

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

**Additional Manual for Android**

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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 laptop with M1 (ARM) processor

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 off 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/>

Dutch version: OTOmanualBLE\_NL.pdf, URL: <https://www.cursorengineering.nl/documentatie-ble/>

German 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

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 permissions

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. More information about these and other permissions can be found in section 4.5.1.

## 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 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

## 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 BLE2002 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 green] : 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. 20 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. 3.3V.

### 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 reset the 'time out' counter in both *app* and tester without the need to run a *dummy* test or restart unit and *app*; there is a warning when entering the '*standby*' mode; read §4.1.4 on how 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: a 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 twenty 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, or after tapping the *Cursor* logo, see §4.1.4.

#### 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 twenty 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 five minutes left to reset the *countdown* timer.

#### 4.1.4 reset 'time out'

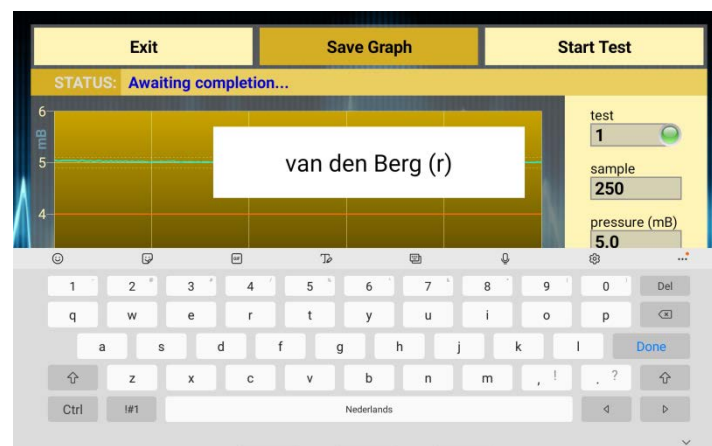
You can reset the *'time out'* counter without the need to start a (dummy) session.

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 *time out* timer will be reset to twenty minutes (*'idle'* mode).

### 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

#### 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. A date/time stamp is always added at the bottom *inside* the graph.

When all measurements are completed, the program can be terminated by tapping the **EXIT** button.

#### 4.2.3 location

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.

The graphs will be captured and (by default) stored in the directory *OtoBLE*. From there you can edit the graphs, email them etc. or possibly transfer them to another platform where the report will be processed.

#### 4.2.4 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 in the directory *.../OtoBLE*

## 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. An overview of the most important messages:

- **ONLY USER CAN ENABLE LOCATION SERVICES:** Bluetooth® *needs* location services, read §4.5.1 \*
- **BLUETOOTH MUST BE TURNED ON FIRST:** Bluetooth® hardware is available, but is still switched off, read §2.3.2 on how to turn the Bluetooth® radio (back) on \*
- **SCANNING FOR BLE DEVICES...:** the *app* explicitly searches for leakage testers of the type BLExxxx for approx. three seconds, your tester should be turned on beforehand
- **NO BLE LEAKAGE TESTER FOUND:** no tester was found in the immediate vicinity; your tester might be switched off \*
- **CONNECTED TO BLExxxx:** a leakage tester was identified and the *app* will try to upload settings and exchange data
- **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

## 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, but 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 the otoplastic is properly attached to the ear
- **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 (< 3.7V) 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 only five minutes are left to easily reset the *countdown* timer; read §4.1.4 on how to perform the reset

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