Aerobits

Subsystems for the
UAS intergration into
the airspace

AERO-RPi-HAT

Data sheet & User manual

Introduction

The **AERO-RPi-HAT** integrates **Micro ADS-B** and **GNSS** technologies with the most popular single board computer in the world. This allows easy access to data collected by the TT-MC1 module. The integration of GNSS technology allows you to mark frames with an accurate timestamp for multilateration purposes. For easy outdoor installation, optional the entire system can be powered by using PoE (Power-over-Ethernet) technology - so the only cable you need to connect is an Ethernet cable.

Applications

- Ground stations
- UTM/U-Space proof of concepts
- Data collecting and airspace monitoring

For more information please contact: support@aerobits.pl.

Contents

1 Technical parameters

1.1 Basic technical information

Parameter	Description	Typ.	Unit
Raspberry model	Raspberry Pi 3 Model B+		
Raspberry CPU	ARM11	900	MHz
PoE standard (optional)	IEEE 802.3at		
Sensitivity (ADS-B)	TT-MC1a	1090	MHz
Antenna connector	2xSMA		

Table 1: General technical parameters.

1.1.1 Populated devices on board

- Aerobits TT-MC1a 1090MHz receiver (accessible via UART and GPIO)
- uBlox NEOM8N - Multi-GNSS receiver (accessible via USB or TT-MC1)
- PoE supply (optional) - Silvertel
- various minor circuitry

1.1.2 Block diagram

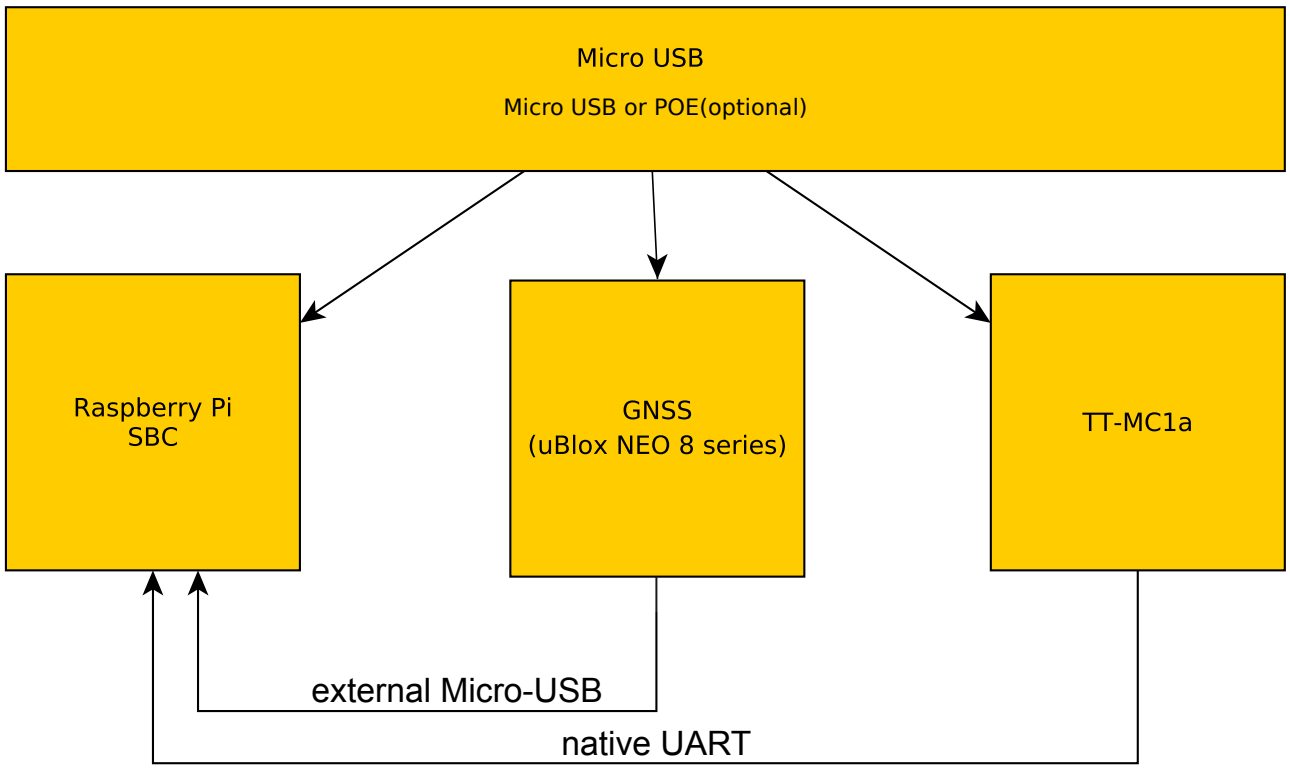

Figure 1: Block diagram

Please note that direct connection between GNSS module and Raspberry Pi is only avaliable via Micro-USB cable which cannot fit in the stock case presented on the top of this document, however TT-MC1a can stream GNSS data to native RPi UART together with its own decoded data.

1.2 Electrical specification

1.2.1 Power supply

Parameter	Value
Power connector	Standard micro USB connector or PoE (optional)
Power consumption	500 mA
Power supply	5 V (recommend 2.5A micro USB Supply)

Table 2: Power supply of RPI

1.2.2 LED indicators

LED	Color	Function
A (ADS-B)	White	Flashing – reception of 1090 MHz avionics frame (ADS-B)
G (GNSS)	White	Flashing – GNSS fixed Off – No GNSS fix, wait or change position for better satellite coverage
P (Power)	Green	Constant light - Power supply presence Off – No power, connect or recharge power source

Table 3: Electrical parameters

Figure 2: RPI front

For more information about power supply, please refer to official documentation available on raspberrypi.org/documentation/hardware/raspberrypi/power/

1.2.3 Raspberry Pi Pinout

For convenience, the pinout for Raspberry Pi is shown on figure 3. For more pinout information, please refer to official documentation available on raspberrypi.org/documentation/usage/gpio

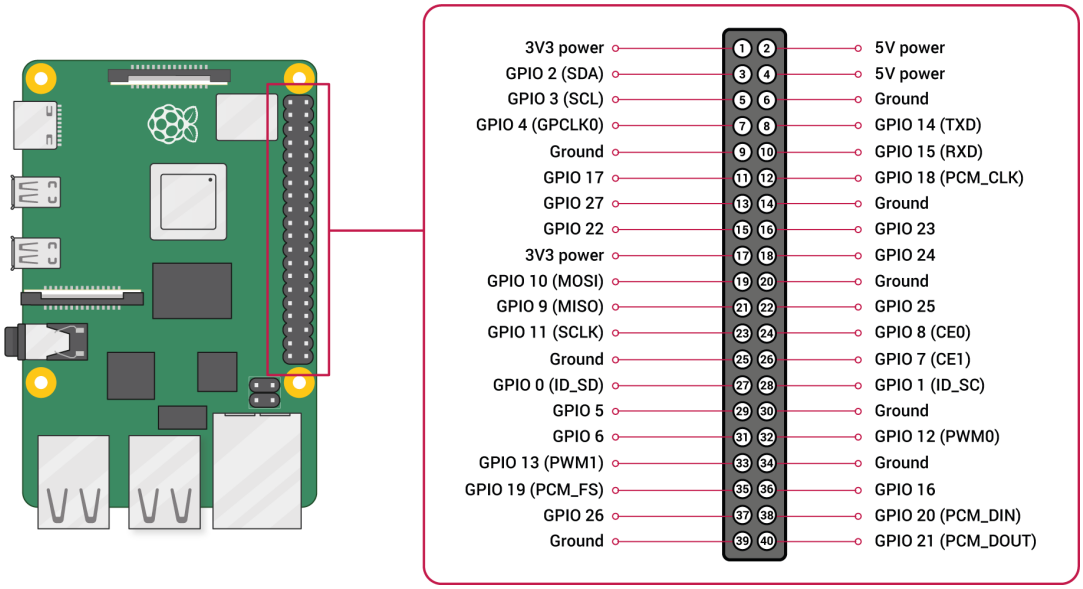

Figure 3: Raspberry Pi pinout. Source: official Raspberry Pi documentation.

Following pins are reserved for AERO-RPi-HAT1 communication:

- GPIO 2: Temperature and air quality sensor SDA
- GPIO 3: Temperature and air quality sensor SCL
- GPIO 4: AERO-RPi-HAT1 power switch
- GPIO 5: TT-MC1 BOOT/CONFIG pin
- GPIO 6: TT-MC1 RESET pin
- GPIO 14: TT-MC1 TX
- GPIO 15: TT-MC1 RX

1.3 Mechanical specification

1.3.1 Mechanical parameters

Parameter	Value
Dimensions	85.6 x 56.5 x 17.0 mm
Weight	45g

Table 4: Mechanical parameters of RPI

1.3.2 Dimensions

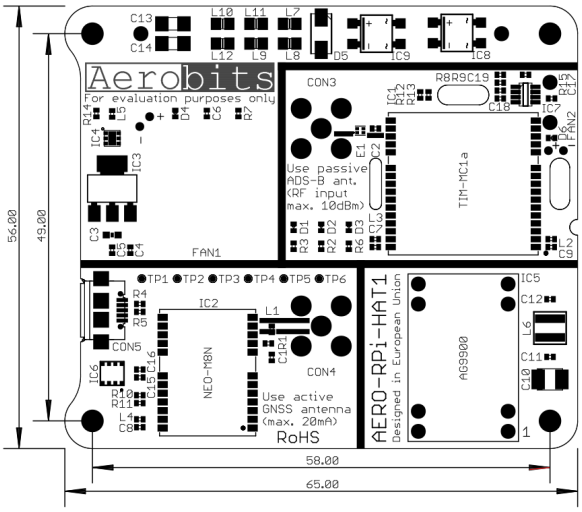

Figure 4: Dimensions of AERO-RPi-HAT

1.3.3 PCB view

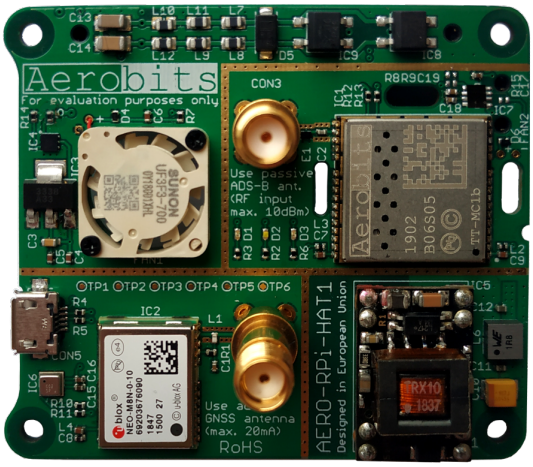

Figure 5: PCB view of AERO-RPi-HAT

2 Quick start

2.1 Scope of delivery

1. AERO-RPi-HAT1 module with Raspberry Pi 3 Model B+
2. GNSS Antenna
3. ADS-B Antenna
4. MicroSD memory card with bootable Raspberry Pi OS image

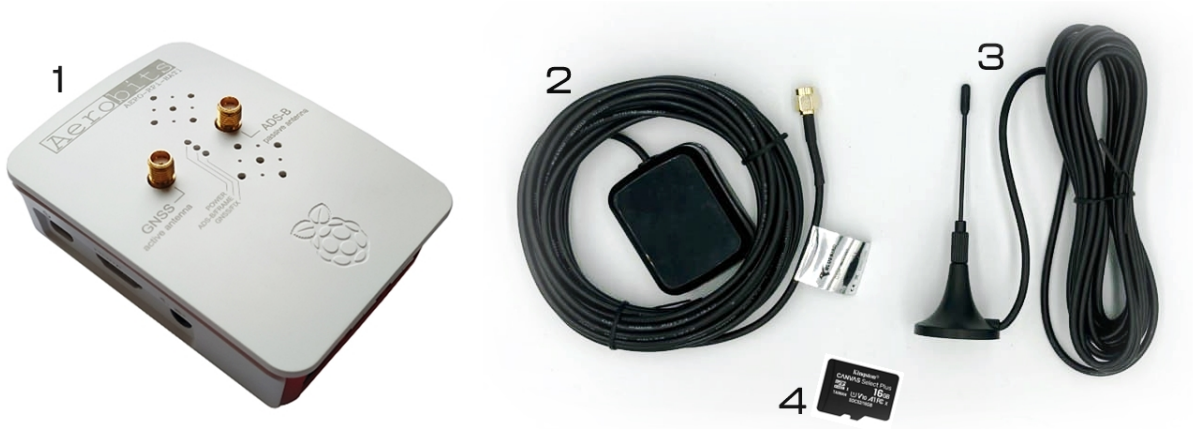

Figure 6: RPI equipment kit

NOTE: To order AERO-RPI-HAT1 board separately please contact support@aerobits.pl.

2.2 Possible output formats

- Aero (ASCII protocol)
- Raw (with or without signal strength)
- ASTERIX
- MAVLink
- On request - implementation of your protocol

2.3 Usage

The AERO-RPi-HAT1 is bundled with SD card with preinstalled Raspberry Pi OS as well as basic evaluation software. The default username is `pi` and password is set to `aerobits`. To evaluate TT-MC1 functionality, you can use Micro ADS-B App, which can be found under Accessories category of application menu.

NOTE: Change default password for your own safety.

2.4 Programming Examples

The preinstalled OS has example Python scripts, which can be found in `/home/pi/rpi_hat_utils` directory. Their purpose is to demonstrate simplicity of interfacing with AERO-RPi-HAT1 peripherals by using RPi.GPIO and SMBus packages. Some basic example scripts are shown below.

To turn on the power for Raspberry Pi HAT devices (`rpi_hat_utils/enablePower.py`):

```
import RPi.GPIO as GPIO
GPIO.setwarnings(False)
GPIO.setmode(GPIO.BCM)
GPIO.setup(4, GPIO.OUT)
GPIO.output(4,GPIO.HIGH) # Put pin 4 to high state
```

To reboot TT-MC1 module (`rpi_hat_utils/assertReset.py`):

```
import RPi.GPIO as GPIO
import time
GPIO.setwarnings(False)
GPIO.setmode(GPIO.BCM)
GPIO.setup(6, GPIO.OUT)
GPIO.output(6,GPIO.HIGH)
time.sleep(0.1)
GPIO.output(6,GPIO.LOW) # Put pin 6 to low state for 0.1s
time.sleep(0.1)
GPIO.output(6,GPIO.HIGH)
```

To enable TT-MC1's configuration mode via BOOT/CONFIG pin (`rpi_hat_utils/enableBootConfig.py`):

```
import RPi.GPIO as GPIO
import time
GPIO.setwarnings(False)
GPIO.setmode(GPIO.BCM)
GPIO.setup(5, GPIO.OUT)
GPIO.output(5,GPIO.LOW) # Put pin 5 to low state
```

Example script which uses the air quality sensor can be found in `rpi_hat_utils/indoor-air-quality.py`.

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