

Graphical Tester for Otoplastics
With Bluetooth® Low Energy Interface
Software Manual

**Additional Manual for Android
API23+**

2023

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1 INTRODUCTION

1.1 Purpose

This paper walks you through the process of obtaining, installing and using the application software (*app*) to control the Bluetooth® LE leakage tester on **Android** platforms. The *app* is called **OtoBLE** for each platform. Find a brief explanation on how to download and install the *app* from the Google Play Store in chapter 2. It is assumed that the user is sufficient familiar with the Android OS and that the controlling *app* 'OtoBLE' already has been downloaded and installed.

1.2 Platforms

The *app* can run on three platforms:

- **Windows 10**, in the Universal Windows Platform (UWP), this platform is an exclusive part of W10 OS a.k.a. Universal App Platform (UAP), hardware: desktop, laptop and tablet
- **Android OS**, as of Android 6.0 (Marshmallow, API 23), hardware: tablet and smartphone
- **Apple iOS**, from: iPad model Air, iPhone model 6 (both iOS12.5.1) and MacBook equipped with Apple *silicon* (CPU M1+)

The 'look and feel' of the *app* on the different platforms is much the same. For each platform, there is **no** need to run the classic Bluetooth® pairing procedure (one-time sign-up) for your Bluetooth® LE leakage tester.

In the upcoming chapters you will find a description on how to operate the Bluetooth® LE leakage tester with the *app* running on **Android** smartphones and tablets.

2 INSTALLATION

2.1 Acquisition

To acquire the *app* OtoBLE to run on your Android device you have to visit the Google Play Store. In order to carry out the installation it is necessary that you have a Google-account.

If you are not already the owner of such an account, you can sign-up and sign-in in the process.

The *app* resides in "Utilities & Tools", search for 'OtoBLE'.

The secure link: <https://play.google.com/store/apps/details?id=ble.leak.bletesting&hl=en>

After tapping **Install**, the download starts and after some time you can tap **Open**: the *app* OtoBLE will start and is now available in the *app* list.

2.2 Procedure

Turn your Bluetooth® LE Leakage Tester on, wait for the beep. Then start the OtoBLE *app*, in this order please. When the Android OS asks in the *app* whether to enable the Bluetooth® radio, allow it (§2.3.2).

If the *app* announces that the location service must be switched on, read §2.3.4.

When there is more than one active BLE leakage tester within range of the Android platform, then the *app* will connect to the tester that appears first in the list of Bluetooth® LE devices. A situation with several active testers is undesirable and should be avoided.

For further information on the leakage tester's **hardware**, download the document **OTOmanualBLE_EN** from our website.

English version: OTOmanualBLE_EN.pdf, URL: <https://www.cursorengineering.nl/en/documentation-ble/>

Nederlandse versie: OTOmanualBLE_NL.pdf, URL: <https://www.cursorengineering.nl/documentatie-ble/>

Deutsche Version: OTOmanualBLE_DE.pdf, URL: <https://www.cursorengineering.nl/de/dokumentation-ble/>

2.3 Bluetooth® LE

2.3.1 version

The leakage tester is a Bluetooth® Low Energy device and it is necessary to have, *at least*, Bluetooth® v4.0 available on your platform. However, there is no need to worry about versions: during the installation of the *app*, it immediately becomes clear whether the *app* is suitable for the hardware you are using. In general, all Android platforms as off version 6.0 (Marshmallow) are suitable.

2.3.2 switching on

The Bluetooth® **radio** can be turned **Off**, but should be **On**. The *app* checks whether the Bluetooth® radio is **On** and will, if not, ask the user permission to enable the radio, choice: **Allow** or **Deny**; denial terminates the *app*.

2.3.3 pairing

Bluetooth® LE devices are always advertising their capabilities to their environment, this is why there is no explicit need to go through the so-called *pairing* procedure, which is common and necessary with *classic*. There are however, Bluetooth® chip manufacturers who do not allow *unpaired* access to low energy devices with a *custom* (proprietary) profile. To prevent unexpected behaviour of the *app*, do **not** perform pairing procedures on Android platform for BLE leakage testers.

2.3.4 permission

A necessary part of Bluetooth® LE is sharing location information. This information is privacy sensitive and therefore requires user consent. If the *location service* is off and because the activation of the *location service* is not allowed automatically, the operating system (OS) will ask to close the *app*.

To enable *location service*, go to **Settings > Location** and slide the switch to *On*. You can then restart OtoBLE.

3 MEASUREMENTS

3.1 Start off

Switch on the leakage tester and wait for a short beep, then activate the OtoBLE *app*, in this order.

In most cases however, only one leakage device is present (*paired* or not) and the *app* will to connect to that device straight away. After a successful connection the *app* shall look like the picture below, from this screen all measurements (*sessions*) will be performed. In the next chapter, all screen elements will be discussed.



Picture 3.1.1: the measurement screen is ready to go

3.2 Screen legend

3.2.1 general

In the following sections, the functionality of the various screen elements shall be discussed.

3.2.2 buttons

- **Exit:** the *app* will be terminated and, if there was a connection present, the leakage tester on his turn will enter the '*sleep*' mode, this mode is discussed in §4.1.2
- **Save Graph:** the graph can be saved with a name of your choice plus date/time stamp, the procedure to save the graph is being treated in §4.2
- **Start Test:** a new measurement starts: the caption on the **Exit** button will change to **Stop Test**
- **Stop Test:** the running measurement will be aborted, after a short time the *app* returns to *READY*

3.2.3 graph

- **mB:** the y-axis indicates the relative pressure in millibar [mB] with respect to existing air pressure; measurements are always taken with a pressure of 5mB. The dotted lines above and below the 5mB value form the extreme limits within which a perfect measurement result has been or will be achieved ($5\text{mB} \pm 0.1\text{mB}$). The orange line indicates the value (4mB) at which the measurement is still considered sufficient (the hearing care professional decides). SI unit for pressure: the Pascal [Pa] ($5\text{mB} \equiv 500\text{Pa}$).
- **sec.:** the x-axis represents the total measurement time in seconds. The measurement time can only start when an initial pressure of 5mB has been achieved.

3.2.4 status

The status line, displayed just above the graph, shows to the right of [STATUS:] the condition the leakage tester is in. At the end, the *progress bar*, indicating the duration of a changing status.

The leakage tester has a number of conditions, the most important of which will be discussed in chapter 5. If only the user's attention is required, the background will turn **orange**, however, in the event of an error message, the background will turn **red**.

One status message has already passed: **Your BLE2023 is ready to go!**: the leakage tester is ready for the first session, you guessed it.

3.2.5 info panel

To the right of the graph, the data is visible with information about the course of a measurement:

- **test** : [number] : the number of measurements since the *app* was launched
 [LED colour] : *example*
 [light green] : the last measurement completed within specifications
 [dark blue] : measurement is running, not finished yet
 [red] : something went wrong: see status line for more information
 [orange] : last measurement completed, but outside the specifications
- **sample** : the current number of measurements (samples) during the total session time
- **pressure** : the current measured pressure, or the last measured pressure (**mB**)
- **time out** : the time [mm:ss] remaining before automatic *app* termination **and** putting the tester into '*sleep*' mode (max. 60 minutes)

3.2.6 battery icon

The battery icon shows the charge status of the batteries in the leakage tester. The value is only an indication, remember that a transitional situation can occur in which the tester will start normally, but may not have sufficient power to operate the pump and valve, or build up sufficient pressure. The battery *voltage* (V) has been chosen as a reference; the unit operates reliably at battery voltages greater than approx. 3.5V.

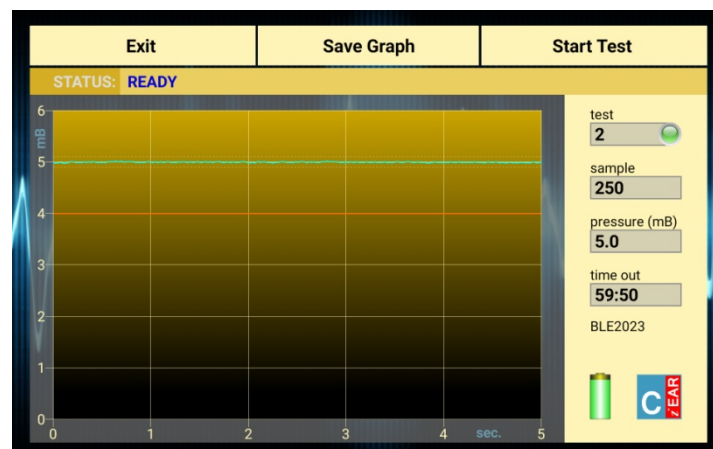
3.2.7 company logo

Tapping the logo (bottom right) offers two functions:

- it opens a pop-up window with some information about the tester, software etc. for five seconds
- it can change the screen 'time out' behaviour: the screen enters lock mode in sync with the value set by the user, or the screen stays on continuously; read §4.1.4 on how to use this function

3.3 Start measuring

To start a leakage test session, tap the **Start Test** button, the air pump in the tester will increase the pressure in the system in short time to a stable 5mB. When this pressure is reached and stable, the actual leak measurement will start and takes five seconds. During this period the graph is drawn *'real time'* and ideally the pressure should remain at 5mB. A margin of 4mB is adhered to indicate that a lower value is to be interpreted as an insufficient fitting of the earpiece, but as written before: the hearing care professional ultimately decides. The picture below shows an ideal result of a measurement; note that the **Save Graph** button is now clickable.



Picture 3.3.1: an ideal measurement result

A standard measurement procedure goes through a number of different stages:

SESSION START	: just a very short notice
AIR IN	: the air pump starts and brings the pressure to just above 5mB
STABILIZING PRESSURE	: the pump stops, the air valve regulates the pressure to 5mB and closes the system
MEASURING PRESSURE	: the test starts sampling with an initial pressure of 5mB; the graph will be plot
SESSION FINISHED	: the last sample has been taken, the valve opens and the deflating procedure begins
READY	: the system is ready for the next session

When the session is finished, the **Save Graph** button is enabled and after tapping it the user can save the recorded graph. This procedure is explained in paragraph 4.2.

4 MISCELLANEOUS

4.1 Modes

4.1.1 idle

This is the mode the system is in when it is waiting for the next session. The *idle* mode lasts sixty minutes and when the user does not take any action the timer counts down to zero: the *app* puts the tester into '*sleep*' mode and terminates itself. The down counter will be reset every time a session starts.

4.1.2 sleep

In order not unnecessarily shortening the lifespan of the batteries, the tester is powered down if it is not used for a certain period. The system has a so-called *countdown* timer for this purpose and is visible in the info panel (*time out*). The time to power-down is set to sixty minutes at the start. De tester is given one minute more so that it never switches itself off too soon.

4.1.3 standby

Before entering the '*sleep*' mode, which is irreversible by software, a warning is presented to the user on the status line: 'STANDBY MODE ENTERED!'. From this moment the system is de facto in *standby* mode and the user has fifteen minutes left to reset the *countdown* timer by doing a (dummy) test.

4.1.4 screen 'time out'

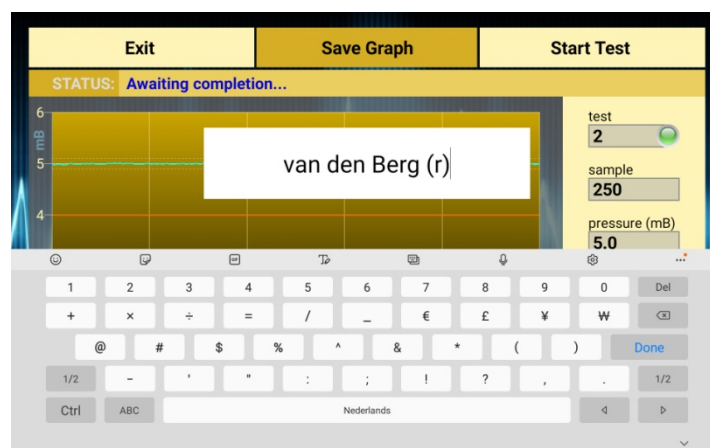
Because the *standby* time has been extended to one hour, we have made the screen *time out* selectable: if nothing is done the *time out* will follow the value set by the user (default).

After tapping the *Cursor* logo the information panel pops up, however, if the fingertip is now held a little longer on the logo, then the screen *time out* timer will be overruled and de screen will be visible continuously until this action is repeated or the *app* is closed. The choice has feedback.

4.2 Archive

4.2.1 general

After each test, the user has the opportunity to save the resulting graph to a *file* for later use in documents. Tapping the **Save Graph** button a window will pop up that allows you to enter a filename as shown below:



Picture 4.2.1: saving a graph under Android OS

4.2.2 procedure

Click in the *pop-up* window on the so-called *placeholder* (filename[.png]) and enter the name; a maximum of 48 characters can be used, conclude with **[Done]**.

Touching the screen outside this pop-up window terminates the saving procedure, but can be restarted or continued by tapping **Save Graph** again until the saving procedure has been completed or until the next measurement starts. The graphic result of an ear measurement can only be saved once.

Two files will be saved: one in colour (avg. size 38kB) and one in b&w (avg. size 21kB) with a transparent background. The graph will be saved to the so-called 'Portable Network Graphics' file format, therefore the *extension* name reads **.png**. One should not enter this extension name: the extension will be automatically added. A date/time stamp is always added at the bottom *inside* the graph.

4.2.3 directory location

The graphs will be captured and stored in the directory .../Internal storage/Pictures/Images)/*OtoBLE*. Use an *app* e.g. "My Files" from the *Google Play Store* and from the aforementioned map you can edit the graphs, email them etc. or possibly transfer them to another platform where the report will be processed.

For certain Android versions, storing data in the internal memory (still) requires the user's permission read about this in the next section (4.2.4).

4.2.4 permission

The version of the Android Operating System (OS) on your platform determines whether *user permission* is required to save the graphs to internal memory. At times where permission is required (if it is not yet been given), the app will ask for permission via a so-called pup-up window, once permission has been given, the question will not be asked again until the permission is withdrawn; without this permission the app works fine, but no graph can be saved.

All Android versions from 6 (Marshmallow, API 23) up to and including version 10 (Queen Cake, API 29) request permission to store data. From Android version 11 (Red Velvet, API 30) permission is no longer required and thus no longer asked for.

4.2.5 messages

Some common status messages during archiving:

- **file 'filename.png' already exists:** the *filename* already exists, make up and (re-)enter a different name
- **Filename cannot be empty:** the *filename* may not be empty
- **Character (x) not allowed in a filename:** although strictly allowed, characters are banned from the range $x = ["\\", "/", "*", "?", ":", "<", ">", "\\\"", "["]$ for compatibility reasons; these tokens are automatically deleted as you type
- **Press 'Save Graph' again to resume:** because the screen has been touched outside the text box, the text box disappeared: tap **Save Graph** again, already filled characters will be preserved
- **Graph has been saved:** the file '*filename.png*' has been saved

5 STATUS MESSAGES

5.1 During connection set-up

Immediately after launch, the *app* searches for available leakage testers nearby. If a device is found, the software tries to establish a Bluetooth® connection – direct or indirect via selection - with the tester. While setting up this connection several status messages will appear on screen: mostly it is progress information, occasionally user action is required. On the next page there is an overview of the most important messages. The most important messages that can occur while establishing a connection to the tester are:

- **ONLY USER CAN ENABLE LOCATION SERVICES:** Bluetooth® *needs* location services, read §2.3.4 *
- **BLUETOOTH MUST BE TURNED ON:** Bluetooth® hardware is available, but is still switched off, read §2.3.2 on how to turn the Bluetooth® radio (back) on *
- **GRANT PERMISSION FOR 'BLUETOOTH CONNECT' PLEASE:** in a pop-up pane a *one-time* permission must be given to allow the *app* to connect to nearby devices **
- **SCANNING FOR (BLE) LEAKAGE TESTERS...:** the *app* explicitly searches for leakage testers of the type BLExxxx for approx. ten seconds, your tester should be turned on and in *idle* mode, beforehand
- **NO (BLE) LEAKAGE TESTER DETECTED:** no tester was found in the immediate vicinity; your tester might be switched off or still not in *idle* mode *
- **CONNECTED TO BLExxxx:** a leakage tester was identified and the *app* will try to upload settings
- **IDENTIFICATION OF BLExxxx FAILED:** unknown problem occurred; maybe tester was only switched on while the *app* was already running * (occasionally the *app* can get *back on track*)
- **OFFSET UNSTABLE, RESTART YOUR BLExxxx:** the *ambient* air pressure which is a reference (0mB) for every measurement is not stable enough, in most cases the tester is not yet acclimatized enough; wait a few moments after this message and then start again *
- **Your BLExxxx is ready to go!:** the tester has passed all initial tests and the settings are implemented and checked; you can start measurements now

* leads to **Exit (only)**, the *app* terminates automatically within two minutes

** rejection is **permanent**; restore: select below >Settings >Apps >Manage apps the OtoBLE *app* and below >App permissions >Nearby devices and change the *Nearby devices* permission

5.2 During measurements

The messages during a standard measurement procedure were already mentioned in section 3.3.

Here follows an addition for deviating cases:

- **TARGET PRESSURE NOT REACHED OR UNSTABLE:** the system loses so much air that the pressure cannot be increased sufficiently, before drawing any conclusions, the system should be checked for leaks without an otoplastic and with the air hose sealed at the very end; check that the air pump operates and whether air is coming out of the tester at all
- **PRESSURE DISCHARGE TOO SLOW:** when a measurement has finished the system should be depressurized in a few seconds, but when this procedure takes too long it indicates malfunction or contamination of the internal air valve; if this problem persists service is required
- **READY (BELOW REJECTION LEVEL):** the session has finished, but during the inquiry the system pressure has been at or below 4mB at some point
- **READY (POOR BATTERY POWER):** the session has finished, but the batteries are exhausted (< 3.5V) and should be replaced; remember that a transitional situation can occur where the tester will start normally, but will not have sufficient power to operate the pump or valve

5.3 During idle time

While waiting for the next session, the system is '*inactive*'. Even during this '*idle*' mode, data is exchanged with the tester and notifications can come up from the *app*. We will name a few:

- **CONNECTION WITH 'BLExxxx' LOST:** the existing Bluetooth® connection went down on either side; most common reason is a switched off device *
- **STANDBY MODE ENTERED!:** this is a warning initiated by the tester to inform the user that 75% of the '*idle*' time has passed and thus makes clear that the *countdown* timer should be reset

* leads to **Exit (only)**, the *app* terminates automatically within two minutes