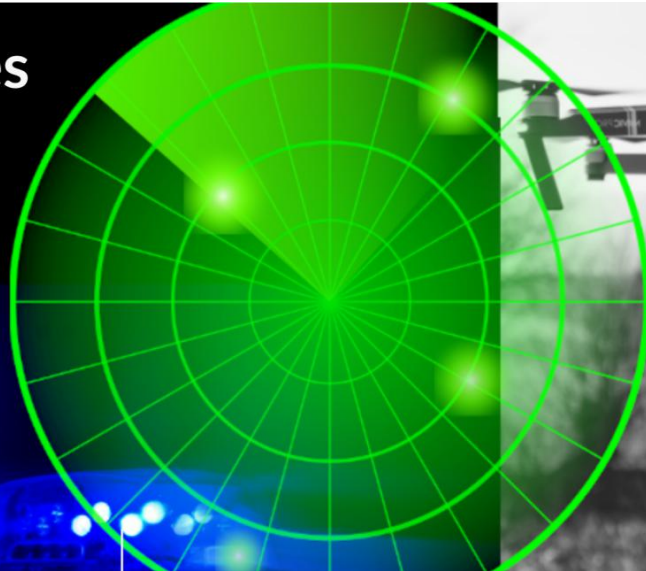# DroneBeacon MAVLink/DroneCAN Transponder Manual 2xx-series

*July 2023 - version 1.9*



The latest version of this manual is located here:
https://download.bluemark.io/db200.pdf

**Intended audience**: users of the db200, db201, db202mav,db203can and db210pro transponder

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

*Version history*

| version | date | | description |
|---------|------|---|-------------|
| 1.0 | September 2022 | ● | Initial release |
| 1.1 | September 2022 | ● | Added information about termination resistors |
| 1.2 | September 2022 | ● | Added information about firmware upgrade via the web interface |
| 1.3 | October 2022 | ● | Added information about configuration of the board |
| 1.4 | October 2022 | ● | Added pin-out of the TELEM and CAN ports |
| 1.5 | December 2022 | ●<br>● | db201 information added<br>Added more information about serial configuration if connected via MAVLink |
| 1.6 | March 2023 | ● | Added brief information about the db202mav/db203can |
| 1.7 | May 2023 | ●<br>● | Update manual with latest information<br>Added db210pro |
| 1.8 | July 2023 | ● | Fix typos and links to ArduPilot Remote ID pages |
| 1.9 | July 2023 | ● | Updated PX4 information |

# QUICK START

1. Connect the antenna to the IPEX antenna connector of the radio module. (This is already done for the included antenna.

2. Install the db2xx series transponder to the drone chassis using 4x M2 screws or cable ties.

3. 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.

4. Install the db2xx radio module to the auto pilot system. In case of a Cube Orange:
   a) Attach the db2xx module (db200, db201, db203can, db210pro) via *CAN 1* or *CAN 2* to a free *CAN* port of the Cube Orange using a 4-pin JST-GH 1.25mm cable.
   b) Or attach the db2xx module (db200, db201, db202mav, db210pro) via the *TELEM* port to a free *TELEM* port of the Cube Orange using a 6-pin JST-GH 1.25mm cable.

5. Turn the auto pilot system on. A white LED on the module should be ON. It means the db2xx module has power. In addition, the red status LED will likely also be flashing to indicate a configuration error.

6. Configure Remote ID in the auto pilot system. For ArduPilot see this page:
   https://ardupilot.org/dev/docs/opendroneid.html#opendroneid
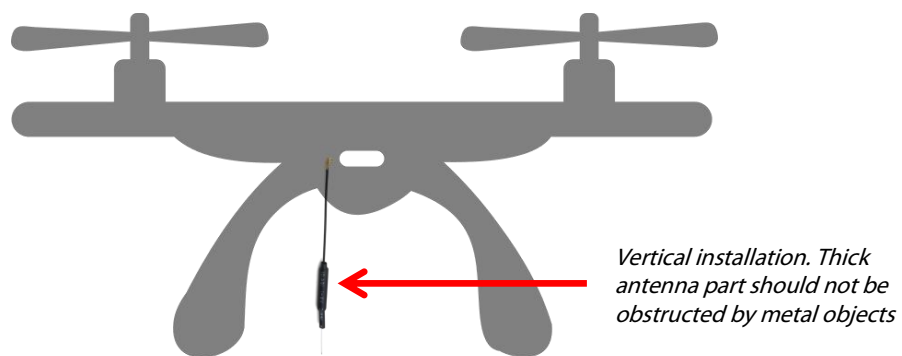


*Vertical installation. Thick antenna part should not be obstructed by metal objects*

⚠ *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).*

# Contents

# 1 INTRODUCTION

Thank you for purchasing and using DroneBeacon products!

The latest version of this user manual can be downloaded at the following link, where the most up-to-date version is located:
https://download.bluemark.io/db200.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, USA and Japan plan or 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 is an add-on (transponder) for drones which broadcasts Remote ID beacon signals. 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.

There are two Remote ID categories defined by the FAA (USA): a) standard Remote ID and b) Remote ID broadcast module. https://www.faa.gov/uas/getting_started/remote_id/drone_pilots In other regions (Japan, EU) these categories do not exist, there is only one (Direct/Broadcast) Remote ID category. In the EU there exists also network Remote ID. In this category, Remote ID information is sent via a mobile internet connection to a portal. Network Remote ID is only mandatory in specific cases such as U-Space defined areas. (U-space is to drones what traditional air traffic control is to airplanes.)

This first Remote ID category (standard Remote ID) allows BVLOS (Beyond Visual Line of Sight) flights and is integrated into the auto pilot system (such as ArduPilot) and GCS (Ground Control Station) like QGC (QGroundControl). The GCS software allows you to monitor the RemoteID status and you will get a warning if it fails. The other category (Remote ID broadcast module)is a stand-alone product without interaction with the drone. At the moment we offer several products in this category: db120 (with battery), db121pcb (PCB version without battery), db122fpv (place between GPS receiver and auto pilot system).

At the moment BlueMark offers 4 different standard Remote ID modules that interface via MAVLink or DroneCAN to the autopilot system:

- ~~**db200** - (replaced by the db201)~~
- **db201** - drop-in replacement of the db200 with where only the ESP32-C3 module has been replaced
- **db202mav** - cost effective module with only 1 MAVLink interface
- **db203can** - cost effective module with only 1 DroneCAN interface
- **db210pro** - pro version with a ESP32-S3 module and IO rich

## 1.1 Audience

This document is intended for users that want to use the *DroneBeacon MAVLink db2xx* transponder family that can be integrated into drone products. It is designed for drone manufacturers, system integrators or DIY enthusiast that want to have a standard Remote ID solution.

# 1.2 External information

ArduPilot has a page on Remote ID and how to set it up.
https://ardupilot.org/plane/docs/common-remoteid.html

Note that ArduPilot needs a special ArduPilot firmware version. Standard ArduPilot firmware does not have Remote ID included! See this page:
https://ardupilot.org/dev/docs/opendroneid.html

QGroundControl will have support for RemoteID in the upcoming stable release. For now users can use this version:
https://github.com/mavlink/qgroundcontrol/pull/10600

# 1.3 Specifications

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

## db201 module

The db201 transponder is a drop-in replacement of the db200 module. The specifications are similar; only a different ESP-C3 module is used as the AI-Thinker module of the db200 has become suddenly EoL (End of Life).

**Key specifications:**
- *Radio module:*
    - Espressif ESP32-C3 module with 4 MB flash
    - output power Bluetooth and WiFi 2.4GHz (ERP): + 20 dBm (100 mW)
    - FCC/CE certified radio module
- *Antenna:*  3 dBi omni-directional antenna with IPEX connector (included)
- *Firmware*:  ArduRemoteID (https://github.com/ArduPilot/ArduRemoteID)
                      Supports upgrading firmware via the web interface ("OTA")
- *Compliant with international regulations*
    - EU        ASD-STAN DIN EN 4709-002
    - USA       ASTM Remote ID Standard ASTM F3411-22a-RID-B/ F3586-22
        - FAA ready[1]
- *Long range:*   > 5 km detection range[2]
- *Connectivity*:
    - 2x JST GH 4-pin CAN (*DroneCAN*) port (1 Mbps)
    - 1x JST GH 6-pin TELEM (*UART*) port
- *Power:*   +5V supplied from *TELEM* or *CAN* port
- *LED lights*:   power and status LED
- *Fastening mechanism*:   4x M2 screws
- *CAN termination resistors*: yes (software controlled)
- *Size:*   38 x 32 x 5 mm

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[1]  We can help business customers in our BlueMark Partner program
https://bluemark.io/drone-remote-id-partner-program/ to submit a Declaration of Compliance (DoC).

[2]  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 of 5 km and more is possible. See the DroneScout manual for more details.

- *Operating temperature:*   -40℃ to +85℃
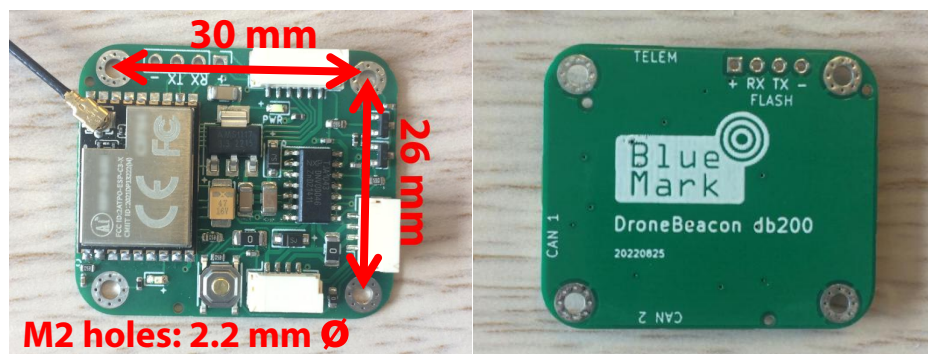- *Weight:*   ~ 5 gram (without antenna)





*Figure 1 - DroneBeacon db200 transponder*

*db202mav module*

**Key specifications:**
- *Radio module:*
  - Espressif ESP32-C3 module with 4 MB flash
  - output power Bluetooth and WiFi 2.4GHz (ERP): + 20 dBm (100 mW)
  - FCC/CE certified radio module
- *Antenna:*   not included! IPEX3 antenna connector (this is smaller than u.FL)
- *Firmware*:   ArduRemoteID (https://github.com/ArduPilot/ArduRemoteID)
    Supports upgrading firmware via the web interface ("OTA")
- *Compliant with international regulations*
  - EU       ASD-STAN DIN EN 4709-002
  - USA      ASTM Remote ID Standard ASTM F3411-22a-RID-B/ F3586-22
    - FAA ready (see footnote 1 on page 6)
- *Long range:*   > 5 km detection range (see footnote 2 on page 6)
- *Connectivity*:
  - 1x JST GH 6-pin TELEM (*UART*) port
- *Power:*   +5V supplied from *TELEM* port
- *LED lights*:   power and status LED
- *Fastening mechanism:*   4x M2 screws: 20 x 20 mm grid
- *Size:*   26 x 26 x 5 mm
- *Operating temperature:*   -40℃ to +85℃
- *Weight:*   ~ 2.6 gram (without antenna)

*db203can module*

**Key specifications:**
- *Radio module:*
  - Espressif ESP32-C3 module with 4 MB flash
  - output power Bluetooth and WiFi 2.4GHz (ERP): + 20 dBm (100 mW)
  - FCC/CE certified radio module
- *Antenna:*   3 dBi omni-directional antenna (included) with IPEX3 connector (this is smaller than u.FL)
- *Firmware*:   ArduRemoteID (https://github.com/ArduPilot/ArduRemoteID)
    Supports upgrading firmware via the web interface ("OTA")
- *Compliant with international regulations*
  - EU   ASD-STAN DIN EN 4709-002
  - USA   ASTM Remote ID Standard ASTM F3411-22a-RID-B/ F3586-22
    - FAA ready (see footnote 1 on page 6)
- *Long range:*   > 5 km detection range (see footnote 2 on page 6)
- *Connectivity*:
  - 1x JST GH 4-pin CAN (*DroneCAN*) port (1 Mbps)
- *Power:*   +5V supplied from *TELEM* port
- *LED lights*:   power and status LED
- *Fastening mechanism*:   4x M2 screws: 20 x 20 mm grid
- *Size:*   31 x 26 x 5 mm
- *Operating temperature:*   -40°C to +85°C
- *Weight:*   ~ 2.8 gram (without antenna)

*db210pro module*

**Key specifications:**
- *Radio module:*
  - Espressif ESP32-S3 module with 16 MB flash and 8 MB PSRAM
  - output power Bluetooth and WiFi 2.4GHz (ERP): + 20 dBm (100 mW)
  - FCC/CE certified radio module
- *Antenna:*   3 dBi omni-directional antenna with IPEX connector (included)
- *Firmware*:   ArduRemoteID (https://github.com/ArduPilot/ArduRemoteID)
    Supports upgrading firmware via the web interface ("OTA")
- *Compliant with international regulations*
  - EU   ASD-STAN DIN EN 4709-002
  - USA   ASTM Remote ID Standard ASTM F3411-22a-RID-B/ F3586-22
    - FAA ready (see footnote 1 on page 6)

- *Long range:* > 5 km detection range (see footnote 2 on page 6)
- *Connectivity*:
  - 2x JST GH 4-pin CAN (*DroneCAN*) port (1 Mbps)
  - 2x JST GH 6-pin TELEM (*UART*) port
  - 1x Buzzer out
  - 6x I/O connector (2.54 mm unpopulated header)
- *Power:* +5V supplied from *TELEM* or *CAN* port
- *LED lights*: power and 2x W2812 color LED
- *Fastening mechanism*: 4x M2 screws
- *CAN termination resistors*: yes (software controlled)
- *Size:* 42 x 33 x 5 mm
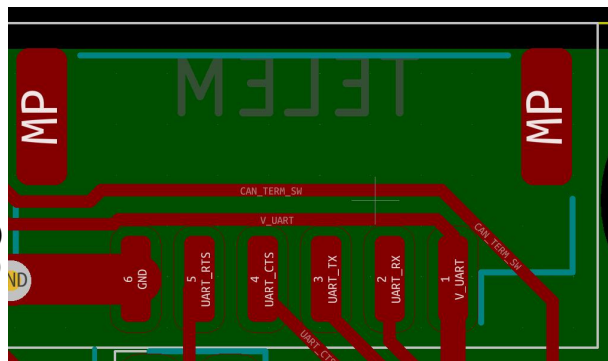- *Operating temperature:* -40℃ to +85℃
- *Weight:* ~ 6 gram

## 1.4 Pin-out

**TELEM connector**
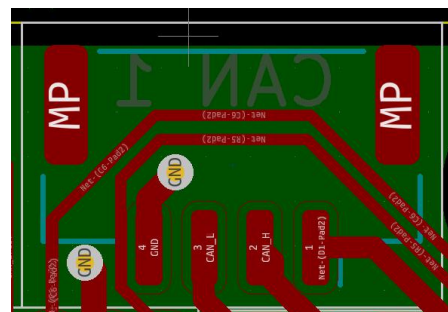
The pin-out of this connector is:

1 - VCC (5V)
2 - UART RX
3 - UART TX (db2xx transmits on this line)
4 - UART CTS (not implemented in firmware)
5 - UART RTS (not implemented in firmware)
6 - GND



**CAN 1/2 connector (1 Mbps)**

1 - VCC (5V)
2 - CAN H
3 - CAN L
4 - GND



## 1.5 Installation

See the quick-start description on page 3 of this document.

# 1.6 Using the transponder

The db200/db201 transponder is controlled by the autopilot system. For normal operation, make sure the transponder is powered on (white power LED is ON) and make sure the module can communicate with the autopilot system. **In normal operation, the red status LED is OFF.** ON (flashing) means that there is an error.

**Ardupilot**
Ardupilot has support for Remote ID in version 4.x and newer. See this link for more information:
https://ardupilot.org/dev/docs/opendroneid.html#opendroneid

**PX4**
PX4 has support for Remote ID in version PX4 v1.14 and newer. See this link for more information:
https://docs.px4.io/main/en/peripherals/remote_id.html

*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).*

# 1.7 Android 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

Note: only few Android smartphones support reception of Bluetooth Long Range and/or WLAN NaN signals. A list of supported smartphones is presented, in the link below.
https://github.com/opendroneid/receiver-android/blob/master/supported-smartphones.md

# 1.8 Open Drone ID

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

# 2  FIRMWARE

ArduRemoteID firmware is already installed on the module. The latest version can be found here: https://github.com/ArduPilot/ArduRemoteID/releases

Since September 19th 2022, db200/db201 modules are shipped with firmware version 1.9+. This and newer releases support upgrading firmware via the web interface (so called OTA firmware updates). **This is the preferred method for upgrading firmware.**

## 2.1 Web interface (OTA firmware upgrade method)

Default the db200/db201 will act as a WiFi Access Point. Connect to the RID_xxxxxxxxxxxx WiFi network. The default password is ArduRemoteID

After connecting to this WiFi network, point your browser to http://192.168.4.1

At the bottom of the page you can upload and flash the new firmware.

Remarks:
● Important: download the *ArduRemoteID_BLUEMARK_DB200_**OTA**.bin* file from the latest release from this page https://github.com/ArduPilot/ArduRemoteID/releases
● Use this file for uploading the new firmware.
● Press the update button to update the firmware
● In case, the firmware update would fail, it will revert to using the factory installed firmware.

**ArduRemoteID**

**Status**

**System**
| | |
|---|---|
| Version | 1.10 (07541fd3) |
| Up Time | 0:1:18 |
| Free Memory | 148000 |

**BasicID**
UAType NONE
IDType  NONE
UASID

**OperatorID**
IDType 0
ID

**SelfID**
DescriptionType TEXT
Description

**System**
| | |
|---|---|
| OperatorLocationType | TAKEOFF |
| ClassificationType | UNDECLARED |
| OperatorLatitude | 0.00000000 |
| OperatorLongitude | 0.00000000 |
| AreaCount | 1 |
| AreaRadius | 0 |
| AreaCeiling | -1000.00 |
| AreaFloor | -1000.00 |
| CategoryEU | UNDECLARED |
| ClassEU | UNDECLARED |
| OperatorAltitudeGeo | -1000.00 |
| Timestamp | 0 |

**Location**
| | |
|---|---|
| Status | REMOTE_ID_SYSTEM_FAILURE |
| Direction | 361.00 |
| SpeedHorizontal | 255.00 |
| SpeedVertical | 63.00 |
| Latitude | 0.00000000 |
| Longitude | 0.00000000 |
| AltitudeBaro | -1000.00 |
| AltitudeGeo | -1000.00 |
| HeightType | OVER_TAKEOFF |
| Height | -1000.00 |
| HorizAccuracy | UNKNOWN |
| VertAccuracy | UNKNOWN |
| BaroAccuracy | UNKNOWN |
| SpeedAccuracy | UNKNOWN |
| TSAccuracy | UNKNOWN |
| TimeStamp | 0.00 |

**Documentation**

- ArduPilot Project
- ArduRemoteID Project
- ArduPilot RemoteID Documentation
- OpenDroneID Website

**Firmware Update**

Choose File | No file chosen     Update
upload progress: 0%

*Figure 2 - ArduRemoteID web interface*

## 2.2 Serial interface (fall-back firmware upgrade method)

We advise to customers to use the OTA firmware upgrade method of the previous section. There is also another method; here the flash UART interface of the db200/db201 board is used to flash a new firmware. In this case, the existing firmware is totally overwritten with the new firmware. If you flash a wrong firmware file, the db200/db201 won't boot. However, in such case you can keep using this method to flash a new firmware.

*Hardware setup*

For upgrading the firmware, please disconnect it first from the autopilot system! This means remove the JST-GH cable.

If you want to upgrade the firmware you need:
● An USB-to-UART dongle (e.g. dongles with P2303-chip).
● 4x DuPont wire to connect the USB-to-UART dongle with the UART flash interface
● Solder the 4-pin header to the unpopulated UART flash interface
● Alternative: use a Pogo-pin clamp (4x 2.54mm).

Connect the USB-to-UART dongle to the db200/db201 module with 4x DuPont wires using the following wiring:

● db200/db201   **+**   <--> **5V**    USB-to-UART dongle
● db200/db201   **RX**  <--> **TX**    USB-to-UART dongle
● db200/db201   **TX**  <--> **RX**    USB-to-UART dongle
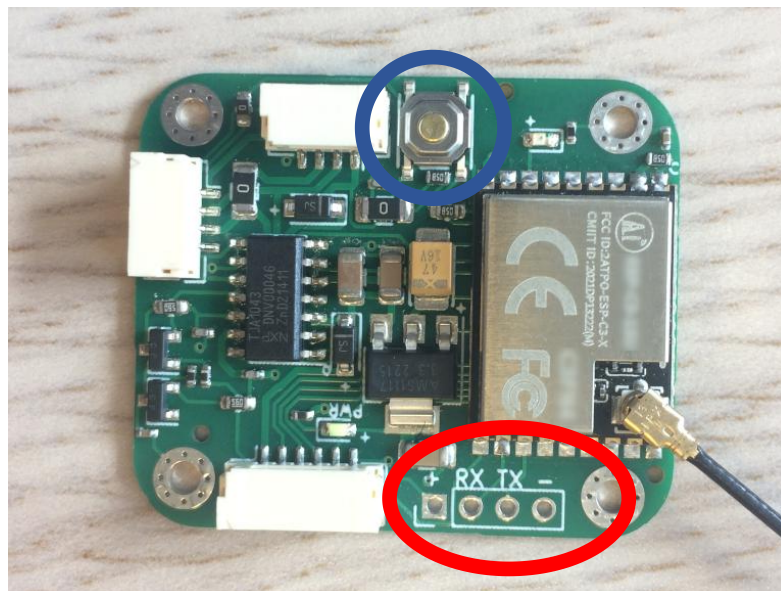● db200/db201   **-**   <--> **GND**   USB-to-UART dongle
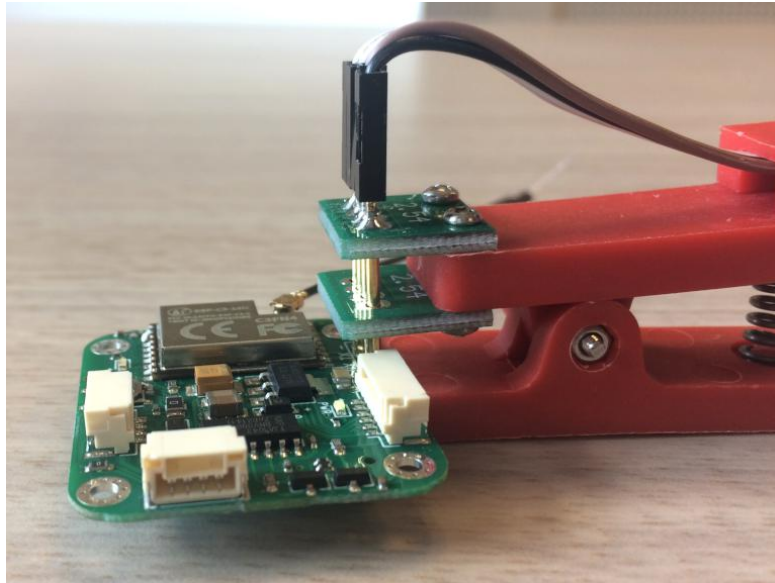


*Figure 3 - Flash connector for upgrading firmware*

*Figure 4 - Pogo pin clamp*

## Download mode

The db200/db201 transponder needs to be set to *download mode*. Only in download mode, the module accepts new firmware for flashing.

- Disconnect the USB-to-UART dongle from your computer
- Hold the *download* button (indicated in the blue circle).
- Connect the USB-to-UART dongle to your computer. The white power LED will turn ON.
- If the red status LED does not turn ON within 3 seconds, but instead is OFF (emitting at a low intensity), the module is in download mode.
- You can release the *download* button.

Now you can proceed with flashing the module.

## Flashing new firmware

Download the latest firmware from this link: https://github.com/ArduPilot/ArduRemoteID/releases
Select and download the file **ArduRemoteID-BLUEMARK_DB200.bin**

**Windows**
For Windows you need to install the Flash Download Tools of this page:
https://www.espressif.com/en/support/download/other-tools

Follow the instructions on this page:
https://github.com/ArduPilot/ArduRemoteID#flashing

*Remarks:*
- Select for chipType: ESP32C3.
- You always need to follow the instructions in *section 2.2 Download mode* to put the module in to download mode.

**Linux/macOS**
For Linux operating systems, please install the ESP-IDF environment. This is described on this page:
https://docs.espressif.com/projects/esp-idf/en/latest/esp32/get-started/linux-macos-setup.html

*Remarks*:
- In *Step 3. Set up the tools* use this command:
  - ```./install.sh esp32c3```


Use the following command to flash the firmware (one line):

```
esptool.py --chip esp32c3 --port=/dev/ttyUSB0 --baud=921600
--before=no_reset --after=no_reset write_flash --flash_mode dio
--flash_freq 40m --flash_size 4MB 0x0 ./ArduRemoteID-BLUEMARK_DB200.bin
```

*Remarks*:
- ```/dev/ttyUSB0``` indicates the port of the USB-to-UART dongle. Change in case your dongle uses a different port.
- ```./ArduRemoteID-BLUEMARK_DB200.bin``` is the location of the firmware file.

After the command has successful flashed the firmware, disconnect the USB cable and connect it to the autopilot again. This will exit download mode and will return to normal booting of the firmware.

# 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 (db200 with ArduRemoteID firmware 1.6) 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 0.5 second.
- The average current is 98 mA.
- The peak current is 395 mA[3].
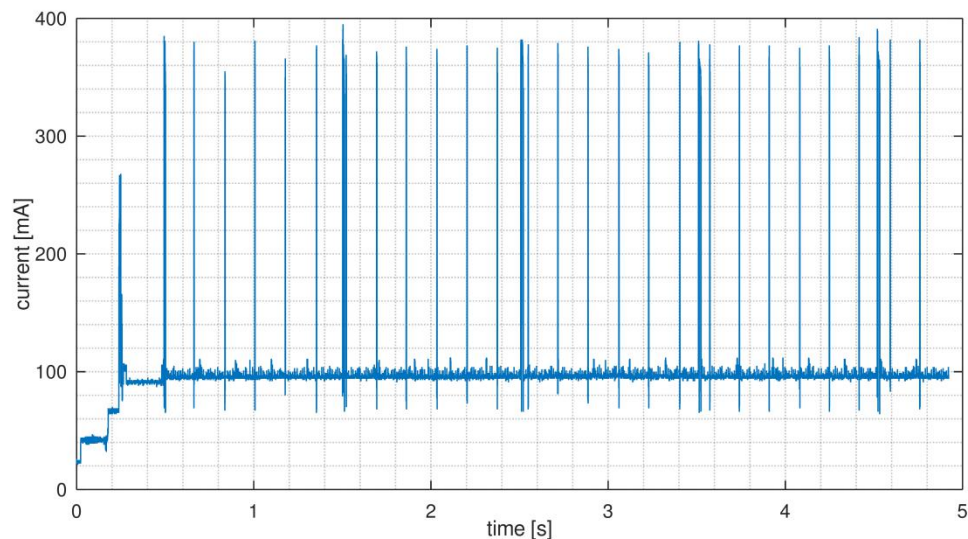- If the transmit power is reduced in the firmware, the peak current will also be smaller.



*Figure 4 - Current profile of the db200 module, ArduRemoteID firmware 1.6 with BLE legacy and BLE Long Range enabled*

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

# 4 Configuration

The db200/db201 module can be configured via the CAN bus (DroneCAN) or UART/TELEM (MAVLink). For instance, you can configure the transmission modes, set the UAS_ID etc. Currently, the MAVLink interface only supports editing integer parameters. *Therefore, we recommend to connect the module via DroneCAN.*

More information can also be found on this pages:
https://ardupilot.org/dev/docs/opendroneid.html
https://github.com/ArduPilot/ArduRemoteID/#parameters

And this video: https://www.youtube.com/watch?v=Az8v4Kx4hS0

**Note: for ArduPilot, the standard firmware does not include Remote ID functionality. You need to compile your own ArduPilot with Remote ID included. See this page for more information:** https://ardupilot.org/dev/docs/opendroneid.html

## MAVLink (not preferred)

In this section, the db200/db201 is connected to the flight controller using the MAVLink/TELEM interface. Open MissionPlanner and make sure you run the latest stable version (1.3.77 or higher).

**Setup**
Set the following parameters in MissionPlanner (Config --> Full Parameter List) :

- DID_ENABLE 1
- DID_OPTIONS 1
- DID_MAVPORT X where X is the serial port attached to OpenDroneID module
- DID_CANDRIVER 0
- AHRS_EKF_TYPE 3
- GPS_TYPE 1
- GPS_TYPE2 0
- SERIAL**X**_BAUD 57 where X is the serial port attached to OpenDroneID module. Set this to 57, 57600 baud rate
- SERIAL**X**_PROTOCOL 2 where X is the serial port attached to OpenDroneID module. Set this to 2, MAVLink2 mode.

**Configuration**
Below the COM port settings, select the interface ending with *-ODID TXRX 1*. In MissionPlanner go to *Config --> Full Parameter List* to see the list of Remote ID parameters. If the list is empty, press the Refresh Params button.
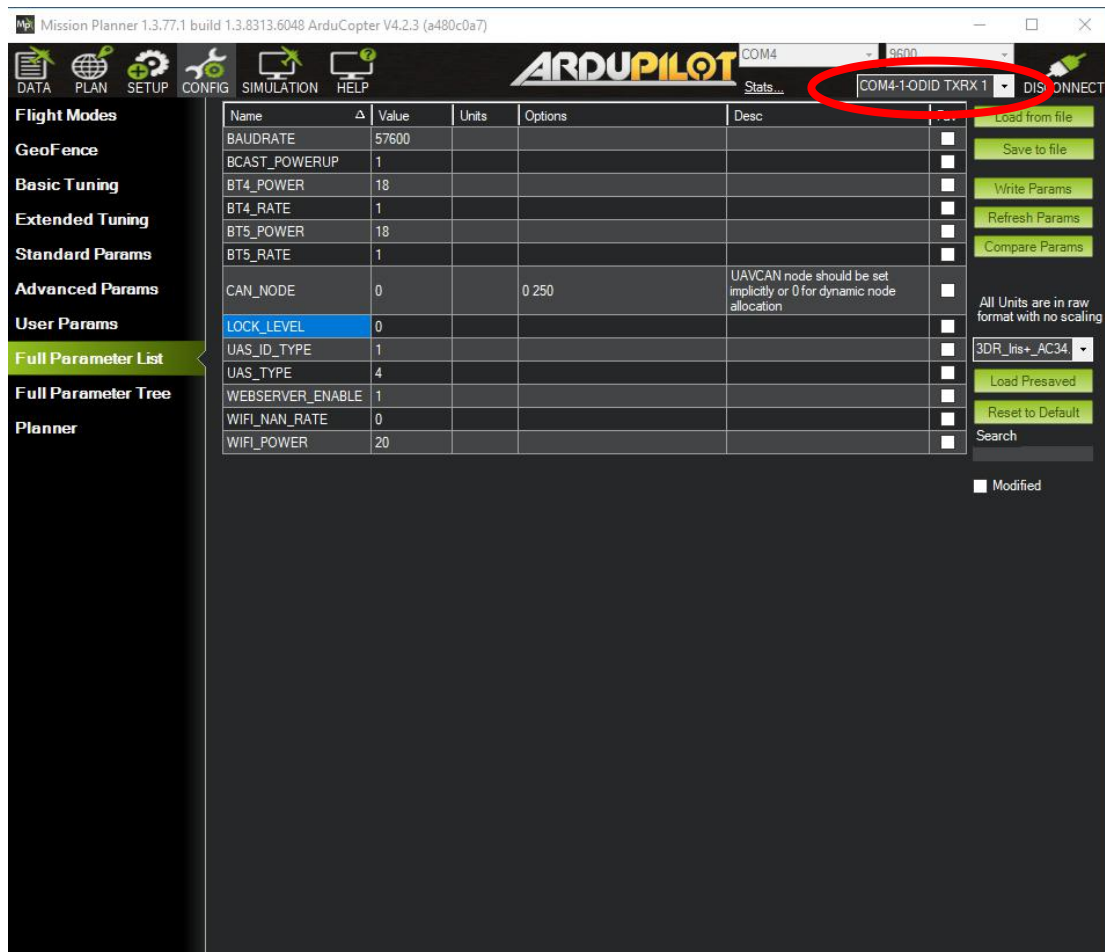
Figure 5 - Using MissionPlanner to configure the db200/db201 module using the MAVLink interface

## DroneCAN (preferred)

In this section, the db200/db201 is connected to the flight controller using the DroneCAN/CAN interface. Open MissionPlanner and make sure you run the latest stable version (1.3.77 or higher).

**Setup**
Set the following parameters in MissionPlanner (Config --> Full Parameter List) :

- DID_ENABLE 1
- DID_OPTIONS 1
- DID_MAVPORT -1
- DID_CANDRIVER 1 where 1 is the CAN 1 interface of the flight controller
- AHRS_EKF_TYPE 3
- GPS_TYPE 1
- GPS_TYPE2 0

**Configuration**
In MissionPlanner go to *Setup --> Optional Hardware --> DroneCAN/UAVCAN.* Click on the top button called "*MAVLink CAN1*". If the module is connected to CAN2, the click on the button called "*MAVLink CAN2*". After a few seconds, the list of connected CAN devices should be listed. The BlueMark DB200 should be one of the devices. Click on the *menu* action-button on the right of the module name and select parameters. Then the list of parameters will be displayed. See the figures below.
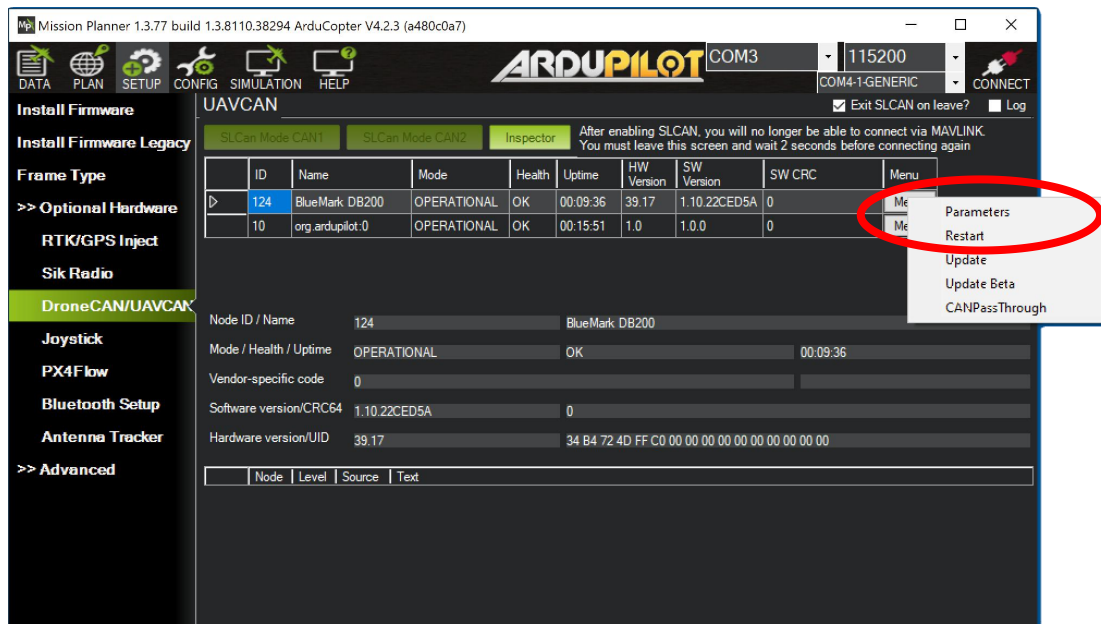
*Figure 6 - Select Parameters in MissionPlanner to configure the db200/db201 module using the DroneCAN interface*
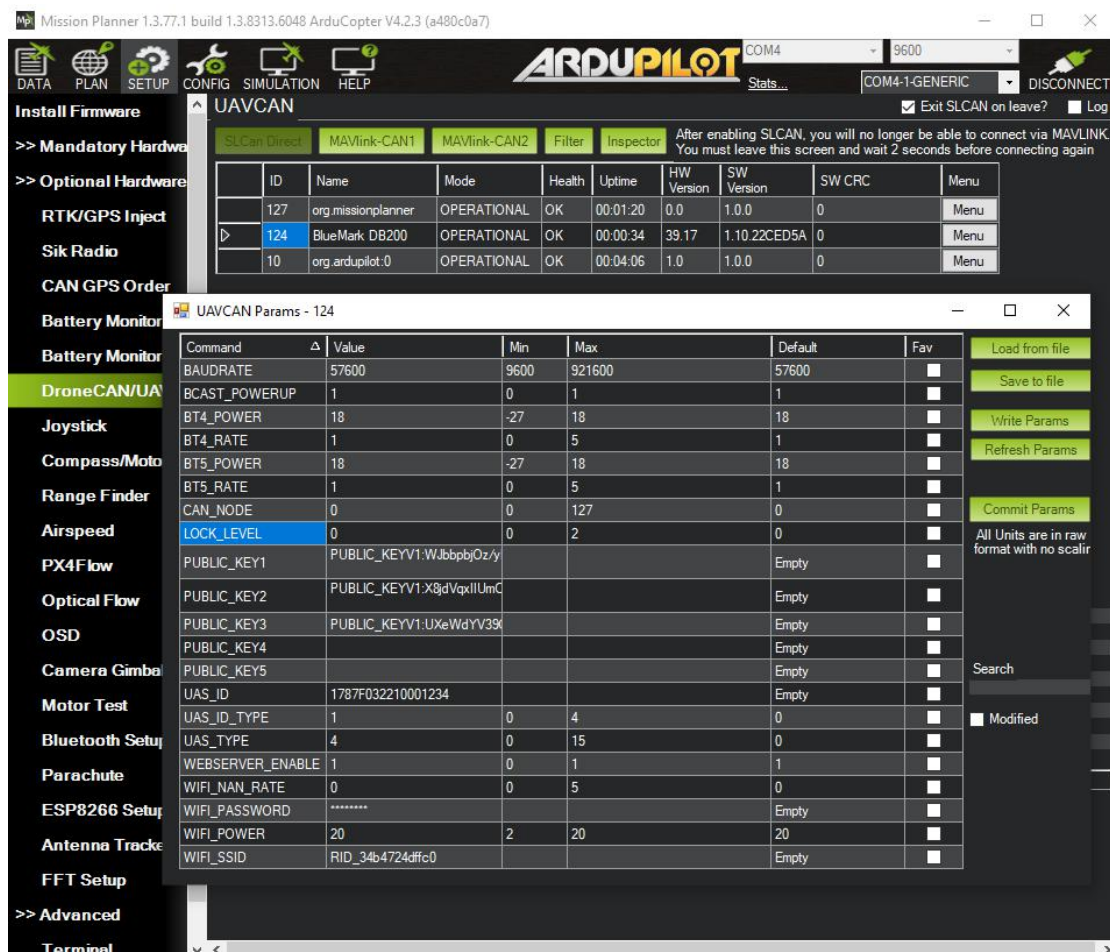


*Figure 7 - Parameters list in MissionPlanner of the db200/db201 module using the DroneCAN interface*

## Remote ID parameters

The meaning of the parameters is described on this page:
https://github.com/ArduPilot/ArduRemoteID/#parameters

If you need more information, please consider to join our Partner program. In this program we support partners with configuration and submission of the FAA DoC (Declaration of Conformance)
https://bluemark.io/drone-remote-id-partner-program/


## DroneCAN GUI tool

The db200/db201 module can also be configured using the DroneCAN GUI tool via the DroneCAN interface. In this case, you don't need to use MissionPlanner. See this page for more information:
https://ardupilot.org/plane/docs/common-uavcan-gui.html

# 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. The product is eligible for future firmware updates as described in the Firmware section.

# 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/