

Instructions for use

AT-research / AT2000



CE 0123

Preface

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Version: 1.07 - Status: 10.03.2026

Underlying software name: **Audiometersoftware**

Underlying software version: **1.0.15.1**

Audiometer

Model number:

Serial number:

Date of purchase:

Location:

Version overview

Status	date	Comment	Processor
1.07	10.03.2026	The following chapters have been updated (text): 2.2 Product description 3.3 Software requirements 3.5 Update of audiometer software 4.1.1 Keyboard (shortcuts) 5.2 Speech audiometry 6.2.1 Searching for a patient 6.6 Shortcuts 8.5 Further functions 8.6.4.3 Tinnitus 10.5.5 Comments 10.9.4 Dichotic tests 10.10.1 Mainz children's songs 10.10.2 Göttingen sounds 11.1.3 Additional functions 11.1.5.6 Comments 13.2.2 Free speech test settings 15.4 List of all Westra speech tests 21.1.3 Basic settings – general speech audiometry 21.2.1 Tone audiometry 24.3.1 Safety inspection / VDE test – STK The following chapters have been added: 4.1.2 Operation without control panel 6.4.2 Merge dataa 6.4.4 Show comments 8.6.4.7 Békésy sliding frequency 8.6.4.8 Langenbeck 8.6.4.9 Hearing loss according to the Röser table 8.8.4 Langenbeck test 8.9 Automatic tests 8.10 Other tests 10.11.4 Images 20 ERKI 21.1.5 Basic settings – hearing loss 21.2.4 Automatic tests Screenshots have also been updated.	Ananth Rasaratnam Stephan Meier
1.06	13.06.2025	The following chapters have been updated (text/screenshots): 4.1 Control elements 7 Test selection 8 Tone audiometry 10 Speech audiometry 20 Settings 24.4 Care instructions The following chapters have been added: 11 Regiometry 12 Multichannel audiometry 13 Free audiometry – applies only to AT-research 14 Oldenburg measurement programmes 15 WESTRA 16.2 Avantgarde 18 Implants 19 Trainshow 23 Database-Tool 24.8 Tutorials	Ananth Rasaratnam Leif Jensen Stephan Meier

Version overview

Status	date	Comment	Processor
1.05	30.04.2025	Adaptation of screenshots	Ananth Rasaratnam Stephan Meier
1.04	23.04.2025	Adaptation of screenshots	Ananth Rasaratnam Stephan Meier
1.03	01.04.2025	Adaptation of screenshots	Ananth Rasaratnam Stephan Meier
1.02	21.03.2025	Adaptation of screenshots	Ananth Rasaratnam Stephan Meier
1.01	10.03.2025	Adaptation of screenshots	Ananth Rasaratnam Stephan Meier
1.00	05.03.2025	created	Ananth Rasaratnam Stephan Meier

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Ownership and the right to use the software may only be transferred to a third party if

- a) the installed software and any further stored data are deleted, the third party agrees to the provisions of this agreement in writing to **AURITEC medizindiagnostische Systeme GmbH**,
- b) all contractual objects belonging to the software are transferred together with all accompanying written material and
- c) the transfer includes the latest updated version of the software together with all previous versions.

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AURITEC medizindiagnostische Systeme GmbH warrants to the original contractual partner that at the time the software is handed over, the data carrier on which the software is recorded and the programme description and instructions for use handed over together with it are free of significant errors under the assumed operating conditions.

Due to the large number of data and operating constellations that occur in practice, as well as operating errors, **AURITEC medizindiagnostische Systeme GmbH** does not guarantee complete freedom from defects. A software error does not exist if the programme function concerned works on the recommended hardware constellation. If the data carrier and / or the programme description and instructions for use provided with it are faulty, the contractual partner may demand a replacement delivery during the warranty period of 6 months from delivery. For this purpose, the data carrier including the backup copy and / or the programme description and instructions for use must be returned to **AURITEC medizindiagnostische Systeme GmbH**.

If **AURITEC medizindiagnostische Systeme GmbH** a reasonable grace period with the declaration that the replacement delivery will be rejected after expiry of the grace period.

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The warranty does not cover the rectification of faults and/or liability for damage caused by external influences, operating or maintenance errors. This depends on the information in the programme description and the instructions for use.

No warranty is assumed if the contractual partner / user uses the software for a purpose other than that specified above.

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Furthermore, **AURITEC medizindiagnostische Systeme GmbH** is not liable for the recovery of data. It is the responsibility of the contractual partner / user to take care of any reconstruction in the event of loss.

Furthermore, **AURITEC medizindiagnostische Systeme GmbH** shall only be liable for damages caused by intent, gross negligence or the absence of warranted characteristics.

The indispensable liability according to the ProdHaftG remains otherwise unaffected.

2 Introduction

2.1 Manufacturer information

<u>Device:</u>	AT-research / AT2000
<u>Manufacturer:</u>	AURITEC medizindiagnostische Systeme GmbH Dernauer Straße 12, 22047 Hamburg, Germany
<u>Authorised representative:</u>	AURITEC medizindiagnostische Systeme GmbH Dernauer Straße 12, 22047 Hamburg, Germany

2.2 Product description

The audiometer **AT-research / AT2000**, Class I/II, is a PC-controlled audiometer. The modular design enables configuration to meet current measurement requirements. Future-orientated and cost-effective system expansions are possible.

The audiometer is operated via a control unit that meets audiometric requirements. The measurement module is controlled via software specially developed for the audiometer, which runs under the Windows 11 operating system.

The system offers the option of audiological measurement data storage and data transfer to the electronic patient file or a data network.

2.3 Intended use

The **AT-research / AT2000** is designed for the detection and diagnosis of suspected hearing loss.

The results can be used for further test procedures.

Performance and specificity for this type of device are based on user-defined test characteristics and may vary depending on environment and operating conditions.

The diagnosis of hearing loss with this type of diagnostic audiometer depends on the co-operation of the patient. For patients who do not respond positively to individual tests, the user should consult additional assessment methods. If sensitivity is suspected, a complete audiological examination should be performed.

Tone audiometry:

Tone audiometry is used to generate and adjust test tones of different frequencies with presentation via acoustic and mechanical transducers.

The hearing threshold of the air conduction is determined using headphones and the hearing threshold of the bone conduction is determined using bonephones. A hearing impairment is localised using supra-threshold test methods, for example in the middle ear, cochlea and retro-cochlear damage.

Speech audiometry:

Speech audiometry is used to determine the hearing loss for speech and to determine the intelligibility of speech. Various speech tests are used for this purpose

Intended operator: Trained personnel such as audiologists, hearing aid acousticians or trained technicians.

The staff is trained. The "Handover protocol" document is completed during the briefing.

Intended population/patient selection

The test procedures of the **AT-research / AT2000** require the patient to be able to provide feedback/reaction to the signals heard. The feedback can be provided via an aid (touch screen, button), gestures, facial expressions or speech. The doctor / operator must assess whether the patient is able to provide this feedback. This applies in particular to vulnerable groups of people, such as babies and small children up to the age of 4 and other people with physiological or psychological impairments. There are no other restrictions on the part of the device.

Patient target group:

ENT university clinics, research / science (**AT-research**)

ENT university clinics, ENT care hospitals, ENT hospitals, ENT medical practices, CI centres, occupational physicians, hearing aid acousticians, paediatric audiology advice centres, schools for the hearing impaired (AT2000)

Indications: Suspected hearing loss, sudden hearing loss, ringing in the ears such as tinnitus, suspected hearing impairment, dizziness, noise exposure

Contraindications: As the **AT-research / AT2000** is a non-invasive medical device, there are no contraindications.

2.4 Privacy policy

General information

The EU's General Data Protection Regulation (GDPR) came into force on 25 May 2018. Personal data is therefore subject to stricter security regulations.

Person responsible for the personal data

Your customer database does not contain any customer data on delivery and is therefore automatically GDPR-compliant. When you create the first customer, you start entering personal data into the system and are responsible for compliance with the GDPR rules. In GDPR parlance, you are the data controller.

AURITEC medizindiagnostische Systeme GmbH is not responsible for compliance with the GDPR and for the security of your data. **AURITEC medizindiagnostische Systeme GmbH** does not have access to the stored data at any time without your consent.

Support with the implementation of the GDPR

Chapter 3 of the General Data Protection Regulation sets out the rights of the data subject (the patient).

According to Article 15, every person has the right to access all data concerning them. You have the option of creating a printout of all of a patient's stored data in the software.

According to Article 16, the data subject has a right to rectification of incorrect data. It is possible to change the stored patient data in the software at any time.

The right to be forgotten, which is explicitly mentioned in the title of Article 17, is one of the central rights of the GDPR. On the one hand, it means that a data subject has the right to request the erasure of all data concerning them if the reasons for storing the data no longer apply. On the other hand, the processor must also actively delete the data itself if there is no longer a reason for storing and processing it. The deletion of patient data is provided for in the software. Please also consider any existing backup copies.

2.5 Service life

The service life of the audiometer is set at **10 years**. This does not apply to consumables.

2.6 Labels

The labels refer to the labels that can be found on the appliance.

Explanation of the notes:

Please note!



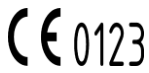
Failure to observe this warning may result in incorrect measurement or damage to the appliance if used incorrectly.

Warning!



Failure to observe this warning may result in imminent danger which could lead to injury to the user or patient.

2.6.1 Inscriptions



The **AT-research / AT2000** is labelled with the CE mark in accordance with the Medical Devices Directive. The identification number belongs to TÜV Süd.



The **AT-research / AT2000** is labelled with this symbol to indicate compliance with the requirements of EN 60601-1 with type BF applied parts.



This symbol requires the user to observe the corresponding warnings in the accompanying documents or in the instructions for use.



Information on the manufacturer of the device



Information on the date of manufacture of the device



Serial number of the device



Manufacturer reference number (article number)



Medical Device



Do not dispose of the appliance with household waste.

2.6.2 Safety instructions

The safety instructions in these instructions for use do not relate exclusively to the safety of patients and users, but also to the safety of the components of the **AT-research / AT2000**



The device **AT-research / AT2000** may only be used for the purposes described in the instructions for use. The instructions for use contain important information and instructions. It is essential that you are familiar with the operating instructions and follow the information and instructions when using the device.



The device may only be operated by trained medical personnel.

The instructions for use are not a substitute for specialised audiometric training. Such specialised training is a prerequisite for using the software. Please refer to the applicable regulations: **DIN ISO 8253 Part 1-3 - Audiometric test methods**.



Please refer to the Medical Devices Operator Ordinance (**§11 MPBetreibV**) with regard to the safety measures for maintaining device and measurement safety.



The correct installation of the audiometer requires a suitable, medically usable room.

Do not place this appliance on an unstable trolley, stand or table. The device could fall and be seriously damaged. The audiometer must be set up in such a way that sufficient ventilation is provided. It should always be placed on a firm surface and should not be covered. The minimum distance between the subject and the device should be one metre.

Please contact our medical product consultants for the right location.



Before each use of the device on test subjects, a functional check and test for mechanical integrity must be carried out.



The specified calibration accuracy applies to an ambient air pressure of 98 kPa to 104 kPa. If the ambient air pressure is regularly outside this range, the calibration must be carried out under the local ambient conditions.



Please also observe the safety instructions in the manuals of the products supplied by other manufacturers, e.g. notebook, printer, monitor, etc.

The greatest possible care has been taken to ensure the handling and correctness of these instructions for use. These instructions for use and the use of the audiometer **AT-research / AT2000** require a certain degree of familiarity with Windows. We recommend that you familiarise yourself with the user interface of your operating system before you start using your audiometer measuring station **AT-research / AT2000**.



The audiometer software AT-research / AT2000 forms a unit with the audiometer module. If third-party software is installed on the PC in addition to the control software AT-research / AT2000, this installation must be authorised or released in writing by the company AURITEC medizindiagnostische Systeme GmbH. If this authorisation or release has not been obtained, this is considered to be a third-party intervention. No liability can be accepted for any errors or damage that may occur. Warranty claims no longer exist.

2.6.3 Switch off the appliance before cleaning



Disconnect the appliance from the socket before cleaning it. Do not use any liquid cleaners or sprays. Use a damp cloth for cleaning.

2.6.4 Pulling out the plug

Please observe the following instructions when connecting or disconnecting power cables to or from the appliance:

- Connect the device to the mains cable before connecting the mains cable to the mains socket.
- Disconnect the mains cable from the mains socket before removing the mains cable from the appliance.
- If the system has multiple power sources, disconnect the power supply to the system by disconnecting all power cables from the devices.

2.6.5 Warnings



Only use stimulus levels that are tolerable for patients.



The sound transducers supplied with the audiometer, e.g. headphones or bone conduction headphones, have been calibrated on this audiometer. Replacing one of these transducers requires recalibration on the audiometer.



Connecting other devices to this system may result in safety regulations no longer being complied with.



If this system is electrically connected to other ME devices, the CE marking is only valid if the supplier certifies with a declaration of conformity that conformity exists for the entire system.



Use of this appliance adjacent to other appliances or stacked with other appliances, other than products authorised by the manufacturer, should be avoided as this may result in incorrect operation.



The use of components, transducers and cables other than those specified or provided by the manufacturer of this device may result in increased electromagnetic emissions or decreased electromagnetic immunity of the device and result in improper operation.



Portable RF communications equipment (including its components, such as antenna cables and external antennas) should be used no closer than 30 cm (or 12 inches) to any part or cable of the **AT-research / AT2000** specified by the manufacturer. Failure to observe this can lead to a reduction in the performance characteristics of the device.



Do not use the appliance near water.



The appliance may only be operated in dry rooms.

Do not use the appliance if liquids have got inside the housing, as this can lead to short circuits inside the appliance.



Slots and openings are used for ventilation; this guarantees reliable operation of the appliance and protects it from overheating. These openings must not be blocked or covered under any circumstances. Do not cover the openings by placing the appliance on a bed, sofa, carpet or similar surface. Under no circumstances should the appliance be placed near a heater or radiator or installed in an enclosure unless adequate ventilation is provided.



Never insert any objects through the housing slots, as this may touch or short-circuit parts with dangerous voltage, which may result in fire or electric shock. Never spill any liquids on the appliance.



To avoid damaging internal components, do not place the product on a vibrating surface.



Strong electromagnetic fields can cause unwanted sound radiation in the transducers. Such sources of interference can be radiation therapy devices or mobile phones, for example. To ensure interference-free operation, such devices must be kept away from the **AT-research / AT2000**.

2.6.6 Use of mains power



The appliance should be operated with the type of power indicated on the corresponding label. If you are not sure of the available power source, contact your service partner or local electricity supplier for advice.



Do not place any objects on the power cable. Do not place the device in a location where people could step on the cable.



If you use an extension cable for the appliance, make sure that the total current consumption of the appliance connected to the extension cable does not exceed the maximum permissible current of the extension cable. Also ensure that the total value for all devices connected to the mains socket does not exceed the value for the electrical fuse.



Do not overload the mains socket, the multiple plug or the junction box by connecting too many devices. The total charge of the system must not exceed 80% of the power of the branch circuit. If you are using a multiple plug, the charge should not exceed 80% of the input power for the plug.



Only use the mains cable intended for the appliance. The maximum length is 3 metres.

2.6.7 Maintenance of the product

Never attempt to repair this appliance yourself, as opening or removing the covers may expose you to parts with dangerous voltage or other risks. Refer all repairs to a qualified technician. Opening the appliance will destroy the seal sticker and invalidate the warranty.

Under the following circumstances, disconnect the appliance from the mains socket and leave the repair to a qualified specialist:

- The mains cable or plug is damaged or frayed.
- Liquid was spilt over the appliance.
- The device has been exposed to rain or water.
- The device has been dropped or the housing has been damaged.
- The performance of the appliance deteriorates considerably, so that a repair is necessary.
- The appliance will not work properly if it is operated according to the instructions.



Only change the settings that are described in the operating instructions, as changing other settings incorrectly can lead to damage that requires extensive repairs by a qualified technician to restore the appliance to its normal state.

2.7 Measuring conditions

Audiometry should be carried out in a quiet room in order to minimise the influence of background noise on the audiometric measurements. Electromedical devices that emit strong electromagnetic fields can impair the function of the audiometer and must therefore not be operated in the immediate vicinity.

Make sure that there is no hair between the receiver and your ear. Spectacle wearers should remove their glasses for measurement. Place the headphones on the correct side. The side marked in red is on the right and the side marked in blue is on the left.



For reasons of hygiene, it is important to clean the ear pads of the headphones after completing the measurements on the patient.

2.8 Packaging, transport, storage

The audiometer will be delivered to you in a cardboard box provided for this purpose. It is advisable to store the packaging. The original packaging is helpful in the event of a defect or maintenance that needs to be carried out by post and prevents any damage during transport.



Please check the box and contents for damage and completeness immediately after each dispatch or transport and notify the transport company of any defects without delay.



It is advisable to allow the appliance to acclimatise to room temperature for at least half an hour after transport before using it.



If the device is to be temporarily stored or transported, please ensure that the storage room or vehicle is dry and that the temperature during storage is within the range of -20 to + 60°C. This applies to both packaged and unpackaged devices. This applies to both packaged and unpackaged devices.

2.9 Notes on disposal

The audiometer **AT-research / AT2000** fulfils the RoHS-II according to the EU directive 2002/95/EC and the respective necessary laws.

In addition, the audiometer contains electronic components, cables, metals, plastics, etc. and must be disposed of in accordance with the applicable environmental regulations of the respective country. In Germany, the disposal of the product is subject to the Elektro-G and in Europe to EU Directive 2002/96/EC or the respective national legislation.

Do not dispose of this electronic device in your household waste. Please contact your local authority to find out which waste disposal companies can dispose of the device properly in accordance with WEEE and local regulations.

2.10 Manufacturer's liability

The manufacturer is only liable for the safety, reliability and scope of performance of the device if the following conditions are met:

- ✓ Installation, extensions, new settings, modifications and repairs may only be carried out by specialist personnel authorised by the manufacturer.
- ✓ The mains supply to which the appliance is connected must comply with local IEC regulations. Please consult your local electrician.
- ✓ The appliance may only be operated in accordance with the operating instructions.

The manufacturer reserves the right to decline all responsibility with regard to the safety, reliability and operation of the appliance if it has been repaired, maintained or modified by a third party.

2.11 Tips and information for convenient use

Computer users can suffer from eyestrain and headaches when using computers for long periods of time. Users also expose themselves to the risk of physical damage when working on a computer for long hours. Long working hours, incorrect sitting position, poor working habits, stress, inappropriate working conditions, personal condition and other factors can increase the risk of physical harm.

If the audiometer is operated improperly, carpal tunnel syndrome, tendonitis, tendon sheath inflammation or other musculoskeletal disorders may occur. The following symptoms may occur in the hands, wrists, arms, shoulders, neck or back:

- Numbness, burning or tingling sensations
- Sore muscles, pain or tenderness
- Pain, swelling or palpitations
- Stiffness or tension
- Cold or feeling of weakness

If you experience these symptoms or any other recurring or chronic discomfort and/or pain that can be attributed to the use of the audiometer, please consult a doctor immediately and contact the health and safety department of your practice/clinic.

In the following section you will find tips for more convenient operation of your audiometer.

2.11.1 Creating a pleasant working environment

Make the working environment as comfortable as possible by adjusting the viewing angle of the monitor, using a footrest or adjusting the sitting position for maximum comfort. Please note the following tips:

- Avoid holding the same position for too long.
- Avoid bending forwards or leaning backwards.
- Stand up regularly and walk around to loosen your leg muscles.
- Take short breaks to relax your neck and shoulders.
- Avoid tensing your muscles or raising your shoulders.
- Place the monitor, control panel and mouse within easy reach.

2.11.2 Eye protection

Your eyes can be strained by prolonged use of the monitor, wearing the wrong glasses or contact lenses, bright light, excessive room lighting, blurred screens, very small font and a display with low contrast. In the following section you will find recommendations on how to reduce eye strain.

Eyes

- Rest your eyes at regular intervals.
- Look away from the monitor to a distant point from time to time to give your eyes a break.
- Blink frequently to prevent your eyes from becoming too dry.

Display

- Always keep the display clean.
- The eyes should be above the top edge of the display so that they are facing downwards when you look at the centre of the display.
- Adjust the brightness and/or contrast of the display to a comfortable level to make it easier to read text and see graphics more clearly.
- Avoid bright light and reflections as follows:
 - Position your display so that its side is facing the window or another light source.
 - Minimise the light in the room by using curtains, drapes or blinds.
 - Use a suitable light source.
 - Change the viewing angle of the display.
 - Use a filter that reduces bright light.
- Avoid looking at the display from an unfavourable angle.
- Avoid looking at a bright light source, e.g. an open window, for a long period of time.

2.11.3 Getting into the habit of good working habits

The following work habits will allow you to be more relaxed and productive with your audiometer:

- Take short breaks regularly and often.
- Do regular stretching exercises.
- Breathe in fresh air as often as possible.
- Exercise regularly and keep yourself healthy.

3 Installation

Before you start installing the audiometer software, please read the instructions for use carefully.

3.1 Device configurations

Before installation, check that the audiometer is complete.

A standard appliance has the following features:

- Audiometer module and mains cable
- AURITEC audiometer PC
- Mouse, mouse pad, USB extension
- Control unit
- Patient button left
- USB cable
- USB connection cable for operating unit/PC
- RS232 connection cable for control unit/audiometer
- User microphone
- Monitor, extension cable
- Headphones DD45
- Bone receiver B81
- Customer folder, USB stick with the software and GA

The following components can be purchased in addition to the standard device.

- First surround module, mains cable and fibre optic cable
- Second surround module, mains cable and fibre optic cable
- Monitor
- Printer with connection cable and installation data carrier
- Patient button right, Y-cable for the patient buttons
- Big Buddy Button, Y-cable for the patient buttons
- Headphones DD450
- ER3C plug-in headphones
- Bone receiver KLH96
- 90dB or 100dB loudspeaker

3.2 Hardware requirements

The AT-research / AT2000 is only supplied with the audiometer PC from **AURITEC medizindiagnostische Systeme GmbH**.

The following requirements are placed on the monitor:

- ✓ Screen resolution: 1920 x 1080 pixels
- ✓ Aspect ratio: 16:9

Our audiometer **AT-research / AT2000** is only approved in conjunction with the PC supplied by AURITEC. No separate optical isolator is required for connection to an IT network.

With regard to Wi-Fi and Bluetooth, we recommend switching these off if they are not required.

The components supplied by us are connected to the PC. It is also permitted to connect monitors and printers that run under Windows and fulfil the minimum requirements to the PC. Medical devices from other manufacturers may only be connected to the PC and installed after approval by AURITEC.

The customer bears full responsibility for the IT measures selected.

We recommend the following measures to customers:

The final security configuration at the customer site can be improved by following best security practices and guidelines. This includes in particular the recommendations contained in the following paragraphs.

Establishing a safe environment

- ✓ Prevent physical access to the medical device by unauthorised persons.
- ✓ Only connect the medical device to secure networks. Do not use the medical device in a wide-open network, including networks based on WLAN, Bluetooth, etc. This also applies to stand-alone systems. This also applies to stand-alone systems.
- ✓ Always keep the network software up to date with the latest patches.
- ✓ Preferably use encrypted data communication instead of "less secure" network segments (IPsec, VPN, ...).
- ✓ Carry out regular system backups and save them on a secure device.
- ✓ Ensure that only authenticated users can access all resources within the network (shares, printers, other devices).
- ✓ Protect the system with updated virus protection.
- ✓ Use the Windows firewall.

Securing access to Windows systems

- ✓ Use of a domain-based network and domain-based authentication methods enables verification of system usage, including Windows logins to the operating system.

Confidentiality of data

- ✓ If the user is inactive, the Windows system should be locked automatically.
- ✓ If the system is left unattended, the user should lock the system manually.

Minimisation of potential data leaks

- ✓ Do not install any third-party software that is not intended for use with the application. Unknown software can pose a potential security risk.
- ✓ Encrypt drives that contain archived data. Create a backup copy of the archived data that is stored on another secure device.
- ✓ Avoid using recording systems that are linked to patient data as network servers for other functions.
- ✓ Disable unnecessary Windows services designed for non-work related functions. For example: Messenger, CD burning services, Netmeeting, remote sharing, session manager for remote desktop help, Dropbox, Skype, e-mail, etc..

Control user access

- ✓ Use fixed guidelines when assigning passwords to ensure that they are complex, do not repeat themselves and are changed regularly.
- ✓ Consider assigning users only the lowest possible user rights, as no special increased authorisations are required to use the application.

Definition of secure organisational guidelines/framework conditions

The danger of cyber attacks often comes from emails and access to malicious websites.

- ✓ Avoid using dedicated measurement systems for patients for purposes other than those for which they are intended. Examples of this are Use as an office work computer for reading/editing e-mails, browsing the Internet, etc.
- ✓ Only use personal user accounts to ensure that the system can identify the user.
- ✓ Do not use known shared accounts in the company/operation to access systems that contain confidential data.
- ✓ Ensure that only trained personnel have access to the application.

Implementation of statutory safety regulations

- ✓ The medical software is subject to local regulations. Use the software in accordance with the regulations.

Working with Windows updates and ensuring system availability

Patches are regularly released for the Microsoft Windows operating system to eliminate security vulnerabilities

Install the updates outside normal working hours so that they do not interfere with your daily work.

- ✓ Check the system after the update to ensure that all its components are working properly.

3.3 Software requirements

The following software requirements must be met for the installation of the audiometer software:

- ✓ Operating system Windows 11 - 32-bit/64-bit

Before installing the audiometer software, the PC must be fully set up and any existing printer should be installed



Local administrator rights are required to install the audiometer software.



Before installation, make sure that you have a working backup of the database. No liability is accepted for loss of data due to incorrect installation.

3.4 Installing the audiometer software

The audiometer software is already installed on the AURITEC PC when it is first delivered.

3.5 Update of audiometer software

Updates can also be done by customers.

During an update, the licence and configuration files are automatically transferred.

Open the setup folder and start the setup as an administrator.

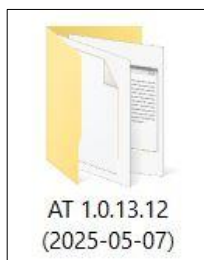


Figure 1: Setup File

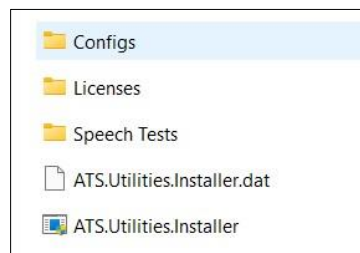


Figure 2: Setup File

Click on Continue anyway.



Figure 3: Update-1

Select the language and click Continue.

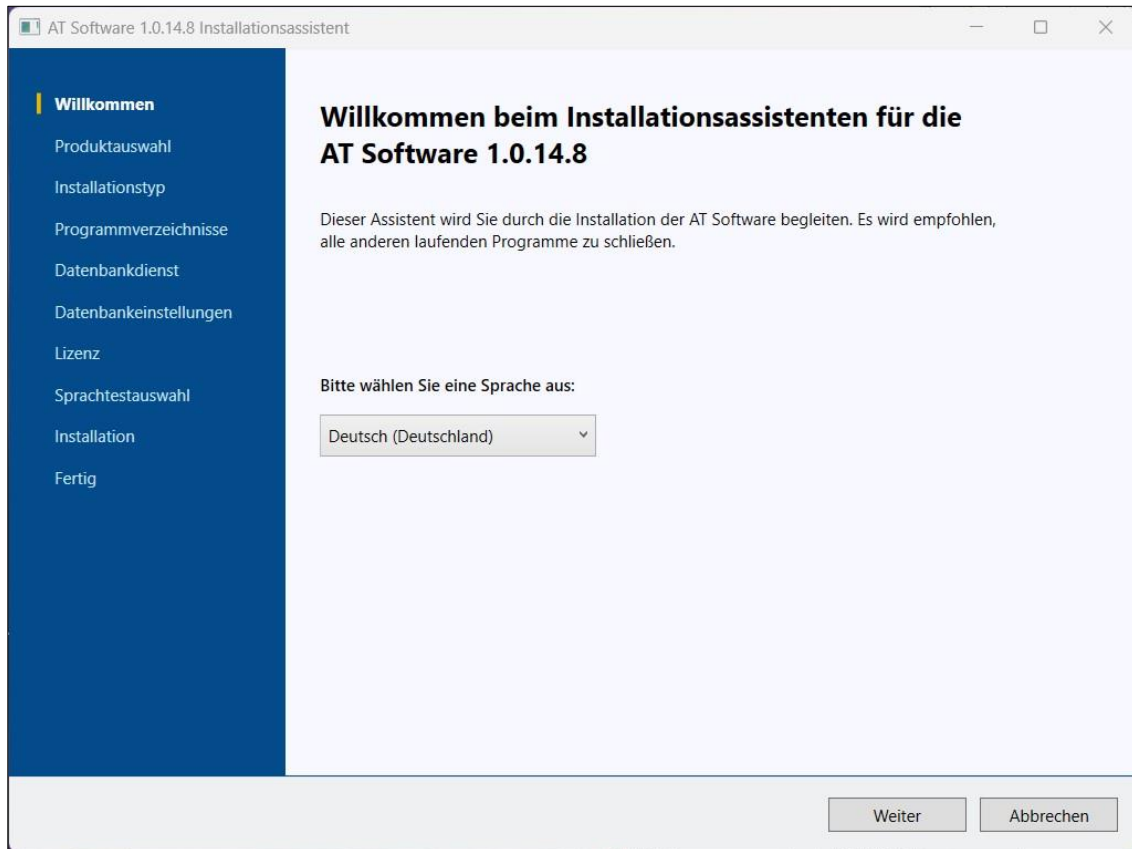


Figure 4: Update-2

Select the product type. Next to the correct product type, you will see 'Update'. Click on Continue.

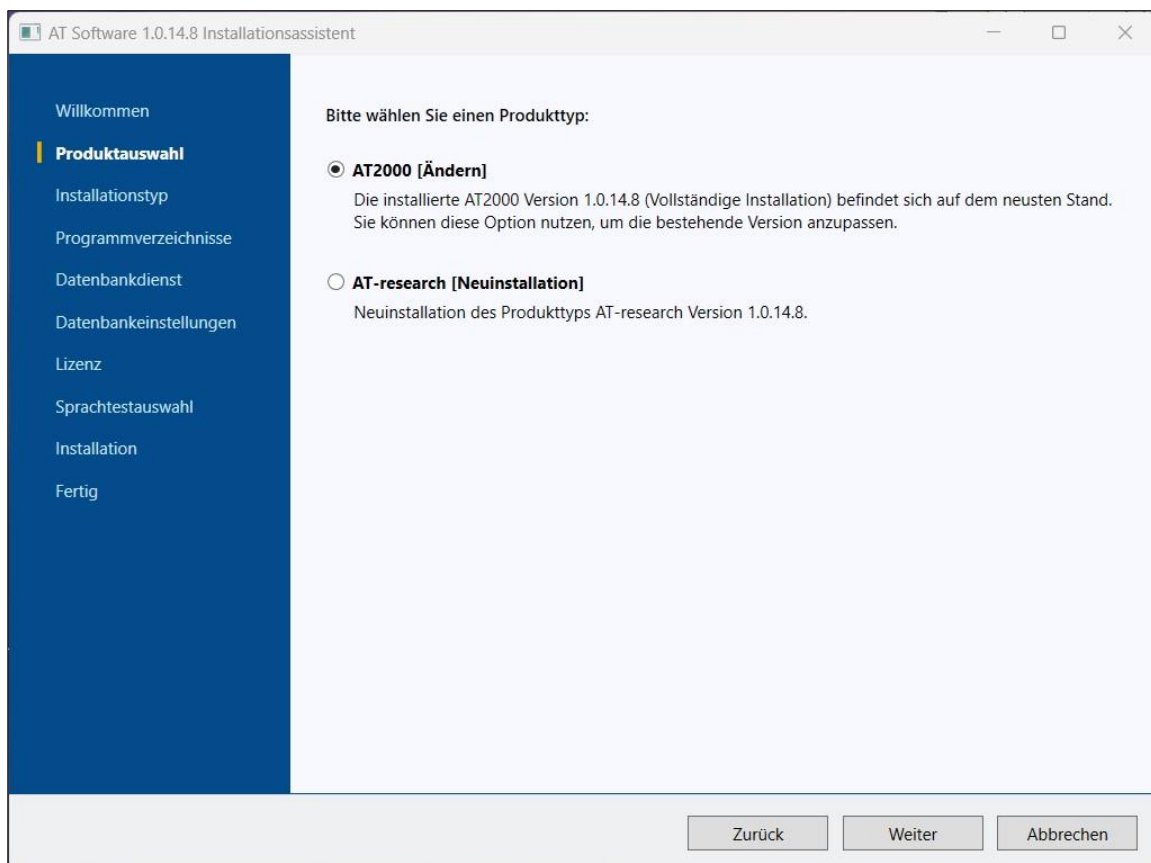


Figure 5: Update-3

Select the installation type and click Next.

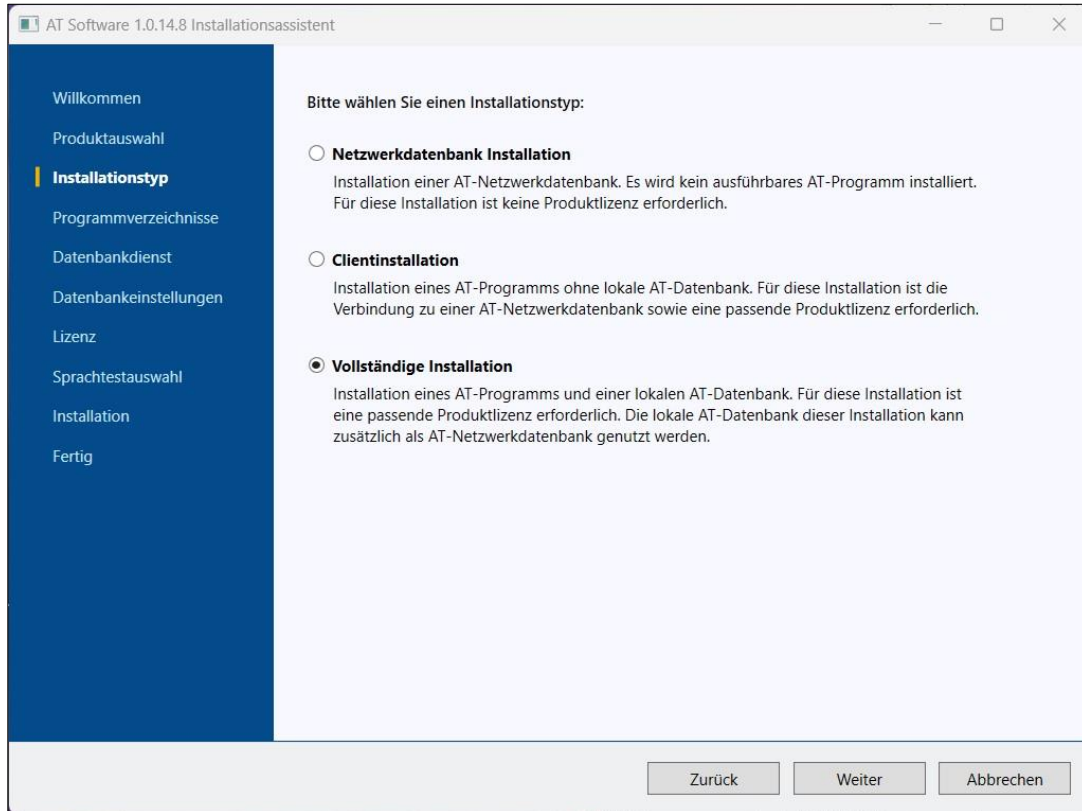


Figure 6: Update-4

Click on Continue.

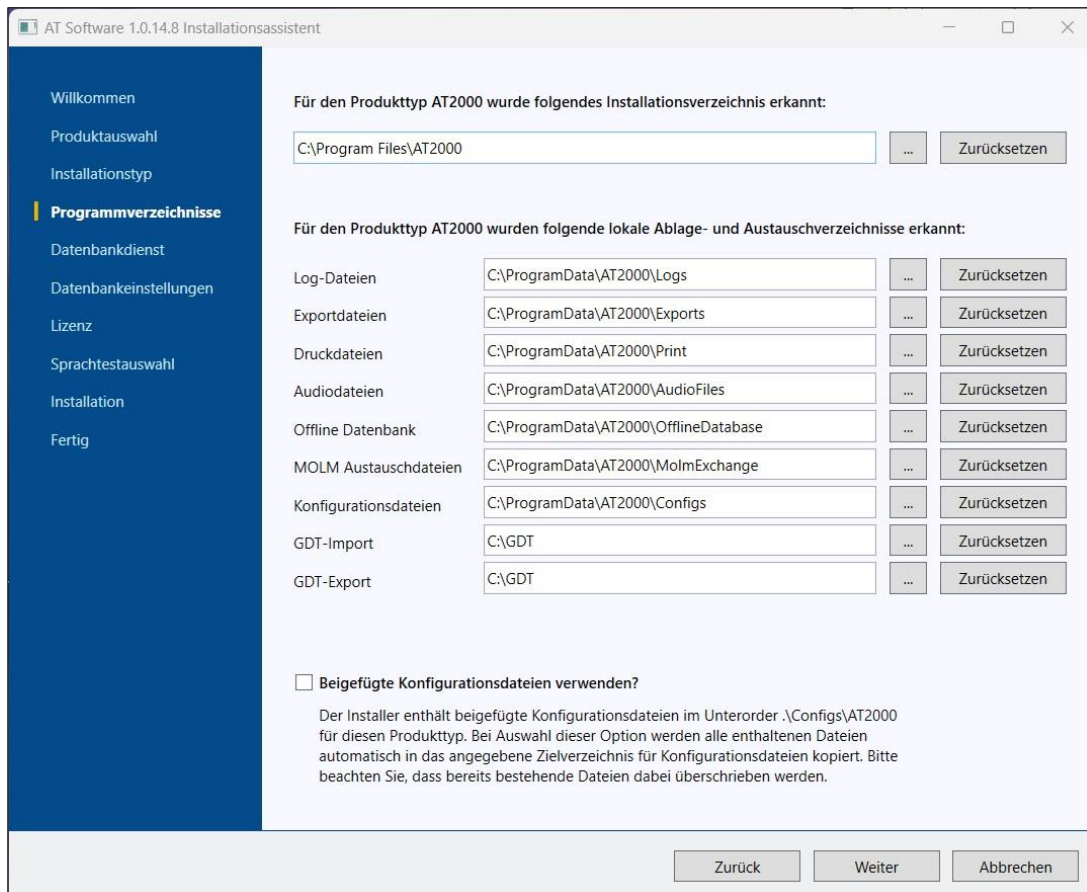


Figure 7: Update-5

Click on Continue.

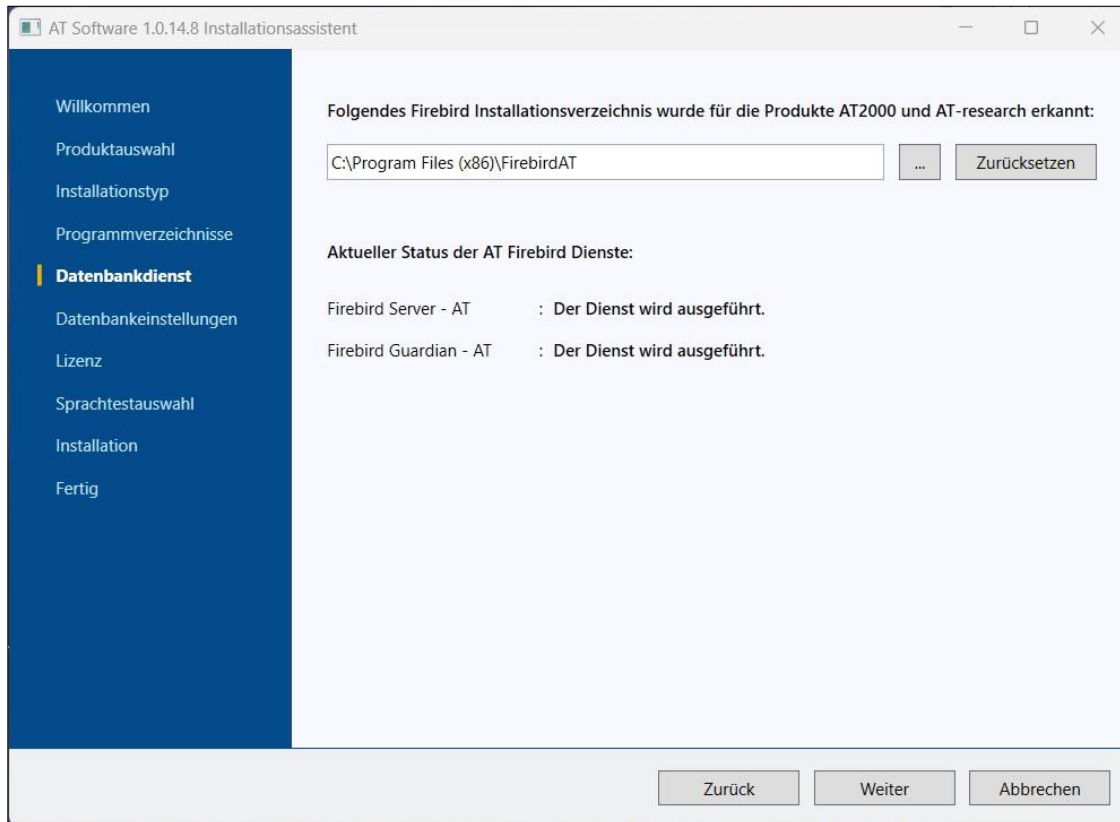


Figure 8: Update-6

Click on 'Test connection'. If this is successful, click on Continue.

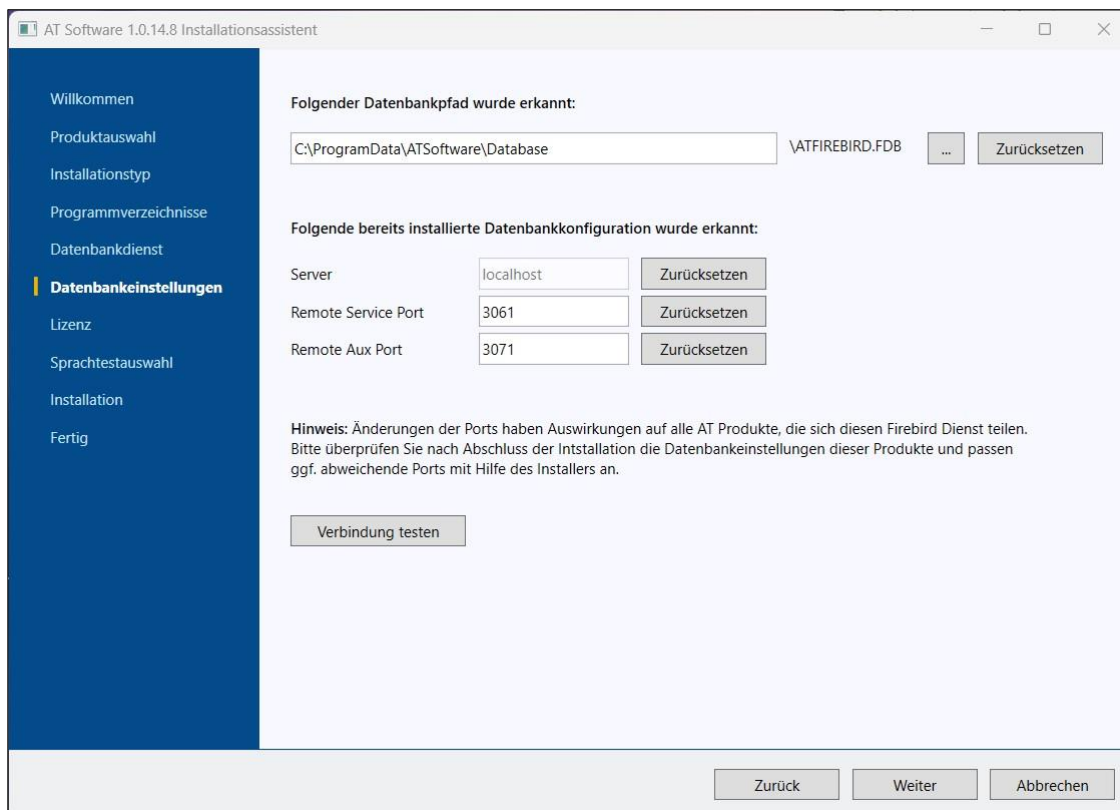


Figure 9: Update-7

Click on Continue.

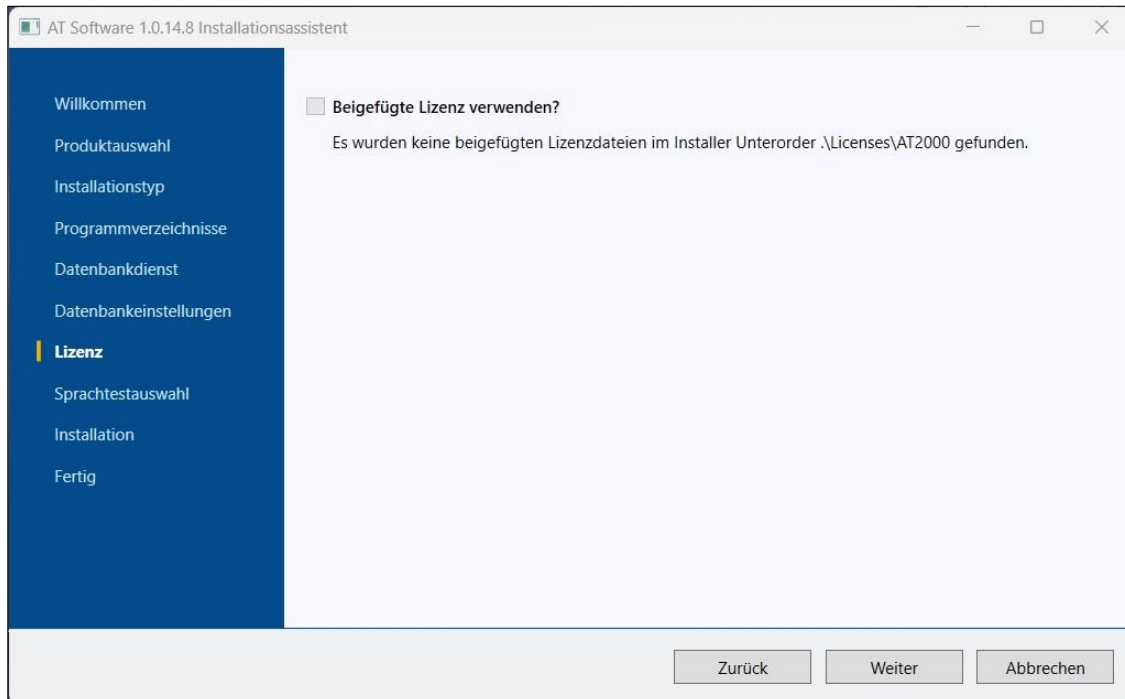


Figure 10: Update-8

Select the speech tests and click on Install.

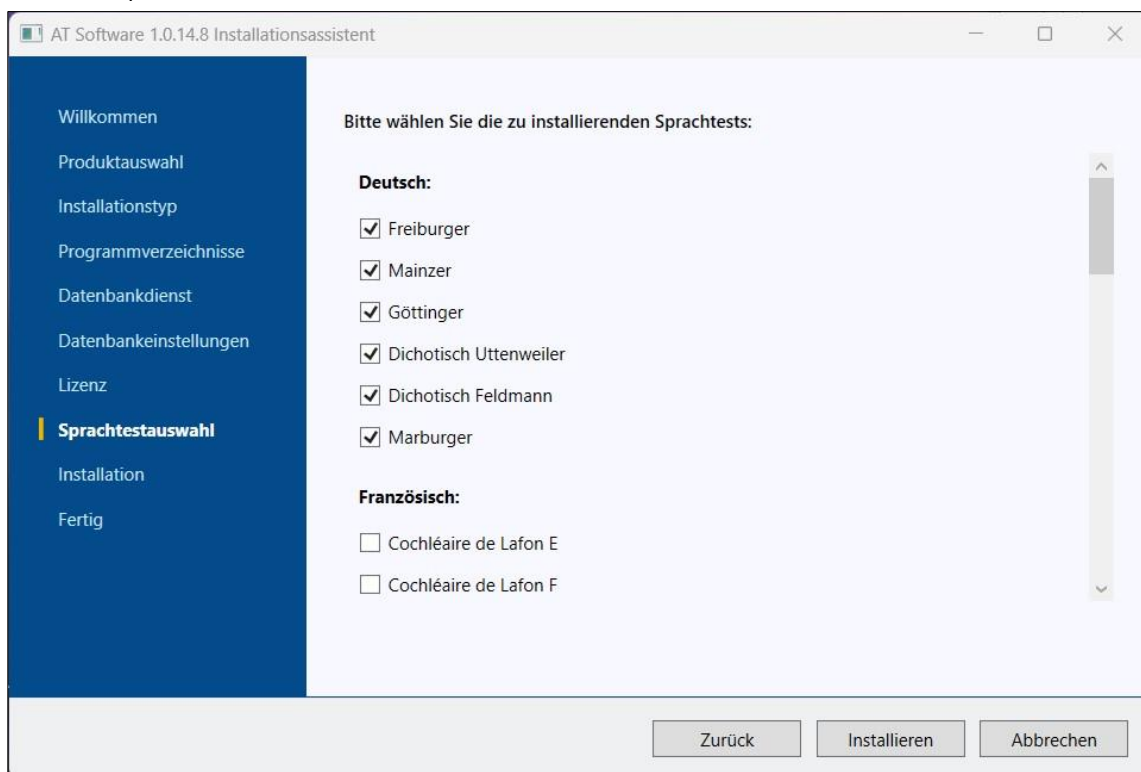


Figure 11: Update-9

The update is now running.

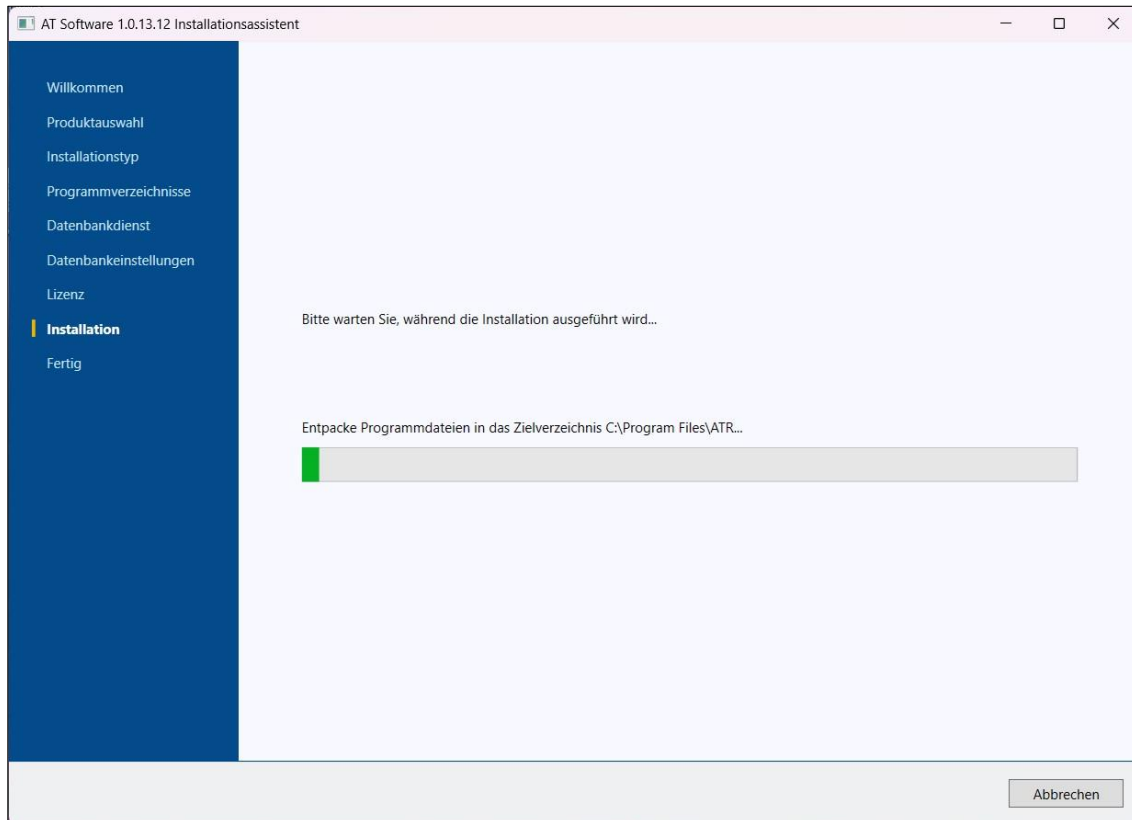


Figure 12: Update-10

The update has been successfully completed. Click Finish

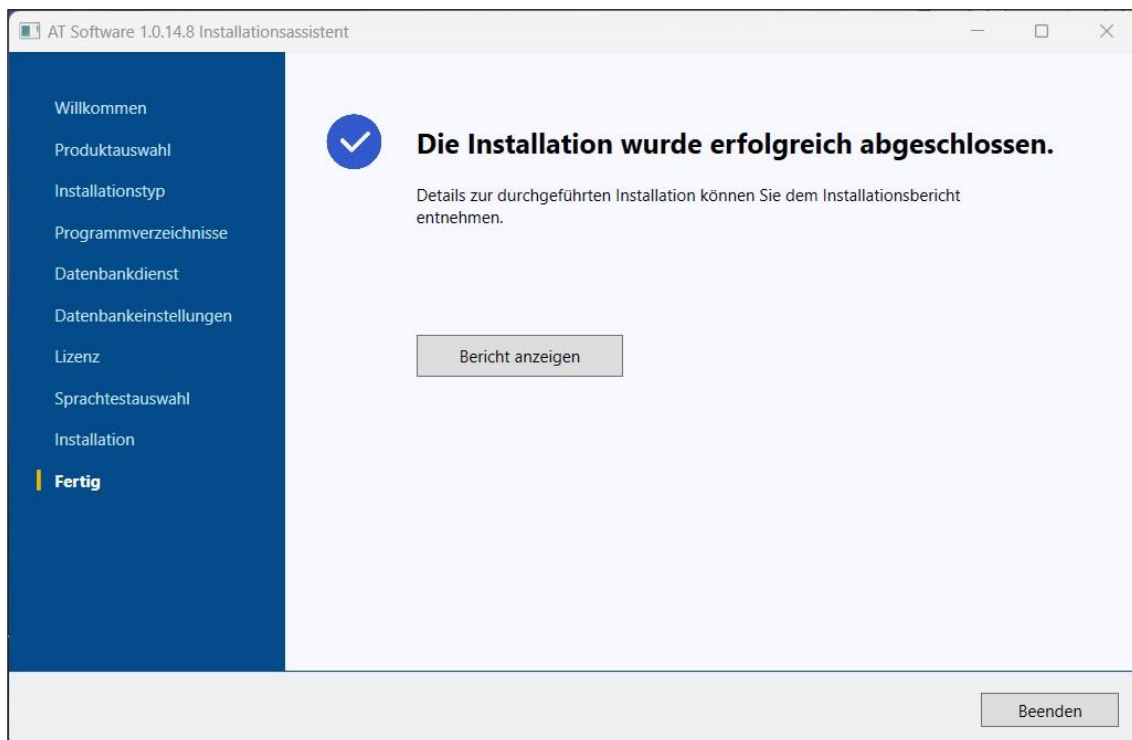


Figure 13: Update-11

Start the software. To update the database, you must confirm with Yes.



Figure 14: AT2000 Software



Figure 15: Update Database

4 Control elements and modules

The **AT-research / AT2000** is controlled using the control unit. There are all shortcuts, which are listed below. The buttons on the control unit are also described.

The audiometer module, the surround module and the connections are described in more detail below.

4.1 Control elements

4.1.1 Keyboard (short cuts)

Table 1: Keyboard (Short-Cuts)

Short-Cut	Operation	Modul
V	Masking ON/OFF	Tone audiometry, speech audiometry
R/L	Signal right/left ON/OFF	Tone audiometry
F3	Switch test ear	Tone audiometry, speech audiometry, regiometry
M	User microphone ON/OFF	Tone audiometry, speech audiometry
F4	Change transducer (right)	Tone audiometry, speech audiometry, regiometry
F5	Change signal (right)	Tone audiometry, regiometry
F6	Change signal modulation (right)	Tone audiometry, regiometry
F7	Change signal modulation (left)	Tone audiometry, regiometry
F8	Change signal (left)	Tone audiometry, regiometry
F9	Change transducer (left)	Tone audiometry, speech audiometry, regiometry
F12	Print	Tone audiometry, speech audiometry, regiometry multi-channel
1,2,3,4,5,6,7,8	Change of test side loudspeaker	Regiometrie, speech audiometry, regiometry
Shift + 1,2,3,4,5,6,7,8	Change of masking side loudspeaker	Regiometrie, speech audiometry, regiometry
Ctrl + F7	Logout	Tone audiometry, regiometry
Ctrl + F2	Test selection	Tone audiometry, speech audiometry, regiometry, multi-channel
Ctrl + P	+20dB ON/OFF	Tone audiometry, speech audiometry
Ctrl + J	Mark „no threshold“	Tone audiometry, regiometry
Ctrl + U	Mark „unsure response“	Tone audiometry, regiometry
Ctrl + I	Mark „Tinnitus threshold“	Tone audiometry
Ctrl + C	Delete current measurement point	Tone audiometry, speech audiometry, regiometry
Ctrl + X	Delete current measurement row	Tone audiometry, speech audiometry, regiometry
Ctrl + B	Comment	Tone audiometry, speech audiometry
Ctrl + O	Show last session	Tone audiometry, speech audiometry, regiometry
Ctrl + L	Air conduction	Tone audiometry, regiometry
Ctrl + K	Bone conduction	Tone audiometry, regiometry
Ctrl + F	Freefield	Tone audiometry, regiometry
Ctrl + V	Blähkurve	Tone audiometry
Ctrl + A	Tinnitus test module	Tone audiometry, regiometry
Ctrl + W	Regiometry	Tone audiometry

4.1.2 Operation without control panel

Short-Cut	Operation	Modul
Space	Test signal ON/OFF	Tone audiometry
↑	Reduce test level	Tone audiometry, speech audiometry, regiometry
Ctrl + ↑	Reduce masking level	Tone audiometry, speech audiometry, regiometry
↓	Increase test level	Tone audiometry, speech audiometry, regiometry
Ctrl + ↓	Increase masking level	Tone audiometry, speech audiometry, regiometry
→	Increase frequency	Tone audiometry, regiometry
	Mark reaction threshold	Verhaltensaudiometrie
	Speech item correct	speech audiometry
	Left ear: 1x each correct, 2x each false, 3x and 4x toggle mixed re- sponse	Dichotische Tests
←	Reduce frequency	Tone audiometry, regiometry
	Delete reaction threshold	Behavioural audiometry
	Speech item false or no response	speech audiometry
	Right ear: 1x each correct, 2x each false, 3x and 4x toggle mixed re- sponse	Dichotic tests
Enter	Enter threshold/measurement point	Tone audiometry, regiometry
	Start/stop song/sound	Behavioural audiometry

4.1.3 Control unit

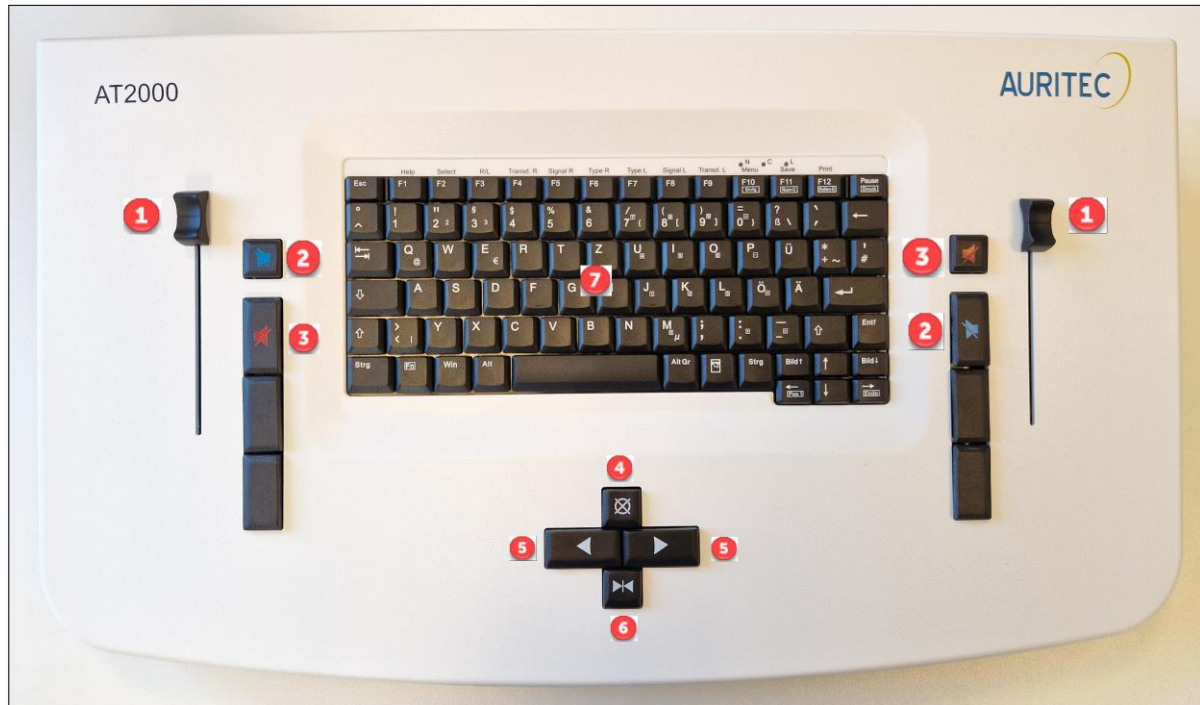


Figure 16 : Operating unit

Table2 : Description of the operating unit

1	Level slider in dB: for setting the volume for the right and left ear.
2	Interrupter buttons for the left ear (blue).
3	Interrupter buttons for the right ear (red).

4	Set measuring point (DÜ button, data transfer) or cancel / stop
5	Frequency change to change the measuring frequency. Speech audiometry - Left arrow: heard wrong - Right arrow: heard correctly Behavioural audiometry - Left arrow: Delete reaction threshold - Right arrow: Enter reaction threshold Dichotic speech tests - Left arrow / right ear: 1x all correct, 2x all incorrect, 3x or 4x toggle - Right arrow / left ear: 1x all correct, 2x all incorrect, 3x or 4x toggle
6	Return button to change the measuring frequency or start / continue / start next measurement
7	PC keyboard for entering patient data, shortcuts, function keys, etc.

4.2 Modules

4.2.1 Audiometer module

Only the LED is visible on the front of the audiometer module.



Figure17 : Front of the audiometer module

The connection sockets for connecting the transducers and the on/off switch are located on the rear of the audiometer module.



Figure18 : Rear of the audiometer module

Table3 : Description of the audiometry module

1	USB: Connection of the USB cable
2	Connection of the fibre optic cable (surround module) - TOS-Link fibre optic cable
3	Line In: Connection of an external signal source, e.g. CD player
4	RS232: Connection of the interface cable for the operating unit
5	PR: Connection of the patient button (patient application part)
6	Monitor: 3.5 mm stereo jack connection of the handset
7	MIC PATIENT: 3.5 mm jack connection of the talkback microphone (patient application part)
8	MIC USER: 3.5 mm jack connection or 6.3 mm jack connection for user microphone
9	AC1-AC3: Headphone connections (patient application part)
10	BC1, BC2: Bone conduction handset connections (patient application part)
11	IMP (shown as 'CI' in the image): Connection for implants
12	FFR, FFL: Speaker connections (right / left)
13	On/off switch
14	Primary fuses
15	Mains connection
16	Potential equalisation

4.2.2 Surround module

In addition to the audiometer module, eight further loudspeakers can be connected with a surround module. With the additional installation of a second surround module, up to 16 further free-field outputs can be controlled. Each surround module is connected to the audiometer module via two TOSLINK cables.

The surround modules are differentiated by a small blue button on the back of the module. There are two status LEDs next to the blue button.

Table4 : Status LEDs of the surround module

Upper LED (status of the fibre optic connection)	
LED: OFF	No connection via fibre optics
LED: blue	Only fibre optic connection, but no HID data: Check whether the fibre optic cables are connected correctly.
LED: green	Fibre optic connection is OK.
Lower LED (boot mode status)	
LED: red	Safety boot mode: This mode is only accessed if an update has failed or the standard firmware in the internal memory has been corrupted. This boot mode allows a firmware update to be carried out in order to restore the device to its normal state.
LED: green	Normal boot mode: The standard firmware has been loaded.

Only the LED is visible on the front of the surround module.



Figure19 : Front of the surround module

The connection sockets for connecting the transducers and the on/off switch are located on the rear of the surround module.



Figure20 : Rear of the surround module

Table5 : Description of the surround module

1	Connecting the fibre optic cable - TOS-Link fibre optic cable
2	Speaker connections
3	On/off switch
4	Primary fuses
5	Mains connection

5 Audiogram symbols

5.1 Tone audiometry

Table6 : Audiogram symbols - Tone audiometry - Basic symbols

Description of the	right	left	Source
Hearing threshold LL, unatomised			DIN EN ISO 8253-1: Table 1
Hearing threshold LL, anaesthetised			DIN EN ISO 8253-1: Table 1
Anaesthetisation of the opposite side (LL)			
Hearing threshold KL, unatomised			DIN EN ISO 8253-1: Table 1
Hearing threshold KL, anaesthetised			DIN EN ISO 8253-1: Table 1
Anaesthetisation of the opposite side (KL)			
Hearing threshold FF			
Anaesthetisation of the opposite side (FF)			
Comfort threshold			
Discomfort threshold			
Tinnitus			

Table7 : Audiogram symbols - Tone audiometry - Additional symbols

Description of the	Symbol	Example right	Example left
Supplied measurement			
Supplied measurement with implant			
Uncertain information			
No indication/"not heard"			
Second measurement curve			

5.2 Speech audiometry

Table 8 : Audiogram symbols - Speech audiometry - Basic symbols

Description of the	right	left	Source
Speech intelligibility LL, unmasked			DIN EN ISO 8253-3: Table C.3
Speech intelligibility LL, masked			DIN EN ISO 8253-3: Table C.3
Speech intelligibility LL, with background noise			DIN EN ISO 8253-3: Table C.3
Speech intelligibility KL, unmasked			DIN EN ISO 8253-1: Table 1
Speech intelligibility KL, masked			
Speech intelligibility KL, with noise			
Speech intelligibility FF, unmasked			DIN EN ISO 8253-3: Table C.3
Speech intelligibility FF, masked			DIN EN ISO 8253-3: Table C.3
Speech intelligibility FF, with background noise			DIN EN ISO 8253-3: Table C.3
Comfort threshold			
Discomfort threshold			
Reaction threshold (children's songs and Göttingen sounds)			
Binaural speech intelligibility			

Table9 : Audiogram symbols - Speech audiometry - Additional symbols

Description of the	Symbol	Example right	Example left
Supplied measurement			
Supplied measurement with implant			
Second measurement curve			

Table10 : Audiogram symbols - Speech audiometry - Test abbreviations

Test designation	Test abbreviation	Test designation	Test abbreviation
Freiburg figures	FZ	Mainzer 3	M3
Freiburg words	FW	Göttingen 1	G1
Marburg sentence test	MS	Göttingen 2	G2
Mainzer 1	M1	Children's songs	MK
Mainzer 2	M2	Sounds of Göttingen	GG

6 Patient management

6.1 Overview of patient management

After starting the software, you will find yourself in the patient administration.

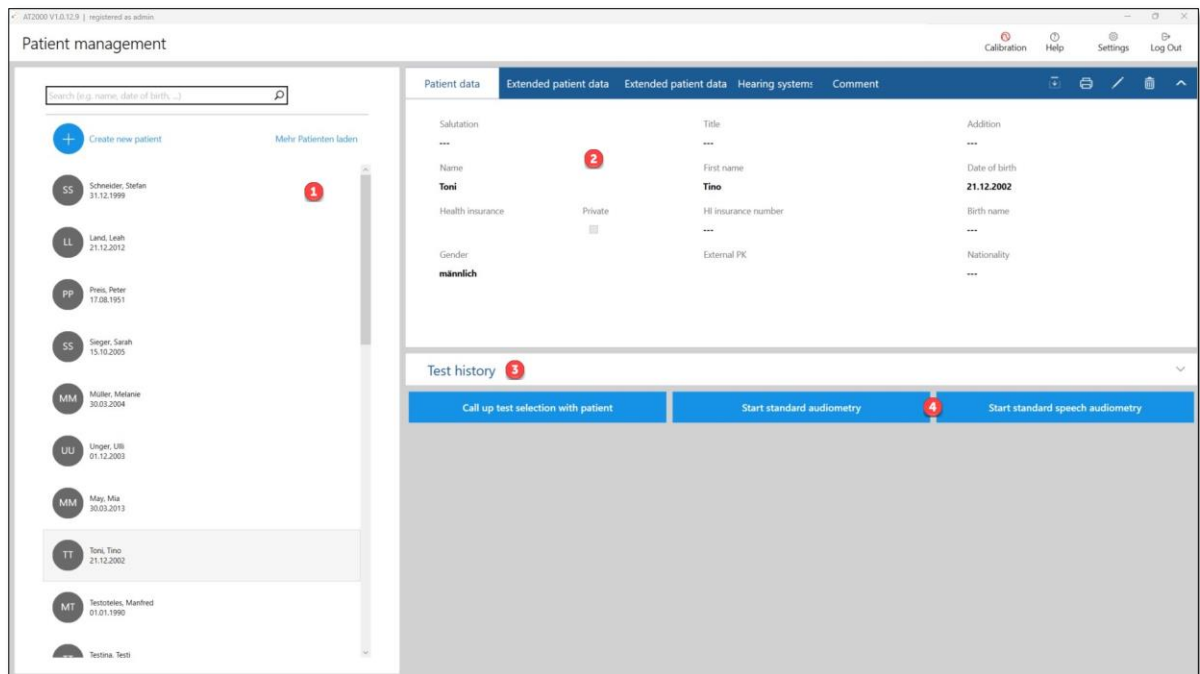


Figure21 : Overview of patient management

Patient administration is divided into four areas. These areas are described in more detail in the following chapters.

Table11 : Areas in patient administration

1	Overview of all patients - see chapter 6.2 Overview of all patients
2	Editing patient data - see chapter 6.3 Editing patient data
3	Test history - see chapter 6.4 Test history
4	Short cuts - see chapter 6.5 Short-Cuts

6.2 Overview of all patients

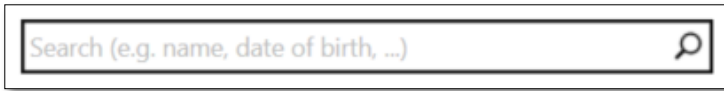
6.2.1 Searching for a patient

Numbers, letters and special characters can be entered as free text in the search field of the patient management system.

The entry is automatically compared with the data fields first name, surname, date of birth (DD.MM.YYYY), external PK, case number and patient ID. A filtered list of matching entries is displayed as soon as the first character is entered.

Upper and lower case letters are not distinguished. In addition, common alternative spellings are automatically taken into account, for example 'ä' = 'ae', 'ö' = 'oe', 'ü' = 'ue', 'ß' = 'ss' or 'sz', 'ph' = 'f' or "é" = 'e'.

No additional search commands or filter criteria are available; multiple terms separated by spaces are interpreted as individual search components and compared with all data fields mentioned.



A search bar with the placeholder text "Search (e.g. name, date of birth, ...)" and a magnifying glass icon on the right.

Figure22 : Searching for a patient

6.2.2 Creating a new patient

If you create a patient who already exists in the patient data, an information window appears.

Click on the following icon to create a new patient master record.

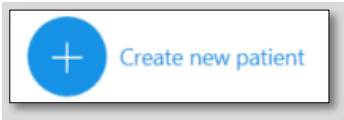
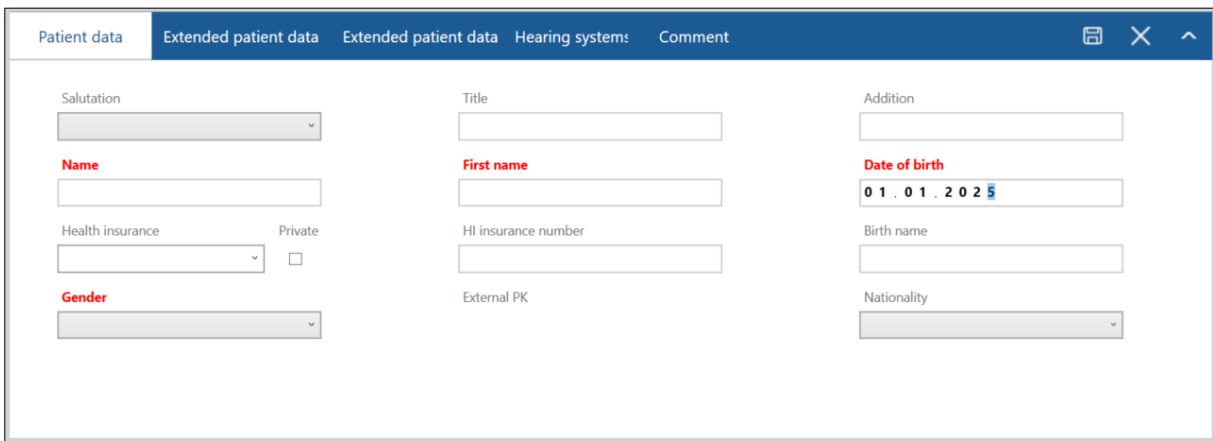


Figure23 : Creating a new patient - 1

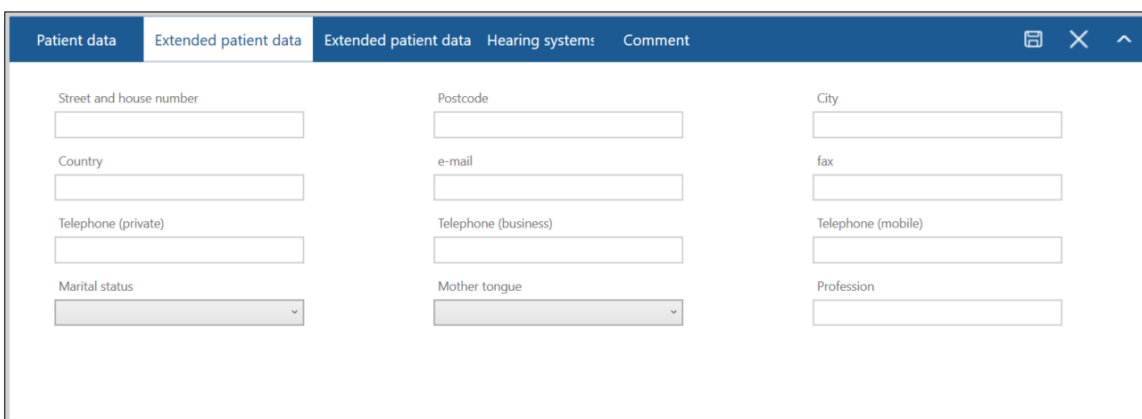
The following screen for entering patient data is activated. The fields labelled in red must always be completed. You can also enter the form of address, the title, an addendum, the health insurance fund, the health insurance number, the maiden name, an external health insurance fund and the nationality.



A form for entering patient data. The top bar has tabs: "Patient data" (selected), "Extended patient data", "Extended patient data", "Hearing system:", and "Comment". The form contains several fields: "Salutation" (dropdown), "Name" (text, red label), "Health insurance" (dropdown), "Gender" (dropdown, red label), "Title" (text), "First name" (text, red label), "HI insurance number" (text), "External PK" (text), "Addition" (text), "Date of birth" (text, red label, value: 01.01.2025), "Birth name" (text), and "Nationality" (dropdown). There is also a "Private" checkbox.

Figure24 : Creating a new patient - 2

To enter further information about the patient, select "Extended patient data" in the top tab. Here you can enter the home address, e-mail address, telephone or fax number, marital status, mother tongue and profession.



A form for entering extended patient data. The top bar has tabs: "Patient data", "Extended patient data" (selected), "Extended patient data", "Hearing system:", and "Comment". The form contains several fields: "Street and house number" (text), "Country" (text), "Telephone (private)" (text), "Marital status" (dropdown), "Postcode" (text), "e-mail" (text), "Telephone (business)" (text), "Mother tongue" (dropdown), "City" (text), "fax" (text), "Telephone (mobile)" (text), and "Profession" (text).

Figure25 : Creating a new patient - 3

Further data defined by the user can be entered in the second tab of the "Extended patient data".

The screenshot shows a software window with five tabs: 'Patient data', 'Extended patient data', 'Extended patient data', 'Hearing systems', and 'Comment'. The third 'Extended patient data' tab is active. It contains a grid of nine text input fields arranged in three rows and three columns. The first column has labels 'Case number', 'Patient ID', and 'Project number'. The second column has labels 'User-defined 1', 'User-defined 2', and 'User-defined 3'. The third column has labels 'User-defined 4', 'User-defined 5', and 'User-defined 6'.

Figure26 : Creating a new patient - 4

If a patient wears hearing aids, this information can be entered in the "Hearing aids" tab. Enter the model name, the manufacturer, the serial number of the respective hearing system, the side (left or right) and the date of purchase.

The screenshot shows the same software window with the 'Hearing systems' tab active. It displays a table with five columns: 'Model', 'Manufacturer', 'Serial number', 'Side', and 'Acquisition date'. Below the table, there is a form with five input fields corresponding to these columns. The 'Side' field is a dropdown menu currently showing 'Right'. The 'Acquisition date' field shows '1/2/2025' with a calendar icon. To the right of these fields is a blue 'Add' button.

Figure27 : Creating a new patient - 5

To add a comment, select "Comments" in the top tab.

The screenshot shows the software window with the 'Comment' tab active. It features a large, empty rectangular text area for entering a comment. The tab bar at the top shows 'Patient data', 'Extended patient data', 'Extended patient data', 'Hearing systems', and 'Comment'.

Figure28 : Creating a new patient - 6

The following symbol cancels the entry without saving.



Figure29 : Cancelling the patient entry

Click the save icon to the left to finalise your entries and save the data.



Figure30 : Saving the patient data

6.3 Editing patient data

6.3.1 Changing or adding to patient data

To change the patient data for an already created patient, first click on the respective patient on the left-hand side and then on the following symbol in the blue bar. The fields are activated and you can make the changes. You must then save the changes.



Figure31 : Editing patient data

6.3.2 Deleting patient data

To delete the patient data for a patient that has already been created, first click on the respective patient on the left-hand side and then on the following symbol in the blue bar.



Figure32 : Deleting patient data - 1

After you have clicked on the delete icon, the following window appears. Here you will be asked again whether the patient data and all measurements carried out should be irrevocably deleted.

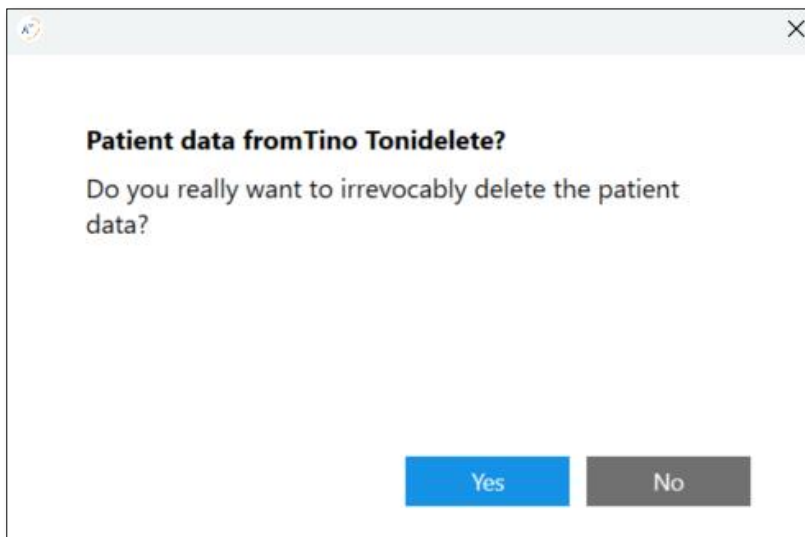


Figure33 : Deleting patient data - 2

6.3.3 Printing patient data

To print the patient data, click on the following symbol in the blue bar.



Figure34 : Printing the patient data - 1

The Windows print manager will then open.

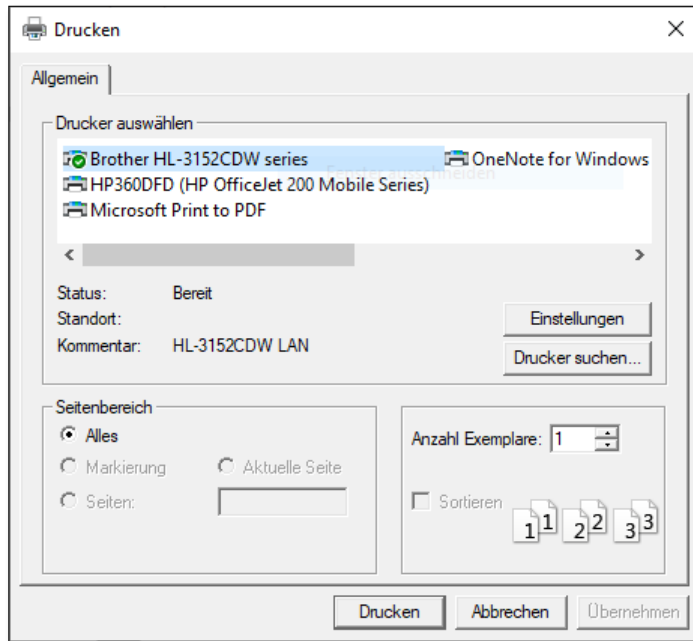


Figure35 : Example - Printing the patient data - 2

6.3.4 GDT master data import

A GDT master data import can be carried out using the following symbol in the blue bar.

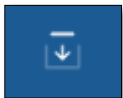


Figure36 : GDT master data import - 1

After clicking on the symbol, the following window opens. The GDT file must be selected here.

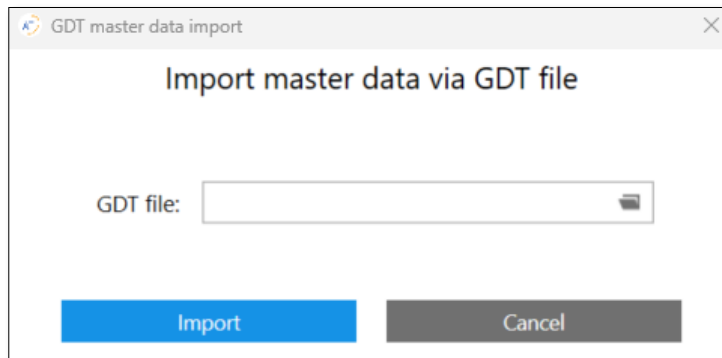


Figure37 : GDT master data import - 2

6.4 Test history

All tests for the selected patient are listed in the test history. You can view, print or delete older tests. It is also possible to continue a new test based on an existing measurement.

If you would like a detailed view of the sessions, you can use the arrow to expand the session.

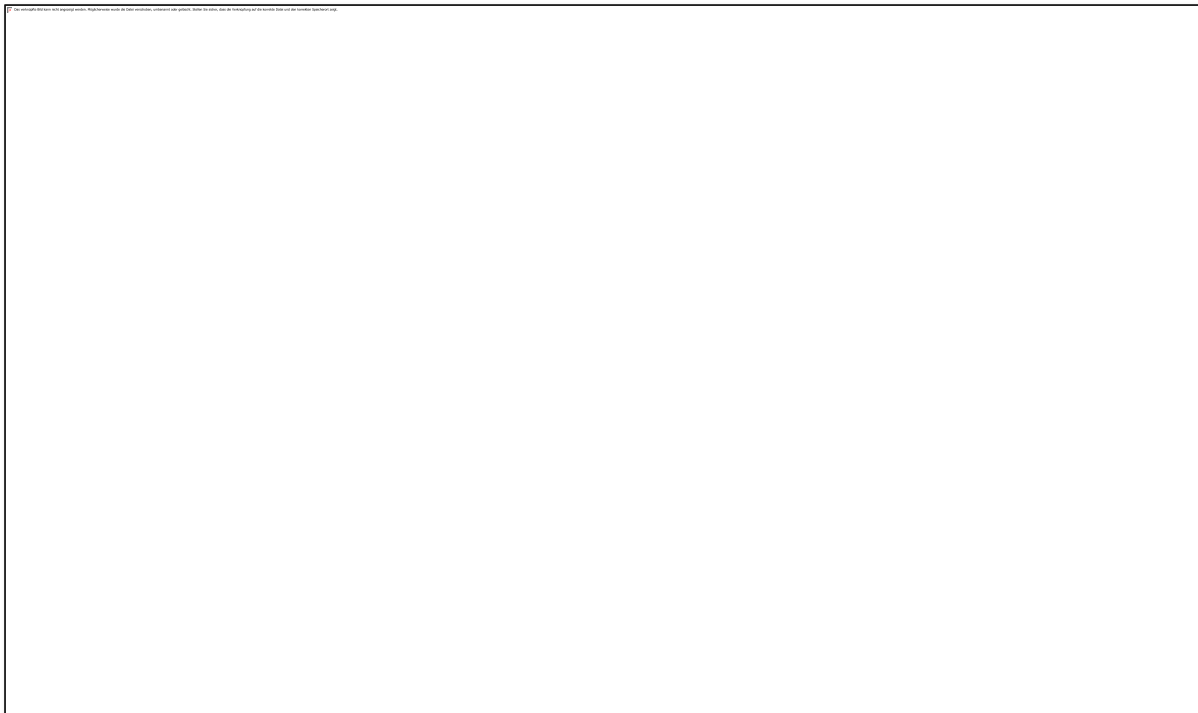


Figure38 : Test history

6.4.1 Export of patient data

To export the patient data, click on the following icon in the blue bar.



Figure39 : Exporting patient data - 1

After clicking on the icon, the following window opens. The storage location and the respective sessions must be selected here. The export can also be anonymised. The export takes place in .csv format.

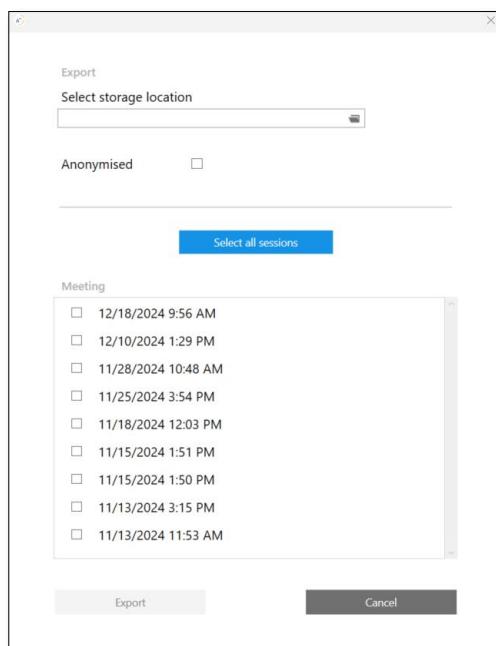


Figure40 : Exporting patient data - 2

6.4.2 Merge Data

This function allows you to assign examinations to another patient. This can be used if an examination was accidentally performed on the wrong patient or if a patient was created multiple times with different names and the examination data needs to be merged.

To transfer examination data, click on the corresponding icon.



Figure41: Merge data– 1

A window opens. In the first section, the target patient can be entered using the search function. To do this, enter the name in the search field and select the desired patient from the drop-down menu. After selection, the patient appears in the second section, 'Target patient'. The surname, first name, date of birth and external PK are automatically transferred to the corresponding fields. In the third section, you select the sessions that are to be transferred from the source patient to the target patient.

Figure42: Merge data– 2

Clicking on 'Transfer' brings up a security prompt in which you must confirm that the selected sessions are to be transferred and then deleted from the source patient.

Figure43: Merge data– 3

After clicking 'Yes', the transfer will be carried out. A success message will then appear.

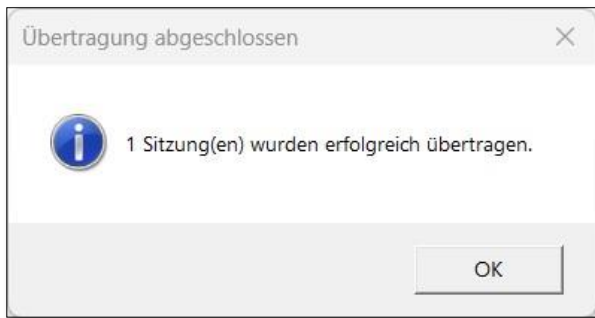


Figure44: Merge data– 4

6.4.3 Display of old measurements

After you have opened the respective session with the arrow, you will see an overview of the tests performed. If you click on a test, a view opens where you can take another look at the measurement carried out.

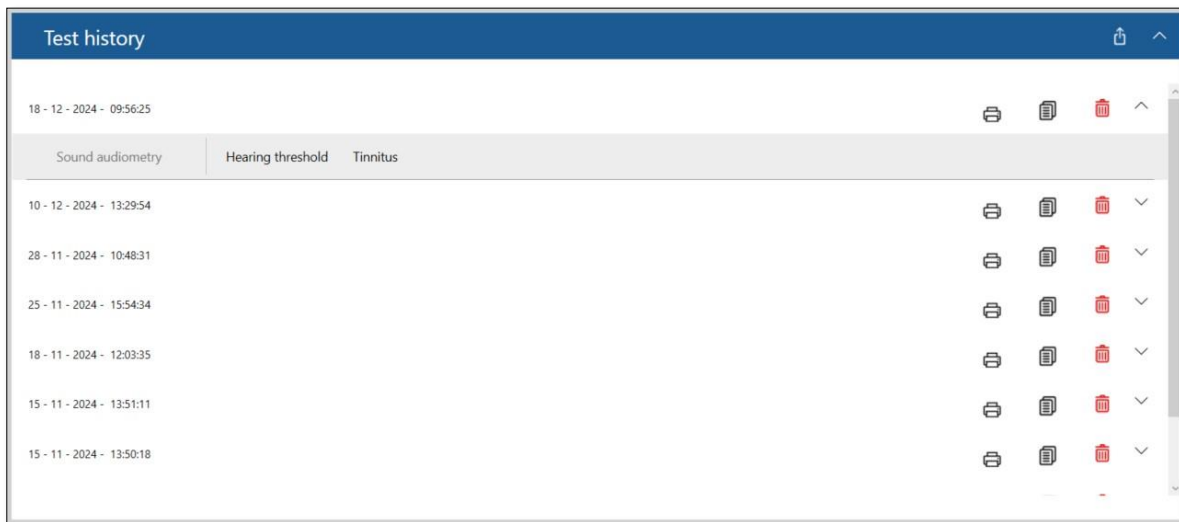


Figure45 : Display of old measurements

6.4.4 Show comments

If the following symbol appears next to an entry in the test history, there is a comment for this measurement. This can be opened and copied by clicking on the symbol.

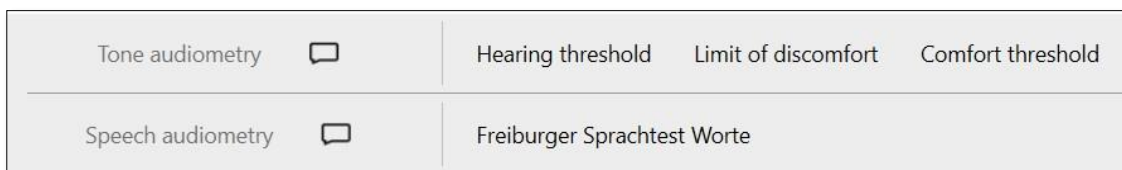


Figure46: Comment symbol in test history

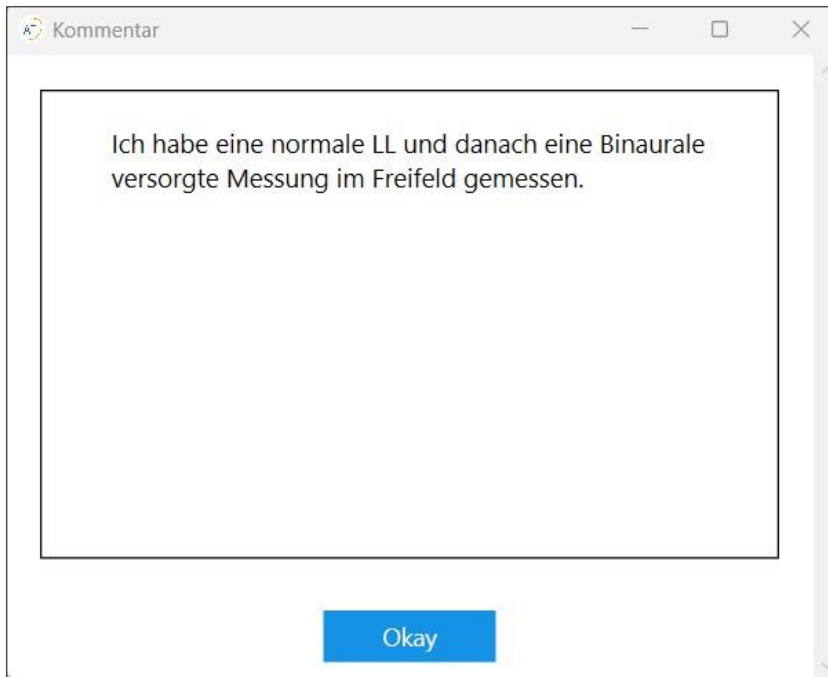


Figure47: Open view of the comment in test history

6.4.5 Printing of old measurements

To print measurements within a session, select the respective session and click on the following symbol in the line.



Figure48 : Printing old measurements - 1

The print manager then opens. The user can configure their print here. For default settings, see the chapter 21.1.8 Print.

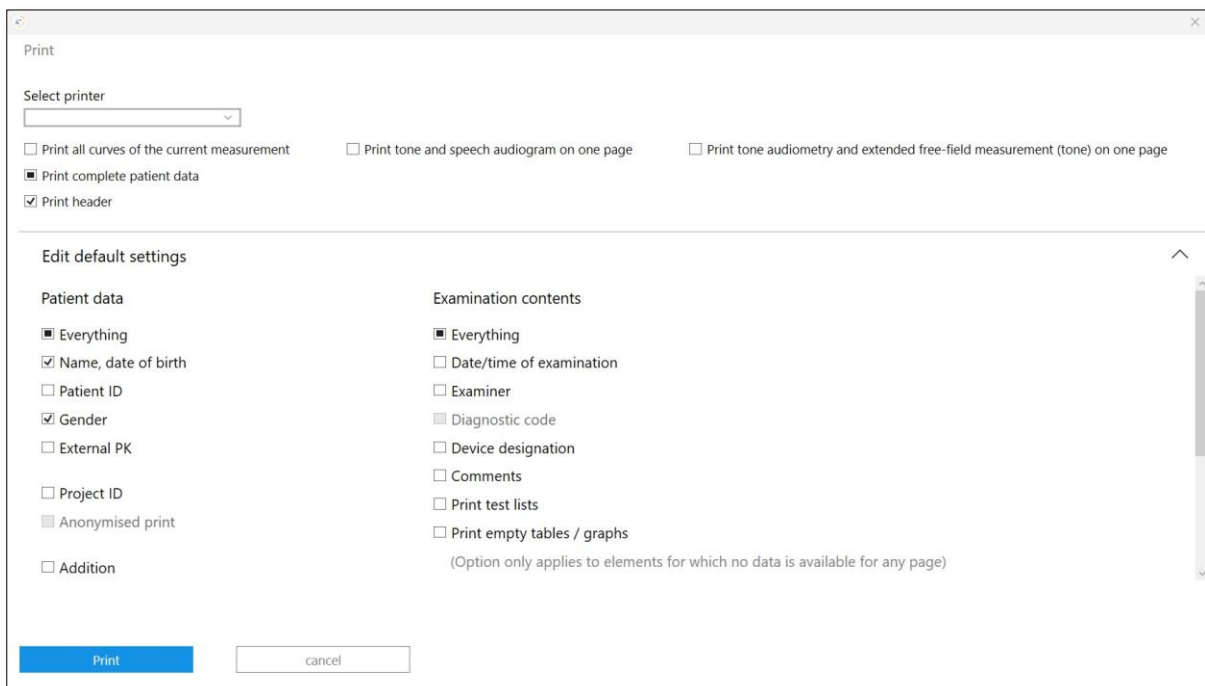


Figure49 : Printing old measurements - 2

6.4.6 Duplicate and resume a session

To continue a session with further measurements, select the respective session and click on the following symbol in the line. Sessions can only be duplicated and continued within 30 days.



Figure50 : Duplicating and resuming a session - 1

A message window will now appear. This must be confirmed.



Figure51 : Continue measuring message window - 1

The selected session is duplicated and saved as a new session. To carry out further measurements, click on one of the light blue shortcuts.

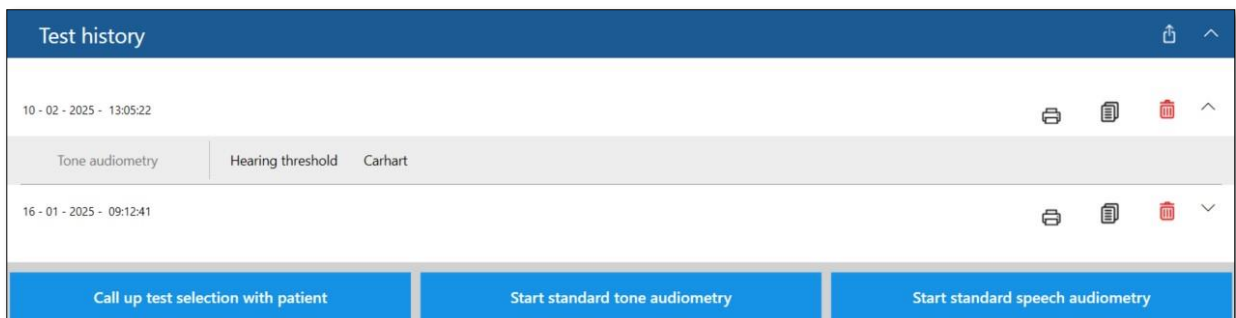


Figure52 : Duplicating and resuming a session - 2

A dialogue box then appears, which you must confirm.

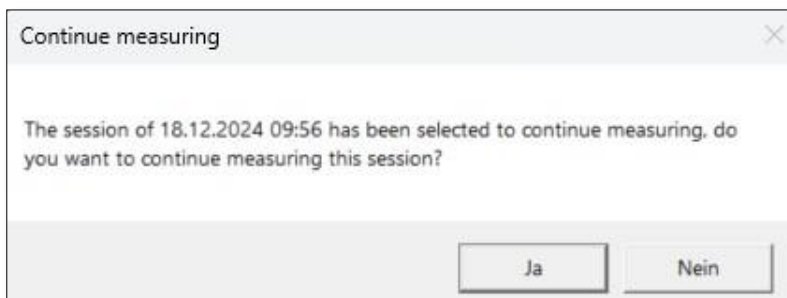


Figure53 : Continue measuring message window - 2

Sessions that are older than 30 days cannot be duplicated and continued, as this cannot produce a valid result. The following window will then appear.

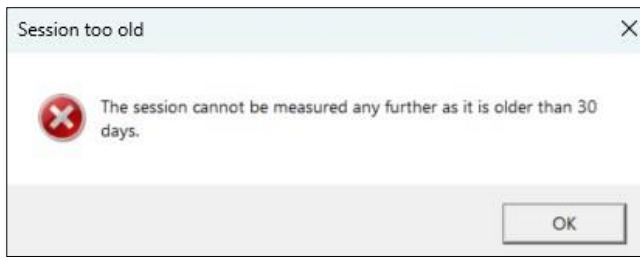


Figure54 : Duplicating and resuming a session - 3

6.4.7 Delete a session

To delete a session, select the respective session and click on the following symbol in the line.



Figure55 : Deleting a session - 1

After you have clicked on the delete icon, the following window appears. Here you will be asked again whether the session should be irrevocably deleted.

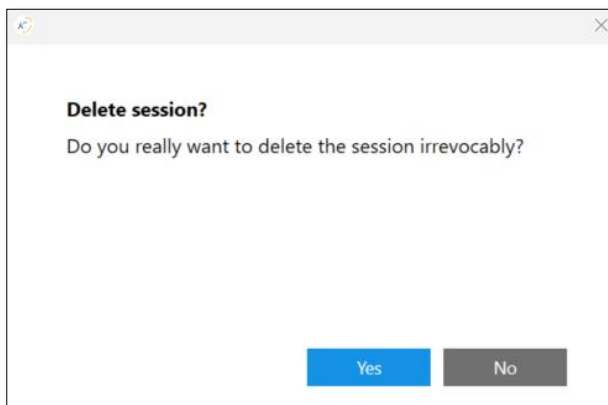


Figure56 : Deleting a session - 2

6.5 Short-Cuts

Click here to go to the test selection, tone audiometry or speech audiometry.

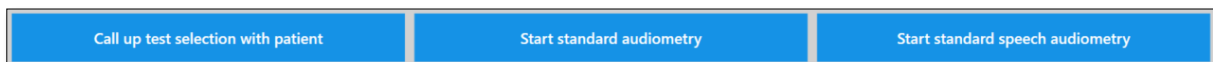


Figure57 : Short cuts in patient management

6.6 Further functions

There are three icons in the top menu bar.

Click on the following icon to open a window containing the instructions for use, the manufacturer's contact details and the device information. The button for remote maintenance via Team Viewer can also be found here. For more information, [see the chapter 22 Help](#).

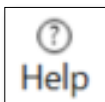


Figure58 : Help icon

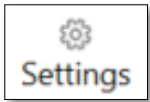


Figure59 : Icon for the settings

As you have to log in with a user, this symbol appears here. If you click on it, you will be logged out.

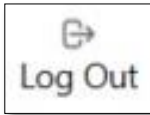


Figure60 : Icon for logging out

7 Test selection

The individual tests of the various modules can be selected directly in the test selection. First select the respective patient in the patient administration. Then click directly on the following button to access the test selection.

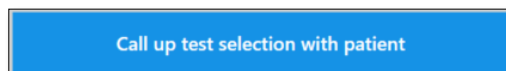


Figure61 : Button for test selection

This looks, for example, as shown in Figure63 : Test selection . The test selection depends on which licences you have purchased. The selected patient is noted in the menu bar at the top right. The test date is also entered. The following button takes you back to patient management.

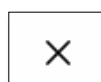


Figure62 : Back to patient management

The various modules can be found in the left-hand sidebar. If you click on one of the modules, the corresponding tests are displayed. The left sidebar is described in more detail below.

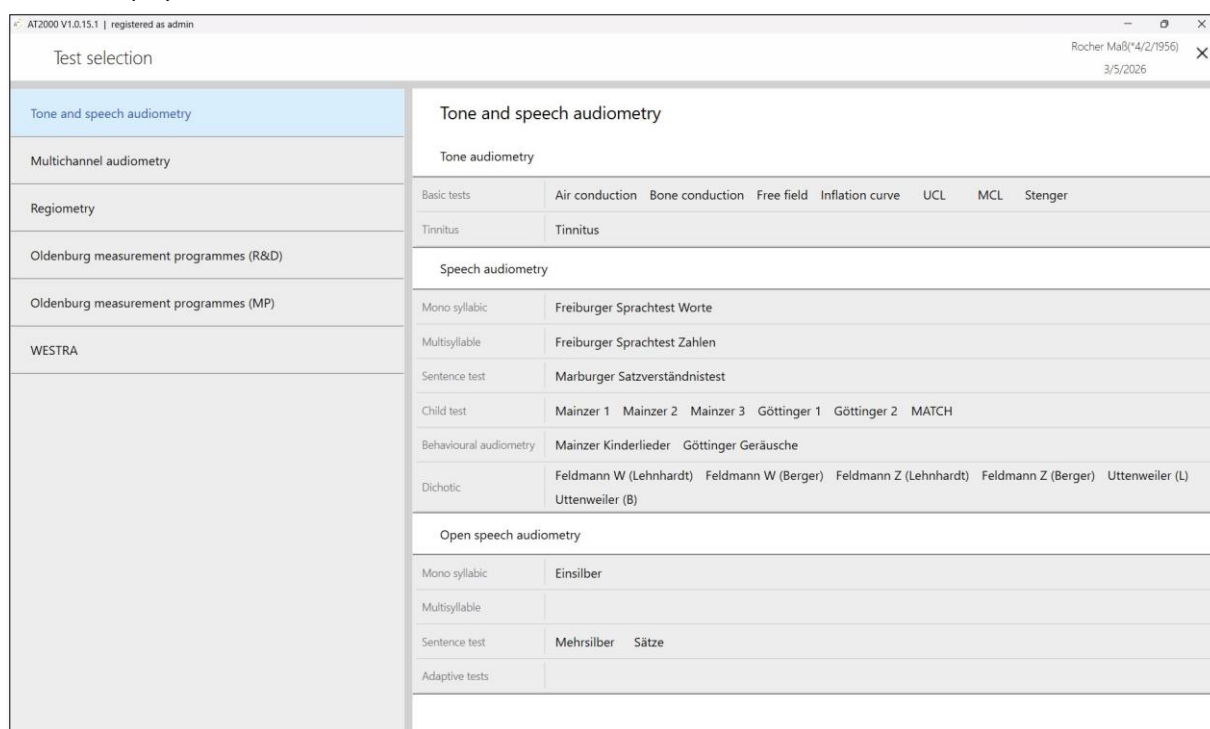


Figure63 : Test selection

7.1 Sound and speech audiometry

If you click on Tone and Speech Audiometry on the left sidebar, you will see that the test selection for this is divided into different areas - Tone Audiometry, Speech Audiometry, Free Speech Audiometry and Free Tone Audiometry.

7.1.1 Tone audiometry

In tonal audiometry, the basic tests include air conduction / bone conduction and free-field measurement. There are also flatulence curves and the UCL and MCL measurements.

If you click on the bone conduction measurement, for example, you are taken directly to a tone audiometry where the transducer has already been set to bone conduction. This also applies to the other measurements.

For more on tonal audiometry - see the chapter 8 Tone audiometry.

Tone audiometry							
Basic tests	Air conduction	Bone conduction	Free field	Inflation curve	UCL	MCL	Stenger
Tinnitus	Tinnitus						

Figure64 : Test selection - Tone audiometry

7.1.2 Speech audiometry

The speech audiometry test selection is divided into single-syllable, multi-syllable, sentence test, child test, behavioural audiometry and dichotic tests.

For more on speech audiometry - see the chapter 10 Speech audiometry.

Speech audiometry							
Mono syllabic	Freiburg words						
Multisyllable	Freiburg figures						
Sentence test	Marburg language test						
Child test	Mainzer 1	Mainzer 2	Mainzer 3	Göttingen 1	Göttingen 2	MATCH	
Behavioural audiometry	Children's songs Sounds of Göttingen						
Dichotic	Feldmann W (Lehnhardt)	Feldmann W (Berger)	Feldmann Z (Lehnhardt)	Feldmann Z (Berger)	Uttenweiler (Lehnhardt)	Uttenweiler (Berger)	

Figure65 : Test selection - Speech audiometry

In both tone audiometry and speech audiometry, it is possible to access speech audiometry or tone audiometry or other tests within the module by right-clicking.

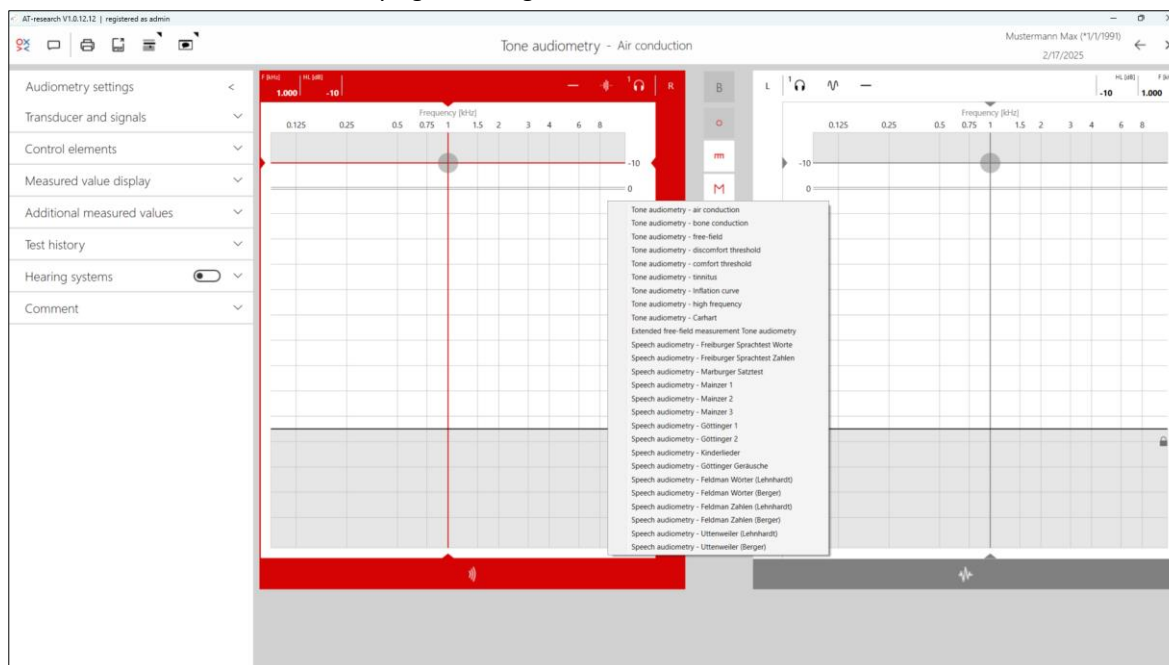


Figure66 : Test selection for audio audiometry by right-clicking

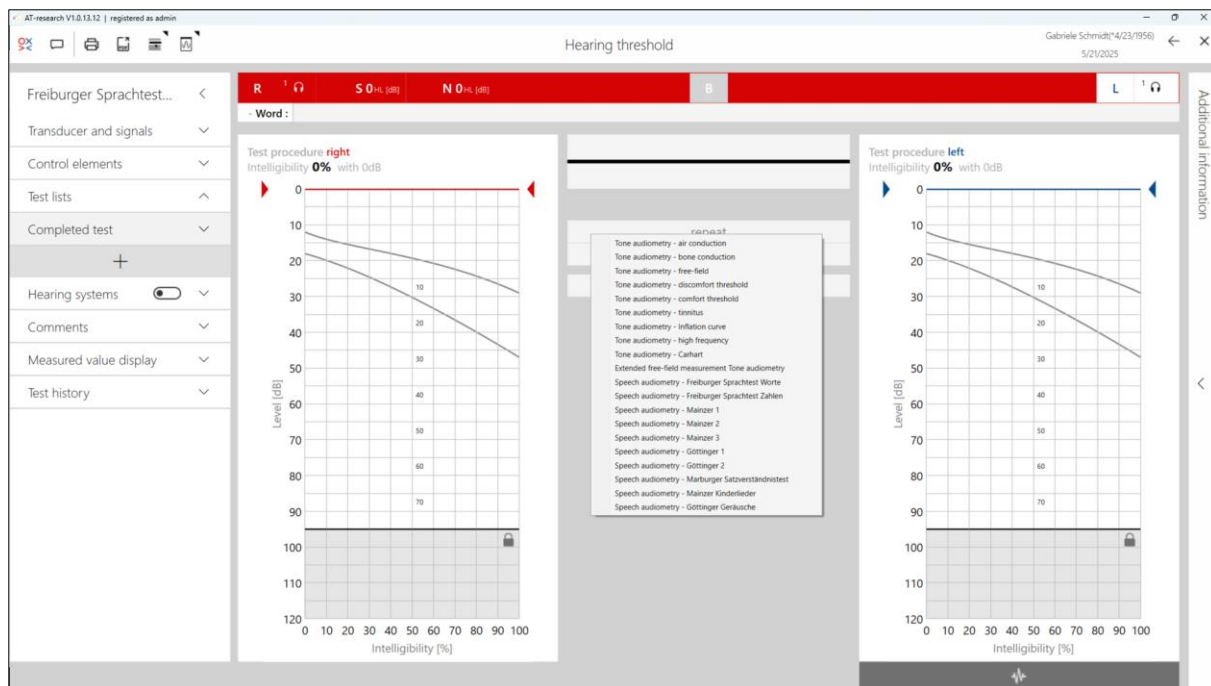


Figure67 : Right-click to select the speech audiometry test

7.1.3 Free speech audiometry

The self-created speech tests are listed in the test selection of free speech audiometry - divided into word tests (single-syllable), word tests (multi-syllable), sentence tests and adaptive tests.

For more on free speech audiometry – see chapter 13 Free audiometry – applies only to AT-research.

Open speech audiometry	
Word test (monosyllabic)	Simple Open Speech Test
Word test (multisyllabic)	
Sentence test	
Adaptive tests	

Figure68 : Test selection - Free speech audiometry

7.1.4 Free tone audiometry

The self-created sound tests are listed in the test selection of free tone audiometry.

Freie Tonaudiometrie	
Eigener tonaler Test	Hupen

Figure69 : Test selection - Free tone audiometry

7.2 Multi-channel audiometry (speech)

All saved configurations are listed in multi-channel audiometry (speech). If there are favourites, you can click on the asterisk and the configuration will always appear in first place - sorted alphabetically. For more information on multi-channel audiometry (speech), see the chapter 12.1 Multichannel audiometry – speech.

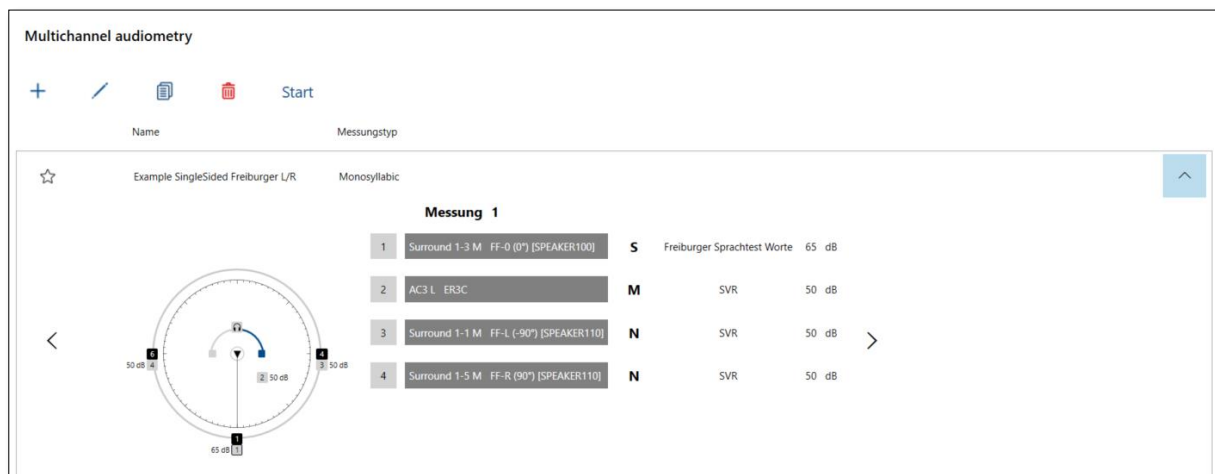


Figure70: Test selection - Multi channel speech

7.3 Regiometry

The extended free-field measurement can be found in the regiometry test selection. For more on regiometry – see 11.1 Extended free field measurement – Tone.

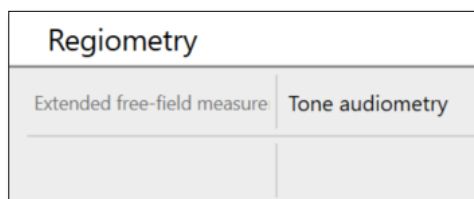


Figure71 : Test selection - Regiometry

7.4 Oldenburg measurement programmes (R&D)

All Oldenburg measurement programmes (R&D) are listed here. More about the Oldenburg measurement programmes – see 14 Oldenburg measurement programmes.

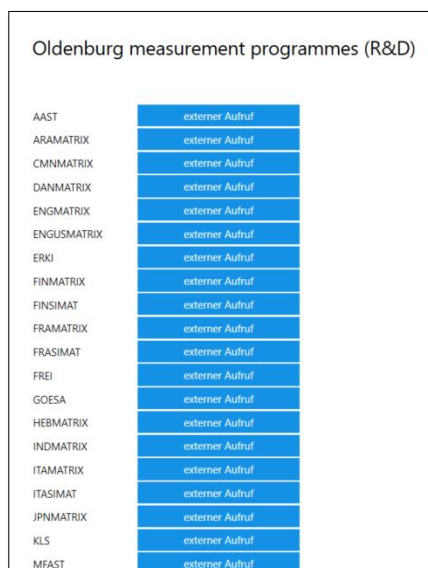


Figure72 : Test selection - Oldenburg measurement programmes (R&D)

7.5 Westra

All Westra tests are listed here. More about the Westra tests - [see 15 WESTRA](#).

Testauswahl

WESTRA - Testauswahl

Seite	Ausgang	Pegel
Rechts	S1_1_M [SPEAKER90]	65 dB
Links	---	65 dB

Schmalbandgeräusche starten

Figure73 : Test selection - Westra

8 Tone audiometry

Tone audiometry can be started either from the patient administration - see chapter 6 Patient management - or from the test selection - see chapter 7 Test selection.

8.1 Measuring method

All measurement procedures in audiometry are displayed in the test selection - see chapter 7 Test selection.

8.2 Tone audiometry software interface

After starting audiometry, the following software interface appears.

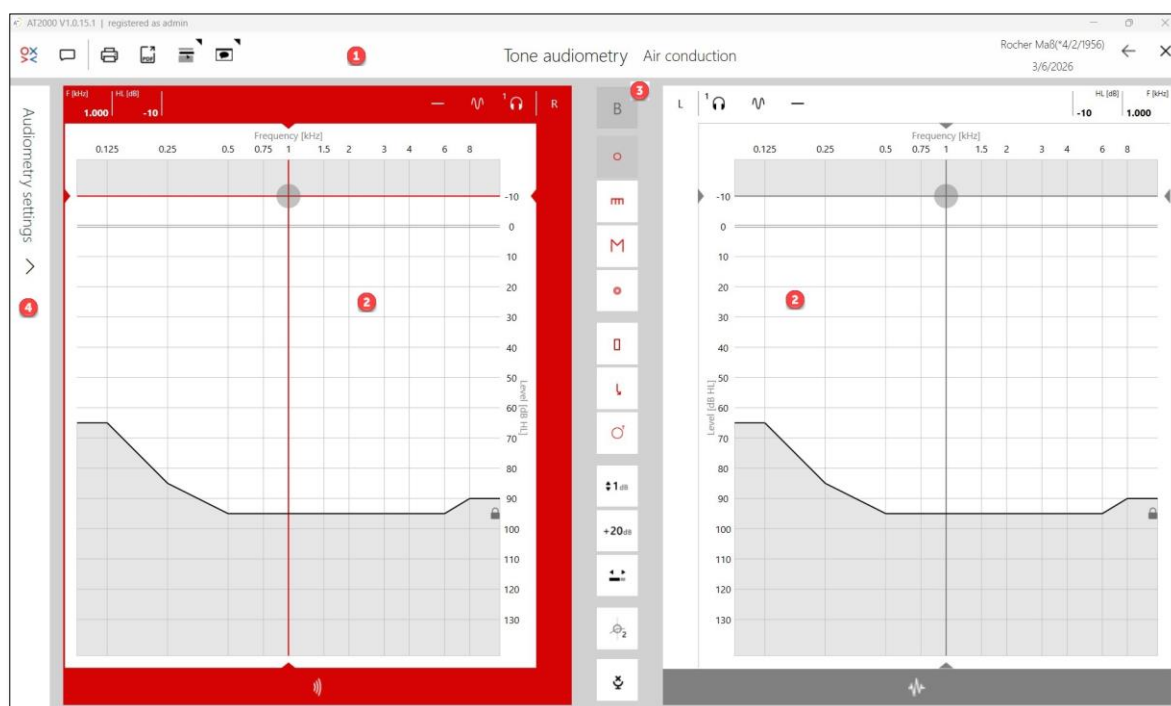


Figure74 : Surface of the tone audiometry

The surface of tonal audiometry is divided into four areas. These areas are described in more detail in the following chapters.

Table12 : Areas in tonal audiometry

1	Tone audiometry menu bar - see chapter 8.3 Tone audiometry menu bar
2	Tone audiograms - see chapter 8.4 Audio audiograms
3	Further functions - see chapter 8.5 Further functions
4	Tone audiometry sidebar - see chapter 8.6 Tone audiometry sidebar

8.3 Tone audiometry menu bar

The menu bar is described below from left to right.

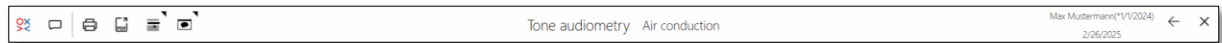
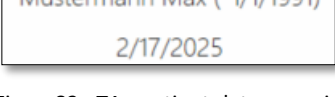
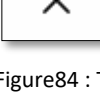


Figure75 : Tone audiometry menu bar

Table13 : Tone audiometry menu bar

 Figure76 : TA - Show legend	The legend is displayed - see chapter 8.6.3 Measured value display
 Figure77 : TA - Show comment field	You can enter a comment - see chapter 8.6.7 Comments
 Figure78 : TA - Print audio audiogram	The measurement results can be printed out - see chapter 8.3.1 Pressure in tonal audiometry
 Figure79 : TA - Export audio audiogram as PDF	This symbol can be used to create a PDF directly - see chapter 8.3.2 PDF export in tonal audiometry
 Figure80 : TA - Test selection	One click takes you to the test selection - see chapter 7 Test selection
 Figure81 : TA - Speech audiometry	One click takes you directly to speech audiometry - see the chapter 10 Speech audiometry
 Figure82 : TA - patient data, examination date	Here you can check whether the correct patient (first name, surname and date of birth) has been selected. The second line shows the date of the examination.
 Figure83 : TA - Back to test selection	After clicking this button, you are in the test selection and still in the same session.
 Figure84 : TA - End measurement and return to patient administration	If you click on this button, the measurement is automatically saved and ended. You are then in patient management.

8.3.1 Pressure in tonal audiometry

To print the audiometry measurement results, click on the print icon. The following window then opens. First select the correct printer here. Individual settings can then be made. For default settings, see the chapter 21.1.8 Print.

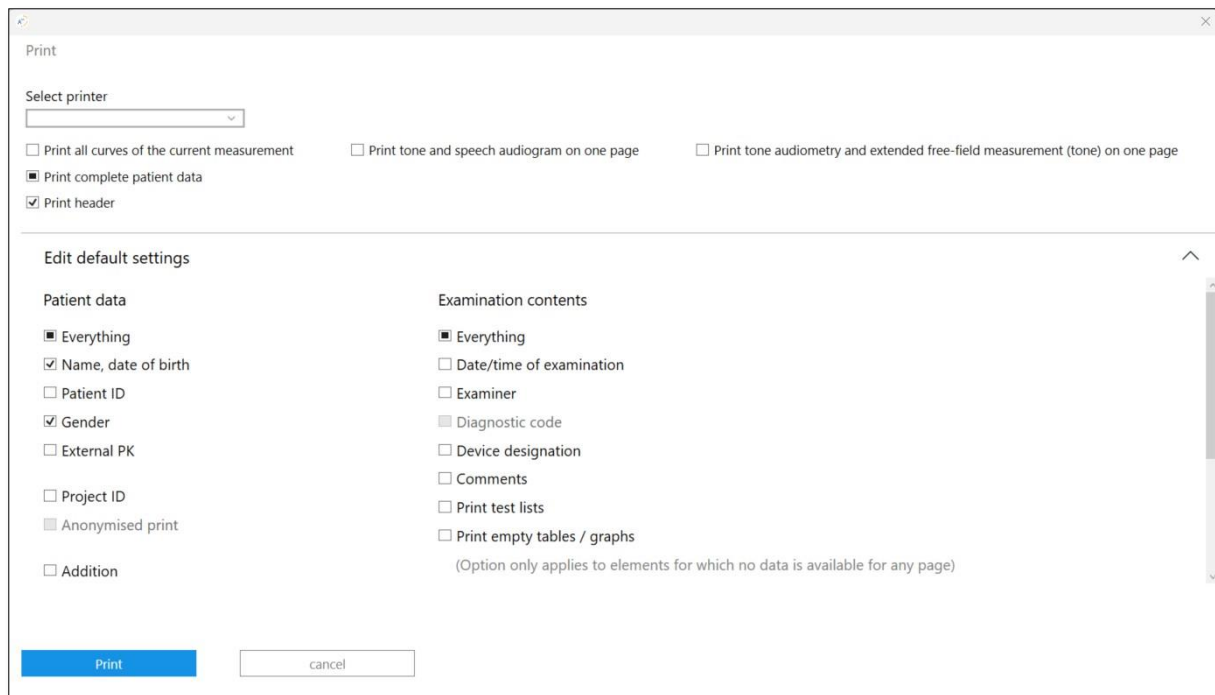


Figure85 : Print in tonal audiometry

8.3.2 PDF export in tonal audiometry

If you click on the PDF symbol, the following window opens. Individual settings can be made here and the PDF created. For default settings, see the chapter 21.1.8 Print.

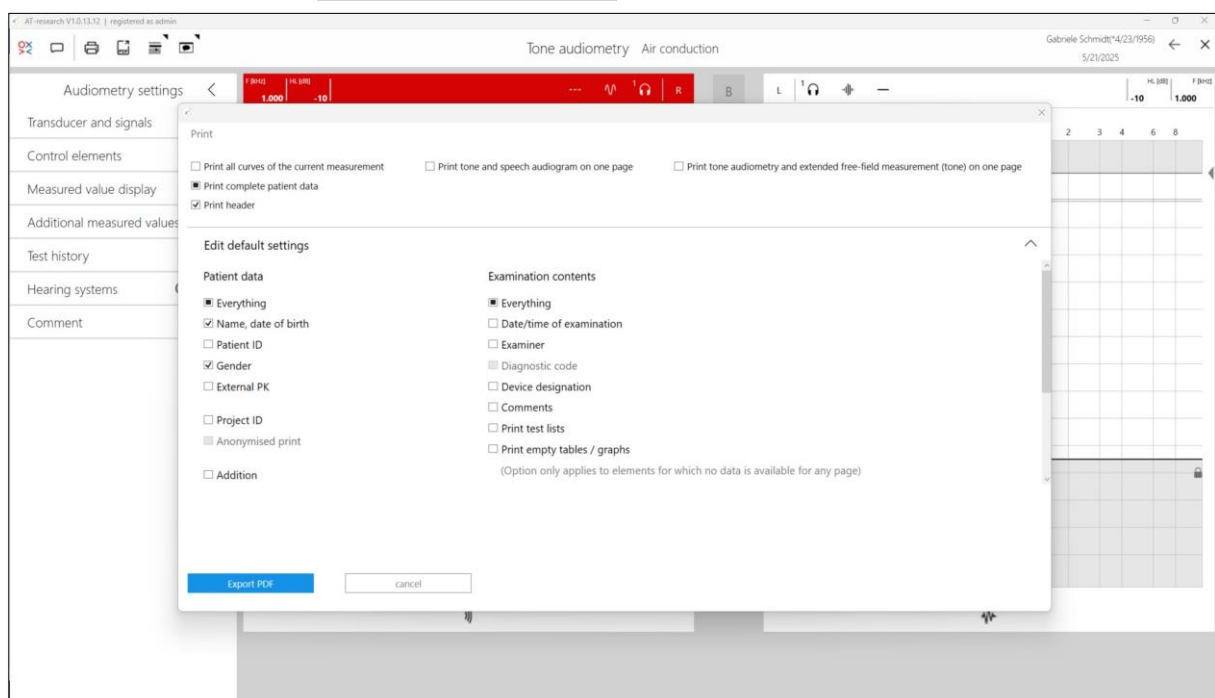


Figure86 : PDF export in tonal audiometry

8.4 Audio audiograms

8.4.1 Signal on/off

If the sound is switched on, this is indicated by the coloured bar below the sound audiogram - red for the right ear side, blue for the left ear side and grey for deafening. If the sound is not switched on, the bar below the sound audiogram remains white.

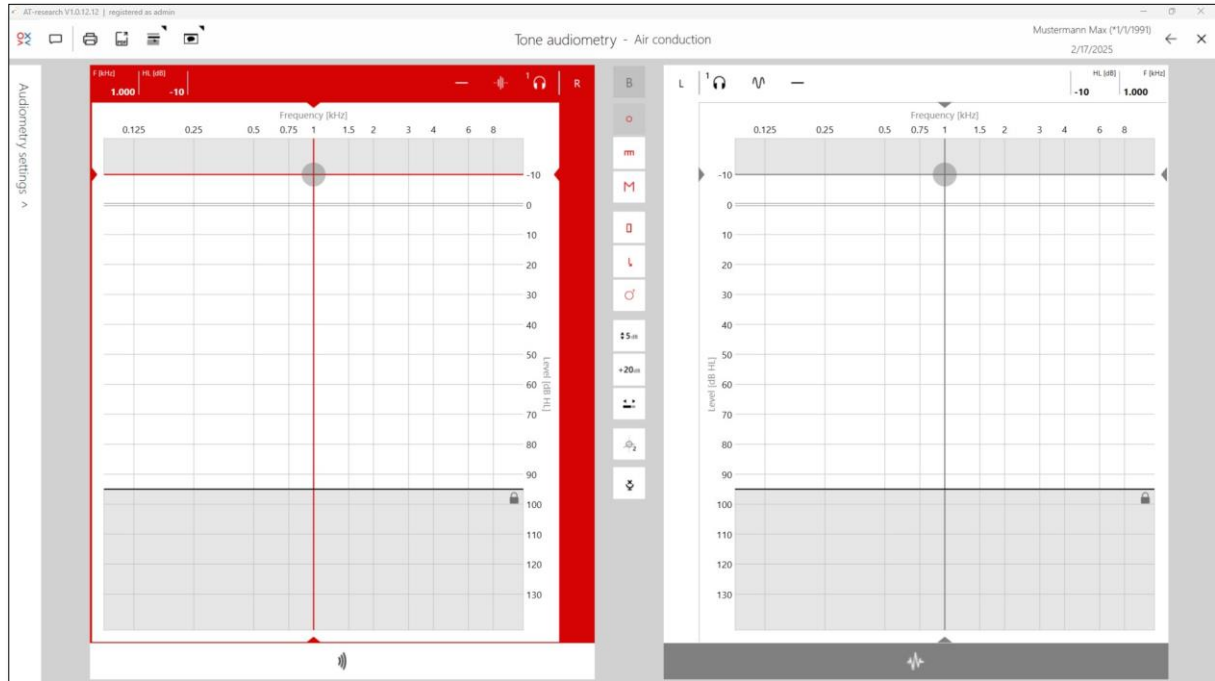


Figure87 : Signal on/off in audiometry

8.4.2 Signalling performance

You can choose between the signal types - continuous, pulsating and wobble. Depending on the selected signal type and transducer, not all options may be displayed.

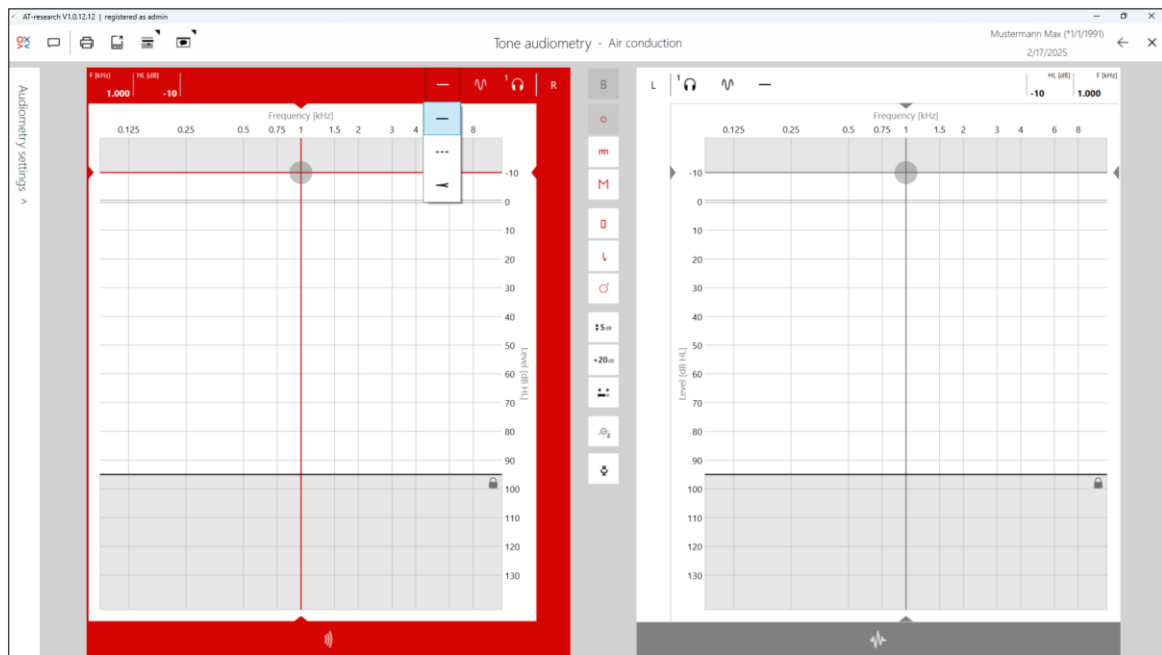


Figure88 : Signal presentation in tonal audiometry

8.4.3 Signal types

You can choose between the signal types - sine, white noise, pink noise, narrowband noise and steep narrowband noise. Depending on the selected transducer, not all options may be displayed.

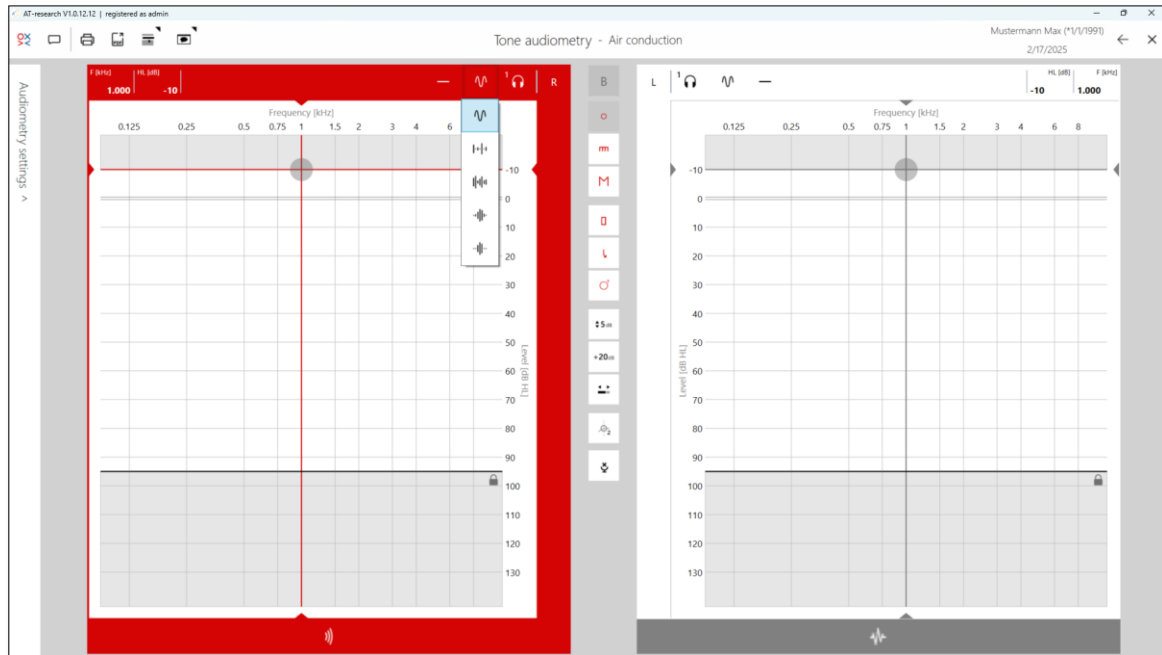


Figure89 : Signal types in tonal audiometry

8.4.4 Transducer

You can choose between transducers - headphones (DD45, DD450), plug-in headphones (ER3C), bone conductors (B81), free-field loudspeakers (90dB and 100dB) and implants.

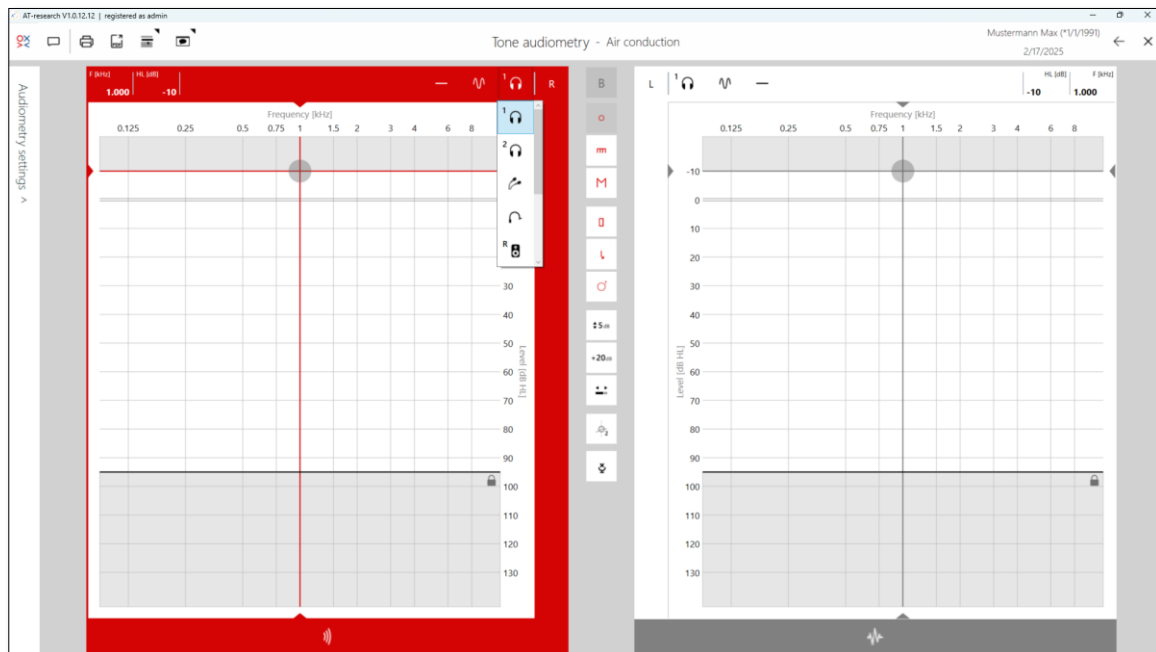


Figure90 : Transducer in tonal audiometry

8.4.4.1 Implants

If you click on one of the implants in the transducerselection, the following message appears. This message must first be confirmed before you can carry out a measurement with the implant.

The implant measurement can only be carried out if the licence and cable have been purchased.

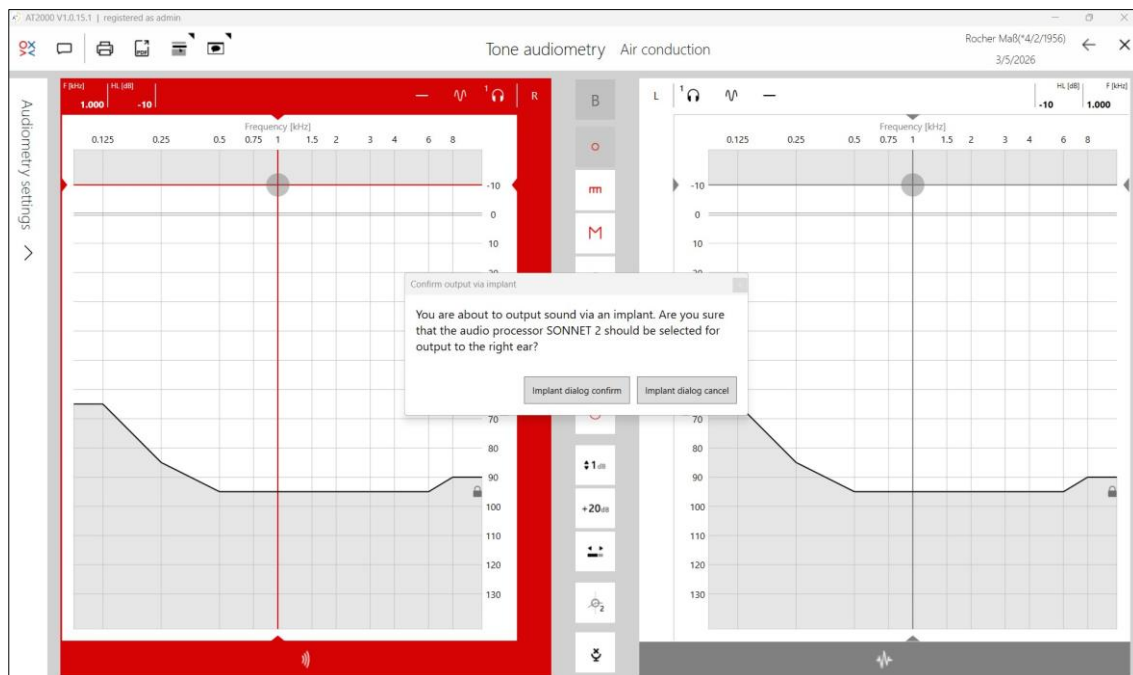


Figure91 : TA - Implant measurement

8.4.5 Side change

You can change side either by pressing "F3" or by clicking on "R" or "L" above the audio audiogram.

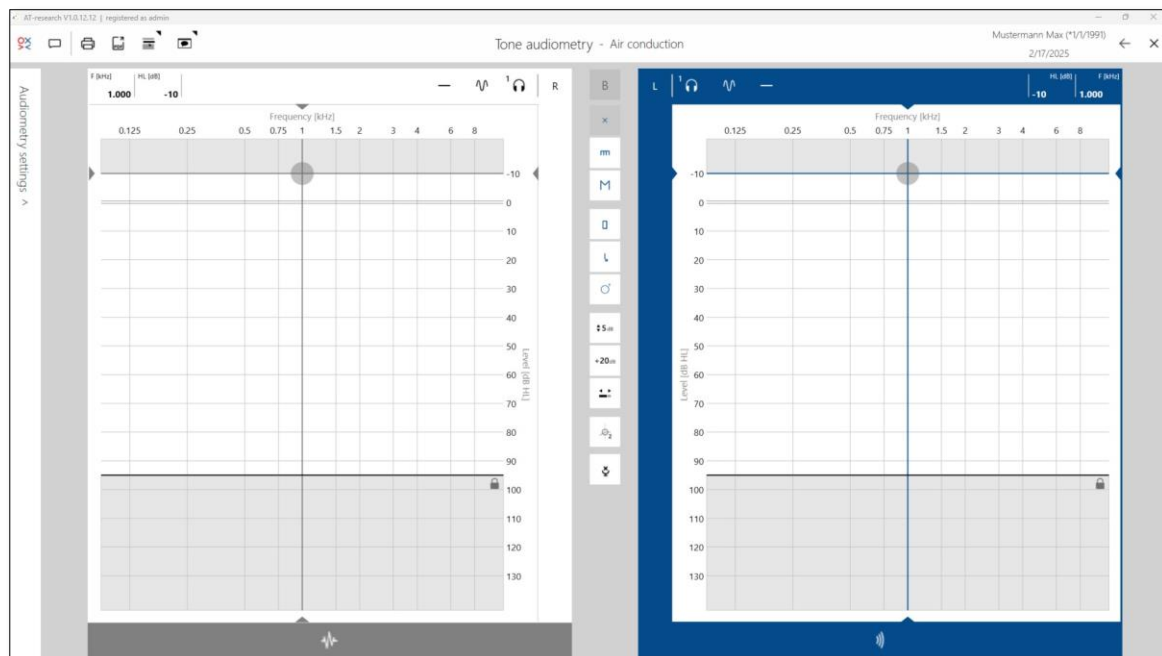


Figure92 : Side change in tonal audiometry

8.4.6 Save measurement

The measurements are saved automatically. After closing, the session appears in the test history with the date and time as well as an entry of the test procedures performed.

8.4.7 Delete measuring point or measuring series

To delete one or more measuring points, place the cursor on the corresponding frequency value and right-click with the mouse. After the right mouse click, you can choose between "Delete measurement point", "Delete entire curve" and "Delete measurement series".

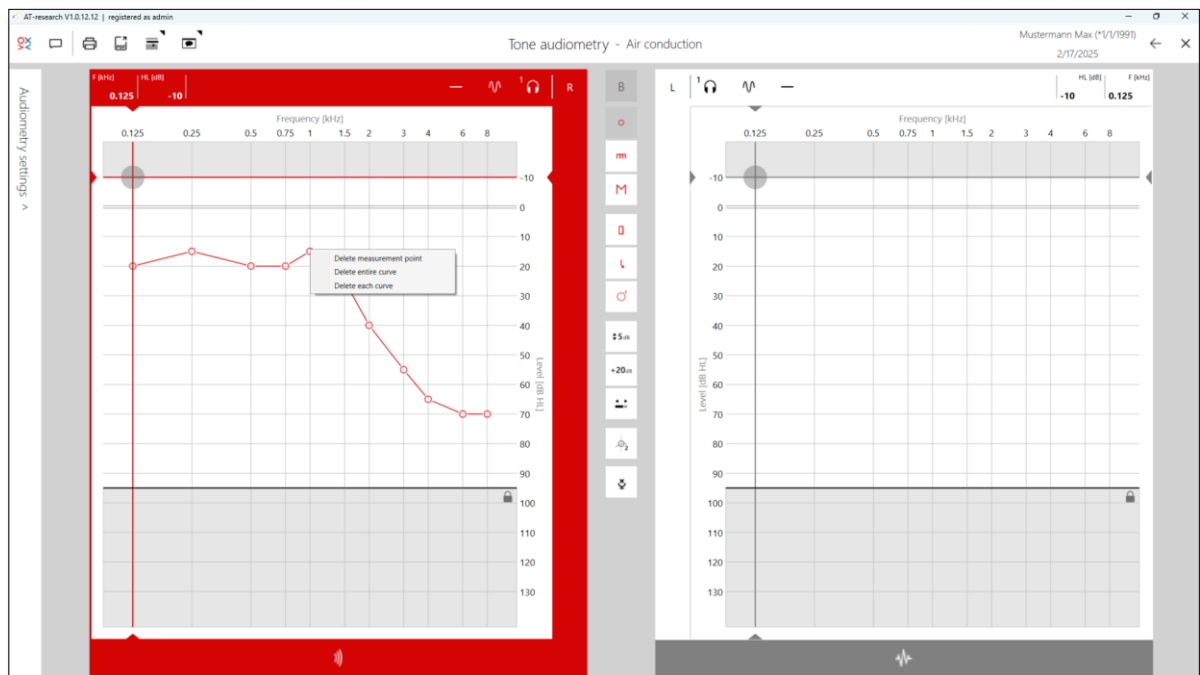


Figure93 : Delete measurement point, whole curve and measurement series in tonal audiometry

8.4.8 Warning above 80dB

If the level is already set above 80dB and a frequency change is carried out, there is a warning that both level controls must be set below 80dB - for headphones and free field. The signal is automatically switched off for safety reasons.

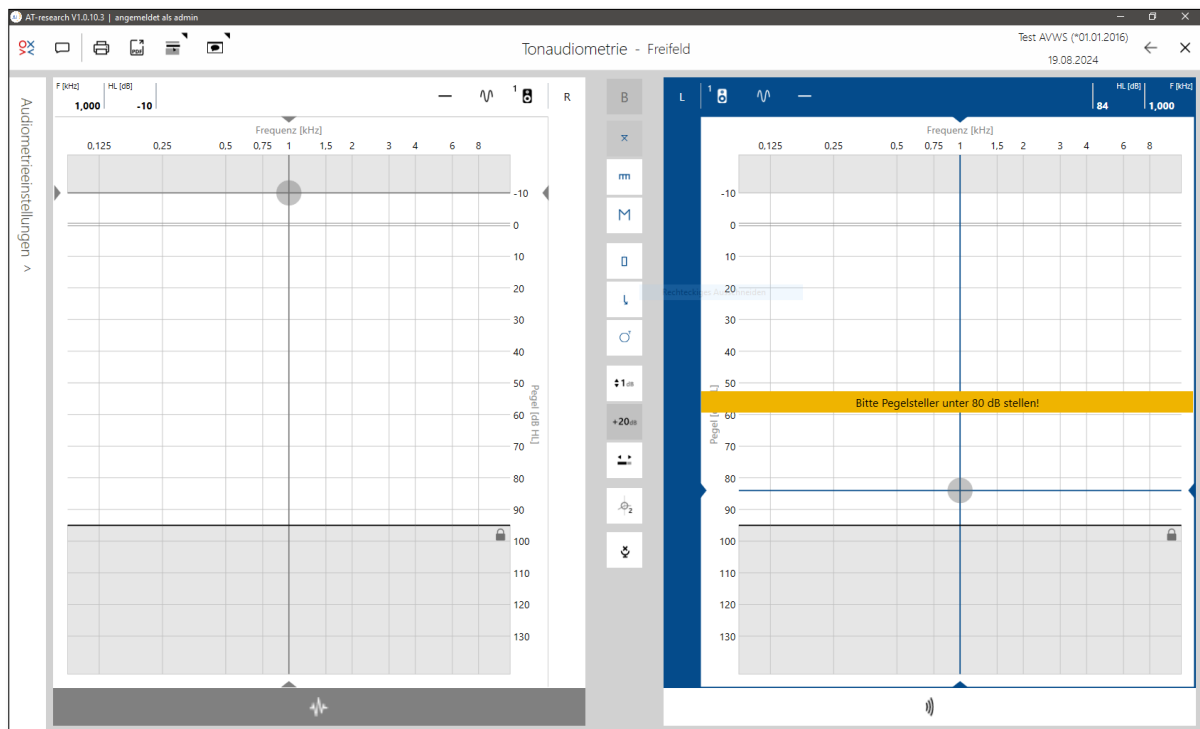


Figure94 : Warning in audiometry - 1

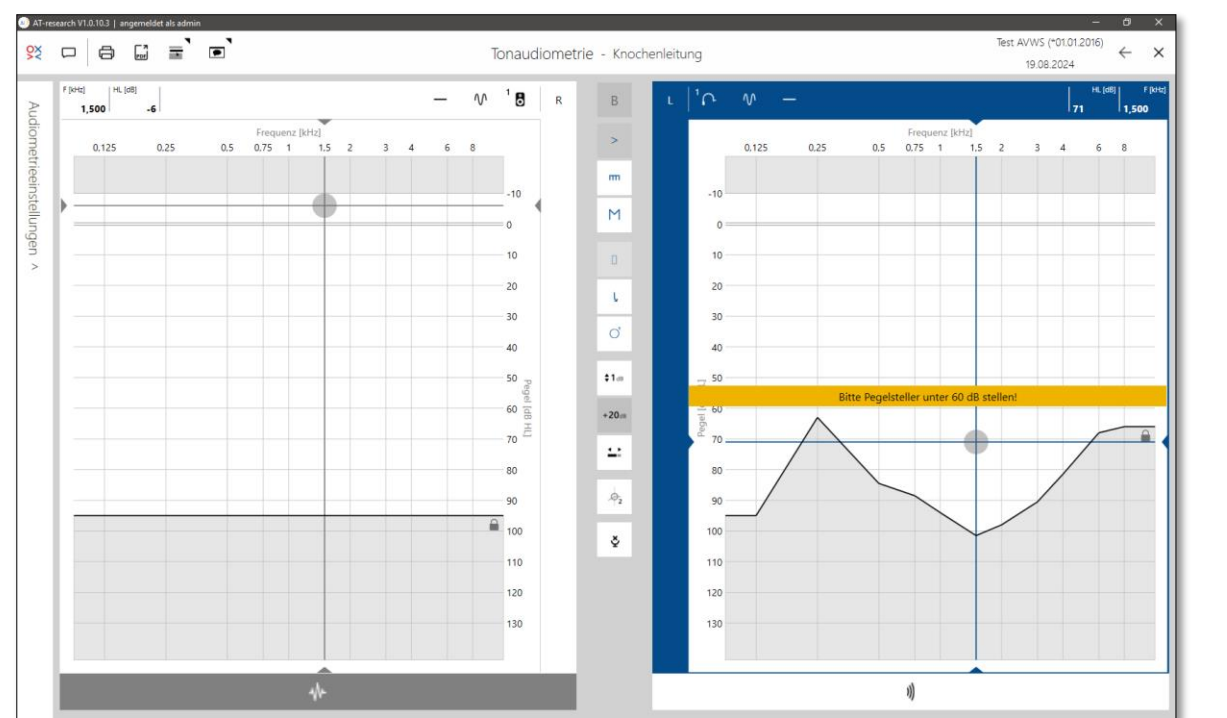


Table14 : Further functions in tone audiometry (example right side)

 Figure97 : TA - Binaural	The binaural measurement is activated (not yet implemented).
 Figure98 : TA - Measure hearing threshold	The hearing threshold is measured here - see chapter 8.7.1 Hearing threshold measurement. This symbol is automatically adjusted when changing sides or transducers.
 Figure99 : TA - Measure discomfort threshold	If you click on this button, the discomfort threshold can be determined - see the chapter 8.7.1.3 Discomfort threshold (UCL).
 Figure100 : TA - Measure comfort threshold	If you click on this button, the comfort threshold can be determined - see chapter 8.7.1.4 Comfort threshold (MCL)
 Abbildung 101: TA - Stenger Test	The Stenger test can be drawn in.
 Figure102 : TA - Draw in uncertain information	The uncertain specification can be drawn in.
 Figure103 : Draw TA - No specification	No information can be entered.
 Figure104 : TA - Tinnitus	Tinnitus can be entered.
 Figure105 : TA - increment in dB	The step width can be set to 1 dB, 2 dB and 5 dB.
 Figure106 : TA - Switch amplification on/off	The gain of 20 dB can be switched on and off here.  This function is only intended for a short-term measurement to determine the patient's residual hearing loss. Sound levels of 130dB over a longer period of time can damage both the patient in question and the headphones.
 Figure107 : TA - Switch view	The view for the highest tone audiometry can be switched here - see chapter 9 Highest tone audiometry
 Figure108 : TA - Second measurement curve	This button is used to enter a second measurement curve A second measurement curve in tone audiometry can be recorded within the following measurements: Air conduction, bone conduction, free-field measurement, flatness curve measurement, discomfort threshold measurement.



Figure109 : TA - Microphone

The microphone can be switched on and off with this button.

8.6 Tone audiometry sidebar

Many other settings can be made in the left-hand sidebar. It is advisable to use the sidebar before starting the measurement and to collapse it again after setting and before starting the measurement. These settings are described in more detail in the following chapters.

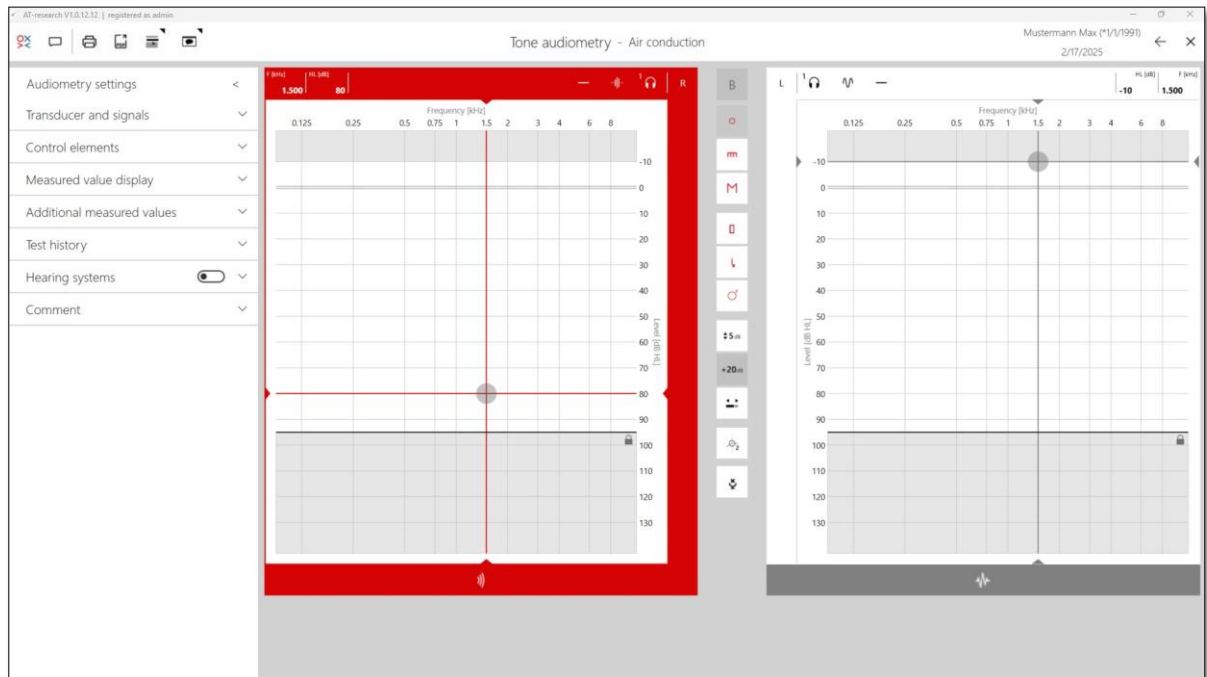


Figure110 : Left sidebar in tone audiometry

8.6.1 Transducer and signal

The transducer used, the signal type used and the type of signal presentation can be set both in the audiogram area and in the left-hand side list. The settings for the sweep tone are made in the sidebar. The default setting for the sweep tone is 4Hz with 2.5%.

Transducer and signals	
Side	R L
Transducer	1 1
Signal	~ ~
Signal type	— <
Wobbletone	4Hz
	5%
pulse duration	200 ms
pulse-pause-ratio	1:1

Figure111 : TA - Transducer and signal

8.6.2 Control elements

In the control elements, you will find the setting for the sliding masking, monitor, microphone and the dB increment.

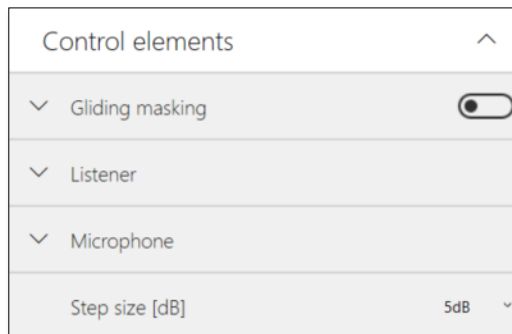


Figure112 : TA - Control elements - 1

Floating masking can be activated or deactivated. The distance between the masking level and the signal level can be entered and fixed for the air line, bone line and free field.

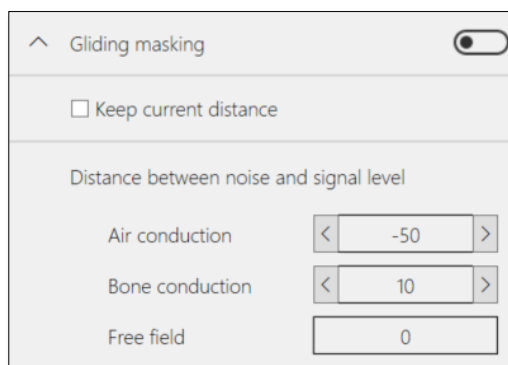


Figure113 : TA - Control elements - 2

The handset monitor can be activated or deactivated on the left or right at a specific volume.

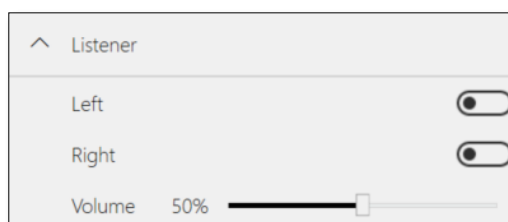


Figure114 : TA - Control elements - 3

The microphone can be enabled or disabled at a specific volume.

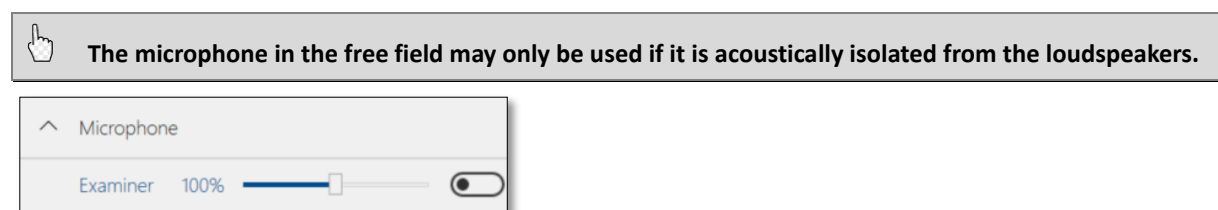


Figure115 : TA - Control elements - 4

The dB increment can also be set in the left-hand sidebar.

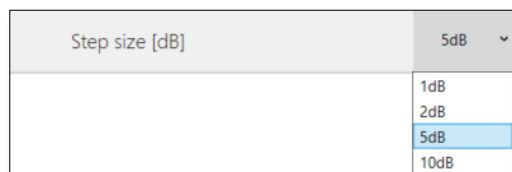


Figure116 : TA - Control elements - 5

8.6.3 Measured value display

When you open the legend or the measured value display, only the symbols required for audiometry will be visible.

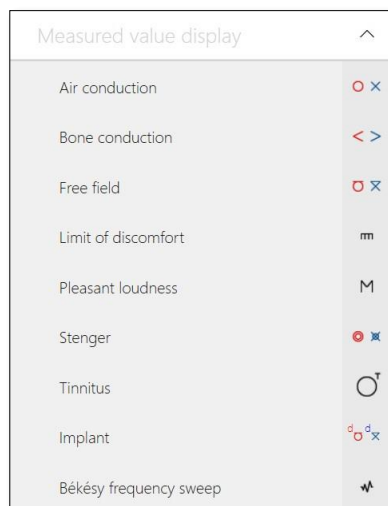


Figure117 : TA - Measured value display

8.6.4 Additional measured values

Additional measurements such as Rinne, Weber, Tinnitus, SISI and Lüscher can be selected via the Additional measured values.

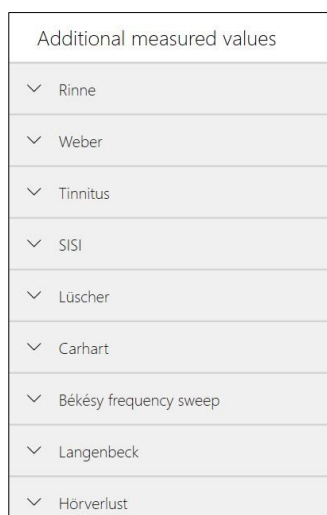


Figure118 : TA - Additional measured values

8.6.4.1 Rinne

In the Gutter menu, the display of the results table in the tone audiogram can be switched on and off using a button. The results of the test are only documented via the sidebar. For each page, the type of measurement used, the test frequency, the level with the bone receiver used and the result in the form "empty", "plus" or

"minus" can be entered. When using the bone receiver, the stimulus presentation is also switched on and off using the "Play sound" button. See also chapter 8.7.3.2 Rinne test.

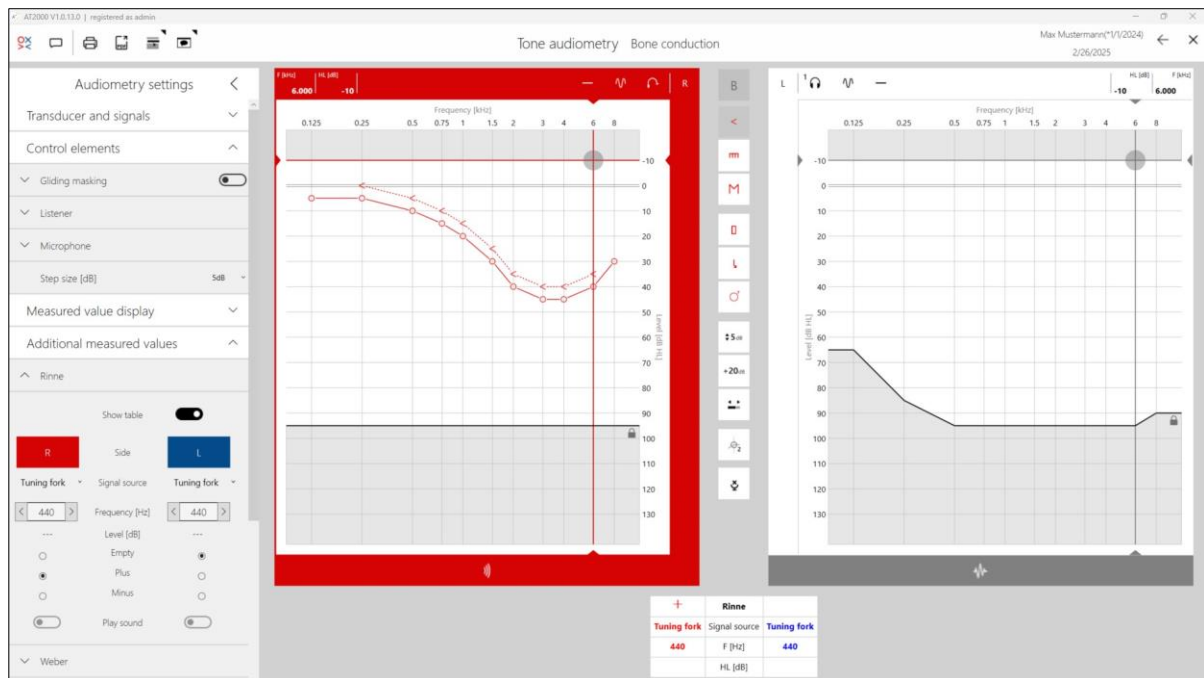


Figure119 : TA channel

8.6.4.2 Weber

In the Weber menu, the display of the results table in the tone audiogram can be switched on and off using a button. The results of the test are only documented via the sidebar. The type of measurement used, test frequency, the level with the bone receiver used and the result in the form "empty", "right", "centre" or "minus" can be entered. When using the bone receiver, the stimulus presentation is also switched on and off using the "Play sound" button. See also chapter 8.7.3.1 Weber test.

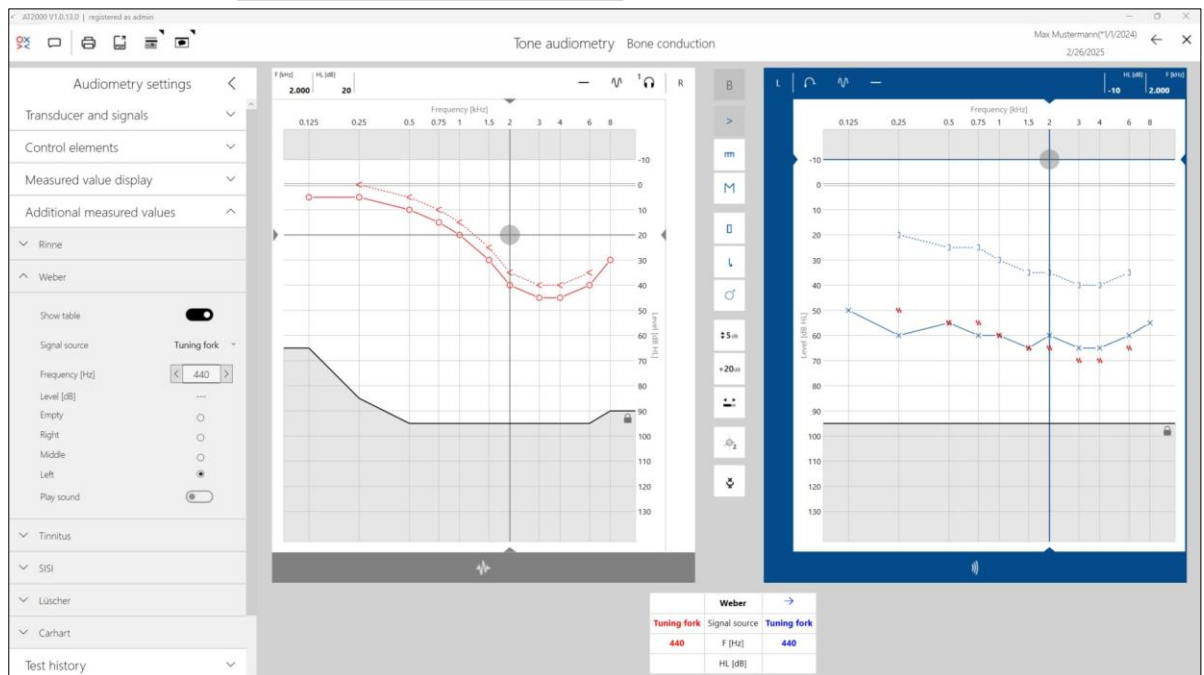


Figure120 : TA - Weber

8.6.4.3 Tinnitus

In the Tinnitus menu, the display of the results table in the tone audiogram can be switched on and off using a button. The results of the measurement can be documented directly via the sidebar. The signal used, the tinnitus

frequency and the determined level can be entered for each page. The "No tinnitus" button sets all entries for the respective ear to "No tinnitus". The "Delete value" button completely removes all entries for the respective ear from the table

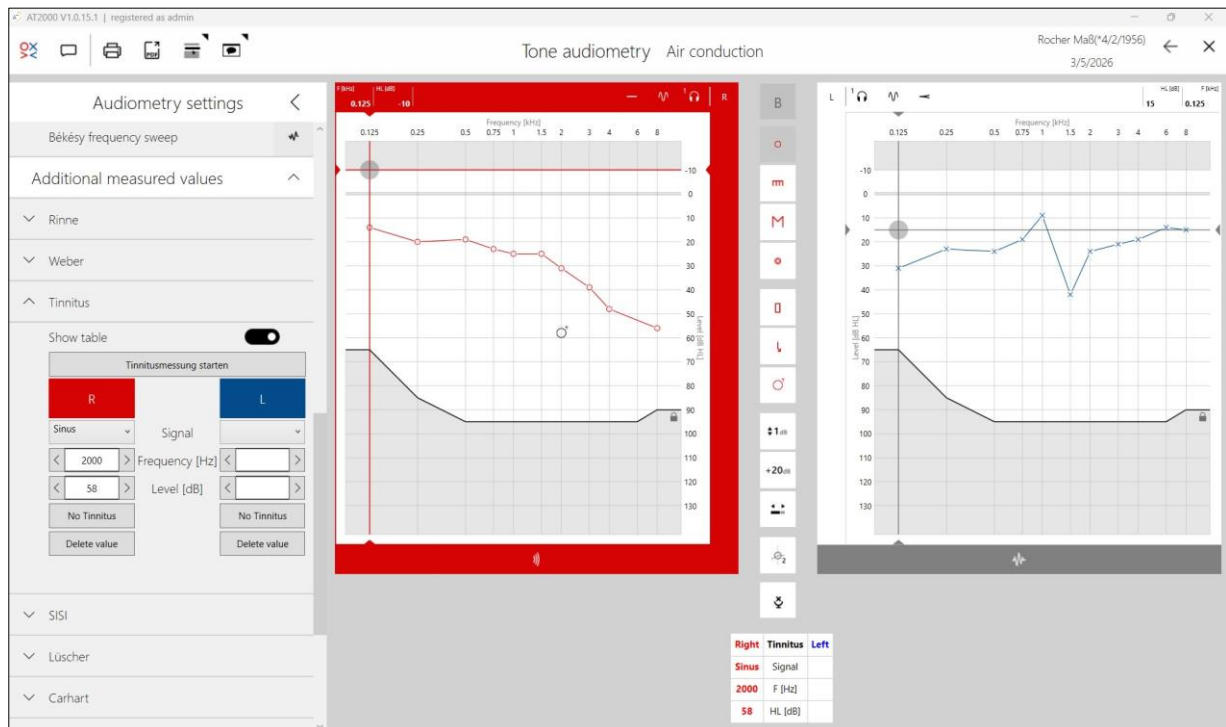


Figure121 : TA – Tinnitus

Once the tinnitus measurement mode is installed, you can also switch to tinnitus measurement mode by clicking on the 'Start tinnitus measurement' button, which allows you to determine the tinnitus threshold in 25 Hz increments. The other level controls remain unchanged. Only sine wave signals can be used in tinnitus measurement mode. In measurement mode, a tinnitus threshold is always set instead of a hearing threshold. The 'Stop tinnitus measurement' button exits measurement mode and returns to conventional tone audiometry.

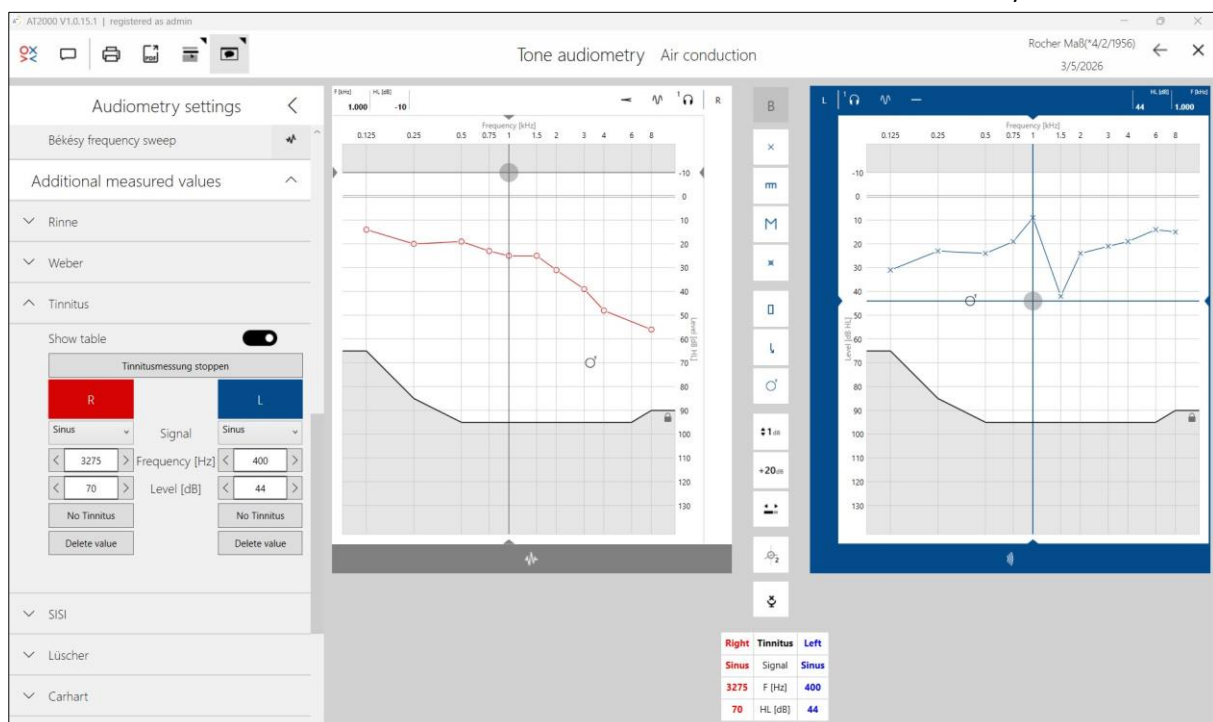


Figure122 : TA – tinnitus measurement mode



Due to hardware limitations, the DD45 transducer may exhibit deviations in the 3–4 kHz and 6–8 kHz ranges compared to other transducers. These deviations are not indicative of missing or inadequate calibration.

8.6.4.4 SISI

The SISI test can be carried out in the SISI menu. The results of the test are documented in the sidebar. The results table can also be displayed in the audiogram using the "Table in interface" button. The respective parameters can be adjusted before starting the test using the "Frequency", "Start step size" and "Offset hearing threshold" controls. The "Delete value" button deletes a measurement that has already been carried out at the currently entered frequency. The "Correct answers" button automatically determines the current percentage value during the test. The "Start SISI" button starts the test in the currently selected conditions. See also chapter 8.8.1 SISI test.

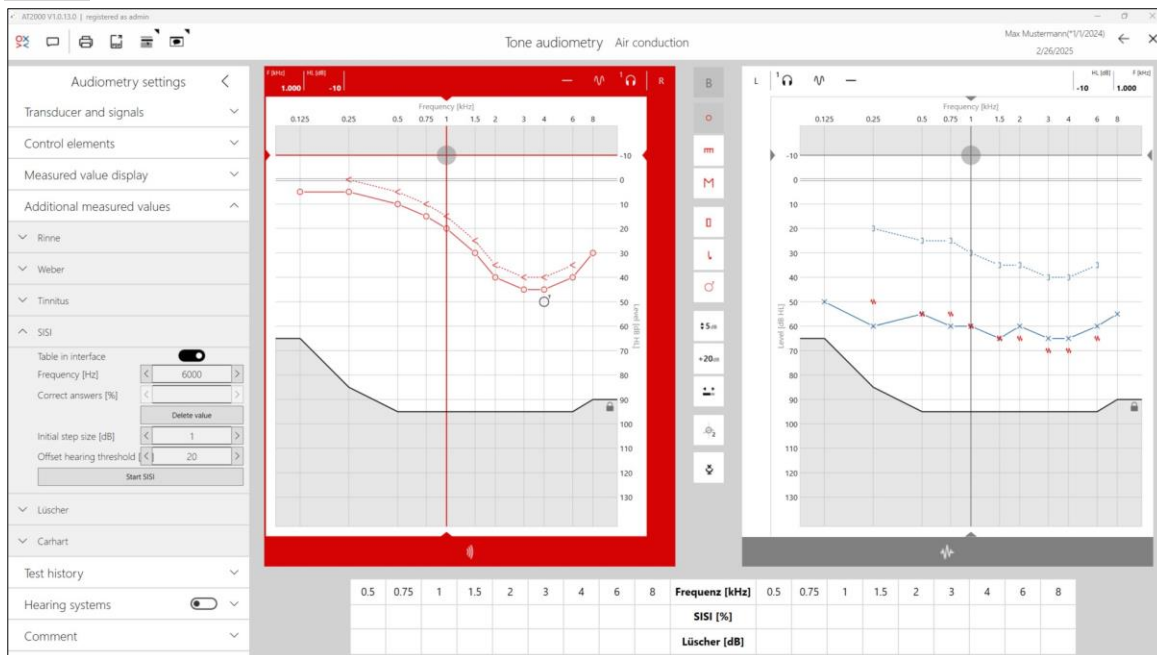


Figure123 : TA - SISI

8.6.4.5 Lüscher

The Lüscher test can be carried out in the Lüscher menu. The results of the test are documented in the sidebar. The results table can also be displayed in the audiogram using the "Table in interface" button. The "Frequency" slider can be used to adjust the parameter before starting the test. The "Delete value" button deletes a measurement that has already been carried out at the currently entered frequency. The last correctly recognised step size in dB is automatically entered via "Step size" during the test. The "Start Lüscher" button starts the test in the currently selected conditions. See also chapter 8.8.2 Lüscher test.

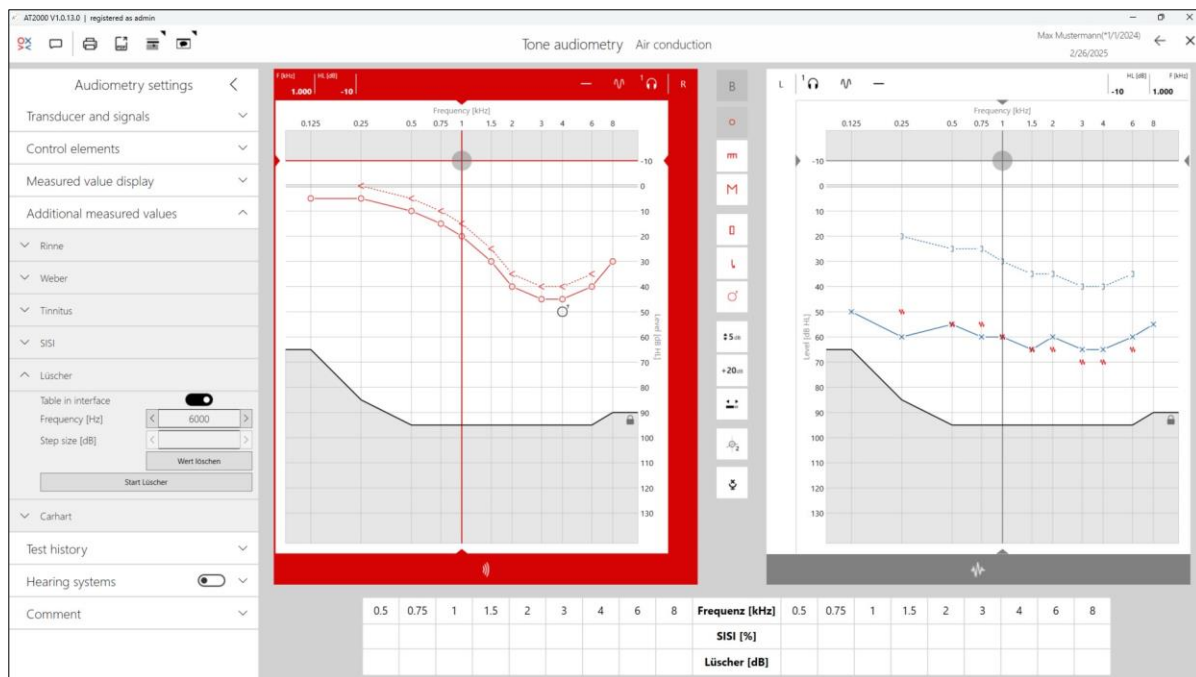


Figure124 : TA - Lüscher

8.6.4.6 Carhart / threshold tone decay test

The Button “Start Carhart Mode” in the Carhart menu activates the Carhart view. The results are documented in a diagram on the right-hand side of the screen. The measurement frequency can be set before starting the test using the selection field on the left or the control unit/keyboard. The test is started or stopped at the currently selected frequency using the ‘„Start [Stop] Carhart measurement” button. Clicking on the ‘Delete current measurement’ button deletes the measurement at the currently selected frequency. See chapter 8.8.3 Carhart test.

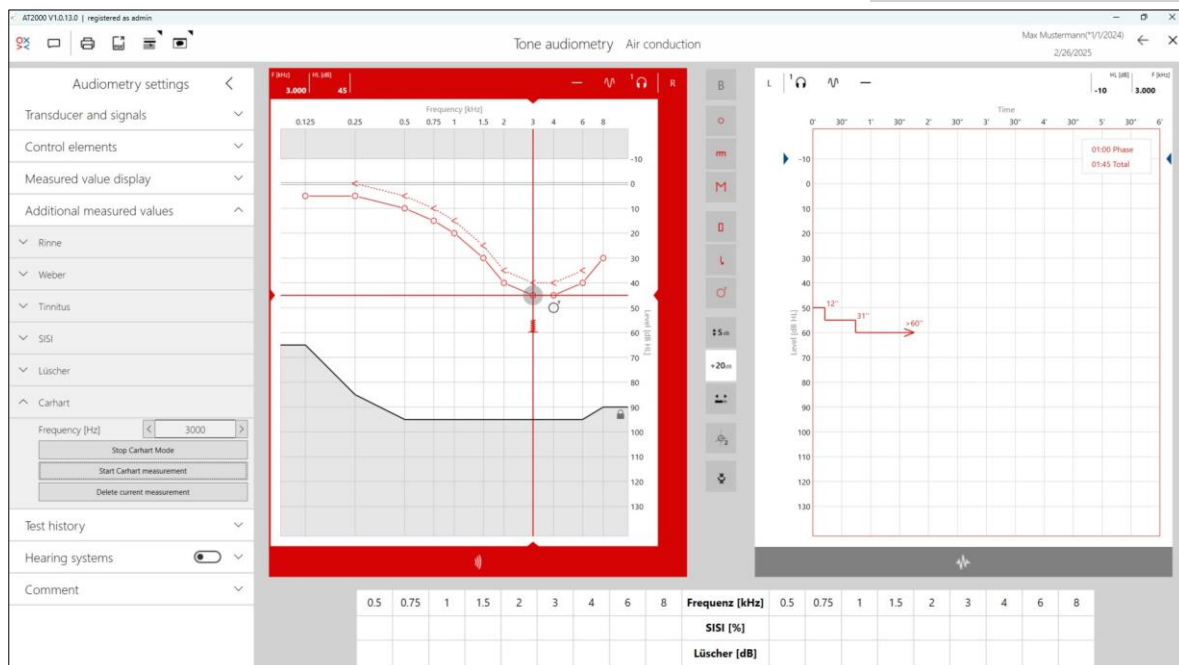


Figure125: TA – Carhart

8.6.4.7 Békésy sliding frequency

The Bekesy sliding frequency menu is used to configure and start automatic tone audiometry according to Békésy. To do this, the examiner selects a frequency speed in octaves/min (0.25, 0.5, 1 or 2) and a level speed in dB/s (2.5 or 5). The frequency range to be tested is automatically defined by the transducer used. The maximum

test level can be extended using the +20 dB button. A continuous or pulsed signal presentation must be selected. Pressing the 'Start test' button starts the test on the active ear side. The start level is determined by the current position of the level slider. The button changes to 'Stop test' and another button, 'Pause test', appears. During the test, the test level and test frequency increase continuously. The patient can influence the test level by pressing the patient button. If the button is not pressed, the level continues to increase. As long as the button is held down, the test level decreases. The test frequency cannot be influenced. The patient must be instructed by the examiner to press the button as long as they can hear a tone and to release it when the tone disappears. This process is repeated until the examiner confirms that the measurement is complete or is cancelled.

If the audiometry is stopped using the 'Stop test' button, the test signal is interrupted and the examiner must specify how to proceed in a warning window. The examiner can save the incomplete measurement and end the test, or the measurement can be discarded or continued.

One measurement with continuous and pulsed tone can be saved for each ear. The saved measurement is deleted using the 'Delete current measurement' button. The button can only be selected if automatic audiometry is available for the currently selected signal type.

See also chapter 8.9.1 Békésy test (sliding frequency).



Due to hardware limitations, the DD45 transducer may exhibit deviations in the 3–4 kHz and 6–8 kHz ranges compared to other transducers. These deviations are not indicative of missing or inadequate calibration.

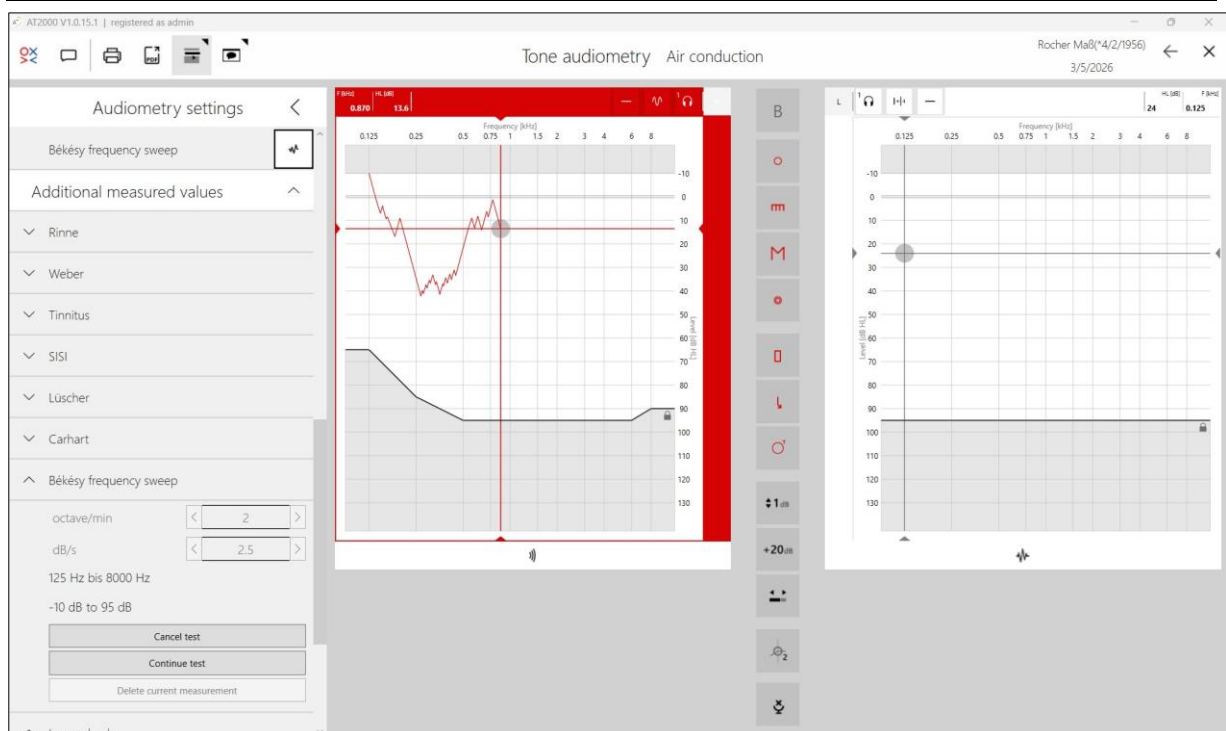


Figure126: TA – Békésy sliding frequency

8.6.4.8 Langenbeck

The Langenbeck test can be performed in the Langenbeck menu. The test is started or stopped using the 'Start or stop Langenbeck mode' button. Clicking on the 'Delete current measurement' button deletes the measurement.

Two markers are set in the tone audiogram each time the 'Apply' button is pressed. One marker is set at the current level of the test signal, using the air conduction hearing threshold symbol (right/left) in black. In addition, the noise level used is represented by a second marker. Markers for the test signal and noise levels are connected with a black line as long as they are no more than two frequencies apart.

See also chapter 8.8.4 Langenbeck.

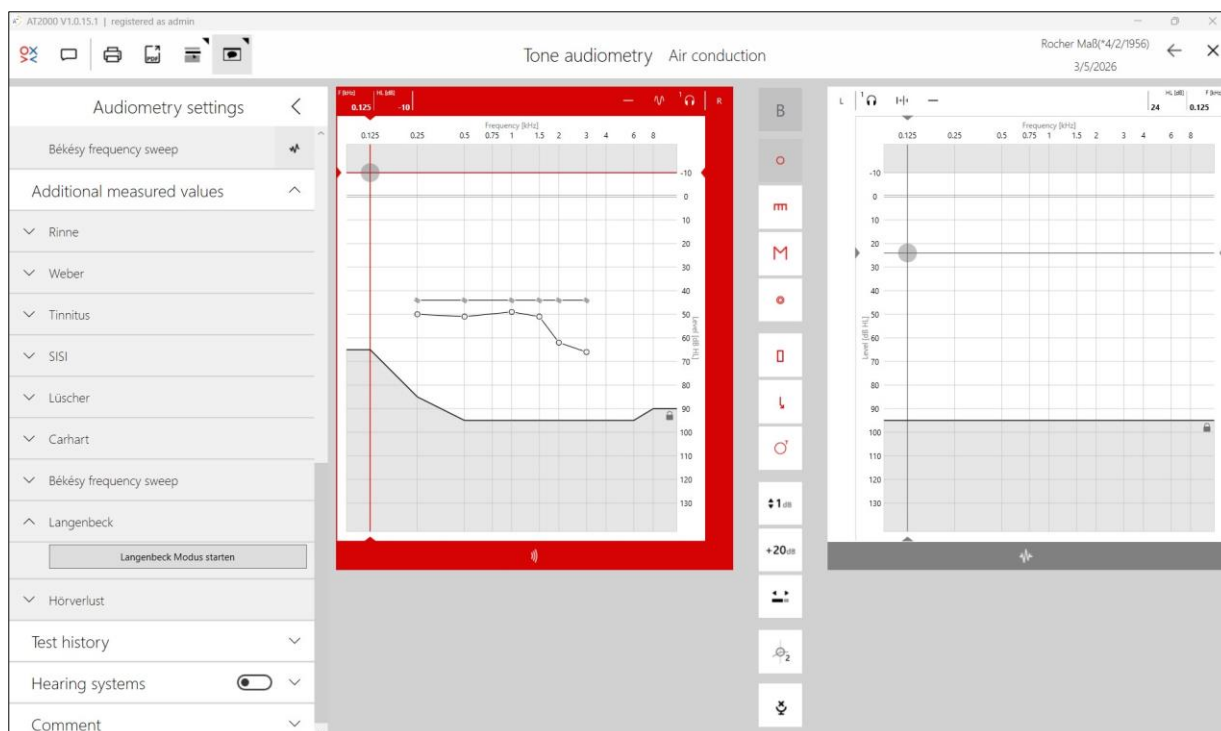


Figure127: TA – Langenbeck

8.6.4.9 Hearing loss according to the 'Röser Table

In the Hearing Loss menu, you can show or hide the hearing loss table selected in the settings. The table is automatically filled or updated as soon as the necessary audiometric measurement points are complete or have been changed.

See also Chapter 8.10.3 Hearing loss according to the 'Röser Table".

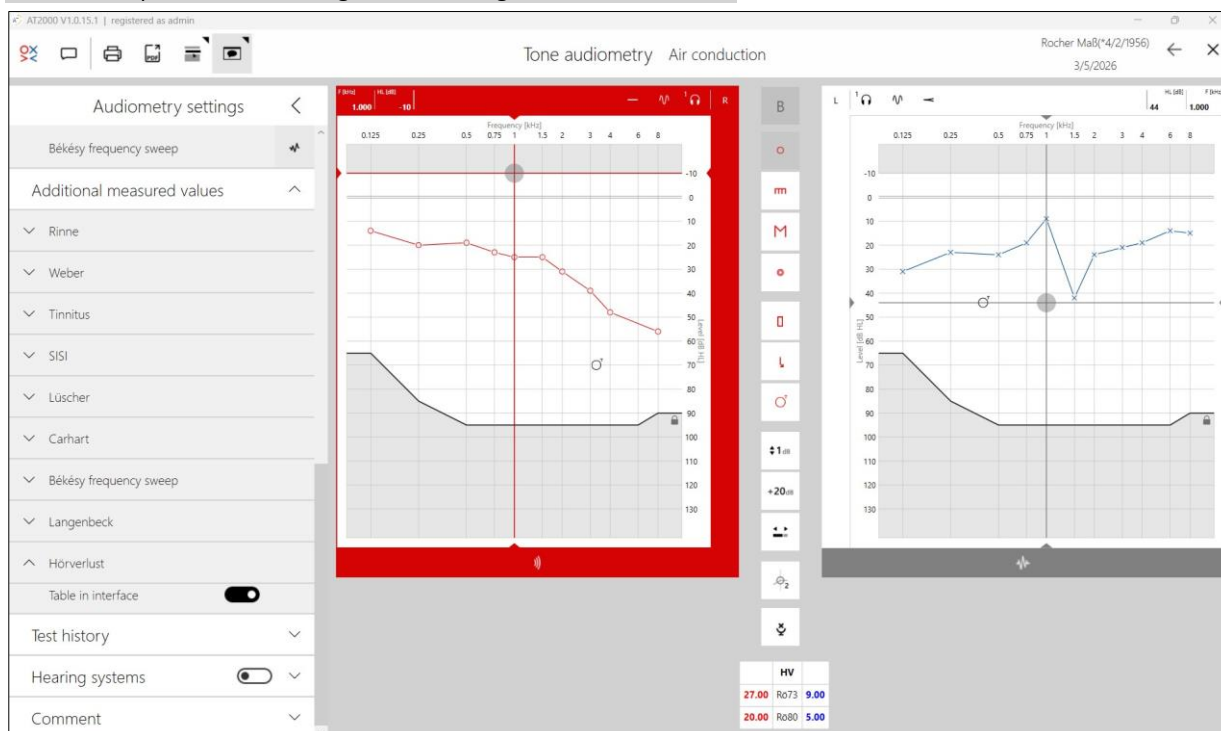


Figure128: TA – Hearing loss according to the 'Röser Table

8.6.5 Old investigations

It is possible to show an old examination in a measurement. To do this, the field in the left sidebar must be activated and the measurement to be displayed selected.

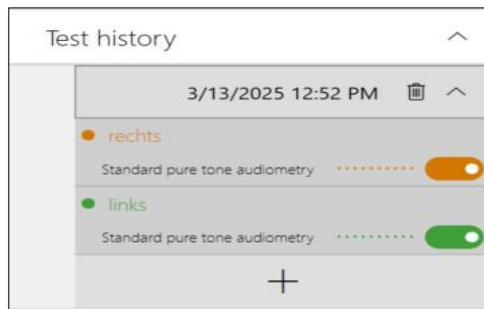


Figure129 : TA - Old investigations - 1

Once you have selected a measurement, it appears in a grey colour in the tone audiograms.

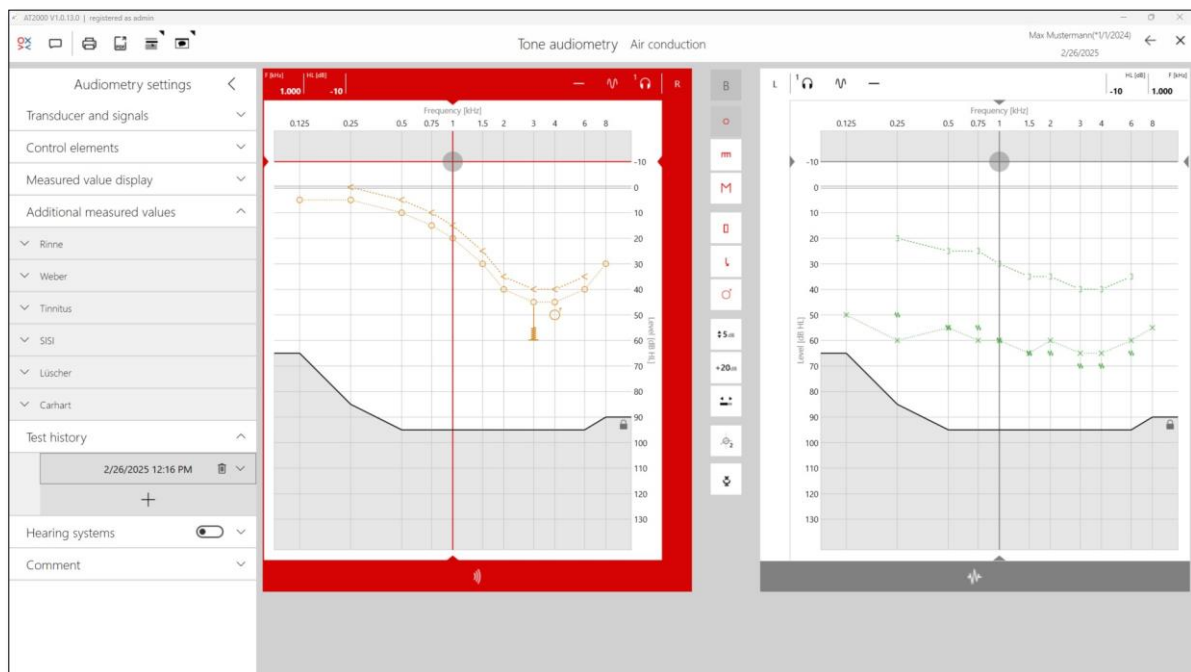


Figure130 : TA - Old investigations - 2

8.6.6 Hearing systems

It is also possible to document the measurements with a hearing aid on the right and / or left ear. To do this, you can activate the field in the left sidebar and select the appropriate hearing aid.



Figure131 : TA - Hearing systems

8.6.7 Comments

The comment field can be opened in the respective measurement and is saved for each measurement carried out. Comments that have already been entered can be deleted using the recycle bin symbol.

The comments can be copied and edited (after further measurement), and old measurements are also displayed with comments.

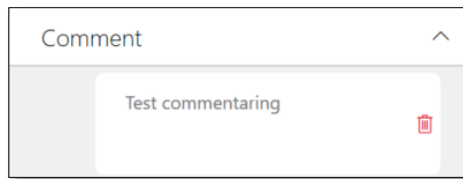


Figure132 : TA - Comments

8.7 Procedures in tonal audiometry

8.7.1 Hearing threshold measurement

8.7.1.1 Air conduction

Once the measurement programme has been started, the dB slider, interrupter, frequency switch and subject response system controls are already activated. By default, the right channel is set to air conduction "continuous sine tone" and the left channel to air conduction "narrowband noise" with smoothly calculated masking. The start measurement frequency is 1 KHz.

You can change the volume using the dB sliders. The interrupter buttons switch the sound off silently. The inverse switches allow the sound to be played manually.

The measurement volume is displayed in the audiogram using a cursor and as a numerical value above the audiogram.

The measuring frequencies are changed using the frequency buttons. Pressing the left side of the frequency button causes a change to the next lower frequency. Pressing the right side of the frequency button causes a change to the next higher frequency.

A measured value is transferred and saved by pressing the upper data transfer button.

If the frequency is to be reset to 1 kHz, the reset button must be pressed.

You can approach the hearing threshold several times and overwrite previously measured values. The last entry is retained. The measured values are automatically linked to the hearing threshold curve if the distance between the measuring points is no more than one octave.

The exact procedure for recording the air conduction threshold can be found in the relevant reference books and the audiometry standard in ISO 8253.

8.7.1.2 Bone conduction

Bone conduction, i.e. the transmission of sound waves via the skull bone directly to the inner ear, provides information about the function of the inner ear.

The procedure for recording the bone conduction threshold corresponds to the recording of the air conduction threshold.



For reasons of hygiene, it is important to clean the bone conduction receiver after completing the measurements on the patient.



Recording the bone conduction threshold almost always requires the ear with poorer hearing to be anaesthetised with airborne sound.

8.7.1.3 Discomfort threshold (UCL)

The uncomfortable loudness level describes the sound threshold at which patients perceive the sounds as uncomfortably loud.

To measure the discomfort threshold, it may be necessary to extend the measuring range by 20dB.

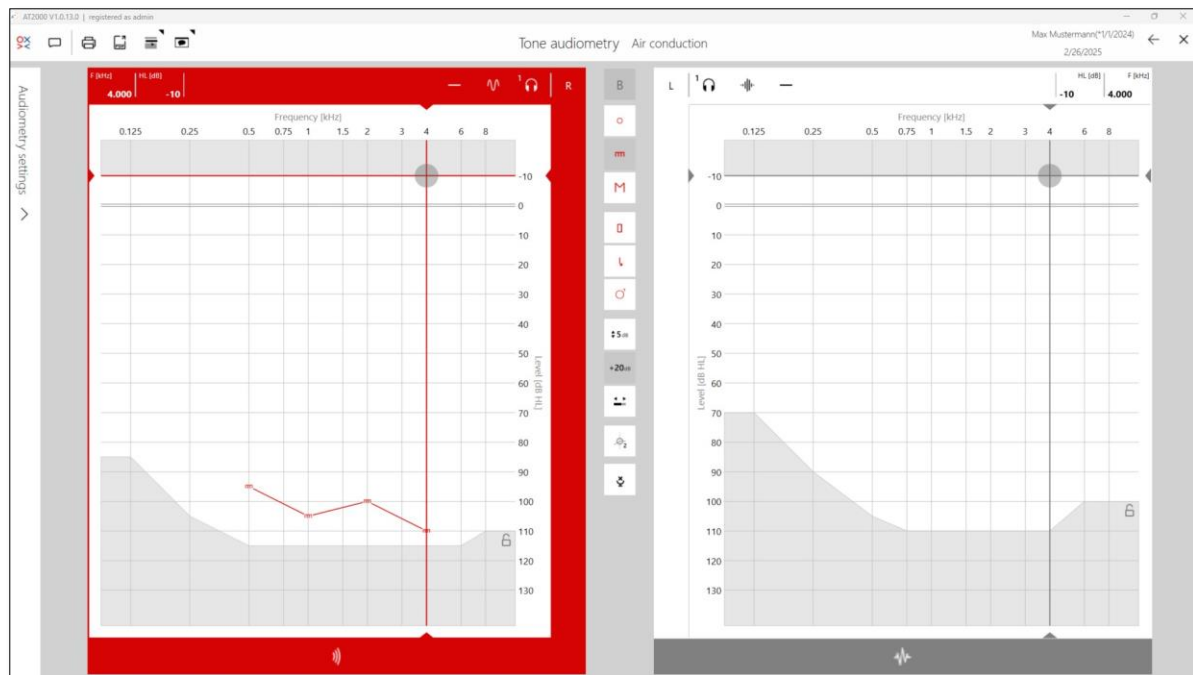


Figure133 : TA - discomfort threshold, also uncomfortable loudness levels



To avoid hearing damage, this test, which uses high sound pressure levels, should be carried out with the utmost care.



Great care must be taken when determining the discomfort threshold. If high levels are offered over a longer period of time, the hearing can be damaged.

8.7.1.4 Comfort threshold (MCL)

The comfort threshold, also known as the most comfortable loudness levels, describes the sound threshold at which patients perceive the sounds as pleasantly loud.

To measure the discomfort threshold, it may be necessary to extend the measuring range by 20dB.

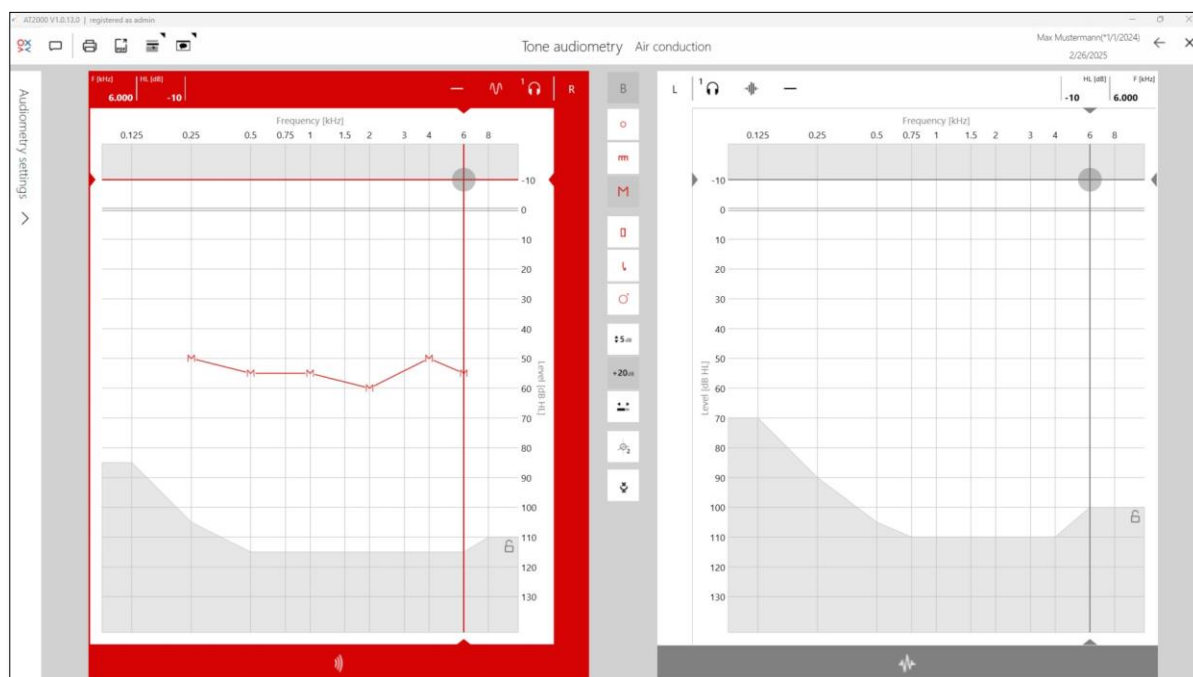


Figure134 : TA: Comfort threshold, also most comfortable loudness levels



To avoid hearing damage, this test, which uses high sound pressure levels, should be carried out with the utmost care.



Great care must be taken when determining the comfort threshold. If high levels are offered over a longer period of time, the hearing can be damaged.

8.7.2 Masking

The masking is performed with a noise signal that is emitted via the air line receiver.



When measuring bone conduction in particular, the patient's attention should be drawn to the fact that they should indicate which ear they are hearing the sound in. Overhearing can thus be quickly recognised.

If the hearing thresholds differ from side to side, especially when measuring bone conduction, it may be necessary to mask the better hearing threshold in order to avoid overhearing from the better ear to the worse ear. Specialised knowledge and a lot of practice are required to correctly assess which hearing threshold measurement values need to be masked.

The masking is always assigned to the opposite ear by default. By default, the masking noise is a narrowband noise at the current measurement frequency.

8.7.2.1 Manual masking

With manual masking, the volume of the masking sound is changed manually using the slider.

8.7.2.2 Gliding masking

The slider for the masking noise is locked for the sliding masking.

The distance between the masking level and the signal level is set in the sidebar and fixed if necessary. The volume is automatically increased with the measurement signal when the set minimum distance from the bone conduction to the air conduction is reached.

The sliding pre-calculated masking assumes that the better ear has already been measured and then takes into account the distance to the respective better bone or air conduction before the measurement signal is automatically played back.

The following distances between the dampening level and the signal level are possible

- Bone conduction: +10 dB, +20 dB
- Air duct: -30 dB, -40 dB, -50 dB

8.7.3 Tuning fork tests

8.7.3.1 Weber test

The appropriate tuning fork or the audiometer's bone receiver is required to carry out the Weber test.

The bone conduction earphone must be set to a volume of approx. 50 dB at 250 or 500 Hz and placed on the top of the subject's head. The patient must now say whether and in which ear the sound is heard louder.

The sound is either perceived diffusely in the head in the case of equal-sided hearing, is lateralised to the better inner ear hearing threshold in the case of unilateral or bilateral sensorineural hearing loss or to the larger sound conduction in the case of middle ear and combined hearing loss.

8.7.3.2 Rinne test

The tuning fork must be used to carry out the Rinne test.

After striking the tuning fork, it is placed on the tip of the mastoid if possible. The patient must now let you know when the sound is no longer audible to them. The still vibrating tuning fork is then held in front of the same ear. If the patient hears the sound again, then he is Rinne-positive on the tested side. If he still does not hear the sound, then he is Rinne-negative on the tested side.

The channel test can be anaesthetised via the air line receiver. The masking level must be set individually. The frequency of the masking sound should match that of the tuning fork as far as possible. This can simplify the Rinne test, especially with asymmetrical hearing

8.8 Supra-threshold tests

8.8.1 SISI test

The SISI test is a test procedure for determining the ability to discriminate intensity. The SISI test is usually carried out at 20 dB above the air conduction hearing threshold, and from 40 dB of sensorineural hearing loss. A level increase of 5 dB to 1 dB is available for conditioning. The actual test is performed with a 1 dB level increase. The patient button is enabled for recording the increment heard. The findings are entered under the audiogram.

The basis and prerequisite for the SISI test is the tone audiometry (LL and KL) that has already been carried out or an existing measurement in active status (further measurement).

8.8.2 Lüscher test

The Lüscher test is a variation of the SISI test and a method for determining intensity discrimination. It is usually carried out at 20 dB above the air conduction hearing threshold, and from 40 dB of sensorineural hearing loss. In contrast to the SISI test, the Lüscher test tests the limit value for the recognisable change in the sound pressure level. The modulation differences can be set from 5 dB to 0.2 dB during the test. The patient probe is enabled to register the increment heard.

The basis and prerequisite for the Lüscher test is the tone audiometry (LL and KL) that has already been carried out or an existing measurement in active status (further measurement).

8.8.3 Carhart test / threshold tone decay

The Carhart test / threshold tone decay test is a suprathreshold measurement method that detects threshold decay. The Carhart test can only be performed at frequencies with a measured tone hearing threshold. To start the Carhart test, you must first activate Carhart mode in the left sidebar using a button. The current measuring ear is used for the test. The display of the second ear is replaced by a time/level diagram of the measuring ear. A masking signal can still be presented using the slider for the opposite ear. This is indicated by a coloured arrow on the level axis. When the test is started, a sine tone at the selected frequency is played at 5 dB HL above the hearing threshold. The patient confirms with the button as soon as they feel they can no longer hear the tone. The time interval between the presentation of the level and the patient's response is decisive for the test procedure. Up to a test duration of 29 and 59 seconds, the test tone is increased by 5 dB and the test is continued. Only the graphical notation is adjusted in these ranges. If the patient does not respond for 60 seconds or if the test level reaches 110 dB HL, the test is ended.

8.8.4 Langenbeck test

The Langenbeck test is used to diagnose neural hearing loss. The test performs tone audiometry via headphones with parallel noise presented in the same ear. The noise is set slightly below the highest measured hearing threshold level. This is followed by another hearing threshold audiometry for all or some frequencies. In frequency ranges where the noise level is presented above the threshold, the patient with inner ear disease will indicate the noise thresholds at approximately the noise level. For noise levels below the hearing thresholds, the patient with inner ear disease will be able to confirm the hearing thresholds again despite the background noise. This convergence of the hearing threshold in the noise to the original hearing threshold is absent in patients with neural hearing loss. In the frequency range with subthreshold noise, patients with neural hearing loss are unable to confirm the original hearing thresholds again. This is followed by a shift to higher levels. The test can be very tiring for the patient. The examiner should be able to guide the patient through the test confidently and quickly, briefly interrupting the noise between test phases. The Langenbeck test is not indicated for middle ear disorders.

8.9 Automatic Tests

8.9.1 Békésy test (sliding frequency)

Automatic tone audiometry according to Békésy is selected via the left sidebar under 'Additional measurements – Bekesy sliding frequency'. A tone with a continuously increasing frequency is automatically emitted. The test level increases automatically as long as the patient button is not pressed. The patient should press the button continuously whenever a tone is audible. In this way, a tone audiometric hearing threshold is determined across the entire frequency range. This is particularly suitable for patients with severe hearing fatigue or for patients who are difficult to examine. Tone audiometry according to Békésy can only be performed with continuous and pulsed sine tones. The frequency range tested is automatically determined by the selected transducer. Before starting the measurement, the examiner determines the frequency change rate and the level change rate. The frequency change rate significantly increases or decreases the measurement duration. The measurement accuracy can be increased by selecting the appropriate level change speed. During the measurement, the examiner can increase the maximum level range to be tested using the +20 dB button, depending on the selected transducer. During the measurement, the test can also be paused, interrupted, saved incompletely or cancelled.

8.10 Other Tests

8.10.1 Tinnitus measurement mode

The tinnitus measurement mode is used to localise the patient's perceived tinnitus as accurately as possible. The test allows testing in 25 Hz steps across the entire test range of the selected transducer. The examiner selects the 'Start tinnitus measurement' button under 'Additional measurements – Tinnitus'. The current transducer is used for the active ear. Only sine wave signals can be tested in tinnitus measurement mode. The audiometer is operated in the same way as for conventional tone audiometry, except that the frequency change is now performed in 25 Hz steps instead of octave steps, and the confirmation button places or shifts the tinnitus hearing threshold. The tinnitus measurement mode can be ended by selecting the 'End tinnitus measurement' button in the sidebar, changing the test procedure, e.g. via the context menu, or ending the session.

8.10.2 Stenger-Test

The Stenger test is an advanced measurement method for transferring aggravating patients. The test is based on the observation that a tone presented via air conduction is perceived on the side of the ear where the loudness is highest. If the difference is particularly pronounced, the tone is only perceived on the more strongly stimulated ear. A patient with unilateral deafness who is stimulated on both sides with 10 dB HL on the hearing side and a continuously increasing level on the deaf ear will always report hearing the tone on the hearing side. The aggravating patient will report that they can no longer perceive the tone when there is a high level difference between the well-hearing ear and the questionably deaf ear. This results from the effect of the high level difference, whereby the sound is primarily heard on the ear with questionable hearing loss, and the attempt to deny the ability to hear on the ear in question. If the level on the ear with questionable hearing loss is now gradually reduced, the patient will report hearing the sound again. The actual hearing threshold is approximately halfway between the initial 'not heard' and the renewed confirmation of "hearing", minus 10 dB. The Stenger procedure is selected in tone audiometry in the middle bar via the 'Stenger test' button. The active ear side sets the level for the ear in question. On the opposite ear side, the control level is set once to 10 dB above the tone hearing threshold found. The test frequency and the hearing threshold entry are operated as in conventional tone audiometry via the control panel or keyboard.

8.10.3 Hearing loss table

The hearing loss table is not a standalone test. Depending on the selected basic settings, a hearing loss value is automatically calculated in the background according to specific criteria. As long as not all conditions are met for a value, the corresponding field remains empty. In tone audiometry, the criterion is an air conduction hearing threshold in selected frequencies.

For tone audiometry, the hearing loss tables according to Röser and Boenninghaus (1973) and according to Röser (1980) are stored in the device settings under Basic Settings - Hearing Loss as the procedure for Germany. Alternatively, Switzerland can also be selected in the settings. Here, the table will display the CPT-AMA value in tone audiometry.

The underlying tables are shown below:

8.10.3.1 Röser / Boenninghaus (1973)

Table 15: Röser / Boenninghaus (1973)

hearing loss	Points according to Röser / Boenninghaus			
In dB	500 Hz	1000 Hz	2000 Hz	4000 Hz
10	0	0	0	0
15	2	3	2	1
20	3	5	5	2
25	4	8	7	4
30	6	10	9	5
35	8	13	11	6
40	9	16	13	7
45	11	18	16	8
50	12	21	18	9
55	14	24	20	10
60	15	26	23	11
65	17	29	25	12
70	18	32	27	13
75	19	32	28	14
80	19	33	29	14
Ab 85	20	35	30	15

Source: Boenninghaus, H.-G., Röser, D.: Neue Tabellen zur Bestimmung des prozentualen Hörverlustes für das Sprachgehör. Z. Laryng. Rhinol. 52, 153 – 161 (1973)

8.10.3.2 Röser (1980)

Table 16: Röser (1980)

Total hearing loss at 2 and 3 kHz	dB	hearing loss at 1 kHz									
		0	5	15	25	35	45	55	65	75	85 95
		0	10	20	30	40	50	60	70	80	90 100
	0 – 15	0	0	0	0	5	10				
	20 – 35	0	0	0	5	10	20	30			
	40 – 55	0	5	10	15	20	25	35	45		
	60 – 75	5	10	15	20	25	35	40	50	60	
	80 – 95	10	15	20	25	30	40	50	60	70	80
	100 – 115	15	20	20	30	40	45	55	70	80	90 100
	120 – 135	20	20	30	35	45	55	65	75	90	100 100
	140 – 155	20	25	35	45	50	60	75	85	95	100 100
	160 – 175	25	35	40	50	60	75	80	95	100	100 100
	180 – 195	30	40	50	55	70	80	90	100	100	100 100
	Ab 200	40	45	55	65	75	90	100	100	100	100 100

Source: Brusis, T.: Aus der Gutachtenpraxis: Anpassung der Drei-Frequenz-Tabelle von Röser (1980) an die Bedeutung des Gehörs in der heutigen Arbeitswelt. Laryngol. Rhinol. Otol. 2017b; 96 (09):625-627

8.10.3.3 CPT-AMA

Table 17: CPT-AMA

HV*	500 Hz	1000 Hz	2000 Hz	4000 Hz
10	0.2	0.3	0.4	0.1
15	0.5	0.9	1.3	0.3
20	1.1	2.1	2.9	0.9
25	1.8	3.6	4.9	1.7
30	2.6	5.4	7.3	2.7
35	3.7	7.7	9.8	3.8
40	4.9	10.2	12.9	5.0
45	6.3	13.0	17.3	6.4
50	7.9	15.7	22.4	8.0
55	9.6	19.0	25.7	9.7
60	11.3	21.5	28.0	11.2
65	12.8	23.5	30.2	12.5
70	13.8	25.5	32.2	13.5
75	14.6	27.2	34.0	14.2
80	14.8	28.8	35.8	14.6
85	14.9	29.8	37.5	14.8
90	15.0	29.9	39.2	14.9
95	15.0	30.0	40.0	15.0
100	15.0	30.0	40.0	15.0

Source: Council on Physical Therapy, American Medical Association (1942) J Am MedAssoc 119 , 1108 - 11

9 Highest tone audiometry

High tone audiometry is used to record high-frequency hearing thresholds from 10 kHz in tone audiometry.

The DD450 headphones are a prerequisite for measuring maximum sound levels.

The highest tone audiometry is called up via the button described in the chapter 8.5 Further functions or the menu available by right-clicking.

You can recognise the highest tone audiometry from the following view.

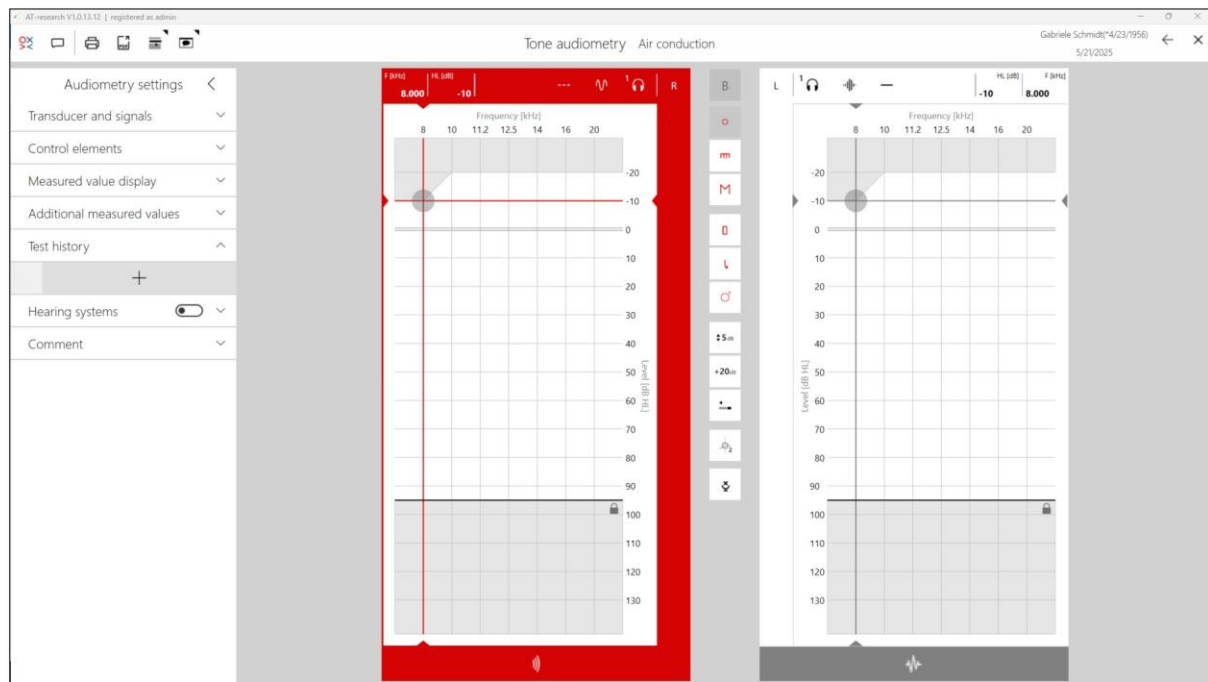


Figure135 : Highest tone audiometry

10 Speech audiometry

Speech audiometry can be started either from the patient administration - see chapter 6 Patient management - or from the test selection - see chapter 7 Test selection.

10.1 Measuring method

All measurement procedures in speech audiometry are displayed in the test selection - see chapter 7 Test selection.

10.2 Software interface for speech audiometry

After starting speech audiometry, you will find yourself in the following software interface.

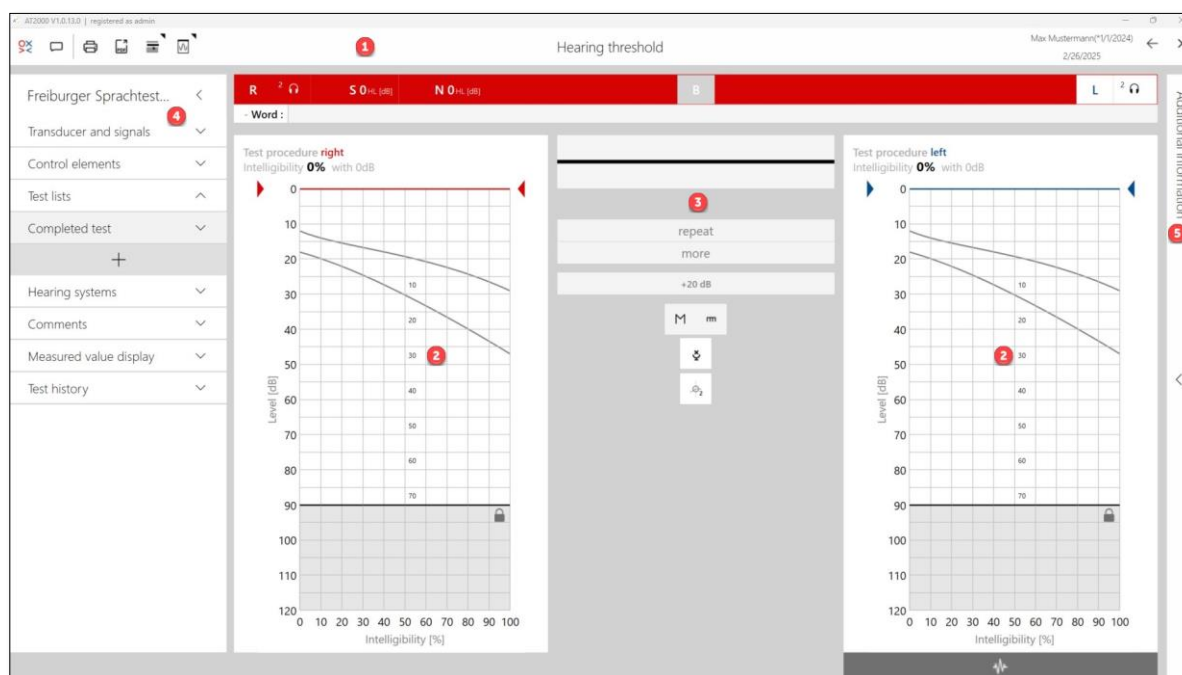


Figure136 : Speech audiometry interface

The speech audiometry interface is divided into five areas. These areas are described in more detail in the following chapters.

Table18 : Areas in speech audiometry

1	Speech audiometry menu bar - see chapter 8.3 Tone audiometry menu bar
2	Speech audiograms - see chapter 10.3 Speech audiograms
3	Further functions - see chapter 10.4 Further functions
4	Speech audiometry sidebar - see chapter 10.5 Speech audiometry sidebar
5	Additional information on speech audiometry - see chapter 10.6 Additional information on speech audiometry

10.3 Speech audiograms

10.3.1 Signal on/off

The signal is already switched on in the speech audiogram. When the speech is played, a coloured bar appears under the respective speech audiogram - red for the right ear side, blue for the left ear side and grey for the deafening.

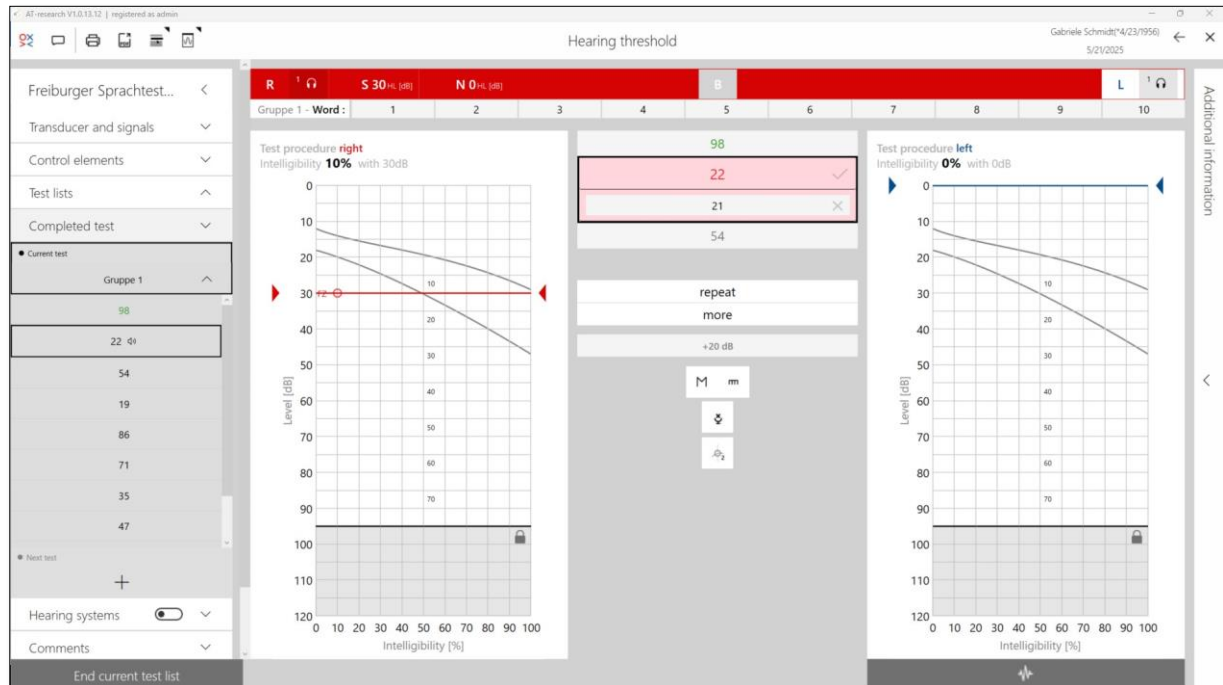


Figure137 : Signal on/off in speech audiometry

10.3.2 Transducer

You can choose between transducers - headphones (DD45, DD450), plug-in headphones (ER3C), bone conductors (B81), free-field loudspeakers (90dB and 100dB) and implants.

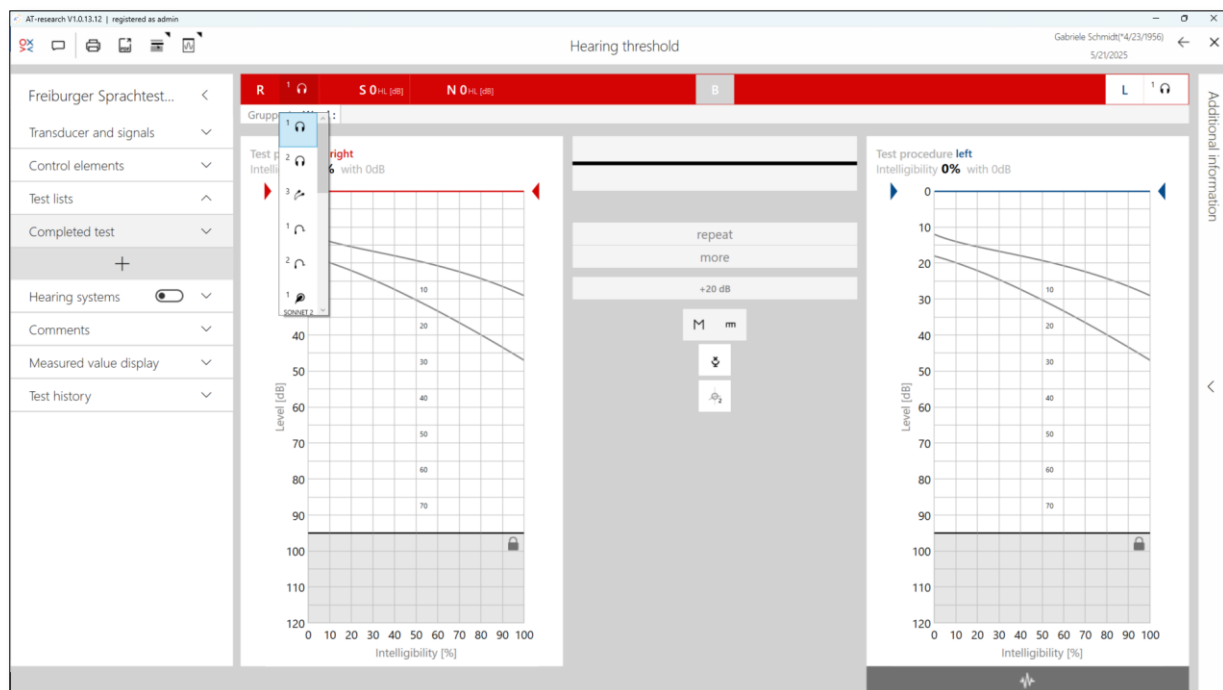


Figure138 : Transducer in speech audiometry

10.3.2.1 Implants

If you click on one of the implants in the transducerselection, you can carry out a measurement with the implant.

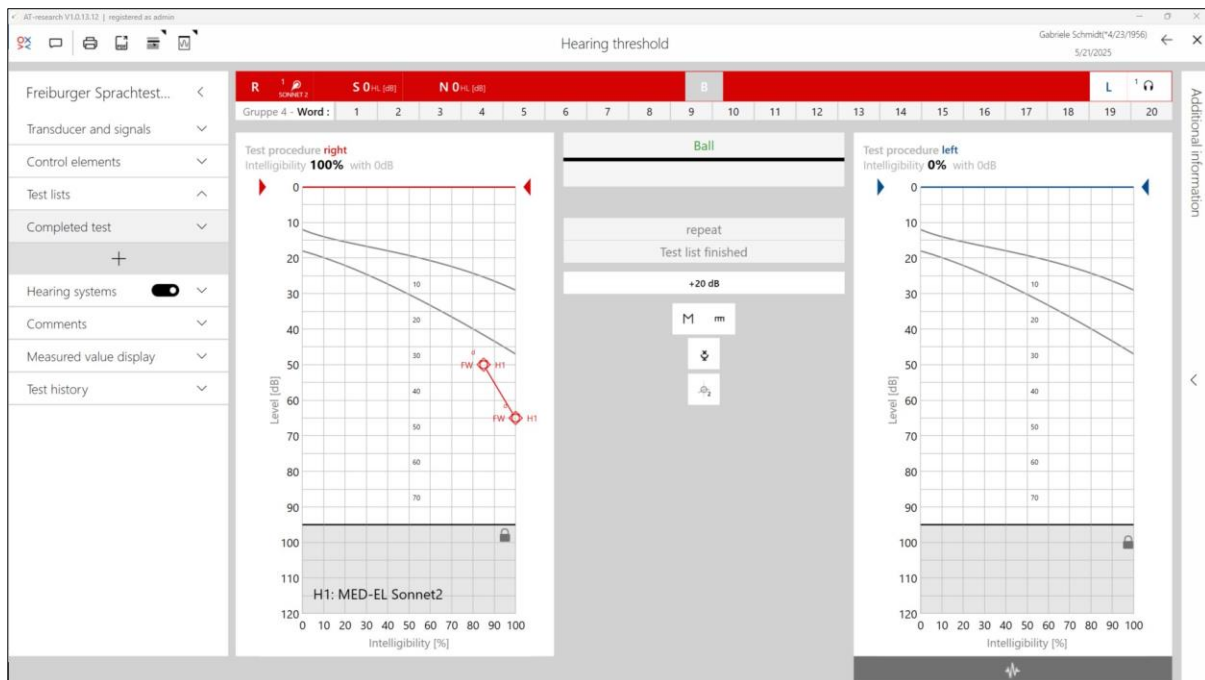


Figure139 : SA - Implant measurement

10.3.3 Side change

You can switch pages either by pressing F3 or by clicking on "R" or "L" above the speech audiogram.

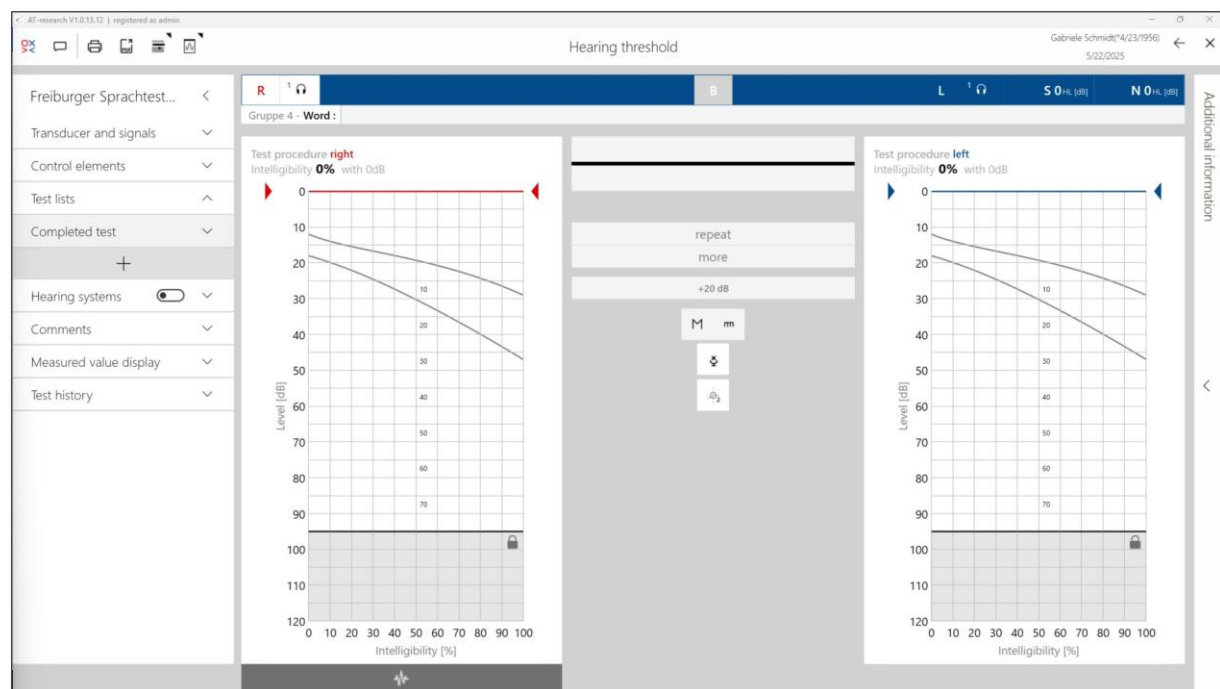


Figure140 : Side change in speech audiometry

10.3.4 Save measurement

The measurements are saved automatically. After closing, the session appears in the test history with the date and time as well as an abbreviation of the measurement performed.

10.3.5 Delete measuring point or measuring series

To delete a measuring point or a measurement curve, right-click on the measuring point. After right-clicking, you can choose between "Delete measuring point" and "Delete current measurement curve".

You can also call up the test list for the respective measuring point by right-clicking with the mouse.

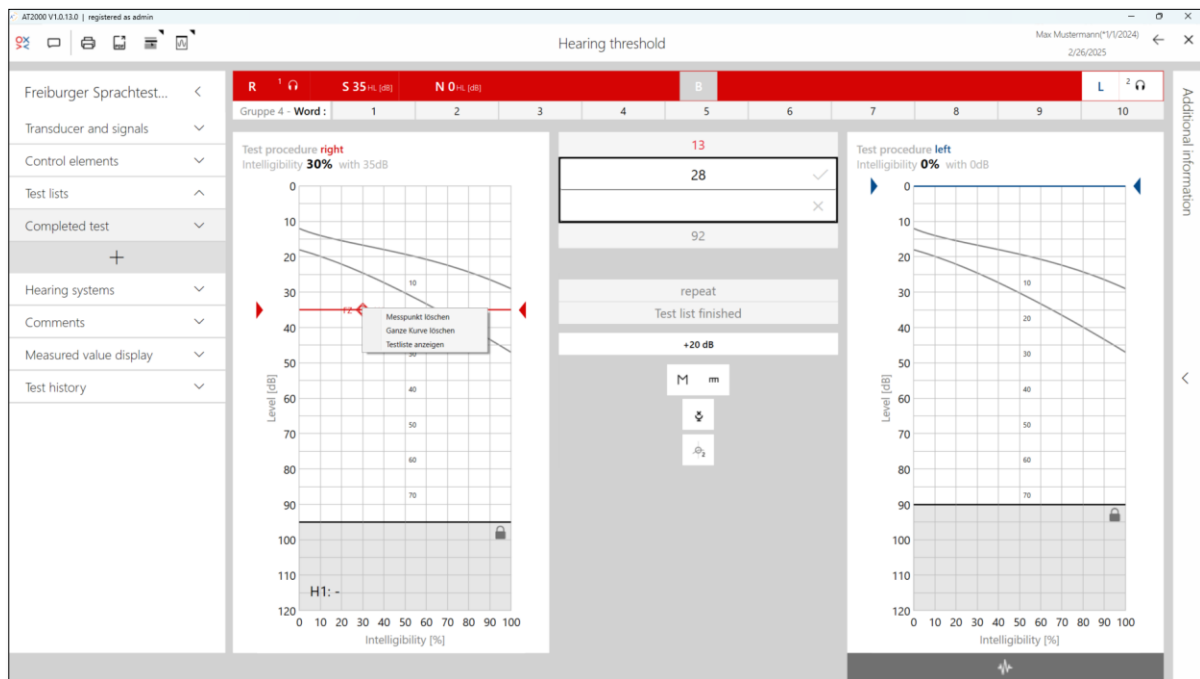


Figure141 : Measuring point, delete measurement curve, display test list in speech audiometry

10.4 Further functions

The other functions are described below from top to bottom.

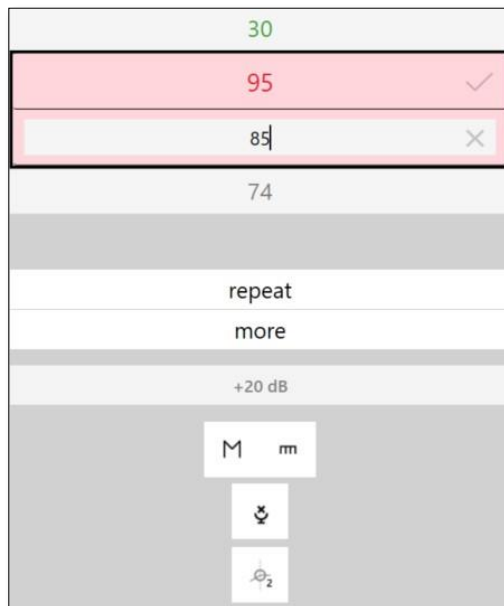
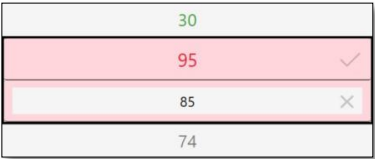
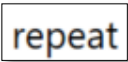
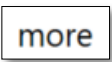
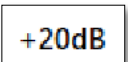


Figure142 : Further functions in speech audiometry

Table19 : Further functions in speech audiometry

 Figure143 : SA - Binaural	The binaural measurement is activated.
 Figure144 : SA - Correct/incorrect language	The language being played is displayed in the thick bordered frame. If you click on the tick, the frame turns green. If you click on the field, you can enter the incorrectly heard language and click on Next. Otherwise, click directly on the cross. The field appears red. The language already played is displayed above the frame. The next language to be played appears below the frame. In addition, signals that have been heard correctly can be confirmed with the Right arrow button and signals that have been heard incorrectly can be confirmed with the Left arrow button on the control unit.
 Figure145 : SA - Repeat	This button can be used to repeat the signal that has already been played.
 Figure146 : SA - Next	With this button you can manually click on continue.
 Figure147 : SA - Switch amplification on/off	The gain of 20 dB can be switched on and off here.  This function is only intended for a short-term measurement to determine the patient's residual hearing loss. Sound levels of 130dB over a longer period of time can damage both the patient in question and the headphones.
 Figure148 : SA - CSL	If you click on this button, the comfort threshold can be determined - see the section 10.7.4 Comfortable speech levels (CSL)
 Figure149 : SA - UCL	If you click on this button, the discomfort threshold can be determined - see the chapter 10.7.3 Uncomfortable loudness level (UCL)
 Figure150 : SA - Microphone	The microphone can be switched on and off with this button.
 Figure151 : SA - Second measurement curve	This button is used to enter a second measurement curve

10.5 Speech audiometry sidebar

Many other settings can be made in the left-hand sidebar. These are described in more detail in the following chapters.

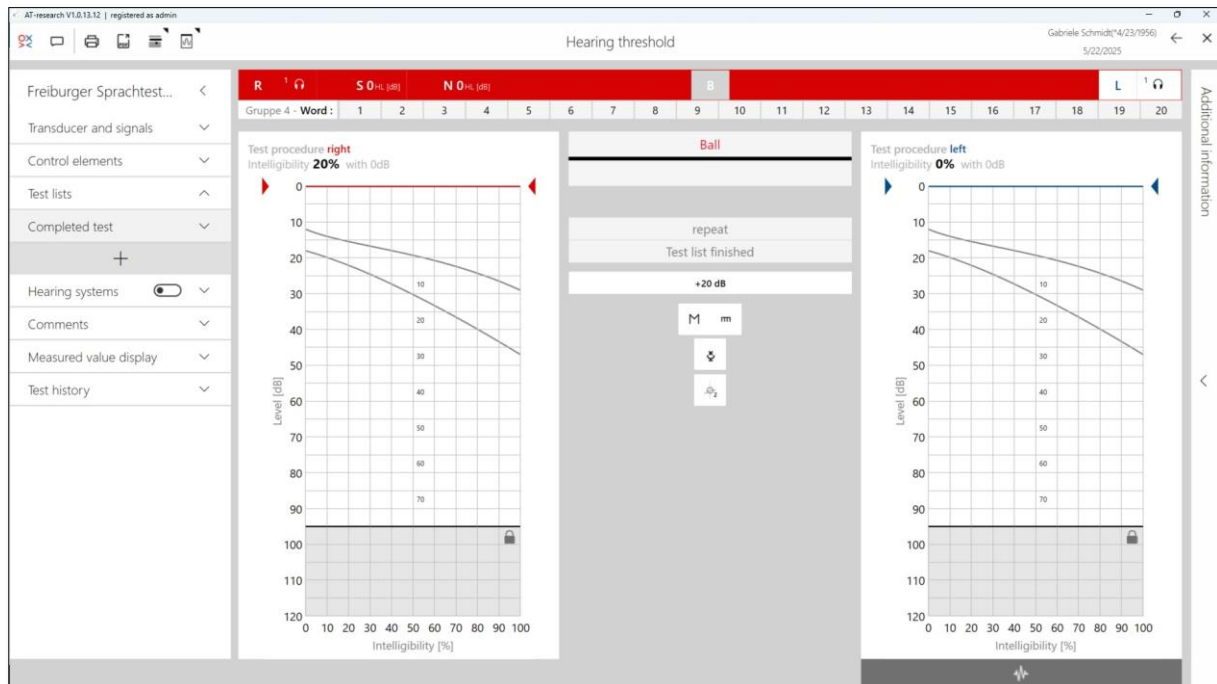


Figure152 : Left sidebar in speech audiometry

10.5.1 Transducer and signal

The transducers and the measurement page can be set both in the audiogram area and in the left-hand side list. The settings for the noise are also made in the left sidebar.

When speech audiometry is started, the background noise is activated by default. This can be recognised by the activated button. If you move the level slider, you will hear the background noise directly. The range below this cannot be used.

If you only want to hear the noise when starting a measurement, you can proceed as follows. Firstly, the button must be deactivated so that the lower area can be activated. In this area, you can choose between "continuous" and "with pauses".

If you select "continuous", the background noise is played depending on the lead time. The background noise then remains on until the end of the measurement.

If you select "with pauses", the background noise is only played while the speech is being played, depending on the lead time. The background noise is cancelled between the signals.

If you want to have a randomised sequence within a test list, you can activate the Randomised test list button.

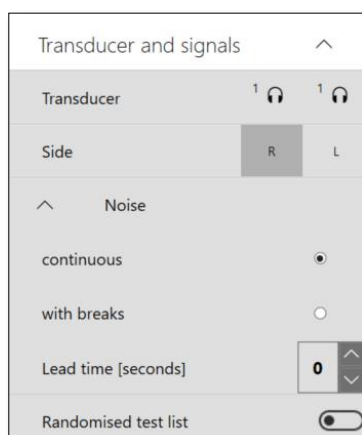


Figure153 : SA - Transducer and signal

10.5.2 Control elements

In the control elements you will find the settings for the level increment, counting method, extension of the measuring range, monitor, microphone and the VU meter.

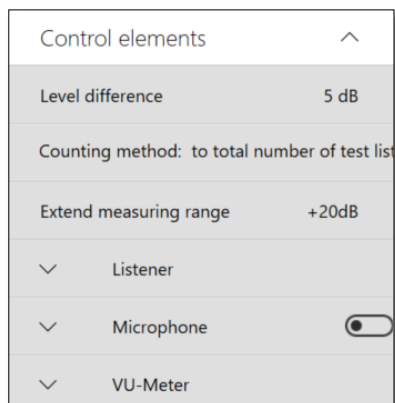


Figure154 : SA - Controls - 1

The counting method can be selected in the left sidebar. You can either select "to total number of test list", i.e. a calculation from 0%, or "to number of words presented", i.e. a calculation from 100% downwards.

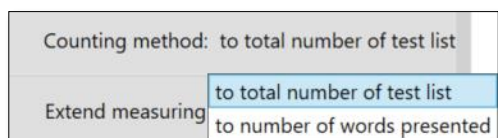


Figure155 : SA - Controls - 2

The handset monitor can be activated or deactivated on the left or right at a specific volume.

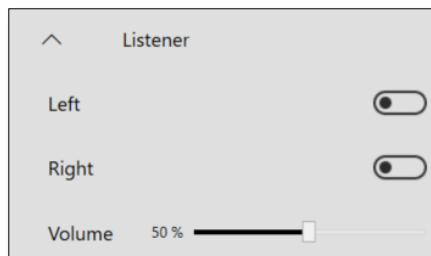


Figure156 : SA - Control elements - 3

The microphone can be enabled or disabled at a specific volume.

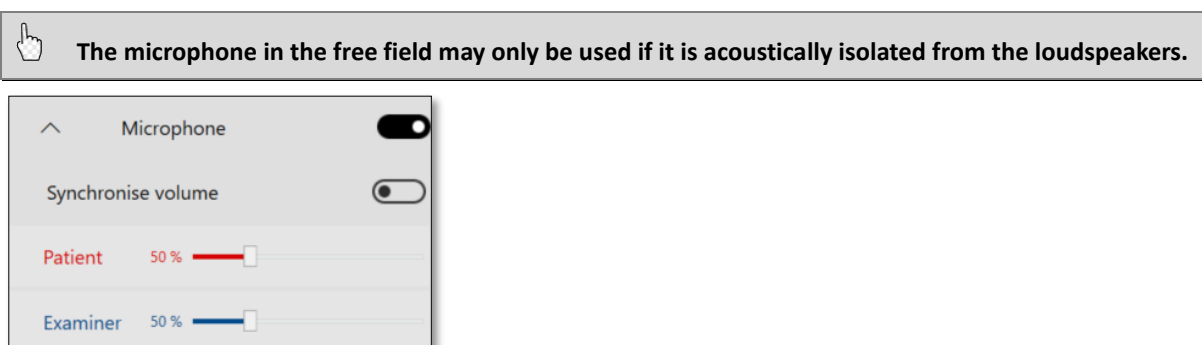


Figure157 : SA - Control elements - 4

With the VU-Meter, speech materials can be set to a defined value.

To do this, select a file and play it using the Play button. Then use the arrows to adjust the input level to the zero position. Once the zero position has been reached, click on "Accept value".

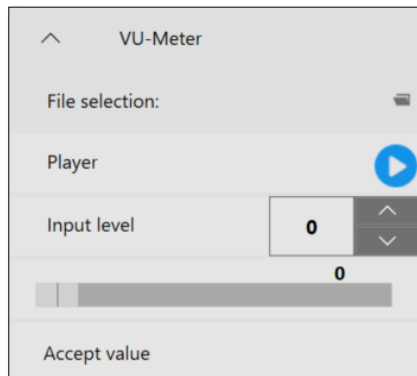


Figure158 : SA - Control elements - 5

10.5.3 Test lists

To call up test lists, click on the plus sign and then on the corresponding groups.

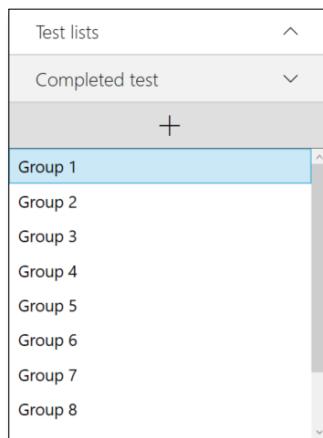


Figure159 : SA - Test lists - 1

To view the contents of the group, click on the arrow. If you click on the recycle bin, you can delete the added group.

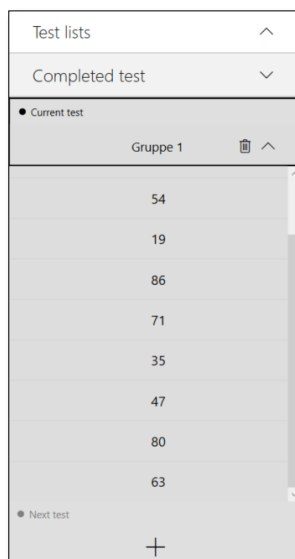


Figure160 : SA - Test lists - 2

10.5.4 Hearing systems

It is also possible to document the measurements with a hearing aid on the right and / or left ear. To do this, you can activate the field in the left sidebar and select the corresponding hearing aid that was entered in the patient data. It is also possible to take a measurement without selecting a specific hearing aid.

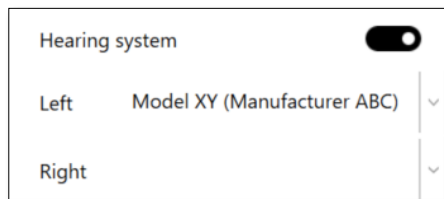


Figure161 : SA - Hearing systems

10.5.5 Comments

The comment field can be opened in the respective measurement and is saved for each measurement carried out. Comments that have already been entered can be deleted using the recycle bin symbol.

Comments can be copied and edited (after further measurement), and comments from previous measurements are also displayed.

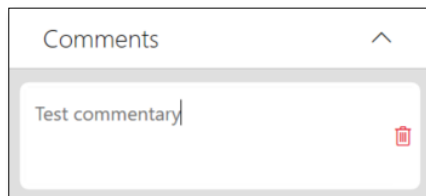


Figure162 : SA - Comments

10.5.6 Measured value display

When you open the legend or the measured value display, only the symbols required for speech audiometry will be visible.

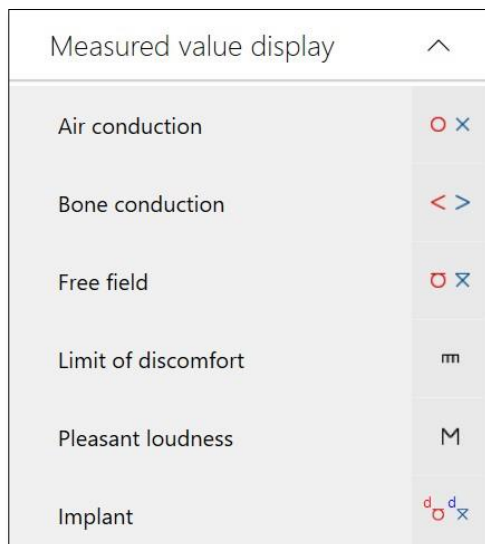


Figure163 : SA - Measured value display

10.5.7 Old investigations

It is possible to show up to three old analyses in one measurement. To do this, the field in the left sidebar must be activated and the measurement to be displayed selected.

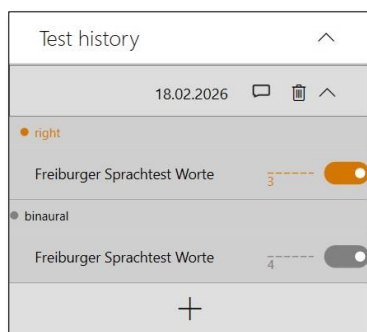


Figure164 : SA - Old investigations -1

Once you have selected one or more measurements, they appear in different colours in the speech audiograms.

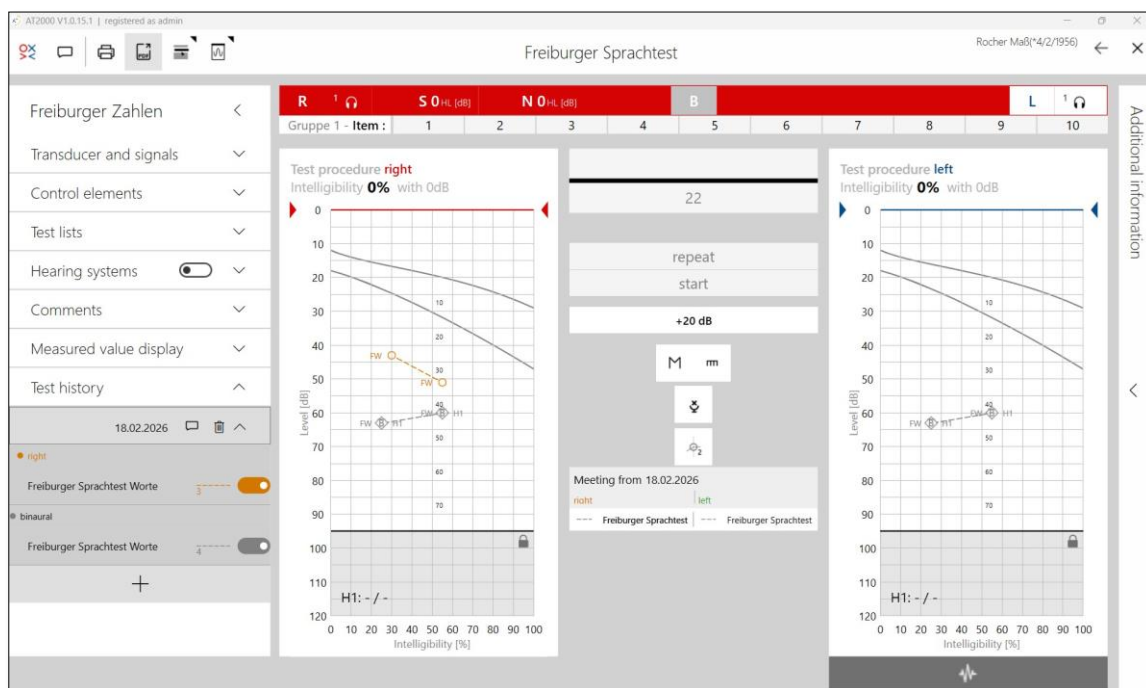


Figure165 : SA - Old investigations -2

10.6 Additional information on speech audiometry

In the right sidebar - in the additional information - you can display the audiograms performed on the patient.



Figure166 : SA - Additional information - 1

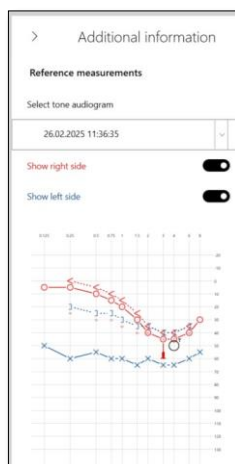


Figure167 : SA - Additional information - 2

10.7 Types of diagnostics

The four types of speech audiometry diagnostics are described below.

10.7.1 Hearing loss - HV (50% threshold)

Here, the 50% threshold is determined with the respective speech material. The result of speech intelligibility should only be between 20% and 70%. However, 50% is optimal.

The level is set so quietly that intelligibility is achieved. The patient repeats what they have understood and the examiner documents the answers with correct and incorrect (using the arrow keys on the control unit).

A maximum of 2 levels are measured with this type of diagnostics. If, for example, 50% is not reached immediately, but only 30%, a higher level is measured again. If the intelligibility is above 50%, the level is reduced.

10.7.2 Speech intelligibility (dB-opt)

The aim of this type of diagnosis is to determine optimum speech intelligibility.

The level is set louder than for hearing loss for speech, as the patient should be able to understand better here. The starting level is usually 65 dB.

The level is set so quietly that intelligibility is achieved. The patient repeats what they have understood and the examiner documents the answers with correct and incorrect (using the arrow keys on the control unit).

In this type of diagnosis, 3 test lists are usually played to produce a speech intelligibility curve - for quiet speech, medium speech and louder speech. The focus is on 100% speech intelligibility. There are also cases where comprehension deteriorates with increased volume.

The measuring points are all connected to each other in the level sequence (from quiet to loud).

The measurement is ended when the test list is finished or cancelled beforehand (button: End current test list).

This diagnostics type is active by default when starting or switching to speech audiometry.

10.7.3 Uncomfortable loudness level (UCL)

The uncomfortable loudness level describes the threshold at which the patient perceives the level as uncomfortably loud. Speech intelligibility does not play a role here.

The level is slowly increased by the user from 60dB. The signals are not confirmed as correct or incorrect, it is sufficient to click on "Continue". To measure the discomfort threshold, it may be necessary to extend the measuring range by 20dB.

In this measurement there is also only one measuring point which is displayed at the end as a line at the specified level.

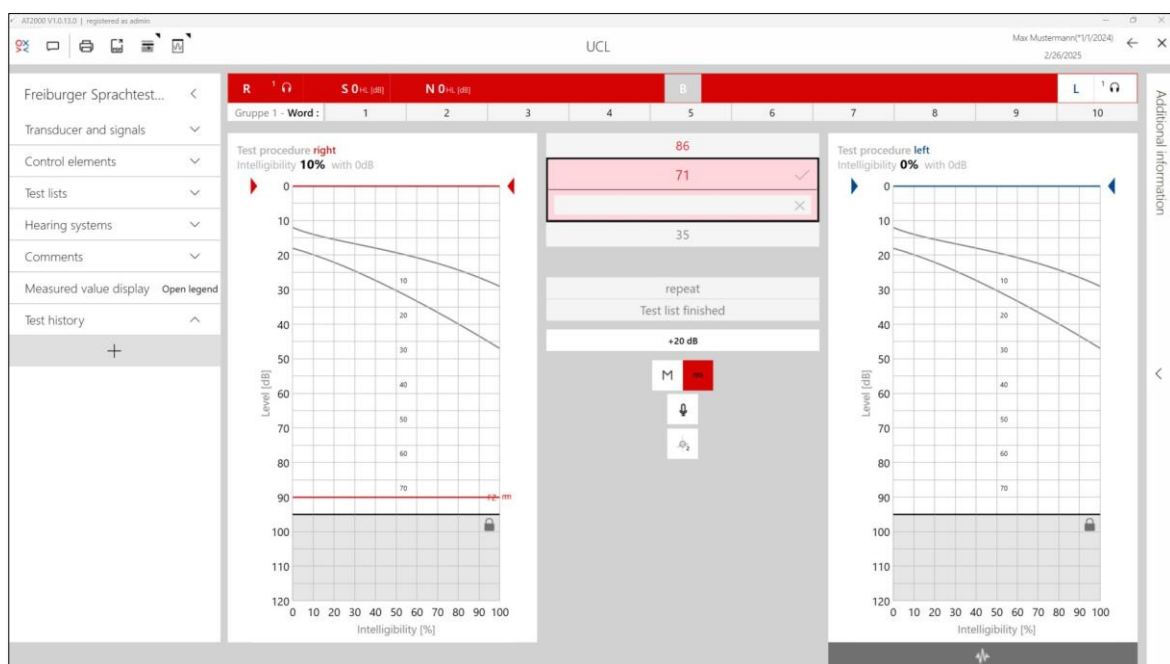


Figure168 : SA - discomfort threshold, also uncomfortable loudness levels



To avoid hearing damage, this test, which uses high sound pressure levels, should be carried out with the utmost care.



Great care must be taken when determining the discomfort threshold. If high levels are offered over a longer period of time, the hearing can be damaged.

10.7.4 Comfortable speech levels (CSL)

The comfortable speech levels describe the hearing threshold at which the patient perceives the level as pleasantly loud. Speech intelligibility does not play a role here.

To measure the discomfort threshold, it may be necessary to extend the measuring range by 20dB.

The level is started clearly above the threshold, i.e. approx. 5-10 dB before the already determined dB opt. The levels are played back and the patient must determine whether the level needs to be louder or quieter. The signals are not confirmed as correct or incorrect, but it is sufficient to click on "continue".

In this measurement there is also only one measuring point which is displayed at the end as a line at the specified level.

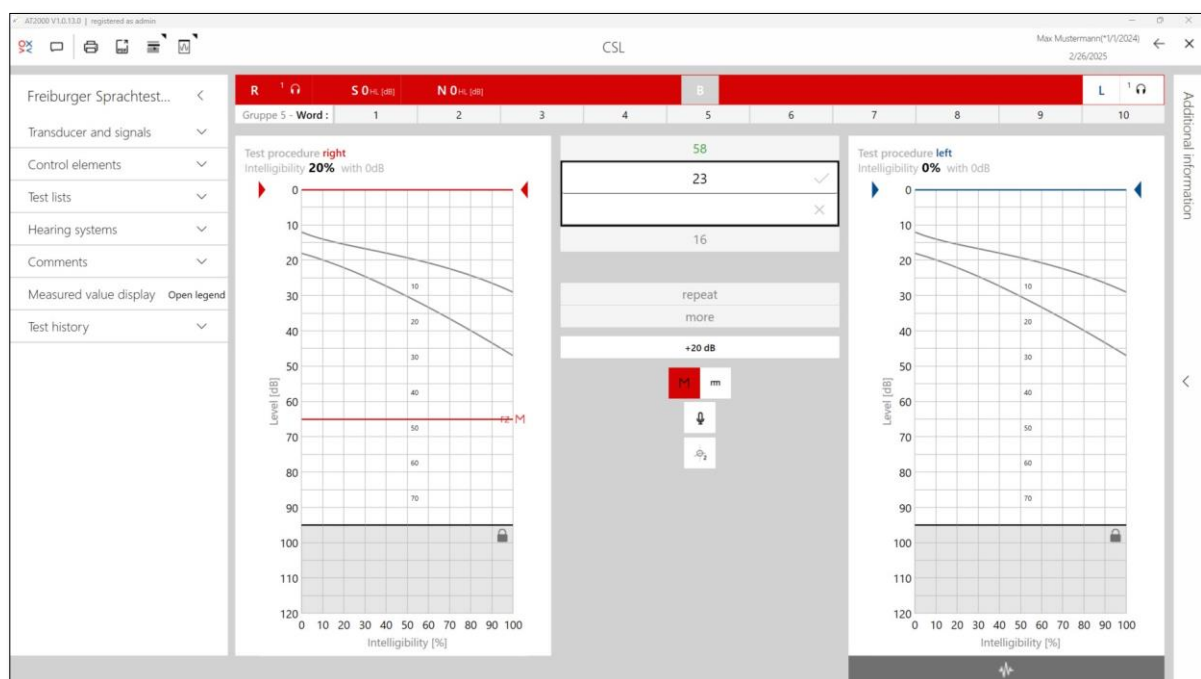


Figure169 : SA - Comfortable speech levels



To avoid hearing damage, this test, which uses high sound pressure levels, should be carried out with the utmost care.



Great care must be taken when determining the comfort threshold. If high levels are offered over a longer period of time, the hearing can be damaged.

10.8 Freiburg test

The Freiburg test can be divided into the following categories - single silver and multi-silver.

Before you start the test, you must define the counting method. This is because it is also possible to end the test list during a measurement.

10.8.1 Freiburg numbers (multi-silver)

The aim of the numerical intelligibility test is to find the hearing loss at 50% of intelligibility.

To determine the initial level for the test with numbers, the sound audiogram must be displayed - see chapter 10.6 Additional information on speech audiometry.

Add 20dB to the value for 500 Hz hearing loss, if there is a lower hearing loss at one of the two neighbouring frequencies than the hearing loss at 500 Hz, add the value of 20dB to the arithmetic mean of these two hearing losses.

This value is set with the level slider and the measurement is started. Press the left frequency button to confirm the incorrectly heard signals and the right frequency button to confirm the correctly heard signals. The measuring point is set automatically.

It is also possible to enter incorrectly heard signals in the centre field.

If the measured value is between 30% and 70% of comprehension, a parallel to the normal curve is automatically drawn. The point of intersection with the standardised hearing loss scale for numbers at 50% comprehension gives the hearing loss for numbers (HVZ).

If you obtain measured values that are outside the 30% to 70% intelligibility range, check the numerical intelligibility again with a second series of numbers ± 5 dB difference in volume. The second measurement point found is connected to the first measurement point and you will now also receive an intersection point with the hearing loss scale (HVZ).

10.8.2 Freiburg words (Einsilber)

The Freiburg word test is carried out after the number test. The aim is to test the volume for maximum intelligibility (100%) of monosyllabic words without reaching the discomfort threshold.

To determine the initial level for the test with numbers, the sound audiogram must be displayed - see chapter 10.6 Additional information on speech audiometry.

For minor hearing losses, start the test at 65 dB (normal speech volume). For hearing losses > 50 dB in the mid-tone range, it makes sense to start at a volume of 80 dB.

Press the left frequency button to confirm the incorrectly heard signals and the right frequency button to confirm the correctly heard signals. The measuring point is set automatically.

It is also possible to enter incorrectly heard signals in the centre field.

If 100% intelligibility is not yet achieved, increase the measurement level by 15 dB and check again with a new group.

The goal of the single-silver test of 100% intelligibility is not achieved if intelligibility has increased but the audiometer limit (120dB) no longer allows a further increase in the volume setting, the discomfort threshold has already been reached or intelligibility has already decreased again.

10.9 Further tests in speech audiometry

In addition to the Freiburg test, other standardised tests are also available.

10.9.1 Mainz children's speech test

This test consists of 3 subtests of 50 words with 10 words/groups each.

Test 1 is intended for children with normal hearing aged 4, test 2 for children aged around 5 and test 3 for children aged around 6.

10.9.2 Göttingen children's speech test

The word material for this test is also available for two age groups: Test 1 for children aged 3-4 years: 100 words with 10 words/groups each and Test 2 for children aged 5-6 years: 100 words with 10 words/groups each.

There are also two additional groups with 10 words/groups each for younger children.

10.9.3 Marburg sentence test

This test examines the comprehension of sentences.

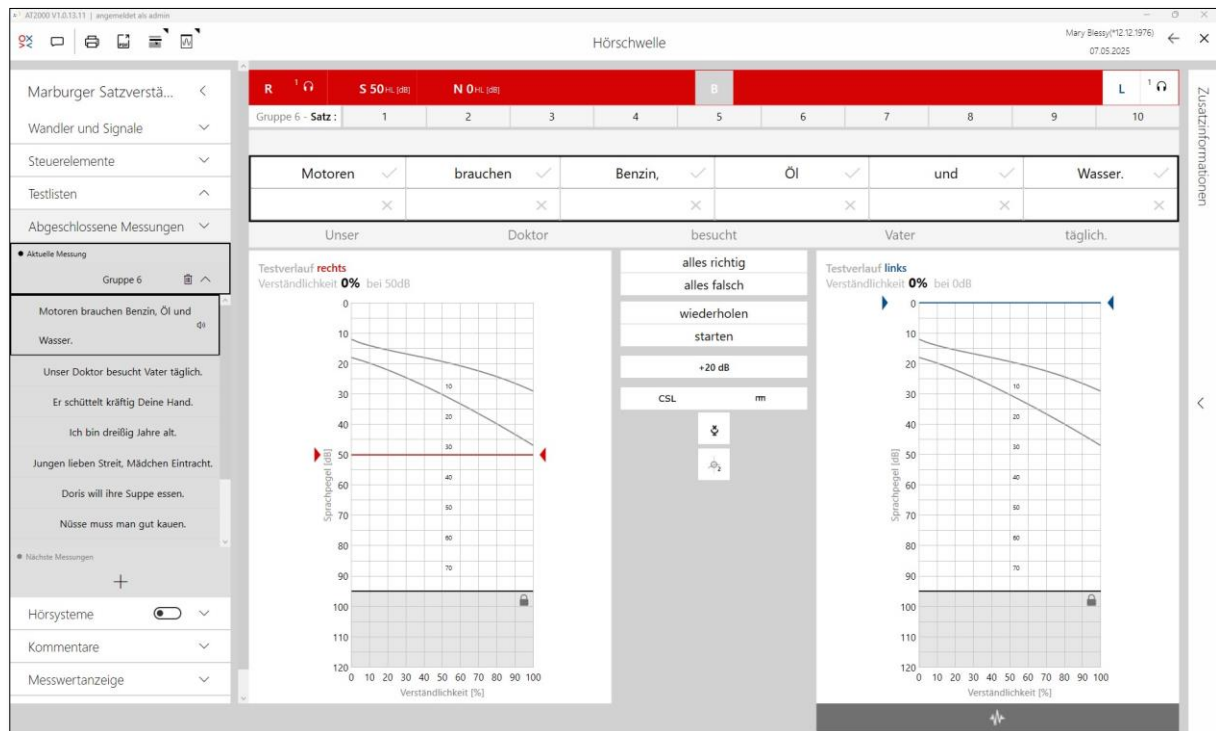


Figure170: Marburg sentence test

10.9.4 Dichotic tests

Table20 : Dichotic tests

	Fieldman Words (Lehnhardt)	Fieldman Figures (Lehnhardt)	Uttenweiler (Lehnhardt)	Fieldman Words (Berger)	Fieldman Figures (Berger)	Uttenweiler (Berger)
Page selection	<u>Fixed order:</u> - L → until 100% is reached - R → until 100% is reached - B → up to a maximum of 4 test lists			Free choice of R, L or B		
Level selection	- Free level selection for monaural measurements R and L - For 1st binaural measurement: Start level = level of the monaural measurements R and L with 100% speech intelligibility - For 2nd to 4th binaural measurements: Level = previous level +10dB if <50 % or + 5dB, if >= 50% or + 0dB, if >= 90%			Free level selection for all sides		
Test list entries	10	10	5	10	10	5
Test list content per page	Word with 2 syllables each	Number	Word with 2 syllables each	Word with 2 syllables each	Number	Word with 2 syllables each
Number of answers to be submitted per page and test list	20	10	10	20	10	10
Percentage of understandably correct answers per page and test list entry	5%	10%	10%	5%	10%	10%
Additional calculation of a dich. value	No	No	No	Yes	Yes	Yes

Dichotic value according to the Berger-Procedure	-	-	-	1/40	1/40	1/20
--	---	---	---	------	------	------

10.9.4.1 Dichotic tests according to Lehnhardt

This test is designed to detect central auditory perception disorders. The test is based on the ability to fully understand and reproduce dichotic (binaurally simultaneous but different signals in each ear) signals. Initially, each ear is tested monotonically, i.e. individually, at a signal level at which 100% intelligibility can be expected. The signal level at which approx. 70-80% monosyllabic intelligibility was achieved can serve as a guide here. Correctly recognised words are accepted with the left or right frequency button. If comprehension of less than 80% is achieved for one of the monotone tests, the test is cancelled. If, on the other hand, 80% or more per ear is achieved, the dichotic test follows. The level is now automatically preset for each word group. The dichotic test is completed when either 4 dichotic groups have been completed or an understanding of 90% or more has been achieved for each ear.

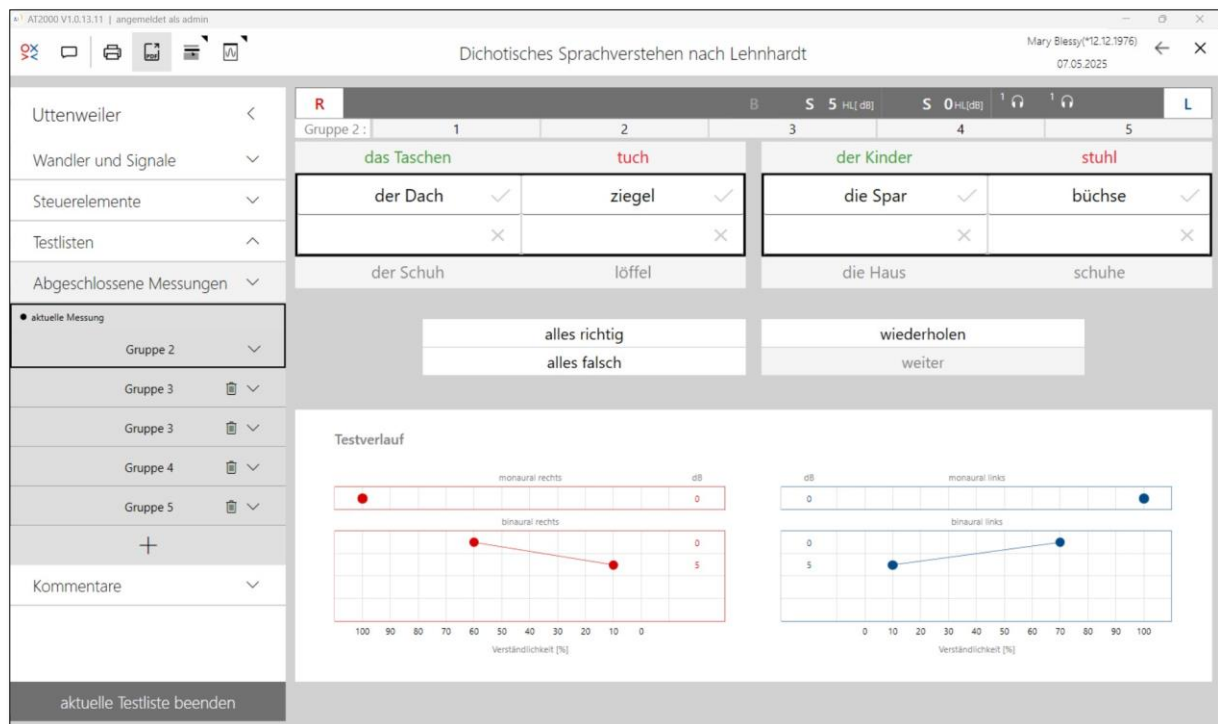


Figure171: Dichotic tests according to Lehnhardt

10.9.4.2 Dichotic tests according to Berger

This test is designed to detect central auditory perception disorders. The side and level selection is freely adjustable. In addition, a dichotic value is calculated for completely correctly understood dichotic word pairs. The Berger method requires the dichotic testing of 4 complete word groups at the same test level for a correct evaluation.

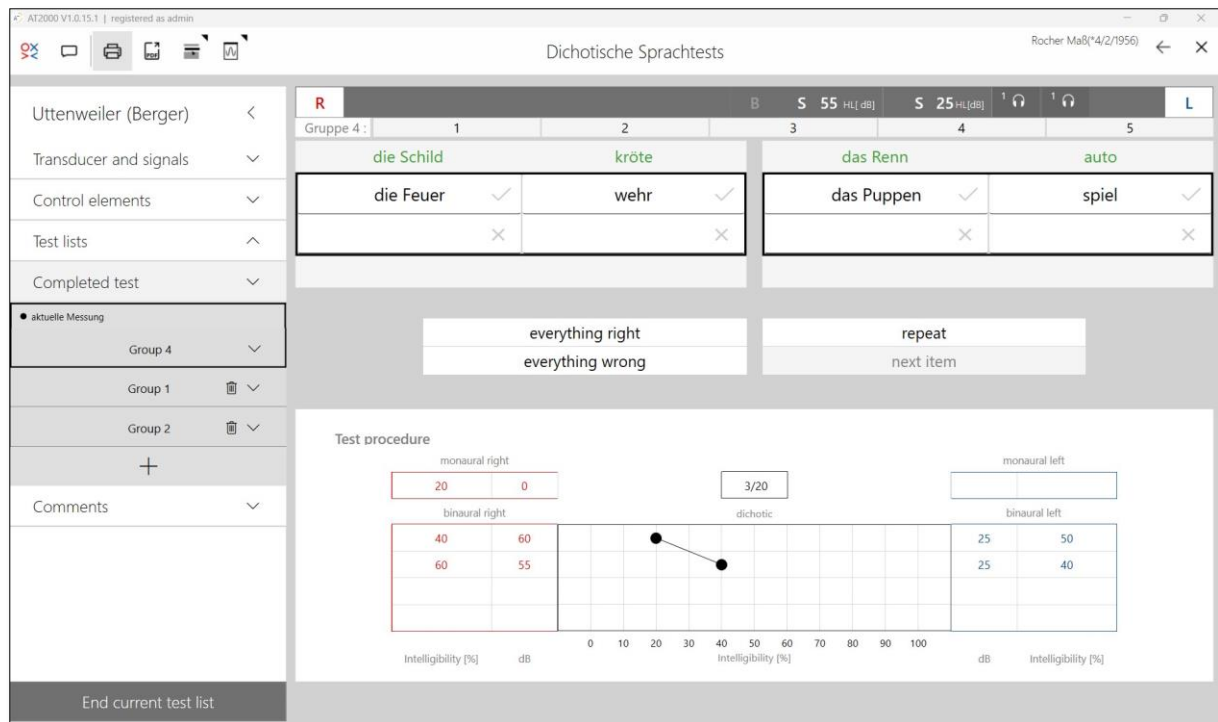


Figure172: Dichotic tests according to Berger

10.10 Behavioural audiometry

Behavioural audiometry includes the Mainz children's songs and the Göttingen sounds.

10.10.1 Mainz children's song

The Mainz children's songs comprise seven different songs.

To document the response threshold, either the right frequency button on the control unit or the 'Response threshold' button can be used. Pressing the left frequency button on the control unit or right-clicking on the entered threshold and selecting the 'Delete measuring point' option will delete the previously entered response threshold.

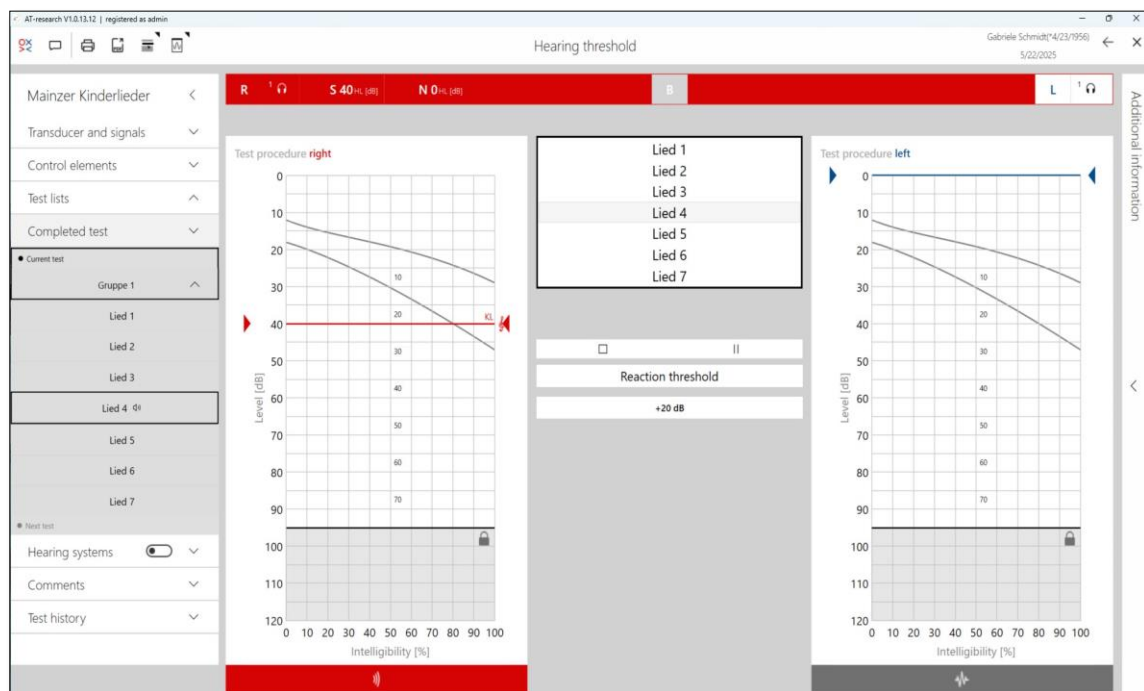


Figure173: SA – Mainz children songs

10.10.2 Göttingen sounds

The Göttingen sounds comprise ten different sounds.

To document the response threshold, either the right frequency button on the control unit or the 'Response threshold' button can be used. Pressing the left frequency button on the control unit deletes the previously entered response threshold.

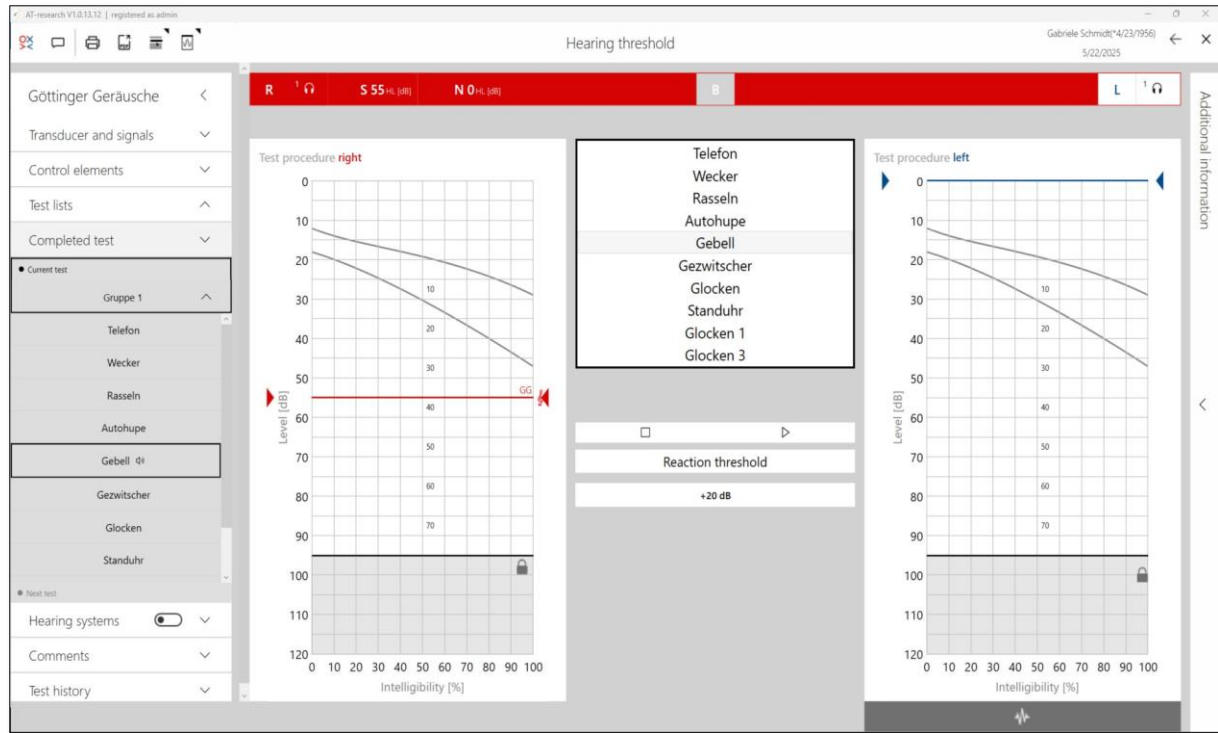


Figure174: SA – Göttingen sounds

10.11 MATCH (ONLY GERMAN TEST)

The MATCH test, also known as the Mainz children's speech test, is a speech test with 26 words (nouns). This test is suitable for children from the age of two

10.11.1 MATCH sidebar

Many other settings can be made in the left-hand sidebar. These are described in more detail in the following.

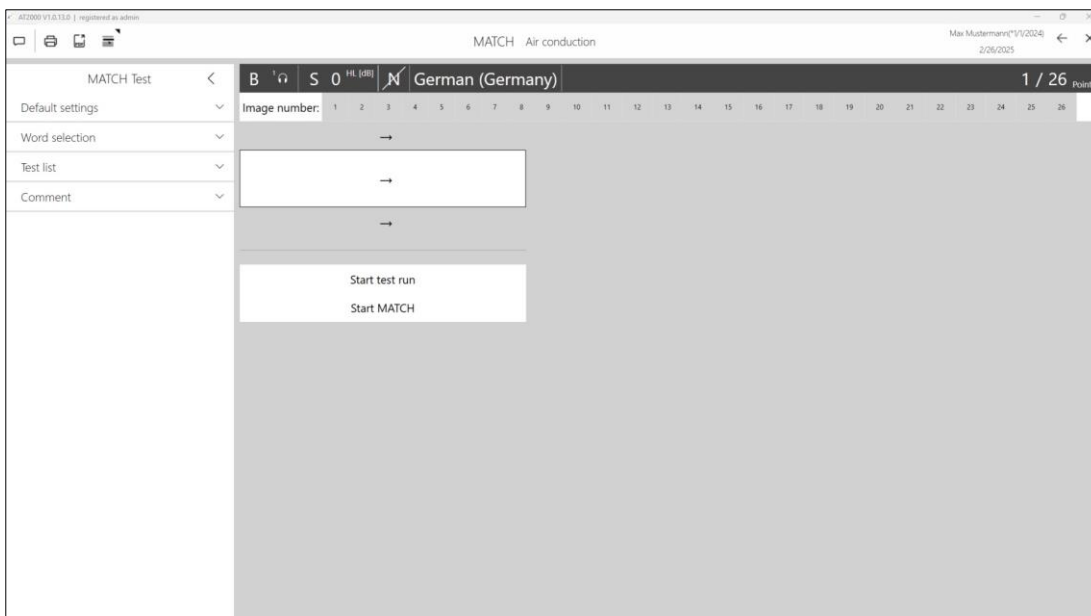


Figure175 : Left sidebar MATCH

10.11.1.1 Default settings

The following settings can be found in the default settings.

You can switch between the right, binaural or left measurement side. You can select the transducer (headphones, plug-in headphones or loudspeakers). The measurement can be carried out in two different measurement modes (see below). The noise level is fixed at 65 dB IPSI (measurement side). This can be switched on and off. The language can be changed. The response interface can be operated separately via a touch screen.

Figure176 : MATCH default settings

To start the test, either fixed or adaptive level must be activated.

Measuring mode: fixed level

The level can be set between 0 dB and 100 dB. The speech intelligibility at the level is determined here.

Figure177 : MATCH fixed level measurement mode

Measuring mode: adaptive level

The level can be set between 0 dB and 100 dB. The 71.4 % speech intelligibility threshold is determined here.

Figure178 : MATCH measurement mode adaptive level

10.11.1.2 Word selection

Up to 26 words can be selected for the measurement. At least four words must be selected.

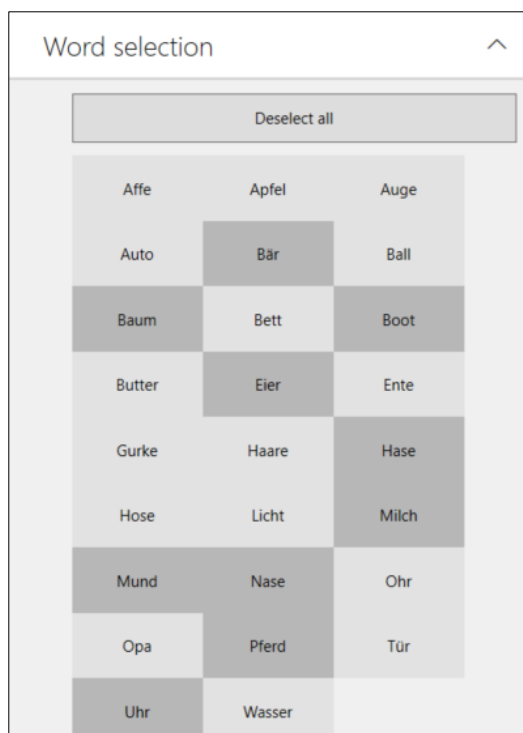


Figure179 : MATCH word selection

10.11.1.3 Test list

The selected words and the answers are displayed here in colour.

#	Word	Alt. 1	Alt. 2	Alt. 3	?	Pres.
1	Uhr	Wasser	Baum	Eier	?	1
2	Pferd	Wasser	Boot	Auto	?	1
3	Eier	Auge	Licht	Affe	?	2
4	Bär	Nase	Butter	Licht	?	3
5	Nase	Ohr	Haare	Auto	?	1
6	Hase	Tür	Nase	Bett	?	0
7	Baum	Boot	Affe	Ball	?	0
8	Boot	Bett	Baum	Ente	?	0
9	Mund	Eier	Wasser	Haare	?	0
10	Milch	Butter	Pferd	Affe	?	0

Figure180 : MATCH test list

10.11.1.4 Comment

Comments can be written and deleted here.

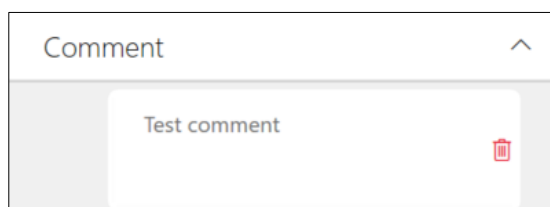


Figure181 : MATCH comment

10.11.2 MATCH interface

A test run is mandatory. This is always carried out binaurally. This is important so that the child can get used to the test procedure. The test run can also be cancelled. Once you have completed the test run, you must also click "Start MATCH" so that the MATCH test can be carried out with the default settings.

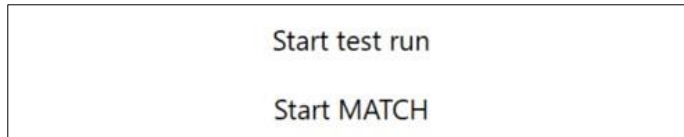


Figure182 : MATCH test run, start

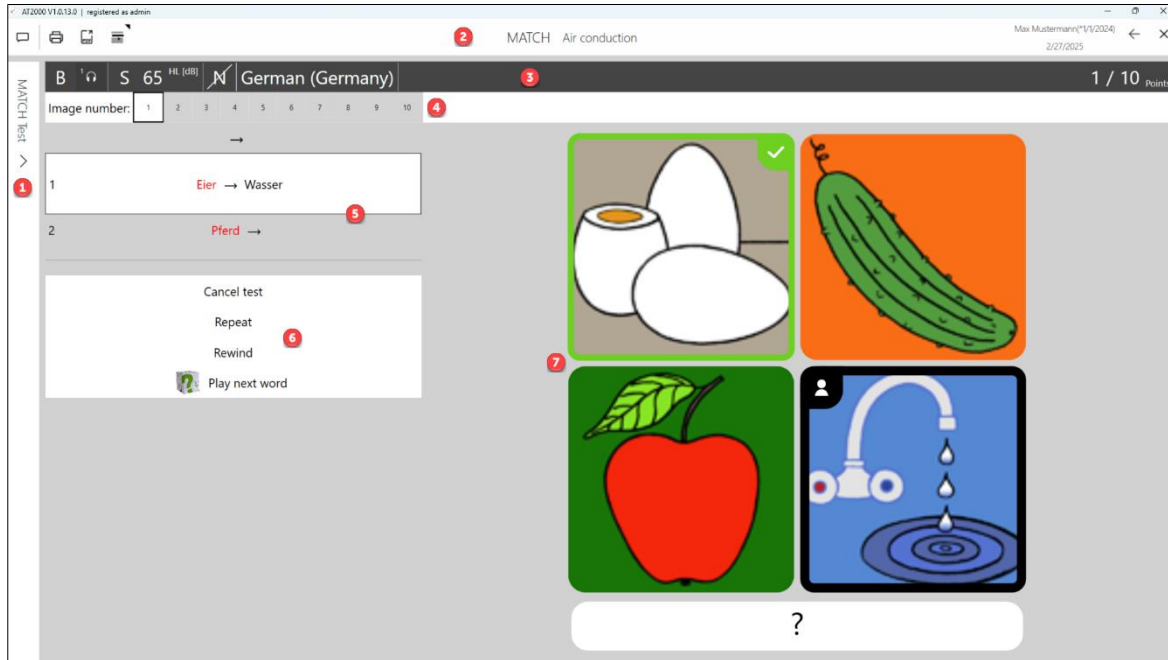


Figure183 : MATCH interface

The MATCH interface is divided into six areas.

Table21 : MATCH interface

1	Left sidebar - see chapter 10.11.1 MATCH sidebar
2	Menu bar - see chapter 8.3 Tone audiometry menu bar
3	The default settings are displayed here.
4	The number of words is shown here.
5	The language being played is displayed in the thick bordered frame. The language already played is displayed above the frame. The next language to be played appears below the frame.
6	If the test is cancelled, the measurement is lost. Presented words can be repeated. Answers that have already been answered can be cancelled. If no touch screen is connected, the user can play the next word manually.
7	The green border shows which word is the correct one. The black border shows what the patient has answered. The patient can click on the question mark if the answer cannot be given.

10.11.3 Results

After the test has been completed, the results are displayed.

10.11.4 Images

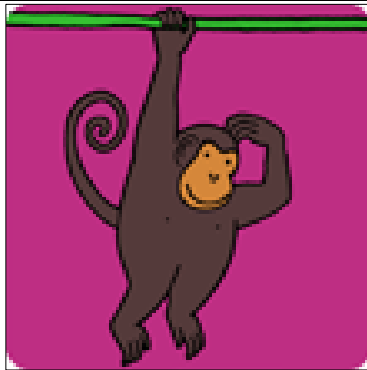


Figure184: Match - Affe

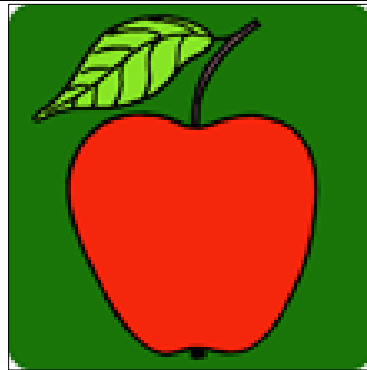


Figure185: Match - Apfel

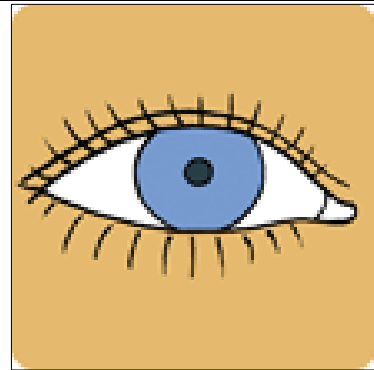


Figure186: Match - Auge



Figure187: Match - Auto

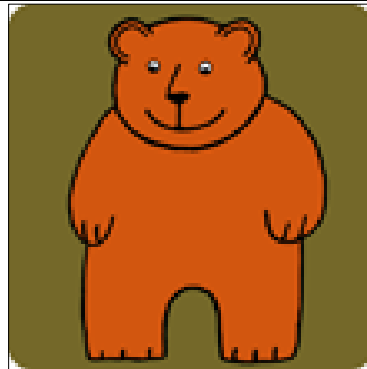


Figure188: Match - Bär



Figure189: Match - Ball



Figure190: Match - Baum



Figure191: Match - Bett



Figure192: Match - Boot



Figure193: Match - Butter

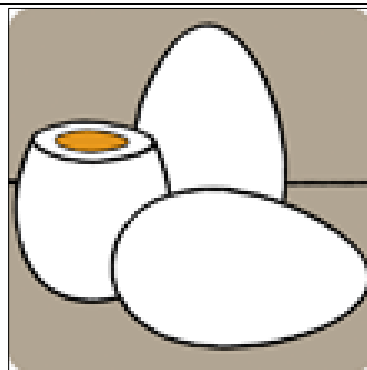


Figure194: Match - Eier

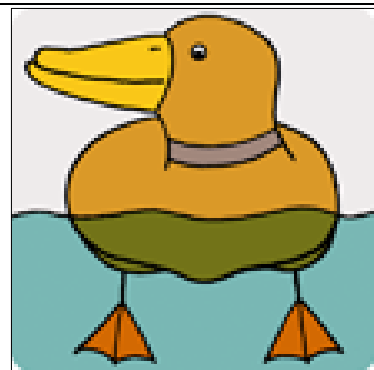


Figure195: Match - Ente

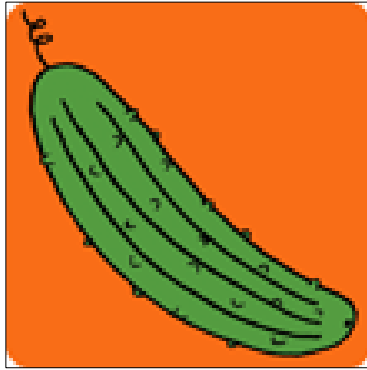


Figure196: Match - Gurke



Figure197: Match - Haare

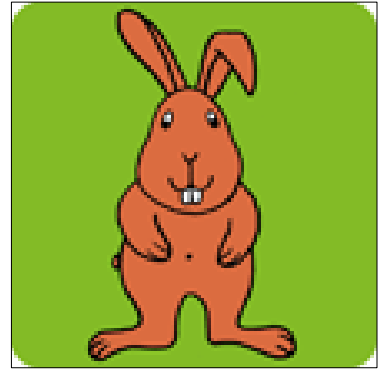


Figure198: Match - Hase



Figure199: Match - Hose

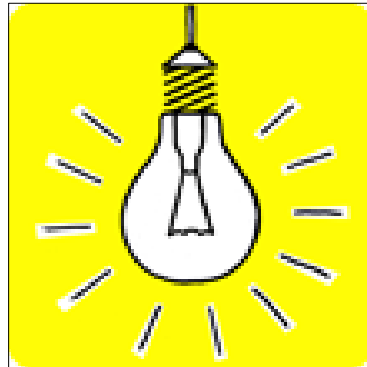


Figure200: Match - Licht

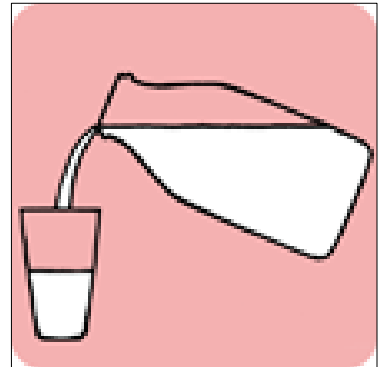


Figure201: Match - Milch

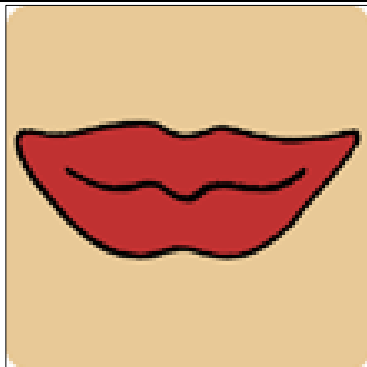


Figure202: Match - Mund

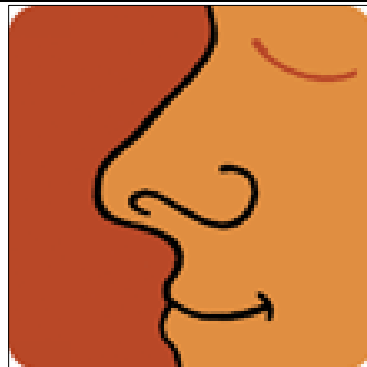


Figure203: Match - Nase



Figure204: Match - Ohr

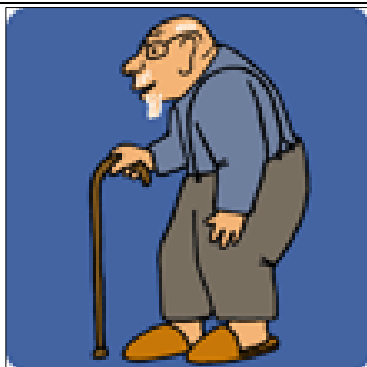


Figure205: Match - Opa

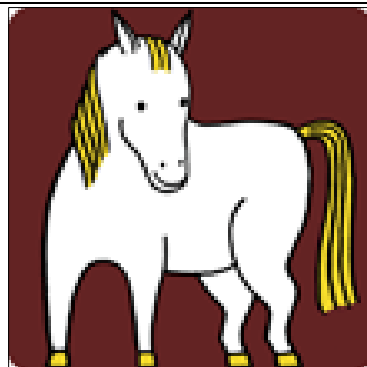


Figure206: Match - Pferd



Figure207: Match - Tür

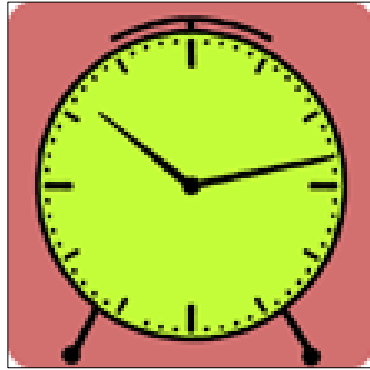


Figure208: Match – Uhr



Figure209: Match – Wasser

11 Regiometry

Extended free field measurement is a method for testing hearing in a free field using multiple loudspeakers. Sound is not generated via headphones or bone conduction headphones, but via loudspeakers positioned in the room. Additional masking using headphones is possible if required.



However, measurements of implants are not permitted within the scope of extended free field measurements.

11.1 Extended free field measurement – Tone

This chapter describes tone regiometry.

11.1.1 Software interface of the regiometry

After starting the regiometry, you will find yourself in the following software interface.

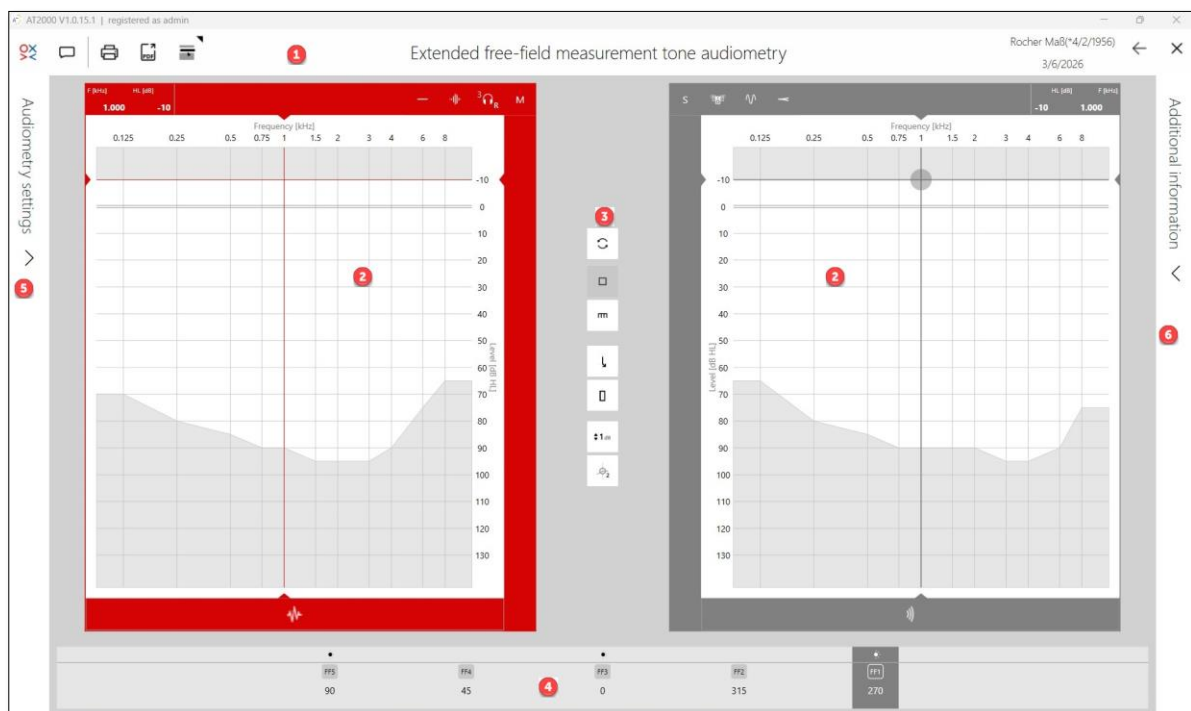


Figure210: Surface of the regiometry

The Regiometry interface is divided into six areas. These areas are described in more detail in the following chapters.

Table22: Areas in regiometry

1	Regiometry menu bar – see chapter 8.3 Tone audiometry menu bar
2	Regiometry audiograms – see chapter 11.1.2 Audiograms of regiometry
3	Additional functions – see chapter 11.1.3 Additional functions
4	Speaker arrangement – see chapter 11.1.4 Speaker arrangement
5	Sidebar of the regiometry – see chapter 11.1.5 Sidebar of the Regiometry
6	Additional information on the regiometry – see chapter 11.1.6 Additional information on regiometry

11.1.2 Audiograms of regiometry

In regiometry, there is a measurement audiogram ("S" on the audiogram) and a masking audiogram ("M" on the audiogram). Depending on which side the measurement audiogram is on, the masking audiogram with the corresponding transducers is displayed on the other side. On the signal side, only the loudspeaker can be selected.

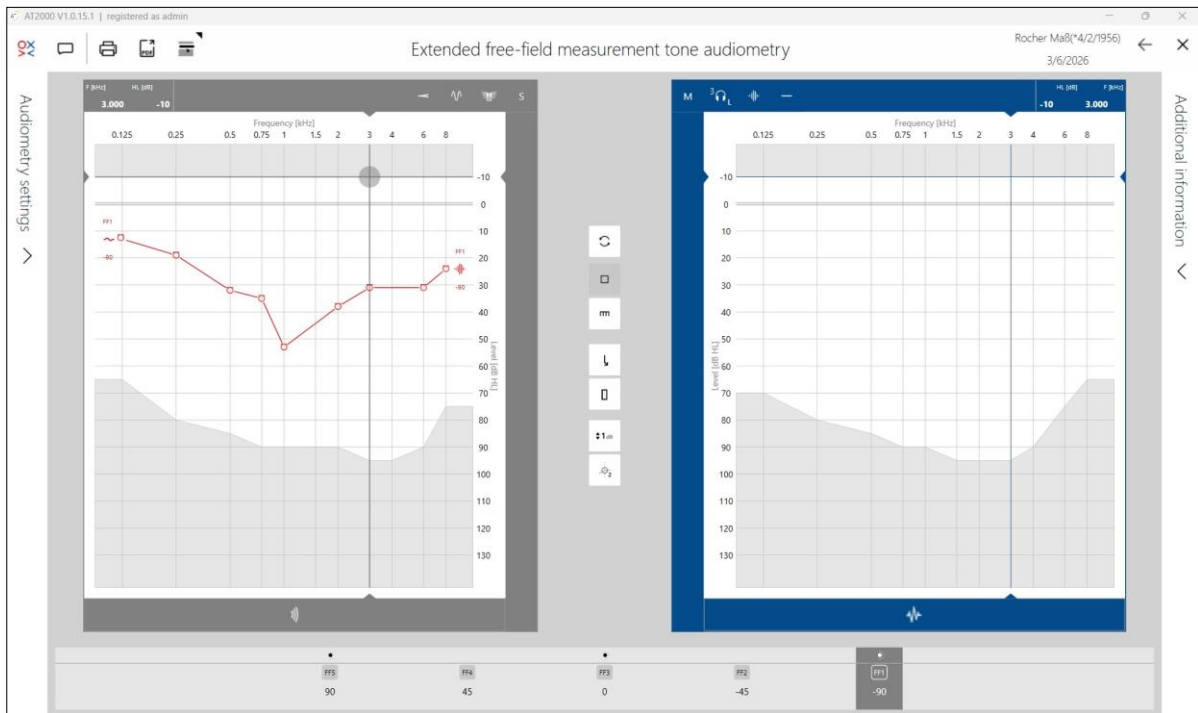


Figure211: RegioT - signal page

The side can be changed either by pressing 'F3' or by clicking on the 'Change measurement page' button. The page will only change if both level sliders are set to 0dB.

If the measurement audiogram is on the left-hand side, all transducers for masking on the left ear are displayed on the right-hand side.

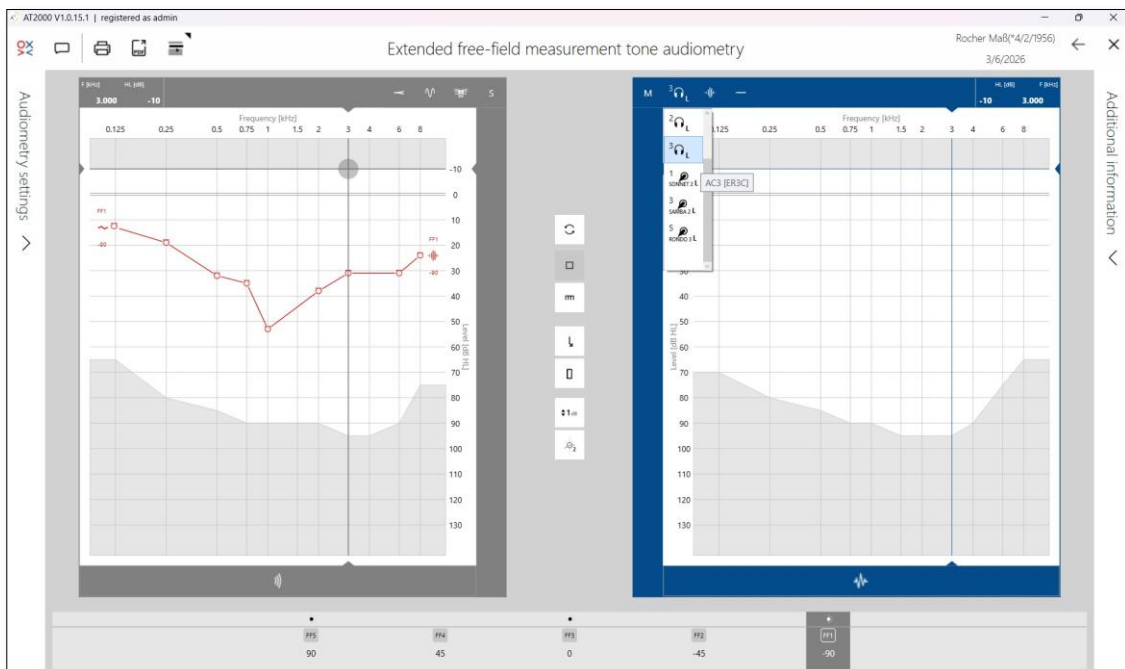


Figure212: RegioT – Masking on the left

If the audiogram is on the right-hand side, all transducers for right ear masking are displayed on the left-hand side.

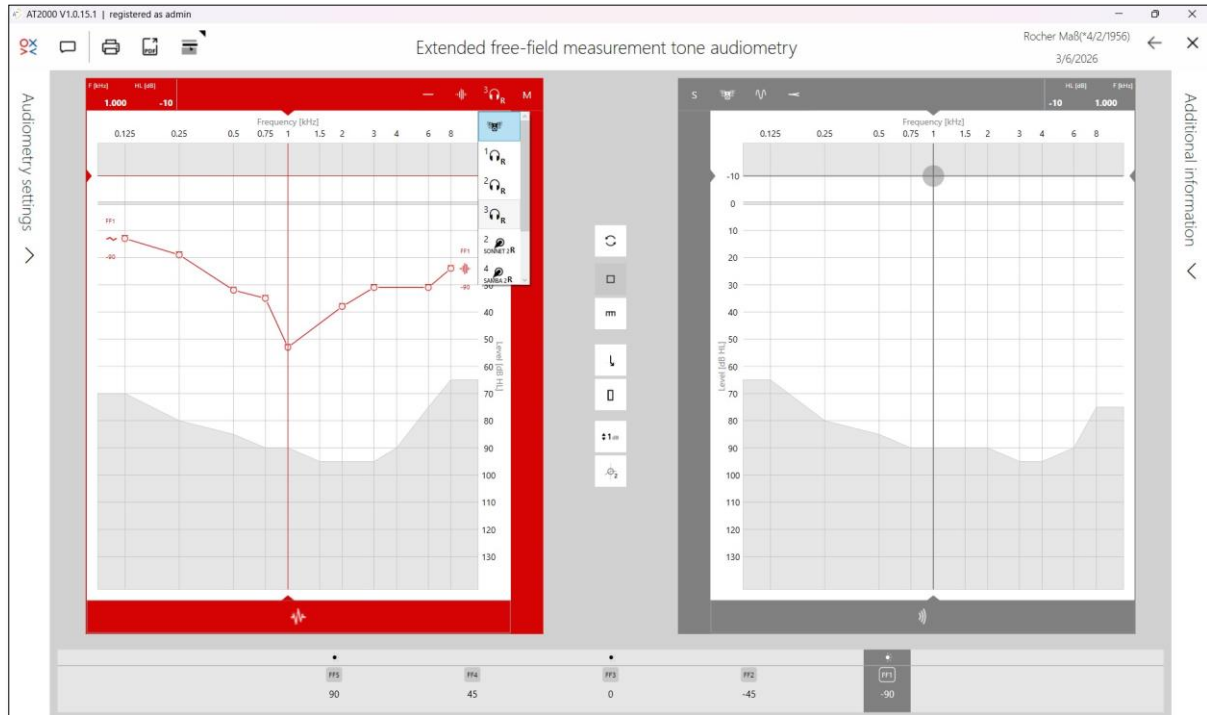


Figure213: RegioT – Masking on the right

11.1.2.1 Warning when overwriting current curve configuration

If the measurement settings are changed and overwriting of the current curve configuration is necessary, the following warning appears. This warning can be deactivated in the settings.

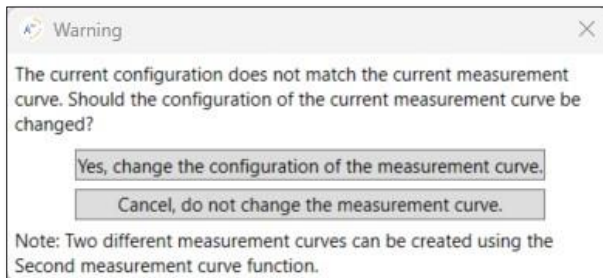


Figure214: RegioT - Warning when overwriting

11.1.3 Additional functions

The other functions are described below from top to bottom.



Figure215: Additional functions

Table23: Additional functions in regiometry

 Figure216: RegioT – Switch measuring side	The measurement side is changed.
 Figure217: RegioT - auditory threshold	The hearing threshold is measured here.
 Figure218: RegioT – discomfort threshold	Clicking on this button allows you to note the discomfort threshold.
 Figure219: RegioT - No information available	No threshold could be measured on this frequency.
 Figure220: RegioT - Mark uncertain information.	Uncertain information can be marked.
 Figure221: RegioT - Step size in dB	The step size can be set to 1 dB, 2 dB and 5 dB.
 Figure222: RegioT - Second measurement curve	This button is used to enter a second measurement curve.

11.1.4 Speaker arrangement

If you click on a speaker in the speaker layout with the left mouse button, it will turn grey. This means that the measurement signal is coming from this speaker.

If you click on a speaker in the speaker layout with the right mouse button, it will turn black. This means that the noise is coming from this speaker.



Figure223: RegioT - Speaker arrangement for measurement signal/masking signal 1

It is also possible that both the measurement signal and the noise are coming from the same loudspeaker.



Figure224: RegioT - Speaker arrangement for measurement signal/masking signal 2

11.1.5 Sidebar of the Regiometry

Many more settings can be configured in the left sidebar. We recommend using the sidebar before starting the measurement and closing it again after configuring the settings and before starting the measurement. These settings are described in more detail in the following chapters.

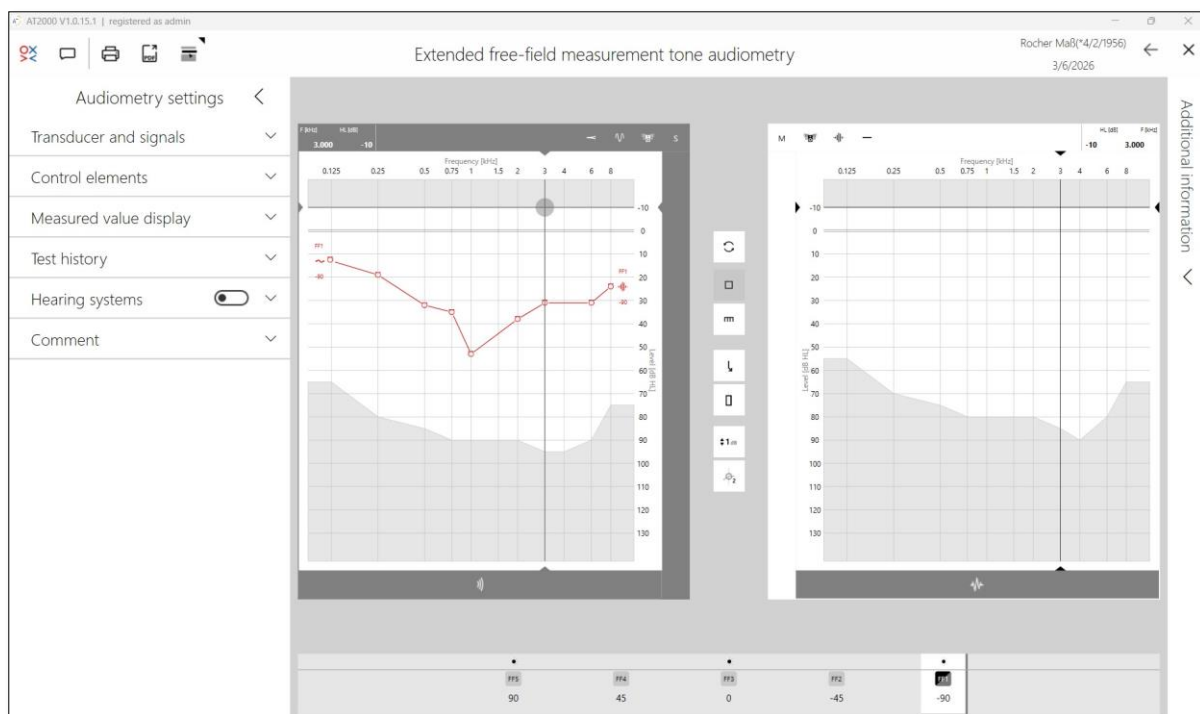


Figure225: Left sidebar of the region measurement

11.1.5.1 Transducers and signals

The transducer used, the signal type and the type of signal presentation can be selected in the audiogram area and in the list on the left-hand side. The settings for the wobble tone can be adjusted in the sidebar. The default setting for the wobble tone is 4 Hz with 2.5%.

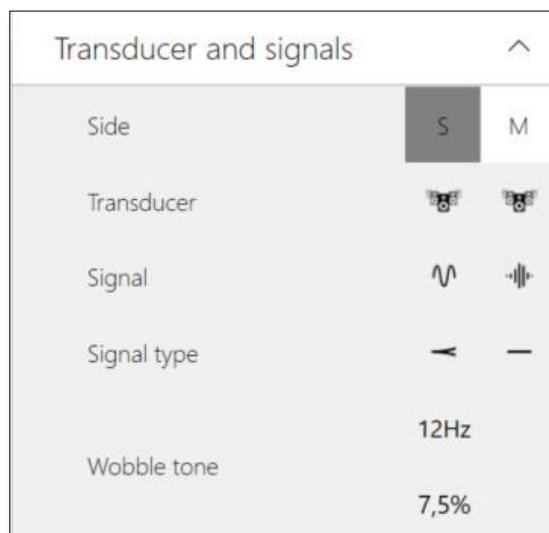


Figure226: RegioT - Transducers and signals

11.1.5.2 Steuerelemente Control elements

The dB increment can be adjusted in the Controls tab.



Figure227: RegioT - Control elements

11.1.5.3 Measured value display

When you open the legend or the measured value display, only the symbols required for the Regiometry will be visible.



Figure228: RegioT - Measured value display

11.1.5.4 Test history

It is possible to display an old examination in a measurement. To do this, activate the field in the left sidebar and select the measurement to be displayed.

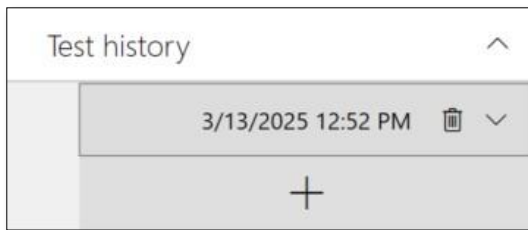


Figure229: RegioT - Test history

11.1.5.5 Hearing aids

It is also possible to document measurements with a hearing aid in the right and/or left ear. To do this, activate the field in the left sidebar and select the appropriate hearing aid.

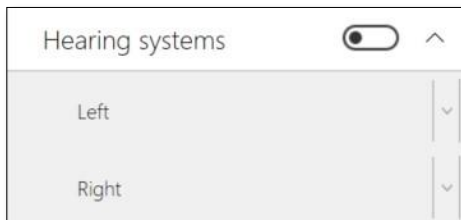


Figure230: RegioT - Hearing aids

11.1.5.6 Comments

The comment field can be opened in the respective measurement and is saved with the measurement performed. Comments that have already been entered can be deleted using the trash can icon. The comments can be copied and edited, and old measurements that have been displayed are also shown with comments.

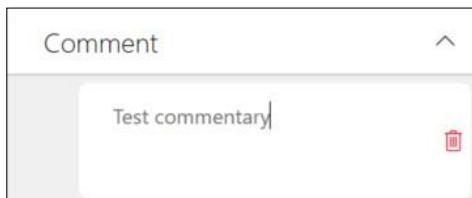


Figure231: RegioT – Comments

11.1.6 Additional information on regiometry

In the right-hand sidebar – in the additional information – you can display the polar plot of the regiometry.



Figure232: RegioT - additional information – 1

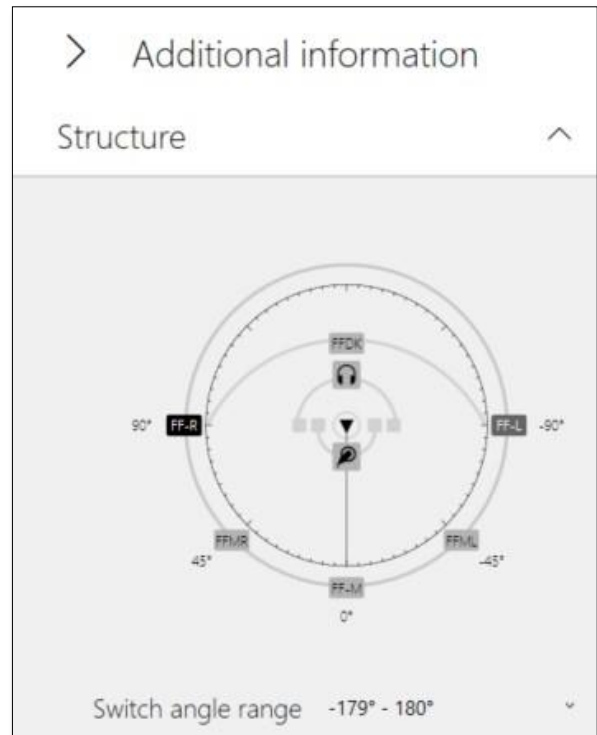


Figure233: RegioT - additional information – 2

12 Multichannel audiometry

Multi-channel audiometry offers the option of outputting more than 2 channels for a speech test in noise, mixing them and controlling several transducers simultaneously. With the exception of the bone conduction transducer, any transducer connected to the AT2000 can be used for multi-channel audiometry. With a surround module, up to 8 additional speakers can be connected. Using 2 surround modules would allow for up to 16 speakers.

12.1 Multichannel audiometry – speech

This chapter describes multichannel speech audiometry.

12.1.1 Test selection in multichannel speech

In the test selection of multichannel speech audiometry, you can create, save, edit, copy, delete and start tests. The user decides how the measurement configuration should look.

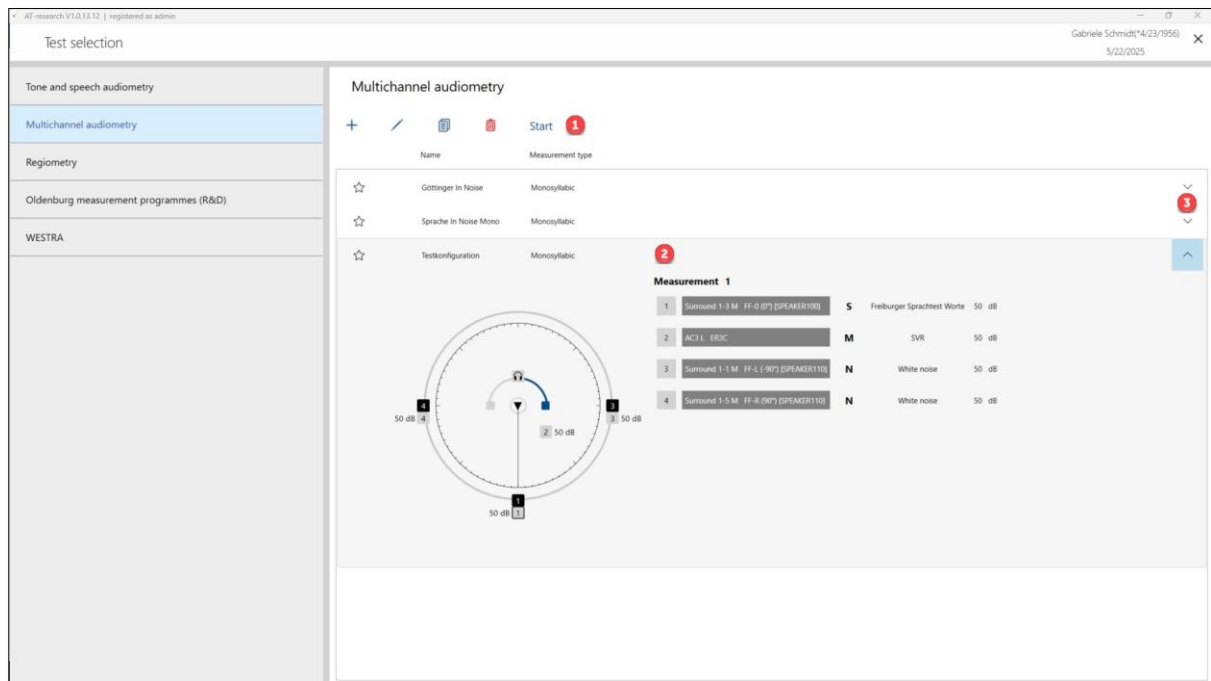


Figure234: Test selection Multi-channel language

Table24: Test selection Multi-channel

1	Menu bar – see Chapter 12.1.1.1 Menu bar in the test selection
2	The saved configurations are listed here in alphabetical order. If you click on the star, they will appear at the top.
3	If you select a configuration and click on the arrow on the right, the polar plot for the respective configurations is displayed.

12.1.1.1 Menu bar in the test selection



Figure235: Multichannel functions

Table25: Multichannel functions

	A configuration can be created.
	A saved configuration can be edited.
	A saved configuration can be copied, modified and saved again.
	A saved configuration can be deleted.
	A saved configuration can be started.

12.1.2 Configuration overview in multi-channel speech

After clicking on the 'Create' button, 'Edit' button or 'Copy' button, you will be taken to the following software interface.

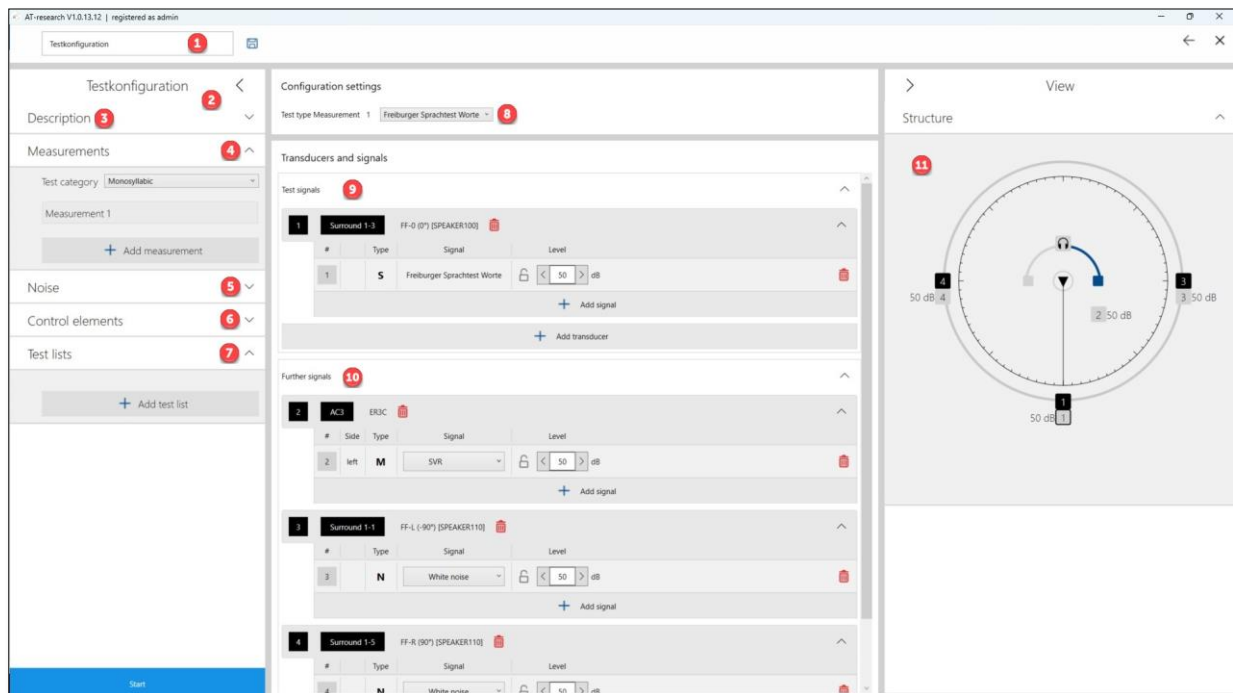


Figure241: Configuration overview in multichannel speech

Table26: Configuration overview in multichannel speech

	To save a configuration, you must give it a unique name.
	Test settings are made here – see points 4 to 7.
	A description of the test can be entered here.

4	The test category must be selected here. Depending on which test category you have selected, the corresponding tests will appear in the dropdown menu 8. In addition, several measurements can be added to this configuration.
5	The settings for the background noise can be made here.
6	The counting method can be adjusted. The test lists can be played back with a random word order. The measurement range can be extended. In addition, the step size can be adjusted.
7	The test lists can be added.
8	Depending on the test category selected, the corresponding tests appear here.
9	The test signal is set here. To do this, first click on 'Add transducer' and select the appropriate transducer. Then click on 'Add signal' and adjust the level. All „locked“ signals are linked and level changes are applied to all linked signals. The 'trash can icon' can be used to delete either the test signal or the transducer. Only one transducer with a test signal can be added!
10	Additional signals are set here. Up to three signals can be added per transducer!
11	The measurement setup is visually displayed here in a polar plot.

12.1.3 Interface in multichannel speech

After starting a configuration, you will find yourself on the following measurement interface.

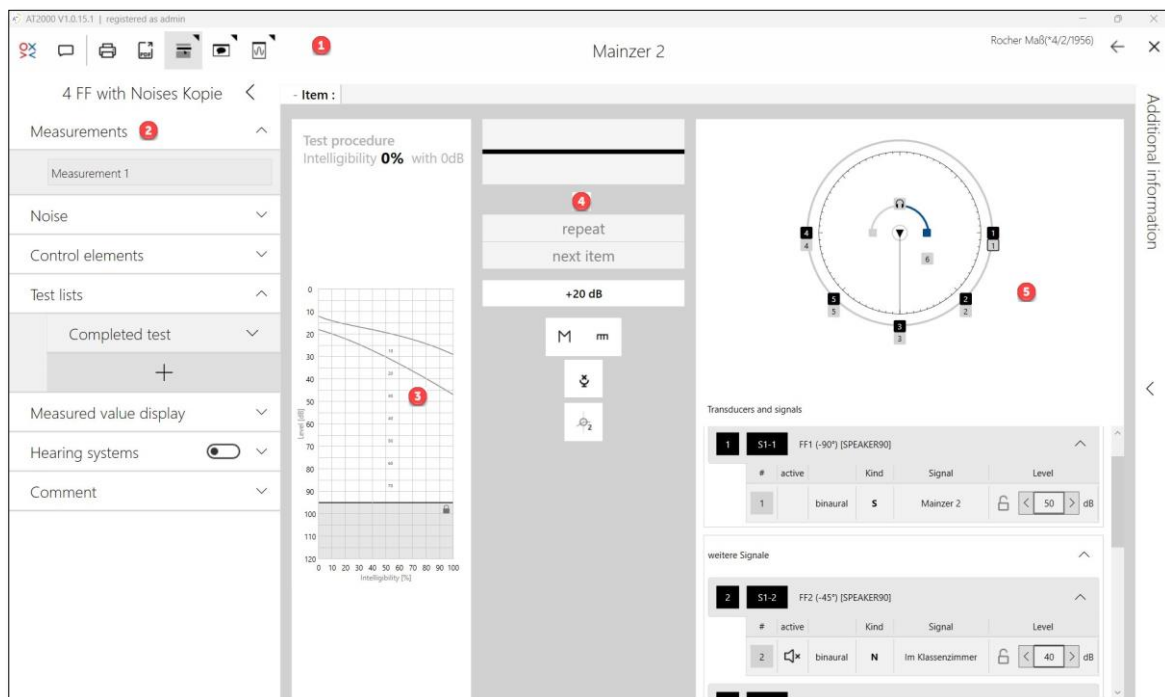


Figure242: interface in multichannel language

Table27: interface in multichannel speech

1	Menu bar – see chapter 8.3 Tone audiometry menu bar
2	Side bar – see Chapter 12.1.5 Sidebar in multichannel
3	Speech audiogram
4	Additional functions as in speech audiometry. The 'Switch all signals on or off' button switches all added signals on or off simultaneously.
5	View of the signals – see Chapter 12.1.4 Viewing signals in multichannel

12.1.4 Viewing signals in multichannel speech

The polar plot of the configuration is displayed here.

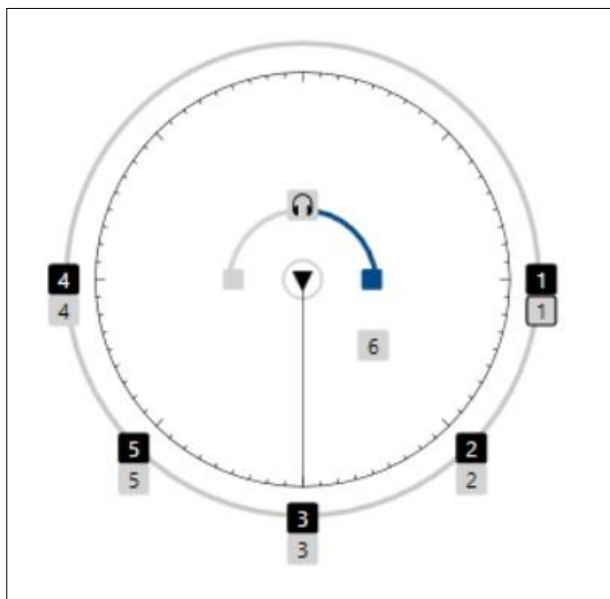


Figure243: interface in multichannel speech – structure overview

The test signal is displayed here. The volume can be adjusted. The lock symbol can be activated or deactivated.

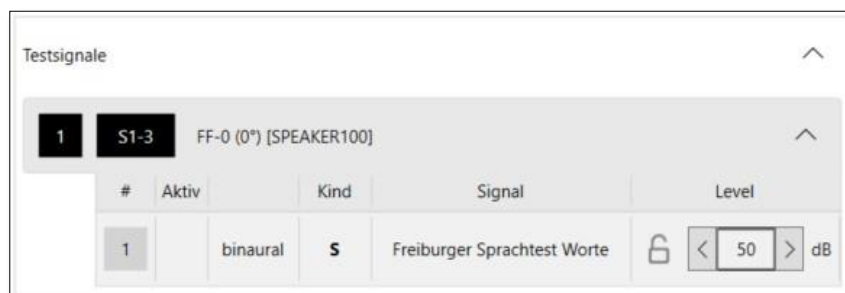


Figure244: interface in multichannel speech - test signal

The other signals are displayed here. The volume can be adjusted. The lock symbol can be activated or deactivated. You can also use the 'speaker symbol' to switch the signal on or off.

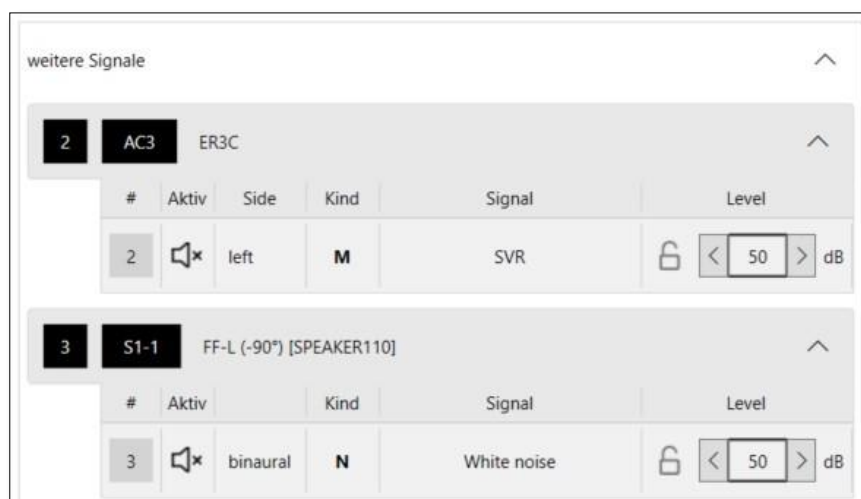


Figure245: interface in multichannel speech – additional signals

12.1.5 Sidebar in multichannel speech

Previously created measurements in this configuration are displayed here. Click on a measurement to switch to the selected measurement.



Figure246: Sidebar in multichannel speech - Measurements

The interference signal can be played continuously or with pauses and a defined lead time – as in speech audiometry.



Figure247: Sidebar in multichannel speech - Noise signal

The counting method can be adjusted. The test lists can be played back with a random word order. The measurement range can be expanded. In addition, the step size can be adjusted.

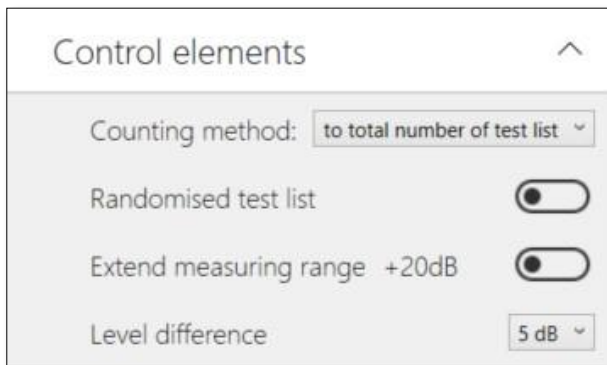


Figure248: Sidebar in multichannel speech – controls

The inserted test lists appear here. Additional groups can also be added.

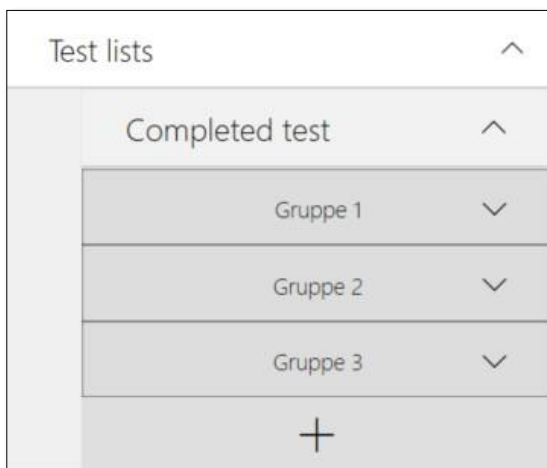


Figure249: Sidebar in multichannel speech – test lists

When you open the legend or the measured value display, only the symbols required for multichannel audiometry will be visible.

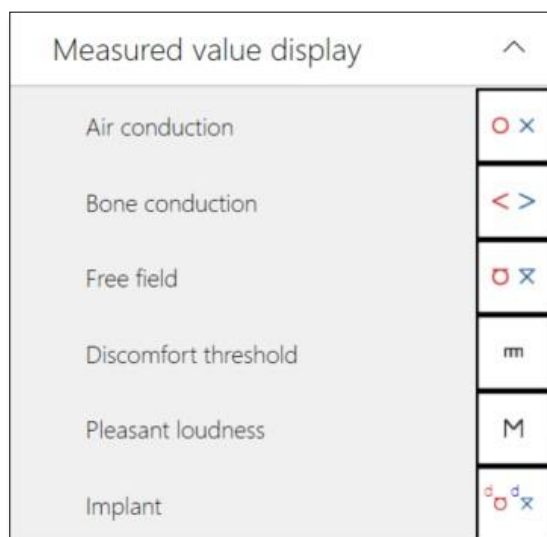


Figure250: Sidebar in multichannel speech – measured value display

Here you can select and activate hearing systems.

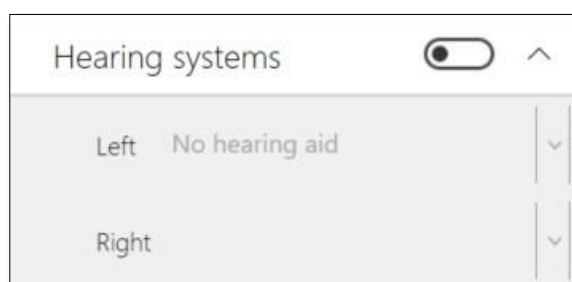


Figure251: Sidebar in multichannel speech – hearing systems

Comments are written here.

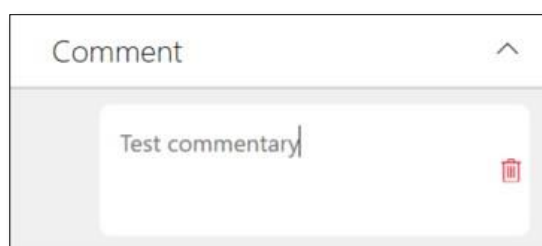


Figure252: Sidebar in multichannel speech - Comment

12.1.6 Results view in multichannel speech

The results of the multichannel measurement are displayed here. The comment field can be seen in the left sidebar. A black bar can be seen to the left of the audiogram. When you open it, you will see the group and the corresponding responses. The polar plot is located to the right of the audiogram.

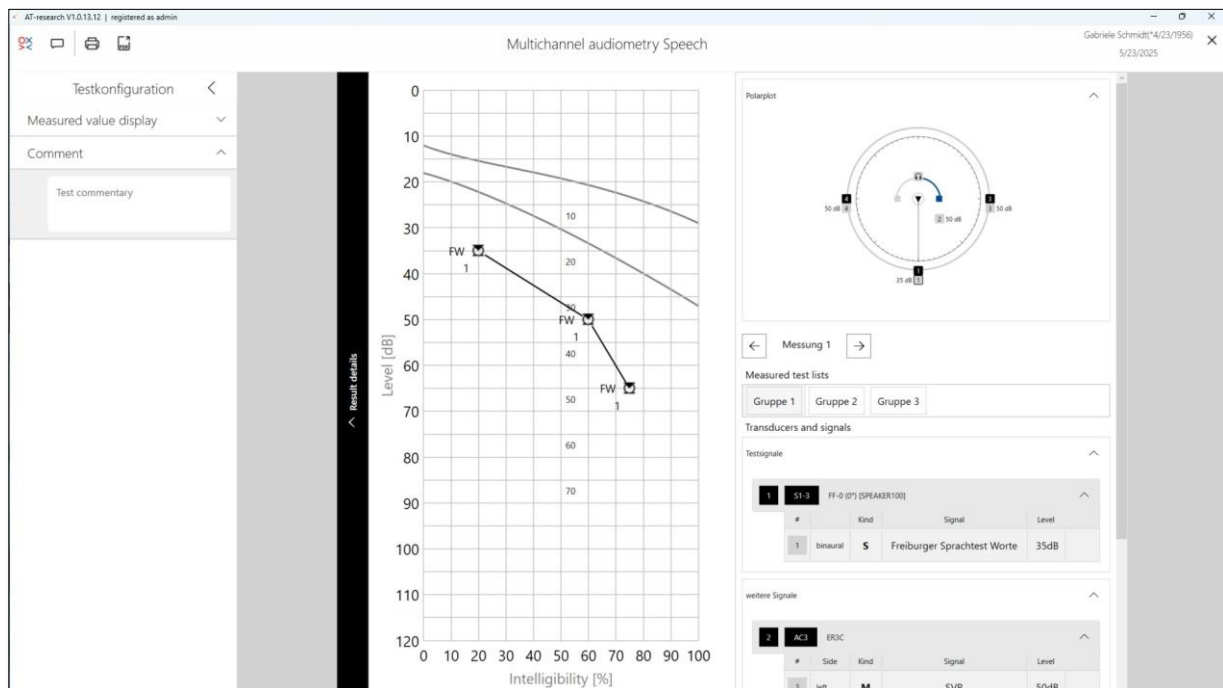


Figure253: Results view in multichannel speech

13 Free audiometry – applies only to AT-research

Free audiometry allows individual background noise and individual speech tests to be created.

13.1 Free noise

This chapter describes how to create free noise.

13.1.1 Software interface for free noise

To access the free noise interface, go to Settings and click on 'Free noise' under Global settings.

You will now see the following interface.

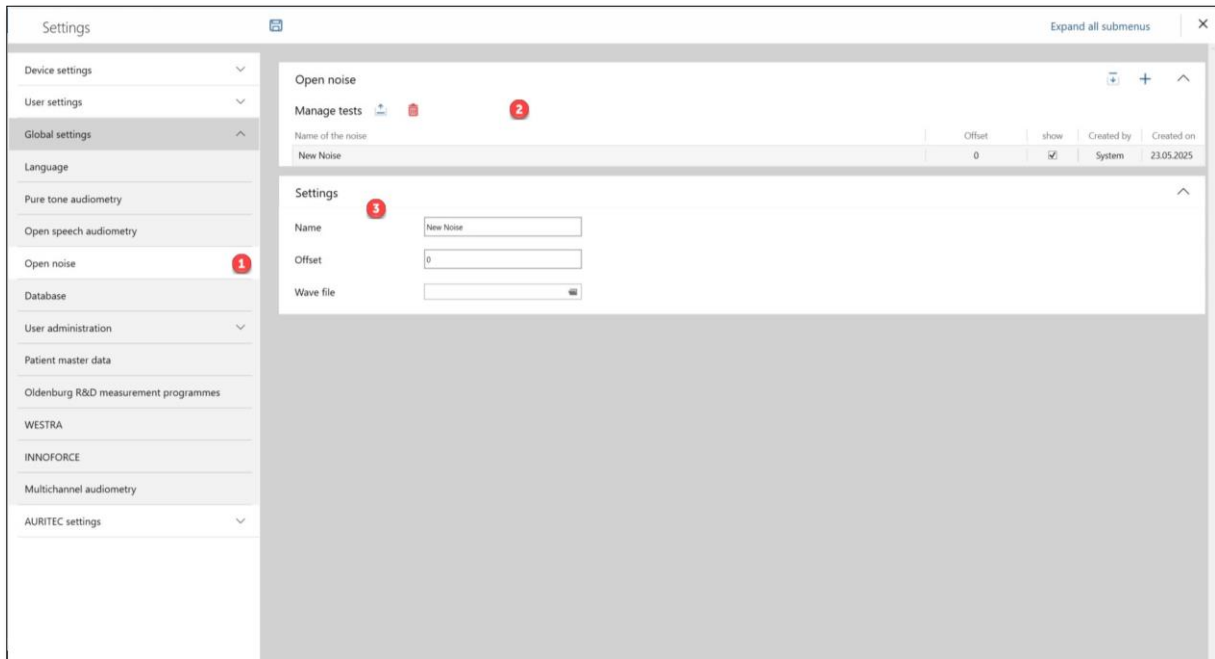


Figure254: Surface of free noise

Table28: Areas in the free noise

1	Calling up free noise
2	All noise settings are displayed here – see chapter 13.1.2 Managing tests
3	Noise can be created here – see chapter 13.1.3 Free noise settings

To save the created noise, use the following symbol.



Figure255: Save

13.1.2 Managing tests

The functions are described below from left to right.

To display created configurations (free speech tests) in the test selection, you must check the box in the 'Display' column.

If you check this box for created background noises, they will be listed in the selection when creating free speech tests.



Name of the noise	Offset	show	Created by	Created on
New Noise	0	☒	System	23.05.2025

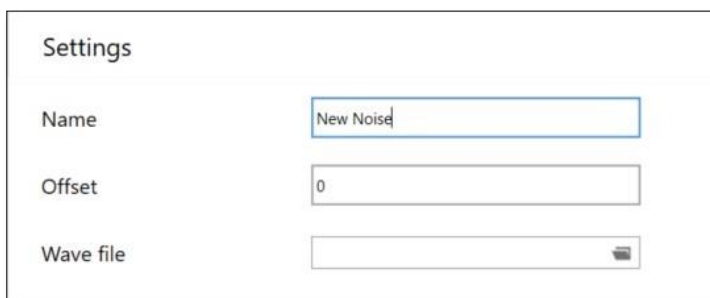
Figure256: Free noise - Manage tests

Table29: Functions Free audiometry

 Figure257: Free audiometry – export	A saved configuration can be exported.
 Figure258: Free audiometry – delete	The saved configuration can be deleted.
 Figure259: Free audiometry – import	A configuration can be imported.
 Figure260: Free audiometry – create	A configuration can be created.

13.1.3 Free noise settings

To create a noise, you must give it a name and select the appropriate wave file.



Settings

Name

Offset

Wave file

Figure261: Free noise settings

13.1.4 Selection of newly created free noise

The background noise added is listed under noise when creating the free speech tests – see chapter 13.2.2 Free speech test settings.

13.2 Free speech tests

This chapter describes how to create free speech tests.

13.2.1 Software interface of the free speech tests

To access the software interface for the free speech tests, go to Settings and click on 'Free speech audiometry' under Global settings.

The following interface will now appear.

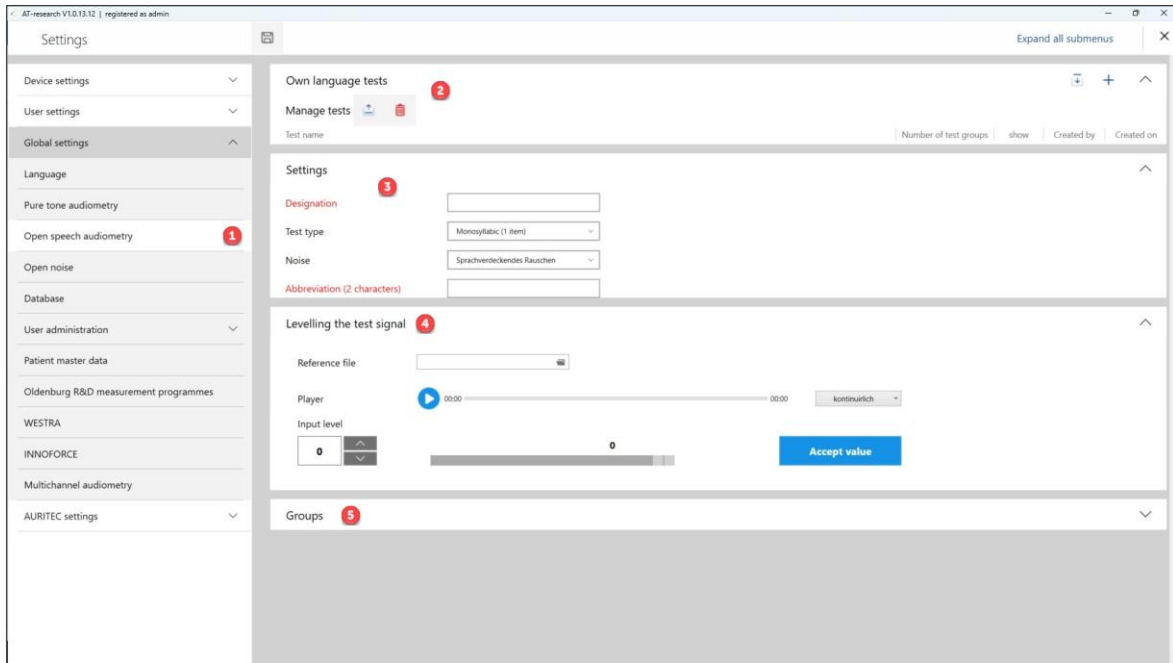


Figure262: Interface of the free speech tests

Table30: Areas covered in free speech tests

1	Calling up free speech audiometry
2	All created speech tests are displayed here – see chapter 13.1.2 Managing tests
3	Speech tests can be created here – see chapter 13.2.2 Free speech test settings
4	The test signal can be levelled here – see chapter 13.2.3 Leveling the test signal for free speech tests
5	The groups and wave files are added here – see chapter 13.2.4 Groups of free speech tests

To save the created speech test, use the following symbol.



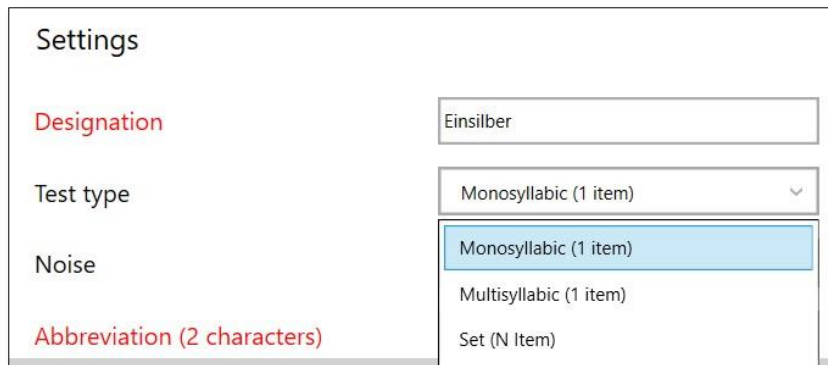
Figure263: Save

13.2.2 Free speech test settings

To create a free speech test, you must enter a name in the Name field.

Under Test type, you can choose between 'Monosyllabic (1 item)', 'Polysyllabic (1 item)', 'Sentence (N items)', 'Sentence (N items) Adaptive (equal)' and 'Sentence (N items) Adaptive (unequal)'.

You must enter 2 characters under Abbreviation.

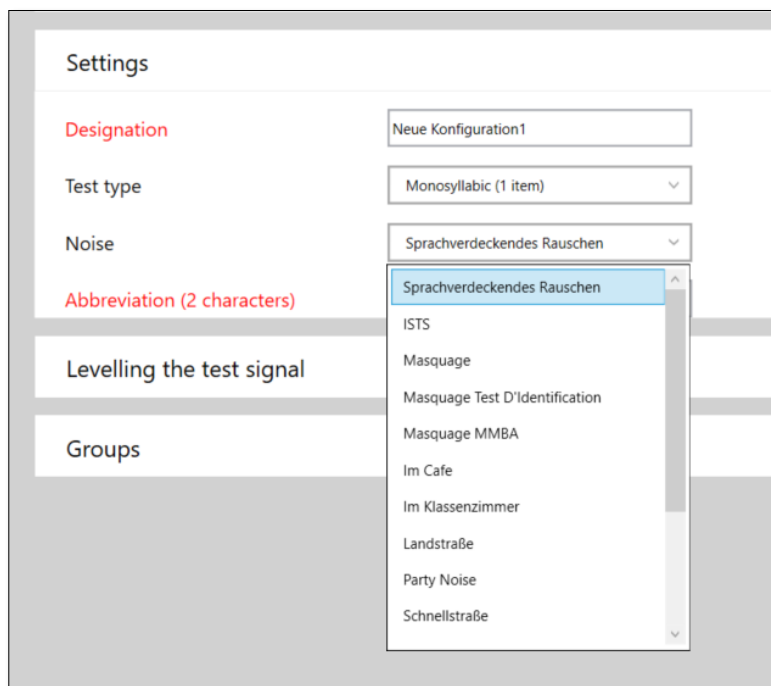


The screenshot shows a 'Settings' form with the following fields and values:

- Designation:** Einsilber
- Test type:** Monosyllabic (1 item)
- Noise:** Monosyllabic (1 item)
- Abbreviation (2 characters):** Set (N Item)

Figure264: Free speech tests - Settings 1

If you click on the drop-down menu for noise, the currently available noises and the freely created noises are displayed.



The screenshot shows the 'Settings' form with the 'Noise' dropdown menu open. The menu lists the following options:

- Sprachverdeckendes Rauschen
- ISTS
- Masquage
- Masquage Test D'identification
- Masquage MMBA
- Im Cafe
- Im Klassenzimmer
- Landstraße
- Party Noise
- Schnellstraße

Figure265: Free speech tests - Settings 2

13.2.3 Leveling the test signal for free speech tests

The test signal can be levelled here.

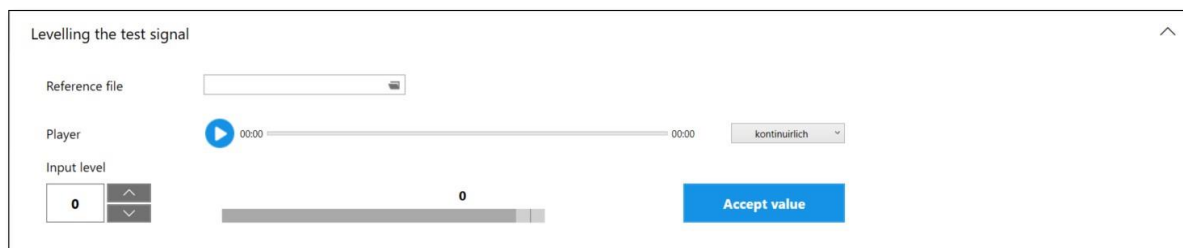


Figure266: Free speech tests - placement tests

13.2.4 Groups of free speech tests

The group creation interface is described below.

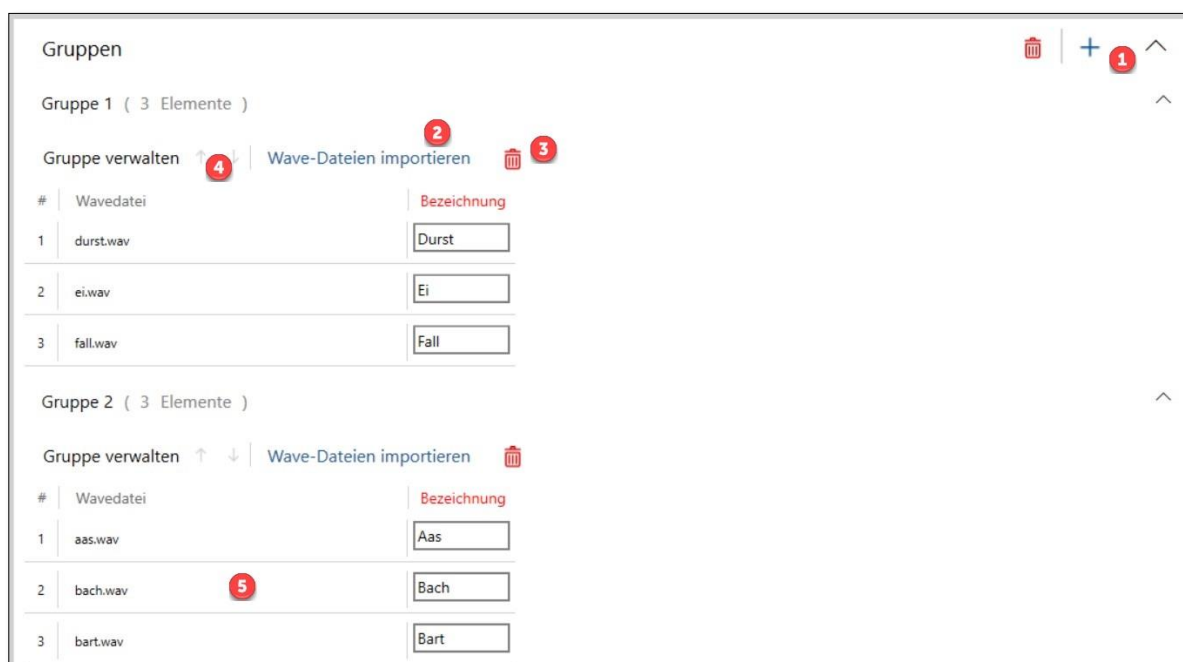


Figure267: Free speech tests - Groups 1



Figure268: Free speech tests - Groups 2

Table31: Free speech test groups

1	Clicking on the plus sign adds a group. To delete a group you have added, select or click on the group and then click on the trash can icon.
2	Clicking here allows you to import wave files.
3	The individual wave files can be deleted. To do this, select the corresponding line.

	The groups can be reordered using the arrows.
 	The wave files are displayed here.
	Individual fields can be added using this plus sign.
	The individual fields can be deleted again using this trash can icon.

14 Oldenburg measurement programmes

The Oldenburg measurement programmes are independent software developed by the Hörzentrum Oldenburg, which can be accessed from the **AT-research / AT2000** software. The specific procedures and functions are determined by the Hörzentrum Oldenburg. These applications are simply accessed via **AT-research / AT2000** and the results are saved as raw data and as PDF files.

14.1 Calling up an Oldenburg test

The installed Oldenburg tests can be called up in the test selection using the 'Oldenburg measurement programmes (MP)' or 'Oldenburg measurement programmes (R&D)' selection field.

The transducer selection opens first, followed by the Oldenburger measurement window. To perform a measurement in the Oldenburger measurement programmes, please refer to the operating instructions for the hearing centre software.

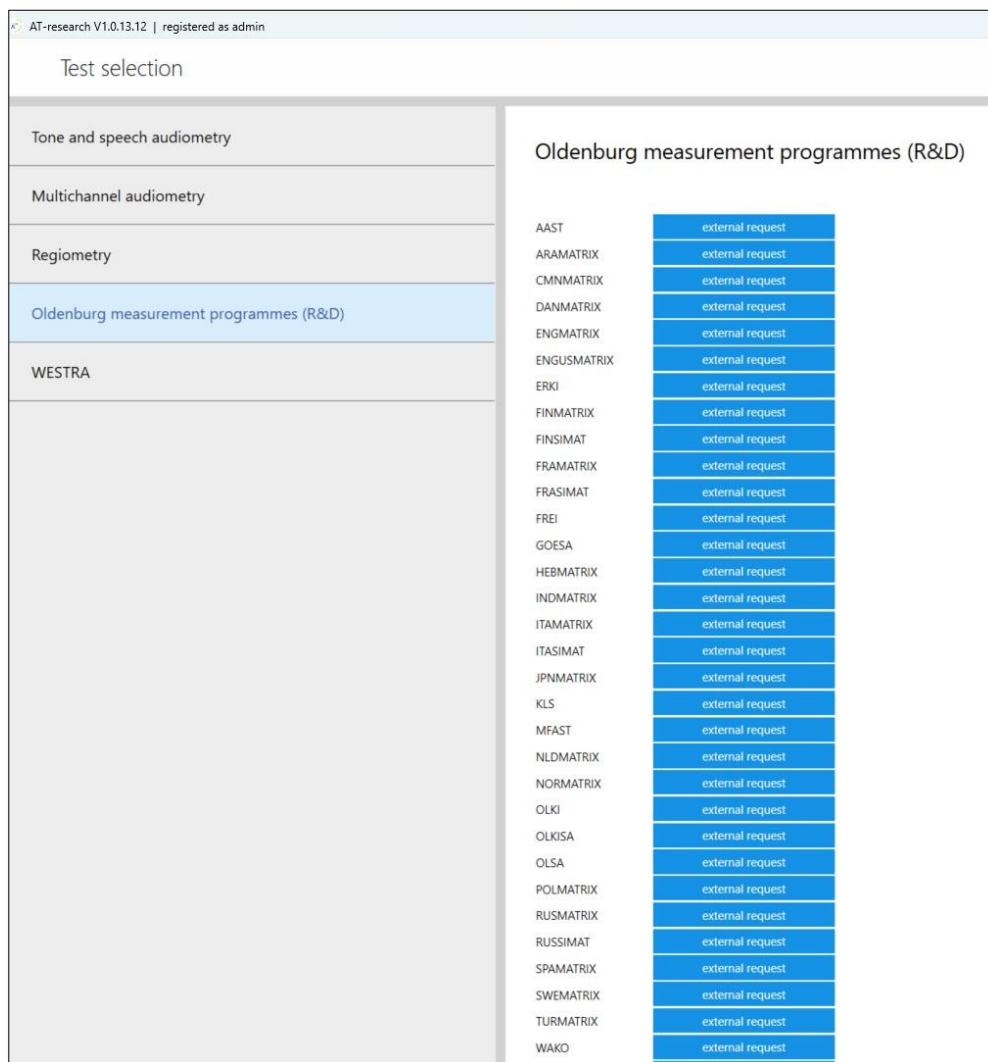


Figure269: Test selection from the Oldenburg measurement programmes



As the Oldenburg measurement programmes are complex measurement software, it may take a few seconds for the individual tests to start.



The button for starting the Oldenburg measurement programmes should only be pressed once.

14.2 Saving, viewing, continuing measurement

To save the results of a measurement taken with the Oldenburg measurement programmes, the test must be saved before exiting. To do this, use the 'Save' or 'Save and exit' buttons.

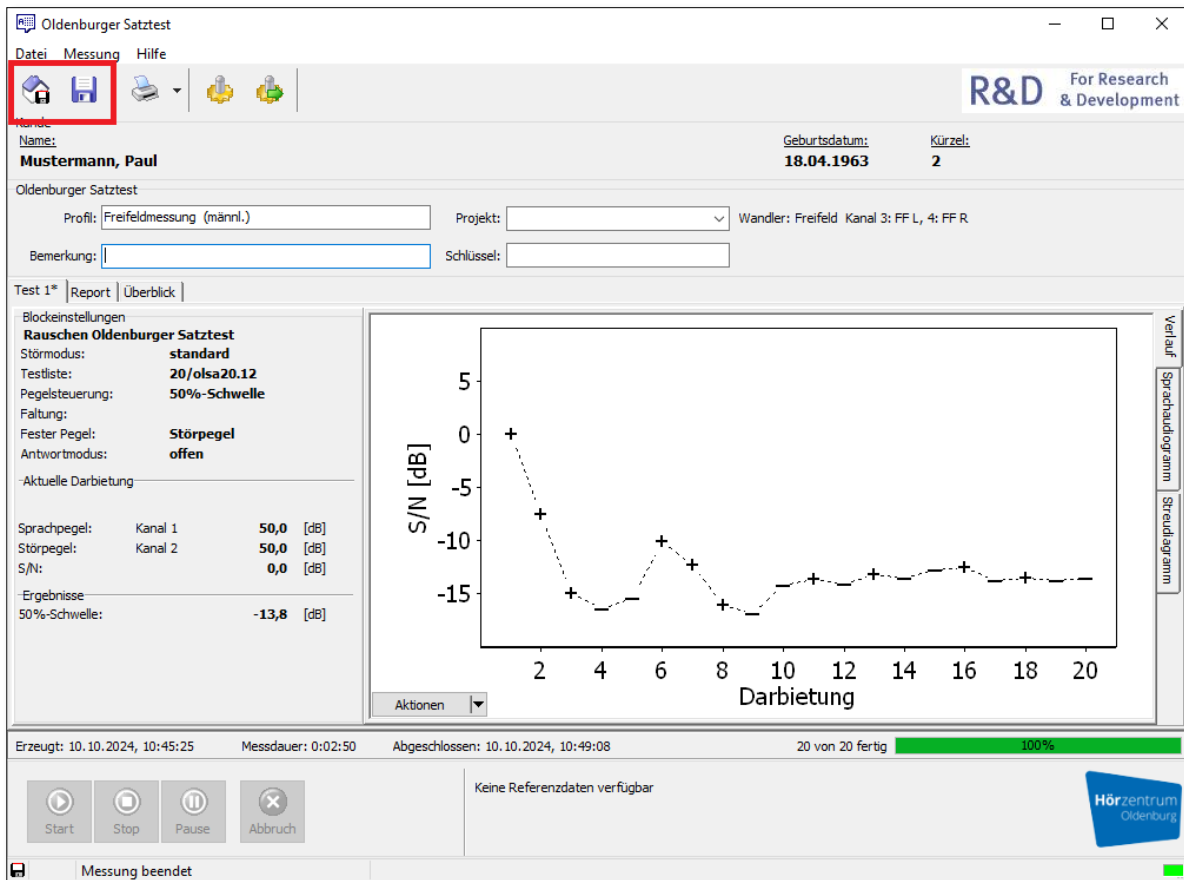


Figure270: Saving the OLSA before exiting the application

The measurement result is saved as a PDF printout in the **AT-research / AT2000** database. It is also possible to call up the same measurement again and continue measuring by selecting 'Duplicate and continue measuring'.

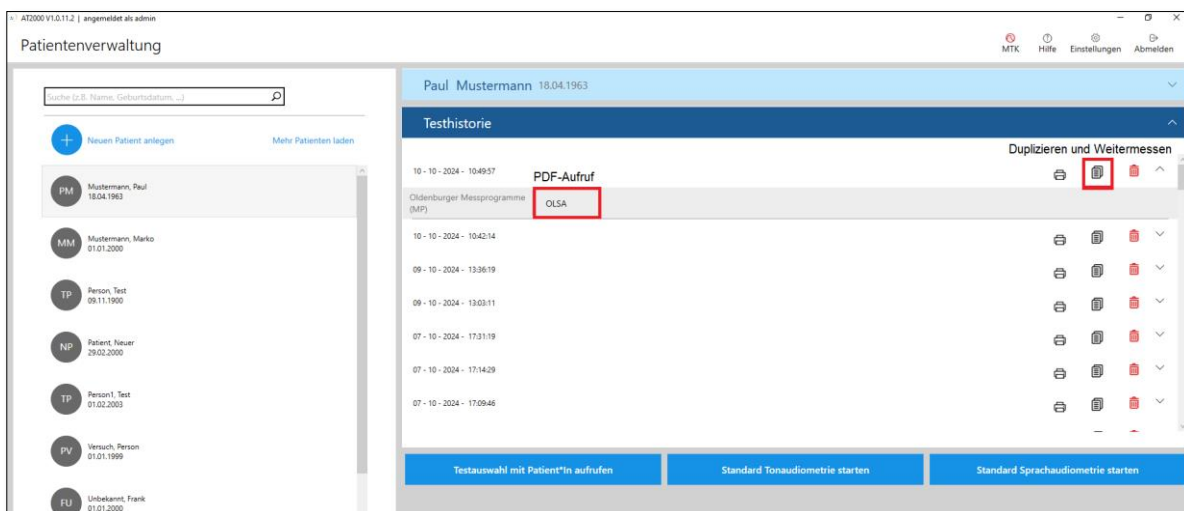


Figure271: Oldenburg measurement in the test history

15 WESTRA

The most popular speech tests from Westra ('Mainzer Kindertest', 'Göttinger Kindertests' and 'Dichotische Speech tests') are directly implemented in the AT2000 speech audiometry. Many additional Westra tests can be purchased separately. These appear in the test selection in the 'Westra' tab.

15.1 Calling up a Westra test

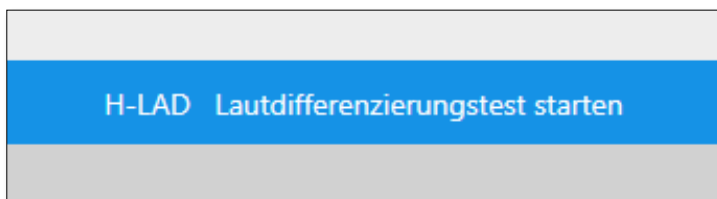
Select the desired test in the test selection. Select two outputs and a volume at which the signals are to be played.



Seite	Ausgang	Pegel
Rechts	AC1_L [DD45]	65 dB
Links	AC1_R [DD45]	65 dB

Figure272: Transducer and level selection in the Westra tests

This volume cannot be changed during a measurement. The test is started by clicking the blue button 'Start [test name]'.



H-LAD Lautdifferenzierungstest starten

Figure273: Starting the Westra tests

15.2 Performing a Westra test

The Westra tests are separate programmes that are programmed and maintained by Westra. The procedures within a measurement are specified by Westra. When the test starts, the programme opens in a separate window. After the measurement is complete, the user must close the window themselves.

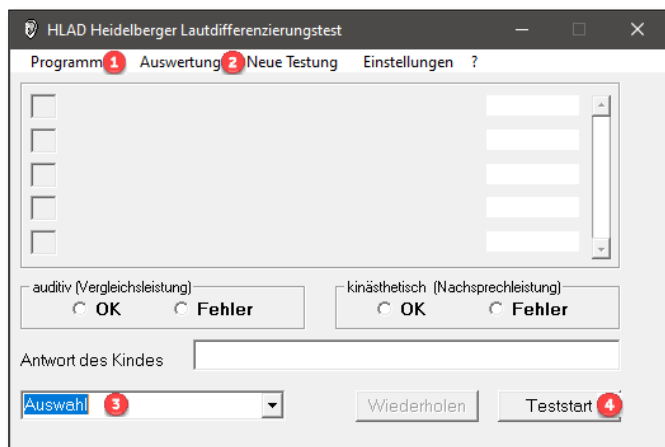


Figure274: Westra interface

Table32: Westra interface

1	Program settings – Import old data, print settings, exit
2	Evaluation – View results, save, print
3	Test selection – Select the speech test to be performed
4	Test start – Start the speech test

15.3 Printing and saving

The 'Save' function saves the measurement data in a test-specific file format (here: .HLAD) locally on the PC. The 'Load saved test' function can be used to recall a saved measurement and adjust/continue it.

The 'Print' function prints the result on the configured printer. If PDFCreator has been set up as the printer, a PDF printout of the measurement results is automatically generated in C:\Data\Westra. This PDF is imported into the AT2000 database when the Westra test is ended.

Some Westra tests do not include print or save functions. The following chapter contains a list of all the necessary information.



If the user does not print a PDF, no PDF is stored in the database and measurement results may be lost.

After exiting the measurement programme, a message may appear stating that no PDF was found in the C:\Data\Westra folder. Here, the user has the option of manually navigating to the storage location of the PDF and saving it to the database. This option is one-time only and cannot be called up again after closing the dialogue window.

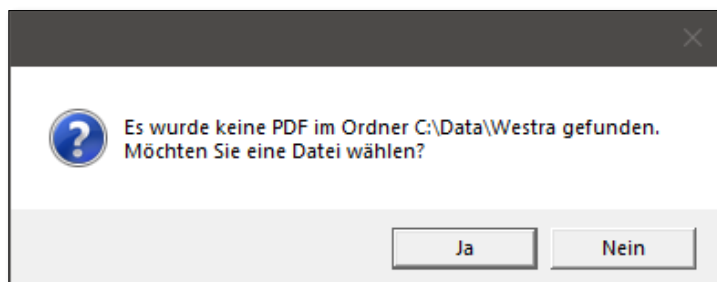


Figure275: Printing and saving

15.4 List of all Westra speech tests

Table33: List of all Westra speech tests

CD number	Westra designation	AT2000 designation	Comments
1	Freiburg number and word test	Freiburg words/Freiburg figures	Implemented directly
2	Marburg sentence comprehension test	Marburg sentence test	Implemented directly
3	Suprathreshold test signals (Sisi, Lüscher test)	SiSi/Lüscher	Implemented directly
4	Mainz & Göttingen	Mainz/Göttingen children's speech test	Implemented directly
5	Dichotic speech tests Feldmann/Uttenweiler	Dichotic speech tests	Directly implemented, no dichotic records
6	Rhyme test according to Sotschek	-	Alternative: MOLM WAKO
7	Würzburg auditory field scaling	-	Alternative: MOLM KLS
8	Three-silver test Freiburg words with special noise	-	Alternative: MOLM FREE
9	Sounds for audiometry incl. sounds of the Franck case	-	-
10	Freiburg words fade away	-	-
11	Freiburg words with noise according to Fastl	-	Alternative: MOLM FREE
12	Beido ear number test in background noise	-	-
12	Infant speech intelligibility test	-	-
14	Polish speech tests	-	Alternative: POLMATRIX
15	HSM sentence test in noise - modern, simple sentence test for patients with severe hearing loss and CI patients	HSM record test	Westra test with print function
16	Arabic speech tests	-	Alternative: ARAMATRIX/A-RASIMAT
17	Frequency-specific filtered sounds for paediatric audiometry	Narrowband noise	Westra test without print function
18	Hanover Sound Discrimination Test / Time Compressed Speech (HZS)	-	Not as software version, CD only
19	H-LAD Heidelberg phonetic differentiation test	H-LAD phonetic differentiation test	Westra test with print function
20	Hearing test with time-compressed speech for children	Time-compressed speech	Westra test without print function
21	HVS Heidelberg preschool screening	HVS Heidelberg preschool screening	Westra test with print function
22	HASE Heidelberg Auditory Screening	HASE Heid. Auditory screening	Westra test with print function
23	Audio samples	-	Not as software version, CD only
24	MAUS screening test	MAUS	Westra test with print function
25	Speech comprehension tests for adults and children in Turkish	-	Alternative: MOLM TUR-MATRIX
26	Würzburg children's language comprehension test in background noise	Würzburg children's test	Westra test without print function
27	HVDT Heidelberg Vowel Differentiation Test	-	-
28	RVF directional hearing test in virtual free field*	-	AT2000 integration in progress
29	Göttinger Dichotischer Zweisilbertest (GÖDZ) for testing auditory parallel processing*	-	AT2000 integration in progress
30	HVT (Heidelberg Vowel Length Differentiation Test)	HVT Vowel Length Test	Westra Test without print function

16 Connection to external programmes

16.1 Innoforce - ENTstatistics

The **AT-research / AT2000** can be used in conjunction with the ENTstatistics database software from Innoforce. The audiometer is called up via ENTstatistics, the measurement is carried out and all data is stored in the database of the ENTstatistics programme. The measurements can be viewed retrospectively both via the software of the **AT-research / AT2000** and via ENTstatistics. To carry out a measurement from ENTstatistics, both programmes must be started. A patient is selected or newly created via the patient selection in ENTstatistics.

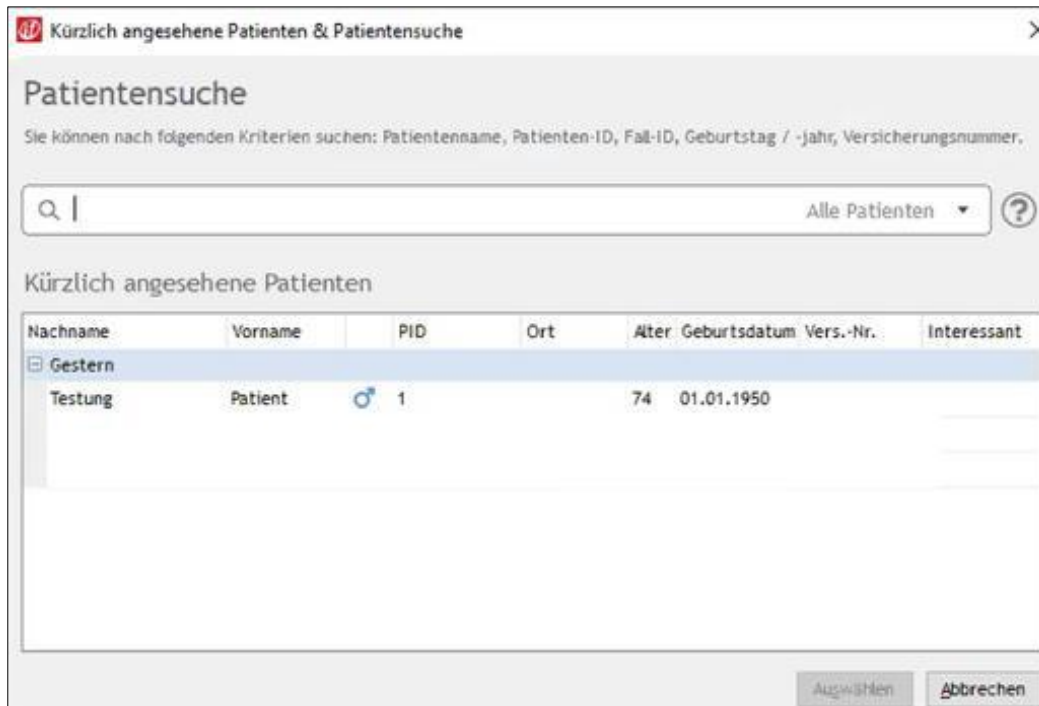


Figure276 : Patient search in ENTstatistics

Then select **AT-research / AT2000** (blue box) from the top menu bar. The patient data is transferred to the audiometer via the GDT interface.



Figure277 : Selection of the AT2000 in ENTstatistics

A measurement can now be carried out as usual in the **AT-research / AT2000** software. As the patient was transferred from an external programme, no patient selection takes place in the **AT-research / AT2000** software. Once the examination is complete, the external session can be ended in the patient administration.

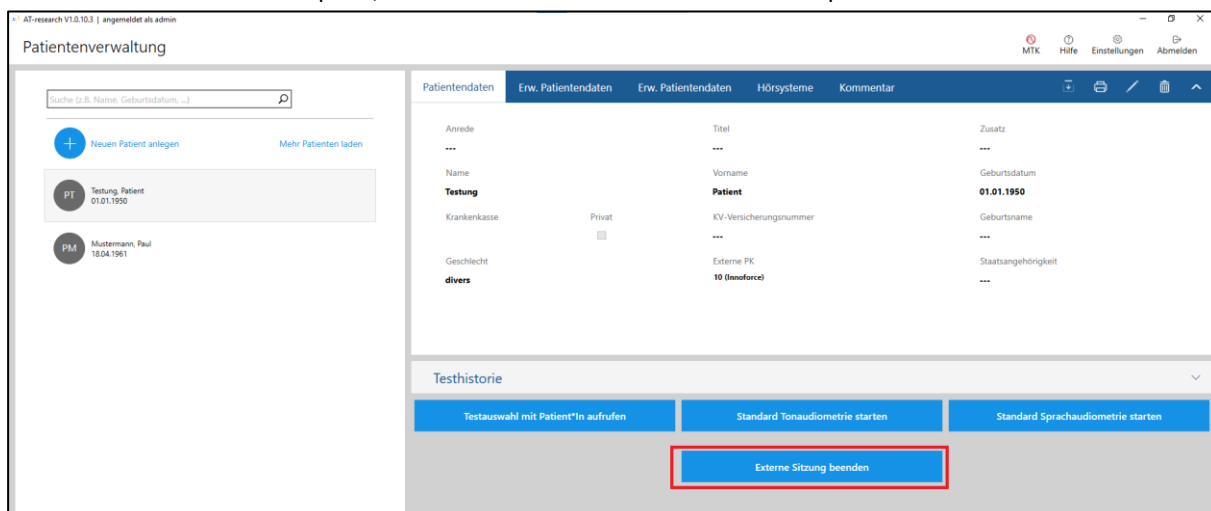


Figure278 : Patient management of the AT2000 in an external session

The measurement data is transferred to ENTstatistics and assigned to the patient. The completed measurements can then be subsequently viewed both in the AT software and in ENTstatistics.

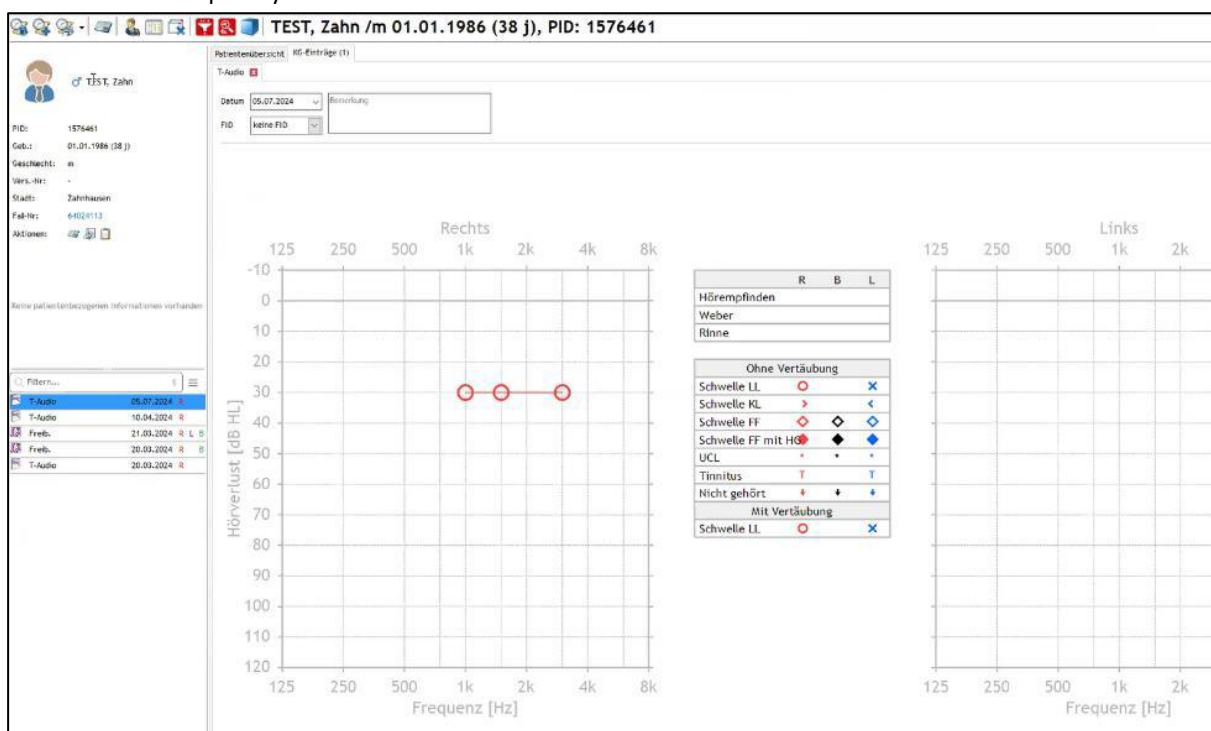


Figure279 : Viewing an old measurement in ENTstatistics

16.2 Avantgarde

The **AT-research / AT2000** can be used in conjunction with Avantgarde. For this purpose, the audiometer is connected as an external measuring module. Selected patient master data is transferred to the audiometer via GDT. The measurements taken are saved as PDF files. To take a measurement of a patient from Avantgarde on the **AT-research / AT2000**, the patient is selected in the Avantgarde interface and the measurement on the audiometer is started by clicking the 'AT2000' button in the top bar.

The measurement software should already be running in the background.

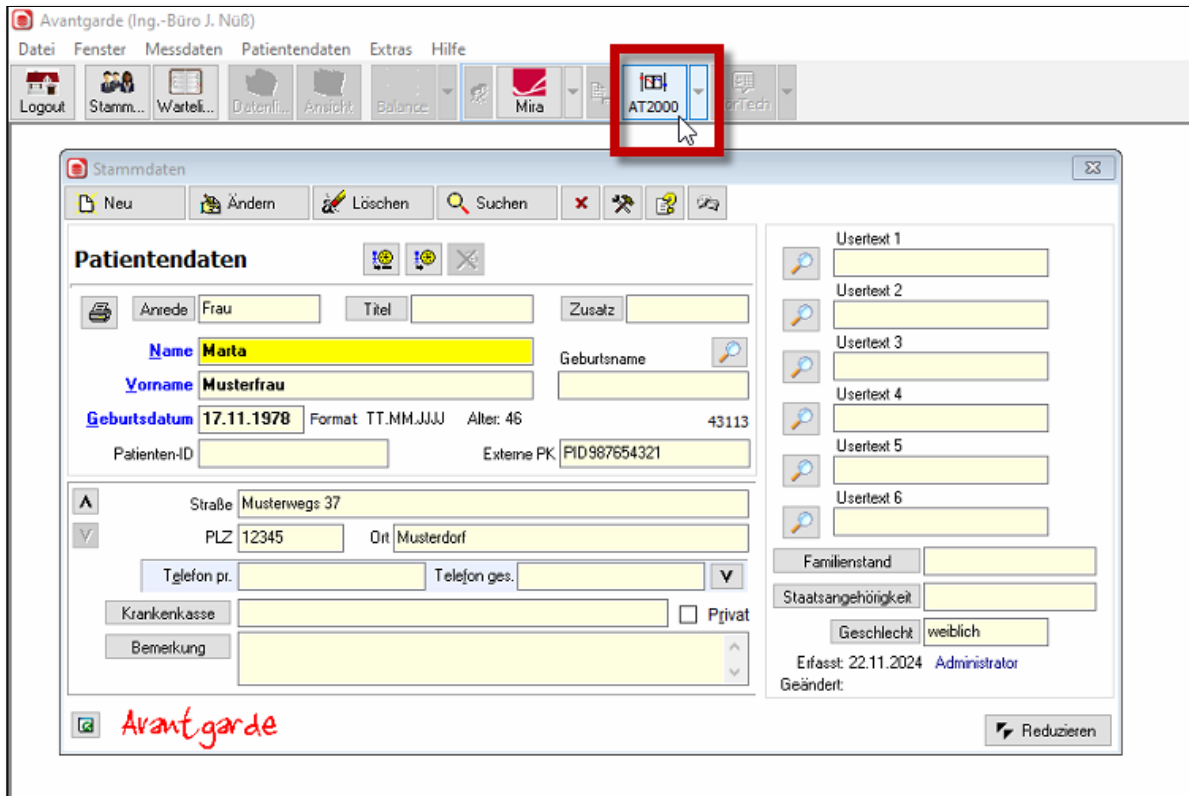


Figure280: Start measurement on the AT2000 from Avantgarde

The patient transferred via GDT is called up or created. No other patient can be selected at this point.

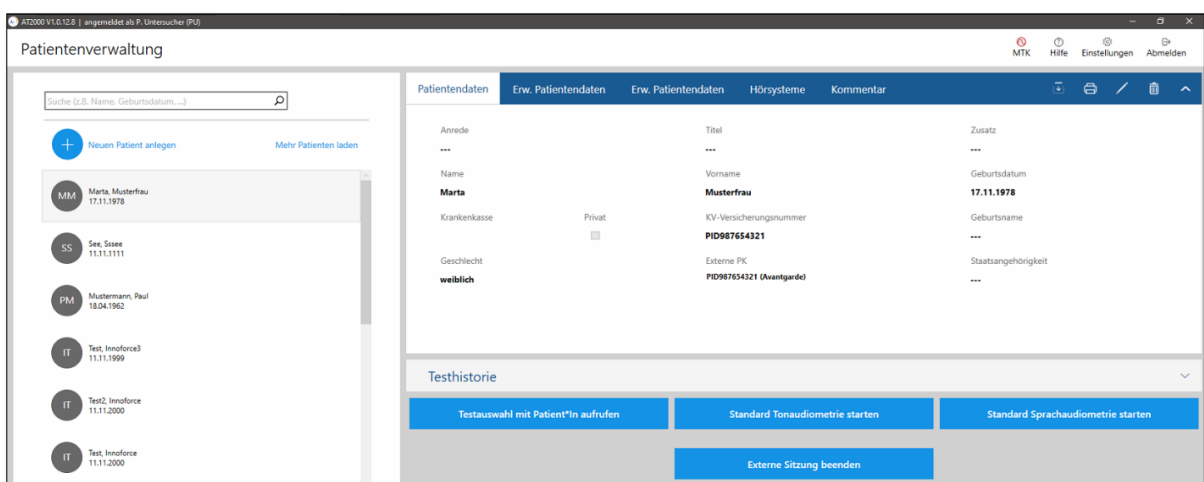


Figure281: Patient management in the AT2000

The measurements are performed as usual via the test selection or stored standard procedures and do not differ from the procedure without Avantgarde.

After completing the measurements, we return to patient management by clicking on the 'X' in the upper right corner. Unlike when using **AT-research / AT2000** without Avantgarde, the current session is not yet finished. By calling up the tests again, measurements that have already been taken can be adjusted or supplemented. Only by clicking on the 'End external session' button in patient management is the current examination ended and Avantgarde opened. The user must now confirm that an examination has been carried out.

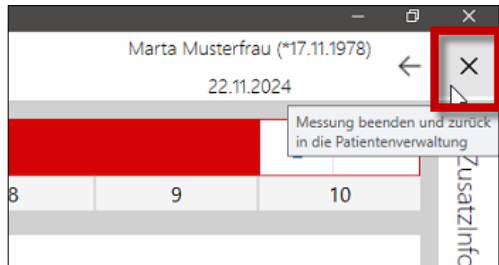


Figure282: End measurement (AT2000)

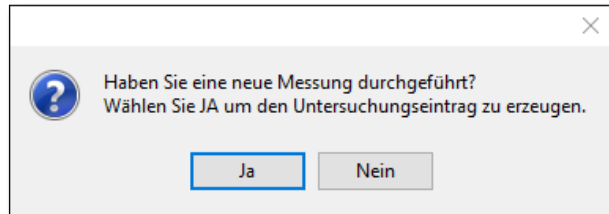


Figure283: Query (Avantgarde)

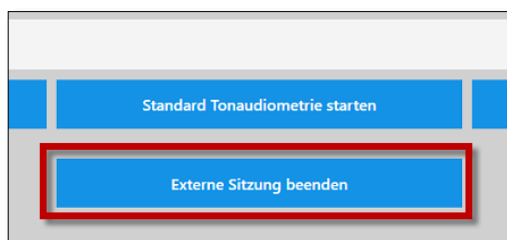


Figure284: End external session (AT2000)

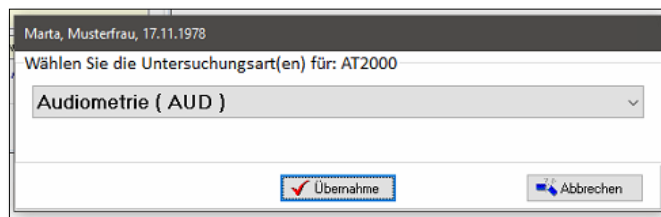


Figure285: Examination type (Avantgarde)

Avantgarde now takes the measurements performed in **AT-research / AT2000** in PDF format and stores them in the patient's data list. All measurements performed on the patient can be viewed in the data list.

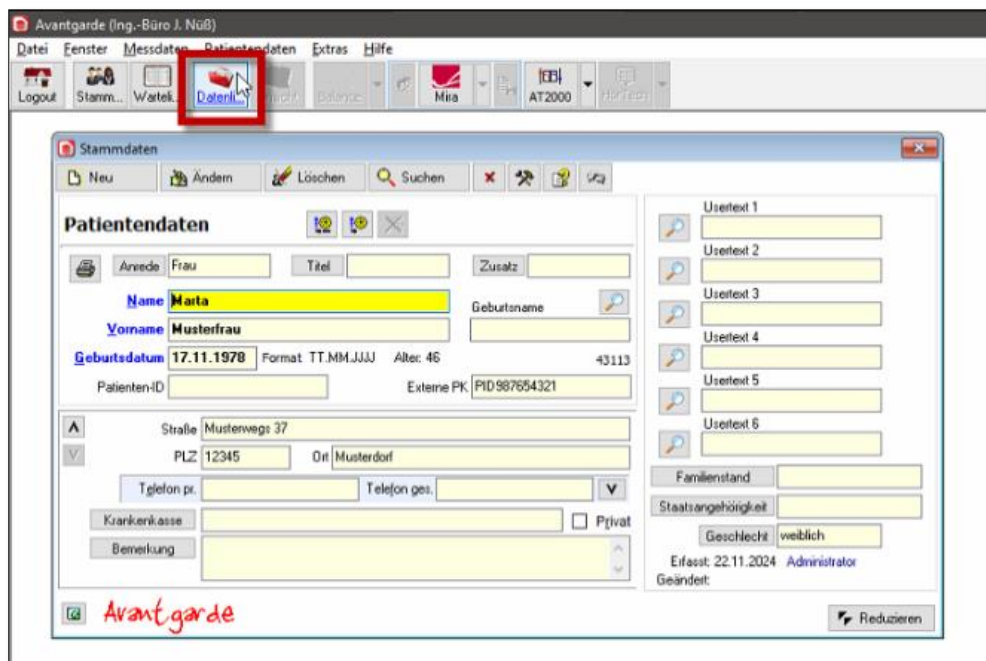


Figure286: Data list (Avantgarde)

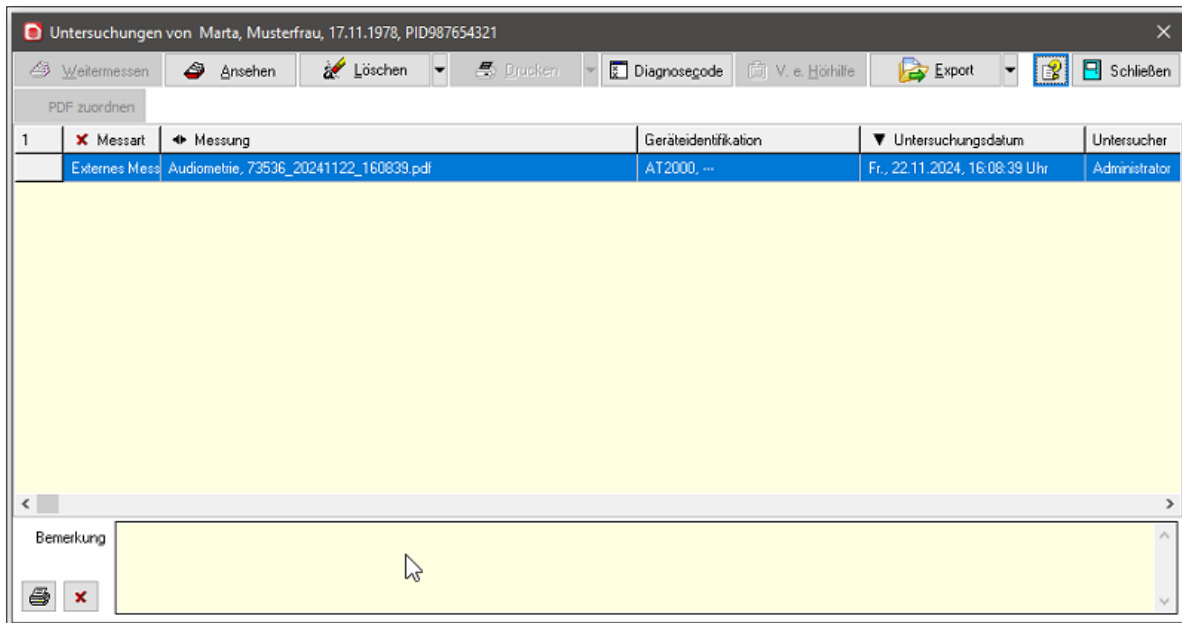


Figure287: Investigations in Avantgarde

The measurement performed can be viewed as a PDF printout and can also be printed directly from the view. The print settings for the PDF exported to Avantgarde can be adjusted in the print settings; for more information, see Chapter 21.1.8 Print.

17 Matlab connection (Hardware release) - applies only to AT-research

To be able to operate Matlab, you must first go to the settings in the software. Click on the blue button in the "Enable ASIO" tab. You will now hear several relays being switched on the hardware ("clicking").

Matlab can now be started. If necessary, change to a suitable folder. Call up the Matlab script for sound output - see example script below. After completing the Matlab activities, exit Matlab.

Click on the blue "End release" button in the software.

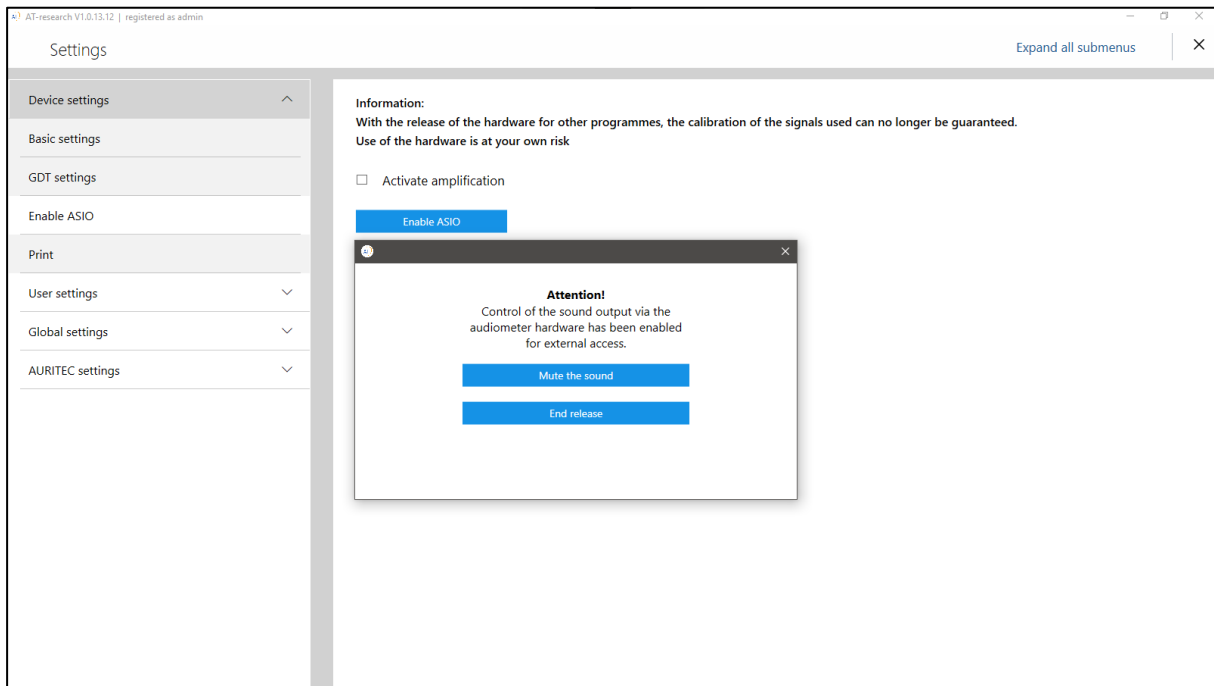


Figure288 : Matlab - Release Asio, end release

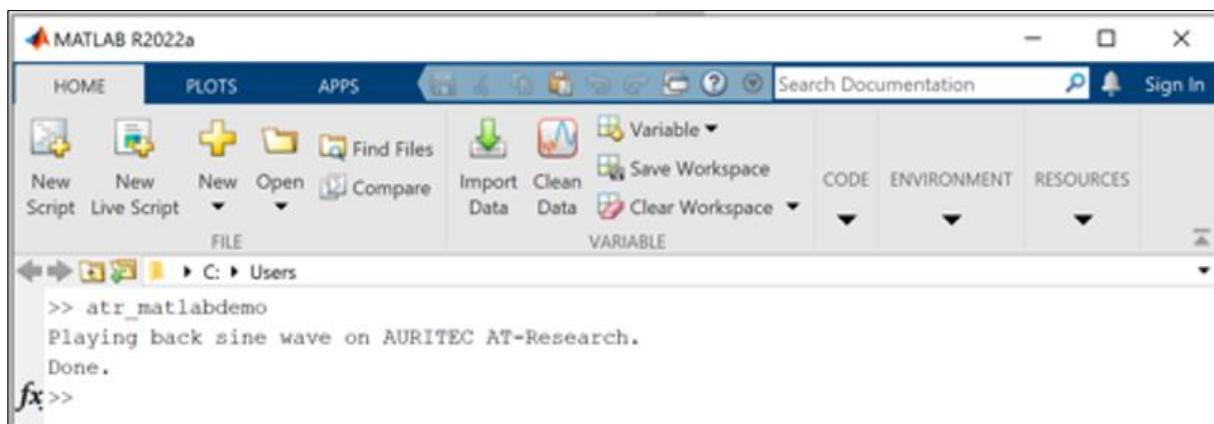


Figure289 : Matlab - 1

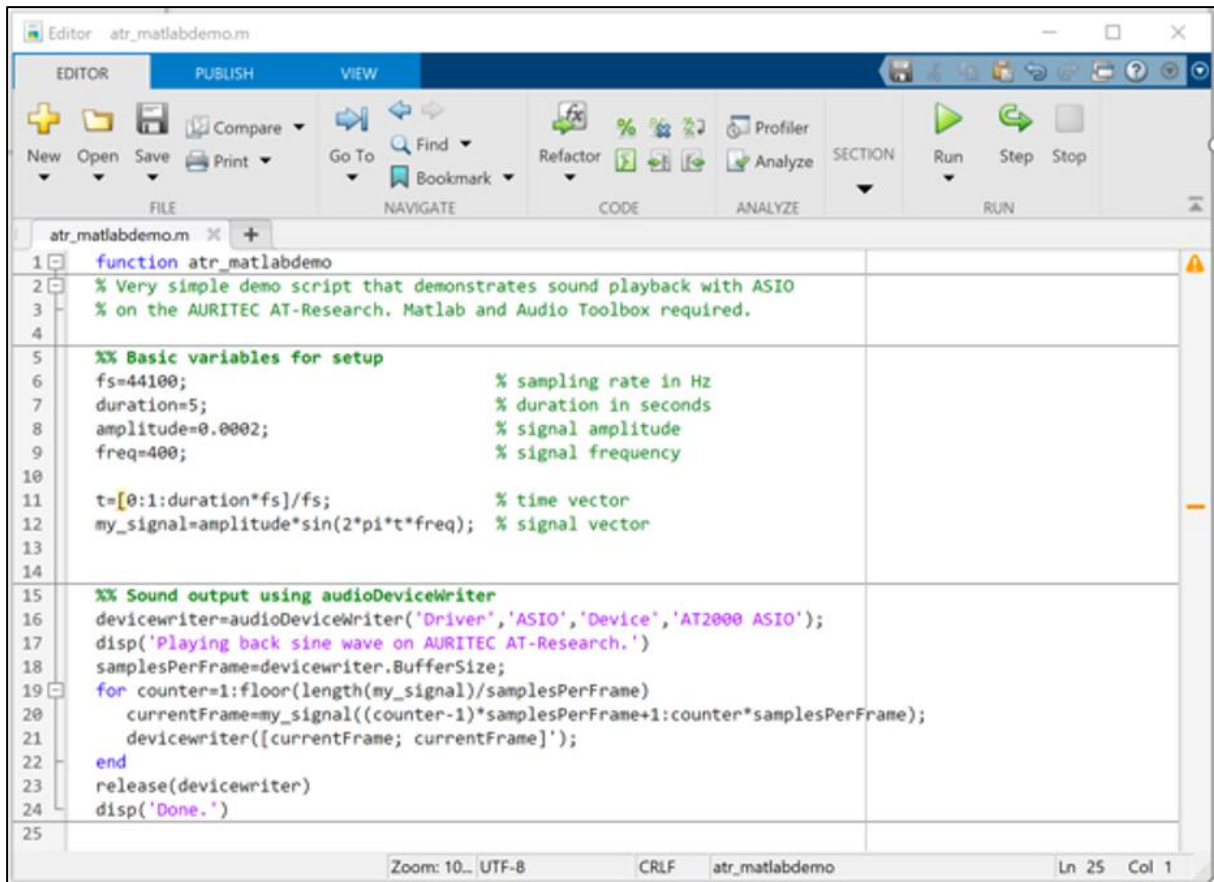


Figure290 : Matlab - 2

Very simple example script to make a sound output with Matlab (with audio toolbox) via the AT-research:

```
function atr_matlabdemo
% Very simple demo script that demonstrates sound playback with ASIO
% on the AURITEC AT-Research. Matlab and Audio Toolbox required.

%% Basic variables for setup
fs=44100; % sampling rate in Hz
duration=5; % duration in seconds
amplitude=0.0002; % signal amplitude
freq=400; % signal frequency

t=[0:1:duration*fs]/fs; % time vector
my_signal=amplitude*sin(2*pi*t*freq); % signal vector

%% Sound output using audioDeviceWriter
devicewriter=audioDeviceWriter('Driver','ASIO','Device','AT-module22 ASIO');
disp('Playing back sine wave on AURITEC AT-Research.')
samplesPerFrame=devicewriter.BufferSize;
for counter=1:floor(length(my_signal)/samplesPerFrame)
    currentFrame=my_signal((counter-1)*samplesPerFrame+1:counter*samplesPerFrame);
    devicewriter([currentFrame; currentFrame]);
end
release(devicewriter)
disp('Done.')
```

ATTENTION: The control of the AT-research hardware via third-party software is at your own risk.

18 Implants

The **AT-research / AT2000** enables direct control of hearing implants via a separate hardware output. This offers advantages such as reduced interference from room acoustics and other sources, and completely eliminates the need for masking during monaural measurements in cases of single sided deafness. The signal is transmitted either via a direct cable connection to the CI processor or via a streamer with inductive transmission via a telecoil.

For more details, see the separate Manual „Anleitung_Nutzung des Implantat-Anschlusses_AT2000“.



Figure291: Setup with the audiometer and direct cable feed into the SONNET CI processor



Figure292: Setup with the audiometer and cable connection to the SAMBA 2 G streamer

19 Trainshow

The train show is designed as a conditioning toy to support audiometry with children. It is optional for a standard **AT-research / AT2000** setup.

Conditioned Play Audiometry (CPA) is a proven concept in subjective paediatric audiometry to improve the validity of tests.

A playful conditioning audiometry test can offer the following advantages:

- Reduced risk of the child pressing buttons out of habit due to greater involvement
- A playful environment is more enjoyable
- Generally higher reliability of test results

Conditioned play audiometry is used for children between the ages of 2 and 6. The use of a remote control (or an additional remote control that can be activated) allows for better control over false positive responses from the child. In this case, the child is led to believe that they can start the train.

For more details, see the separate Manual „Manual TrainShow“.

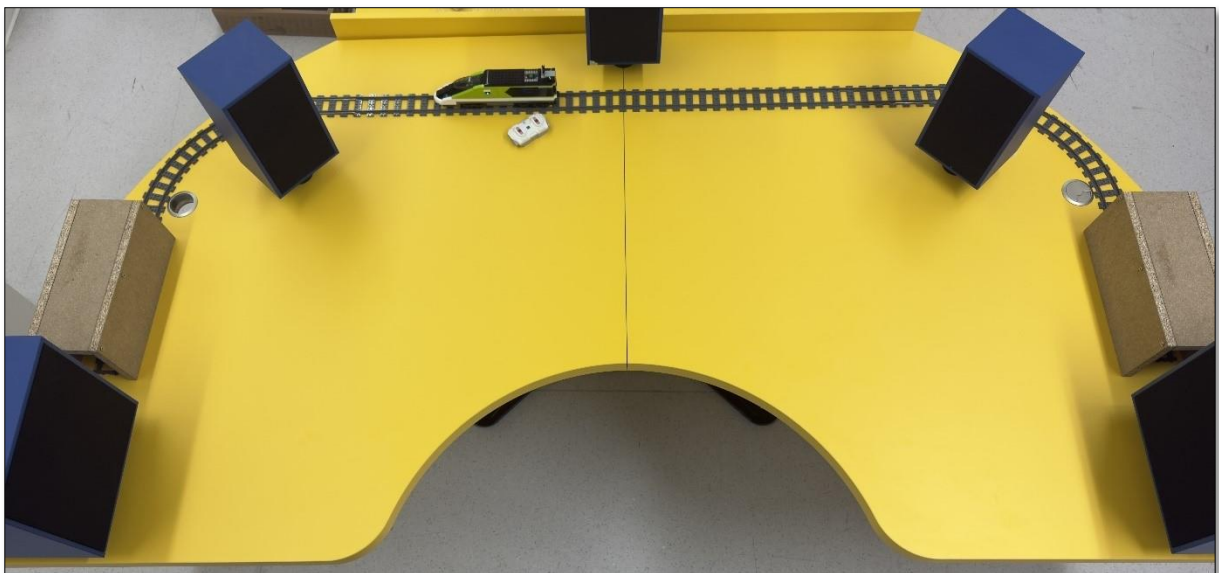


Figure293: Structure of the TrainShow

20 ERKI

ERKI is the first medical device in Germany that enables automated testing of directional hearing within a very short time (<10 minutes). This provides important information for diagnosis and therapy. The areas of application are diverse.

- Based on AT1000 / AT2000 and Mainz children's table
- 5 real sound sources and 32 virtual sound sources enable 5° resolution
- 300 ms acoustic and randomised signal with optional white, (pulsed) pink noise or ISTS (International Speech Test Signal)
- Intuitive operation, automatic sequence, short measurement time
- LED bar with rotary control for precise angle adjustment

For more details, see the separate 'ERKI Manual'.

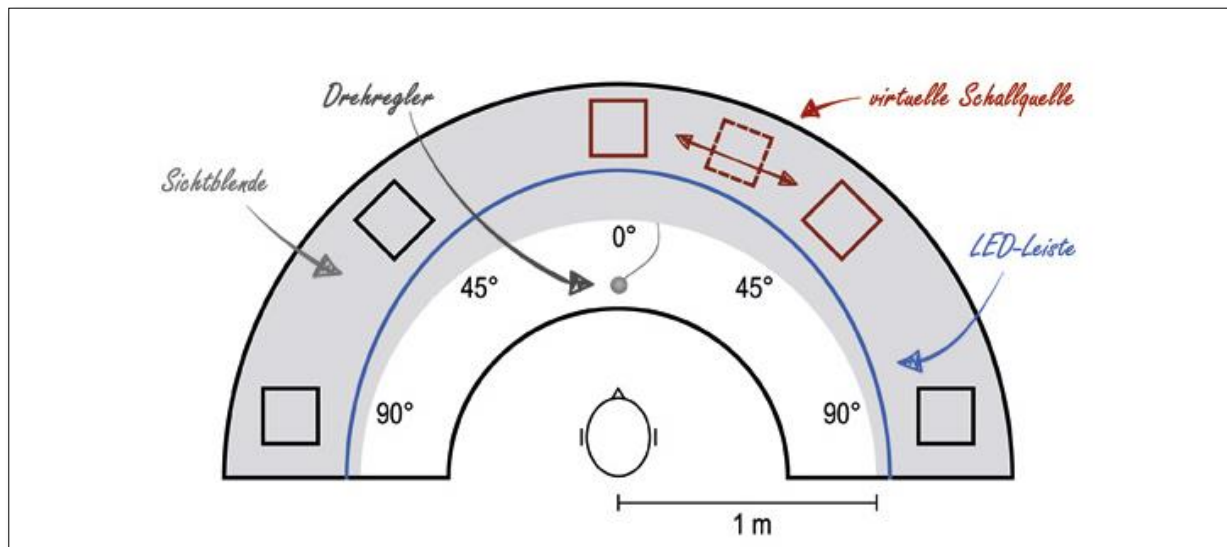


Figure294: ERKI

21 Settings

The settings are divided into four categories. For more information, see the following chapters.

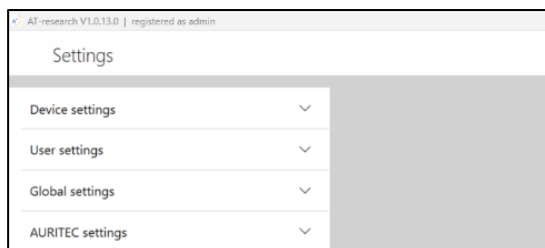


Figure295 : Settings

21.1 Device settings

The device settings are explained in the following chapters.

21.1.1 Basic settings - Registered transducers

This area is password-protected and can only be used by service technicians.

The screenshot shows the 'Registered transducers' settings page. It has a 'Save' button (blue) and a 'Reset' button (red). Below the buttons is a table with three columns: 'Connection', 'Compatible transducers', and 'Serial number'. The table contains 24 rows of data, including connections like AC1, AC2, AC3, BC1, BC2, IMP, FFR, FFL, S1_1 through S1_8, S2_1 through S2_8, and their corresponding transducers and serial numbers.

Connection	Compatible transducers	Serial number
AC1	DD45	12345
AC2	DD450	23456
AC3	ER3C	34567
BC1	B71	45678
BC2		
IMP	IMPLANT	192837
FFR		
FFL		
S1_1	SPEAKER110	98765
S1_2	SPEAKER90	87654
S1_3	SPEAKER100	76543
S1_4	SPEAKER90	65432
S1_5	SPEAKER110	54321
S1_6		
S1_7		
S1_8	ACTIVE90	12349876
S2_1		
S2_2		
S2_3		
S2_4		
S2_5		
S2_6		
S2_7		
S2_8		

Figure296 : Settings - Basic settings - Registered transducers

21.1.2 Basic settings - General audiogram

Transducers can be defined as standard for the measuring side and for the masking side - for the air line and for the bone line respectively.

The screenshot shows the 'General tone audiometry' settings page. It contains four rows of settings, each with a label, a value, and a dropdown arrow:

General tone audiometry		
Pre-selected transducer air conduction (measurement side)	DD45	v
Pre-selected transducer bone conduction (measurement side)	B71	v
Pre-selected transducer air conduction (Masking side)	DD45	v
Pre-selected transducer bone conduction (masking side)	DD45	v

Figure297 : Settings - Basic settings - TA general

21.1.3 Basic settings - General speech audiometry

You can set transducers for the right and left side of the ear as standard. The standard test can also be selected.

Speech audiometry in general	
Standard speech test	Freiburger Sprachtest Zahlen ▼
preselected transducer right ear	DD45 ▼
preselected transducer left ear	DD45 ▼
Sprachaudiogramm horizontal darstellen	☐

Figure298 : Settings - Basic settings - SA general

A horizontal speech audiogram looks like this.

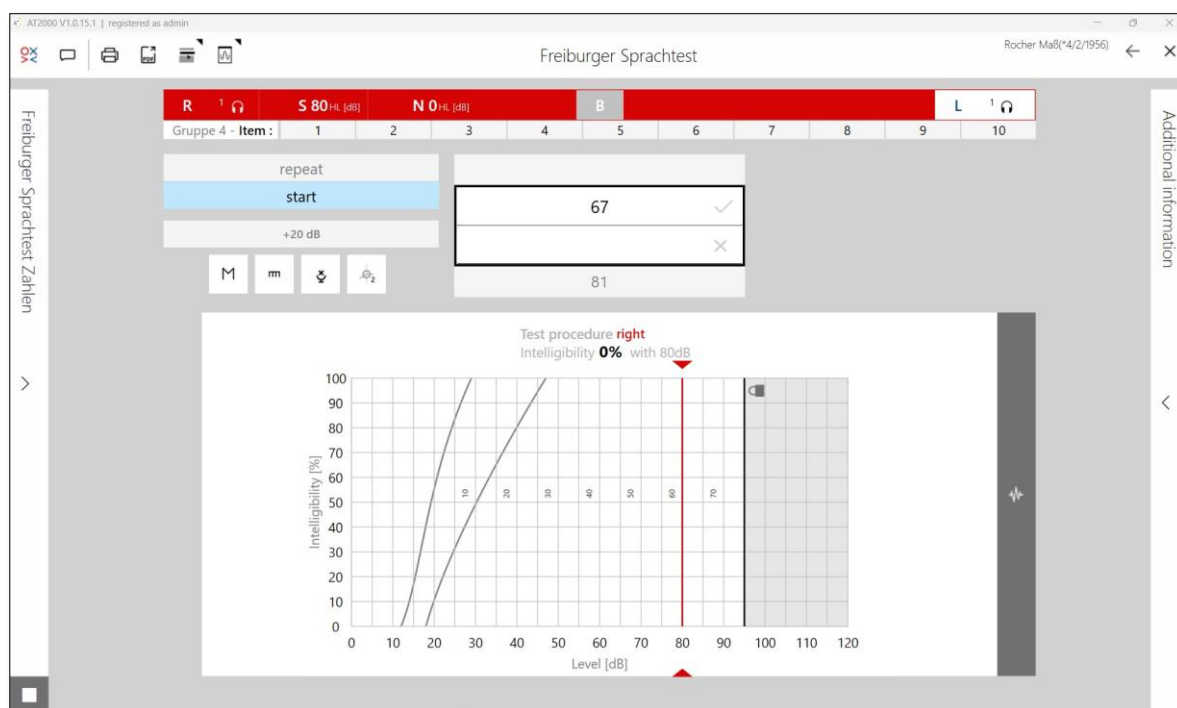


Figure299: SA – horizontal speech audiogram

21.1.4 Basic settings - Regiometry

You can set speakers for the right and left side of the ear as standard.

Regiometry	
Preselected loudspeaker (signal)	FF-R Angle: 90° ▼
Preselected converter (masking)	FF-L Angle: -90° ▼

Figure300 : Settings - Basic settings - Regiometry

21.1.5 Basic settings – hearing loss

Here you can set whether the hearing loss should be calculated as a percentage according to the British or American method.

Hörverlust [%]

Verfahren für: Deutschland (selected)
 Deutschland
 Schweiz

Figure301 Settings - Basic settings – hearing loss

21.1.6 GDT settings

Settings for the connection to external programmes via GDT must be made here.

Import

☐ Automatically import patient master data
☒ Automatically delete import file after successful import

Import file storage location: C:\GDT\ATImport.gdt

Export

☒ Export measurement data (XML file)
☒ Automatic export
☐ Confirm export by user

Export file name: ATExport.gdt Storage location: C:\GDT

Recipient ID: Praxis

Sender ID: AT-R-01

☐ Export measurement data additionally as a PDF printout
☐ Write the examination date at the beginning of the file name
☐ Write patient info in front of the file name
☐ Patient name ☒ Patient ID ☐ External PI
☐ Append ongoing number to file name

PDF file name: ATSession.pdf Storage location: C:\GDT

Figure302 : Settings - GDT settings - 1

Optional GDT field identifiers

☐ GDT-ID des Empfängers ☐ GDT-ID des Senders ☐ Zeichensatz ☐ Softwareunternehmen
☐ Softwarename ☐ Softwareversion ☐ Patient Namenszusatz ☐ Patient Titel
☐ Patient Versichertennummer ☐ Patient Wohnort ☐ Patient Straße ☐ Patient Geschlecht
☐ Patient Muttersprache

Compatibility

Compatibility: Automatic
 Character set used: ISO_10646_1
 Date format: DDMMYYYY

Figure303 : Settings - GDT settings - 2

21.1.7 Enable ASIO

If the corresponding licence has been purchased, see chapter 17 Software licence agreement

Information:

With the release of the hardware for other programmes, the calibration of the signals used can no longer be guaranteed.
Use of the hardware is at your own risk

☐ Activate amplification

[Enable ASIO](#)

Figure304 : Settings - Enable ASIO

21.1.8 Print

Test printouts for tone audiometry and speech audiometry can be created in the first line.

You can insert a logo and enter up to three headers. The format (line width for the measurement curves and text size for the audiogram) is set here.

Test print

Tone audiometry

Speech audiometry

Print sheet layout

^

Logo

☐ Logo left
 ☒ Logo right

Header

☒ One row
 ☐ Two rows
 ☐ Three rows

Header 1

Format

line width measuring curves

1pt

font size axis labels

11pt

font size comments

11pt

font size header

11pt

font thickness header

normal

Figure305 : Settings - Print - 1

Default settings for the print manager must be defined here.

Default setting

Restore stand

Select printer

Microsoft Print to PDF

☐ Print all curves of the current measurement
 ☐ Print tone and speech audiogram on one page
 ☒ Print tone audiometry and extended free-field measurement (tone) on one page

☒ Print header

Patient data

☒ Everything
 ☒ Name, date of birth
 ☐ Patient ID
 ☒ Gender
 ☐ External PI
 ☐ Project ID
 ☐ Anonymised print
 ☐ Addition
 ☐ Salutation
 ☐ Title

Symbol size

large

Examination contents

☒ Everything
 ☒ Date/time of examination
 ☒ Examiner
 ☐ Diagnostic code
 ☐ Device designation
 ☒ Comments
 ☒ Print test lists
 ☐ Print empty tables / graphs

(Option only applies to elements for which no data is available for any page)

☐ Print polar plot
 ☒ Tinnitus table
 ☒ Hörverlust Tabelle
 ☒ Gleitfrequenz Békésy drucken
 ☒ Print legend
 ☐ Little legend
 ☒ Full legend

(incl. transducer, signal, settings, comments)

☐ Black/white printing

Figure306 : Settings - Print - 2

21.2 User settings

The user settings are explained in the following chapters.

21.2.1 Tone audiometry

The function of the interrupt buttons for signal and noise can be defined here. A distinction is made between the tone generator, tone interrupt and an on/off toggle function. You can set how many patient buttons are used, on which ear side the tone audiometry begins and which level increment is preset as standard. A standard frequency is defined (500, 1000, 2000 or 4000 Hz), which is automatically selected at the start of tone audiometry and when performing the subsequent, selected actions.

The start measurement page and the dB increment can be set here.

Operation

Function Interrupter button Signal

Sound off when the interrupter button (R/L button) is pressed

▼

Function Interrupter button Noise

Interrupt button (R/L button) toggles between sound on/off

▼

Patient button function

Only one patient button is used

▼

Start-measuring side

Rechts

▼

Step size [dB]

5

▼

Sprung zu Standardfrequenz

Standardfrequenz [Hz]

1000

▼

☐ Springe zu Standardfrequenz bei Wandlerwechsel

☒ Springe zu Standardfrequenz bei Seitenwechsel

☒ Springe zu Standardfrequenz bei Testwechsel

☐ Springe zu Standardfrequenz bei Überschreiten des erlaubten Frequenzbereichs

Figure307 : Settings - Tone audiometry - Operation

Further settings for handling with and without a control panel can be defined here. The default signals can be set for the measuring side and for the masking side - for air line, bone line, free field and inflation curve.

Sound and signals

Masking

☒ Masking independent of the stimulus

With control panel

Reaction to test side change

No reaction

▼

Reaction to frequency change

No reaction

▼

Response to transducer change

No reaction

▼

With keyboard (without control panel)

Reaction to test side change

No reaction

▼

Reaction to frequency change

No reaction

▼

Response to transducer change

No reaction

▼

☐ Use sliding masking as standard

☐ Switch off masking when changing frequency

Wobble

Frequency

4Hz

▼

Amplitude

5%

▼

Pulston

pulse duration

200ms

▼

pulse-pause-ratio

1:1

▼

Figure308: Tone audiometry - Sound and signals

Signals - air conduction		
preselected signal for measurement side	Sinus	v
General modulation measurement	Continuous	v
preselected signal for masking	Sinus	v
General modulation noise	Continuous	v
Signals - UCL		
preselected signal for measurement side	Sinus	v
General modulation measurement	Continuous	v
preselected signal for masking	Sinus	v
General modulation noise	Continuous	v
Stenger		
preselected signal for measurement side	Sinus	v
General modulation measurement	Continuous	v
preselected signal for masking	Sinus	v
General modulation noise	Continuous	v

Figure309 : Settings - Tone audiometry - Sound and signals 1

Signals - free-field		
preselected signal for measurement side	Sinus	v
General modulation measurement	Continuous	v
preselected signal for masking	Sinus	v
General modulation noise	Continuous	v
Signals - bone conduction		
preselected signal for measurement side	Sinus	v
General modulation measurement	Continuous	v
preselected signal for masking	Sinus	v
General modulation noise	Continuous	v
Signals - inflation curve		
preselected signal for measurement side	Sinus	v
General modulation measurement	Continuous	v
preselected signal for masking	Sinus	v
General modulation noise	Continuous	v
Reset settings		

Figure310 : Settings - Tone audiometry - Sound and signals 2

21.2.2 Speech audiometry

The function of the interrupter buttons for signal and noise can be defined here.

The dB increment can be set here.

Operation	
Function Interrupter button Signal	Sound off when the interrupter button (R/L button) is pressed ▼
Function Interrupter button Noise	Sound off when the interrupter button (R/L button) is pressed ▼
Step size [dB]	5 ▼
Query whether the results view should be displayed.	☐
Allow level change during speech test.	For 3 items ▼
Reset settings No For 3 items Always	

Figure311 : Settings - Speech audiometry – Operation

21.2.3 Regiometry

The duration for which the lamps are switched on and the wobble setting are defined here.

Operation	
Function Interrupter button Signal	Interrupt button (R/L button) toggles between sound on/off ▼
Function Interrupter button Noise	Interrupt button (R/L button) toggles between sound on/off ▼
Patient button function	Only one patient button is used ▼
Start-measuring side	Links ▼
Step size [dB]	5 ▼
Warnung anzeigen, wenn sich die Konfiguration der aktuellen Messkurve ändert	☒
Sprung zu Standardfrequenz	
Standardfrequenz [Hz]	1000 ▼
☐ Springe zu Standardfrequenz bei Wandlerwechsel	
☒ Springe zu Standardfrequenz bei Seitenwechsel	
☒ Springe zu Standardfrequenz bei Testwechsel	
☐ Springe zu Standardfrequenz bei Überschreiten des erlaubten Frequenzbereichs	

Figure312 : Settings - Regiometry 1

Sound and signals

Signals - free-field

preselected signal for measurement side

Sinus

⌵

General modulation measurement

preselected signal for masking

Narrowband noise

⌵

General modulation noise

Continuous

⌵

Wobble

Frequency

8Hz

⌵

Amplitude

12,5%

⌵

Pulston

pulse duration

400ms

⌵

pulse-pause-ratio

1:1

⌵

Shining duration of speaker lamps

<

3

>

Figure313 : Settings - Regiometry 2

21.2.4 Automatic Tests

This is where settings for automatic tests are defined.

Békésy frequency sweep

octave/min

<

2

>

dB/s

<

2.5

>

Figure314 : Settings – Automatic tests

21.3 Global settings

The global settings are explained in the following chapters.

21.3.1 Language

The language of the software can be changed here.

Language

English (United States)

⌵

German (Germany)

English (United States)

French (France)

Figure315 : Settings - Language

21.3.2 Tone audiometry

A distinction can be made between three anaesthetic markings in tonal audiometry.

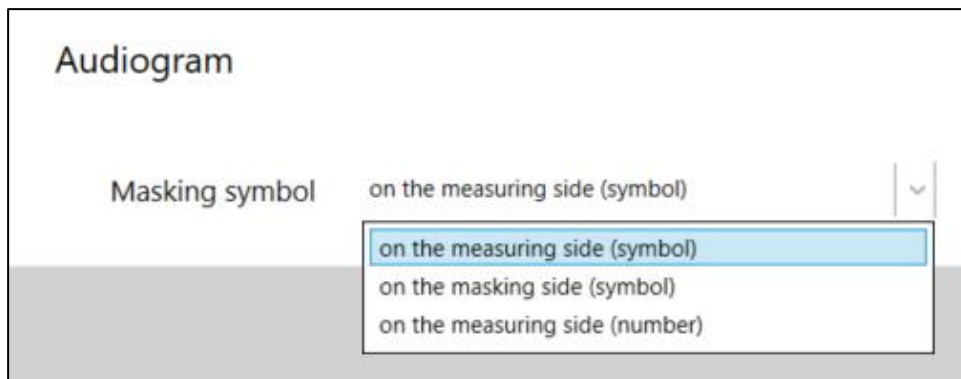


Figure316 : Settings - Tone audiometry - Audiogram

21.3.3 Database

The database settings are made here.

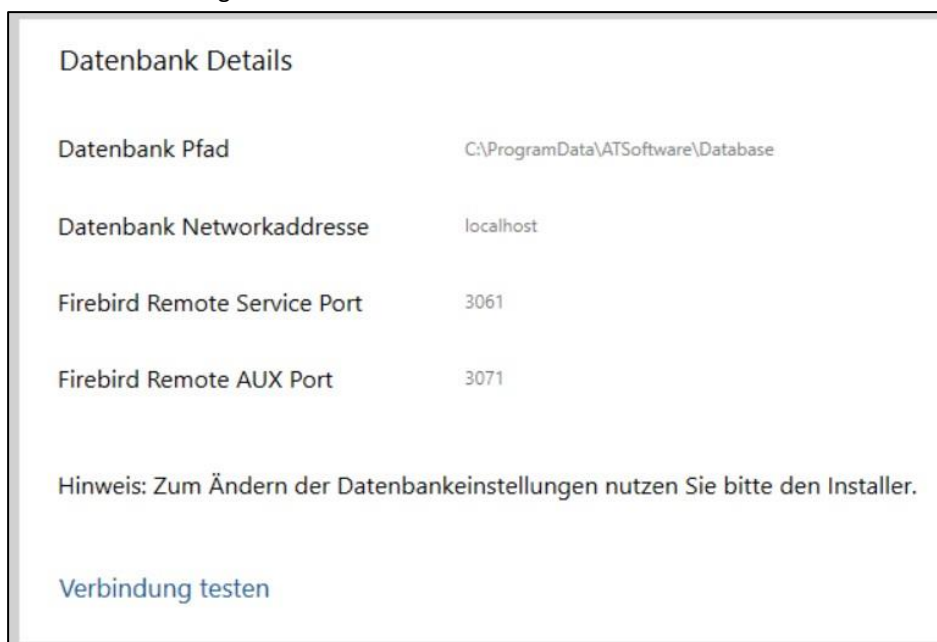


Figure317 : Settings - Database

21.3.4 User administration

Users can be created, changed and deleted here.

User accounts				
Surname	First name	User name	Account type	
---	---	admin	Administrator	
a	b	a	Administrator	 

Figure318 : Settings - User administration

To create a user, you must enter the surname, first name and user name. You must also enter a password or tick the "Password not required" box.

Create new user

Surname

First name

User name

Account type

Administrator

Password

☐ nicht erforderlich

Repeat password

Validate Cancel

Figure319 : Settings - User account

21.3.5 Patient master data

Patient fields can be defined here. You can enter alternative names and create new fields.

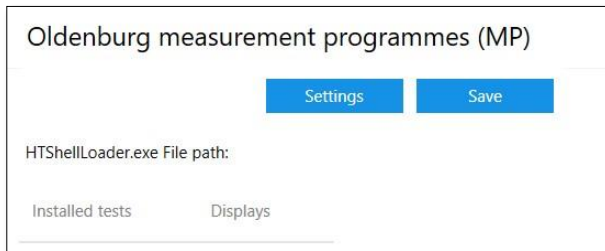
You can also specify for each field whether it should be displayed in the patient master data management and whether it should be a mandatory field.

Patient master data			
Standard data field	alternative name	Displays	Mandatory field
Name		☒	☒
First name		☒	☒
Date of birth		☒	☒
Gender		☒	☒
Patient ID		☒	☐
External PK		☒	☐
Case number		☒	☐
Project number		☒	☐
Health insurance		☒	☐
HI insurance number		☒	☐
Free data fields			
Free data field	alternative name	Displays	Mandatory field
User-defined 1		☒	☐
User-defined 2		☒	☐
User-defined 3		☒	☐
User-defined 4		☒	☐
User-defined 5		☒	☐
User-defined 6		☒	☐

Figure320 : Settings - Patient master data

21.3.6 Oldenburg measurement programmes

This area is only accessible to service technicians. Test activations, settings and calibrations are carried out here.



The screenshot shows a window titled "Oldenburg measurement programmes (MP)". At the top right are two blue buttons: "Settings" and "Save". Below them is a label "HTShellLoader.exe File path:" followed by a text input field. At the bottom, there are two tabs: "Installed tests" and "Displays".

Figure321: Settings - Oldenburg measurement programmes

21.3.7 Westra

This area is only accessible to service technicians.

Test activations are carried out here.

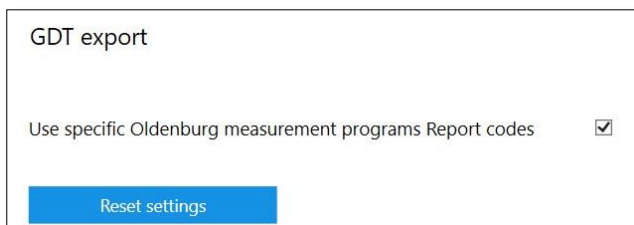


The screenshot shows a window titled "WESTRA". It has two sections for folder selection. The first section is labeled "installation folder:" and contains a text input field with "C:\Audiometrie" and a blue "Change" button. The second section is labeled "PDF measurement results storage folder:" and contains a text input field with "C:\Data\Westra" and a blue "Change" button. At the bottom, there are two tabs: "Installed tests" and "Licensed".

Figure322: Settings - Westra

21.3.8 Innoforce

The export for Innoforce regarding the Oldenburg measurement programmes is defined here.



The screenshot shows a window titled "GDT export". It contains a checkbox labeled "Use specific Oldenburg measurement programs Report codes" which is checked. At the bottom is a blue button labeled "Reset settings".

Figure323: Settings - Innoforce

21.3.9 Multichannel audiometry

This ensures that the summation effect compensation is activated in the multichannel.



The screenshot shows a window titled "Sound and signals". It contains a checkbox labeled "Sum level calculation" which is checked. At the bottom is a blue button labeled "Reset settings".

Figure324: Settings - Multichannel audiometry

21.4 AURITEC settings

This area is password-protected and can only be used by service technicians.

22 Help

To access help, you need to navigate to patient management and then to "Help" at the top right.



Figure325 : Help button

You are now in the help interface.

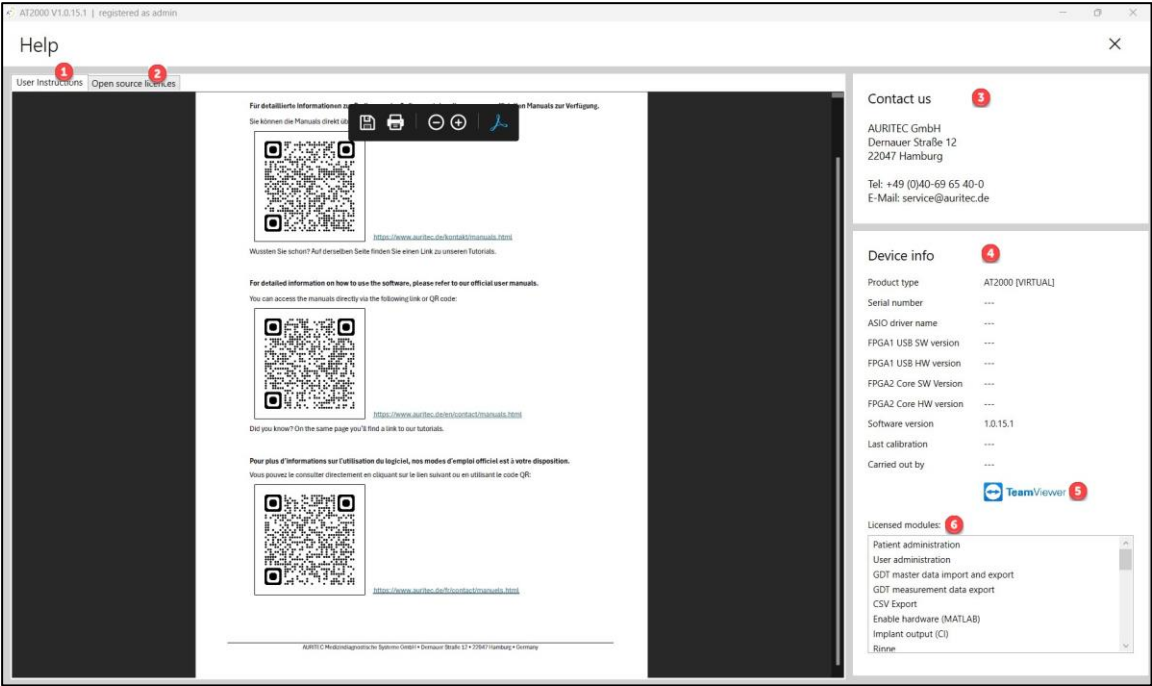


Figure326 : Help interface

This help interface is divided into six areas.

Table34 : Areas in the help

1	There is a link to the instructions for use here.
2	The open source licences used for programming are listed here.
3	The manufacturer's contact information is given here
4	General device information is given here.
5	To enable quick remote maintenance, you can click directly on this button.
6	Licensed modules are listed here.

23 Database-Tool

There is a separate programme for merging two databases, performing database backup and restoration, and performing a anonymisation on an existing database.

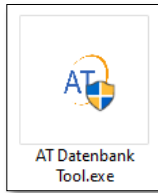


Figure327: DB-Tool

23.1 DB-Backup

Under the 'Database backup' tab, you can configure a one-time backup, a backup restoration and an automatic backup.

The areas are described below.

23.1.1 Creating a backup

AT Datenbank Tool (1.0.13.10)

Datenbanken zusammenführen | Datenbank Backup | Datenbank anonymisieren

Sicherung erstellen

Lokal ☒ Netzwerk

Datenbank Pfad 1

Zielpfad der Sicherungsdatei 2

☒ Sicherungsdateiname mit Datum (ssmmHHddMMyyyy) 3

4

Sicherung wiederherstellen

Lokal

Pfad der Sicherung

Zielpfad der Wiederherstellung

Einstellung der automatischen Sicherung

Pfad der Datenbank

Zielpfad der Sicherungsdatei

Figure328: DB-Backup 1

AT Datenbank Tool (1.0.13.10)

Datenbanken zusammenführen | Datenbank Backup | Datenbank anonymisieren

Sicherung erstellen

Lokal ☒ Netzwerk

Datenbank Pfad 1

Datenbank Netzwerkadresse 5

Firebird Port 6

Zielpfad der Sicherungsdatei 2

☒ Sicherungsdateiname mit Datum (ssmmHHddMMyyyy) 3

Datenbanksicherung erstellen 4

Sicherung wiederherstellen

Lokal

Pfad der Sicherung

Zielpfad der Wiederherstellung

Datenbanksicherung wiederherstellen

Einstellung der automatischen Sicherung

Pfad der Datenbank

Zielpfad der Sicherungsdatei

Speichern

Figure329: DB-Backup 2

Table35: DB-Backup 1,2

1	Directory of the database file. By default, the database is located in the (hidden) directory C:\ProgramData\ATSoftware\Database . The file name is ATFirebird.fdb .
2	Directory for the backup. Here you specify a directory where the backup should be stored, e.g. C:\Datensicherung . It is important that you have write access to this directory.
3	Check this box to add the date and time to the backup file name.
4	Starts the backup.
5	For a network database, the name of the server or the IP address on which the Firebird SQL server service is running.
6	The agreed port through which network communication with the Firebird SQL server runs.

23.1.2 Restoring the backup

The screenshot shows the 'AT Datenbank Tool (1.0.13.10)' window with three tabs: 'Datenbanken zusammenführen', 'Datenbank Backup', and 'Datenbank anonymisieren'. The 'Datenbank Backup' tab is active, displaying two main sections: 'Sicherung erstellen' (Create Backup) and 'Sicherung wiederherstellen' (Restore Backup).

Sicherung erstellen (Create Backup):

- Radio buttons for 'Lokal' (selected) and 'Netzwerk'.
- 'Datenbank Pfad' (Database Path): C:\ProgramData\ATSoftware\Database\A...
- 'Zielpfad der Sicherungsdatei' (Destination path of backup file): [Empty field]
- Checkbox: 'Sicherungsdateiname mit Datum (ssmmHHddMMyyyy)' (Backup filename with date).
- Button: 'Datenbanksicherung erstellen' (Create database backup).

Sicherung wiederherstellen (Restore Backup):

- Radio button for 'Lokal'.
- 'Pfad der Sicherung' (Backup path): C:\Datenbanksicherung\AT_Backup3533... (marked with red circle 1).
- 'Zielpfad der Wiederherstellung' (Destination path of restoration): C:\ProgramData\ATSoftware\Database\AT... (marked with red circle 2).
- Button: 'Datenbanksicherung wiederherstellen' (Restore database backup) (marked with red circle 3).

Einstellung der automatischen Sicherung (Automatic backup settings):

- 'Pfad der Datenbank' (Database path): [Empty field]
- 'Zielpfad der Sicherungsdatei' (Destination path of backup file): [Empty field]
- Button: 'Speichern' (Save).

Figure330: DB-Backup 3

Table36: DB-Backup 3

1	Backup directory. Here you specify a directory where the backup was saved, e.g. C:\Data backup .
2	Database file directory. By default, the database is located in the (hidden) directory C:\ProgramData\ATSoftware\Database . The file name is ATFirebird.fdb . Caution! An existing database will be overwritten.
3	Start restoration.

23.1.3 Setting the automatic backup

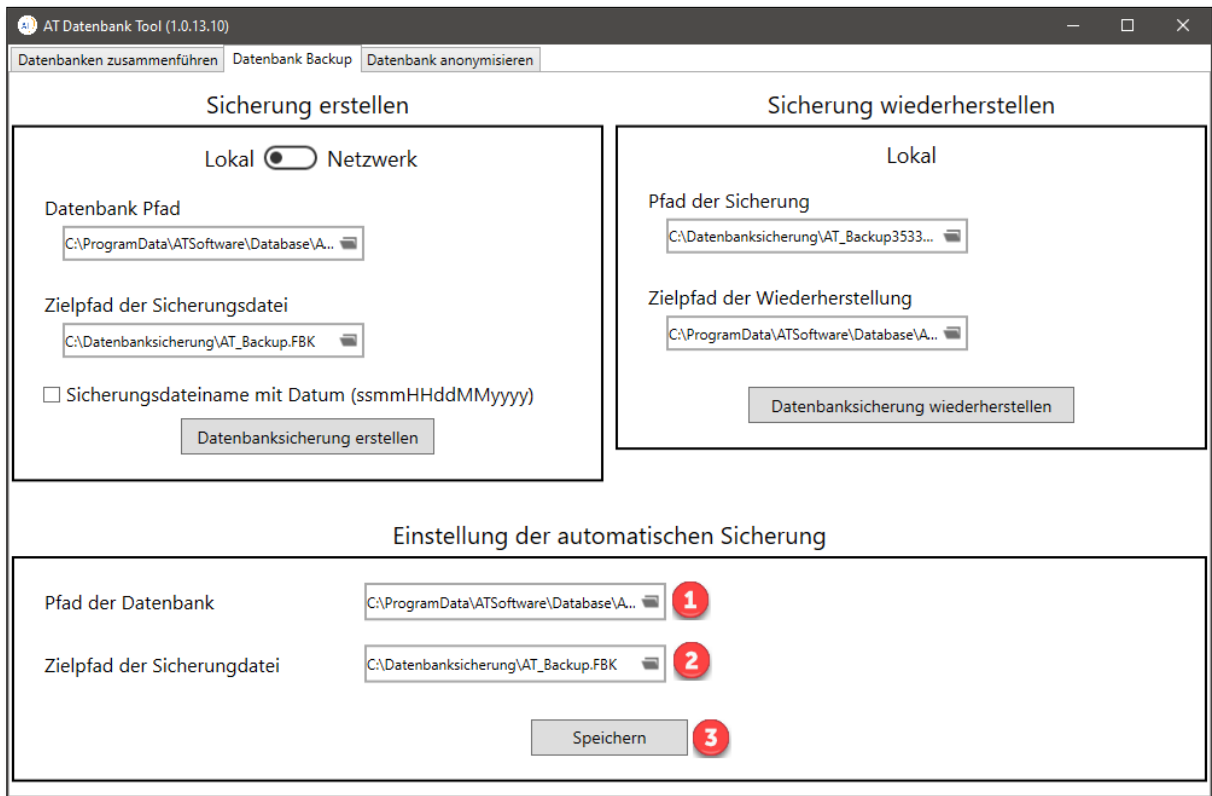


Figure331: DB-Backup 4

Table37: DB-Backup 4

1	Directory of the database file. By default, the database is located in the (hidden) directory C:\ProgramData\ATSoftware\Database . The file name is ATFirebird.fdb .
2	Directory for the backup. Here you specify a directory where the backup should be stored, e.g. C:\Data backup . It is important that you have write access to this directory.
3	Click the Save button to save the settings for future use. The settings are stored in the BackupSettings.conf file in the \Configs folder in the current program directory.

Once these settings have been made and saved, an automatic backup can be set up using the Windows Task Scheduler.

23.1.4 Establishment of regular database backups

To set up automatic database backup with Windows Task Scheduler, you need the DB tool. In this tool, you must first configure the settings for automatic backup as described above and save them.

Windows Task Scheduler is started by pressing **Windows + R** and entering the command **taskschd.msc**.

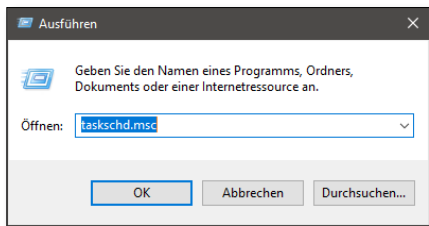


Figure332: Start task planning

The task planning view has been divided into three parts.

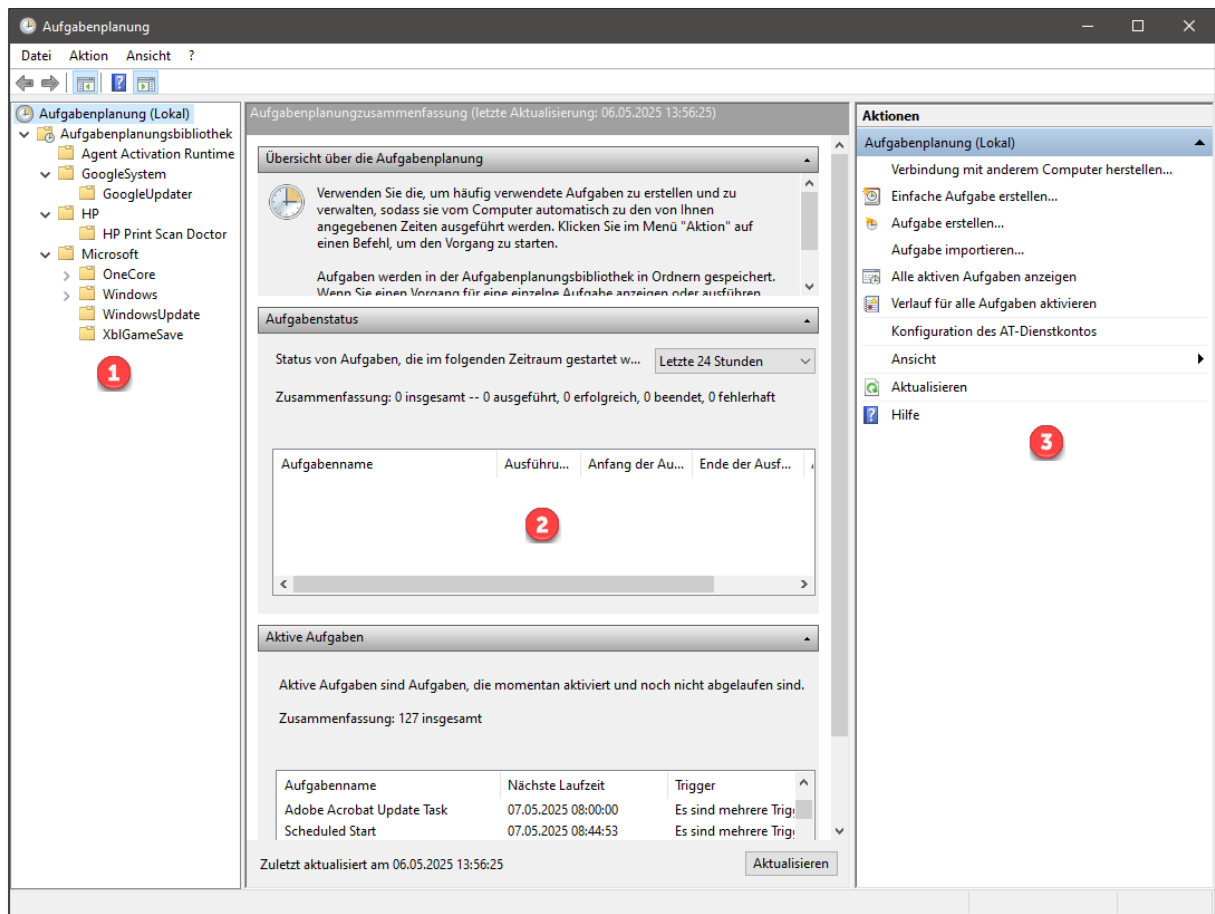


Figure333: Windows Task planning, overview

Table38: Task planning

1	The task planning library is located on the left-hand side, where all defined tasks are displayed.
2	The actions used to configure the settings can be found on the right-hand side.
3	In the middle section, there is a brief description of the tool at the top. Below this, you will find the current task status. It shows which tasks have been executed, when they were executed and their current status. Below Active Tasks, you will find the tasks that are currently being executed and are still active.

The task scheduler already contains several tasks by default, which can be found under the entry **Microsoft\Windows**, divided into further folders.

23.1.4.1 Creating a new task

There are two ways to create a new task.

Before creating a new task, you should create a new folder on the left-hand side, e.g. with the name My Tasks..

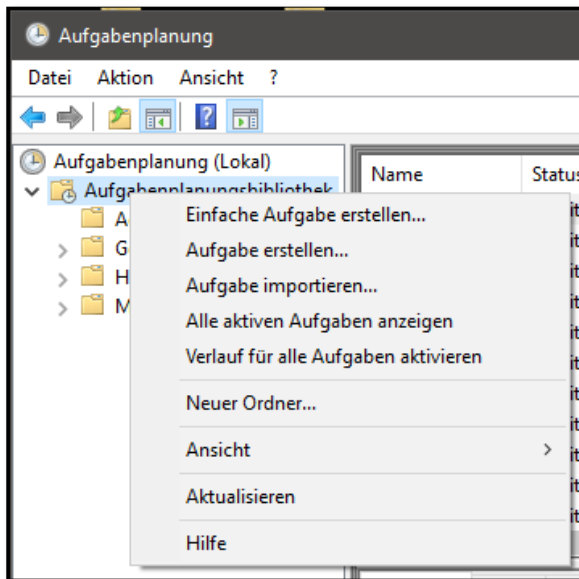


Figure334: New folder

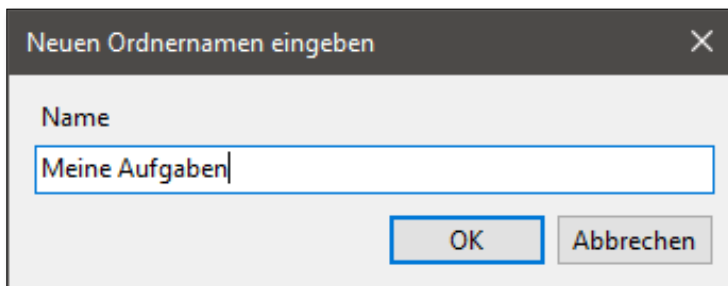


Figure335: Name of the new folder

Before you can create a new task, you must select this folder. The new task will be saved there.

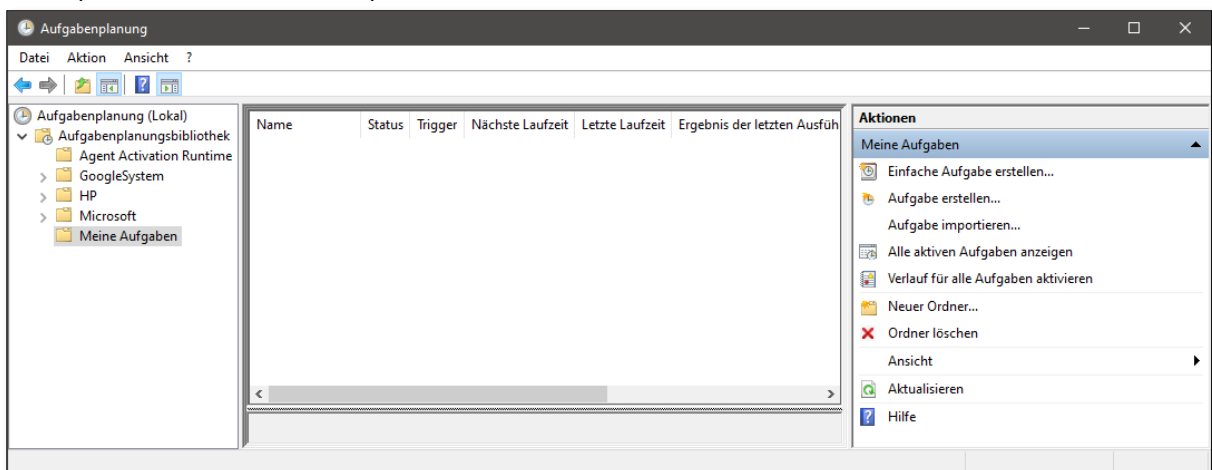


Figure336: New folder created

23.1.4.2 Entry 'Create simple task' using a wizard

The 'Create simple task' entry on the right-hand side can be used to add a new task with the help of a wizard.

First, a 'Name' and, if necessary, a description for the new task must be entered.

The screenshot shows a wizard window titled 'Assistent für das Erstellen einfacher Aufgaben'. The left sidebar has four items: 'Einfache Aufgabe erstellen' (selected), 'Trigger', 'Aktion', and 'Fertig stellen'. The main area contains the following text: 'Mit diesem Assistenten können Sie eine häufig ausgeführte Aufgabe schnell erstellen. Erweiterte Optionen oder Einstellungen, z. B. Aufgaben für mehrere Aktionen oder Trigger, können Sie mit dem Befehl "Aufgabe erstellen" im Aktionsbereich festlegen.' Below this text are two input fields: 'Name:' with the value 'AT2000 Datenbank sichern' and 'Beschreibung:' which is empty. At the bottom right are three buttons: '< Zurück', 'Weiter >', and 'Abbrechen'.

Figure337: Create a simple task

Next, you need to specify a 'trigger' to determine when the task should start. You have the following options:

The screenshot shows the same wizard window, but now at the 'Aufgabentrigger' step. The left sidebar has five items: 'Einfache Aufgabe erstellen', 'Trigger' (selected), 'Monatlich', 'Aktion', and 'Fertig stellen'. The main area contains the text 'Wann soll die Aufgabe gestartet werden?' followed by a list of radio button options: 'Täglich', 'Wöchentlich', 'Monatlich' (selected), 'Einmal', 'Beim Start des Computers', 'Beim Anmelden', and 'Bei Protokollierung eines bestimmten Ereignisses'. At the bottom right are three buttons: '< Zurück', 'Weiter >', and 'Abbrechen'.

Figure338: Create a simple task - Trigger

Now, under 'Action', you must specify which of the specified actions are to be performed by the task.

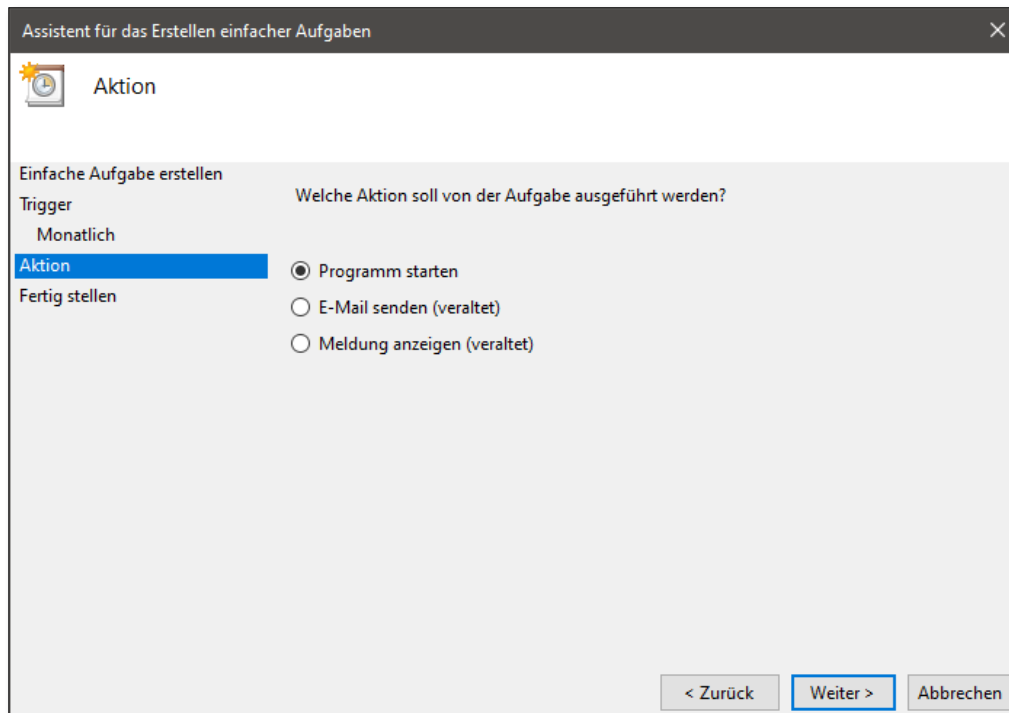


Figure339: Create a simple task - Action

Then click on 'Finish'.

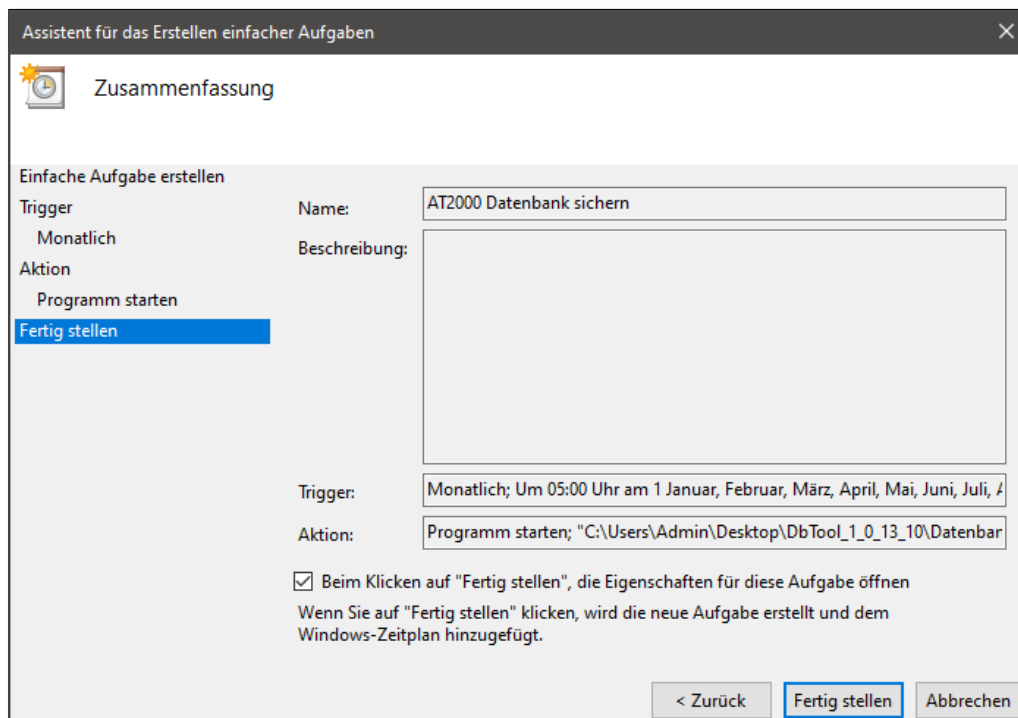


Figure340: Create a simple task - Complete

23.1.4.3 'Create task' entry

If new tasks are set up via this item, no wizard is started, but additional functions are available. Here you also have the option of executing the task under a different user account.

When you execute 'Create task', a new dialogue window opens, displaying the following tabs.

Register: General

The name for the new task is specified here. A description can also be entered.

The 'Security options' area is used to specify the permissions with which the application/script should be started.

For applications that require extended permissions and therefore cannot be executed via the autostart function with the message 'Some autostart programs have been blocked', the following must be set:

- Select a user account with administrator rights
- Select Run regardless of user login
- Select Run with highest privileges

Figure341: Create task - General

Register: Trigger

First, click on 'New'.

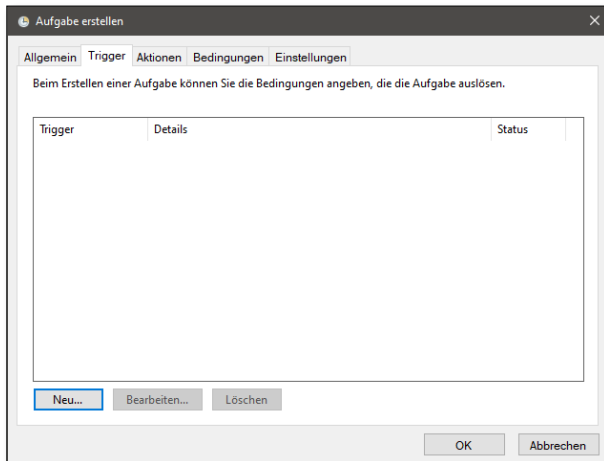


Figure342: Create task - Trigger 1

You can configure which action or at what time (daily, etc.) the new task should be executed.

To activate the trigger, you must select the corresponding checkbox under 'Advanced settings' for "Enabled".

For autostart programmes that require extended rights, the following must be set:

- Start task: Select 'On a schedule'
- Under Settings, select 'Daily'
- Under Advanced settings, select 'Enabled'.

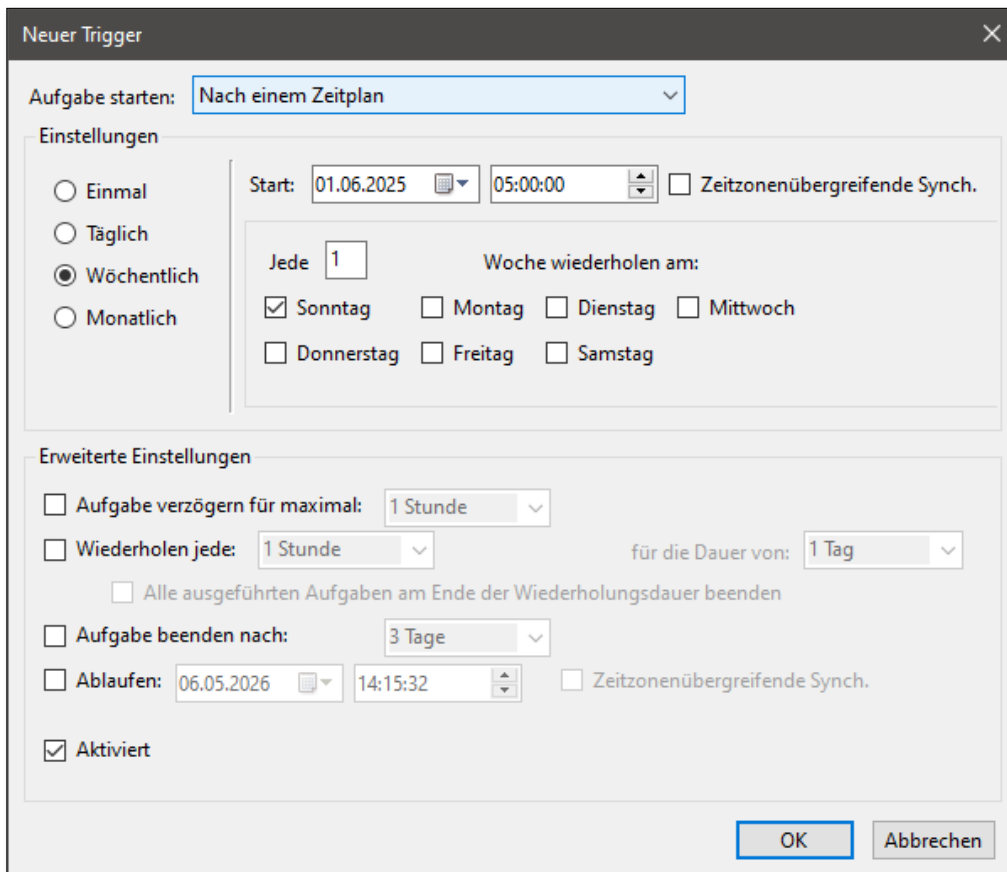


Figure343: Create task - Trigger 2

Register: Actions

First, click on 'New'.

The actions are processed in the order specified, whereby the order can be changed later using the arrow buttons on the right-hand side.

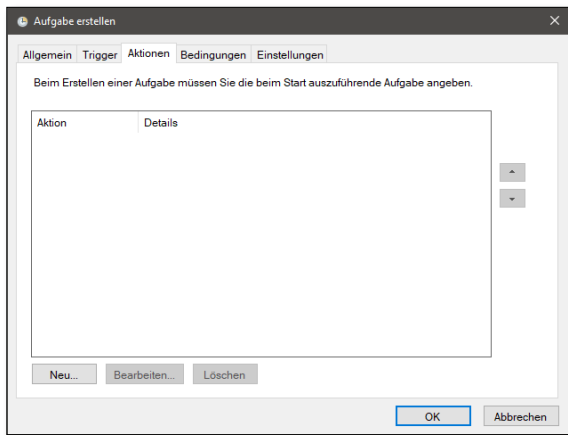


Figure344: Create task – Action 1

The actions to be performed are inserted here.

The ability to call any programs and scripts should allow you to fulfil all your requirements. The following data must be entered:

In the Program/Script field, select the executable program **AT Database Tool.exe** from the installation.

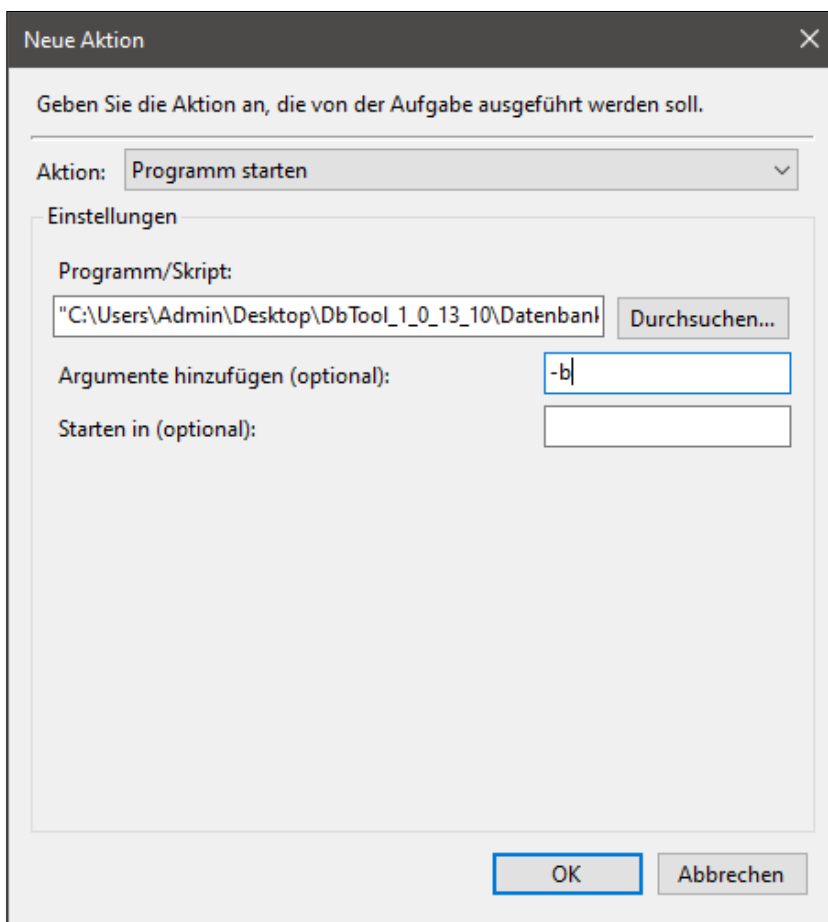


Figure345: Create task – Action 2

Register: Conditions

Here you can specify prerequisites that must be met for the task to be executed.

Figure346: Create task - Conditions

Register: Settings

Here you can define general settings for the task.

Figure347: Create task - Settings

23.2 Anonymise database

The DB tool can be used to anonymise a database.

To do this, select the database you want to anonymise and click on the 'Anonymise database' button.

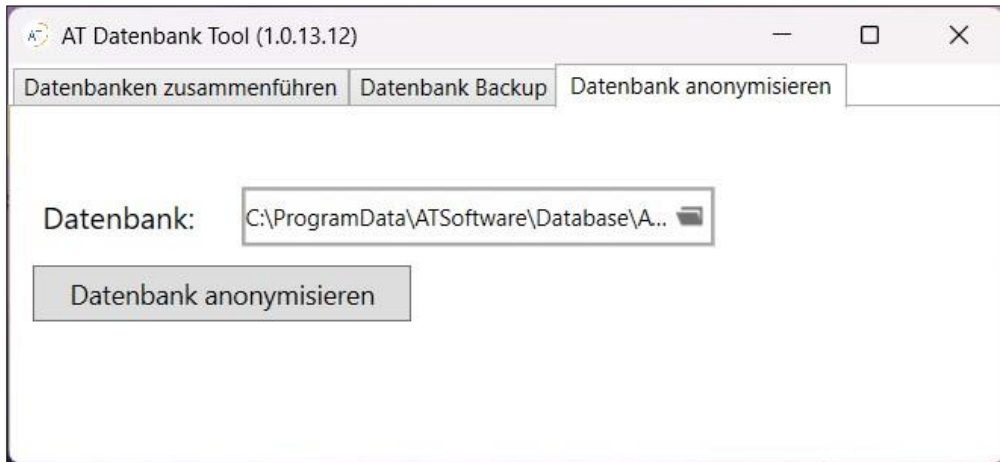


Figure348: Anonymise database

Then specify a storage location for the anonymised database.

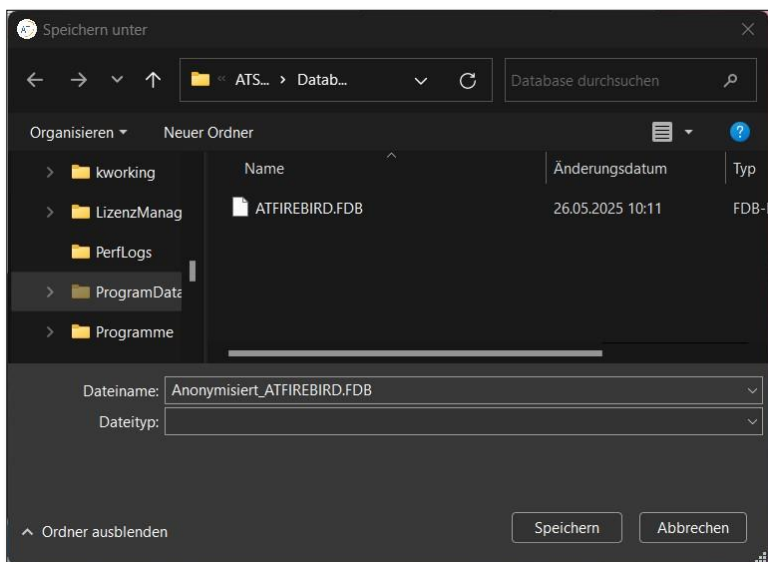


Figure349: Storage location for anonymised database

Then confirm the following message with 'OK'.

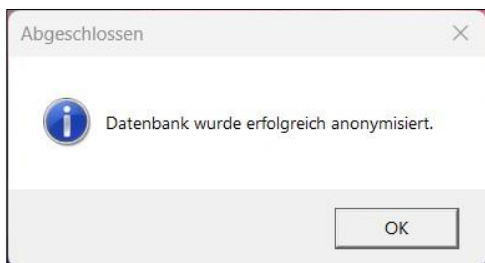


Figure350: anonymised database

23.3 Merging databases

There are two databases, 'ATFIREBIRD_A2.FDB' and 'ATFIREBIRD_B2.FDB'. The database 'ATFIREBIRD_A2.FDB' should be transferred to the database 'ATFIREBIRD_B2.FDB'. You can also copy a database from a server, but you must stop the Firebird server service before copying.

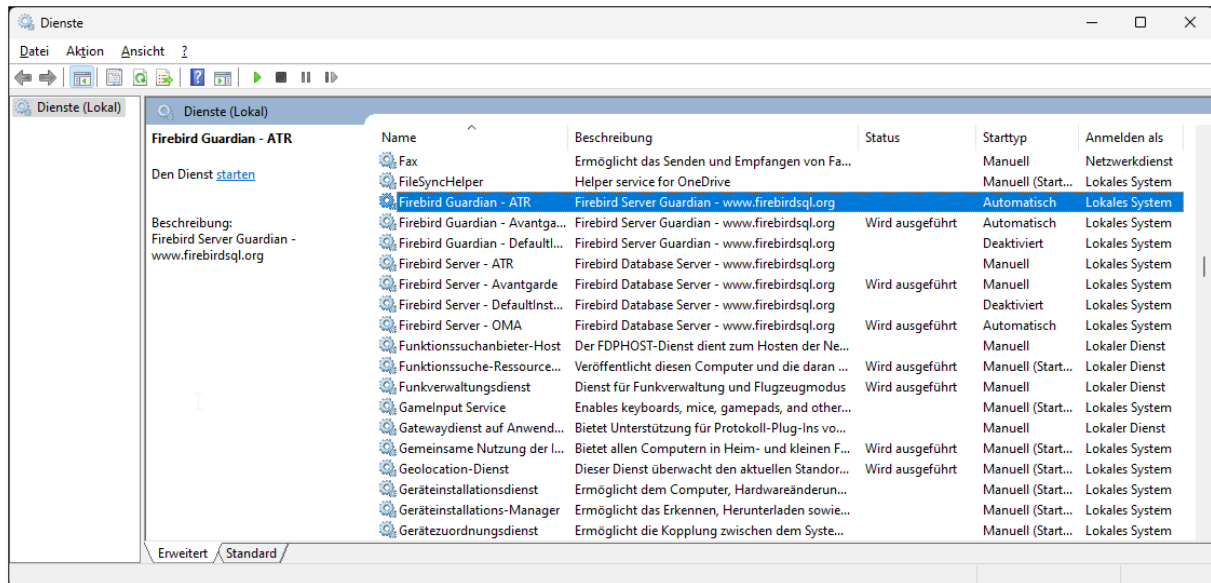


Figure351: Firebird

To merge the databases, start the DB tool on a computer and select the two databases as the source and destination.

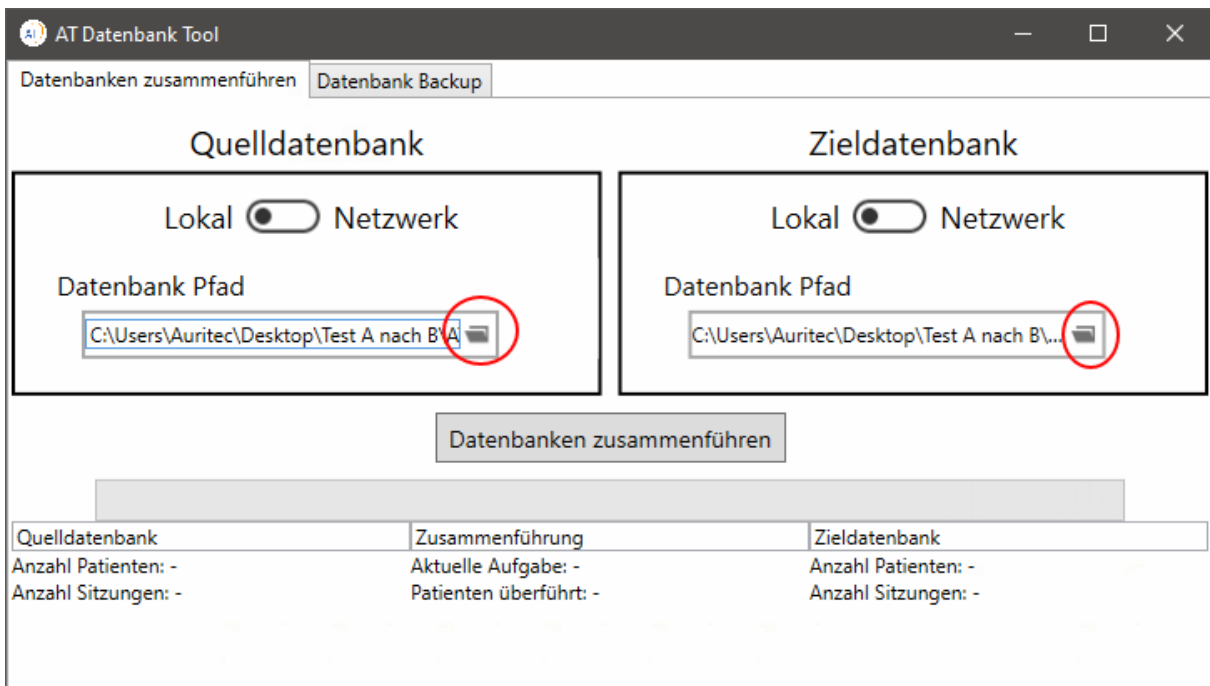


Figure352: Merge databases

After clicking on 'Merge databases', the following message may appear:

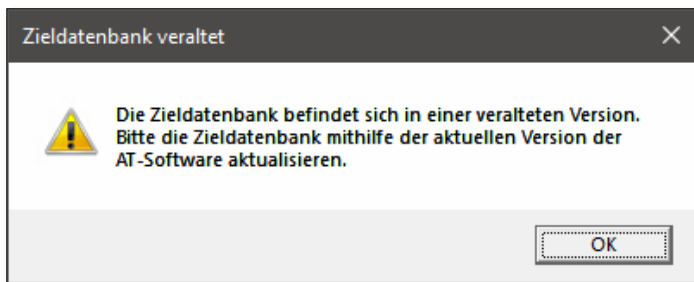


Figure353: notification

This means that the database specified as the target database has an older version than the 'AT Database Tool'. To update the database to the current version, see chapter 23.4 Raise database.

Once the database has been upgraded to the current version, you can continue.

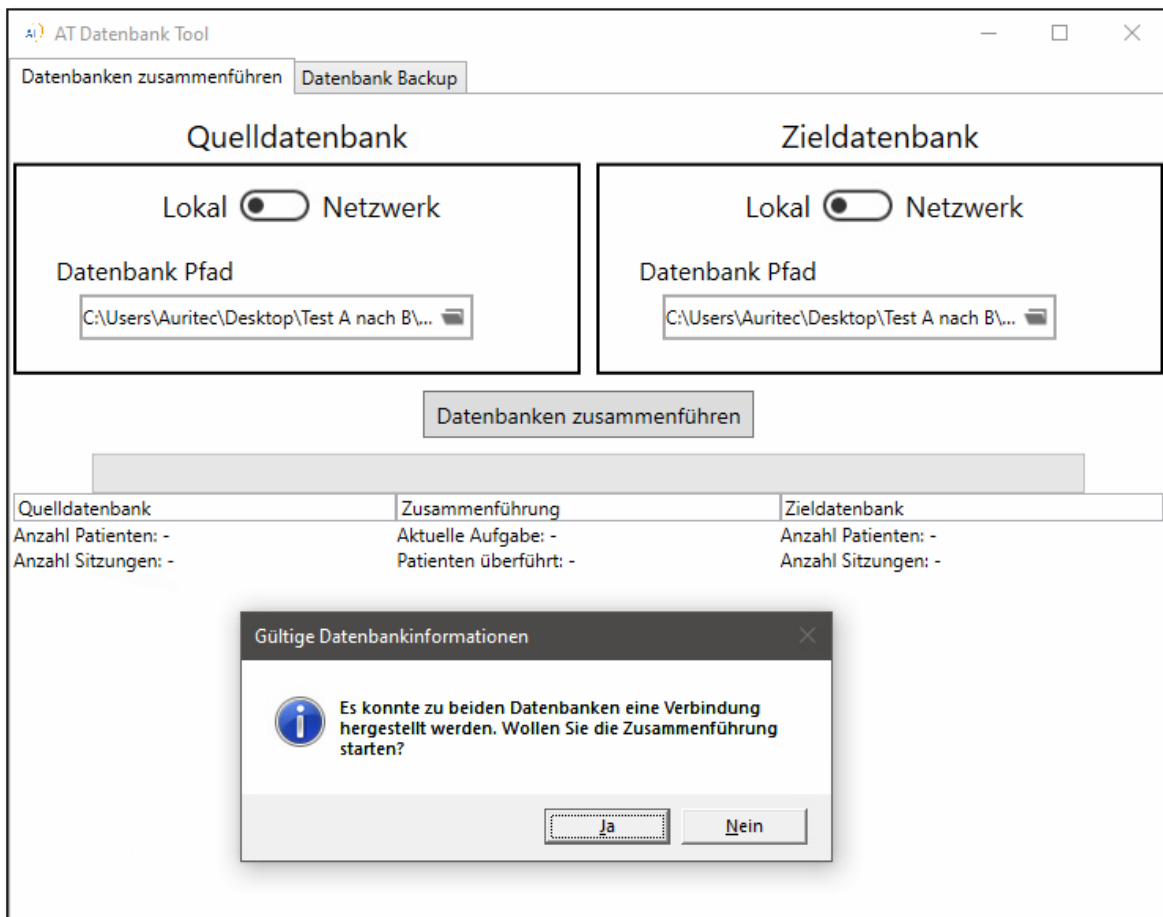


Figure354: Merge DB 1

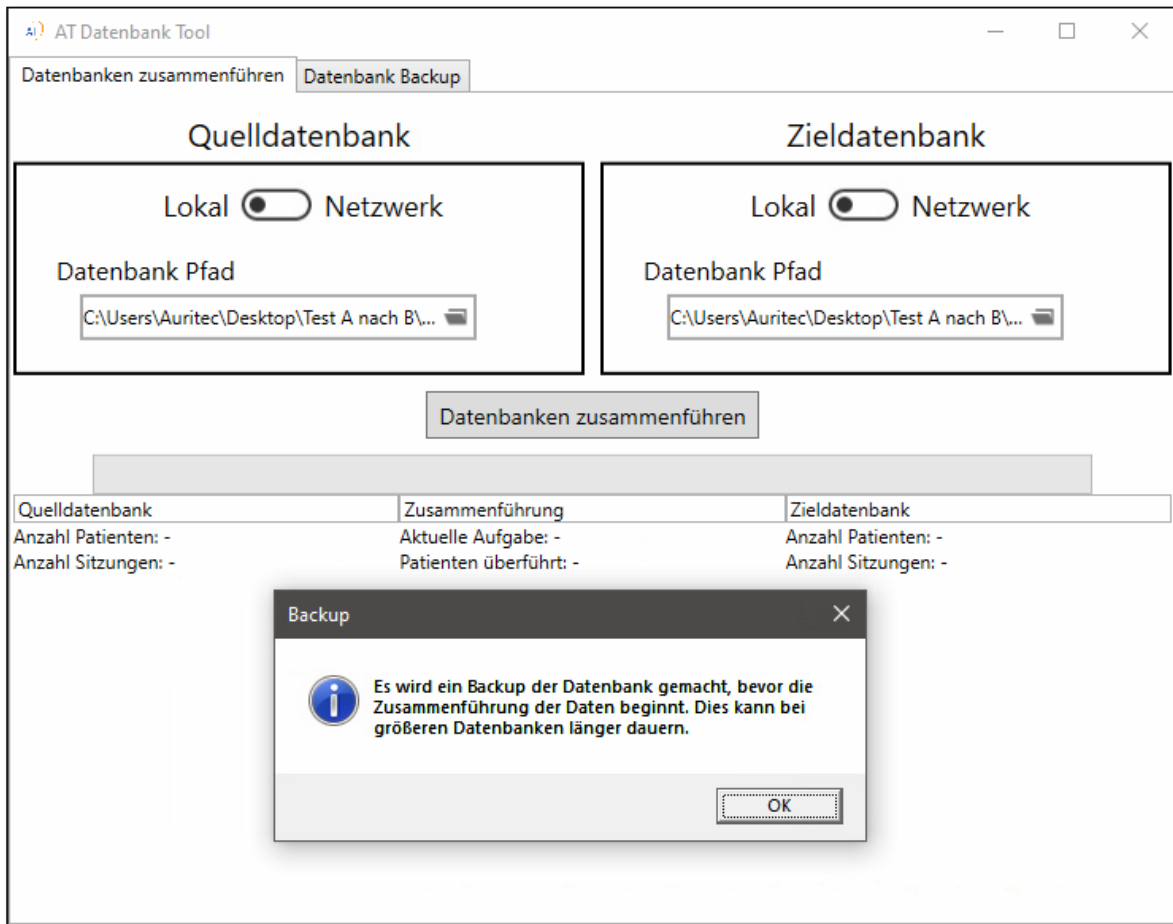


Figure355: Merge DB 2

A backup of the target database is performed. This backup has the file extension .FBK and is then stored in the subfolder 'Backup'.

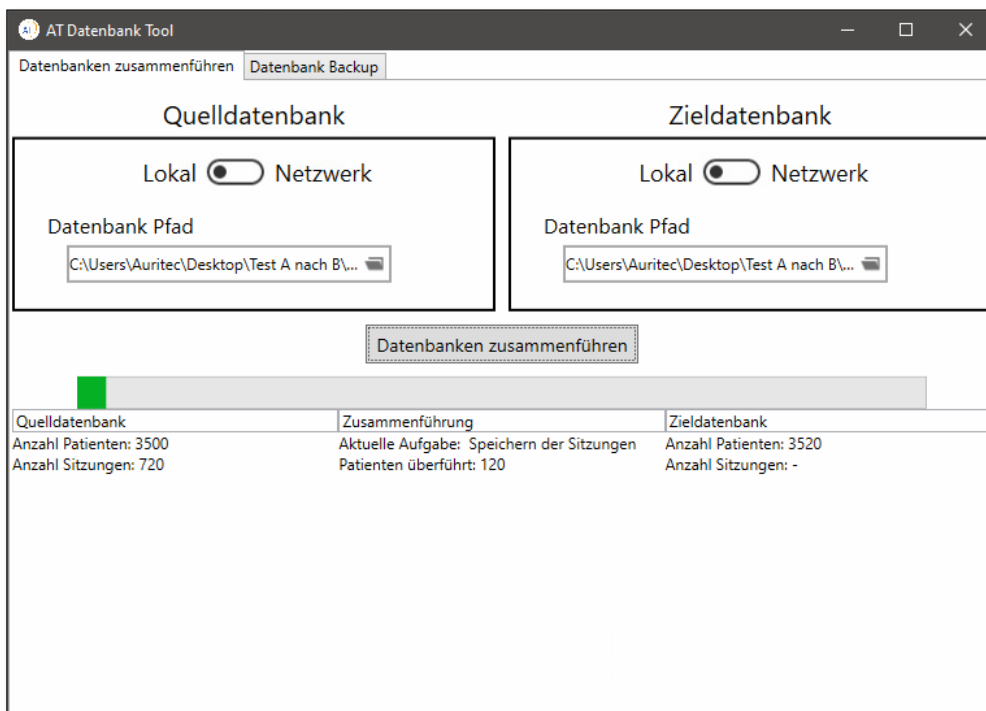


Figure356: Merge DB 3

After successful merging, the target database can be renamed back to 'ATFIREBIRD.FDB' and copied to the configured storage location.

In a network environment, make sure that the Firebird server service is restarted.

23.4 Raise database

First reset the paths for the current program database to default values. The directories are located in the 'DatabaseSettings.conf' file in the "Configs" directory of the current program installation. Rename this file, e.g. to 'DatabaseSettings_NETWORK.conf'. Then start 'ATS.PL.LoaderV2.exe'. A new 'DatabaseSettings.conf' file with default values will be created. Rename the target database 'ATFIRE-BIRD_B2.FDB' to 'ATFIREBIRD.FDB' and enter the directory in the database settings.

After clicking on 'Connect', the database will be updated to the current version.

The settings made previously can then be reversed.

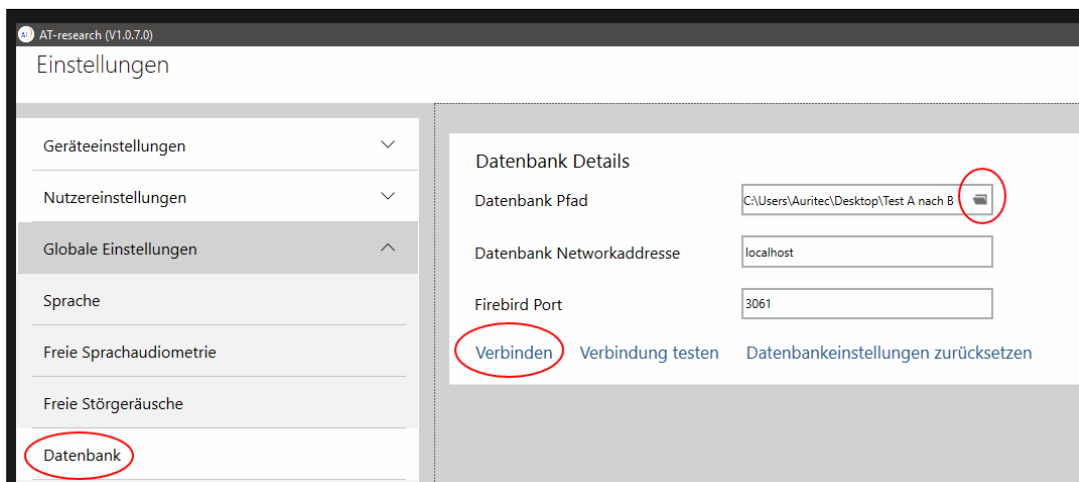


Figure357: Raise DB

24 Appendix

24.1 Subjective audiometer test

The user should carry out a subjective device check on their audiometer system (recommended every 4 weeks). This subjective audiometer check serves to ensure measurement reliability and prevents non-recognition of slowly changing measurement results.

The control is to be carried out with ontologically normal hearing test subjects who show no impairment of hearing and have had at least a 12-hour break from noise.

Step 1

Check cables and plugs for damage and ageing, untangle the component leads and check the patient response system. In the event of defects and damage, inform your service centre

Step 2

After the initial installation of the audiometer, you should take an air conduction, bone conduction and speech audiogram measurement with the test subject, which can also be you as the user. For the speech audiogram, you only need to determine the hearing loss for polysyllables (numbers).

These audiograms are saved as reference audiograms in your database.

After the recommended time interval (4 weeks), take another air conduction, bone conduction and speech audiogram measurement with the same test subject. Superimpose the old reference curve for each test onto the new audiogram; the difference must not and should not exceed ± 10 dB at any frequency in the audiogram. If this is the case, inform your service centre.

24.2 Technical data

The manufacturer will not provide wiring diagrams, etc. on request.

24.2.1 Ambient conditions

Operation

Ambient temperature:	+15°C to +35°C
relative humidity (max.):	30% to 90% (non-condensing)
Air pressure:	70 kPa to 106 kPa
Accuracy of the calibration:	at 98 kPa to 104 kPa ambient air pressure

Storage and transport

Ambient temperature:	-20°C to +60°C
Relative humidity (max.):	5% to 95% (non-condensing)
Air pressure:	70 kPa to 106 kPa



Operation at temperatures below -20°C (-4°F) or above +60°C (140°F) can cause permanent damage!

24.2.2 Power supply

Mains voltage:	100 V AC - 240 V AC
Mains frequency:	50 Hz / 60 Hz
max. power consumption:	150 VA (audiometer); 225 VA (per surround module)
Primary fuses:	3.15 A (audiometer); 6.3 A (AT-surround)

24.2.3 Classifications and standards

MDR:	Class IIa
Protection type according to EN 60601-1:2013-12:	Protection class 1
Degree of protection according to EN 60601-1:2013-12:	Applied parts type BF
Degree of protection according to DIN EN 60529:2014-09:	IP40 (audiometer, surround module), IP20 (control panel)
Operating mode according to EN 60601-1:2013-12:	Continuous operation
Classification according to EN 60645-1:2018:	Pure-tone audiometer class 2 (class 1 optional), speech audiometer class B-E

24.2.4 Measuring frequencies

Tone audiometry:	125 Hz to 8,000 Hz
Highest tone audiometry:	10,000 Hz to 16,000 Hz (with corresponding transducer)

24.2.5 Masking noises

- ✓ Sine wave
- ✓ Narrowband noise in tonal audiometry (EN 60645-1)
- ✓ Steep narrowband noise
- ✓ Broadband noise - White noise (linear)
- ✓ Broadband noise - pink noise (12 dB / octave decreasing)
- ✓ Speech masking noise in speech audiometry

24.2.6 Signals

- ✓ Sine wave
- ✓ Narrowband noise in tonal audiometry (EN 60645-1)
- ✓ Steep narrowband noise
- ✓ Broadband noise - White noise (linear)
- ✓ Broadband noise - pink noise (12 dB / octave decreasing)

24.2.7 Signal types

- ✓ Continuous tone
- ✓ Pulse tone
- ✓ Wobble tone (modulation type triangle; modulation frequency 4 Hz, 8 Hz, 12 Hz, 16 Hz, 20 Hz; frequency deviation 2.5%, 5%, 7.5%, 10%, 12.5%)
- ✓ Steep narrow band noise (SNBN)

Note: To make the SNBN suitable for or comparable with other hearing level measurements, it is calibrated in dB HL, not in EML (Effective Masking Level) like the masking noise.

24.2.8 Dimensions and weight

Audiometry module:	<u>Dimensions:</u> 355 x 150 x 305 mm (width x height x depth) <u>Weight:</u> 5.5 kg
Surround module:	<u>Dimensions:</u> 357 x 100 x 305 mm (width x height x depth) <u>Weight:</u> 4 kg
Control panel:	<u>Dimensions:</u> 587 x 118 x 330 mm (width x height x depth) <u>Weight:</u> 2.9 kg

24.2.9 Calibration data

The calibration data is saved in the Calibration.xml file and (if available) in the EEPROMs in the transducer plug.

For more details, see the data sheets of the respective manufacturers with the corresponding calibration certificates.

24.3 Maintenance instructions

The operator of the **AT-research / AT2000** is obliged under MPBetreibV (Ordinance on the Installation and Use of Medical Devices) Section 3, § 11, Appendix 2, to have the audiometer subjected to an annual safety and metrological check by an approved authorised maintenance company.

24.3.1 Safety inspection / VDE test – STK

First, a visual inspection must be carried out to ensure that all cables are undamaged and that the entire system is connected correctly.

The VDE test must be carried out annually and includes the following checks: protective conductor resistance, device leakage current, touch current, patient leakage currents and patient auxiliary currents.

24.3.2 Metrological control - MTK

The MTK must be carried out annually by the manufacturer.

24.3.3 Documents

24.3.3.1 Declaration of conformity (example)



EU-Declaration of Conformity

We, AURITEC medizinische Systeme GmbH, Dernaer Straße 12, 22047 Hamburg, Germany, hereby declare under our sole responsibility that the below-mentioned medical device meets the provisions of the Regulation (EU) 2017 / 745 of European Parliament and of the Council of 5 April 2017 on medical devices, and the conditions set out in Annex I, "General Safety and Performance Requirements".

Product:	Puretone- / Speechaudiometer
Model:	AT2000
Serial Number:	Seriennummer eingeben
Classification according to Annex VIII:	Ila
First CE-Marking:	06.11.2023
SRN:	DE-MF-000023154
Basis-UDI:	42623650813496452590000JJ

This audiometer is designed for the detection and diagnosis of suspected hearing loss. The results can be used for further test procedures. Performance and specificity depend on user-defined test characteristics and may vary depending on environment and operating conditions. The diagnosis depends on patient cooperation. For patients who do not respond positively, additional assessment methods should be consulted, and a complete audiological examination should be performed if sensitivity is suspected.

 Conformity declared in accordance with Annex IX of the Medical Device Regulation.

 AURITEC is in compliance with the following European Union Directives and is actively restricting the use of designate substances.

Conformity declared in accordance with 2011/65/EU RoHS Recast Directive (RoHS-II).

Restriction of Hazardous Substances	Content of Compliance
Lead – Pb	<0,1% (1000ppm)
Mercury – Hg	<0,1% (1000ppm)
Cadmium – Cd	<0,01% (100ppm)
Hexavalent Chrome – (Cr+6)	<0,1% (1000ppm)
Polybrominated Biphenyls – PBB	<0,1% (1000ppm)
Polybrominated Diphenyl Ethers – PBDE	<0,1% (1000ppm)

In addition to the basic requirements of the Medical Device Regulation, we confirm compliance with all relevant standards and legislation, for the above-mentioned medical device.

This declaration only applies to the above-mentioned medical device with the corresponding components clearly defined by serial numbers. If any of these components is replaced, an authorized service partner has to transmit a measurement report, so the conformity can be renewed.

The validity of the DoC is bound to the EU Certificate (Certificate Number: G10 033395 0016 – Rev. 00). Involved in the conformity-assessment-procedure as the notified body is TÜV SÜD Product Service GmbH, Ridlerstrasse 65, D-80339 Munich with the ID-number 0123.

Hamburg, 26.01.2026

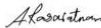

 Anandhi Narasimhan (Quality Manager)

Figure358 : Declaration of conformity (example)

24.3.3.2 Conformity protocol - first delivery (example)

6.5 Produktion
Produkte Allgemein

**Prüfprotokoll Konformität
Ton- und Sprachaudiometer**

AURITEC

Modell: AT2000

Seriennummer: _____

Objektive Prüfung durchgeführt mit: MP5

Verwendete Prüfmittel	Hersteller	Seriennummer	Typ	nächster Prüftermin
1/2" Freielektroden	Norsonic AS	571856	1225	März 2027
1/2" Kondensatormikrofon	G.R.A.S.	962953	40A2	März 2027
Akustischer Kalibrator	Norsonic AS	125627021	1256	März 2027
Akustischer Kuppler	G.R.A.S.	55192	RA0045	März 2027
Akustischer Kuppler	G.R.A.S.	608104	RA0039	März 2027
Mechanischer Kuppler	BrüelKjaer	556 002	4930	September 2025
Schallpegelmessgerät	Norsonic AS	140 8019	140	März 2027
Sicherheitstester	S.P.L. Elektronik	8010M200	GM-200	November 2027

Umgebungsbedingungen

Kontrolle, ob die Festlegung der Umgebungsbedingungen gemäß DIN EN 60645-1 Abschnitt 5.3 eingehalten wurde.

Temperatur	Luftfeuchte	Luftdruck
Soll: 15 °C - 35 °C	30 % - 90 %	98 kPa - 104 kPa
gemessen:		

Andruckkräfte

Messung der Andruckkraft des Luftleitungswandlers gemäß DIN EN ISO 389-1.

Kopf- hörer	min. N	Soll N	max. N	ist N
DD45	4,0	4,5	5,0	
DD450	9,5	10,0	10,5	

Messung der Andruckkraft des Knochenhörs gemäß DIN EN ISO 389-3.

Knochen- hörer	min. N	Soll N	max. N	ist N
BB1	4,9	5,4	5,9	

Erstellt von: Lisa Hagenstock
L:\Produkt_Dokumente\Makro\Makro Prüfprotokolle_V2.0

Revision: 2.0

gültig ab: 25.04.2024

Figure359 : Conformity protocol - p. 1

6.5 Produktion
Produkte Allgemein

**Prüfprotokoll Konformität
Ton- und Sprachaudiometer**

AURITEC

Wandler DD45

Seriennummer: _____

Kalibriert von: _____

Tonaudiometrie:

Kontrolle, ob die Pegelsteller das Signal über den gesamten Dynamikbereich gemäß DIN EN 60645-1 Abschnitt 8.4.4 abschwächen.
Die maximal zulässige Abweichung über den gesamten Bereich beträgt 1 dB.
Wird die zulässige Abweichung bei 125 Hz und 1000 Hz eingehalten? Ja O

Messung des Gesamtklirfaktors gemäß DIN EN 60645-1 Abschnitt 6.1.3.
Die zulässigen Toleranzen betragen: Luftleitung 2,5%; Knochenleitung 5,5%.
Werden die zulässigen Toleranzen eingehalten? Ja O

Messung der Frequenzgenauigkeit der reinen Töne gemäß DIN EN 60645-1 Abschnitt 6.2.1.
Die zulässige Toleranz beträgt ±1%.
Werden die zulässigen Toleranzen eingehalten? Ja O

Messung der Schalldruckpegel gemäß DIN EN 60645-1 Abschnitt 8.3 und 8.5.3. Kuppler nach DIN EN 60318-1 ("1")

Frequenz Hz	Hörpegel dB	Kupp.-Korr. dB	Mic.-Korr. dB	rechts ±3 dB	Sollpegel dB	links ±3 dB	SBR-Korr. dB	rechts +5/-3 dB	Sollpegel dB	links +5/-3 dB
125	70,0	48,0	0,0		119,0		4,0		119,0	
250	70,0	27,0	0,0		97,0		4,0		101,0	
500	70,0	13,5	0,0		83,5		4,0		87,5	
750	70,0	9,0	0,0		79,0		5,0		84,0	
1000	70,0	7,5	0,0		77,5		6,0		83,5	
1500	70,0	7,5	0,0		77,5		6,0		83,5	
2000	70,0	9,0	0,0		79,0		6,0		85,0	
3000	70,0	11,5	0,1		81,6		6,0		87,6	
4000	70,0	12,0	0,1		82,1		5,0		87,1	
8000	70,0	16,0	0,2	±5 dB	86,2	±5 dB	5,0	+5/-3 dB	91,2	+5/-3 dB
8000	70,0	15,5	0,4		85,9		5,0		90,9	
PN	70,0	8,0	0,0		78,0		-	-	-	-
WN	70,0	8,0	0,0		78,0		-	-	-	-

Messung der Schalldruckpegel - stilles SBR (Werte wie Sinus). Ja O

Messung der Schalldruckpegel mit Verstärkung. Ja O

Erstellt von: Lisa Hagenstock
L:\Produkt_Dokumente\Makro\Makro Prüfprotokolle_V2.0

Revision: 2.0

gültig ab: 25.04.2024

Figure360 : Conformity protocol - p. 2

6.5 Produktion
Produkte Allgemein

**Prüfprotokoll Konformität
Ton- und Sprachaudiometer**

AURITEC

Sprachaudiometrie:

Messung des Gesamtklirfaktors gemäß DIN EN 60645-2 Abschnitt 11.1 und 11.3.
Wird die zulässige Toleranz von 2,5% eingehalten? Ja O

Messung der Sprachschalldruckpegel/Verdeckungsgeräusch gemäß DIN EN 60645-2 Abschnitt 9.

Kopfhörer	Hörpegel dB	Korr.-wert SBR dB	Sollpegel dB	max. Abw. SBR ±2 dB rechts	max. Abw. SBR ±2 dB links	Korr.-wert SVR dB	Sollpegel SVR dB	max. Abw. SVR ±2 dB rechts	max. Abw. SVR ±2 dB links
DD45	70,0	9,0	79,0			8,0	79,0		

Soll-Bezugspegel = (Summe Ist-Pegel(200Hz, 4000Hz)) - GC-GF-Mittelwert / 5
Abweichung Ist/Soll = Ist-Pegel - GC-GF - Soll-Bezugspegel

Messung des Frequenzganges gemäß DIN EN 60645-1 Abschnitt 6.3.2.

Frequenz Hz	Pegel rechts dB	Pegel links dB	Mic.-Korr. dB	GC-GF Mik.-Wert	GC-GF dB	Ist/Soll- Bezug rechts	Toleranz dB	Ist/Soll- Bezug links
125					19,5		+4 bis -11	
250					12,0			
500					8,0			
1000				44,0	4,5		-14	
2000					8,0			
4000			0,1		11,5			
8000			0,2		12,0		+4 bis -6	
Soll-Bezug	-	-	-	-	-	-	-	-

Messung des Frequenzganges gemäß DIN EN 60645-1 Abschnitt 6.1.6.
Werden die Toleranzwerte eingehalten? Ja O

Messung des Signal-Rausch-Abstandes gemäß DIN EN 60645-2 Abschnitt 12.
Sind die Rauschkurven gemäß DIN EN 60645-2 Abschnitt 13.1 in Ordnung? Ja O

Erstellt von: Lisa Hagenstock
L:\Produkt_Dokumente\Makro\Makro Prüfprotokolle_V2.0

Revision: 2.0

gültig ab: 25.04.2024

Figure361 : Conformity protocol - p. 3

6.5 Produktion
Produkte Allgemein

**Prüfprotokoll Konformität
Ton- und Sprachaudiometer**

AURITEC

Wandler DD450

Seriennummer: _____

Kalibriert von: _____

Tonaudiometrie:

Kontrolle, ob die Pegelsteller das Signal über den gesamten Dynamikbereich gemäß DIN EN 60645-1 Abschnitt 8.4.4 abschwächen.
Die maximal zulässige Abweichung über den gesamten Bereich beträgt 1 dB.
Wird die zulässige Abweichung bei 125 Hz und 1000 Hz eingehalten? Ja O

Messung des Gesamtklirfaktors gemäß DIN EN 60645-1 Abschnitt 6.1.3.
Die zulässigen Toleranzen betragen: Luftleitung 2,5%; Knochenleitung 5,5%.
Werden die zulässigen Toleranzen eingehalten? Ja O

Messung der Frequenzgenauigkeit der reinen Töne gemäß DIN EN 60645-1 Abschnitt 6.2.1.
Die zulässige Toleranz beträgt ±1%.
Werden die zulässigen Toleranzen eingehalten? Ja O

Messung der Schalldruckpegel gemäß DIN EN 60645-1 Abschnitt 8.3 und 8.5.3. Kuppler nach DIN EN 60318-1 ("1")

Frequenz Hz	Hörpegel dB	Kupp.-Korr. dB	Mic.-Korr. dB	rechts ±3 dB	Sollpegel dB	links ±3 dB	SBR-Korr. dB	rechts +5/-3 dB	Sollpegel dB	links +5/-3 dB
125	70,0	30,5	0,0		100,5		4,0		104,5	
250	70,0	18,0	0,0		88,0		4,0		92,0	
500	70,0	11,5	0,0		81,5		4,0		85,5	
750	70,0	6,0	0,0		76,0		5,0		81,0	
1000	70,0	5,5	0,0		75,5		6,0		81,5	
1500	70,0	5,5	0,0		75,5		6,0		81,5	
2000	70,0	4,5	0,0		74,5		6,0		80,5	
3000	70,0	2,5	0,1		72,6		6,0		78,6	
4000	70,0	9,5	0,1		79,6		5,0	+5/-3 dB	84,6	+5/-3 dB
8000	70,0	17,0	0,2	±5 dB	87,2	±5 dB	5,0		92,2	
8000	70,0	17,5	0,4		87,9		5,0		92,9	
10000	70,0	22,0	0,5		92,5		5,0		97,5	
11200	70,0	23,0	0,4		93,4		5,0		98,4	
12500	70,0	27,5	0,4		97,5		5,0		102,5	
14000	70,0	35,0	0,4		105,4		5,0		110,4	
16000	70,0	56,0	0,2		126,2		-	-	131,2	-
PN	70,0	4,0	0,0		74,0		-	-	-	-
WN	70,0	4,0	0,0		74,0		-	-	-	-

Messung der Schalldruckpegel - stilles SBR (Werte wie Sinus). Ja O

Messung der Schalldruckpegel mit Verstärkung. Ja O

Erstellt von: Lisa Hagenstock
L:\Produkt_Dokumente\Makro\Makro Prüfprotokolle_V2.0

Revision: 2.0

gültig ab: 25.04.2024

Figure362 : Conformity protocol - p. 4

6.5 Produktion **Prüfprotokoll Konformität Ton- und Sprachaudiometer** **AURITEC**

Produkte Allgemein

Sprachaudiometrie:

Messung des **Gesamtklirfaktors** gemäß DIN EN 60645-2 Abschnitt 11.1 und 11.3.
Wird die zulässige Toleranz von 2,5% eingehalten? Ja O

Messung der **Sprachschalldruckpegel/Verdeckungsgeräusch** gemäß DIN EN 60645-2 Abschnitt 9.

Kopfhörer	Hörpegel dB	Korr.-wert SBR dB	Stollpegel SBR dB	max. Abw. SBR ±2 dB rechts	max. Abw. SBR ±2 dB links	Korr.-wert SVR dB	Stollpegel SVR dB	max. Abw. SVR ±2 dB rechts	max. Abw. SVR ±2 dB links
OD450	70,0	4,0	74,0			4,0	74,0		

Stoll-Bezugspegel = (Summe[St-Pegel(250Hz...4000Hz)] – GC-GF-Mittelwert)/5
Abweichung Ist/Stoll = Ist-Pegel – GC-GF – Stoll-Bezugspegel

Messung des **Frequenzganges** gemäß DIN EN 60645-1 Abschnitt 6.3.2

Frequenz Hz	Pegel rechts dB	Pegel links dB	Mid-Korr. dB	GC-GF Mid-Wert	GC-GF dB	Ist/Stoll- Bezug rechts	Toleranz dB	Ist/Stoll- Bezug links
125			0,0			5,0	+4 bis -11	
250			0,0			4,5		
500			0,0		2,5			
1000			0,0	28,5				14
2000			0,0		5,2			
4000			0,1		13,0			
8000			0,2		11,0		+4 bis -6	
Stoll-Bezug	-	-	-	-	-	-	-	-

Messung des **Frequenzganges** gemäß DIN EN 60645-1 Abschnitt 6.1.6.
Werden die Toleranzwerte eingehalten? Ja O

Messung des **Signal-Rausch-Abstandes** gemäß DIN EN 60645-2 Abschnitt 12.
Sind die Rauschkurven gemäß DIN EN 60645-2 Abschnitt 13.1 in Ordnung? Ja O

Erstellt von: Lisa Hagenstock
L:\Produkt Dokumente\Makro\Makro Prüfprotokolle_V2.0
Revision: 2.0
gültig ab: 25.04.2024

Figure363 : Conformity protocol - p. 5

6.5 Produktion **Prüfprotokoll Konformität Ton- und Sprachaudiometer** **AURITEC**

Produkte Allgemein

Wandler ER3C

Seriennummer: _____

Kalibriert von: _____

Tonaudiometrie:

Kontrolle, ob die Pegelsteller das Signal über den gesamten Dynamikbereich gemäß DIN EN 60645-1 Abschnitt 8.4.4 abschwächen.
Die maximal zulässige Abweichung über den gesamten Bereich beträgt 1 dB.
Wird die zulässige Abweichung bei 125 Hz und 1000 Hz eingehalten? Ja O

Messung des **Gesamtklirfaktors** gemäß DIN EN 60645-1 Abschnitt 6.1.3.
Die zulässigen Toleranzen betragen: Luftleitung 2,5%; Knochenleitung 5,5%.
Werden die zulässigen Toleranzen eingehalten? Ja O

Messung der **Frequenzgenauigkeit** der reinen Töne gemäß DIN EN 60645-1 Abschnitt 6.2.1.
Die zulässige Toleranz beträgt ±1%.
Werden die zulässigen Toleranzen eingehalten? Ja O

Messung der **Schalldruckpegel** gemäß DIN EN 60645-1 Abschnitt 8.3 und 8.3.3. **Kuppler nach DIN EN 60319-3 (1°)**

Frequenz Hz	Hörpegel dB	Kupp.-Korr. dB	Mid-Korr. dB	rechts ±3 dB	Stollpegel dB	SBR-Korr. dB	rechts +5/-3 dB	Stollpegel dB	links ±3 dB	SBR-Korr. dB	rechts +5/-3 dB	Stollpegel dB	links ±3 dB
125	70,0	26,0	0,1		96,1		4,0	100,1					
250	70,0	14,0	0,0		84,0		4,0	88,0					
500	70,0	5,5	0,0		75,5		4,0	79,5					
750	70,0	2,0	0,0		72,0		5,0	77,0					
1000	70,0	0,0	0,0		70,0		6,0	76,0					
1500	70,0	2,0	0,1		72,1		6,0	78,1					
2000	70,0	2,0	0,4		72,4		6,0	78,4					
3000	70,0	3,0	0,6		74,1		6,0	80,1					
4000	70,0	5,5	1,0		76,5		5,0	81,5					
6000	70,0	2,0	0,9	±5 dB	72,9		5,0	77,9		±5 dB			
8000	70,0	0,0	-1,6		68,4		5,0	73,4					
PK	70,0	4,0	0,0		74,0		-	-		-			
WN	70,0	4,0	0,0		74,0		-	-		-			

Messung der Schalldruckpegel - steiles SBR (Werte wie Sinus). Ja O
Messung der Schalldruckpegel mit Verstärkung. Ja O

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gültig ab: 25.04.2024

Figure364 : Conformity protocol - p. 6

6.5 Produktion **Prüfprotokoll Konformität Ton- und Sprachaudiometer** **AURITEC**

Produkte Allgemein

Sprachaudiometrie:

Messung des **Gesamtklirfaktors** gemäß DIN EN 60645-2 Abschnitt 11.1 und 11.3.
Wird die zulässige Toleranz von 2,5% eingehalten? Ja O

Messung der **Sprachschalldruckpegel/Verdeckungsgeräusch** gemäß DIN EN 60645-2 Abschnitt 9.

Kopfhörer	Hörpegel dB	Korr.-wert SBR dB	Stollpegel SBR dB	max. Abw. SBR ±2 dB rechts	max. Abw. SBR ±2 dB links	Korr.-wert SVR dB	Stollpegel SVR dB	max. Abw. SVR ±2 dB rechts	max. Abw. SVR ±2 dB links
ER3C	70,0	4,0	74,0			4,0	74,0		

Stoll-Bezugspegel = (Summe[St-Pegel(250Hz...4000Hz)] – GC-GF-Mittelwert)/5
Abweichung Ist/Stoll = Ist-Pegel – GC-GF – Stoll-Bezugspegel

Messung des **Frequenzganges** gemäß DIN EN 60645-1 Abschnitt 6.3.2

Frequenz Hz	Pegel rechts dB	Pegel links dB	Mid-Korr. dB	GC-GF Mid-Wert	GC-GF dB	Ist/Stoll- Bezug rechts	Toleranz dB	Ist/Stoll- Bezug links
125			0,0			6,5	+4 bis -11	
250			0,0			6,5		
500			0,0		3,5			
1000			0,0	30,5	0,5			14
2000			0,0		7,5			
4000			0,1		13,5			
8000			0,2		4,0		+4 bis -6	
Stoll-Bezug	-	-	-	-	-	-	-	-

Messung des **Frequenzganges** gemäß DIN EN 60645-1 Abschnitt 6.1.6.
Werden die Toleranzwerte eingehalten? Ja O

Messung des **Signal-Rausch-Abstandes** gemäß DIN EN 60645-2 Abschnitt 12.
Sind die Rauschkurven gemäß DIN EN 60645-2 Abschnitt 13.1 in Ordnung? Ja O

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Figure365 : Conformity protocol - p. 7

6.5 Produktion **Prüfprotokoll Konformität Ton- und Sprachaudiometer** **AURITEC**

Produkte Allgemein

Wandler B81

Seriennummer: _____

Kalibriert von: _____

Tonaudiometrie:

Kontrolle, ob die Pegelsteller das Signal über den gesamten Dynamikbereich gemäß DIN EN 60645-1 Abschnitt 8.4.4 abschwächen.
Die maximal zulässige Abweichung über den gesamten Bereich beträgt 1 dB.
Wird die zulässige Abweichung bei 125 Hz und 1000 Hz eingehalten? Ja O

Messung des **Gesamtklirfaktors** gemäß DIN EN 60645-1 Abschnitt 6.1.3.
Die zulässigen Toleranzen betragen: Luftleitung 2,5%; Knochenleitung 5,5%.
Werden die zulässigen Toleranzen eingehalten? Ja O

Messung der **Frequenzgenauigkeit** der reinen Töne gemäß DIN EN 60645-1 Abschnitt 6.2.1.
Die zulässige Toleranz beträgt ±1%.
Werden die zulässigen Toleranzen eingehalten? Ja O

Messung der **Kraftpegels KL-Ton** gemäß DIN EN 60645-1 Abschnitt 8.3

Frequenz Hz	Hörpegel dB	Äqu.Best. Schw. dB	Kupp.-Korr. dB	rechts ±3 dB	Stollpegel dB	links ±3 dB
250	30,0	67,0	-18,2		76,8	
500	40,0	58,0	-18,1		79,9	
750	50,0	48,5	-18,0		80,5	
1000	60,0	42,5	-17,7		74,8	
1500	60,0	36,5	-17,2		66,3	
2000	60,0	31,0	-16,6		64,4	
3000	60,0	30,0	-16,4		63,6	
4000	60,0	35,5	-19,5		67,0	
6000	60,0	40,0	-25,9	±5 dB	64,1	±5 dB
8000	60,0	40,0	-26,4		63,6	

Messung der Schalldruckpegel - steiles SBR (Werte wie Sinus). Ja O

Sprachaudiometrie:

Messung des **Gesamtklirfaktors** gemäß DIN EN 60645-2 Abschnitt 11.1 und 11.3.
Wird die zulässige Toleranz von 2,5% eingehalten? Ja O

Messung der **Sprachschalldruckpegel/Verdeckungsgeräusch** gemäß DIN EN 60645-2 Abschnitt 9.

Kopfhörer	Hörpegel dB	Korr.-wert SBR dB	Stollpegel SBR dB	max. Abw. SBR ±2 dB rechts	max. Abw. SBR ±2 dB links	Korr.-wert SVR dB	Stollpegel SVR dB	max. Abw. SVR ±2 dB rechts	max. Abw. SVR ±2 dB links
B81	70,0	17,7	87,7			-	-	-	-

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Figure366 : Conformity protocol - p. 8

6.6 Produktion

Prüfprotokoll Konformität
Ton- und Sprachdiometer

Freifeld

Messung der Schalldruckpegel unter Freifeldbedingungen gemäß DIN EN ISO 388-7 Tabelle 1.

Frequenz Hz	Nominal dB	Kopp-Korr. dB	Ref-Korr. dB	Seitengeh. dB
125	70,0	22,1	-0,2	91,9
250	70,0	11,4	-0,1	81,3
500	70,0	4,4	0,0	74,4
750	70,0	2,4	-0,1	72,3
1000	70,0	2,4	-0,1	72,3
1500	70,0	2,4	-0,1	72,3
2000	70,0	-1,3	-0,1	68,6
3000	70,0	-5,8	-0,2	64,0
4000	70,0	-5,4	-0,2	64,4
6000	70,0	4,3	-0,1	74,2
8000	70,0	12,6	-0,1	82,5

Anzahl der Lautsprecher: _____

Wird die zulässige Toleranz von ±3 dB eingehalten?

Ja O

Sonstiges

Tonschalter bei 8kHz gemäß DIN EN 60645-1 Abschnitt 7.6 überprüft?

Ja O

Sicherheitstechnische Überprüfung nach DIN EN 60601-1 durchgeführt (gesondertes Protokoll)?

Ja O

Datum

Unterschrift

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Figure367 : Conformity protocol - p. 9

24.3.3.3 MTK protocol - annual maintenance (example)

6.7 Service

Prüfprotokoll MTK/STK
gemäß MPBetreibV vom 31.12.2018, §11 und §14

Geräteinformation

Hersteller: AURITEC Medizintechnische Systeme GmbH

Modell: Tonsdiometer nach DIN EN 60645-1

Gerätekategorie: Sprachdiometer nach DIN EN 60645-2

Seriennummer: _____

ID-Nummer: _____

Baujahr: _____

Besteller: _____

PLZ/Ort: _____

Standort des Gerätes: _____

LL-Hörer Typ: DD45 Serien-Nr.: _____

LL-Hörer Typ: DD450 Serien-Nr.: _____

LL-Hörer Typ: DR3C Serien-Nr.: _____

KL-Hörer Typ: BR1 Serien-Nr.: _____

KL-Hörer Typ: _____ Serien-Nr.: _____

Vari-Hörer Typ: _____ Serien-Nr.: _____

Sonstiges Zubehör: _____

Letzte MTK: _____

PC Betriebssystem: _____

R-Adresse Datenbank: _____

Automatiser SW-Version: _____

MOLM SW-Version: _____

Avantgarder SW-Version: _____

Innoforce SW-Version: _____

Sicherprüfung

Seigel unversehrt?

Nein O

Ja O

Medizinproduktebuch und Gebrauchsanweisung vorhanden?

Nein O

Ja O

Gehäuse, Wandler und Zubehörfteile mechanisch ok?

Nein O

Ja O

Bedienelemente leichtgängig und mechanisch ok?

Nein O

Ja O

Kennzeichnungen und Aufschriften vorhanden und lesbar?

Nein O

Ja O

Zubehör und Verbrauchsmaterial wie Ohr-Kopfhörer und Ohrstöpsel hygienisch sauber und frei von Rissen?

Nein O

Ja O

Kopfbugel technisch ok?

Nein O

Ja O

Sondenschläuche haben die richtige Länge von 35 cm?

n/a O

Nein O

Ja O

Stecker und Leitungen sind frei von Mängeln (keine Beschädigungen am Mantel, keine Querschnitte)?

Nein O

Ja O

Ist das ME-System über eine Zuleitung (max. 3 m) an der Hausversorgung angeschlossen?

Nein O

Ja O

Ertüpfeln von außen zugehörige Sicherungen dem richtigen Wert (Aufdruck Gehäuse)?

Nein O

Ja O

Sind die LEDs zur Anzeige eines Betriebszustandes in Ordnung (z.B. "Err", "Sonde")?

Nein O

Ja O

Beim Öffnen des Gehäuses:

Complettable und Schraubverbindungen der Erdleitungen in Ordnung?

Nein O

Ja O

Interne Netzleitungen vom und zum Netzteil frei von Beschädigungen?

Nein O

Ja O

HF-Kabel ohne Beschädigungen und nicht gequetscht?

n/a O

Nein O

Ja O

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Figure368 : MTK protocol - p.1

6.7 Service

Prüfprotokoll MTK/STK
gemäß MPBetreibV vom 31.12.2018, §11 und §14

Objektive Prüfung durchgeführt mit: MPS

Verwendete Prüfmittel	Hersteller	Seriennummer	Typ	nächster Prüftermin
1/2" Freifeldmikrofon	Hansonic AS	579806	1229,0	März 2027
1/2" Kondensatormikrofon	G.R.A.S.	563653	40AG	März 2027
Akustischer Kalibrator	Hansonic AS	129627021	1296,0	März 2027
Akustischer Kuppler	G.R.A.S.	55192	RA0405	März 2027
Akustischer Kuppler	G.R.A.S.	608104	RA0039	März 2027
Mechanischer Kuppler	BrüelKjaer	556 002	4830,0	September 2025
Schallpegelmessgerät	Hansonic AS	140 8019	140,0	März 2027
Sicherheitsstempel	S.P.L. Elektronik	801GMA200	GM-200	November 2027

Umgebungsbedingungen

Kontrolle, ob die Festlegung der Umgebungsbedingungen gemäß DIN EN 60645-1 Abschnitt 5.3 eingehalten wurde

	Temperatur	Luftfeuchte	Luftdruck
Soll	15 °C - 35 °C	30 % - 90 %	98 kPa - 104 kPa
Gemessen			

Andruckkräfte

Messung der Andruckkraft des Luftleitungswandlers gemäß DIN EN ISO 389-1

Kopf-hörer	min. N	Soll N	max. N	Ist N
DD45	4,0	4,5	5,9	
DD450	9,5	10,0	10,5	

Messung der Andruckkraft des Knochenhörsers gemäß DIN EN ISO 389-3

Knochen-hörer	min. N	Soll N	max. N	Ist N
BR1	4,9	5,4	5,9	

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Figure369 : MTK protocol - p.2

6.7 Service **Prüfprotokoll MTK/STK**
Produkt Allgemein gemäß MPBetriebV vom 31.12.2018, §11 und §14 **AURITEC**

Tonaudiometrie

Kontrolle, ob die Pegelsteller das Signal über den gesamten **Dynamikbereich** gemäß DIN EN 60645-1 Abschnitt 8.4.4 abschneiden.
Die maximal zulässige Abweichung über den gesamten Bereich beträgt 1 dB.
Wird die zulässige Abweichung bei 125 Hz und 1000 Hz eingehalten? ☐ Nein ☐ Ja O

Messung des **Gesamtklinkfaktors** gemäß DIN EN 60645-1 Abschnitt 6.1.3.
Die zulässigen Toleranzen betragen: Luftleitung 2,5%, Knochenleitung 5,5%.
Werden die zulässigen Toleranzen eingehalten? ☐ Nein ☐ Ja O

Messung der **Frequenzgenauigkeit** der reinen Töne gemäß DIN EN 60645-1 Abschnitt 6.2.1.
Die zulässige Toleranz beträgt ±1%.
Werden die zulässigen Toleranzen eingehalten? ☐ Nein ☐ Ja O

Messung der **Schalldruckpegel** gemäß DIN EN 60645-1 Abschnitt 8.3 und 8.5.3. **DD45** **Kuppler nach DIN EN 60318-1 (12")**

Frequenz Hz	Hörpegel dB	Kupp.-Korr. dB	Micro-Korr. dB	rechts 13 dB	Sollpegel dB	links 23 dB	SRB-Korr. dB	rechts +5/-3 dB	Sollpegel dB	links +5/-3 dB
125	70,0	45,0	0,0		115,0	4,0		115,0		
250	70,0	27,0	0,0		97,0	4,0		101,0		
500	70,0	13,5	0,0		83,5	4,0		87,5		
750	70,0	9,0	0,0		79,0	5,0		84,0		
1000	70,0	7,5	0,0		77,5	6,0		83,5		
1500	70,0	7,5	0,0		77,5	6,0		83,5		
2000	70,0	9,0	0,0		79,0	6,0		85,0		
3000	70,0	11,5	0,1		81,5	6,0		87,6		
4000	70,0	12,0	0,1		82,0	5,0		87,1		
				±5 dB		±5 dB		+5/-3 dB		+5/-3 dB
6000	70,0	16,0	0,2		86,2	5,0		91,2		
8000	70,0	15,5	0,4		85,9	5,0		90,9		
TWR	70,0	8,0	0,0		78,0	-	-	-	-	-

Messung der **Schalldruckpegel** gemäß DIN EN 60645-1 Abschnitt 8.3 und 8.5.3. **DD480** **Kuppler nach DIN EN 60318-1 (12")**

Frequenz Hz	Hörpegel dB	Kupp.-Korr. dB	Micro-Korr. dB	rechts 13 dB	Sollpegel dB	links 23 dB	SRB-Korr. dB	rechts +5/-3 dB	Sollpegel dB	links +5/-3 dB
125	70,0	30,5	0,0		100,5	4,0		104,5		
250	70,0	18,0	0,0		88,0	4,0		92,0		
500	70,0	11,0	0,0		81,0	4,0		85,0		
750	70,0	6,0	0,0		76,0	5,0		81,0		
1000	70,0	5,5	0,0		75,5	6,0		81,5		
1500	70,0	5,5	0,0		75,5	6,0		81,5		
2000	70,0	4,5	0,0		74,5	6,0		80,5		
3000	70,0	2,5	0,1		72,6	6,0		78,6		
4000	70,0	9,5	0,1		79,6	5,0		84,6		
				±5 dB		±5 dB		+5/-3 dB		+5/-3 dB
6000	70,0	17,0	0,2		87,2	5,0		92,2		
8000	70,0	17,5	0,4		87,9	5,0		92,9		
10000	70,0	22,0	0,5		92,5	5,0		97,5		
11200	70,0	23,0	0,4		93,4	5,0		98,4		
12500	70,0	27,5	0,4		97,9	5,0		102,9		
14000	70,0	35,0	0,4		105,4	5,0		110,4		
16000	70,0	56,0	0,2		126,2	5,0		131,2		
TWR	70,0	4,0	0,0		74,0	-	-	-	-	-

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Figure370 : MTK protocol - p.3

6.7 Service **Prüfprotokoll MTK/STK**
Produkt Allgemein gemäß MPBetriebV vom 31.12.2018, §11 und §14 **AURITEC**

Messung der **Schalldruckpegel** gemäß DIN EN 60645-1 Abschnitt 8.3 und 8.5.3. **ER3C** **Kuppler nach DIN EN 60318-3 (1")**

Frequenz Hz	Hörpegel dB	Kupp.-Korr. dB	Micro-Korr. dB	rechts 13 dB	Sollpegel dB	links 23 dB	SRB-Korr. dB	rechts +5/-3 dB	Sollpegel dB	links +5/-3 dB
125	70,0	26,0	0,1		96,1	4,0		100,1		
250	70,0	14,0	0,0		84,0	4,0		88,0		
500	70,0	5,5	0,0		75,5	4,0		79,5		
750	70,0	2,0	0,0		72,0	5,0		77,0		
1000	70,0	0,0	0,0		70,0	6,0		76,0		
1500	70,0	2,0	0,1		72,1	6,0		78,1		
2000	70,0	3,0	0,4		73,4	6,0		79,4		
3000	70,0	3,5	0,6		74,1	6,0		80,1		
4000	70,0	5,5	1,0		76,5	5,0		81,5		
				±5 dB		±5 dB		+5/-3 dB		+5/-3 dB
6000	70,0	2,0	0,9		72,9	5,0		77,9		
8000	70,0	0,0	-1,6		68,4	5,0		73,4		
TWR	70,0	4,0	0,0		74,0	-	-	-	-	-

Messung des **Kraftpegels** KL-Ton gemäß DIN EN 60645-1 Abschnitt 8.3. **B81**

Frequenz Hz	Hörpegel dB	Kupp.-Korr. dB	Micro-Korr. dB	rechts 13 dB	Sollpegel dB	links 23 dB
250	90,0	17,2	-18,2		79,0	
500	90,0	58,0	-18,1		79,9	
750	90,0	48,5	-18,0		80,5	
1000	90,0	42,5	-17,7		74,8	
1500	90,0	36,5	-17,2		69,3	
2000	90,0	31,0	-16,6		64,4	
3000	90,0	30,0	-16,4		63,6	
4000	90,0	35,5	-18,5		67,0	
				±5 dB		±5 dB
6000	90,0	40,0	-25,9		64,1	
8000	90,0	40,0	-26,4		63,6	

Messung der **Schalldruckpegel** unter **Freifeldbedingungen** gemäß DIN EN ISO 389-7 Tabelle 1.

Frequenz Hz	Hörpegel dB	Kupp.-Korr. dB	Micro-Korr. dB	Sollpegel dB
125	70,0	22,1	-0,2	91,9
250	70,0	11,4	-0,1	81,3
500	70,0	4,4	0,0	74,4
750	70,0	2,4	-0,1	72,3
1000	70,0	2,4	-0,1	72,3
1500	70,0	2,4	-0,1	72,3
2000	70,0	-1,3	-0,1	68,6
3000	70,0	-0,9	-0,2	68,9
4000	70,0	-0,4	-0,2	69,4
6000	70,0	4,3	-0,1	74,2
8000	70,0	12,6	-0,1	82,5
10000	70,0	13,9	-0,1	83,8

Anzahl der Lautsprecher: _____

Wird die zulässige Toleranz von ±3 dB eingehalten? ☐ Ja ☐ O

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Figure371 : MTK protocol - p.4

6.7 Service **Prüfprotokoll MTK/STK**
Produkt Allgemein gemäß MPBetriebV vom 31.12.2018, §11 und §14 **AURITEC**

Sprachaudiometrie

Messung des **Gesamtklinkfaktors** gemäß DIN EN 60645-2 Abschnitt 11.1 und 11.3.
Wird die zulässige Toleranz von 2,5% eingehalten? ☐ Ja ☐ O

Messung der **Sprachschalldruckpegel/Verdeckungsgeräusch** gemäß DIN EN 60645-2 Abschnitt 9.

Kopförer	Hörpegel dB	Korr.-wert SDR dB	Sollpegel dB	max. Abw. SDR 12 dB rechts	max. Abw. SDR 12 dB links	Korr.-wert SDR dB	Sollpegel dB	max. Abw. SDR 12 dB rechts	max. Abw. SDR 12 dB links
DD45	70,0	8,0	78,0			8,5	78,0		
DD450	70,0	4,0	74,0			4,0	74,0		
ER3C	70,0	4,0	74,0			4,0	74,0		
B81	70,0	17,7	87,7			-	-	-	-

Soll-Bezugspegel = (Summe (td Pegel [250 Hz] - GC-GF-Mittelwert) / 5)
Abweichung td Soll = td Pegel - GC-GF - Soll-Bezugspegel

Messung des **Frequenzganges** gemäß DIN EN 60645-1 Abschnitt 6.3.2. **DD45**

Frequenz Hz	Pegel rechts dB	Pegel links dB	Micro-Korr. dB	GC-GF Mit. Wert	GC-GF dB	td Soll-Bezug rechts	Toleranz dB	td Soll-Bezug links
125			0,0		19,5		+4 bis -11	
250			0,0		12,0			
500			0,0		5,0			
1000			0,0	44,0	4,5		±4	
2000			0,0		8,0			
4000			0,1		11,5			
6300			0,2		12,0		+4 bis -6	
Soll-Bezug	-	-	-	-	-	-	-	-

Messung des **Frequenzganges** gemäß DIN EN 60645-1 Abschnitt 6.3.2. **DD450**

Frequenz Hz	Pegel rechts dB	Pegel links dB	Micro-Korr. dB	GC-GF Mit. Wert	GC-GF dB	td Soll-Bezug rechts	Toleranz dB	td Soll-Bezug links
125			0,0		5,0		+4 bis -11	
250			0,0		4,5			
500			0,0		2,5			
1000			0,0	28,5	3,5		±4	
2000			0,0		5,0			
4000			0,1		13,0			
6300			0,2		13,0		+4 bis -6	
Soll-Bezug	-	-	-	-	-	-	-	-

Messung des **Frequenzganges** gemäß DIN EN 60645-1 Abschnitt 6.3.2. **ER3C**

Frequenz Hz	Pegel rechts dB	Pegel links dB	Micro-Korr. dB	GC-GF Mit. Wert	GC-GF dB	td Soll-Bezug rechts	Toleranz dB	td Soll-Bezug links
125			0,0		6,5		+4 bis -11	
250			0,0		6,5			
500			0,0		3,0			
1000			0,0	30,5	6,0		±4	
2000			0,0		7,5			
4000			0,1		13,5			
6300			0,2		-4,0		+4 bis -6	
Soll-Bezug	-	-	-	-	-	-	-	-

Erstellt von: Lisa Hagenstock
L:\Produkt-Dokumente\Makro\Makro-Prüfprotokolle_V2.0
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Figure372 : MTK protocol - p.5

6.7 Service **Prüfprotokoll MTK/STK**
Produkt Allgemein gemäß MPBetriebV vom 31.12.2018, §11 und §14 **AURITEC**

Messung des **Frequenzganges** gemäß DIN EN 60645-1 Abschnitt 6.1.6.
Werden die Toleranzwerte eingehalten? ☐ Ja ☐ O

Messung der **Schalldruckpegel** unter **Freifeldbedingungen** gemäß DIN EN ISO 389-7 Tabelle 1.
Wird die zulässige Toleranz von ±3 dB eingehalten? ☐ Ja ☐ O

Elektrische Sicherheit

Prüfung der elektrischen Sicherheit gemäß DIN EN 62353 durchgeführt? ☐ Nein ☐ Ja O

Schutztyp: _____ Schutzleiter: $R_{SE} =$ _____ Ω Geräteableitstrom: $I_{GE} =$ _____ mA
Schutzklasse: _____ Isolation: $R_{ISO} =$ _____ $M\Omega$ Patientenableitstrom: $I_{PA} =$ _____ mA

Funktionsprüfung

Ist die Tonqualität in Ordnung? ☐ Nein ☐ Ja O
Keine Störgeräusche und Übersprechen? ☐ Nein ☐ Ja O
Funktioniert das Probandenantwortsystem? ☐ Nein ☐ Ja O
Funktionieren alle Wandler und Signale? ☐ Nein ☐ Ja O

Anmerkungen

Entspricht das Gerät den gültigen Vorschriften und Gesetzen? ☐ Nein ☐ Ja O

Der Betreiber ist darüber informiert worden, dass dieses Produkt Bestandteil des von ihm zu führenden Gerätebuches ist und gemäß Herstellerempfehlung eine wöchentliche subjektive Gerätekontrolle durch den Anwender durchgeführt werden sollte (ergänzt durch ein vollständiges Ausloggen einer normal hörenden Testperson).

nächste MTK/STK: _____

Datum: _____ Unterschrift des zugelassenen Technikers: _____

Datum: _____ Unterschrift des Betreibers/Anwenders: _____

Erstellt von: Lisa Hagenstock
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Figure373 : MTK protocol - p.6

24.4 Care instructions

The **AT-research / AT2000** audiometer system is a precision measuring device and should be treated as such. Remember to untangle the cables, check the connections regularly and use the device carefully in rooms intended for this purpose.

Do not use damp or wet cloths, glass cleaners, spirit or similar moist cleaning agents to clean the device. You should wipe your device from time to time with a dry, antistatic cloth or soft dust cloth; the keyboard can be cleaned dry with a brush. However, do not remove the keys for cleaning under any circumstances.

The ear pads of the headphones should be replaced from time to time or after heavy soiling.

Clean the contact surface of the bone conduction headphones with a dry or slightly damp cloth.

For a detailed description, see the Technical Note in the customer folder 'TN2024-08-21_Cleaning_Disinfection'.

If your **AT-research / AT2000** is not going to be used for some time and you need to store it, choose a dry storage location with a temperature between +5° and +40° Celsius. The humidity should be between 10% and 90%.

24.5 Repair management

24.5.1 Repair recording

Telephone recording of customer details, device type, device number, software version and customer data.

24.5.2 Telephone error analysis

- ✓ Record a description of the fault that is as precise and accurate as possible. Attempt to provide telephone support or clarify whether the faults can be rectified by telephone or whether an on-site service is necessary.
- ✓ Clarify whether a replacement of the component is necessary and can be provided.

24.5.3 Service on site

- ✓ For on-site service, note the customer's address and telephone number.
- ✓ Notify the service technician and arrange a repair appointment. Clarification of which replacement component parts may be necessary for a repair.

24.5.3.1 Notes

- ✓ Devices without sufficient fault description require longer repair times.
- ✓ The device is checked for third-party software, hardware and measurement components.
- ✓ The warranty expires accordingly for third-party software, hardware and measurement components.
- ✓ No guarantee can be given for the database application either.
- ✓ The customer is responsible for backing up patient and measurement data.

24.5.3.2 Waiting time

- ✓ The target waiting time from defect recording to on-site service is 5 working days.
- ✓ AURITEC will endeavour to keep waiting and repair times as short as possible.

24.6 Manufacturer's declaration Electromagnetic emissions and immunity

The audiometer **AT-research / AT2000** is part of a medical electrical system and is therefore subject to special safety regulations. For this reason, all installation and operating instructions listed in this document must be strictly observed.

Portable and mobile high-frequency communication devices such as mobile phones can impair the function of the **AT-research / AT2000**.

24.6.1 Guidelines manufacturer's declaration - Electromagnetic emissions

The AT-research / AT2000 tonal audiometer is intended for use in the electromagnetic environment specified below. The user of the AT-research / AT2000 must ensure that the AT-research / AT2000 is used in such an environment.

Table39 : Electromagnetic emission of the entire components and system

Interference emission measurements	Compliance	Electromagnetic environment - Guideline
HF emissions according to CISPR 11	Group 1	The AT-research / AT2000 uses RF energy exclusively for its internal function. Therefore, its RF emission is very low and it is unlikely to interfere with neighbouring electronic devices.
HF emissions according to CISPR 11	Class B	The AT-research / AT2000 is suitable for use in all establishments, including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions according to EN 61000-3-2	Class A	
Transmission of voltage fluctuations/flicker according to EN 61000-3-3	agrees	

24.6.2 Electromagnetic immunity

The AT-research / AT2000 tonal audiometer is intended for use in the electromagnetic environment specified below. The user of the AT-research / AT2000 must ensure that the AT-research / AT2000 is used in such an environment.

Table40 : Electromagnetic immunity

Interference immunity tests	EN 60601 test level	Match level	Electromagnetic environment - Guideline
Discharge of static electricity (ESD) according to EN 61000-4-2	± 8 kV Contact ± 15 kV air	± 8 kV Contact ± 15 kV air	Floors should be made of wood or concrete or covered with ceramic tiles. If the floor is covered with synthetic material, the relative humidity must be at least 30%.
Fast transient disturbances/bursts according to EN 61000-4-4	± 2 kV for mains cables ± 1 kV for input and output lines	± 2 kV ± 1 kV	The quality of the supply voltage should correspond to that of a typical business or hospital environment.
Surges according to EN 61000-4-5	± 1 kV Voltage outer conductor-outer conductor ± 2 kV Voltage phase-to-earth	± 1 kV not applicable	The quality of the supply voltage should correspond to that of a typical business or hospital environment.
Conducted disturbances induced by high-frequency fields in accordance with EN 61000-4-6	3 V 0.15 MHz to 80 MHz 6 V in ISM and amateur radio frequency bands between 0.15 MHz and 80 MHz 80 % AM at 1 kHz	3 V 0.15 MHz to 80 MHz 6 V in ISM and amateur radio frequency bands between 0.15 MHz and 80 MHz 80 % AM at 1 kHz	The quality of the supply voltage should correspond to that of a typical business or hospital environment.
Voltage dips, short-term	0 % U_T ; ½ period	0 % U_T ; ½ period	The quality of the supply voltage

Interference immunity tests	EN 60601 test level	Match level	Electromagnetic environment - Guideline
interruptions and fluctuations in the supply voltage in accordance with EN 61000-4-11	at 0, 45, 90, 135, 180, 225, 270 and 315 degrees 0 % U_T ; 1 period and 70 % U_T ; 25/30 periods Single-phase: at 0 degrees	at 0, 45, 90, 135, 180, 225, 270 and 315 degrees 0 % U_T ; 1 period and 70 % U_T ; 25/30 periods Single-phase: at 0 degrees	should correspond to that of a typical business or hospital environment. If the user of the AT-research / AT2000 requires continued operation even in the event of interruptions to the power supply, it is recommended that the AT-research / AT2000 is powered from an uninterruptible power supply or a battery.
Magnetic field at the supply frequency (50/60 Hz) according to EN 61000-4-8	30 A/m	30 A/m	Magnetic fields at the mains frequency should correspond to the typical values found in business and hospital environments.
Note 1: U_T is the AC mains voltage before the test levels are applied.			
Radiated RF disturbance variables according to EN 61000-4-3	3 V/m 80 MHz to 2.7 GHz		Portable and mobile radio devices should not be used at a distance from the AT-research / AT2000 including the cables that is less than the recommended safety distance, which is calculated according to the equation applicable to the transmission frequency. Recommended safety distance: $d = 1.17\sqrt{P}$ $d = 1.17\sqrt{P}$ for 80 MHz to 800 MHz $d = 2.33\sqrt{P}$ for 800 MHz to 2.5 GHz with P as the rated power of the transmitter in watts (W) according to the transmitter manufacturer's specifications and d as the recommended safety distance in metres (m). The field strength of stationary radio transmitters should be lower than the compliance level at all frequencies according to an on-site investigation^(a). Interference may occur in the vicinity of devices bearing the following symbol. 
Note 2: At 80 MHz and 800 MHz, the higher frequency range applies. Note 3: These guidelines may not apply in all cases. Electromagnetic propagation is affected by absorption and reflection from buildings, objects and people.			
^a Field strengths from fixed transmitters, such as base stations for radio (cellular) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the AT-research / AT2000 is used exceeds the applicable RF compliance level above, the AT-research / AT2000 should be observed to verify normal operation. If			

Interference immunity tests	EN 60601 test level	Match level	Electromagnetic environment - Guideline
unusual performance characteristics are observed, additional measures may be necessary, such as changing the orientation or location of the AT-research / AT2000 ^b The field strength should be less than 3 V/m over the frequency range from 150 kHz to 80 MHz.			

24.6.3 Test specifications for immunity of enclosures to high-frequency wireless communications

The AT-research / AT2000 is intended for use in an electromagnetic environment in which RF disturbances are controlled. The user of the AT-research / AT2000 can thus help to avoid electromagnetic interference.

Table41 : Interference immunity of enclosures to communication equipment

Frequency band ^a MHz	Radio service ^a	Modulation ^b	Immunity test level V/m
380 to 390	TETRA 400	Pulse modulation ^b 18 Hz	27
430 to 470	GMRS 460, FRS460	FM ^c ± 5 kHz stroke 1 kHz sine wave	28
704 to 787	LTE Band 13, 17	Pulse modulation ^b 217 Hz	9
800 to 960	GSM 800/900, TETRA 800, iDEN 820, CDMA 850, LTE Band 5	Pulse modulation ^b 18 Hz	28
1700 to 1990	GSM 1800; CDMA 1900; GSM 1900; DECT; LTE Band 1, 3, 4, 25; UMTS	Pulse modulation ^b 217 Hz	28
2400 to 2570	Bluetooth, WLAN 802.11 b/g/n, RFID 2450, LTE Band 7	Pulse modulation ^b 217 Hz	28
5100 to 5800	WLAN 802.11 a/n	Pulse modulation ^b 217 Hz	9
^a For some radio services, only the frequencies for the radio link from the mobile communication device to the base station (en: uplink) have been included in the table. ^b The carrier must be modulated with a square wave signal with a 50 % duty cycle. ^c As an alternative to frequency modulation (FM), pulse modulation with a 50 % duty cycle at 18 Hz can be used, as this would represent the worst case, if not the actual modulation.			

24.7 Reporting of serious incidents

Any serious incident that has occurred in relation to this device must be reported to the manufacturer and the competent authority of the Member State in which the user is established.

Competent authority in Germany:

Federal Institute for Drugs and Medical Devices - BfArM

https://www.bfarm.de/DE/Medizinprodukte/Antraege-und-Meldungen/Vorkommnis-melden/_node.html

24.8 Tutorials

Tutorials for the modules of this audiometer software can be found on the homepage.

www.auritec.de/en/audiometer/tutorials

24.9 Standards

The following standards apply:

- ✓ DIN EN 60645-1:2018-08: Acoustics - Audiometers - Part 1: Pure-tone audiometers
- ✓ DIN EN 60601-1:2022-11: Medical electrical equipment - Part 1: General requirements for basic safety and essential performance
- ✓ DIN EN ISO 8253-1:2011-04: Acoustics - Audiometric test methods - Part 1: Basic methods of air and bone conduction threshold audiometry with pure tones
- ✓ DIN EN ISO 8253-2:2010-07: Acoustics - Audiometric test methods - Part 2: Sound field audiometry with pure tones and narrowband test signals
- ✓ DIN EN ISO 8253-3:2022-11: Acoustics - Audiometric test methods - Part 3: Speech audiometry

The device complies with REGULATION (EU) 2017/745 for medical devices.

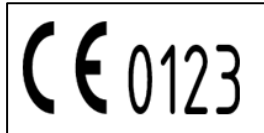


Figure377 : CE mark

24.10 Scope of delivery



The use of components, transducers and cables other than those specified or provided by the manufacturer of this device may result in increased electromagnetic emissions or decreased electromagnetic immunity of the device and result in improper operation.

Table42 : Scope of delivery

Illustration	Item number	Description of the
 Figure378 : Audiometer module	10710001 10710000	Audiometer module AT2000+ Audiometer module AT-research+ Cable
 Figure379 : Control unit	30601016 30601008	AT2000 control unit AT-research control unit
 Figure380 : RS232 interface cable	20202222	RS232 interface cable (module/BE)
 Figure381 : USB cable DIN plug	20202235	USB cable (BE/PC)

Illustration	Item number	Description of the
 Figure382 : USB cable	50902074	USB cable (module/PC)
 Figure383 : Audiometer PC system	78001027	Audiometer PC system + cable
 Figure384 : User monitor	78005013	User monitor (min. 21") + cable
 Figure385 : DD45 headphones	20110015	Headphones DD45, < 3m (patient application part)

Illustration	Item number	Description of the
 Figure386 : DD450 headphones	20112003	DD450 headphones, < 3m (patient application part)
 Figure387 : ER 3C plug-in headphones	20105024	ER 3C plug-in headphones, < 3m (patient application part)
 Figure388 : B81 bone conduction handset	20120023	B81 bone conduction handset, < 3m (patient application part)
 Figure389 : Bone conduction handset KLH96	20121021	Bone conduction handset KLH96, < 3m (patient application part)

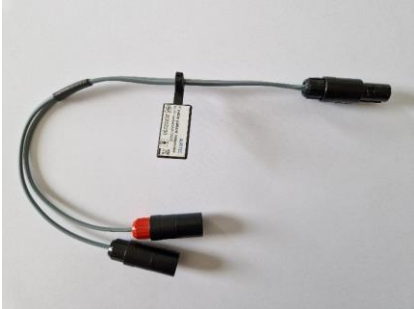
Illustration	Item number	Description of the
 Figure390 : Patient button on the left	20301022	Patient button left (standard), < 3m (patient application part)
 Figure391 : Patient button on the right	20301023	Patient button right, < 3m (patient application part)
 Figure392 : Big Buddy Button	20301025	Big Buddy Button, <3m (patient application part)
 Figure393 : Y-cable	20202230	Y-cable patient button right / Big Buddy

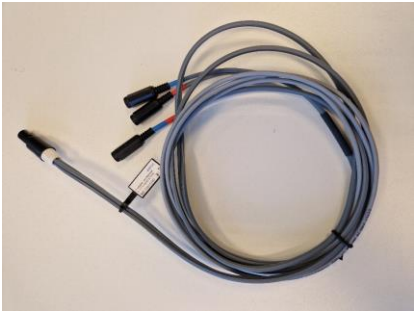
Illustration	Item number	Description of the
 Figure394 : Implant cable	20202240	Implant cable
 Figure395 : Connection cable (left) for 90dB	20202232	Connection cable FFL 90dB without slide
 Figure396 : Connection cable (right) for 90dB	20202233	Connection cable FFR 90dB without slide
 Figure397 : User microphone	20401017	User microphone, < 3m
 Figure398 : Monitor, extension cable	20401027 20201002	Monitor, < 3m Monitor extension

Illustration	Item number	Description of the
 Figure399 : Mouse, mouse pad	78007039 78007014	Mouse Mouse pad
 Figure400 : USB extension	50902055	USB extension 2m
 Figure401 : AT-surround	10710002	AT-surround+ cable
 Figure402 : Fibre optic cable	50902079	Fibre optic cable TOSLink cable 0.5m
 Figure403 : Connection cable (AT-surround) for 90dB	20202229 20202228	Connection cable AT-surround 90dB without slide Connection cable AT-surround 90dB with slide

Illustration	Item number	Description of the
 Figure404 : 90dB loudspeaker	12010006 12010007 12010008 12010009 12010010 12010011 12010012 12010013 12010014 12010018 12010015 12010016 12010003 12010004 12010005	90 dB Loudspeaker (TF) 90 dB loudspeaker (TF/DIA) 90 dB loudspeaker (TF/LED) 90 dB loudspeaker (TFH) 90 dB loudspeaker (TFH/DIA) 90 dB loudspeaker (TFH/LED) 90 dB Loudspeaker (WH) 90 dB loudspeaker (WH/DIA) 90 dB loudspeaker (WH/LED) 90 dB Loudspeaker (TFL) 90 dB Loudspeaker (TFL/DIA) 90 dB Loudspeaker (TFL/LED) 90 dB Loudspeaker (SH) 90 dB loudspeaker (SH/DIA) 90 dB loudspeaker (SH/LED)
 Figure405 : Connection cable (AT-surround) for 100dB	20202237 20202231	Connection cable AT-surround 100dB without slide Connection cable AT-surround 100dB with slide
 Figure406 : 100dB loudspeaker	12020002 12020003 12020004	100 dB loudspeaker (TF) + cable 100 dB loudspeaker (TF/DIA) + cable 100 dB loudspeaker (TF/LED) + cable

Illustration	Item number	Description of the
 Figure407 : TFT monitor 17"	78005004	TFT monitor 17" VGA 1280x1024 + cable
 Figure408 : Touch screen 15"	78005003	Touch screen 15" + cable
 Figure409 : Touch screen 17"	78005005	Touch screen 17" + cable
 Figure410 : REOMED 1000	41600042	REOMED 1000 + cable
 Figure411 : Terminal box	32501011	Terminal box

Illustration	Item number	Description of the
 Figure412 : AC connection cable	20202252	Connection cable AC connection box 3m
 Figure413 : BC connection cable	20202253	Connection cable BC connection box 3m
 Figure414 : PR connection cable	20202254	Connection cable PR connection box 3m
 Figure415 : Ear pads DD45	20110004	Ear pads DD45
 Figure416 : Ear pads DD450	20111004	Ear pads DD450