

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

**Additional Manual for Windows 10 with
the Windows Universal Platform (UWP)**

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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 **Windows 10** platforms. The *app* is called **OtoBLE** for each platform. You will find a brief explanation on how to download and install the *app* from the Microsoft Store in chapter 2. It is assumed that the user is sufficient familiar with the Windows 10 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 **Windows 10**.

2 INSTALLATION

2.1 Acquisition

To acquire the *app* OtoBLE to run on your Windows 10 device you have to visit the Microsoft Store. The Store will automatically select the right *app* for the device (desktop or smartphone) with which you are accessing the Store. In order to carry out the installation it is necessary that you have a Microsoft-account this is just the way it goes. 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' or click the following secure link: <https://www.microsoft.com/store/apps/9p067btst7pl>. After clicking **Download**, the download starts and after some time you can click **Install**: the installation will start and after completion, OtoBLE will be available in the *app* list.

2.2 Procedure

Because Bluetooth® LE devices are always advertising their capabilities to their environment, there is no explicit need to go through the so-called *pairing* procedure, which is common and necessary with *classic* Bluetooth® devices. 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, an automatic and *one time* pairing procedure has been integrated into the *app*. On the Windows 10 platform, you are free to run the pairing procedure in the *settings* all by yourself before starting the *app*.

Attention: when there is more than one *paired* leakage tester in use on the same Windows 10 platform, all the testers will always appear in a selection menu (in the *app*). As a result, you will always have to select your tester first; this prevents the start of the automatic connection procedure with your tester. The automatic connection can be more comfortable for the user. To remove (*paired*) Bluetooth® devices read section 2.3.3 and 4.3 first.

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.

You can check your Bluetooth® version as follows:

- right-click **Start**  > Device Manager > double-click 
- double-click the Bluetooth® radio listing (usually a brand name, e.g. Intel, Asus etc.)
- select the **Advanced** tab, then look for the LMP (Link Manager Protocol) listing in the **Firmware** or **Firmware version** area
- if the LMP number is 6.0000 or higher: the Bluetooth® version is 4.0 or higher

If you cannot find a  icon in the device listing then your platform does not have Bluetooth®; you might consider connecting an external Bluetooth® adapter via the USB port on your device.

2.3.2 switching

Your Bluetooth® radio can be turned **Off**, but should be **On**. To turn the Bluetooth® radio **On** handle as follows:

- click **Start**  Button >  **Settings** >  **Devices** > **Bluetooth & other devices**
- if necessary, slide the Bluetooth® switch to **On**

2.3.3 remove devices

Your Bluetooth® tester can be removed from Windows 10 as follows:

- click **Start**  Button >  **Settings** >  **Devices** > **Bluetooth & other devices**
- scroll down to **Other devices** and click on the name of your leakage tester
- click **Remove device** and take note of the warning, then click **YES**

If the testers name still appears in the *app* and thus you still have to select, read §4.3.1.

2.4 Operation

Turn your Bluetooth® LE Leakage Tester on, wait for the beep and then start the OtoBLE *app*. For further information on the leakage tester's **hardware**, download the document **OTManualBLE_EN** from our website.

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

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

German version: OTManualBLE_DE.pdf, URL: <https://www.cursorengineering.nl/de/dokumentation-ble/>

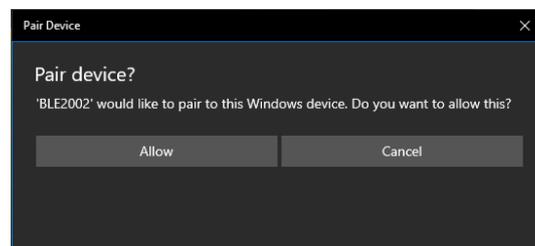
3 MEASUREMENTS

3.1 Start off

Switch on the leakage tester and wait for a short beep, then activate the OtoBLE *app*, in this order. There are two reasons why the *app* might pop-up a device listing:

1. there was at least one tester known to Windows 10, because it was *paired* at some point in the past, the *non paired* tester you just turned on will be added to the list
2. there are two or more physical testers operating in the immediate vicinity

In both cases, you will have to click the correct device in the listing, after which the *app* will try to connect to the selected device. In **most cases** however, only one leakage device is present (*paired* or not) and the *app* will try to connect to that device straight away. If the tester was not *paired* to Windows 10 before, a one-time *pairing* procedure will be initiated and it looks like this:



Picture 3.1.1: pairing to Windows 10

Tap **Allow** to proceed and finish the pairing procedure and the *app* will continue to make a connection to the leakage tester. Anyway, 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 3.1.2: 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. The *app* starts with a fixed size depending on the screen settings of your Windows 10 platform. In between measurement sessions, you can resize the *app* window within reasonable dimensions or set it to *full screen*.

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 §3.45
- **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 section 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**.

If, at the end of the status message, the addition (**RESUMED**) is visible, this indicates that the *app* has been restarted after the screen has been in '*sleep*' mode or after the *app* has been minimized [_].

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:

| | |
|----------------------|--|
| TEST STARTED | : 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'

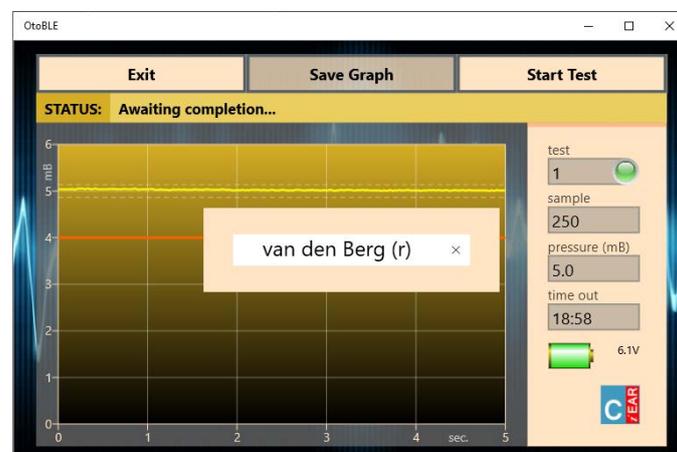
You can reset the *'time out'* counter without the need to start a (dummy) session.

After tapping the *Cursor* logo the information panel pops up, tapping the logo again, *while the panel is visible*, the panel will disappear and the timer starts with a new (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 on Windows 10

The graph will be filed 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. Touching the screen outside this pop-up window terminates the filing 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. A date/time stamp is always added at the bottom *inside* the graph. Two storage procedures are available.

4.2.2 save to a *fixed* location

Click in the pop up window on 'enter filename' and enter the name directly (max. 48 characters) in the text box and finish with [ENTER]. Two files are saved: one in *colour* as seen in the *app* (average size 70kB) and a transparent *b&w* version (average size 40kB). As an example: on an English (EN) Windows 10 version the files are (by default) stored under **C:\Users\<...>\Pictures\ OtoBLE\ Leakage Test\ *name*(*b&w*).png**. Although the quality somewhat depends on the chosen screen size of the *app*, the saved graphs have fixed sizes. From here, you can edit the graphs, email them etc. or transfer them to any platform where the document is being processed. After cancelling this procedure, one can always press **Save Graph** again.

4.2.3 save to a *free* location

Click in the *pop-up* window on the so-called *placeholder* (enter filename) and enter the name; a maximum of 48 characters can be used, conclude with [/], the *slash*. Windows will open a dialog where you can determine the location yourself and, although not recommended, change the name. This method also creates e.g. the possibility to save the graphs at 'OneDrive', so others can start using the results immediately. The filename that will be included in the graph is the name as originally entered in the pop-up window, if the filename has been changed in the dialog box then this change cannot be fed back to the chart. To prevent it from becoming a 'fill-in exercise', it was decided to save only the graph as visible in the *app*, so no *b&w* version. Do **not** change the extension '.png'. After cancelling this procedure, one can always press **Save Graph** again.

4.2.4 storage messages

Some common status messages during save:

- **Enter name, conclude with [enter] or [/] to open a dialog:** chose between the two procedures
- **This filename '*name*' already exists:** the filename *name* already exists, (re-)enter a different name, and remember reserved names from the range *name* = [com1, com2, etc., lpt1, lpt2, etc., con, prn]
- **Character (x) not allowed in a filename:** under Windows 10 a *filename* cannot contain characters from the range $x = ["\", \"/", "*", "?", ":", "<", ">", "\\", "|"]$ the character will be automatically removed
- **Graph '*name*' has been saved:** the file '*filename*.png' has been filed with time/date stamp (*fixed*)
- **Graph has been saved:** the file has been saved after a dialog (name unknown, see §4.2.3)

4.3 Device removal

4.3.1 description

Under Windows 10, it may happen that a Bluetooth Low Energy device, that was once connected and never *paired*, is still recognized by the operating system, despite the fact that the device is not turned on or is even no longer in use at all. Normally, Windows 10 will *forget* all inactive *non-paired* Bluetooth® LE devices after a restart, but sometimes not. It is no big deal, but it can prevent the *app* from connecting directly to the leakage tester and annoyingly obliges the user to click on the correct device via the selection menu each time. Moreover, clicking a *ghost* device can lead to unwanted software behavior. The next section explains how to permanently remove such a device from the Windows 10 OS.

4.3.2 solution

To remove a *stubborn* unpaired Bluetooth® LE device from a Window 10 Operating System, proceed as follows:

- right-click **Start**  > Device Manager > double-click 
- right-click the Bluetooth® radio listing (usually a brand name, e.g. Intel, Asus etc.)
- select **Disable device** and take note of the warning, then click **YES**
- right-click the same, but now *disabled* Bluetooth® radio listing
- select **Enable device** and the Bluetooth® environment will be restored
- close the *Device Manager*

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:

- **Bluetooth® is not available on this platform:** no Bluetooth® hardware was found; read section 2.3 or consult the hardware manual *
- **Bluetooth® must be turned on first:** Bluetooth® hardware is available, but is still switched off, read §2.3.2 on how to turn Bluetooth® back on *
- **Scanning for OtoBLE devices...:** the *app* explicitly searches for leakage testers of the type BLExxxx for approx. three seconds, your tester should be turned on beforehand
- **Could not detect any leakage tester:** no tester was found in the immediate vicinity; your tester might be switched off *
- **Connecting to 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*)
- **Attempt to make a connection to BLExxxx:** a leakage tester was identified and the *app* will try to upload settings and exchange data
- **Offset value appears to be 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 (5mB) NOT REACHED OR UNSTABLE:** the system loses so much air that the pressure cannot become sufficiently high, 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 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 '*devicename*' 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