Manual of Audiometer

AudioTest

Contents

Introduction

The use of personal computers for capturing and storing medical signals such as data from audiometry has enormous advantages:

Inexpensive and very precise.

Ease of use.

Powered by USB cable. No need for batteries.

Better cooperation from the patient.

Possibility of automatic recording.

Continuous or pulsed tones.

High quality printing on A4 paper.

Two buttons for the patient make indication of the reliability of the recording

possible. If the patient presses a button on the wrong site, it is indicated.

Errors of the patient give a good indication of the reliability of an examination.

Recordings are saved in database that can be consulted any time.

Sorting of patients by age, decibels etc. is possible with a single mouse click.

Possibility to send recordings by email

Possibility to compare two recordings on the computer screen.
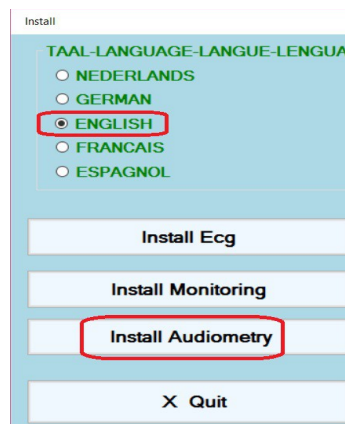
Heavy duty, no mechanical parts inside.

I Installation

1 Software installation

The software works with 32 and 64 bits Windows 7, 8 et 10.
The software is delivered on CD-ROM. Installation software should start-up when inserting the disk into your drive. Allow Installation.exe to execute

Select 'Install Audiometry'. Click always 'Next'. Do not interrupt the installation.

When finished you will find in the default installation directory, C:\AudioTest :
  - AudioTest.exe : the program
  – *.adf Audiometer records
  – AudioTestEn.pdf: this manual
  – AudConfig.xml , xml configuration file.
  - CalibrationData.fil, binaire file that contains calibration date.

Download on our site is also possible.

http://www.ganseman.com/Download.aspx

Download and unzip SetupAudioTest.zip.

Unzip, extract and execute SetupAudioTest.exe

2 Hardware installation

In our delivery you find two main parts.

Headphone

The headphone is connected to the signalisation apparatus**.** It is **not** connected to the speaker output of the PC. On the bottom of the apparatus is a **yellow** label with 4 digits. The user should enter this number in the setup of AudioTest.exe. This is important, since each headphone is calibrated individually.

Signalisation apparatus (19 * 13 * 6 cm)

Two pushbuttons **(1 and 2)** allow patient reaction when he hears a signal. The green LED **(3)** flashes after a button has been pressed during a recording session.
4 is an usb serial converter and **5** is the connector to an USB port.

This LED flash makes sure the patient presses the buttons deep enough.
Another advantage of the LED is that the patient doesn't focus his attention to the clicks of the PC mouse.

Some PC's generate noise. Do not place the patient next to them.

3 Technical data

Frequencies: 125, 187, 250, 375, 500, 750, 1000, 1500, 2000, 3000, 4000, 6000 and 8000 Hertz. Frequency accuracy is better than 0.1 percent. (!)

Intensity -10 at +85 decibels in steps of 5 dB. Precision of 1 decibel.

THD total harmonic distortion is less then 0.7 dB.
The headphone protects up to 30 decibels of environment noise.

FAQ

Is it possible to connect the headphone also to the speaker output, light green port of the PC ?

Yes and this will also work, but the calibration is not ok :
20 dB on one PC could be 30 dB on another PC.
Calibration by means of a decibel meter is then necessary, see further.

In the apparatus is an independent audio sound device incorporated.
This makes the dB level independent of the PC.

II Main Menu

Icons from left to right:

1 New record
2 View the selected record
3 Print
4 PDF
5 Image
6 Setup   (red circle) To do after a new installation.
7 Help
8 Quit

 Blue rectangle: search a record by name,first name, id number, birth date or part of it.(1).
Use the arrow keys and enter to select and view a record

In the list of records are displayed: name(10), first name(11), birth date(12)
and Id number(13) of the patient. The birth date is displayed with the year first : patients
can be sorted by their age.
14   File: each record has an unique name like 'year of birth_month_day_time.adf'
15 Mean total dB losses.
16 Mean dB losses at right side.
17 Mean dB losses at left side.

Important:

*It is possible to sort all the items ascending in the list view by clicking above them on name,
first name, birth date etc.
Clicking once more sorts them descending.*

Clicking **right mouse button** on the list of patients shows a **shortcut menu** with the most important options.
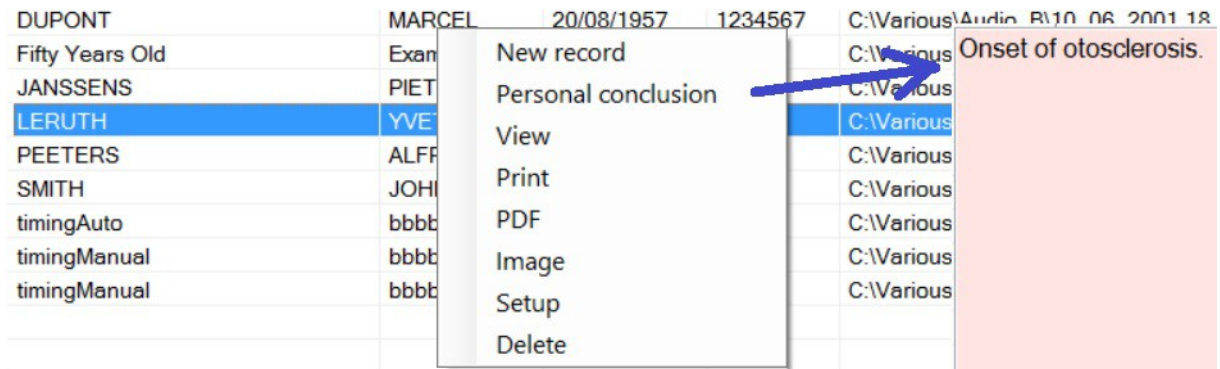
" Personal Conclusion " pops-up at right a Window with your personal conclusion(s)

The other shortcut menus correspond with the icons of the main menu.

Viewing a selected recording:

Four possibilities
  – View button of main menu.
  – Double click on a recording.
  – <Enter key> - <Enter key> once more quits the viewscreen.
    Pressing the <Enter key> twice gives a quick view.
  – Re mouse button shortcut "View"

How to delete a record ?

Select it and tape **'Del'** key**.**

III   Setup

1	**Taal-Sprache-Language-Langue-Lengua** ○ Nederlands ○ Deutsch ⊙ English ○ Français ○ Espagnol
2 - 3	Serial port: [COM4 ▼] <= Serial nr: [6114] ⇐ (COM5, COM3, COM4, COM9)
4	Directory C:\AudioTest ▼ [+] [-]
5 - 6	User(s) **Interface-launch AudioTest.exe from other program** ⊙ None ○ Arguments ○ XML ○ Data.txt
	Setup tones:
7 - 8	[Equalizer] [Automatic recording]
9	**Tone** ○ Pulsed tones
10	⊙ Continuous tone [3000] maximal signaltime
11 - 12	[OK] [Cancel]

1 Language

2 Serial port, comport

After connecting of the apparatus to an USB port, Windows assigns an unique number to it
Windows takes the lowest free number. This number is between 3 and 128. Often but not
always the highest number is that of the latest connected apparatus. It is very important to
select the right number, if not the software will not react when the patient presses a button
on the audiometer.
How detect the assigned number ?
Connect the audiometer and click on the **down arrow at right, in the red circle**.
A list will appear and indicate the existing comport numbers.
If you don't know the right number click **twice** on the down arrow, once with the apparatus
connected with the PC and once without the apparatus connected.
If no possibilities are displayed, then the USB drivers are not properly installed.
Window7, 8, 10 look automatic for driver updates.
After a first connection, the installation process may take several minutes.
Be patient and don't interrupt the process !
Never change this number, except when you move to a new PC.
If the software doesn't react to the button presses, the main reason is the accidental
selection of a wrong comport number.

3 Serial Nr

Enter here the 4 digit number that is located on a yellow label. This label is on the bottom of the apparatus.
This number contains the individually calibrated date of the headphone.
If you don't have an apparatus and want to **try the software**, enter **1234** here. In that case connect a stereo headphone to the light green speaker output of the PC.

4 Directory

Directory were the program works, retrieves and stores recordings.
This can be another directory then the installation directory.

At right a drop down-arrow and two buttons are visible.

With the **'+' button** the user can add up to 12 directories to a list.

With the **'-' button** the user can delete a directory from the list.

The directory itself is not removed from the hard disk.

*With the drop down-arrow switching between the different directories of the list
is easy.*

Network use

Different users connected by a network can store and retrieve all their recordings
on the same shared server directory.
The software is not protected again copying.
In case of network use, install the software on all workstations.
With Setup - **"Dir"** select a shared network directory, entered with '+' button.
(example: //Servername/Audiometry2019)

4 Setup – Users

This option makes it possible to enter your title and name.
PDF, print and image will show it.

Solo user :

Replace "user1" by your name.
If there is only one user, leave the settings "User2" in place. !

Multiple users:

If there is more than one user on the same , you have to select the user name on start of
program. Afterwards, you can always see who performed the examination.

5 Setup – Interface

When the program operates stand alone, **leave 'None' selected.**
The intention of the other options is when the program is launched from another one. See
further 'Integration'

6 Setup - Equalizer

The software is installed with the values that correspond to the serial number of your headset and USB sound device. Modification is only necessary if you change headsets.
In that case you need to use a decibel meter, sound level meter to calibrate.
If you use the headphone delivered with the apparatus, don't change the settings of the equalizer !

The human hearing is not equally sensible at all frequencies. Especially on low and high frequencies the sensitivity is lower. A headphone gives also not equal response on all frequencies. The higher frequencies may show up to 10 dB difference between both sides.

The equalizer screen shows all available frequencies, right and left.
Calibration up to a single decibel is possible by means of the vertical potentiometers.
Below of the potentiometers the dB corrections for each frequency and side are displayed.
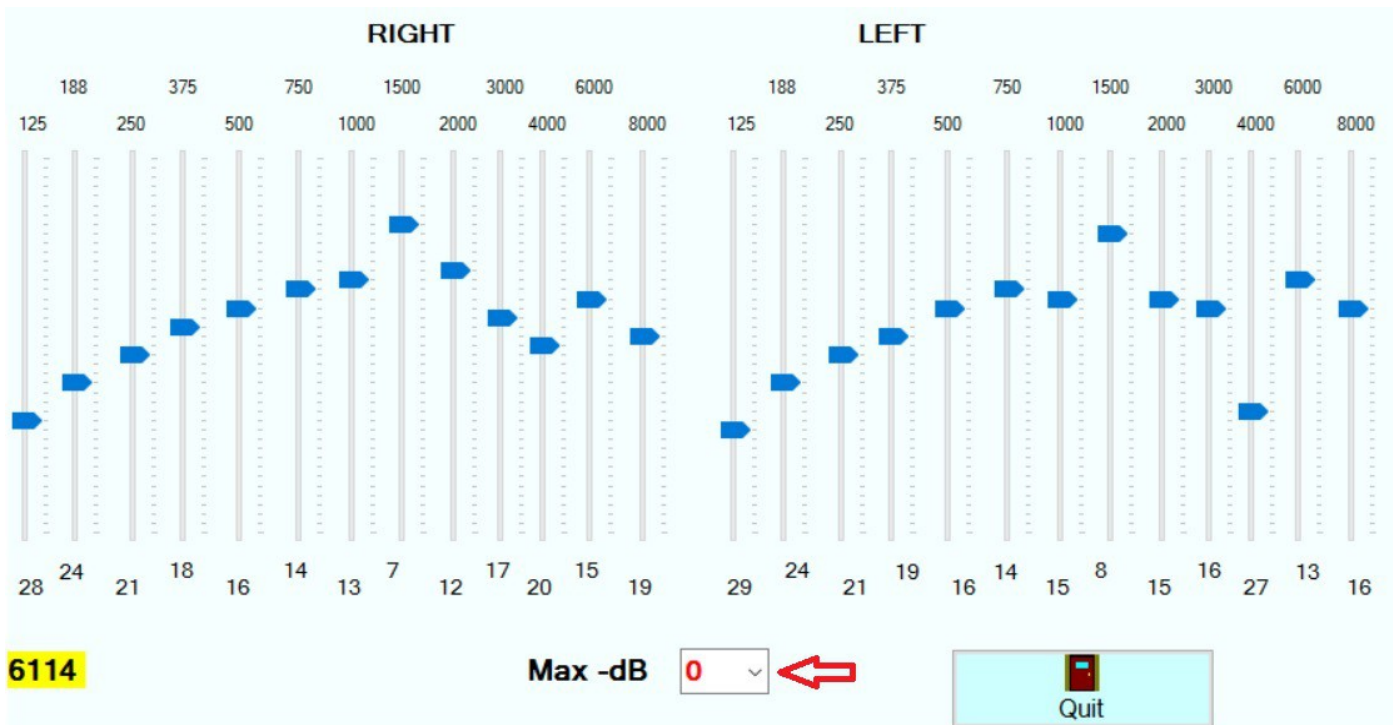
Left below the serial number of the headphone is displayed.
The combo box 'Max – dB' contains a range of 0- 24 dB attenuation in 2 dB steps that apply to all frequencies.
The button 'Quit' saves the equalizer data in the file CalibrationData.fil.

Calibration with a sound level meter - decibel meter

Verify in the setup that continuous tone, long enough, eg 5000 msec is selected.
Place the meter between the headphone as above.
Go to the recording screen. Start eg with 1000 Hertz and **60 decibels** at right.

Suppose that the decibel meter displays 51 decibels. With the equalizer add 9 decibels on 1000 Hertz at right. Verify again and adjust until value between +-1dB. As most audiometers and also our software operates with steps of 5 decibels, it is often assumed that calibration up to a precision of 2 decibels is OK.
If one intensity of a given frequency is correct than the other intensities of that frequency are also correct.

Why not calibrate on 0 decibels ?
Even a silent room has already a noise level of >30 decibels.
Most meters start to measure from 40 decibels.

Why not calibrate on 85 decibels ?
Some margin is necessary for calibration, in particular for the lowest and highest frequencies. On these frequency you could not emit the full 85 dB.

7 Setup – Automatic recording.

Frequencies

For screening purposes 500, 1000, 2000 and 4000 Hertz are enough.
For people, older then about 70 years it is even better to not include 4000 Hertz.
A modified 'Hughson-Westlake' protocol is used. Examination starts at 35 dB. Afterwards, intensity is decreased by 10 dB in case of correct response, increased by 5 dB in case of no response. +5 -10 protocol.
If three reactions on the same intensity are reached, next frequency is examined.

Arbitrary sequence

 When not checked the examination starts with examination of the selected frequencies of the left ear, then the right ear.
Order is 1000, 2000, 4000, 8000, 500, 250, 125 Hertz. (Starting with lowest frequencies would lead to 'ear fatigue').

When 'Arbitrary sequence" is checked, all frequencies are examined in random order.
The advantage is that the patient cannot anticipate.

Correct reactions

It is possible to select here that only 2 reactions are required. This advances much quicker.
After the automatic test, it is possible to examine further manually.

Automatic recording goes as follows:

The software starts with 35 dB on one of the selected frequencies (arbitrary sequence)
or on 1000 Hertz left (fixed sequence)
If patient doesn't press the correct button, 35 + 5 = 40 dB is emitted.
In case of correct reaction, 35 – 10 = 25 dB is emitted.
The Hughson Westlake protocol is often called +5 -10 protocol.
As soon as there are 3 (2) reactions on the same intensity of the frequency, the next
frequency is examined.
Each frequency requires about 14 patient reactions.
When, after emission of 22 sounds, there are not yet 3 (2) reactions on the same intensity,
the software continues with next frequency.

After the automatic examination, additional manual examination is possible.
Examination of additional frequencies becomes easier.
The adjacent levels gives an indication of the level to expect.

8 Setup – Pulsed tones.

Default 3 pulses with duration of 200 ms and pause of 200 ms are used.
Other selections are possible. Number of pulses between 2 and 6.
Adjustment of pulse and pause duration.

9 Setup – Continuous tone

Duration of the sound emission in milliseconds. 3 seconds = 3000. This is long enough for
most patients. When the patient presses a button or the user emits another level, the original
tone stops.

What is better, examination with pulsed tones or continuous tone ?
Double blind examinations do not show an important difference.
A mean difference of about 2 dB in favour of pulsed tones exists.
Probably this is because pulsed tones result in less exhausting.
Most patients seem to prefer pulsed tones.
On the contrary, some users prefer continuous tones.

10 Setup – OK   Setup is saved in the file AudConfig.xml

11 Setup - Cancel Stops setup without saving changes !

IV   Record.

1 Manual recording

Ask the patient to push on the right button if he is **sure** to hear a tone in his right ear, and to push on the left button if he is sure to hear a tone in his left ear.
Ask patient to use **both hands**.
Tell the patient that after pressing a button in relation with a sound, the green LED will flash. The attention of the patient is then focused on the LED and not on the mouse clicks. This could influence the examination. It is even better when the patient has no possibility to see the mouse or the PC screen. Use a silent mouse or touchpad.
Put the headset on the patient his ears. (R) on his right ear, (L) on his left ear.
Click then on the leftmost icon of the main menu "Record".

	Patient
1	Previous Clear
3	Name Smith
4	Firstname John
5	Birthdate 28 ∨ 02 ∨ 1970 ∨ ☐ mm-dd-yyyy **6**
7	Id number 8820
8	Sexe (M or F) ◉ M ○ F
9	OK Cancel

 1 Previous : data of previous patient. If the patient had already a record,
    look first at that record and use this button to take over the same data.
 2 Clear all
 3 Name of the patient
 4 First name
 5 Birth date in format   mm dd yyyy
 6 Checking switches birth date to mode   dd mm yyyy
    The year of birth is mandatory with 4 digits. By doing so patients can be sorted by age.
 7 Id number
 8 M(ale) or (F)emale
 9 Go to the recording screen.
10 Cancel = return without doing anything.

How to proceed.

Click with the left mouse button on the screen to generate the corresponding sound.
Start with a tone that the patient will probably hear, like 40 dB and 1000 Hertz.
During the emission of the sound, at right below of the screen a red rectangle appears.
If the patient doesn't react, click on a higher intensity.
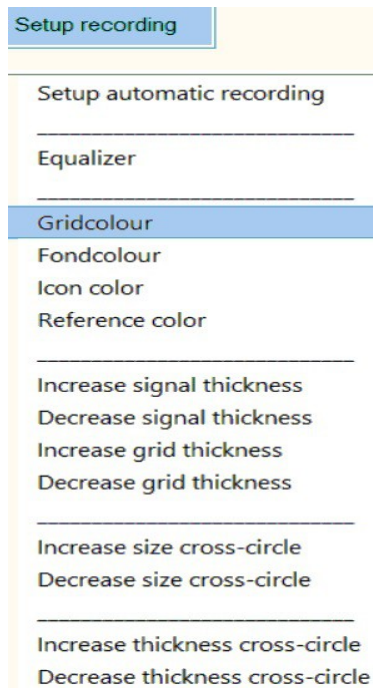If the previous sound is not yet finished, the actual sound stops.
A minimal pause of 800 ms between the sounds is necessary.
This is necessary for debouncing of the mouse clicks.
When examination is finished, verify at right of the screen: name, first name,
date of birth and number. Enter your personal conclusion. Save **(8)**
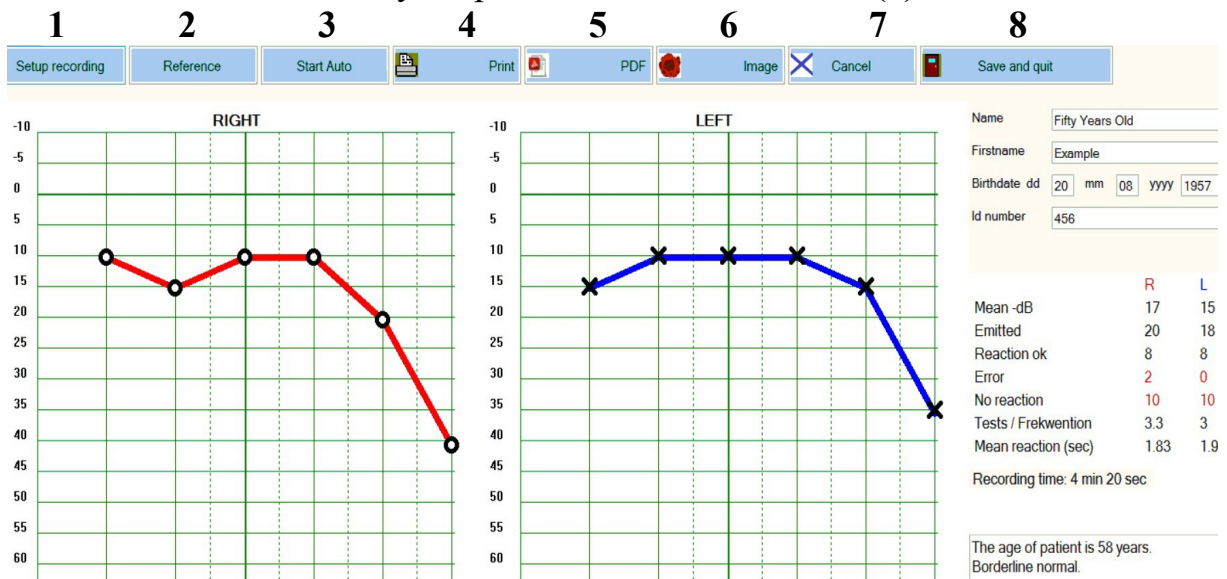
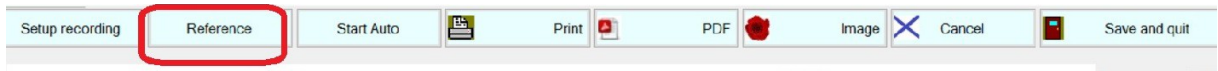
Leftmost icon "**Setup recording (1)**"   shows **:**

Equalizer :
When calibrating with a decibel meter, it is easy to reach this option without the need to leave the recording screen.

All this options are easy to understand.

2 Manual record - 'Reference'

This button becomes only visible if you loaded another recording by viewing at it. So, in case the patient had already a previous examination, before a new recording, keep a look at it. When you click then 'Reference' in the recording screen you have the opportunity to use the previous recording as a guide.
This can speed-up a manual recording very much !

Even when the patient doesn't have a previous recording, the reference button can help.
An example will clarify:
you want to examine a new patient of 80 years old. Use then the recording of another patient of about the same age
(Dupont Philemon in the examples is 80 years old)
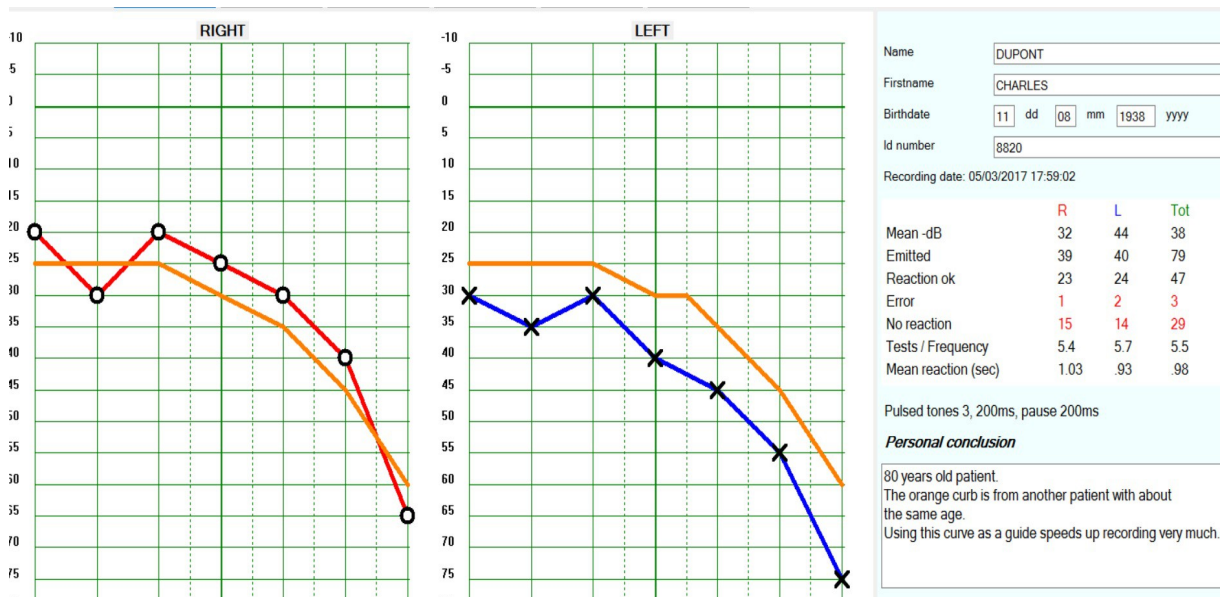
The orange curb is from another patient with about the same age.
Using this curb as a guide speeds up recording very much.

Detail of the recording screen at right

this is about the same as the detail of the view screen.

| Birthdate dd | 20 | mm | 08 | yyyy | 1957 |
| Id number | 456 | | | | |

	R	L	Tot
Mean -dB	17	15	16
Emitted	20	18	38
Reaction ok	8	8	16
Error	2	0	2
No reaction	10	10	20
Tests / Frekwention	3.3	3	3.1
Mean reaction (sec)	1.83	1.9	1.87

Recording time: 4 min 20 sec

Mean dB loss right, left, total
1 Total number of tones
2 Correct button pressed
3 Button of wrong side is pressed
4 No reaction
Number of tests / frequency
Mean reaction time in ms.
Remark   1 = 2 + 3 + 4

The age of patient is 58 years.
Borderline normal.

3 ERROR = button pressed on wrong side.

This is an important indicator of the reliability of a test.
Classic audiometers do not have this possibility.
If more then about 3 errors or 10 percent, instruct the patient again and repeat the test.

The most important instructions were:
1 the patient should use both hands.
2 press only one of the buttons, when the patient is sure to hear the sound.

 A high number of 'no reaction' eg 50 % is fine, you examined carefully.

3 Automatic recording

With this option the software will automatically examine the patient.
Configure first with Setup - Automatic.

Automatic examination takes more time then manual examination.
For a single frequency and ear, about one minute is necessary.

So, to not exhaust the concentration of the patient, its often better to
examine only some frequencies automatically. (eg 500, 1000, 2000 and 4000)

Afterwards, it's possible to continue with manual recording.
Interpolation between the automatic founded values will aid.

To start click on 'Start auto'. This button changes then to 'Stop auto'.

Interruption is possible with 'Stop auto', but wait until the actual tone is
finished before continuing manually.

Each frequency requires about 14 patient réactions.
If no result after 22 sounds on a particular frequency, not yet 3(2) reactions on the same
intensity, the sofware continues with the next frequency.

Other self explanatory options of the recording screen are:

4, 5 and 6   Print, PDF or image generation.
**7 Cancel,** attention. The recording screen is quitted without saving !
8 Save and quit. Not only the recording is saved, but also possible changes to the personal
data of the patient and your personal conclusion.

V.   VIEW a record. (icon 2 of the main menu)

On the main screen, select a record and click on the view icon or 'enter button'
This screen is about the same as the recording screen.
However recording is not possible on this screen !

It's possible to change your personal conclusion.
If you made an error in the personal data of the patient, it can still be changed.

The view screen has as extra option the button '**Previous'** :
the previously **viewed (!)** signal is also displayed and you can compare two recordings on screen:
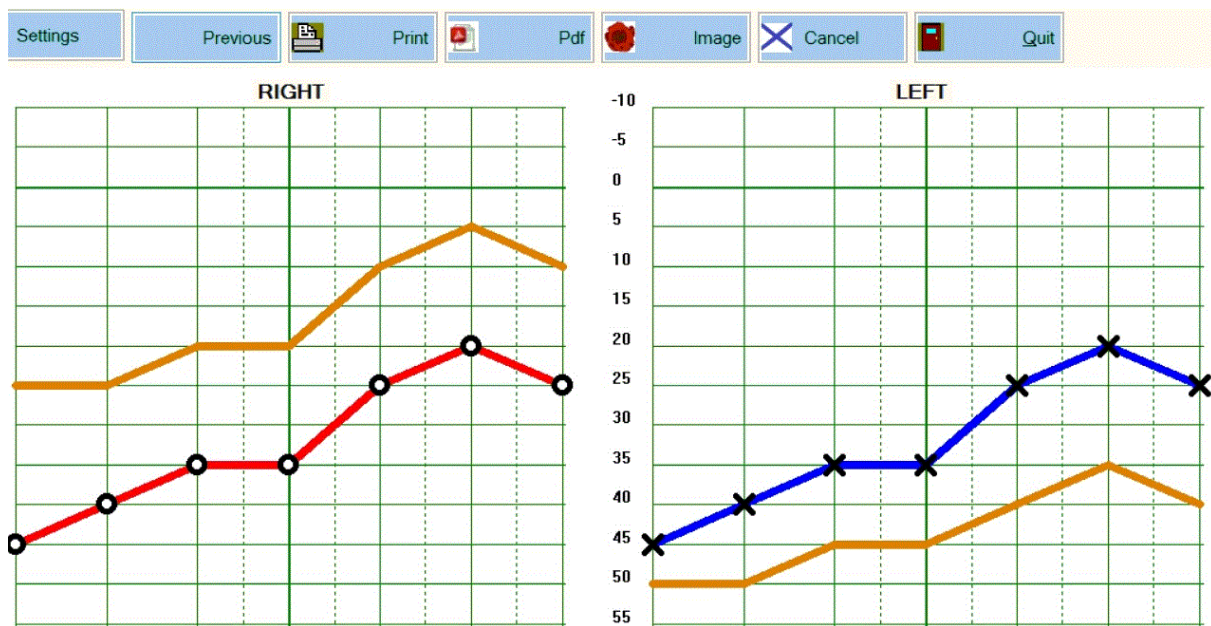
With 'Setting' left above, it is possible to adapt the screen on your personal taste.

VI PDF, print and image generation.

PDF :

Filename. The software purposes   "date_time_record.pdf"
It is possible here to enter another name with the extension .pdf

Password: leave empty if you don't want to protect with a password.
However a password is mandatory when you send a file with personal data as mail attachment.

*** 3 possibilities for the filename: date_time.pdf, name_firstname.pdf and both. The intention is to make the location of the file possible, in case you want to incorporate it in another program.

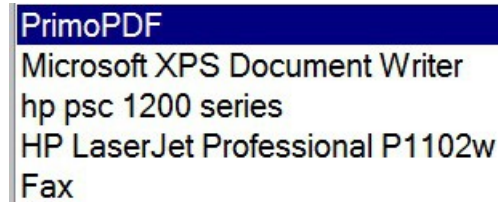**"Setup"** makes fine tuning of the output possible.

"Default" restores the original settings.

"Start" starts the PDF generation.

"Quit" leaves this screen.

Print: output on A4 paper.

Has about the same possibilities as PDF generation. If different printers are installed, it is also possible to select the wanted printer.

PrimoPDF
Microsoft XPS Document Writer
hp psc 1200 series
HP LaserJet Professional P1102w
Fax

Don't overlook the possibility to print and mail also from other programs like your favourite text editor. Copy and paste the viewscreen in the editor with Alt – Print screen and Ctrl-V or Shift - Insert
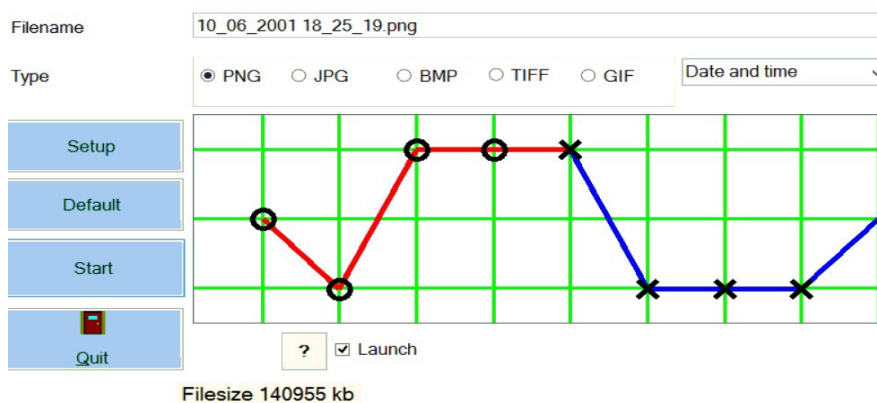
Image generation

 Also the same possibilities as PDF.
It's good to know that image generation is very quick, less then a single second.
The most current graphical data formats are supported.

 PNP, TIFF and GIF are the most compact.
BMP needs a lot of memory, is included only for completeness.

It's possible to send an image file as attachment with a mail, protected with a password.

VII   Integration - FAQ

Integration

Starting from a patient program it is possible to start the Audiometer software directly. The advantage is that it is not necessary for the user to retype the name, first name, birth date and ID of the patient. Select with **setup – interface** one of this three possibilities:

Arguments
Start the Audiometer program with parameters name, first name, birth date and ID. Name and first name can be in different parts and must be put between " "
. Start our software with arguments. Ask your software developer to write in its code one single line like this:
Process.Start('C:\AudioTest\AudioTest.exe "SMITH" "JOHN" 20/08/1951 123');
AudioTest.exe executes and places itself on the patient SMITH JOHN if he is present. If the patient is not yet available, start a new recording of him.

Testing of this possibility is easy. Enter the following line in the Windows - Start ->
Execute (or Win-R keys)
C:\AudioTest\AudioTest.exe "SMITH" "JOHN" 20/08/1951 123

XML
By means of a file with name ident.xml.

Data.txt
If your program has the possibility to generate a text file.

.XML and Data.txt are less used then "Arguments"

Reverse integration

Data of the last loaded *.adf file are exported to an xml file with the name **Protocol.xml,** located in the working directory.

A software developer can capture this file and incorporate the data into its own software.

Import of a pdf or image file is also possible.

FAQ

Help - no sound.

When the user clicks on a loud enough sound and no sound comes out of the headphone, the most common causes are:
- The headphone is not properly connected to the apparatus.
- The headphone or extension cable are not deep enough plugged in.
- Right and left are interchanged.
- Maybe an error in headphone or the extension cable : test them on any other
   stereo audio apparatus.

Pressing right or left signal button gives no reaction on screen.

Wrong choice of serial port – comport number.
Verify with Setup - Comport down arrow, see setup. A wrong choice will not harm your PC but the button presses will give no reaction on screen.
After installation of other **new software,** no reactions on screen.
The new software occupies your serial port even when the software of it is not in use.
Mark in the setup of the blocking software to not use the serial port.

Remark about auto examination.

The purpose of the apparatus is examination of a patient. The patient is located on the opposite site of the user. When the user tries to examine his own, he may not forget that right becomes left and that left becomes right.
It seems obvious to mention this, but in fact this gives confusion to some users.

How to make a backup ?

Copy directory C:\AudioTest and content to another location like a CD, USB stick, external hard disk, other PC of the network, the cloud etc.
This is enough for a complete backup. No files are installed in other directories or in the Windows directory.

New PC– How to move the audiometry *.adf files to a new PC.

Three possibilities:

A/ Install the program again from CD-ROM and copy the old *.adf files to the
 installation directory on the new PC.

B/ Download the newest version on our site www.ganseman.com   Unzip and execute
SetupAudioTest.exe. Copy the old *.adf files to the installation directory on the new PC.

C/ Copy the directory C:\AudioTest and content to the new PC.

Option C/ demands **sometimes** installation of the driver for the USB-serial converter. The
driver is located on the CD in dir \driver and on our website in CDMUSB.zip. Download,
unzip. Execute 'CDMUSB.exe' once.
This seems to do nothing.
Afterwards plug the converter in the pc and wait long enough.

Before recording, go to the setup and make the
correct **comport choice**: see Setup section.

If you have many thousands of audiometry recordings in the directory, start of
AudioTest.exe could take a couple of seconds.

In that case, copy the *.adf files to another directory like   C:\AudiometryOld