THEye
-
User Manual

Version 1.3

FiveCo - Innovative Engineering

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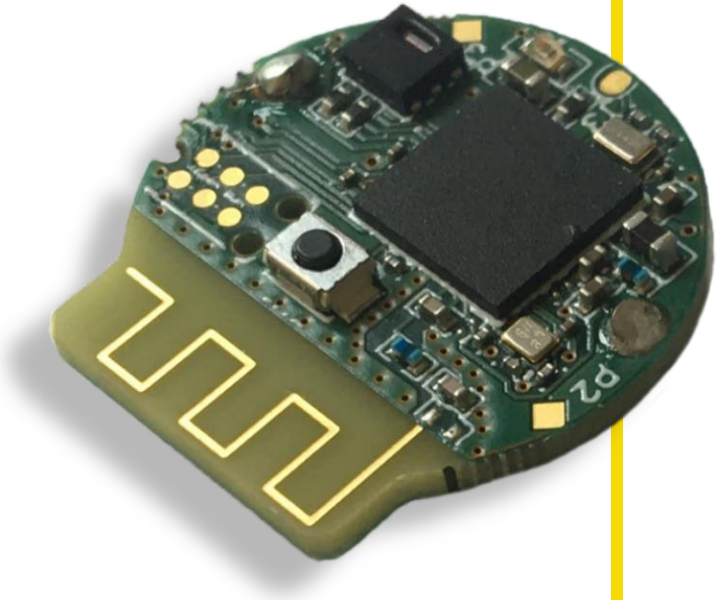
Revisions

Revision	Date	Author	Note	Versions
1.0	12.04.2021	JL	First revision for the first batch of production of THEye modules.	FW – v1.19 SW – v1.16 HW – v1.0
1.1	13.04.2021	JL	Deleted Overview chapter to simplify the document.	FW – v1.19 SW – v1.16 HW – v1.0
1.2	13.04.2021	JL	Added Appendix 2 – Reading the .csv File	FW – v1.19 SW – v1.16 HW – v1.0
1.3	14.04.2021	JL	Replaced QR Codes with newer, correct ones.	FW – v1.19 SW – v1.16 HW – v1.0

Table of content

v1.5 03/23/2021

1 Datasheet

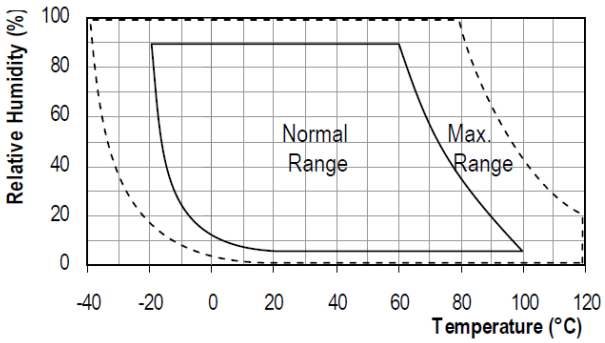


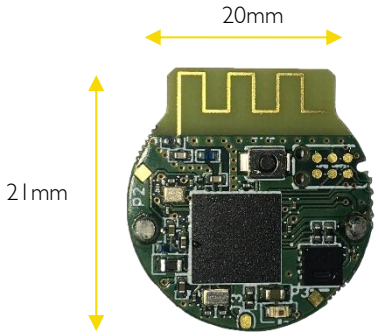
Compact Bluetooth module for secure temperature and humidity recording

Typical applications:
- Cold chain monitoring (food, ...)
- Transport of precious objects
- Etc.

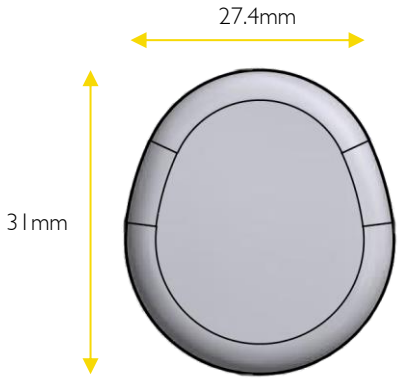
Humidity
- Range: typ 5 to 90% (see graph)
- Accuracy: typ ± 2.0%
- Max ± 3.0% between 20 and 80% RH, ±5.0% outside of this range

Temperature
- Range: typ: -20 to 100°C (see graph)
- Accuracy: typ ± 0.3°C
- Max: ±0.4°C between 5 and 60°C, ±1.6°C outside of this range





Dimensions / Battery
- PCB diameter: 20mm
- PCB height: Diam + 1mm
- Thickness: 6.7mm without the box
- Button cell: CR1632



Autonomy / Consumption

Consumption:
- ~7uA in standby (with an ad every 10 seconds) + 50uAs for each measurement

Autonomy (with a 130mAh battery) :
- 76 days with one measurement per second
- 360 days with one measurement / 10 seconds
- 550 days with one measurement/minute

Amount of recordable values (Temperature on 11bit, res 0.09°C / Humidity on 11bit, res 0.06%) :
- 174'000 Temperature / Humidity measurements
  - ➔ Autonomy of 120 days with one measurement per minute

Communication
Bluetooth 5 LE

Application
Secure application for recording temperature and relative humidity data

For more information
Contact us by e-mail at info@fiveco.ch

2 Overview

The FMod-BTH TI is a compact module for recording temperature and humidity. With its extremely low power consumption, any THEye device can record for up to 2 years[1] on a single battery, and for up to 174'000 readings per log.

It is a perfect tool notably for:

- Cold chain monitoring
- Transport of precious objects
- Etc.

The sensor used for measuring both temperature and relative humidity is the Sensirion SHT21, as of the device's hardware version v1.0.

[1] Depending on the log interval. The greater the interval, the greater the autonomy.

3 Using the App

This section is intended to help users quickly understand how to reach each and every function of THEye's App, available both on the App Store and the Google Play Store.

3.1 Acquiring the App

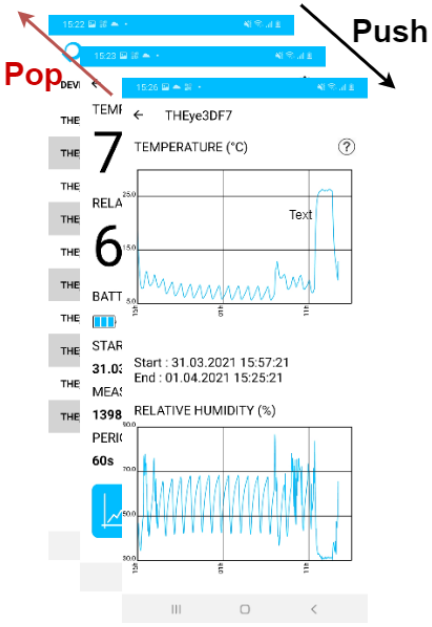
In order to get the app for your Android or iOS device, simply scan with a QR scanner (on newer devices, the phone's camera acts automatically as a QR scanner) the following corresponding QR code:

Download on the App Store

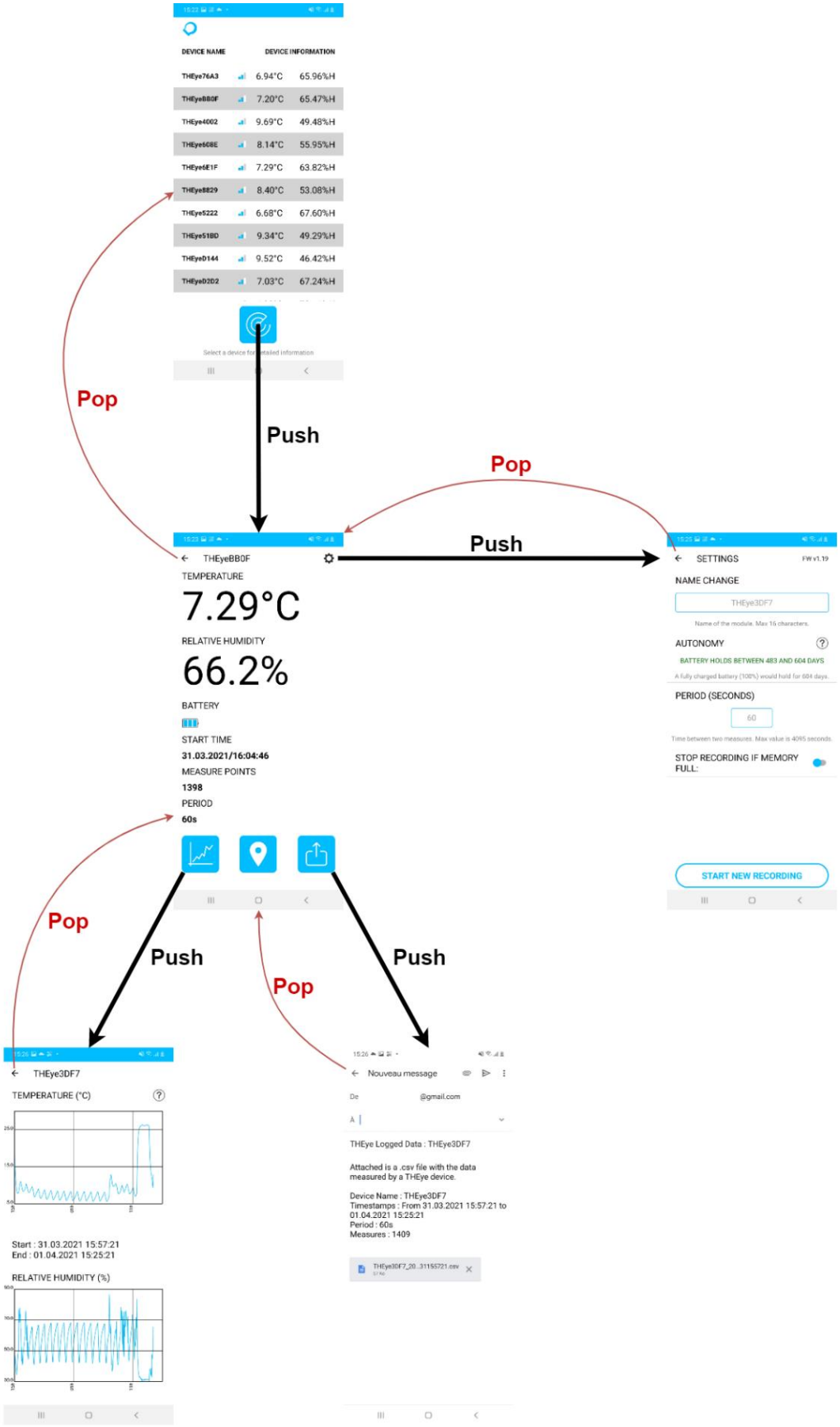
GET IT ON Google Play

3.2 Navigation

Stack Based

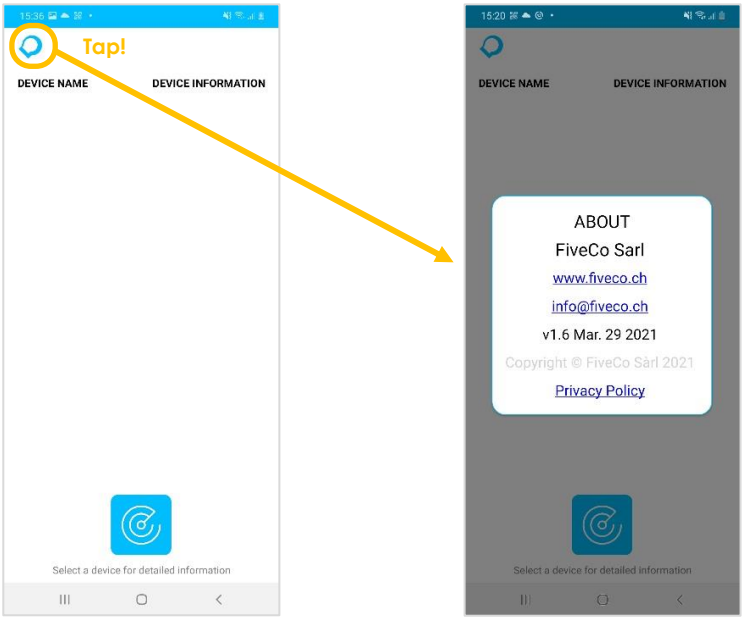


Classic Use Navigation

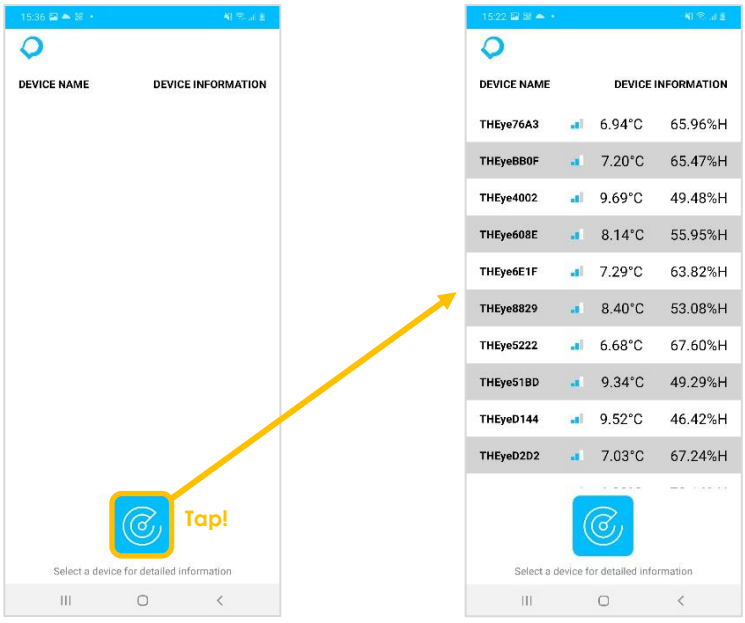


3.3 User Interactions

Policy, Contact and Version Information



Scanning for Devices



Connecting to a Device

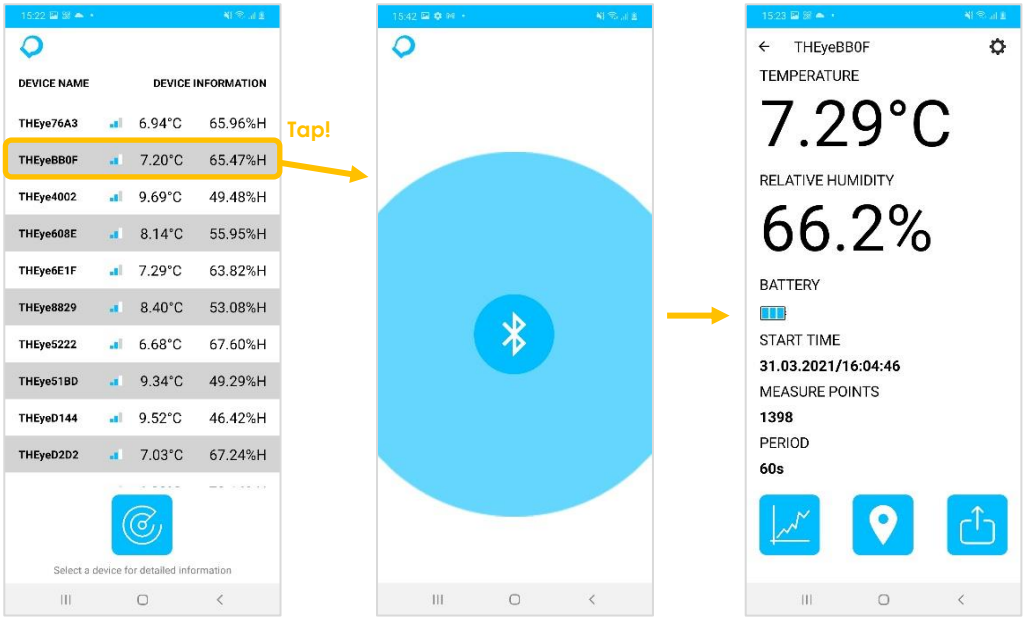


Figure 1 - Connecting to a device with success

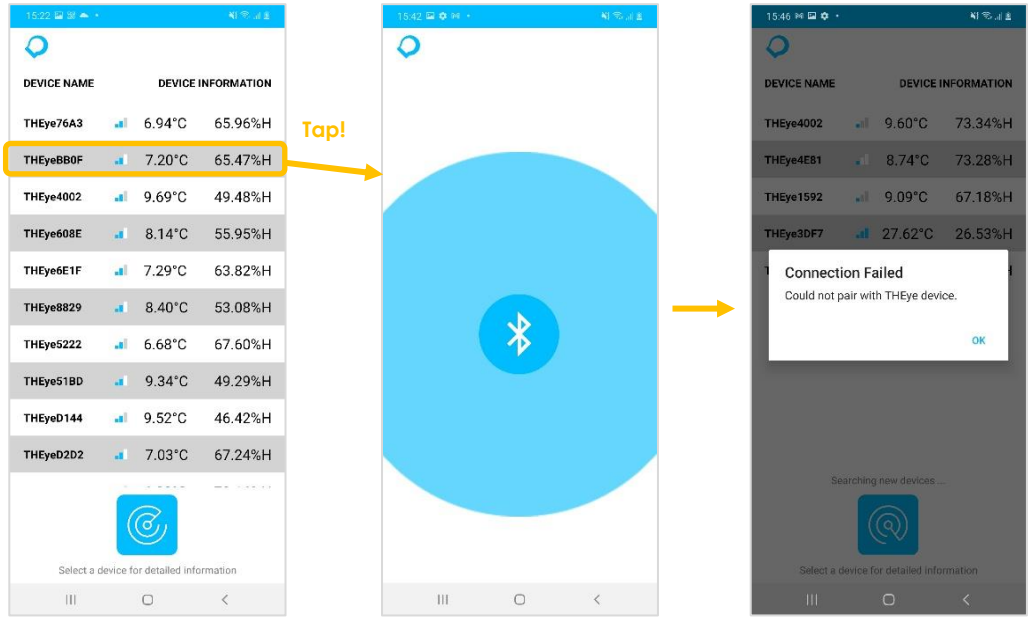
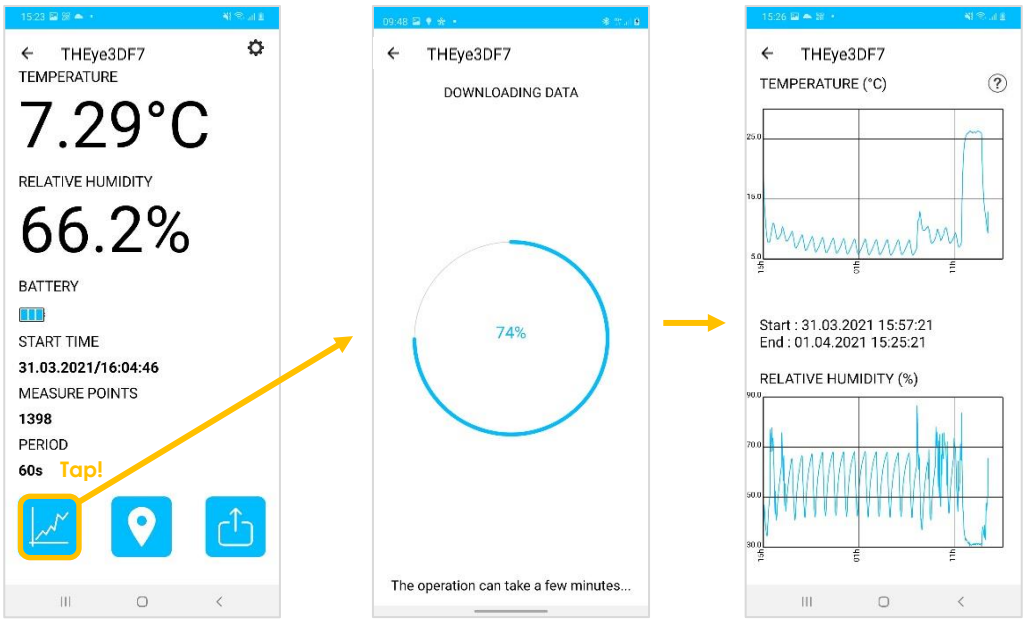


Figure 2 - Failing to connect to a device

Displaying Data

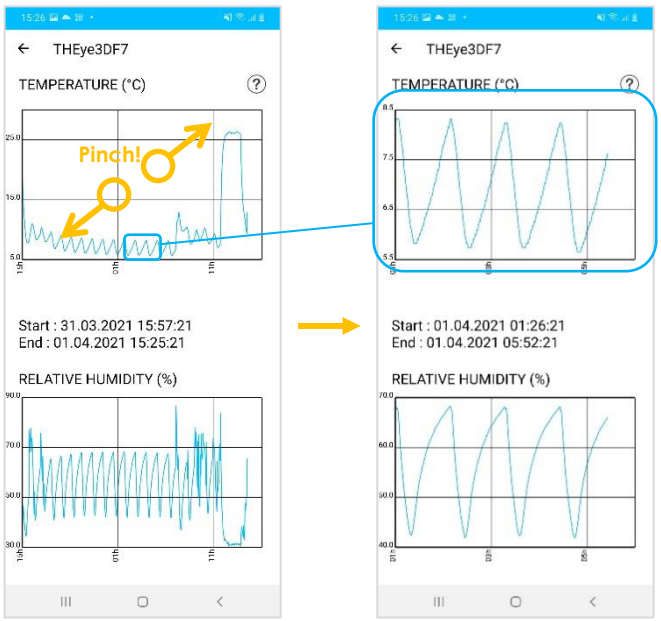
Plotting the Graph



Zooming

The zooming action is made via pinching of the screen by the user. It can be applied to either the temperature graph, or the humidity graph. Zooming on one graph will automatically apply the exact same zoom on the other graph.

Zooming is only applied on the time scale, with the value scale (temperature and humidity) being automatically adapted according to the zoom.

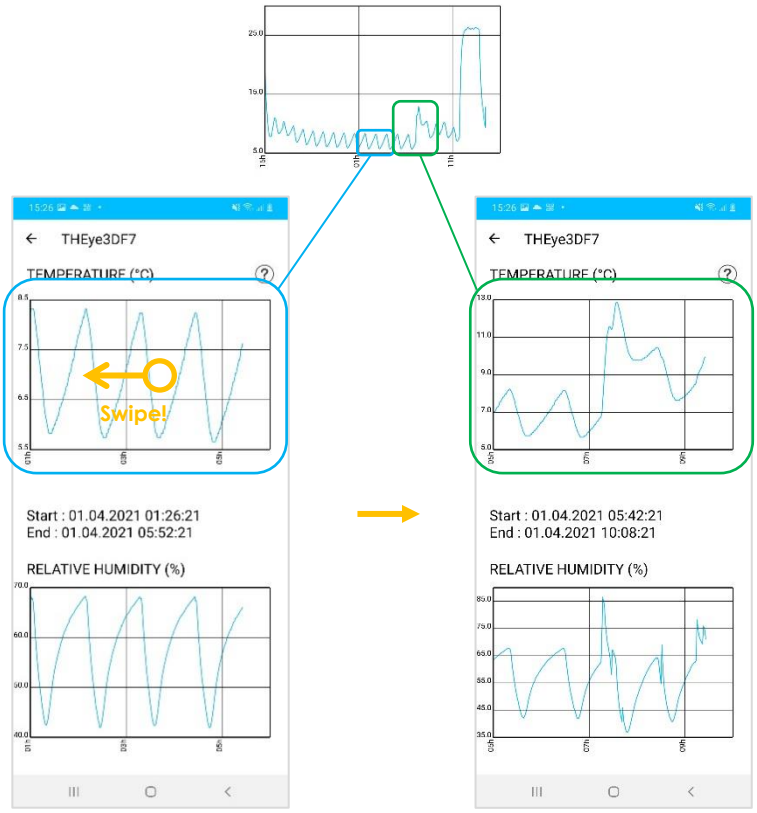


Panning

The panning action is made via swiping of the screen by the user. It can, like the zooming action, be applied to either the temperature graph or the humidity graph. Panning on one graph will automatically apply the exact same pan on the other graph.

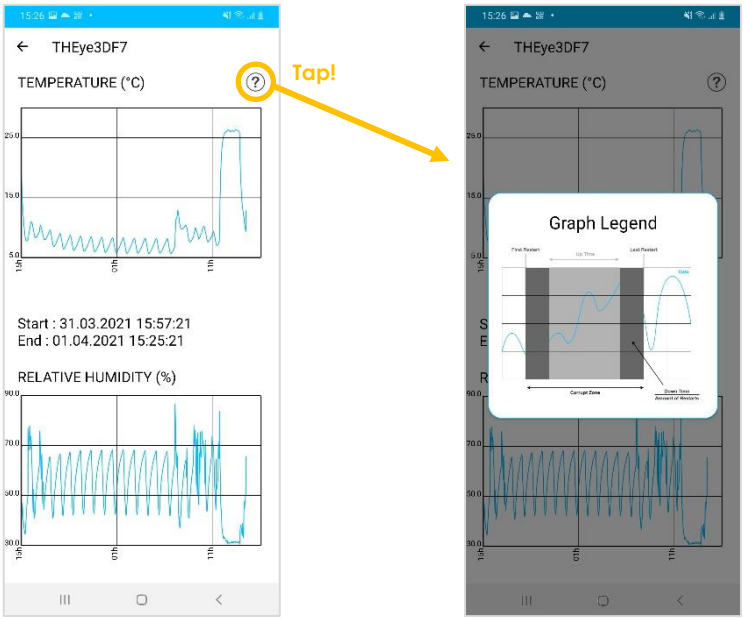
Panning is only applied on the time scale, with the value scale being automatically adapted according to the pan.

The direction of the pan is opposite to the direction of the swipe, as displayed on the following figure.



Graph Legend

The graph yields a detailed explanation by tapping on the question mark icon located in the top-right corner of the Graph Page.



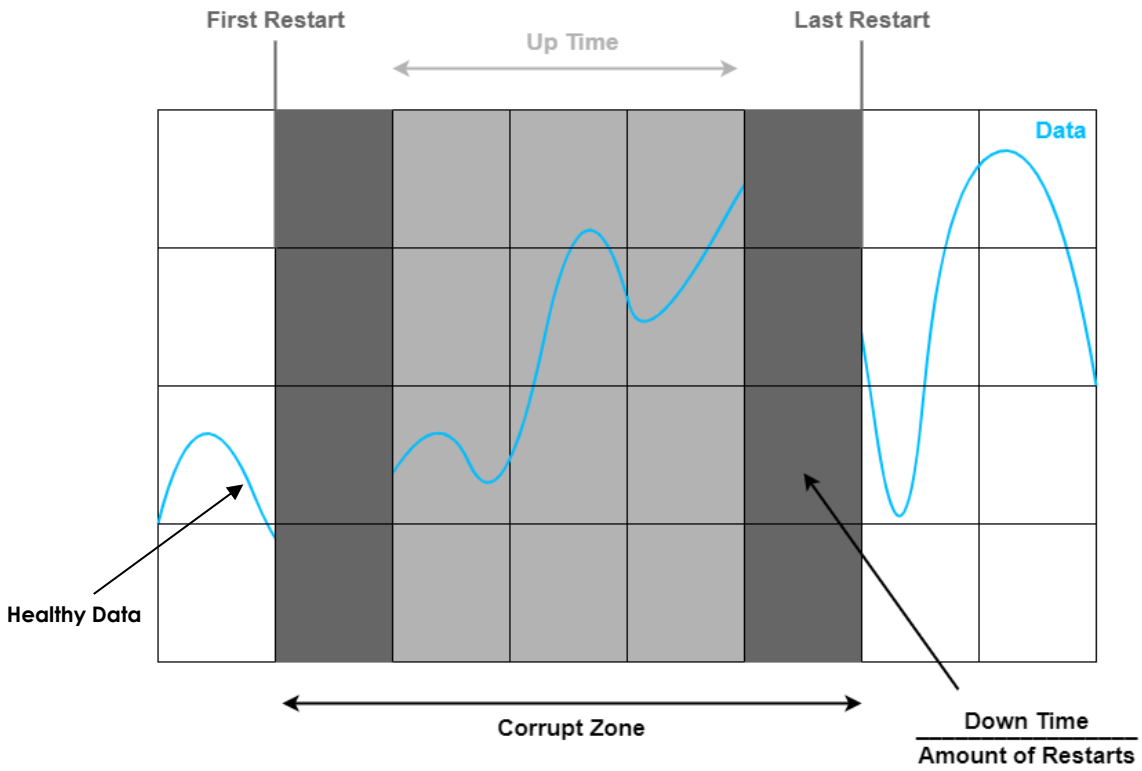
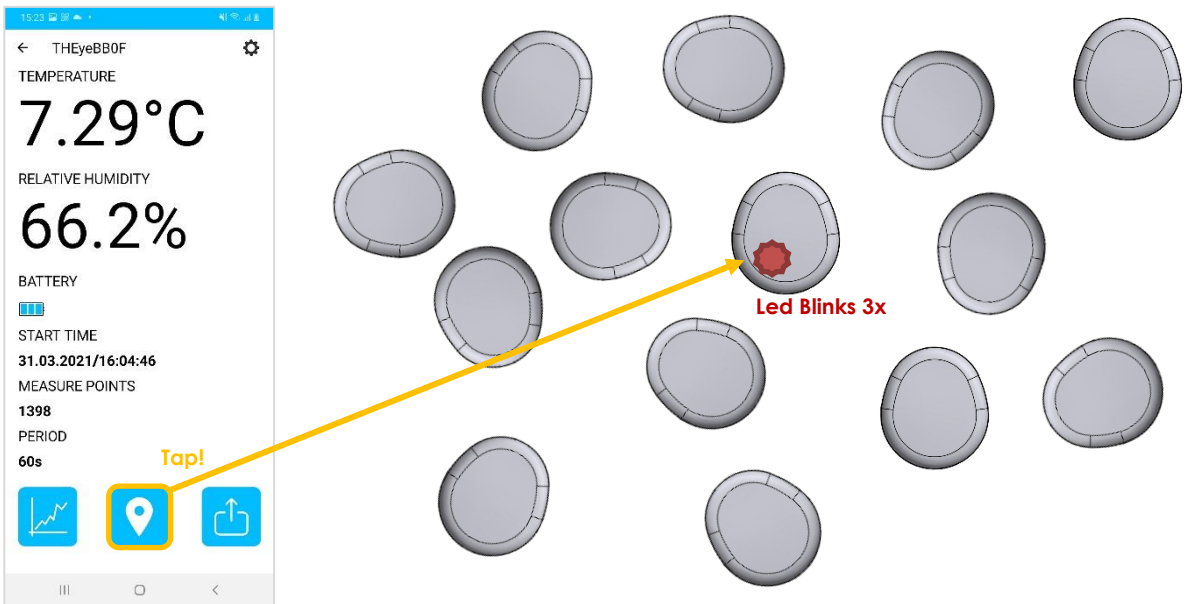


Figure 3 - Graph Legend

The graph legend can be broken down as such:

- Blue line on white background: healthy, reliable data.
- **Blue line on light gray background:** correct data values with unknown precise timestamps. The order of appearance of the data is however correct. This is a rare occurrence, due to the restart of the device.
- **Dark gray background:** time between the first and last restart of the device, where inlying data cannot be precisely timestamped.

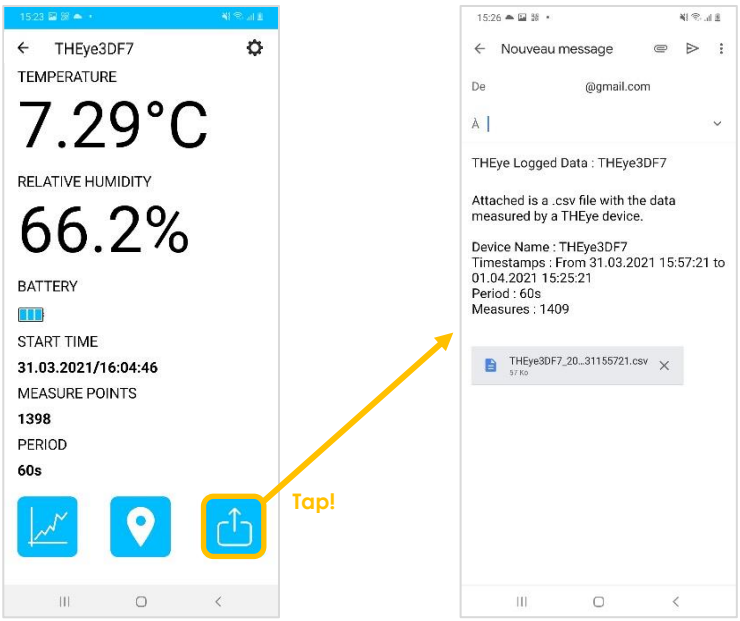
Locating the Connected Device



Exporting Data

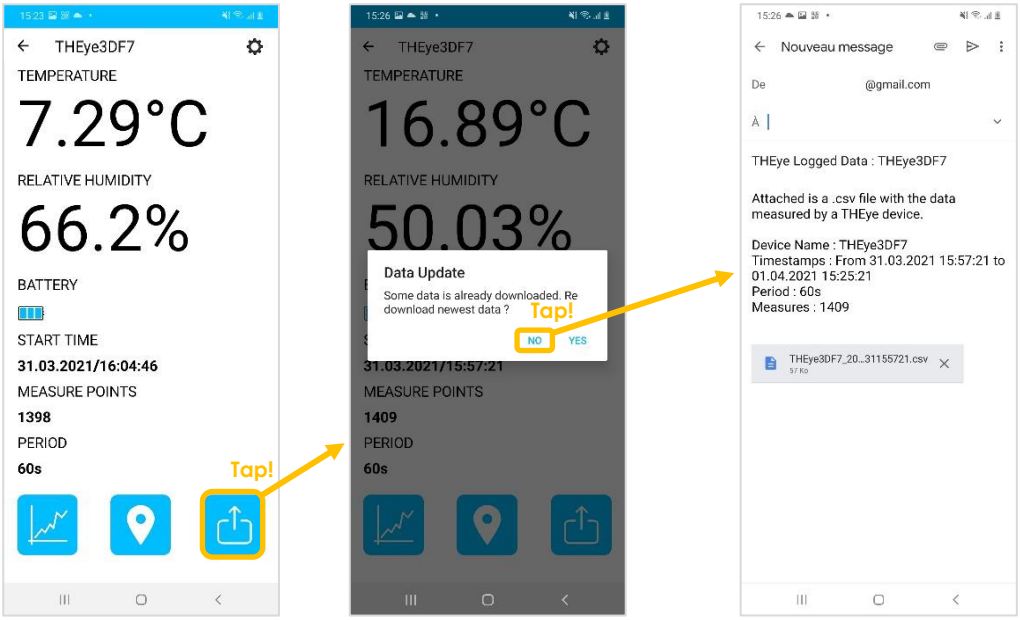
(see Appendix 2 on how to read the CSV file)

If no data has been downloaded from this device yet:

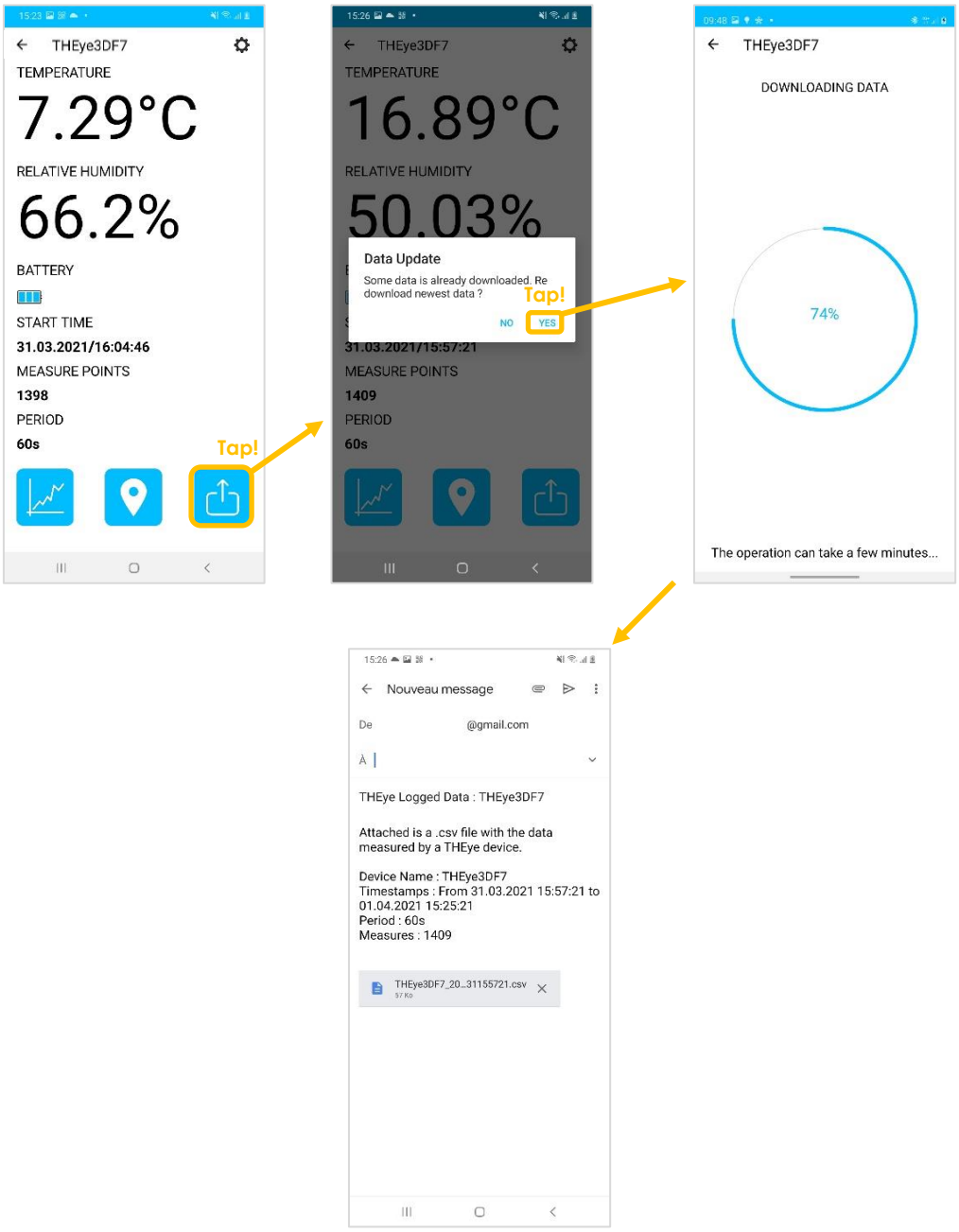


If data has already been downloaded from this device:

- Keeping the already downloaded data

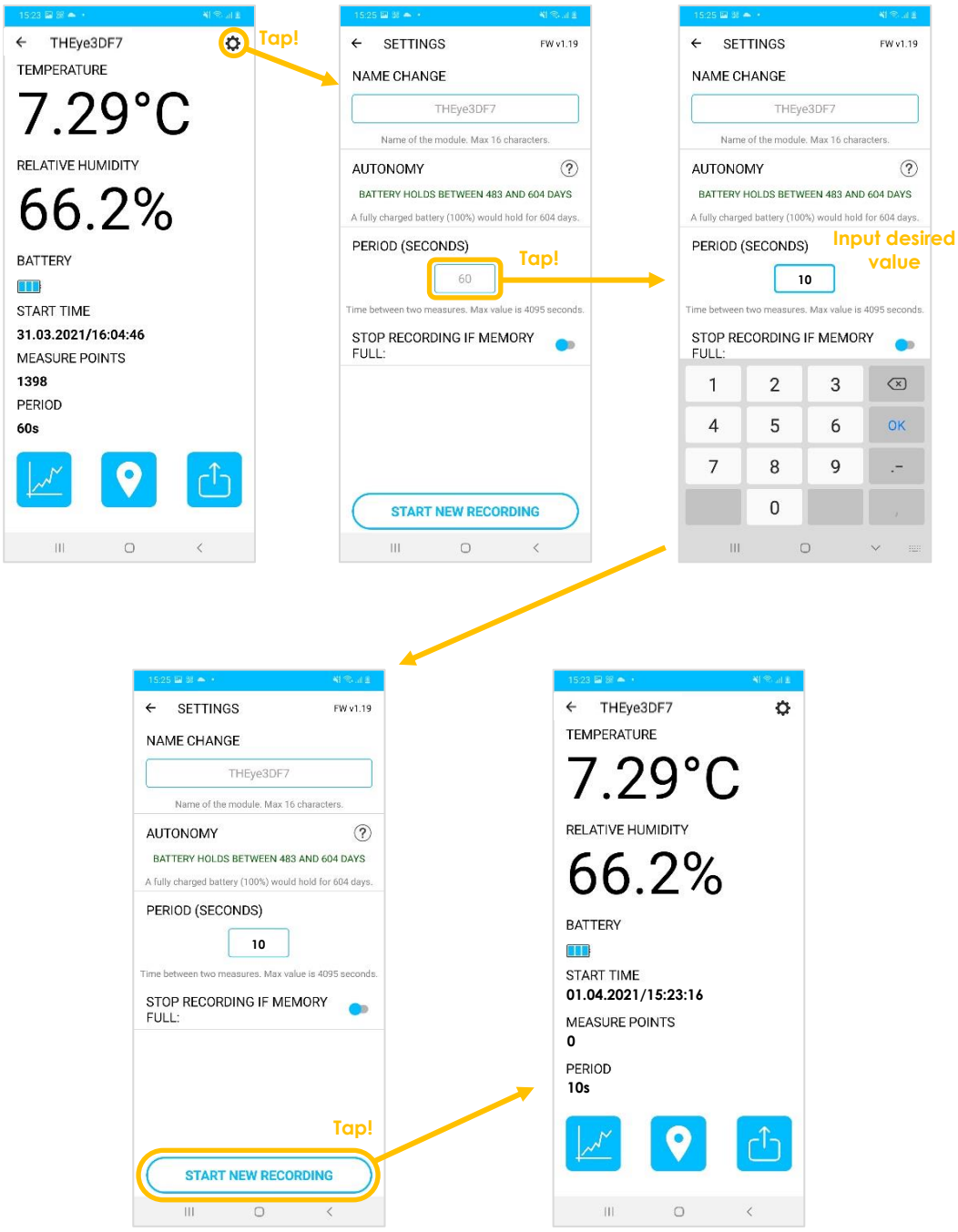


- Downloading the newest data

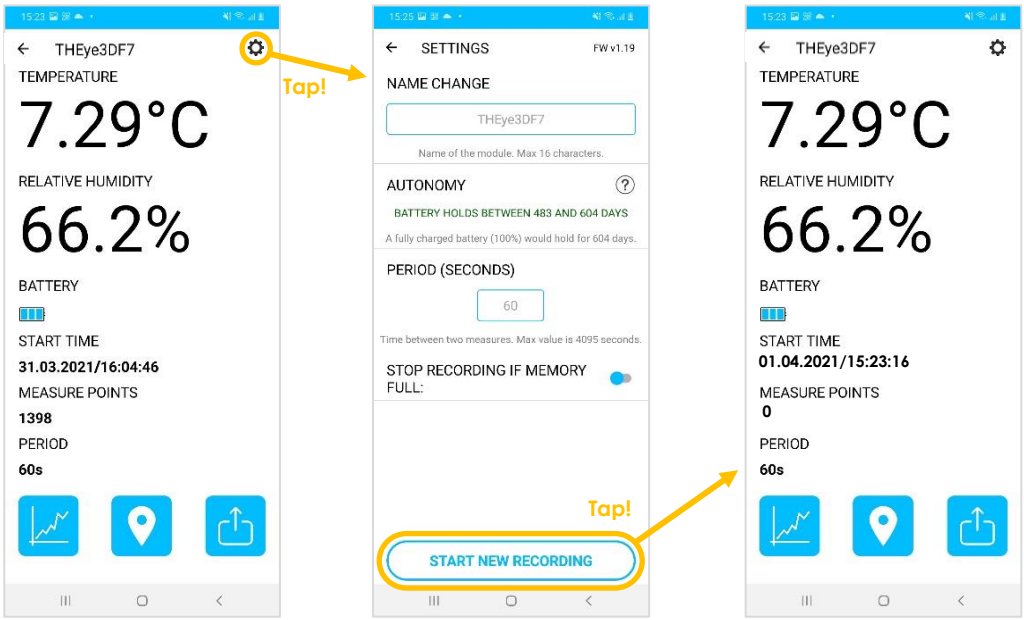


Starting a New Log

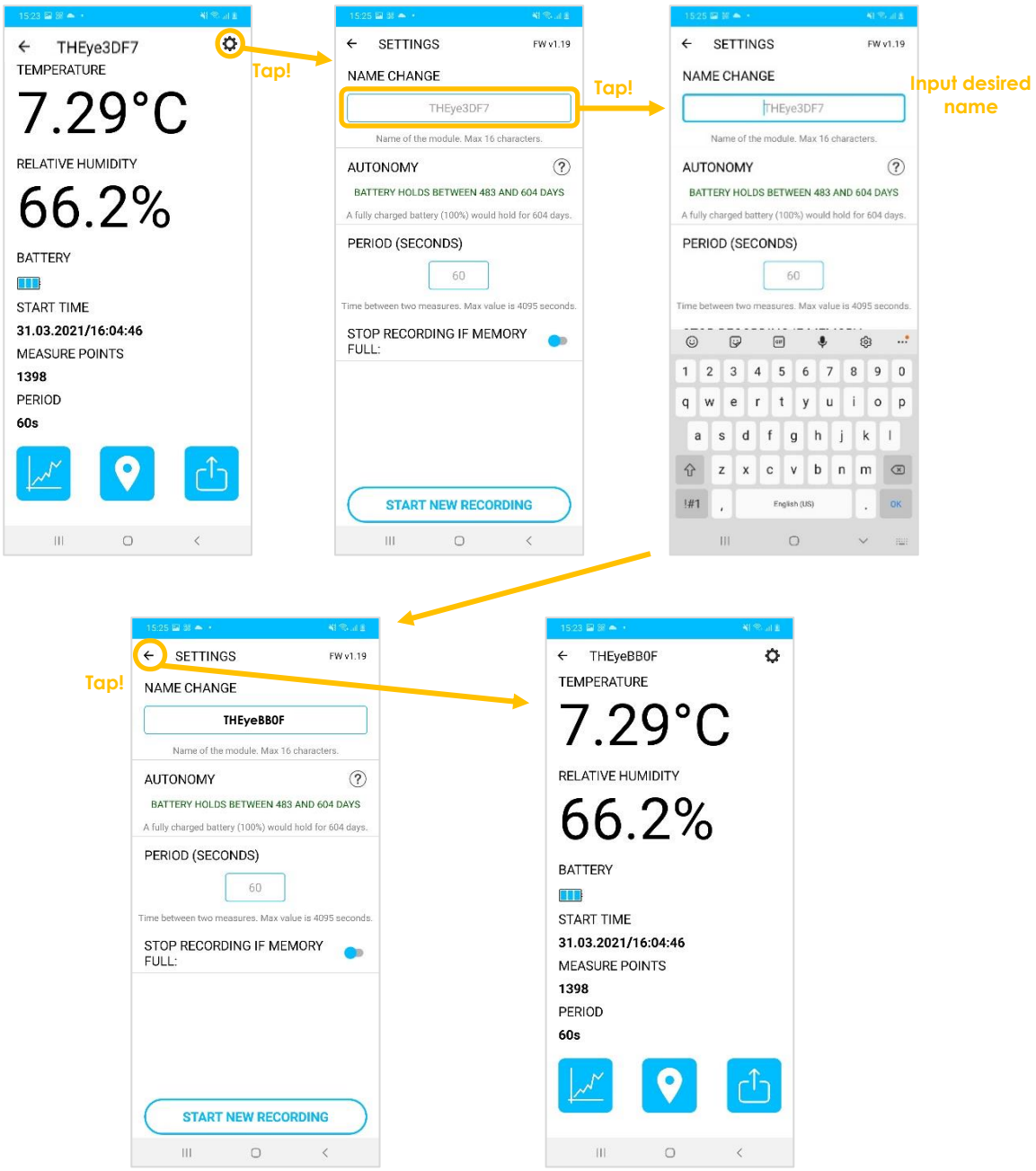
If the interval between two measures should be changed:



If the interval between two measures can stay the same as the previous log:

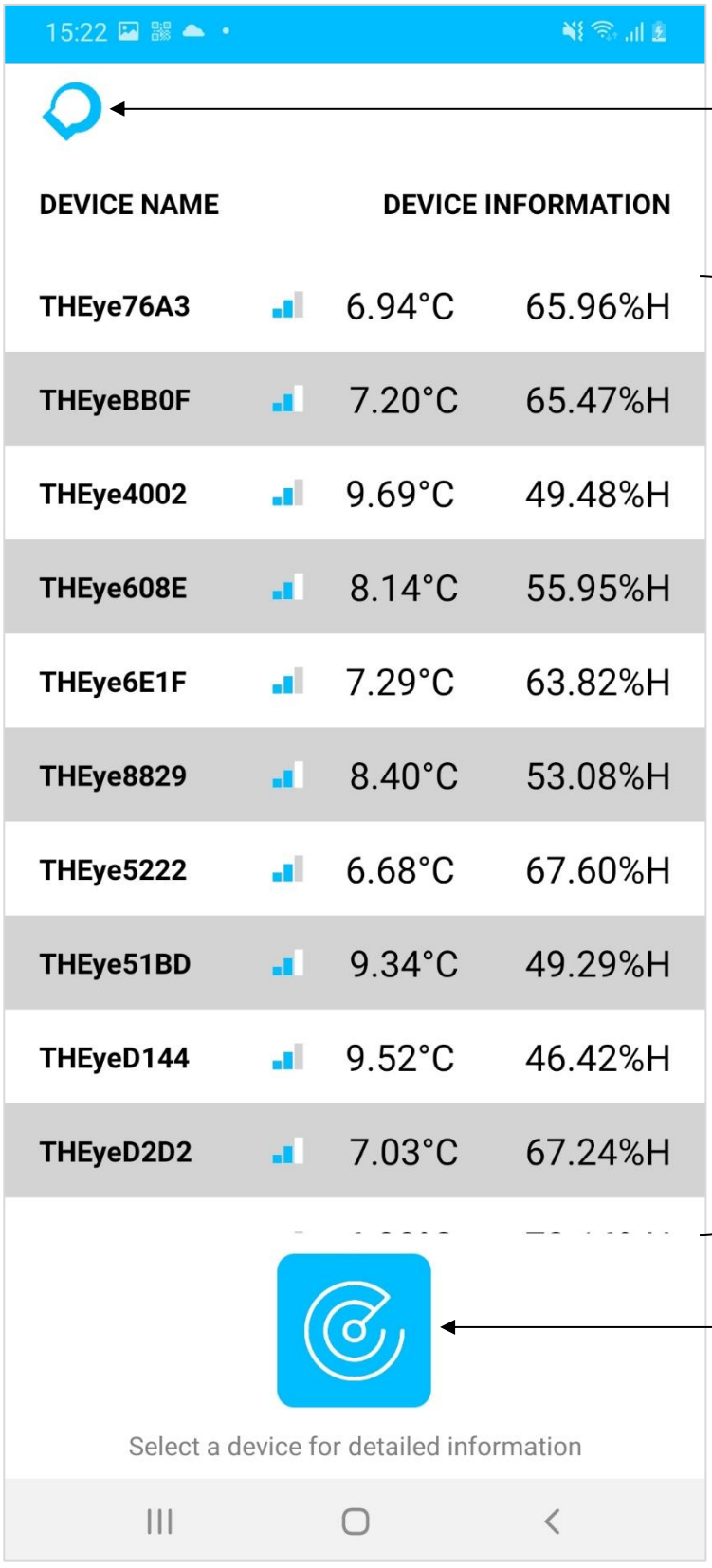


Changing the Device Name



4 App Pages

4.1 Home Page

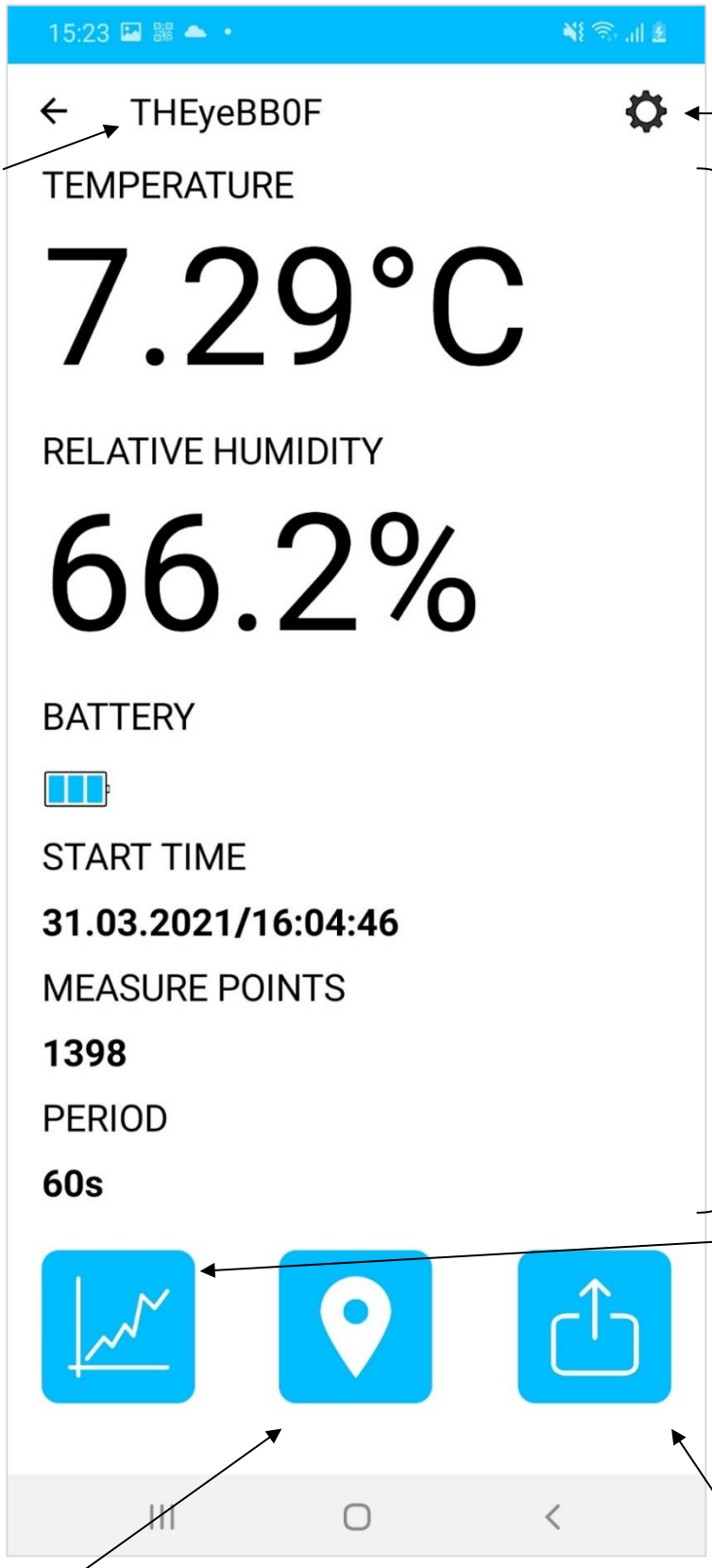


Logo
Tap to display the About Popup

Device List
Tap any device to attempt a Bluetooth connection with the device. A successful connection pushes the Device Page.

Scan Button
Tap to clear current device list and scan for surrounding THEye devices.

4.2 Device Page



Device Name

Settings Cog
Tap to push the Settings Page.

Device Information

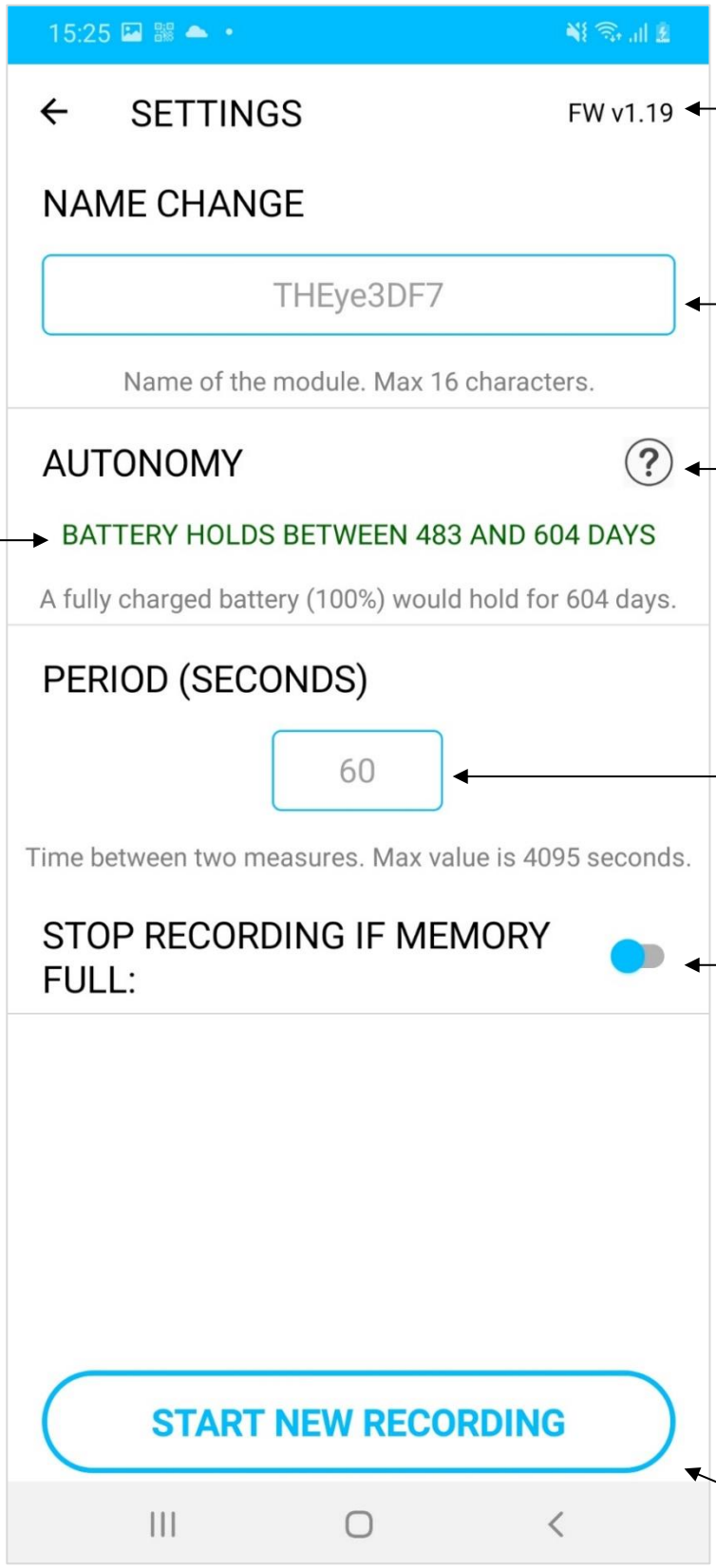
- Temperature (°C)
- Humidity (% relative humidity)
- Battery voltage
- Start time of current log
- Amount of points measured in current log
- Interval between two measures of current log (s)

Graph Button
Tap to download data and push the Graph Page.

Export Button
Tap to download data and push the Email Page.

Location Button
Tap to make the connected device's LED blink 3 times.

4.3 Settings Page



Firmware Version

Device Name
Tap to change the name. The text in light gray is the current device name.

Autonomy
Signals the resulting autonomy from the currently input settings.

Question Mark
Tap to display the additional autonomy information via the Battery Popup.

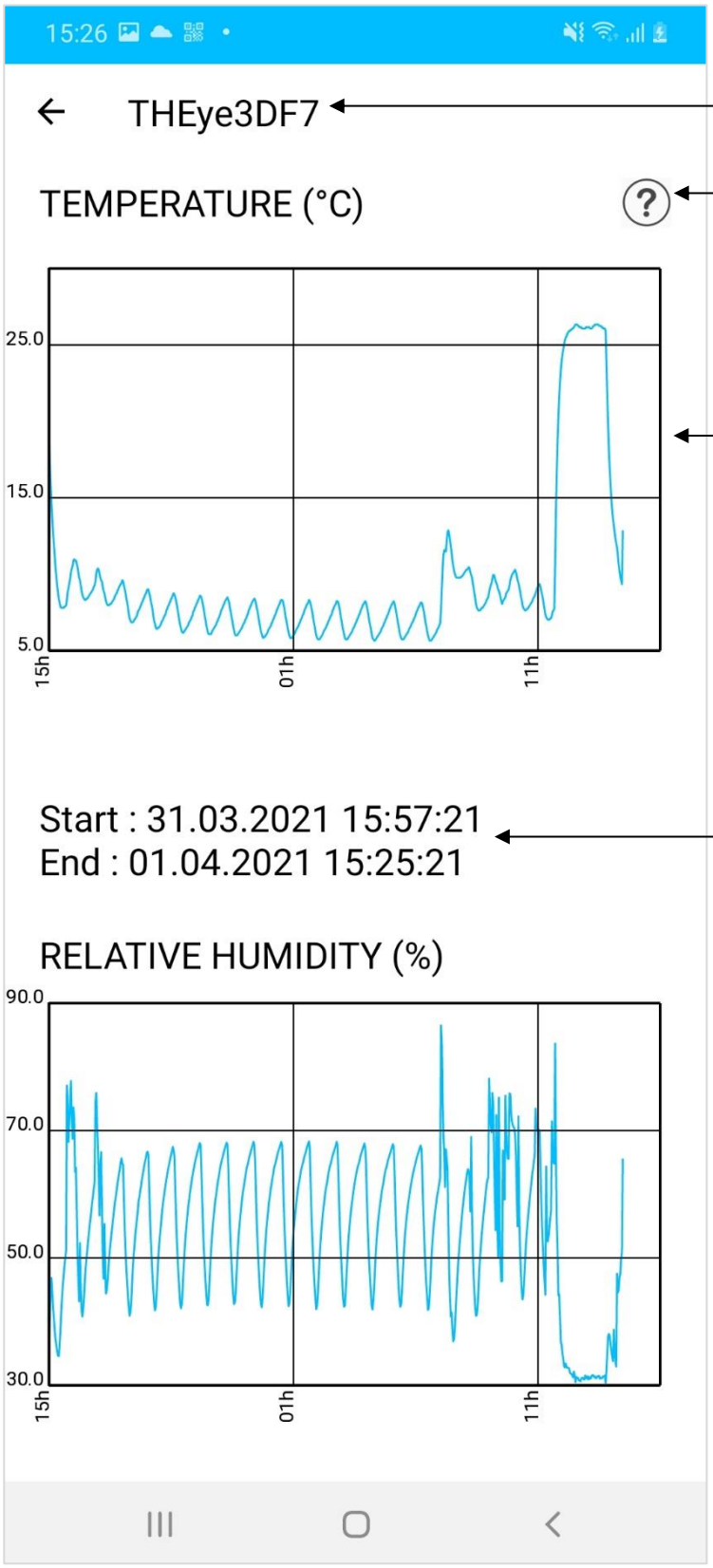
Log Interval
Tap to change the interval between two log measures. The text in light gray is the current log interval.

Memory Handling
Tap to toggle the option.

- If « On », the log will stop as soon as the memory is saturated, therefore prioritizing the early data over latest data.
- If « Off », the log will continue when memory is saturated, overwriting earlier data progressively. This option prioritizes latest data over early data.

New Recording Button
Tap to start a new log with the specified log interval. This will pop the Settings Page.

4.4 Graph Page



Device Name

Question Mark
Tap to display the graph legend via the Graph Popup.

Graphs
Graph of the downloaded temperature and humidity data, in °C and %RH respectively. The graph can be zoomed and panned via respectively a pinch gesture and a swipe gesture.

Log Temporality
Start and end dates of the downloaded data, in format:
day.month.year
hours.minutes.seconds

4.5 Email Page

Device Specific Email

- The device specific email service provider will open.
- The recipient field will be left empty and must be filled by the user.
- The title of the message will always be « THEye Logged Data : Device_Name ».
- The body of the email will always be as the one in this page, with the Device Name information, the first and last timestamps, the log interval in seconds and the amount of measures from the log.
- A .csv file of the downloaded data will be already attached to the email (see Appendix 2).

5 FAQ

Is the app free? Are there advertisements?

Yes! No!

Is my personal information being recorded?

No. In order to enable the Bluetooth scanning, some permissions for location are asked by the app. Although necessary to start the Bluetooth scan, the information is never recorded, seen or used by either the app or FiveCo in any other way than to enable the scan.

Are the permissions necessary for the app to work?

Yes. Saying no to any permission request will result in an app that won't function properly.

Can I connect to multiple devices simultaneously?

No. Only one device can be paired at a time.

Can I give my feedback on the device and/or the app?

Yes, absolutely! If you have not received a feedback document, feel free to contact us via the app's contact link located in the « About Popup ».

6 Undesired Behaviors

The following list showcases possible scenarios where the app presents undesired behaviors:

- A device is out of battery. This will not let the device appear from the scanning operation, and hence will not make it possible for the user to connect to the device. To know if a device is out of battery, check if the front facing LED blinks every 5s. If not, the device is not ON, and hence probably out of battery.
- The "connection failed" alert is displayed. This means that the Bluetooth connection attempt failed. It can be due to the device being too far away, but can also be due to bad luck: **sometimes, Bluetooth connections are unsuccessful and will only succeed after another attempt**.
- Scanning for devices never displays a device, even though the device is clearly on as indicated by it's blinking LED. In this case, download the "nRF Connect" app from the App Store or Google Play Store, launch a scan and filter with "THEye". If the device shows up on this scan, try opening THEye app again and scanning anew. This can fix the bug, and we are currently investigating more thoroughly.

CONTACT ADDRESS:

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Web: www.fiveco.ch

Appendix 1 - Typical Autonomy Estimations

Following is a table recapping some typical autonomy estimations (in days) as a function of the battery status (in bars) and the log interval (in seconds).

	Battery Status			
Log Interval (s)	3 bars	2 bars	1 bar	
1	203-254	50-203	<50	Time Estimation (Days)
5	384-481	76-384	<76	
10	432-541	86-432	<86	
60	483-604	96-483	<96	
600	493-617	98-493	<98	
1000	494-618	98-494	<98	
2000	494-618	98-494	<98	
3000	494-618	98-494	<98	
4095	494-618	98-494	<98	

Appendix 2 - Reading the .csv File

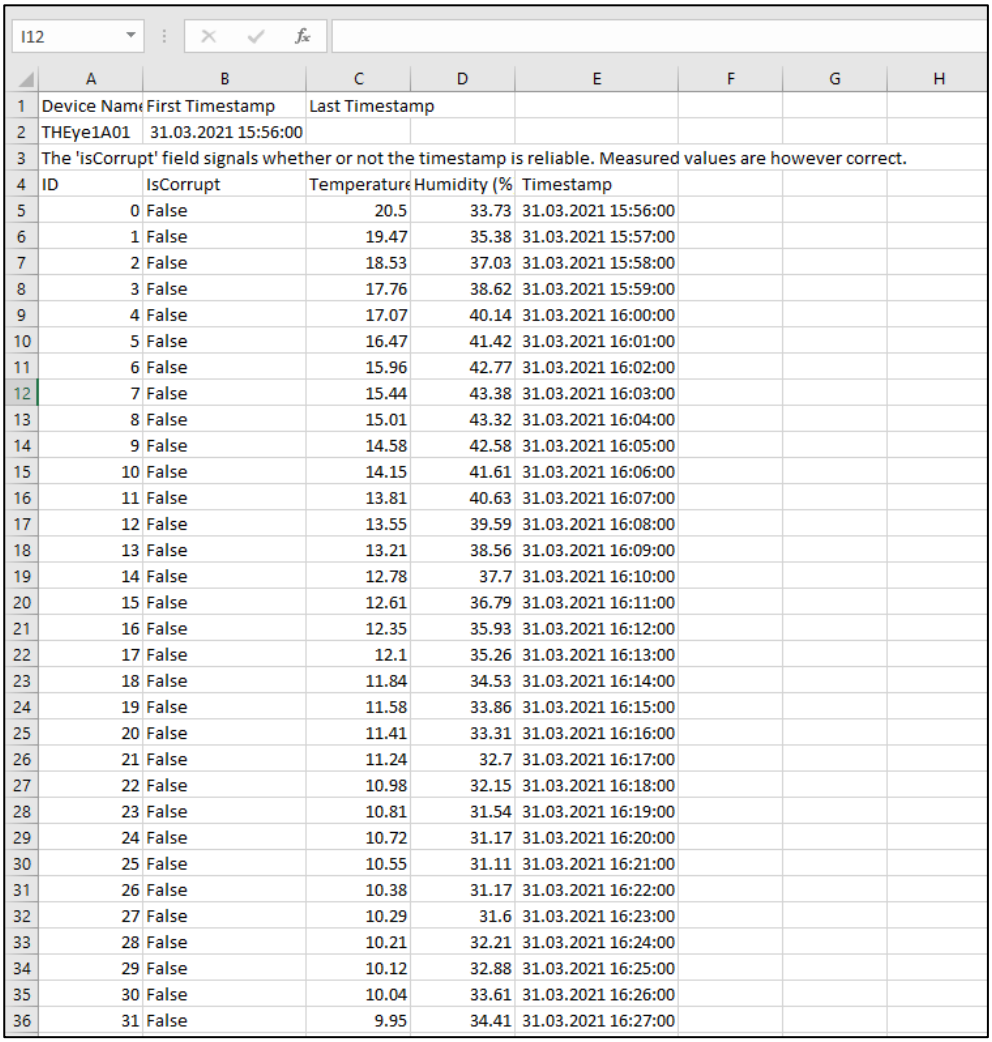
Overview

A .csv file stands for « **c**omma-**s**eparated **v**alues ». It is a file containing a **header** and a **body**, which itself is composed of a list of values, separated by a **delimiter**.

The .csv file generated by our application is defined by :

- Delimiter = ‘,’
- Header = Lines [1 to 3]
- Body = Lines [3 to the end of file]

It should look something like this :



	A	B	C	D	E	F	G	H
1	Device Nam	First Timestamp	Last Timestamp					
2	THEye1A01	31.03.2021 15:56:00						
3	The 'isCorrupt' field signals whether or not the timestamp is reliable. Measured values are however correct.							
4	ID	IsCorrupt	Temperature	Humidity (%	Timestamp			
5	0	False	20.5	33.73	31.03.2021 15:56:00			
6	1	False	19.47	35.38	31.03.2021 15:57:00			
7	2	False	18.53	37.03	31.03.2021 15:58:00			
8	3	False	17.76	38.62	31.03.2021 15:59:00			
9	4	False	17.07	40.14	31.03.2021 16:00:00			
10	5	False	16.47	41.42	31.03.2021 16:01:00			
11	6	False	15.96	42.77	31.03.2021 16:02:00			
12	7	False	15.44	43.38	31.03.2021 16:03:00			
13	8	False	15.01	43.32	31.03.2021 16:04:00			
14	9	False	14.58	42.58	31.03.2021 16:05:00			
15	10	False	14.15	41.61	31.03.2021 16:06:00			
16	11	False	13.81	40.63	31.03.2021 16:07:00			
17	12	False	13.55	39.59	31.03.2021 16:08:00			
18	13	False	13.21	38.56	31.03.2021 16:09:00			
19	14	False	12.78	37.7	31.03.2021 16:10:00			
20	15	False	12.61	36.79	31.03.2021 16:11:00			
21	16	False	12.35	35.93	31.03.2021 16:12:00			
22	17	False	12.1	35.26	31.03.2021 16:13:00			
23	18	False	11.84	34.53	31.03.2021 16:14:00			
24	19	False	11.58	33.86	31.03.2021 16:15:00			
25	20	False	11.41	33.31	31.03.2021 16:16:00			
26	21	False	11.24	32.7	31.03.2021 16:17:00			
27	22	False	10.98	32.15	31.03.2021 16:18:00			
28	23	False	10.81	31.54	31.03.2021 16:19:00			
29	24	False	10.72	31.17	31.03.2021 16:20:00			
30	25	False	10.55	31.11	31.03.2021 16:21:00			
31	26	False	10.38	31.17	31.03.2021 16:22:00			
32	27	False	10.29	31.6	31.03.2021 16:23:00			
33	28	False	10.21	32.21	31.03.2021 16:24:00			
34	29	False	10.12	32.88	31.03.2021 16:25:00			
35	30	False	10.04	33.61	31.03.2021 16:26:00			
36	31	False	9.95	34.41	31.03.2021 16:27:00			

Setting the Delimiter

Such files are typically opened in Excel. However, Excel does not necessarily use the comma as a delimiter. As such, reading the csv file generated by our app requires the following steps :

1. Open the Windows Start Menu, and click Control Panel.
2. Open the Regional and Language Options dialog box.
3. Click the Regional Options tab.
4. Click Customize/Additional settings (Windows 10)
5. Type a comma into the 'List separator' box (,).
6. Click 'OK' twice to confirm the change.

Formatting the Timestamps

The timestamps in the .csv file are in the following format :

dd.mm.yyyy HH:MM:ss

With :

dd = day

mm = month

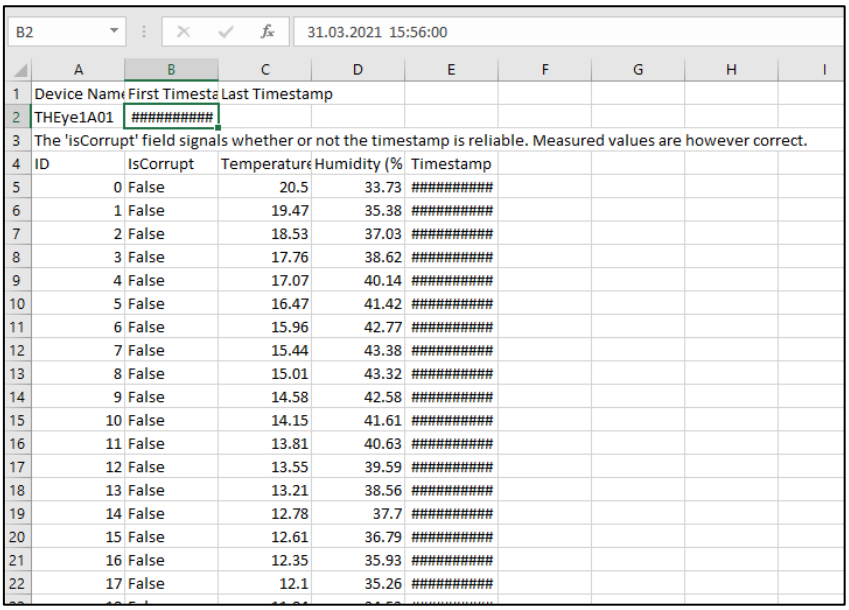
yyyy = year

HH = hours

MM = minutes

ss = seconds

Excel does not necessarily recognize this format by default. If that is the case, opening the csv file in Excel will look something like that:

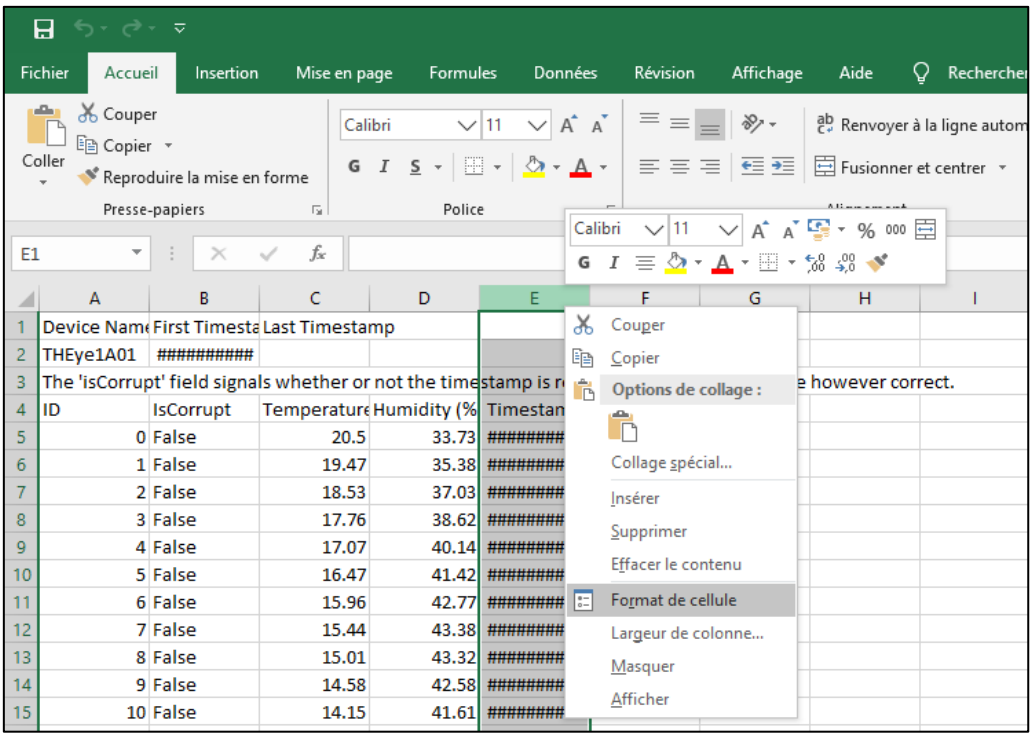


B2 | 31.03.2021 15:56:00

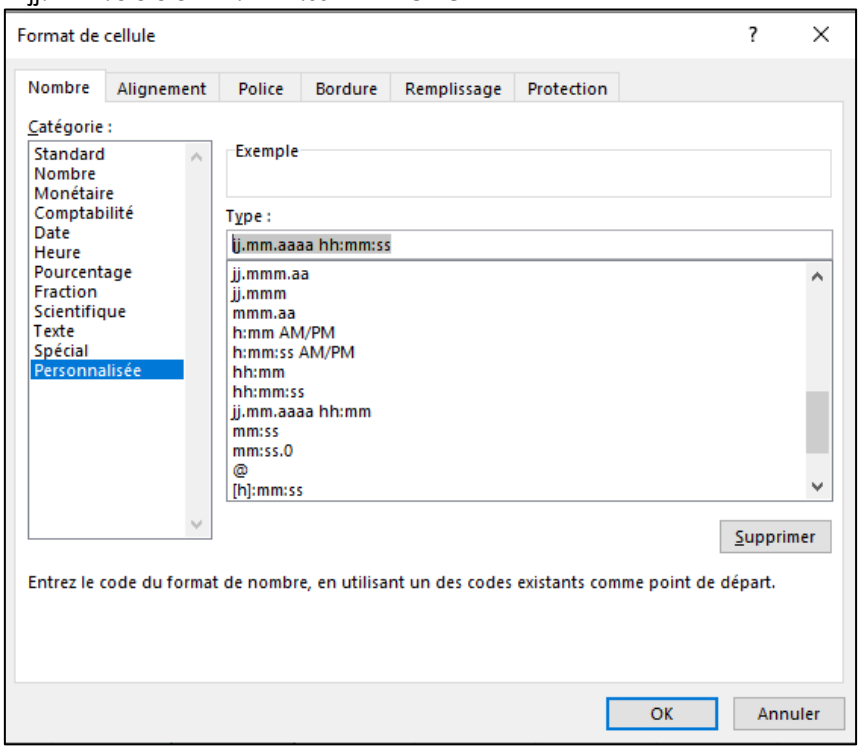
	A	B	C	D	E	F	G	H	I
1	Device Nam	First Timeste	Last Timestamp						
2	THEye1A01	##########							
3	The 'isCorrupt' field signals whether or not the timestamp is reliable. Measured values are however correct.								
4	ID	IsCorrupt	Temperature	Humidity (%	Timestamp				
5	0	False	20.5	33.73	##########				
6	1	False	19.47	35.38	##########				
7	2	False	18.53	37.03	##########				
8	3	False	17.76	38.62	##########				
9	4	False	17.07	40.14	##########				
10	5	False	16.47	41.42	##########				
11	6	False	15.96	42.77	##########				
12	7	False	15.44	43.38	##########				
13	8	False	15.01	43.32	##########				
14	9	False	14.58	42.58	##########				
15	10	False	14.15	41.61	##########				
16	11	False	13.81	40.63	##########				
17	12	False	13.55	39.59	##########				
18	13	False	13.21	38.56	##########				
19	14	False	12.78	37.7	##########				
20	15	False	12.61	36.79	##########				
21	16	False	12.35	35.93	##########				
22	17	False	12.1	35.26	##########				

If this happens, simply follow these steps:

1. Right-click on the cells you want to format (for example, the entire E column)
2. Select "Format the cell"



3. Select "Custom", and in the input box write the correct formatting code (country dependent)
   - "dd.MM.yyyy HH:mm:ss" in English
   - "jj.mm.aaaa hh:mm:ss" in French

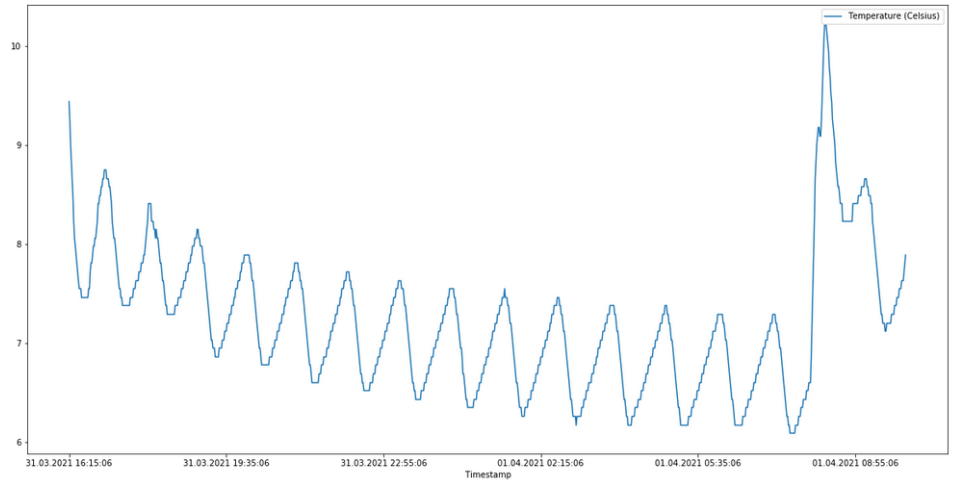


Data Analysis – Jupyter Lab Notebook

You can also find a quick example on how to manipulate the data in our Jupyter Lab Notebook: "*THEye_DataCruncher.ipynb*", located on our webpage at the following link: https://www.fiveco.ch/project-theye-fmod-bht.html.

The notebook is coded in Python, and showcases how to quickly access and graph the data, or even analyze if any device shut down during its log. It is however very minimalistic: any additional data analysis is up to you!

Entrée [9]:
```
fig = File[0].plot(" Timestamp", "Temperature (Celsius)")
plt.rcParams["figure.figsize"] = (20,10)
plt.show()
```



ANALYZE RESTARTS

Do not touch. Execute only !

Entrée [10]:
```
corruption = []
for x in range(file_count) :
    temp = [[],[]]
    corruptIDs = temp[1]
    corruptName = temp[0]
    isAnyCorrupt = False
    for i in range(len(File[x]["IsCorrupt"])) :
        if (File[x]["IsCorrupt"][i] == True) :
            isAnyCorrupt = True
            corruptIDs.append(File[x]["ID"][i])
    if isAnyCorrupt == True :
        corruptName.append(file_list[x])
        corruption.append(temp)

if not corruption :
    print("No restarts occured in any device !")
else :
    for i in range(len(corruption)) :
        print("List of logs containing restarts :")
        print("['Log Name'], Stored desynchronized IDs array, Amount of desynchronized IDs")
        print("")
        print(str(corruption[i][0]) + ", corruption[" + str(i) + "][1]" + ", " + str(len(corruption[i][1])))
```

```
No restarts occured in any device !
```

Figure 4 - A piece of the script