in the figure below where the black wire is ground.

5.3 Choosing a microSD card

For best results, use a class-10 microSD card with a capacity of 16 GB or lower. MicroSD cards featuring capacities larger than 16 GB are not guaranteed to work.

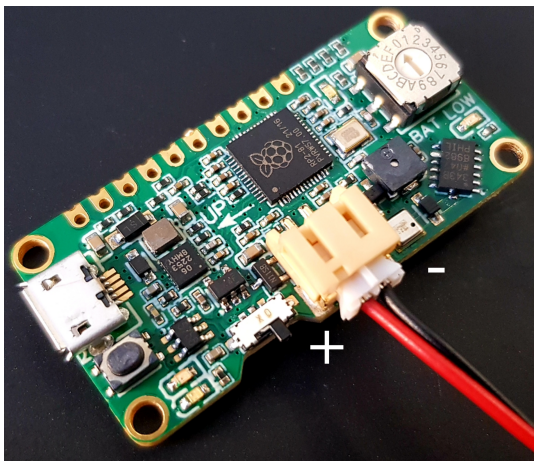

Fig.3. Mind your battery polarity! For rockit to work properly follow the wiring depicted in the image where red corresponds to the battery voltage and black to ground.

5.4 Time and servo motor adjustment

To select an operating mode, with the device off turn the rotary switch to the desired position (see table 2) and switch on the device. When adjusting time and servo motor position, changes are saved automatically.

Both when changing the time and adjusting the servo motor position, the zero position corresponds to ”0” (n = 0) in the rotary switch and the end

position to "F" (n = 15).

Rotary switch position	Main function	Integer n
A	Automatic mode	n = 10
B	Timer mode	n = 11
C	Adjust deployment time for the automatic mode	n = 12
D	Adjust deployment time for timer mode	n = 13
E	Adjust servo 1 start position	n = 14
F	Adjust servo 1 end position	n = 15
0	Adjust servo 2 start position	n = 0
1	Adjust servo 2 end position	n = 1
2	Adjust servo 2 deploy time	n = 2
3 to 9	Sleep mode	n = 3 to 9

Table 2. Mapping of the rotary switch functions

5.4.1 Time adjustment

To adjust the deployment time for servo motor 1 in the automatic or timer mode, turn the rotary switch to C or D. The green LED will start blinking indicating that you can now change this setting.

In automatic mode, the time adjustment follows the equation:

$$t_{servo1}\,(seconds) \;=\; 0.5 * n \quad n = 0, 1, ..., 15$$

And in timer mode

$$t_{servo1}\,(seconds) \;=\; 1 * n \quad n = 0, 1, ..., 15$$

The deployment time for servo motor 2 is adjusted in a similar fashion as in the automatic mode.

$$t_{servo2}\,(seconds) \;=\; 0.5 * n \quad n = 0, 1, ..., 15$$

Note: The deployment time for servo motor 2 is $t_{deploy} = t_{servo1} + t_{servo2}$.

5.4.2 Servo motor adjustment

When adjusting the start and end positions of both servo motors, the orientation of the knob follows the relation:

$$angle(deg) = \frac{n * maxAngle(deg)}{15} \quad n = 0, 1, ..., 15$$

Note: Depending on the servo motor maxAngle will be 90 or 180^{o}.

5.5 Automatic mode

In the automatic mode (A), once launch has been detected and the rocket has reached apogee, servo motor 1 moves followed by servo motor 2.

5.6 Timer mode

In the time mode (B), once launch has been detected and a set amount of time has passed, servo motor 1 moves followed by servo motor 2.

6 Programming Rockit

Rockit comes already programmed, to implement an upgrade, follow these steps:

- Download the .bin file from GitHub containing the desired upgrade.
- Plug a micro-USB cable to Rockit.
- Hold the BOOTSEL button as you connect the other end of the micro-USB cable to your computer.
- Drag and drop the .bin file to the flash drive that is Rockit.
- Rockit is ready to use.

7 Frequently-asked questions

My flight computer keeps beeping while charging the battery. How do I make it stop?

Disconnect the circuit board from the USB cable and turn off the power. Rotate the switch to a position from 2 to 9 and plug the USB cable back in.

My flight computer does not work. I turn it on and the LED stays green. What can I do?

Make sure that you are using a micro SD card no bigger than 16GB. It is possible that micro SD cards with a capacity of 32GB also work. Double check that there are no more than 100 files in your micro SD card.

Launch is not detected even when I tilt the flight computer, what is going on?

In this case, you've got a flight computer with a firmware version other than 1.0. Now the acceleration threshold is 1.5 g and tilting the sensor does not trigger the flight computer. To simulate launch hit with your finger or against the table the edge of the flight computer so that the applied force is upwards (as indicated by the UP arrow).

My servo motor does not move, what is going on?

Make sure that you have properly configured the start and end positions of the servo motor. If the start and the end positions are the same the servo motor will not move.

Why does the flight computer keep blinking even in the A and B modes?

This means that the time delay for servo 1 and servo 2 are not configured. Please visit the section "time adjustment" of this manual.

What is the difference between real-coded and complementary-coded flight computers

Depending on the mapping of the positions of the rotary switch your flight computer is real or complementary coded. You will need different firmware depending on the coding of the rotary switch