Photo 1: The RC Throwmeter mounted on the wing.

Make Your Own Bluetooth RC Throwmeter

A new level of precision for setting up control surface throws.

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Note*: While Medium only permits one author of record to be listed, it's important to note that this article is a collaboration between Yannick Selles, Vitaliy Ryumshyn, Alois Hahn and Pierre Rondel, who share the author credit equally.*

Introduction

The purpose of this article is to propose that you 'build' your own Bluetooth Throwmeter at a very reasonable cost. This RC Throwmeter, in addition to measuring angles and travels, it possesses nice features such as measuring Max UP and DOWN Travels/Angles, or set an visual alarm to a certain position (UP or/and DOWN). In addition the mobile app supports two devices simultaneously which is very convenient.

It doesn't require any soldering or cabling. You just need to have access to a 3D printer! The original idea came after finding by chance on aliExpress an all-in-one 6 Axis Bluetooth Digital Angle Accelerometer Module.

Photo 2: The prototype in yellow and the final device on the left.

Initially, one of us bought two examples of the 'naked' board, then bought a 1S LiPo, a micro switch, and designed the case and the clips. Later we discovered the same component was available with a case, battery, switch, charging plug and a charging cable for about four euros more. It saves lots of soldering and cabling, so the final version we propose hereafter is based on this model.

The Measurement Component

Photo 3: The Wit-Motion component in its package.

The component is the BWT61CL from Wit-Motion, a six axis Bluetooth attitude angle sensor with battery incorporated. You can buy it on AliExpress or Amazon US / EU and it costs between 24 and 35 Euros with free shipping. It is based on the JY61 sensor, has Bluetooth or serial connectivity, integrates a dynamic Kalman filter algorithm, an internal voltage stabilizing circuit module, voltage 3.3v~5v. The only drawback is that the Bluetooth BLE is only compatible with Android. We apologize, in advance, to all iOS users! The battery has a 150mA capacity which provides plenty of operating time. Components are now provided with an USB-C plug instead of the load balancer type plug it had initially.

Photo 4: Comparison between the old and new version of the component, now with an USB-C socket.

Characteristics

- **Voltage**: 3.3V-5V
- **Current**: <40mA
- **Size** : 51.3mm x 36mm X 15mm
- **Weight** : 16gr
- **Dimension**: Accelerated speed -3d Angular speed -3d Magnetic field-3d Angle-3d
- **Air pressure**: 1d
- **Range**: Accelerated speed -±16g Angular speed -±2000°/s Angle — -±180°
- **Stability**: Accelerated speed -0.01g Angular speed -0.05°/s
- **Attitude measurement stability**: 0.05°
- **Output content**: Time, Accelerated speed, Angular speed, Angel.
- **Output frequency**： 100Hz
- **Date interface**: Serial TTL level, Bitrate 115200 (default and can't be changed)
- **Bluetooth transmission distance** : >10m
- **Supported OS**: Android
- **Battery Life:** 2 to 3 hours (full charge)
- **Documentation**: Gyroscope Bluetooth Version BWT61CL (2.3MB PDF)

Let's Start Building Your RC Throwmeter

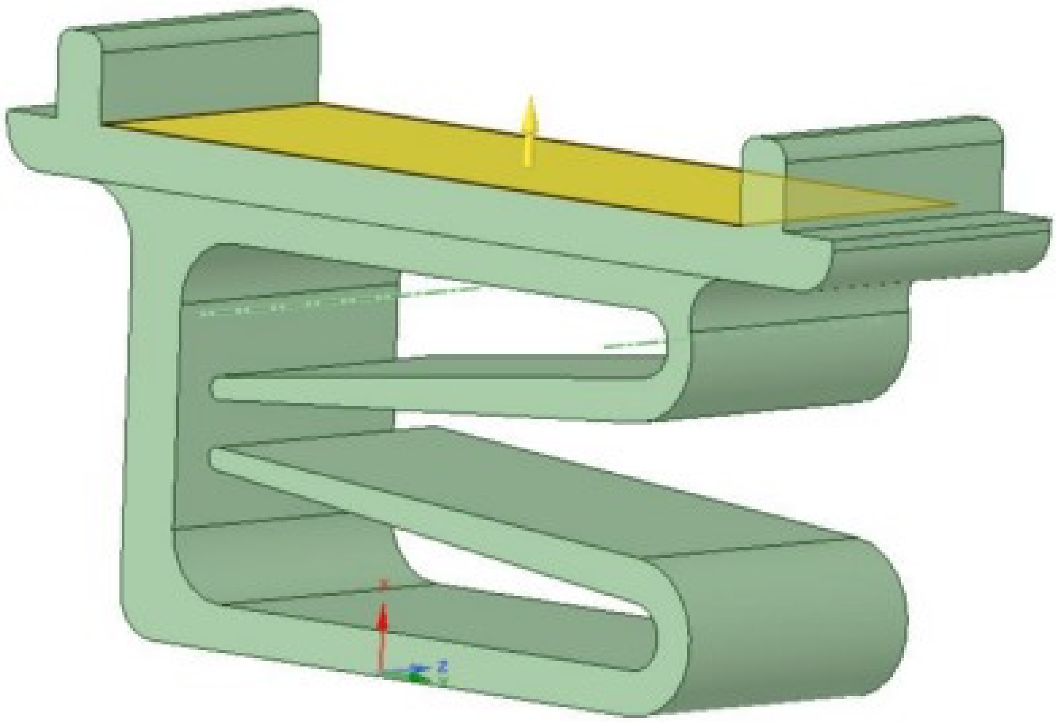


Photo 5: Design of the removable clip.

As stated in the introduction, the work is limited to the 3D printing of the clip that fixes the device to the trailing edge of the glider. It has been designed on DesignSpark, and we are providing the .rsdoc original file (**original file .rsdoc**) in addition to the STL file. If you want to do your own modifications, you can easily to with the **STL file here.**

The clip is removable, so the device, its clips and the charging cable can be carried/stored in a small plastic box.

Photo 6: Once the clip removed, the RC Throwmeter can be stored in a small plastic box.

Just print the part, in PLA, PETG or ABS, 100% infill. The dimension is optimized for F3x plane wings and tail planes. To protect the surface of the control surface and avoid the clips sliding or shifting, we add a piece of rubber (a small piece of bicycle inner tube) on the clips surfaces, with double-sided tape.

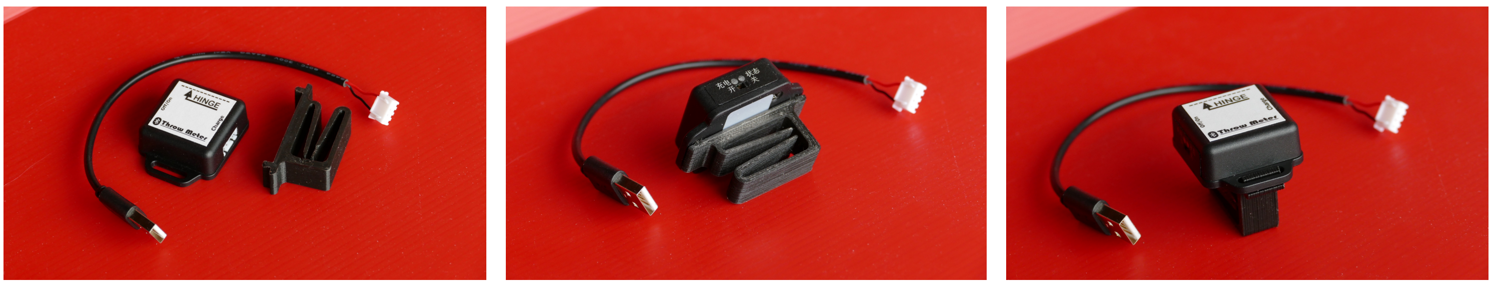


Photo 7 to 9 : Different views of the RC Throwmeter and its clip.

Print the sticker using the .pdf provided (**PDF file for the sticker**). Prior to applying it, don't forget to remove the other sticker. Protect the printed paper with transparent tape at the top, and double-sided tape on the other side, and position it on the top of the case, respecting the correct orientation (`Charge` , `On/Off`). This will give you the orientation when using pointing where is the hinge.

The Mobile App

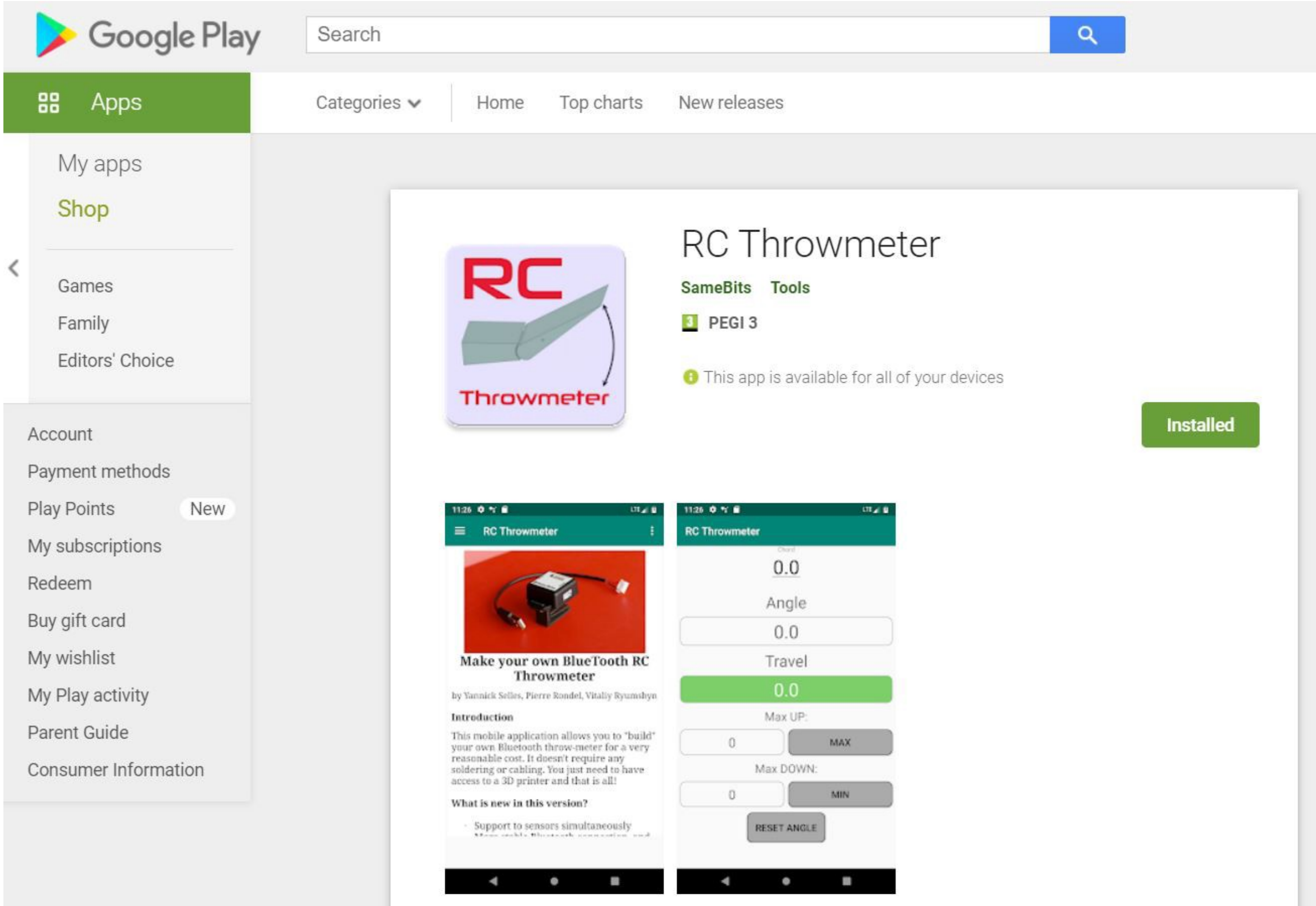


Photo 10: The mobile application can be found only on Google Play — sorry iOS users!

The Android app has been initially developed by Yannick who implemented all the framework and pages, and also the angle/travel calculation. Then Vitaliy added the support of a second Bluetooth connection, and more recently Alois integrated the full calibration commands and made some other improvements.

The app is divided into several screens, the `Start` screen giving access to the top left menu, the `Sensor BT` screen to bind the app with the Throwmeter, and finally the `RC Throwmeter` screen where everything happens once binding is complete.

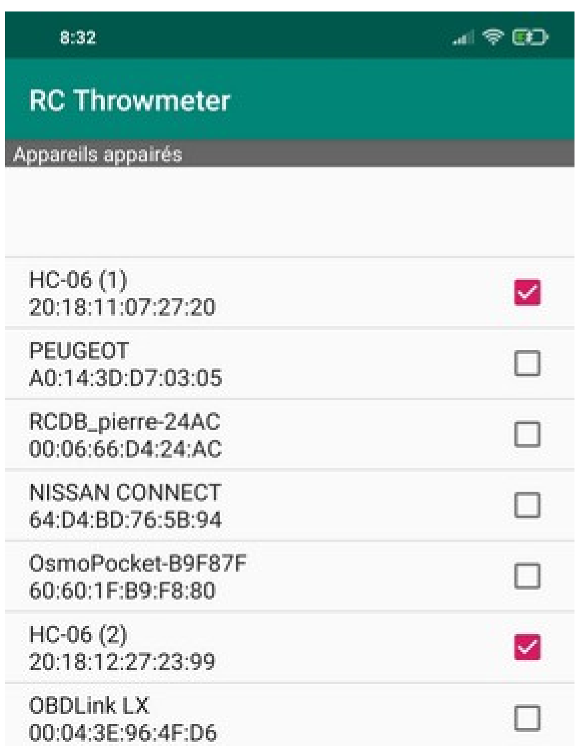
Features of version 1.4

- Support two sensors simultaneously
- Calibration support, no need for manufacturer's app
- Bluetooth status bar
- More stable Bluetooth connection, and re-connection when exiting of standby/sleeping mode

- Clearer separation between max travel feature and limit setting with alarm feature
- Localization
- German language support
- Sensor option to chose more robust X/Y only calculation
- Compacter screen layout for small displays
- Reminder to power off sensor when app is exited

Using Your RC Throwmeter(s)

- **Charging the battery:** Connect the cable provided to the balancer plug. On newer versions just connect the USB cable. The red LED is ON during the charge and switches to OFF once charged.
- **Switching on your Throwmeter(s):** Move the sliding switch from right to left. The blue LED blink which indicates that the device is waiting for the binding.
- **Binding your Android smartphone for the first time:** On your smartphone navigate to the `parameter/Bluetooth` menu and scan for new devices. The BWT61CL will show as HC-06. When asked, enter the code `1234`. The sensor is now bound and you are ready to open the app.



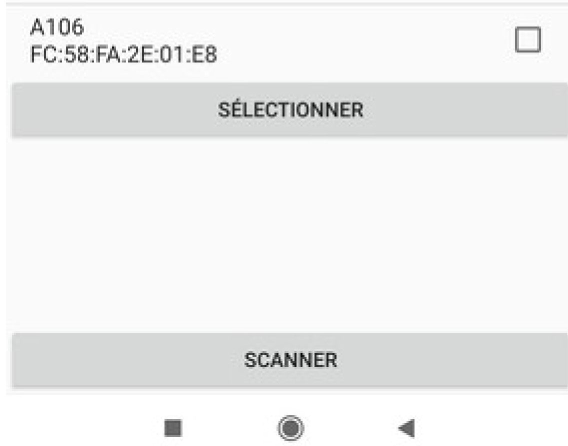


Photo 11: The binding page of the app where you select which device(s) you want to connect to.

- **Binding with the app:** Select the menu on the top left, then open `BT Sensors` and select one (or two) HC-06 sensors or click on `Scan` if the device doesn't appear. Once selected you can return on the start page. Open the menu on the top left and select `RC Throwmeter`.
- **Calibration:** If the device is providing inconsistent or weird measurements, it probably needs a full calibration. Level the sensor(s) horizontally and do not move in. To activate Calibration use a **long press** of the `Reset/Calib` button, confirm dialog and wait until calibration completes.
- **Reset Angle:** The device is supposed to do a calibration at startup. It is recommended to do it with the device installed on a horizontal surface. Once done, you can clip the device on the leading edge of control surface you want to measure. When your control surface is at its neutral position, proceed to a new `Reset` in order for the device to know its spacial position and be ready to measure the angle.

Photo 12: The clip is perfect for F3X planes. CAD files are provided so you can modify it if needed.

- **Travel setup** Measure the chord of your control surface and click on the chord field at the top of the screen to enter the value. There is no unit, so it can be either mm or inches. Travel will be shown in the same unit.
- **Max UP and Max DOWN** This is a very useful feature that allows you to quickly measure the maximum up and down travels of a control surface. Use `Reset` to clear the `Max UP/DOWN` values for a new measurement.

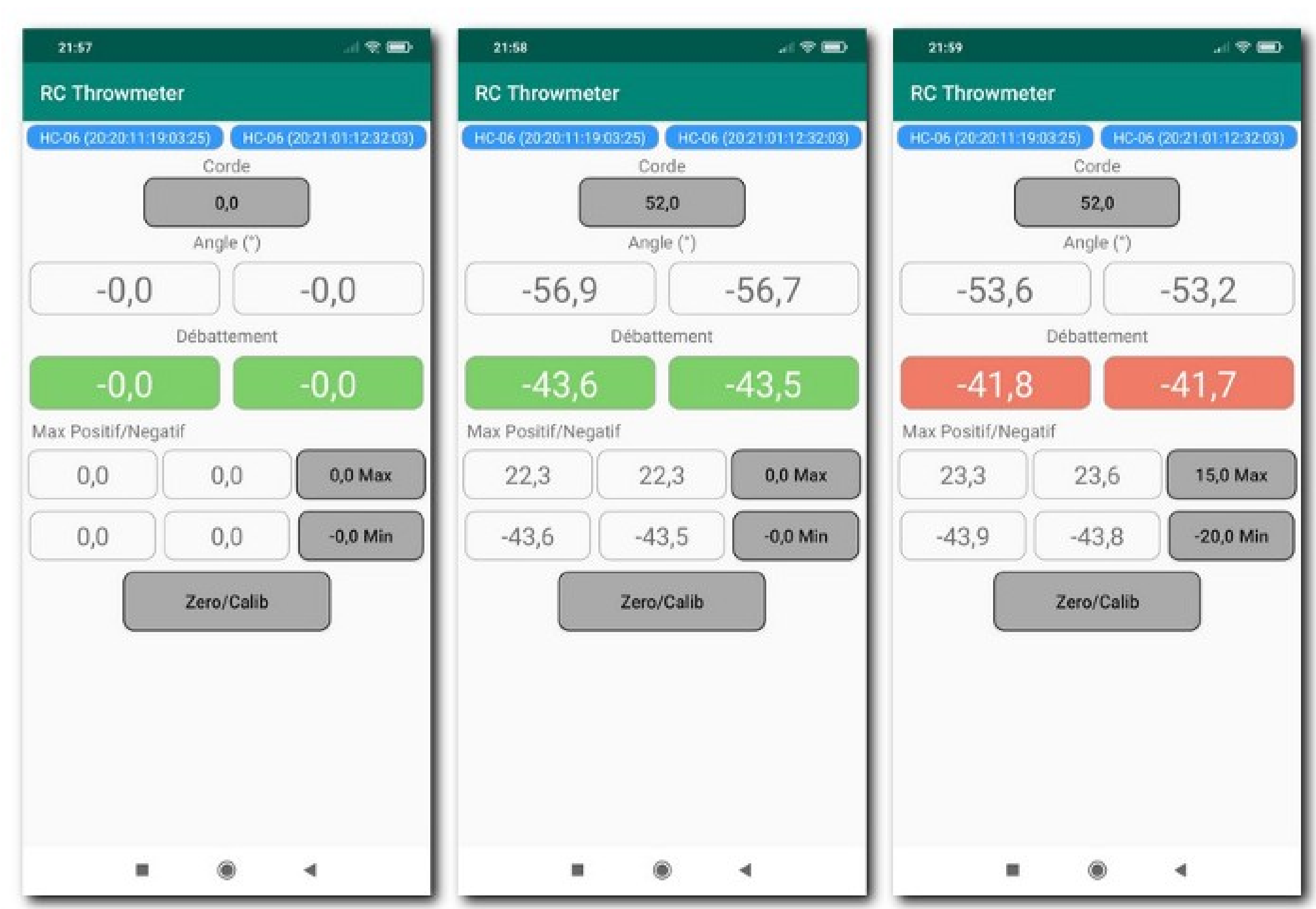


Photo 13: The measurement screen in action: measure, min/max and limits.

- **Set Max UP and Max DOWN Thresholds** If your objective is to do settings, not to measure, you can enter a `Max Positive Travel` and a `Min Negative Travel` separately. This instructs the app to display an alarm (in red instead of green) when the travel value exceeds a threshold, either above the `Max Positive Travel` or below the `Min Negative Travel`.

Photo 14: The clip is holding perfectly.

- **Sensor Options** The app computes its spatial position upon the rotation measurements of the Wit-Motion sensor. The most precise method uses all three axes X,Y and Z. It turned out, that the Wit-Motion sensor can lose the correct Z value when moved fast and irregularly. This may add significant error to the measured angle, specifically around zero. The user has to use `Reset` if this occurs.

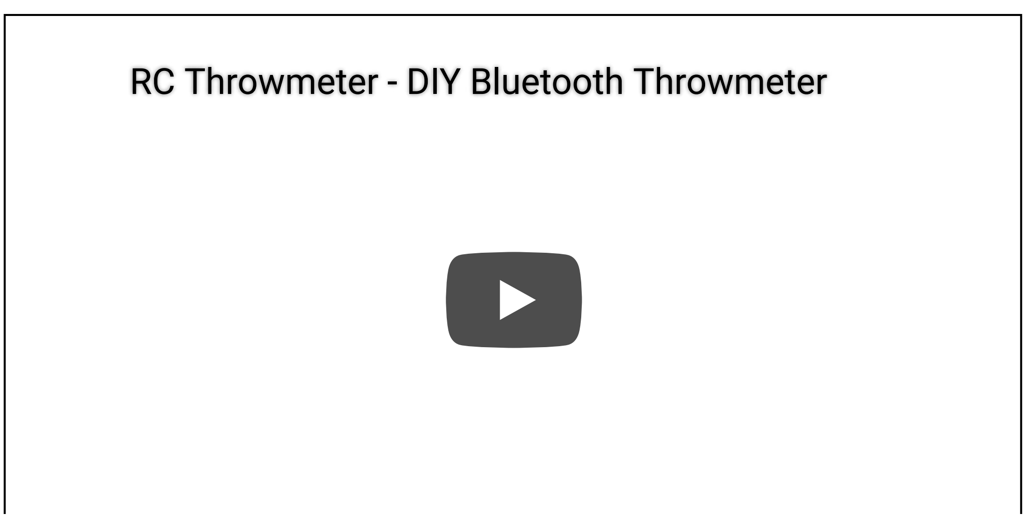
As an alternative, the app may ignore the vertical Z axis. This method is much more robust, but might add some absolute measurement error. In a real life context this can be accepted for the comfort of robustness, thus it is the default setting.

Sensor setting options are provided to allow the user to choose the preferred mode.

Photo 15: A configuration menu allow you to deactivate the Z axis.

Video

Better than any written explanation, hereafter is a very instructive and comprehensive video made by Alois:



Video 16: A great video from Alois to explain everything in a comprehensive way.

Calibration with the Manufacturer App

Alternatively, instead of using the `Calibrate` button as described above, the calibration can be done with the manufacturer's app as well which can be downloaded **here**. To do a full calibration, once selected the correct chipset model WT601, click on `SET` (top left) and then `Acceleration Calibration`. Once calibrated the app can be closed and the user can run the RC Throwmeter application.

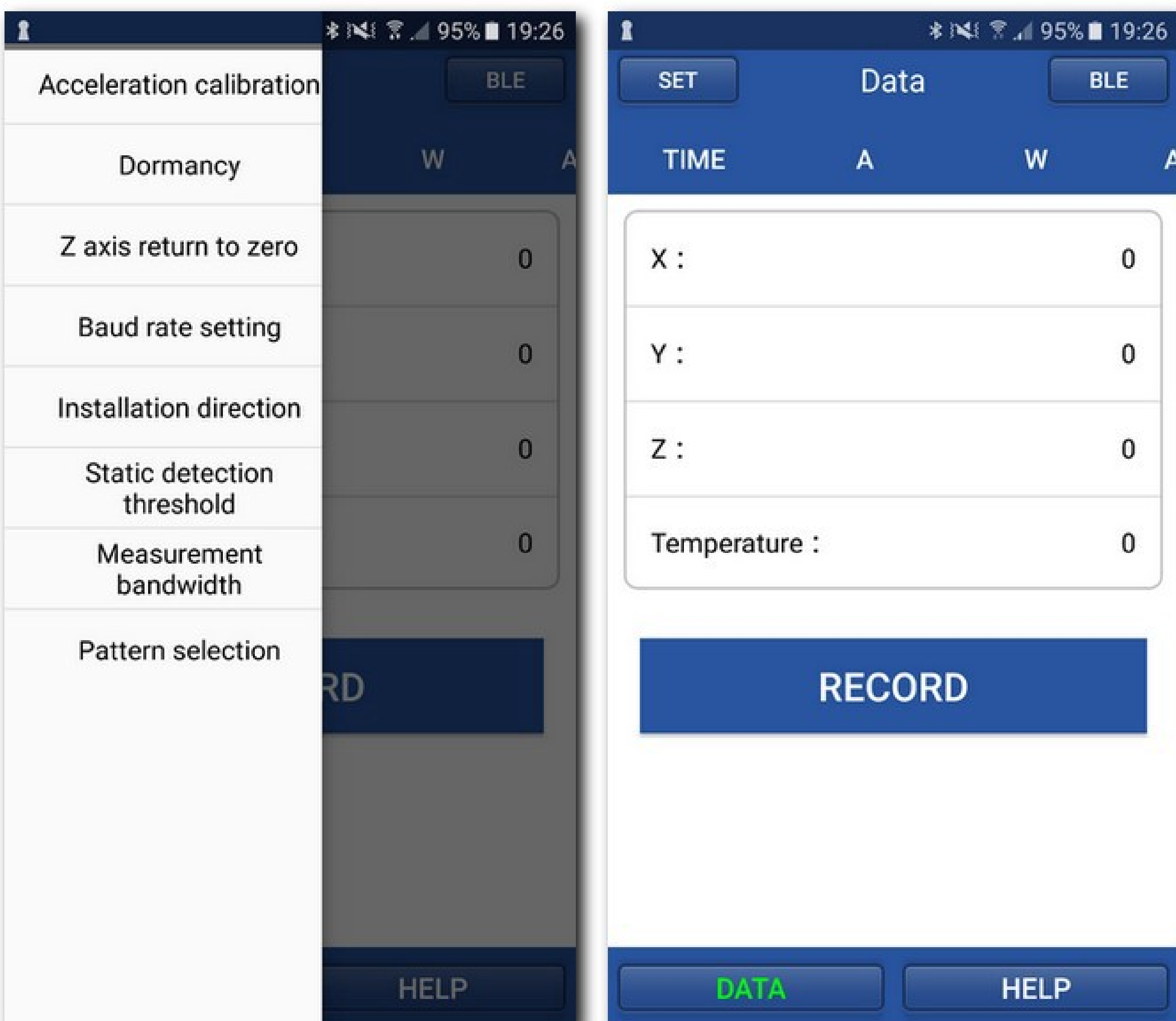


Photo 17: The manufacturer's app can also be used for the initial calibration**.**

The Final Word

We sincerely hope you will enjoy this Bluetooth RC Throwmeter! Please remember that all this work has been done freely as a contribution to the soaring community. There is probably some imperfections or possible improvements (write a response below!) which will come in the future, but believe us: if you try it, you will certainly adopt it and will never go back!

All videos and images are by the authors. Read the ***next article*** *in this issue, return to the* ***previous article*** *or go to the* ***table of contents****. Downloadable PDFS: just this article or this entire issue.*

Bluetooth Throw Meter DIY Android