

DroneBeacon - Transponder Manual

121-series

November 2023 - version 1.2

Remote ID for drones



The latest version of this manual is located here:
<https://download.bluemark.io/db121.pdf>

Intended audience: users of the db121/db121pcb transponder

Disclaimer: we are not responsible or liable for errors or incomplete information in this document.

Version history

version	date	description
1.0	January 2023	● Initial release
1.1	April 2023	● Updated documentation to be in line with newest firmware ● Improved quick start
1.2	November	● Added EU information

QUICK START

Attach to the drone



db121

- For optimal performance attach the db121 on the top of your drone/airframe:
 - ✓ Use the 3M dual lock™ stickers (included).
clean the surface and remove the foil of the 3M dual lock sticker, apply firm pressure and wait 1 hour for optimal adhesion. Use a sticker for both the db121 and drone. Snap the db121 to the counter part sticker on the drone. The stickers allow you to easily remove or attach the db121.
 - ✓ Or/and use two M5 screws.
the db121 has two M5 screw noses that can be used for attaching the db121 to your drone.
- connect power (5 - 14V) to the power connector (JST-GH 1.25mm 2-pin)

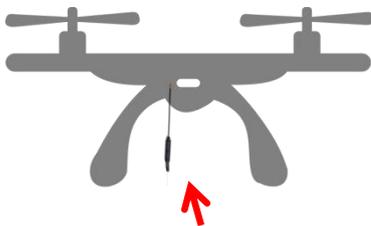
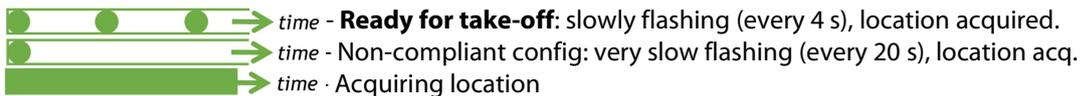
db121pcb

- install the db121pcb to the drone chassis using 4x M2 screws or cable ties
- Install the antenna vertical to make sure the antenna pattern is omni-directional and the Remote ID signals can be received from each direction. Also make sure that the last part of the antenna (where it gets thicker) is not obstructed by metal objects that could block radio reception in that direction.
- Install the GPS antenna to a location not near metal objects or ground planes. For optimal performance install the GPS antenna in the horizontal plane.
- connect power (5 - 14V) to the db121pcb using the 2-pin power connector (JST-GH 1.25mm 2-pin) or use the (non-populated) auxiliary 2.54mm 2-pin header.

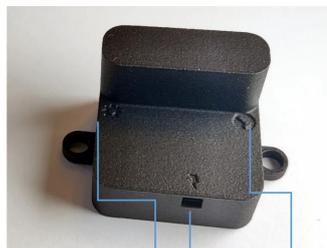
Use the db121/db121pcb

- If you power on the drone, the db121/db121pcb will be automatically powered on too.
- Wait for a GPS fix (slowly flashing status LED every 4 seconds). You are ready to fly.

Status LED



db121/db121pcb Vertical antenna installation. Thick antenna part should not be obstructed by metal objects



configuration button and LED
power connector
status LED



WLAN/BLE ant conn
GPS ant conn
configuration button and LED
power connector
status LED
aux power connector

Configuration

For typical use in the USA no configuration is required. USA: use the db121/db121pcb S/N number for registering your drone at the [FAA](#). For the EU, you need to enter your operator ID and UA class.

- After the db121/db121pcb is powered, press the configuration button. The *red* config LED is now solid red.
- Connect to the *dronebeacon* WLAN network (no password needed)
- Point your browser to <http://192.168.50.1> or scan the QR code.



Flying a drone could create risks for people, air traffic and other assets. Before flying, the drone operator has to make sure to know the local rules regarding drone flights and obtain the necessary authorization to fly the drone(s).



configuration web-page

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1 INTRODUCTION

Thank you for purchasing and using DroneBeacon products!

The latest version of this user manual may be downloaded at the following link:

<https://download.bluemark.io/db121.pdf>

(Direct/Broadcast) Remote Identification (Remote ID) adds “beacon” capability to drones to broadcast basic information of airborne drones, such as the operator’s registration number, drone serial number and current position. The EU and USA have new rules that make Remote ID mandatory for drones over 250 grams weight. The beacon information can be used by general public, law enforcement and drones to give better situation awareness of the airspace around them.

BlueMark Innovations BV offers Remote ID transponders and receivers. DroneBeacon db121/db121pcb is an add-on (transponder) for drones that broadcasts Remote ID beacon signals. We also provide other Remote ID add-ons. DroneScout is a receiver that detects Remote ID signals of nearby drones up to several km distance (in open space). See <https://dronescout.co> for more information about our products..

1.1 Audience

This document is intended for users that want to use the *DroneBeacon db121 or db121pcb* transponder as a stand-alone Remote ID add-on for their drone or other UAV product. There is a separate manual for the *DroneBeacon MAVLink db201* transponder (intended for drone manufacturers). Also, we provide a stand-alone Remote ID add-on with battery: the db120 transponder.

1.2 Specifications

The transponder consists of an embedded system and several radio-interfaces to broadcast Remote ID signals.

In the EU, the db121/db121pcb is a *Direct remote identification (DRI) Add-on*. DRI Add-ons are considered as payload in the EU. DRI means a system that ensures the local broadcast of information about a Unmanned Aircraft (UA) in operation, including the marking of the UA, so that this information can be obtained without physical access to the UA. A DRI Add-on is standalone direct remote ID broadcast device integrating a GNSS function and a communication. function, being able to provide position, height, speed over ground, track clockwise with true north, of the UA, and it’s take-off position. In the USA, the db121/db121pcb is a *Remote ID broadcast module*.

Regulation

The db121/db121pcb transponder complies and adheres to the following regulations:

region		
EU	DELEGATED REGULATION (EU) 2019/945 PART 6	March 2019
	DELEGATED REGULATION (EU) 2020/1058	April 2020
	ASD-STAN FprEN-4709-002:2023 (E) (Part 002: Direct Remote Identification)	June 2023
USA	ASTM, International (ASTM) F3586-22, with additions	July 2022

The EU Declaration of Conformity can be found here:

https://dronescout.co/wp-content/uploads/2023/09/EU-DoC_standalone.pdf

Key specifications:

- **Compliant with international regulations**
 - EU ASD-STAN DIN EN 4709-002
 - USA ASTM Remote ID Standard ASTM F3411-22a-RID-B/ F3586-22
 - ◆ Accepted by the FAA
 - db121 <https://uasdoc.faa.gov/listDocs/RID000000088>
 - db121pcb <https://uasdoc.faa.gov/listDocs/RID000000089>
- Supports **all Remote ID transmission protocols**:
 - BLE legacy
 - BLE long range
 - WLAN NaN 2.4 GHz
 - WLAN Beacon 2.4 GHz
- **Long range** up to 5 km detection range¹
 - Omni-directional antenna with 0 (db121) or 3 dBi (db121pcb) gain. Note that a higher *theoretical* antenna gain does not necessary mean a larger detection range in real life.
 - Transmit power: +18 dBm (WLAN and Bluetooth)
- Power
 - 2-pin power connector (JST-GH 1.25mm 2-pin)
 - or use the (non-populated) auxiliary 2.54mm 2-pin header (db121pcb only)
 - Input voltage range: 4.5 to 15 V
- Positioning
 - GPS and BDS: 2.5m positioning precision
- Suited for outdoor operation (only db121):
 - IP43 rating
 - for operation in rainy conditions, the transponder needs to be protected against water.
- Dimensions (l x w x h):
 - db121: 36 x 38 x 28 mm.
 - ◆ with screw nodes the dimensions are 36 x 55 x 28 mm
 - db121pcb: 33 x 35 x 5 mm.
- Operating temperature
 - -5°C to +40°C
- Weight:
 - 11 g (db121)
 - 5 g (db121pcb, including antennas)



¹ The detection range depends on several factors such as the receiver antenna gain, transmission protocol, weather conditions, flying height, receiver height line of sight etc. With professional receivers a range up to 5 km is possible. See the DroneScout manual for more details.

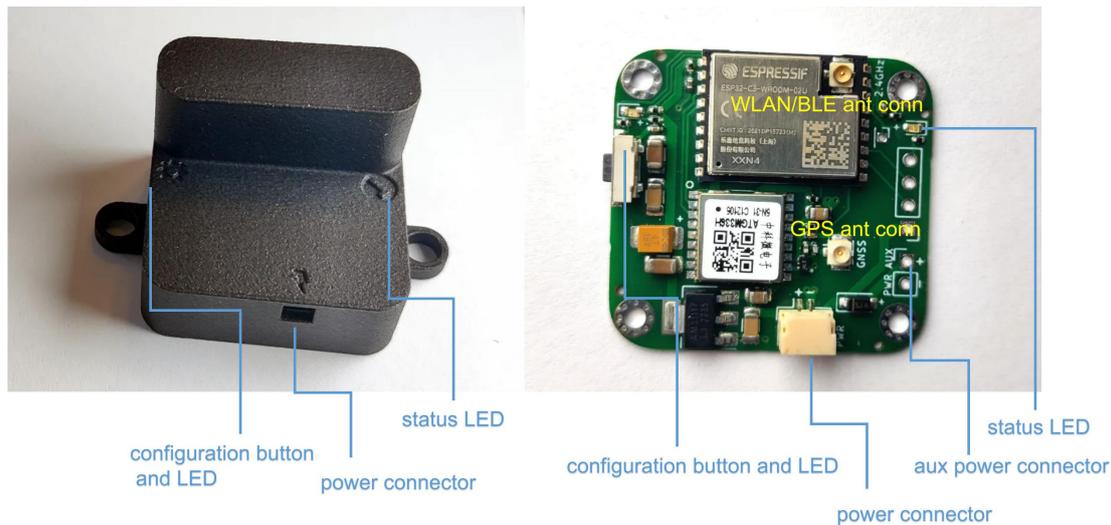


Figure 1 - DroneBeacon db121 (left) and db121pcb (right) transponders

1.3 What's in the Box

The following package contents should be present:

- 1x db121 or db121pcb transponder
- db121: 3x 3M dual-lock stickers (1 extra)
- db121pcb: sticker with valid FAA serial number (programmed in the module, but also provided as sticker.)

1.4 Installation

db121 transponder

Attach the DroneBeacon db121 transponder on the top of your drone for best performance.

- Use the 3M dual lock™ stickers (included).
clean the surface and remove the foil of the 3M dual lock sticker, apply firm pressure Use a sticker for both the db121 and drone. Snap the db121 to the counter part sticker on the drone. The stickers allow you to easy remove or attach the db121.
Note: for a good adhesion/grip, place the dual-lock sticker and apply firm consistent pressure to assure good contact with the substrate you are adhering. Also, it needs 1 hour to 72 hours (preferred) to build a (full) adhesion to the surface. In addition, it is important that the adhesive base for the tape is free of grease and dry, and that it is not covered with a removable lacquer or a layer of paper.
- Or/and use two M5 screws.
The transponder can be attached to the drone using two M5 screws. The distance between the two screw noses is 47 mm.

power

the db121 needs to be connected to a power source (from the drone) and has a JST-GH 1.25mm 2-pin power connector. It needs an input voltage between 4.5 V and 14 V. (15 V is the real maximum input voltage. A higher voltage may damage the transponder.) The current profile is shown in Chapter 3. Pin 1 needs to be connected to the input voltage and pin 2 to GND.



Figure 2 - Power connector the + signs indicates pin 1 and need to be connected to the input voltage.

db121pcb transponder

installation

The transponder can be attached to the drone chassis using 4x M2 screws or cable ties. Next install the antenna vertical (+/- 15 degrees) to make sure the antenna pattern is omni-directional and the Remote ID signals can be received from each direction. Also make sure that the last part of the antenna (where it gets thicker) is not obstructed by metal objects that could block radio reception in that direction. **Replacing the antenna or not obeying the installation instructions for the WLAN/BLE antenna will void the FAA DoC status of the db121pcb product. In such a case you may still use the product, but you need to submit your own DoC to the FAA.**

As a last step install the GPS antenna to a location not near metal objects or ground planes (> 2 cm). Those objects will affect the performance. You can also replace the GPS antenna by your own. The db121pcb needs a *passive* GPS antenna. It has an on-board GPS LNA to amplify GPS signals. For optimal performance install the GPS antenna in the horizontal plane. The data sheet of the provided GPS antenna can be found here: https://download.bluemark.io/gps_db121pcb.pdf

power

the db121pcb needs to be connected to a power source (from the drone) and has a JST-GH 1.25mm 2-pin power connector. It needs an input voltage between 4.5 V and 14 V. (15 V is the real maximum input voltage. A higher voltage may damage the transponder.) The current profile is shown in Chapter 3. Pin 1 needs to be connected to the input voltage and pin 2 to GND. Near the connector there are markings to explain the pin-layout (+ = pin 1 and - = pin 2). Alternatively, there is an AUX power input (unpopulated 2.54mm pin header) that can also be used. This is indicated by the PWR AUX marking on the PCB. Note that this AUX power input has a diode to protect it against reverse currents. The main JST-GH connector has no diode for reverse currents to allow for lower input voltages. (Voltages slightly lower as 5V are allowed.)

status led

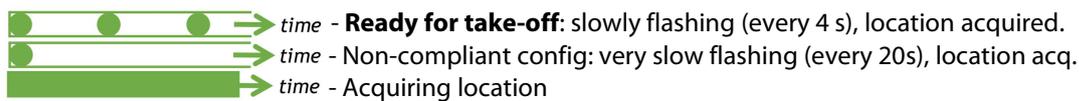
The status led should be visible by the user. And the user can only take-off if the status LED is flashing. **If it is not visible, it will void the FAA DoC status of the db121pcb product!**

1.5 Using the db121/db121pcb

- Power on the drone; the db121/db121pcb will be powered too.
- Wait for a GPS fix (slowly flashing status LED every 4 seconds). This is typically within 90 seconds if the db121/db121pcb is used outdoor.
- You are ready to fly.

Battery/status LED

The status LED can have the following states:



Note:

- For typical use in the USA no configuration is required. USA: use the db121/db121pcb S/N number for registering your drone at the [FAA](#).
- For the EU, you need to enter your operator ID and UA class. See section 2.2.
- A non-compliant configuration can be caused by selecting a non-compliant transmission protocol, selecting a lower transmit power (for WLAN modes) or selecting a different channel for WLAN modes than the default channel 6.



Flying a drone could create risks for people, air traffic and other assets. Before flying, the drone operator has to make sure to know the local rules regarding drone flights and obtain the necessary authorization to fly the drone(s).

1.6 EMC test

To verify that the db121/db121pcb does not produce interference to the drone or receives interference from the drone, it is advised to do a quick EMC test. (Only when attached for the first time to a drone.)

- Power on the drone and remote control. Keep the db121/db121pcb powered off.
- Verify that the drone, remote control and wireless link are functioning properly.
- Power off the drone and remote control.
- Power on the db121/db121pcb (using a different power source). Keep the drone and remote control powered off.
- Verify that the db121/db121pcb is functioning properly. For instance by using the Android in Section 1.6 or by looking at the status LEDs (ready for take-off state).
- Repeat the tests by powering on both the db121/db121pcb, the drone and remote control. If both the db121/db121pcb and drone, remote control and wireless link are functioning properly, there is no EMC interference between both systems.
- In case there is interference, please move the db121/db121pcb to a different place on the drone and repeat the tests. Alternatively lower the output power or change the transmission protocol.

1.7 Android/iOS app

You can use the free *OpenDroneID OSM* Android app to view the DroneBeacon Remote ID signals: https://play.google.com/store/apps/details?id=org.opendroneid.android_osm

Or the Drone Scanner Android app: <https://play.google.com/store/apps/details?id=cz.dronetag.dronesanner>

Note: only few Android smartphones support reception of Bluetooth Long Range and/or WLAN NaN signals. Also, in default Android configuration, WLAN Beacon signals are typically received only once every few minutes. A list of supported smartphones is presented, in the link below. <https://github.com/opendroneid/receiver-android/blob/master/supported-smartphones.md>

iOS

The Drone Scanner app is also available for iOS. Due to limitation of iOS only BT4 reception is possible.

<https://apps.apple.com/gb/app/drone-scanner/id1644548782>

1.8 Open Drone ID

DroneBeacon uses the Open Drone ID framework to broadcast Remote ID signals. The framework can be found on this page: <https://www.opendroneid.org/>

2 CONFIGURATION

The transponder can be configured via a web-interface. To active the configuration mode follow these steps:

- Move the on-off power switch to *on* (to power up the transponder).
- Press the configuration button, the *red* configuration LED is turned on.
- Connect to the *dronebeacon* WLAN network (no password needed)
- Point your browser to <http://192.168.50.1>



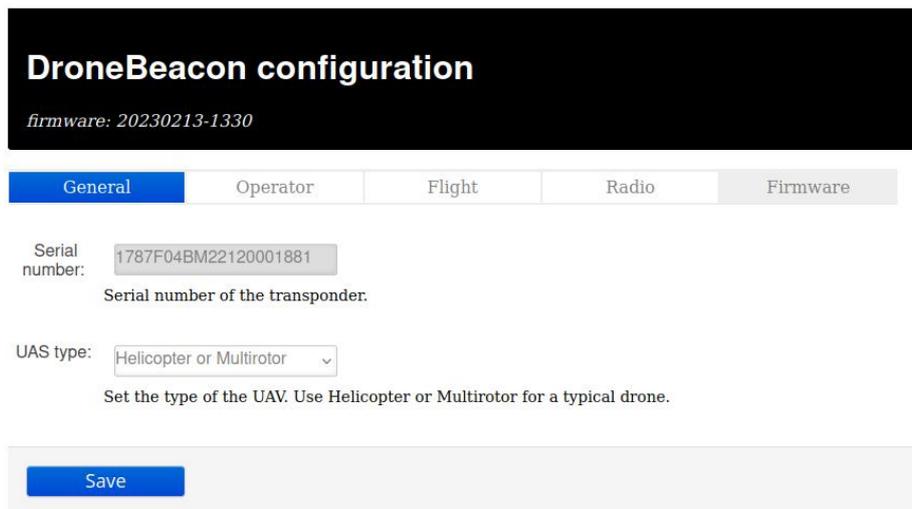
configuration web-page

New settings will only be applied if the Save button is pressed!

Configuration mode will be quit, by pressing the configuration button again. The *red* configuration LED is now turned off. The transponder is now in normal operation mode.

2.1 General

The main configuration can be found on the general tab.



The screenshot shows the 'DroneBeacon configuration' web interface. At the top, it displays the firmware version '20230213-1330'. Below this is a navigation bar with tabs for 'General', 'Operator', 'Flight', 'Radio', and 'Firmware'. The 'General' tab is active. The form contains a 'Serial number' field with the value '1787F04BM22120001881' and a label 'Serial number of the transponder.' Below that is a 'UAS type' dropdown menu with 'Helicopter or Multirotor' selected and a label 'Set the type of the UAV. Use Helicopter or Multirotor for a typical drone.' At the bottom of the form is a blue 'Save' button.

After pressing Save, press the configuration button again to exit this mode and return to normal mode.

Figure 2 - General configuration page

Fill in the drone type of your drone.

2.2 Operator

In the operator tab, you can configure the details of your license provided by the National Aviation Authority. This is an optional setting for the USA. In the USA you need to use the serial number of the db121/db121pcb instead for register your drone at the FAA. For the EU, this is a mandatory setting. *First, select the region where the drone is flying.* Outside the EU, no UAS category or UAS class is required.

Within the EU, only valid license numbers can be entered. In that case the input box becomes green.

DroneBeacon configuration
firmware: 20230213-1330

General **Operator** Flight Radio Firmware

Region: USA (and other regions) ▾
Set the region where the drone is flying.

Registration number:
Optional identifier delivered by the National Aviation Authority after registering your UAS.

Save

After pressing Save, press the configuration button again to exit this mode and return to normal mode.

DroneBeacon configuration
firmware: 20230213-1330

General **Operator** Flight Radio Firmware

Region: EU ▾
Set the region where the drone is flying.

Registration number:
This identifier delivered by the National Aviation Authority after registering your UAS. Enter the full number like NLD87astrdge12k8-abc. It will check if the registration number is valid and will only store the public part. Invalid registration numbers won't be saved.

UAS category: undeclared ▾
The category is delivered by the National Aviation Authority after registering your UAS.

UAS class: undeclared ▾
The class is delivered by the National Aviation Authority after registering your UAS.

Save

After pressing Save, press the configuration button again to exit this mode and return to normal mode.

Figure 3 - Operator configuration page

2.3 Flight

In the flight tab, you can configure an *optional*/text describing the purpose of your flight.

DroneBeacon configuration

firmware: 20230213-1330

General	Operator	Flight	Radio	Firmware
---------	----------	--------	-------	----------

Description:

Enter an optional description (or purpose) for your flight (maximum 23 characters).

After pressing Save, press the configuration button again to exit this mode and return to normal mode.

Figure 4 - Flight configuration page

2.4 Radio

In the radio tab you can configure the transmission mode and other radio-related settings. Most users don't change settings in this section. Note that in the USA only BLE dual-mode and WLAN broadcast transmission mode are allowed.

DroneBeacon configuration

firmware: 20230213-1330

General

Operator

Flight

Radio

Firmware

Advanced settings, most users don't change these settings.

Transmission mode: BLE dual mode: legacy + l (v)

Configure the transmission mode. For maximum compatibility, select BLE dual mode. Using a WLAN transmission mode will lower the battery life by roughly 50%.

Transmission period: 3 Hz (0.33s) (v)

Configure how often the transponder broadcasts its location. Most users keep this value at 1 Hz (1 s).

WLAN channel: 6 (v)

Advanced setting: configure the channel for WLAN transmissions. A channel different than channel 6 will be considered non-compliant by the firmware!

Transmit power: +18 dBm (v)

Set the transmission power. Most users keep this value at +18 dBm. A lower value means that the detection range decreases. This setting is used both for BLE and WLAN transmission. Note: setting a lower transmission power than the maximum (+18 dBm) is non-compliant for WLAN modes. The battery life is extended up to 8% if +6 dBm is selected (compared to +18 dBm).

Save

After pressing Save, press the configuration button again to exit this mode and return to normal mode.

Figure 5 - Radio configuration page

2.5 Firmware

In the firmware tab, you can upgrade the firmware of the transponder.

Firmware files can be found here: <https://dronescout.co/downloads/>
(Version history: https://download.bluemark.io/dronebeacon_transponder_history.txt)

Upload the file and press Flash image to upload new firmware. Upgrading firmware has been tested with Chrome and Firefox. If upgrade fails, please try again or try another browser.

DroneBeacon configuration

firmware: 20230213-1330

General	Operator	Flight	Radio	Firmware
---------	----------	--------	-------	----------

Firmware file: No file selected.

Select the new firmware (with extension bin) and press the flash image button to upgrade. If flashing fails or you flash the wrong file, it will automatically fallback to the previous firmware version.

After pressing the flash image button, the device will automatically reboot within 30 seconds. Press the cfg-button on the device again to check the running firmware.

Figure 6 - Firmware upgrade page

3 CURRENT PROFILE

The current profile has been measured using a digital current meter with a ~ 7.2 kHz sampling rate. Below the current profile (db121/db121pcb) has been shown for 5 seconds. Here, Bluetooth legacy and Bluetooth Long Range have been enabled. Also, the module transmits with maximum transmit power (+18 dBm). On the left the module is powered off and then connected to power (+5 V).

- The startup current profile is shown in the first 1.7 seconds.
- The *average* current is 84 mA (~ 420 mW).
- The *median* current -if there is no transmission- is 66 mA (~ 330 mW).
- The *peak* current is 400 mA² (~ 2 W).
- If the transmit power is reduced in the firmware, the peak current will also be smaller.

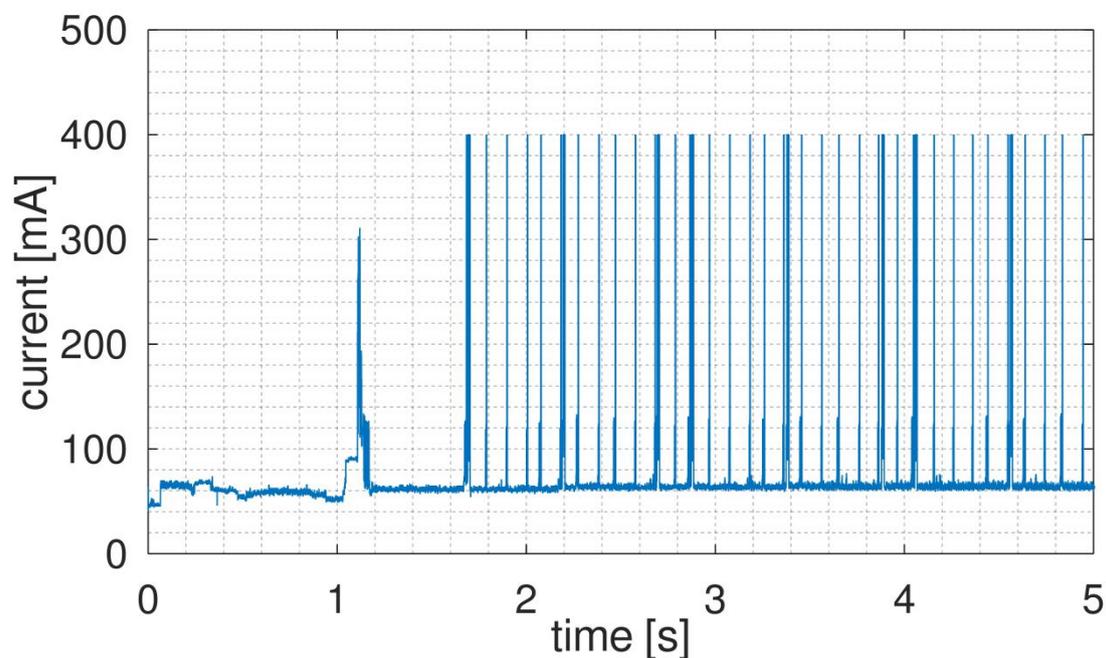


Figure 7 - Current profile of the db121/db121pcb transponder with BLE legacy and BLE Long Range enabled (input voltage +5V)

² The maximum *instantaneous* current may be higher, as the maximum value is limited by the sample rate of the current meter.

4 TROUBLESHOOTING

Access to the configuration web-pages fails.

Failing to access the configuration web-pages can have multiple causes. Make sure the configuration LED is solid red. Also, make sure that you connect to the *dronebeacon* network. If you get a message that the network does not provide internet, make sure you decline the message to disconnect and connect to your default WLAN network again. The browser *Safari* can also give issues to connect to the configuration web-pages. Use a different browser in this case. Also, a VPN, browser add-ons or another active internet connection can give issues. Disconnect the VPN and other internet connections. The easiest solution is use a different device to connect to the configuration pages.

The configuration LED and some battery LEDs glow softly when the db121 is powered on.

If the configuration button is stuck, the db121 will not boot normally, but instead will enter a special boot mode. If this is the case the configuration LED and a few battery LEDs will glow softly. To solve this, make sure that the configuration button is not pressed or is stuck by the enclosure.

The reported height is wrong.

The db121 uses the GNSS (GPS) signal to determine the height of the db121. It needs a good GPS reception/fix for this purpose. Make sure you install the db121 on top of your drone. Also, db121/GNSS receiver has issues to track slow vertical speeds. Make sure you always go up or down with at least 1 m/s vertical speed for your drone.

The db121 interferes with the drone communication link.

Move the db121 to a location further away from the drone communication antenna. Even 10 cm extra distance can make a huge difference. See also section 1.6 EMC test. In addition, change the transmission protocol if the interference persists. Typically, Bluetooth transmission protocols cause less interference to other radio systems. Also a lower the transmit power will reduce interference.

The db121 gets no GPS lock/location data.

In normal outdoor situations, the db121 gets a GPS fix typically within 90 seconds. In indoor locations or blocked GPS reception, a GPS fix may take considerably longer or not all. Please contact us, in case the GPS fix takes always a very long time or there is no GPS fix at all.

5 WARRANTY

The product has a two-year warranty period, starting at the date of receiving the product. Outside warranty are issues like crash damage, improper use, (extreme) weather conditions that damages the product. Also, the battery is excluded from warranty. The product is eligible for future firmware updates as described in the section 2.4 firmware.

Warranty Service

Please email or call us first with a description of the problem. Typically, the customer is responsible for transportation costs to our office. For post-warranty cases contact us too; we will try to do our best to find a solution.

6 MORE INFORMATION

If you need more information, please contact us at info@bluemark.io or by phone: +31 53 711 2104.

All contact information can be found at the *DroneScout* contact page:
<https://dronescout.co/contact/>

Postal address:

BlueMark Innovations BV
Bruggenmorsweg 10
7521ZV Enschede
the Netherlands