

Operating Manual



Software for Hearing Aids Tests

R&S[®] UPV-K7

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Before putting the product into operation for the first time, make sure to read the following



Safety Instructions

All plants and locations of the Rohde & Schwarz group of companies make every effort to keep the safety standard of our products up to date and to offer our customers the highest possible degree of safety. Our products and the auxiliary equipment required for them are designed and tested in accordance with the relevant safety standards. Compliance with these standards is continuously monitored by our quality assurance system. The product described here has been designed and tested in accordance with the EC Certificate of Conformity and has left the manufacturer's plant in a condition fully complying with safety standards. To maintain this condition and to ensure safe operation, observe all instructions and warnings provided in this manual. If you have any questions regarding these safety instructions, the Rohde & Schwarz group of companies will be happy to answer them.

Furthermore, it is your responsibility to use the product in an appropriate manner. This product is designed for use solely in industrial and laboratory environments or in the field and must not be used in any way that may cause personal injury or property damage. You are responsible if the product is used for an intention other than its designated purpose or in disregard of the manufacturer's instructions. The manufacturer shall assume no responsibility for such use of the product.

The product is used for its designated purpose if it is used in accordance with its product documentation and within its performance limits (see data sheet, documentation, the following safety instructions). Using the product requires technical skills and a basic knowledge of English. It is therefore essential that the product be used exclusively by skilled and specialized staff or thoroughly trained personnel with the required skills. If personal safety gear is required for using Rohde & Schwarz products, this will be indicated at the appropriate place in the product documentation.

Symbols and safety labels

Observe product documentation	Weight indication for units >18 kg	Danger of electric shock	Warning! Hot surface	PE terminal	Ground	Ground terminal	Attention! Electrostatic sensitive devices

Supply voltage ON/OFF	Standby indication	Direct current (DC)	Alternating current (AC)	Direct/alternating current (DC/AC)	Device fully protected by double/reinforced insulation

Safety Instructions

Observing the safety instructions will help prevent personal injury or damage of any kind caused by dangerous situations. Therefore, carefully read through and adhere to the following safety instructions before putting the product into operation. It is also absolutely essential to observe the additional safety instructions on personal safety that appear in relevant parts of the product documentation. In these safety instructions, the word "product" refers to all merchandise sold and distributed by the Rohde & Schwarz group of companies, including instruments, systems and all accessories.

Tags and their meaning

DANGER	This tag indicates a definite hazard carrying a high risk of death or serious injury if not avoided.
WARNING	This tag indicates a possible hazard carrying a medium risk of death or (serious) injury if not avoided.
CAUTION	This tag indicates a hazard carrying a low risk of minor or moderate injury if not avoided.
ATTENTION	This tag indicates the possibility of incorrect use that can cause damage to the product.
NOTE	This tag indicates a situation where the user should pay special attention to operating the product but which does not lead to damage.

These tags are in accordance with the standard definition for civil applications in the European Economic Area. Definitions that deviate from the standard definition may also exist in other economic areas or military applications. It is therefore essential to make sure that the tags described here are always used only in connection with the related product documentation and the related product. The use of tags in connection with unrelated products or documentation can result in misinterpretation and thus contribute to personal injury or material damage.

Basic safety instructions

1. The product may be operated only under the operating conditions and in the positions specified by the manufacturer. Its ventilation must not be obstructed during operation. Unless otherwise specified, the following requirements apply to Rohde & Schwarz products:
prescribed operating position is always with the housing floor facing down, IP protection 2X, pollution severity 2, overvoltage category 2, use only in enclosed spaces, max. operation altitude 2000 m above sea level, max. transport altitude 4500 m above sea level.
Unless specified otherwise in the data sheet, a tolerance of $\pm 10\%$ shall apply to the nominal voltage and of $\pm 5\%$ to the nominal frequency.
2. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed. The product may be opened only by authorized, specially trained personnel. Prior to performing any work on the product or opening the product, the product must be disconnected from the supply network. Any adjustments, replacements of parts, maintenance or repair must be carried out only by technical personnel authorized by Rohde & Schwarz. Only original parts may be used for replacing parts relevant to safety (e.g. power switches, power transformers, fuses). A safety test must always be performed after parts relevant to safety have been replaced (visual inspection, PE conductor test, insulation resistance measurement, leakage current measurement, functional test).
3. As with all industrially manufactured goods, the use of substances that induce an allergic reaction (allergens, e.g. nickel) such as aluminum cannot be generally excluded. If you develop an allergic reaction (such as a skin rash, frequent sneezing, red eyes or respiratory difficulties), consult a physician immediately to determine the cause.

Safety Instructions

4. If products/components are mechanically and/or thermally processed in a manner that goes beyond their intended use, hazardous substances (heavy-metal dust such as lead, beryllium, nickel) may be released. For this reason, the product may only be disassembled, e.g. for disposal purposes, by specially trained personnel. Improper disassembly may be hazardous to your health. National waste disposal regulations must be observed.
5. If handling the product yields hazardous substances or fuels that must be disposed of in a special way, e.g. coolants or engine oils that must be replenished regularly, the safety instructions of the manufacturer of the hazardous substances or fuels and the applicable regional waste disposal regulations must be observed. Also observe the relevant safety instructions in the product documentation.
6. Depending on the function, certain products such as RF radio equipment can produce an elevated level of electromagnetic radiation. Considering that unborn life requires increased protection, pregnant women should be protected by appropriate measures. Persons with pacemakers may also be endangered by electromagnetic radiation. The employer/operator is required to assess workplaces where there is a special risk of exposure to radiation and, if necessary, take measures to avert the danger.
7. Operating the products requires special training and intense concentration. Make certain that persons who use the products are physically, mentally and emotionally fit enough to handle operating the products; otherwise injuries or material damage may occur. It is the responsibility of the employer to select suitable personnel for operating the products.
8. Prior to switching on the product, it must be ensured that the nominal voltage setting on the product matches the nominal voltage of the AC supply network. If a different voltage is to be set, the power fuse of the product may have to be changed accordingly.
9. In the case of products of safety class I with movable power cord and connector, operation is permitted only on sockets with earthing contact and protective earth connection.
10. Intentionally breaking the protective earth connection either in the feed line or in the product itself is not permitted. Doing so can result in the danger of an electric shock from the product. If extension cords or connector strips are implemented, they must be checked on a regular basis to ensure that they are safe to use.
11. If the product has no power switch for disconnection from the AC supply, the plug of the connecting cable is regarded as the disconnecting device. In such cases, it must be ensured that the power plug is easily reachable and accessible at all times (corresponding to the length of connecting cable, approx. 2 m). Functional or electronic switches are not suitable for providing disconnection from the AC supply. If products without power switches are integrated in racks or systems, a disconnecting device must be provided at the system level.
12. Never use the product if the power cable is damaged. Check the power cable on a regular basis to ensure that it is in proper operating condition. By taking appropriate safety measures and carefully laying the power cable, ensure that the cable cannot be damaged and that no one can be hurt by e.g. tripping over the cable or suffering an electric shock.
13. The product may be operated only from TN/TT supply networks fused with max. 16 A (higher fuse only after consulting with the Rohde & Schwarz group of companies).
14. Do not insert the plug into sockets that are dusty or dirty. Insert the plug firmly and all the way into the socket. Otherwise, this can result in sparks, fire and/or injuries.
15. Do not overload any sockets, extension cords or connector strips; doing so can cause fire or electric shocks.
16. For measurements in circuits with voltages $V_{\text{rms}} > 30 \text{ V}$, suitable measures (e.g. appropriate measuring equipment, fusing, current limiting, electrical separation, insulation) should be taken to avoid any hazards.
17. Ensure that the connections with information technology equipment comply with IEC 950/EN 60950.
18. Unless expressly permitted, never remove the cover or any part of the housing while the product is in operation. Doing so will expose circuits and components and can lead to injuries, fire or damage to the product.

Safety Instructions

19. If a product is to be permanently installed, the connection between the PE terminal on site and the product's PE conductor must be made first before any other connection is made. The product may be installed and connected only by a license electrician.
20. For permanently installed equipment without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fused in such a way that suitable protection is provided for users and products.
21. Do not insert any objects into the openings in the housing that are not designed for this purpose. Never pour any liquids onto or into the housing. This can cause short circuits inside the product and/or electric shocks, fire or injuries.
22. Use suitable overvoltage protection to ensure that no overvoltage (such as that caused by a thunderstorm) can reach the product. Otherwise the operating personnel will be endangered by electric shocks.
23. Rohde & Schwarz products are not protected against penetration of water, unless otherwise specified (see also safety instruction 1.). If this is not taken into account, there exists the danger of electric shock for the user or damage to the product, which can also lead to personal injury.
24. Never use the product under conditions in which condensation has formed or can form in or on the product, e.g. if the product was moved from a cold to a warm environment.
25. Do not close any slots or openings on the product, since they are necessary for ventilation and prevent the product from overheating. Do not place the product on soft surfaces such as sofas or rugs or inside a closed housing, unless this is well ventilated.
26. Do not place the product on heat-generating devices such as radiators or fan heaters. The temperature of the environment must not exceed the maximum temperature specified in the data sheet.
27. Batteries and storage batteries must not be exposed to high temperatures or fire. Keep batteries and storage batteries away from children. Do not short-circuit batteries and storage batteries.
If batteries or storage batteries are improperly replaced, this can cause an explosion (warning: lithium cells). Replace the battery or storage battery only with the matching Rohde & Schwarz type (see spare parts list). Batteries and storage batteries must be recycled and kept separate from residual waste. Batteries and storage batteries that contain lead, mercury or cadmium are hazardous waste. Observe the national regulations regarding waste disposal and recycling.
28. Please be aware that in the event of a fire, toxic substances (gases, liquids etc.) that may be hazardous to your health may escape from the product.
29. The product can be very heavy. Be careful when moving it to avoid back or other physical injuries.
30. Do not place the product on surfaces, vehicles, cabinets or tables that for reasons of weight or stability are unsuitable for this purpose. Always follow the manufacturer's installation instructions when installing the product and fastening it to objects or structures (e.g. walls and shelves).
31. Handles on the products are designed exclusively for personnel to hold or carry the product. It is therefore not permissible to use handles for fastening the product to or on means of transport such as cranes, fork lifts, wagons, etc. The user is responsible for securely fastening the products to or on the means of transport and for observing the safety regulations of the manufacturer of the means of transport. Noncompliance can result in personal injury or material damage.
32. If you use the product in a vehicle, it is the sole responsibility of the driver to drive the vehicle safely. Adequately secure the product in the vehicle to prevent injuries or other damage in the event of an accident. Never use the product in a moving vehicle if doing so could distract the driver of the vehicle. The driver is always responsible for the safety of the vehicle. The manufacturer assumes no responsibility for accidents or collisions.
33. If a laser product (e.g. a CD/DVD drive) is integrated in a Rohde & Schwarz product, do not use any other settings or functions than those described in the product documentation. Otherwise this may be hazardous to your health, since the laser beam can cause irreversible damage to your eyes. Never try to take such products apart, and never look into the laser beam.



Por favor lea imprescindiblemente antes de la primera puesta en funcionamiento las siguientes



Informaciones de seguridad

El principio del grupo de empresas Rohde & Schwarz consiste en tener nuestros productos siempre al día con los standards de seguridad y de ofrecer a nuestros clientes el máximo grado de seguridad. Nuestros productos y todos los equipos adicionales son siempre fabricados y examinados según las normas de seguridad vigentes. Nuestra sección de gestión de la seguridad de calidad controla constantemente que sean cumplidas estas normas. El presente producto ha sido fabricado y examinado según el comprobante de conformidad adjunto según las normas de la CE y ha salido de nuestra planta en estado impecable según los standards técnicos de seguridad. Para poder preservar este estado y garantizar un funcionamiento libre de peligros, el usuario deberá atenerse a todas las informaciones, informaciones de seguridad y notas de alerta. El grupo de empresas Rohde & Schwarz está siempre a su disposición en caso de que tengan preguntas referentes a estas informaciones de seguridad.

Además queda en la responsabilidad del usuario utilizar el producto en la forma debida. Este producto solamente fue elaborado para ser utilizado en la industria y el laboratorio o para fines de campo y de ninguna manera deberá ser utilizado de modo que alguna persona/cosa pueda ser dañada. El uso del producto fuera de sus fines definidos o despreciando las informaciones de seguridad del fabricante queda en la responsabilidad del usuario. El fabricante no se hace en ninguna forma responsable de consecuencias a causa del mal uso del producto.

Se parte del uso correcto del producto para los fines definidos si el producto es utilizado dentro de las instrucciones de la correspondiente documentación de producto y dentro del margen de rendimiento definido (ver hoja de datos, documentación, informaciones de seguridad que siguen). El uso del producto hace necesarios conocimientos profundos y conocimientos parciales del idioma inglés. Por eso se deberá tener en cuenta de exclusivamente autorizar para el uso del producto a personas peritas o debidamente minuciosamente instruidas con los conocimientos citados. Si fuera necesaria indumentaria de seguridad para el uso de productos de R&S, encontrará la información debida en la documentación del producto en el capítulo correspondiente.

Símbolos y definiciones de seguridad

Ver documentación de producto	Informaciones para maquinaria con un peso de > 18kg	Peligro de golpe de corriente	¡Advertencia! Superficie caliente	Conexión a conductor protector	Conexión a tierra	Conexión a masa conductora	¡Cuidado! Elementos de construcción con peligro de carga electrostática

potencia EN MARCHA/PARADA	Indicación Stand-by	Corriente continua DC	Corriente alterna AC	Corriente continua/alterna DC/AC	El aparato está protegido en su totalidad por un aislamiento de doble refuerzo

Informaciones de seguridad

Tener en cuenta las informaciones de seguridad sirve para tratar de evitar daños y peligros de toda clase. Es necesario de que se lean las siguientes informaciones de seguridad concienzudamente y se tengan en cuenta debidamente antes de la puesta en funcionamiento del producto. También deberán ser tenidas en cuenta las informaciones para la protección de personas que encontrarán en el capítulo correspondiente de la documentación de producto y que también son obligatorias de seguir. En las informaciones de seguridad actuales hemos juntado todos los objetos vendidos por el grupo de empresas Rohde & Schwarz bajo la denominación de „producto“, entre ellos también aparatos, instalaciones así como toda clase de accesorios.

Palabras de señal y su significado

PELIGRO	Identifica un peligro directo con riesgo elevado de provocar muerte o lesiones de gravedad si no se toman las medidas oportunas.
ADVERTENCIA	Identifica un posible peligro con riesgo medio de provocar muerte o lesiones (de gravedad) si no se toman las medidas oportunas.
ATENCIÓN	Identifica un peligro con riesgo reducido de provocar lesiones de gravedad media o leve si no se toman las medidas oportunas.
CUIDADO	Indica la posibilidad de utilizar mal el producto y a consecuencia dañarlo.
INFORMACIÓN	Indica una situación en la que deberían seguirse las instrucciones en el uso del producto, pero que no consecuentemente deben de llevar a un daño del mismo.

Las palabras de señal corresponden a la definición habitual para aplicaciones civiles en el área económica europea. Pueden existir definiciones diferentes a esta definición en otras áreas económicas o en aplicaciones militares. Por eso se deberá tener en cuenta que las palabras de señal aquí descritas sean utilizadas siempre solamente en combinación con la correspondiente documentación de producto y solamente en combinación con el producto correspondiente. La utilización de las palabras de señal en combinación con productos o documentaciones que no les correspondan puede llevar a malinterpretaciones y tener por consecuencia daños en personas u objetos.

Informaciones de seguridad elementales

1. El producto solamente debe ser utilizado según lo indicado por el fabricante referente a la situación y posición de funcionamiento sin que se obstruya la ventilación. Si no se convino de otra manera, es para los productos R&S válido lo que sigue: como posición de funcionamiento se define principalmente la posición con el suelo de la caja para abajo, modo de protección IP 2X, grado de suciedad 2, categoría de sobrecarga eléctrica 2, utilizar solamente en estancias interiores, utilización hasta 2000 m sobre el nivel del mar, transporte hasta 4.500 m sobre el nivel del mar. A menos que se especifique otra cosa en la hoja de datos, se aplicará una tolerancia de $\pm 10\%$ sobre el voltaje nominal y de $\pm 5\%$ sobre la frecuencia nominal.
2. En todos los trabajos deberán ser tenidas en cuenta las normas locales de seguridad de trabajo y de prevención de accidentes. El producto solamente debe de ser abierto por personal perito autorizado. Antes de efectuar trabajos en el producto o abrirlo deberá este ser desconectado de la corriente. El ajuste, el cambio de partes, la manutención y la reparación deberán ser solamente efectuadas por electricistas autorizados por R&S. Si se reponen partes con importancia para los aspectos de seguridad (por ejemplo el enchufe, los transformadores o los fusibles), solamente podrán ser sustituidos por partes originales. Después de cada recambio de partes elementales para la seguridad deberá ser efectuado un control de seguridad (control a primera vista, control de conductor protector, medición de resistencia de aislamiento, medición de medición de la corriente conductora, control de funcionamiento).

Informaciones de seguridad

3. Como en todo producto de fabricación industrial no puede ser excluido en general de que se produzcan al usarlo elementos que puedan generar alergias, los llamados elementos alergénicos (por ejemplo el níquel). Si se produjeran en el trato con productos R&S reacciones alérgicas, como por ejemplo urticaria, estornudos frecuentes, irritación de la conjuntiva o dificultades al respirar, se deberá consultar inmediatamente a un médico para averiguar los motivos de estas reacciones.
4. Si productos / elementos de construcción son tratados fuera del funcionamiento definido de forma mecánica o térmica, pueden generarse elementos peligrosos (polvos de sustancia de metales pesados como por ejemplo plomo, berilio, níquel). La partición elemental del producto, como por ejemplo sucede en el tratamiento de materias residuales, debe de ser efectuada solamente por personal especializado para estos tratamientos. La partición elemental efectuada inadecuadamente puede generar daños para la salud. Se deben tener en cuenta las directivas nacionales referentes al tratamiento de materias residuales.
5. En el caso de que se produjeran agentes de peligro o combustibles en la aplicación del producto que debieran de ser transferidos a un tratamiento de materias residuales, como por ejemplo agentes refrigerantes que deben ser repuestos en periodos definidos, o aceites para motores, deberán ser tenidas en cuenta las prescripciones de seguridad del fabricante de estos agentes de peligro o combustibles y las regulaciones regionales para el tratamiento de materias residuales. Cuiden también de tener en cuenta en caso dado las prescripciones de seguridad especiales en la descripción del producto.
6. Ciertos productos, como por ejemplo las instalaciones de radiación HF, pueden a causa de su función natural, emitir una radiación electromagnética aumentada. En vista a la protección de la vida en desarrollo deberían ser protegidas personas embarazadas debidamente. También las personas con un bypass pueden correr peligro a causa de la radiación electromagnética. El empresario/usuario está comprometido a valorar y señalar áreas de trabajo en las que se corra un riesgo aumentado de exposición a radiaciones para evitar riesgos.
7. La utilización de los productos requiere instrucciones especiales y una alta concentración en el manejo. Debe de ponerse por seguro de que las personas que manejen los productos estén a la altura de los requerimientos necesarios referente a sus aptitudes físicas, psíquicas y emocionales, ya que de otra manera no se pueden excluir lesiones o daños de objetos. El empresario lleva la responsabilidad de seleccionar el personal usuario apto para el manejo de los productos.
8. Antes de la puesta en marcha del producto se deberá tener por seguro de que la tensión preseleccionada en el producto equivalga a la del la red de distribución. Si es necesario cambiar la preselección de la tensión también se deberán en caso dabo cambiar los fusibles correspondientes del producto.
9. Productos de la clase de seguridad I con alimentación móvil y enchufe individual de producto solamente deberán ser conectados para el funcionamiento a tomas de corriente de contacto de seguridad y con conductor protector conectado.
10. Queda prohibida toda clase de interrupción intencionada del conductor protector, tanto en la toma de corriente como en el mismo producto. Puede tener como consecuencia el peligro de golpe de corriente por el producto. Si se utilizaran cables o enchufes de extensión se deberá poner al seguro, que es controlado su estado técnico de seguridad.
11. Si el producto no está equipado con un interruptor para desconectarlo de la red, se deberá considerar el enchufe del cable de distribución como interruptor. En estos casos deberá asegurar de que el enchufe sea de fácil acceso y nabejo (según la medida del cable de distribución, aproximadamente 2 m). Los interruptores de función o electrónicos no son aptos para el corte de la red eléctrica. Si los productos sin interruptor están integrados en construcciones o instalaciones, se deberá instalar el interruptor al nivel de la instalación.

Informaciones de seguridad

12. No utilice nunca el producto si está dañado el cable eléctrico. Compruebe regularmente el correcto estado de los cables de conexión a red. Asegure a través de las medidas de protección y de instalación adecuadas de que el cable de eléctrico no pueda ser dañado o de que nadie pueda ser dañado por él, por ejemplo al tropezar o por un golpe de corriente.
13. Solamente está permitido el funcionamiento en redes de distribución TN/TT aseguradas con fusibles de como máximo 16 A (utilización de fusibles de mayor amperaje sólo previa consulta con el grupo de empresas Rohde & Schwarz).
14. Nunca conecte el enchufe en tomas de corriente sucias o llenas de polvo. Introduzca el enchufe por completo y fuertemente en la toma de corriente. Si no tiene en consideración estas indicaciones se arriesga a que se originen chispas, fuego y/o heridas.
15. No sobrecargue las tomas de corriente, los cables de extensión o los enchufes de extensión ya que esto pudiera causar fuego o golpes de corriente.
16. En las mediciones en circuitos de corriente con una tensión de entrada de $U_{\text{eff}} > 30 \text{ V}$ se deberá tomar las precauciones debidas para impedir cualquier peligro (por ejemplo medios de medición adecuados, seguros, limitación de tensión, corte protector, aislamiento etc.).
17. En caso de conexión con aparatos de la técnica informática se deberá tener en cuenta que estos cumplan los requisitos de la EC950/EN60950.
18. A menos que esté permitido expresamente, no retire nunca la tapa ni componentes de la carcasa mientras el producto esté en servicio. Esto pone a descubierto los cables y componentes eléctricos y puede causar heridas, fuego o daños en el producto.
19. Si un producto es instalado fijamente en un lugar, se deberá primero conectar el conductor protector fijo con el conductor protector del aparato antes de hacer cualquier otra conexión. La instalación y la conexión deberán ser efectuadas por un electricista especializado.
20. En caso de que los productos que son instalados fijamente en un lugar sean sin protector implementado, autointerruptor o similares objetos de protección, el circuito de suministro de corriente deberá estar protegido de manera que usuarios y productos estén suficientemente protegidos.
21. Por favor, no introduzca ningún objeto que no esté destinado a ello en los orificios de la caja del aparato. No vierta nunca ninguna clase de líquidos sobre o en la caja. Esto puede producir corto circuitos en el producto y/o puede causar golpes de corriente, fuego o heridas.
22. Asegúrese con la protección adecuada de que no pueda originarse en el producto una sobrecarga por ejemplo a causa de una tormenta. Si no se verá el personal que lo utilice expuesto al peligro de un golpe de corriente.
23. Los productos R&S no están protegidos contra el agua si no es que exista otra indicación, ver también punto 1. Si no se tiene en cuenta esto se arriesga el peligro de golpe de corriente para el usuario o de daños en el producto lo cual también puede llevar al peligro de personas.
24. No utilice el producto bajo condiciones en las que pueda producirse y se hayan producido líquidos de condensación en o dentro del producto como por ejemplo cuando se desplaza el producto de un lugar frío a un lugar caliente.
25. Por favor no cierre ninguna ranura u orificio del producto, ya que estas son necesarias para la ventilación e impiden que el producto se caliente demasiado. No pongan el producto encima de materiales blandos como por ejemplo sofás o alfombras o dentro de una caja cerrada, si esta no está suficientemente ventilada.
26. No ponga el producto sobre aparatos que produzcan calor, como por ejemplo radiadores o calentadores. La temperatura ambiental no debe superar la temperatura máxima especificada en la hoja de datos.

Informaciones de seguridad

27. Baterías y acumuladores no deben de ser expuestos a temperaturas altas o al fuego. Guardar baterías y acumuladores fuera del alcance de los niños. No cortocircuitar baterías ni acumuladores. Si las baterías o los acumuladores no son cambiados con la debida atención existirá peligro de explosión (atención células de Litio). Cambiar las baterías o los acumuladores solamente por los del tipo R&S correspondiente (ver lista de piezas de recambio). Las baterías y acumuladores deben reutilizarse y no deben acceder a los vertederos. Las baterías y acumuladores que contienen plomo, mercurio o cadmio deben tratarse como residuos especiales. Respete en esta relación las normas nacionales de evacuación y reciclaje.
28. Por favor tengan en cuenta que en caso de un incendio pueden desprenderse del producto agentes venenosos (gases, líquidos etc.) que pueden generar daños a la salud.
29. El producto puede poseer un peso elevado. Muévelo con cuidado para evitar lesiones en la espalda u otras partes corporales.
30. No sitúe el producto encima de superficies, vehículos, estantes o mesas, que por sus características de peso o de estabilidad no sean aptas para él. Siga siempre las instrucciones de instalación del fabricante cuando instale y asegure el producto en objetos o estructuras (por ejemplo paredes y estantes).
31. Las asas instaladas en los productos sirven solamente de ayuda para el manejo que solamente está previsto para personas. Por eso no está permitido utilizar las asas para la sujeción en o sobre medios de transporte como por ejemplo grúas, carretillas elevadoras de horquilla, carros etc. El usuario es responsable de que los productos sean sujetados de forma segura a los medios de transporte y de que las prescripciones de seguridad del fabricante de los medios de transporte sean tenidas en cuenta. En caso de que no se tengan en cuenta pueden causarse daños en personas y objetos.
32. Si llega a utilizar el producto dentro de un vehículo, queda en la responsabilidad absoluta del conductor que conducir el vehículo de manera segura. Asegure el producto dentro del vehículo debidamente para evitar en caso de un accidente las lesiones u otra clase de daños. No utilice nunca el producto dentro de un vehículo en movimiento si esto pudiera distraer al conductor. Siempre queda en la responsabilidad absoluta del conductor la seguridad del vehículo. El fabricante no asumirá ninguna clase de responsabilidad por accidentes o colisiones.
33. Dado el caso de que esté integrado un producto de laser en un producto R&S (por ejemplo CD/DVD-ROM) no utilice otras instalaciones o funciones que las descritas en la documentación de producto. De otra manera pondrá en peligro su salud, ya que el rayo laser puede dañar irreversiblemente sus ojos. Nunca trate de descomponer estos productos. Nunca mire dentro del rayo laser.

Certified Quality System

DIN EN ISO 9001 : 2000

DIN EN 9100 : 2003

DIN EN ISO 14001 : 1996

DQS REG. NO 001954 QM/ST UM

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1 Overview

Tests of basic properties of hearing aids are specified in standards IEC 60118 and ANSI S3.22. They comprise measurement of output sound pressure level, frequency responses, output SPL over input SPL, harmonic distortion, battery current drain and AGC settling.

Audio Analyzer R&S UPV with option R&S UPV-K7 provides a test system which, together with the necessary acoustic accessories, allows measurements according to IEC60118-0:1983, IEC60118-1:1995, IEC60118-2:1983, IEC60118-7:2005 and ANSI S3.22-2003.

In addition to standard measurements it is possible to create own tests by customizing the available parameters.

Automatic test sequences can be compiled from the available tests, and results are compiled for subsequent creation of test reports.

2 Preparation and Start of the Application Software

Required Measuring Instruments and Accessories

The Audio Analyzer R&S UPV with option R&S UPV-K7 is required for the measurements.

Acoustic devices such as measurement couplers, a calibrator and other accessories are required for the measurements. The following equipment from Brüel & Kjær or G.R.A.S. may be used:

Device	Description	Type (examples)
Hearing aid test box	Anechoic box with built-in sound source and induction loop, feed-throughs for the most important connection lines	R&S UPL-B7 or Interacoustics TBS25 or B&K 4232
Measurement microphone	¼" measurement microphone for measurement of artificial mouth output during calibration, to be inserted into IEC 126 2cc coupler, and for comparison measurement	B&K 4938 with B&K 2670 or G.R.A.S. 40BP with G.R.A.S. 26AC
IEC 126 coupler	Acoustic coupler according to IEC 126	Part of R&S UPL-B7 (with internal microphone or with ¼" microphone with preamplifier)
IEC 711 ear simulator (optional)	IEC 711 type occluded ear simulator with adapters for calibration and connection to the output of the DUT, with 1/2" - preamplifier	B&K 4157 & 2669
Acoustic calibrator	Sound level calibrator or pistonphone for calibrating the measuring microphones	B&K 4231 or G.R.A.S. 42AB
Microphone power supply	Power supply and preamplifier for the measuring microphone	B&K 2829, 5935L or 2690A0S2 or G.R.A.S. 12AD or 12AA

Note: *With the amplifier set to 0 dB, the microphone power supply B&K 2690A0S2 produces too much noise for measuring idle noise and distortion. It is therefore advisable to set a gain of 20 dB.*

Theoretically the reference microphone for sound source calibration and comparison measurement should be a free field type and the IEC 126 coupler should be used with a pressure field type. However with a ¼" microphone the frequency response difference is negligible up to at least 10 kHz.

An external USB keyboard and a mouse must be connected to the R&S UPV.

Caution: R&S UPV-K7 does not support the use of headphones. Do not connect headphones to the R&S UPV during hearing aid tests. High level signals may be present at the headphone connector.

The program required and the associated files are in the folder “UPV-K7 Software” on the installation CD supplied with the R&S UPV-K7 option. The audio analyzer must meet the following firmware requirements:

- R&S UPV firmware version 2.0.0 or higher
- Option R&S UPV-K7 installed

Installing the Software

The application program requires option key K7 to be installed. The key is installed in the factory in case a new R&S UPV is ordered together with this option. If the option is ordered separately, the key as well as the installation manual is part of the delivery.

It is recommended to copy the files UPV-K7.msi, Config.ini, dotnetfx.exe, Setup.Exe and Settings.Ini from the folder “UPV-K7 Software” on the installation CD to drive D: on the R&S UPV hard disk drive, e.g. to a folder named “D:\R&S Software\UPV-K7\Version 1.0”. Run the file “Setup.Exe” to start the installation. Follow the instructions of the installer on the screen.

Test Setup

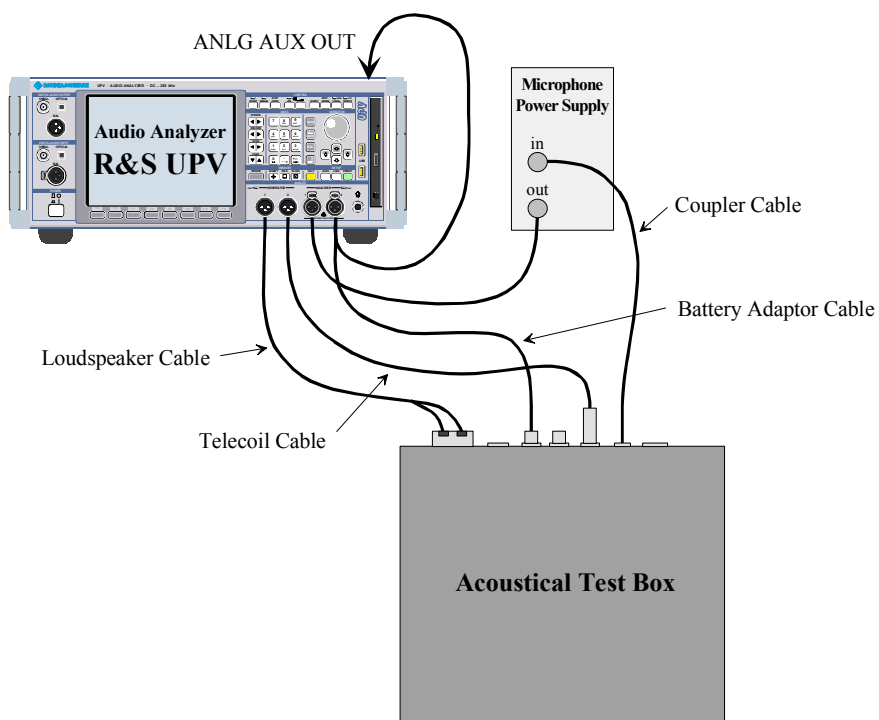


Fig. 1 Test setup and connection of external components

The following cables are required to connect speaker, induction loop and battery voltage supply of the test box delivered with R&S UPL-B7 to the R&S UPV. The microphone signal from the microphone power supply may be connected to the analyzer input with a BNC cable and a R&S UPL-Z1

adapter. If a custom made BNC to XLR cable is used, it should be made following the schematics of the R&S UPL-Z1 adapter (see R&S UPV manual, chapter “Configuring the Analog Analyzer”).

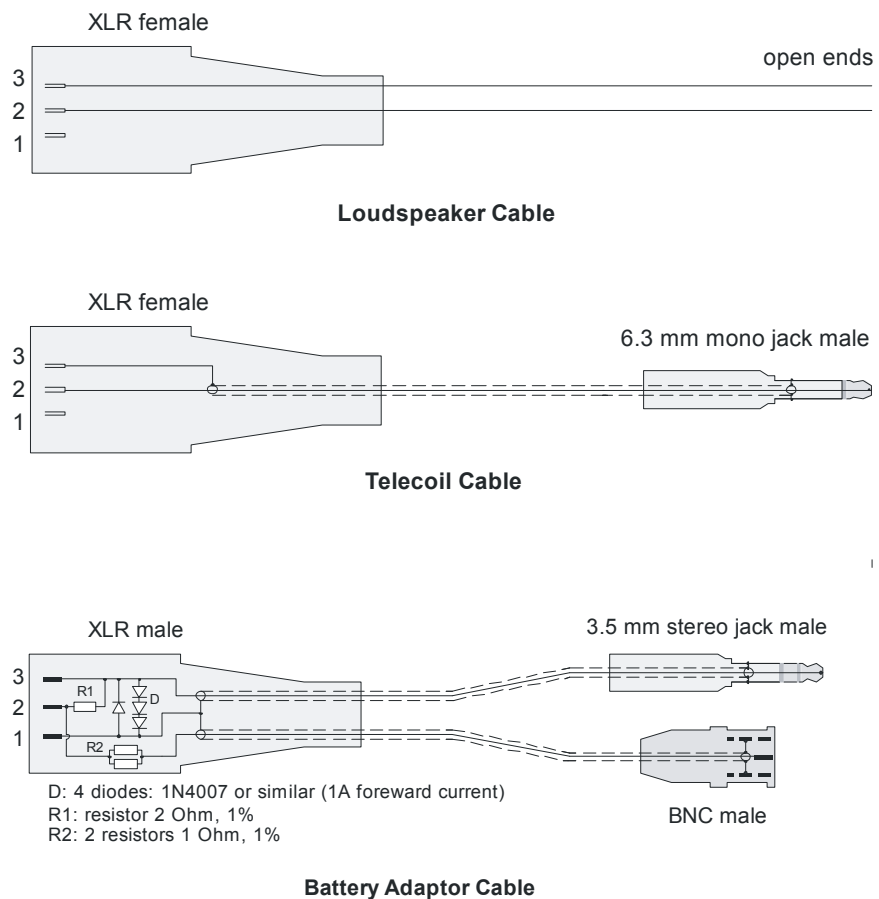


Fig. 2 Connection cables for R&S UPL-B7 (Interacoustics TBS 25) test box

The cables of R&S UPL-B7 can be re-used for R&S UPV-K7. As the supply voltage is now provided by the “ANLG AUX OUT” on the rear panel of the R&S UPV, the following adapter is required in addition.



Fig. 3 Adapter cable to connect the R&S UPL-B7 battery supply cable to the “ANLG AUX OUT” of the R&S UPV

Starting the Application Software

After installation, the program can be started by double-clicking the Icon “UPV-K7 Hearing Aid Tests” or by clicking “R&S UPV Applications → UPV-K7 Hearing Aid Tests” in the “Programs” menu.

At the first start of the program, selection windows appear for the standard according to which the measurements should be made, and for the measurement coupler used.

The entered selections are stored with the settings and automatically loaded at the next start of the program.

At each start of the program, the ambient conditions temperature, relative humidity and atmospheric pressure are queried for protocol purpose. The entered values are not stored in the settings, because the ambient conditions are supposed to change with time. The query can be deselected and values can be changed any time in the “Options” menu.

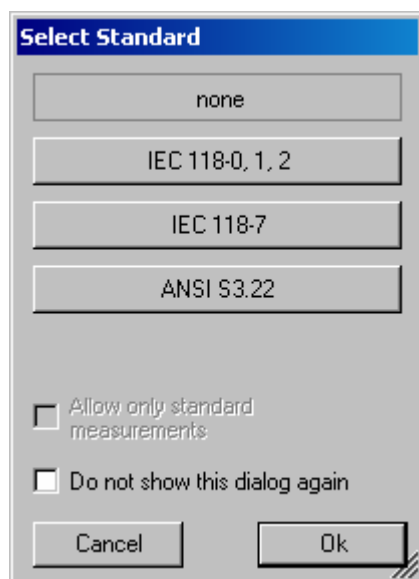


Fig. 4 Query window for selection of applied standard

If “none” is selected in the standard selection window, all measurements appear in the “Measurement” menu. If a standard is selected, all measurements appear in the “Measurement” menu, but compliant measurements are checked in the menu. If “Allow only standard measurements” is checked, non-compliant measurements are suppressed in the Measurement menu.



Fig. 5 Query window for selection of ear simulator

When the checkbox “Do not show this dialog again” is checked, the corresponding selection window will not appear at the program start in future. However, the selection is still available in the “Options” menu (see below).

The next window to open is the input window for the ambient conditions temperature, relative humidity and atmospheric pressure.

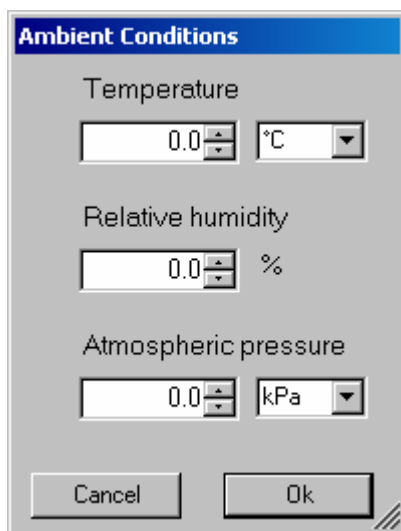


Fig. 6 Query window for input of ambient conditions

The units can be switched between °C and °F and between kPa and mmHg, respectively. After the last of the three selection windows has been closed, the main window of the R&S UPV-K7 opens.

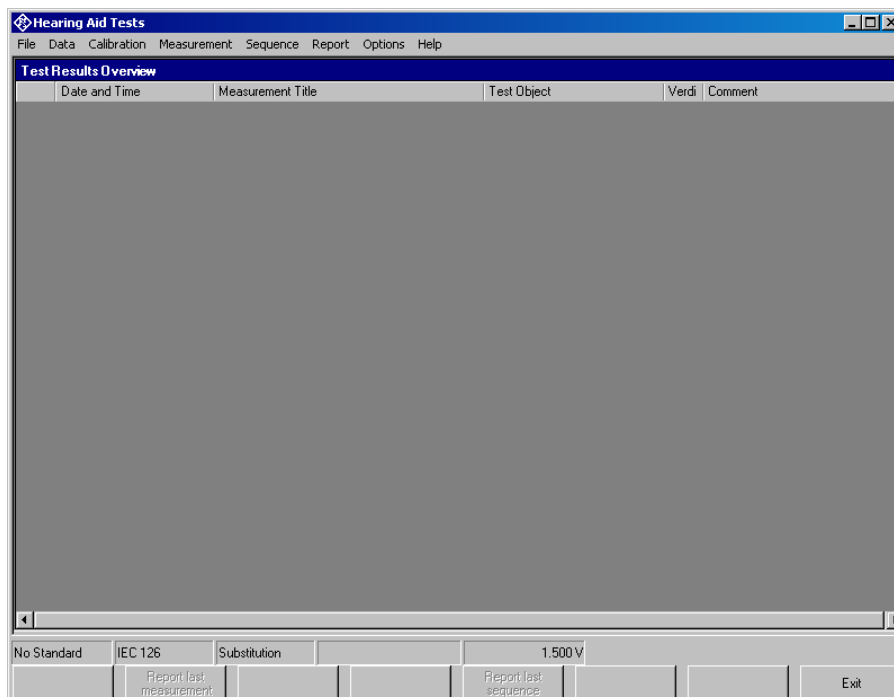


Fig. 7 Main window after first start of the program

Initially the data grid in the centre of the screen which shows the result overview is empty. The screenshot below shows an example after a number of measurements have been made.

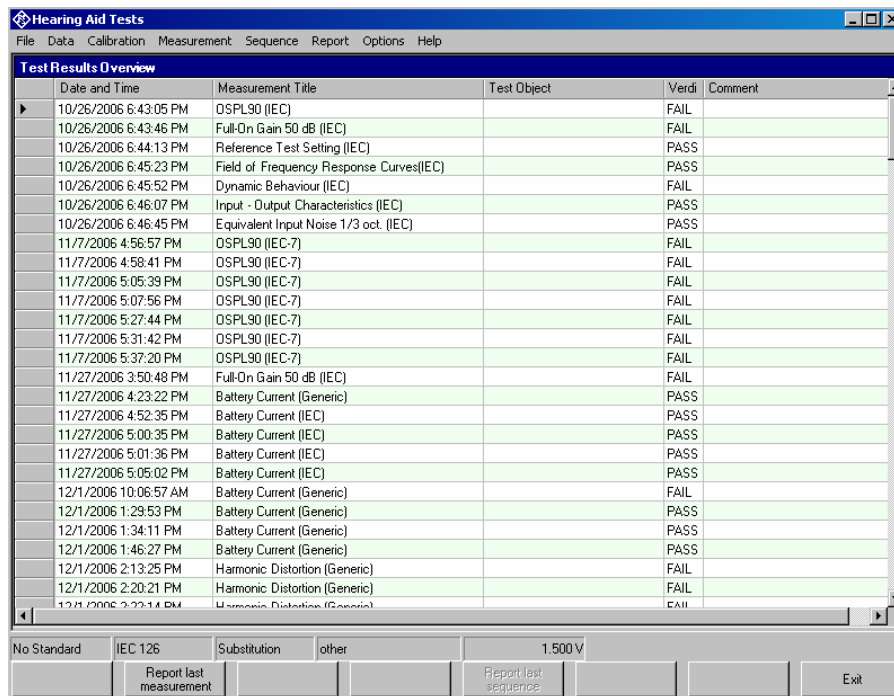


Fig. 8 Main window with results

3 Operating Concept

Options (General settings)

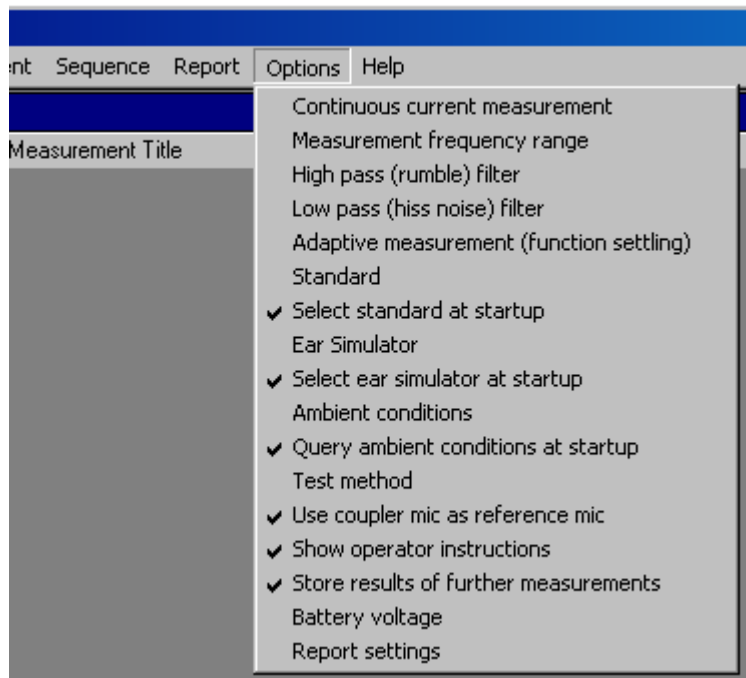


Fig. 9 Options menu

The “Options” menu in the main window allows to change a set of general settings like ear simulator, test method and battery voltage, which are valid for all or at least a plurality of the tests.

“**Continuous current measurement**” allows to measure the supply current at analyzer input 2. This option can only be selected with the substitution method. The value of the shunt resistor for the current measurement can be entered in the calibration menu. By default it is set to 2 Ω .

“**Measurement frequency range**” allows to enter the frequency range in which the sound source is calibrated. In general this will be 100 Hz to 10 kHz which is the default. “Number of points” specifies the number of (logarithmically spaced) frequencies measured for the sound source equalization.

“**High pass (rumble) filter**” allows to set a high pass filter which is active in most measurements except distortion measurements, battery current measurements and noise measurements. The edge frequency of the high pass filter can be set, and the filter can be activated and deactivated. The high pass filter is not applied to battery current measurements.

“**Low pass (hiss noise) filter**” allows to set a low pass filter which is active in most measurements except battery current measurements and noise measurements. The edge frequency of the high pass filter can be set, and the filter can be activated and deactivated. The low pass filter is not applied to battery current and distortion measurements.

With noise measurements, the filters from the “Options” menu are only applied to the gain measurement. The noise measurement has own parameters for the band limits of the noise level measurement.

Note: Filters slow down the measurement. Therefore they should only be used if necessary. In particular a combination of selective measurement with high pass and / or low pass filter is not recommended.

“Adaptive measurement (function settling)” causes gain and level measurements to be repeated until the result has settled within a specified tolerance. This is helpful to assure that an AGC which is present in the signal path has adapted to the applied input signal of the hearing aid.

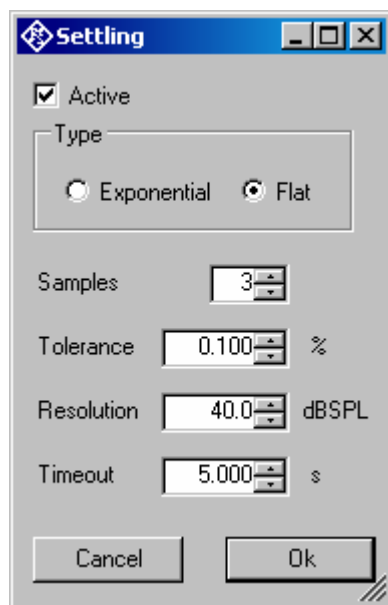


Fig. 10 Input window for adaptive measurement

With the “Flat” type, measurements are repeated until the last “Samples” number of results are within the given “Tolerance” or the difference between two subsequent measurement results is below the “Resolution” value. The “Resolution” can be used to take into account the idle channel noise of hearing aid and measurement equipment.

Note: The resolution value must be set high enough to take idle channel noise into account. If it is set too low, especially measurements with high gain at low input levels may be aborted due to invalid result values.

Note: If the use of filters leads to slow measurements, the timeout value may have to be increased.

With the “exponential” type of settling, differences between the earlier results may be higher than specified, but the results must converge exponentially into the specified values.

If the settling time of the hearing aid is known, measurement may be faster with settling turned off. In this case the known settling time has to be entered as pre-delay in the measurement parameters of each measurement.

Function settling is generally not applied to battery current measurements. For harmonic distortion measurements the resolution is set fix to 0.01 % THD.

“**Standard**” allows to select one of the available standards. Measurements belonging to this standard will be checked in the measurement menu. If “Allow only standard measurements” is checked, it is not possible to start single measurements which do not belong to the standard.

If “**Select standard at startup**” is checked, the selection window for the standard is opened at each start of the program.

“**Ear simulator**” allows to select the type of ear simulator used. For details on the handling of calibration data see section 4 (“Calibration”) below.

If “**Select ear simulator at startup**” is checked, the selection window for the ear simulator is opened at each start of the program.

“**Ambient conditions**” allows to change the temperature, relative humidity and atmospheric pressure values for the protocol.

“**Query ambient conditions at startup**” causes the input window for the ambient condition to be opened at each start of the program.

“**Test method**” allows to select the test method for transfer measurements. With “Substitution”, the nominally set SPL at the input of the hearing aid is assumed to be correct, due to the calibration of the sound source. With “Comparison”, the input SPL is measured simultaneously with the output SPL by the reference microphone in a two channel measurement, and results are corrected for the deviation of the input SPL from the nominal value. “Comparison” can not be selected when the continuous current measurement is active or when the coupler microphone is used as reference microphone (see below).

“**Use coupler mic as reference mic**” allows to use the microphone of the IEC 126 coupler for sound source calibration. In this case the program applies the calibration value of the coupler microphone for the sound source calibration, and the reference microphone has to be connected to analyzer input 1 instead of analyzer input 2.

If “**Show operator instructions**” is checked, instructions to the operator are displayed in a message box before the measurement starts. The operator may be prompted to position the hearing aid in a defined way or to set the volume to a certain setting.

“**Store results of further measurements**” allows to include results obtained with the “Add measurement” softkey to the result database. All curves obtained this way will be reported in the same graph. This allows e.g. to measure responses depending on settings of the hearing aid, and to report them in a field of curves.

“**Battery voltage**” allows to specify the supply voltage for the hearing aid. If a supply voltage is specified in the parameters of a measurement, the general setting is overridden. This allows to measure response curves for different supply voltages within one sequence.

“**Report settings**” allows to define the type of information which should appear in the reports. For details on reporting, see section 8 below.

4 Calibration

Calibration Devices

R&S UPV-K7 allows to simultaneously store calibration values for multiple individuals of the same type. This allows to switch devices without the requirement for re-calibration. However, regular re-calibration is recommended in order to assure the correct function of the used devices.

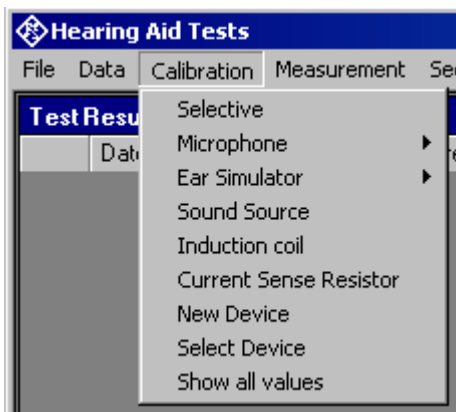


Fig. 11 Calibration menu

For every device to be calibrated, an entry must be created using “Calibration → New device” in the main menu. This menu item opens an entry window to specify the calibrated device. A category of device must be chosen from the combo box on top. Type, manufacturer and serial number are entered into the text boxes below. The entries are confirmed by clicking on the “Save and close” button.

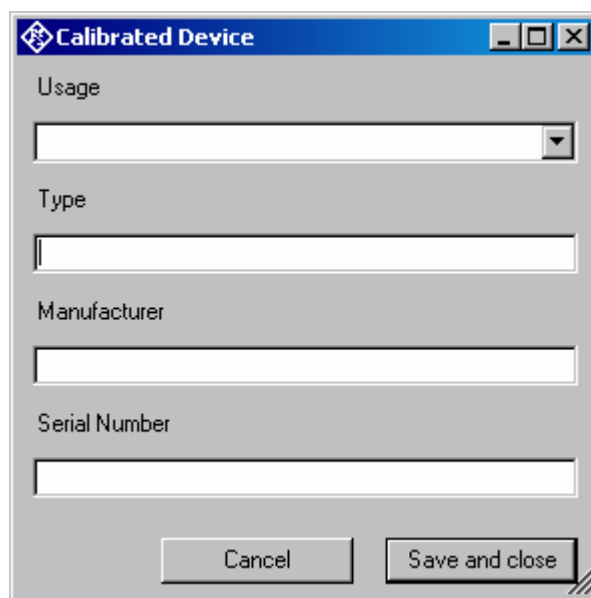


Fig. 12 Input window for information about calibrated device

Before a device can be calibrated or used, it must be selected with “Calibration → Select device” in the main menu. Clicking on this item opens a window with a table of all entered devices.

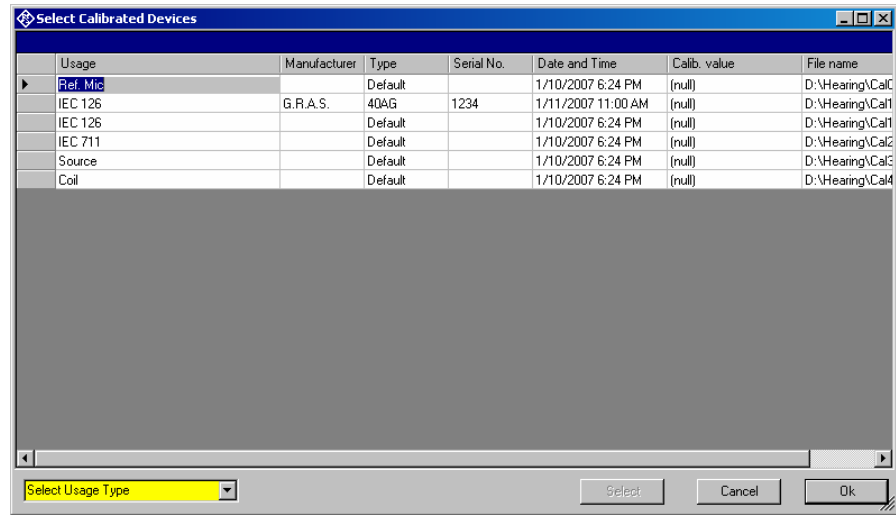


Fig. 13 Window for selection of calibrated devices

In the combo box lower left, a category of devices must be selected. Subsequently the table is reduced to available devices in this category. At first startup, there is only a “Default” device for each category, but when more devices have been created with the “New device” function, a choice will be available in this view. In this state a row in the table can be marked with a mouse click on its left end. A mouse click on the button “Select” selects this device for the associated usage.

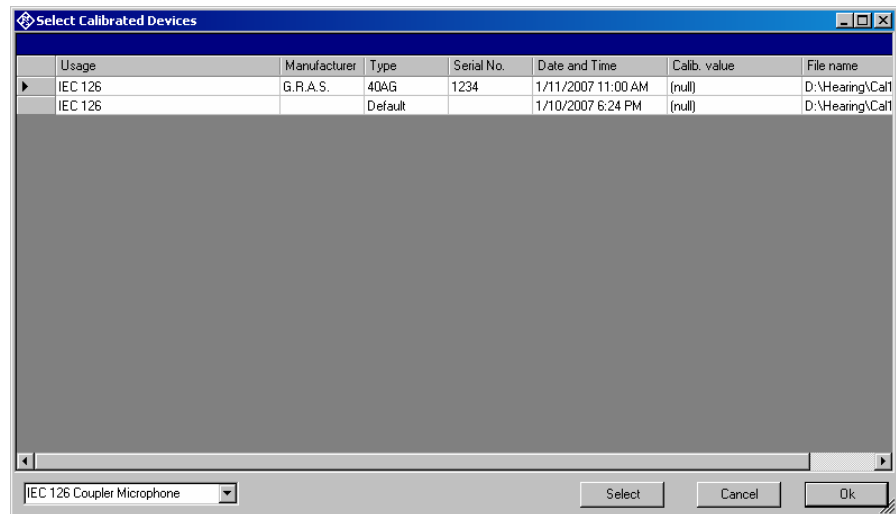


Fig. 14 Selection window for particular device type (here IEC 126 coupler)

Subsequently this procedure may be repeated for other categories. Finally all selections are confirmed by clicking the “Ok” button.

All calibration data are stored on the R&S UPV hard disk and are therefore automatically available again after every restart. The calibration values for the R&S UPV-K7 option are stored independently of other options.

All calibration routines below require as pre-requisite that a device for the respective usage has been generated and selected.

To simplify the procedure for the case that it is not intended to use multiple devices of the same category nor to include information about the used devices into a report, there is a “Default” device selected for each device type or category after the first start of the program.

Microphone Calibration

- **Insert the measuring microphone fully into the adapter of the sound level calibrator and switch on the calibrator.**

Note: After inserting the microphone, wait about 10 s to allow for static pressure equalization.

- **Call the test routine with “Calibration → Microphone → Coupler” or “Calibration → Microphone → Reference” from the main menu, depending on the microphone.**

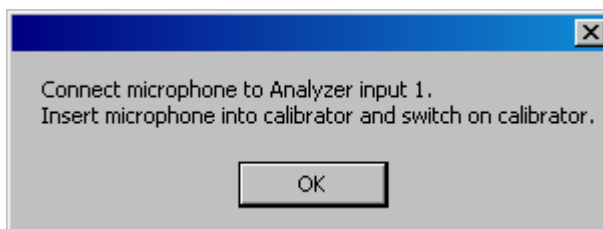


Fig. 15 Initial window of microphone calibration

Next, the nominal SPL of the calibrator has to be entered:

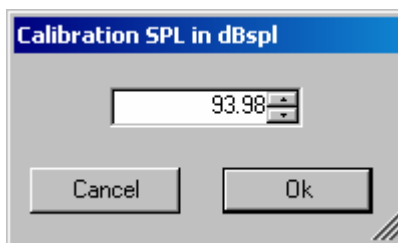


Fig. 16 Input window for calibration SPL

If selective calibration is activated in the calibration menu, the frequency of the calibration signal has to be entered:

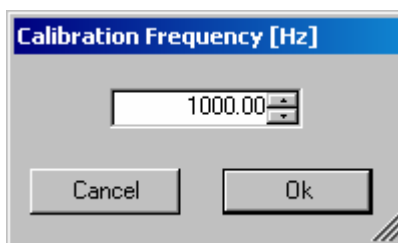


Fig. 17 Input window for calibration frequency

Subsequently, the output voltage of the microphone is measured and the sensitivity displayed with reference to 1 Pa. If a mere power supply without gain is used, the displayed sensitivity must approximately match the value in the calibration certificate of the microphone capsule (typical

value for microphone capsule 4134 of artificial ear 4185 is approx. 12 mV/Pa, display = 120 mV/Pa). If a conditioning amplifier with 20 dB gain (recommended value) is used, the displayed sensitivity must be about 10 times higher. If the voltage measured is below 3 mV or instable, an error message is displayed. Possible error sources are, for example, a switched-off microphone power supply or a disabled calibrator. In this case, the program requests that the calibration is repeated. After switching on the microphone power supply, wait approx. 20 s before starting the calibration again.

Calibration of Ear Simulator IEC 711

For calibration of the IEC 711 ear simulator, an adaptor part must be screwed onto the simulator which allows it to be inserted into the calibrator like a ½" microphone. The calibration routine is started with "Calibration → Ear Simulator → IEC 711" and follows the course described above.

Calibration of Sound Source

Before a hearing aid can be tested, the absolute sensitivity and frequency response of the sound source have to be measured and corrected with the aid of a previously calibrated reference microphone. If "Use coupler mic as reference mic" is activated in the "Options" menu, the microphone of the IEC 126 coupler can be used for this purpose. The frequency response of the microphone can be ignored in the test frequency range (100 Hz to 10 kHz) (see also calibration certificate of microphone capsule). If a separate reference microphone is used, this has to be calibrated beforehand with "Calibration → Microphone → Reference".

After starting the sound source calibration with "Calibration → Sound Source", the calibration level can be defined. This allows to adapt the calibration to specific measurement levels. It is also possible to store calibrations for different levels using multiple calibration devices (see above).

The sound pressure generated at the point of the reference microphone is set to exactly the specified level in an automatic measurement routine at 1 kHz. The generator voltage required is stored in a file on the hard disk and used as a reference for all subsequent settings with the same sound source. If the sound pressure cannot be adjusted to the specified value, an error message is displayed with a request to check the connection to the sound source and to repeat the measurement.

The uncorrected frequency response of the sound source is measured and displayed. Next, the frequency response is measured with the inverse frequency response correction automatically selected in the generator (equalization). Residual errors caused by nonlinearities of the speaker are measured and taken into account in the final equalization file as fine correction.

To verify the results, the absolute sound pressure versus frequency is measured at the specified sound pressure level. Correct calibration without interfering sound yields an almost straight line.

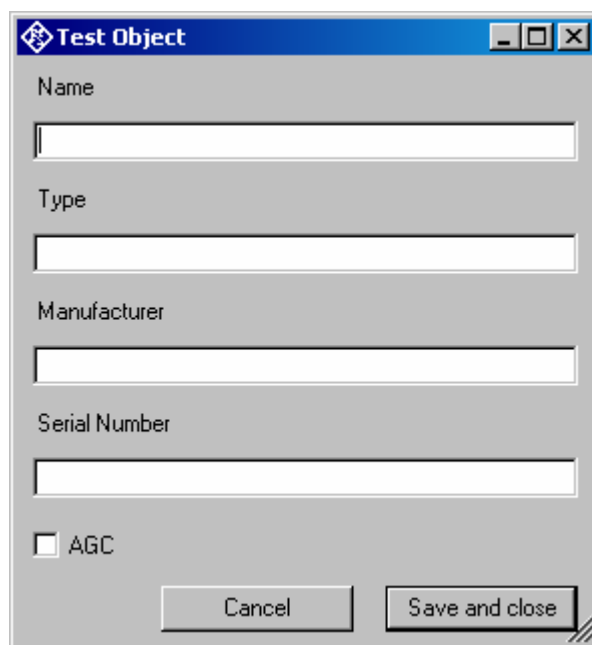
5 Data Entry for Reporting

Operator

Under “Data→Operator” an operator’s name can be entered which is stored in association with all calibration and measurement results. If “Operator” is activated in the report settings, the name will appear in all reports about these measurements.

Test object

Under “Data → Test object → New” a description of the device under test can be entered.



The image shows a software dialog box titled "Test Object". It contains four text input fields for "Name", "Type", "Manufacturer", and "Serial Number". Below these fields is a checkbox labeled "AGC". At the bottom of the dialog, there are two buttons: "Cancel" and "Save and close".

Fig. 18 Window for input of information about a test object

With “Data → Test object → Select” one of the entered test objects can be selected. The data of this selected test object will be stored in association with all measurements and appear on the associated reports if “DUT information” is activated in the report settings.

6 Measurements

Functionality and control of the measurement macros

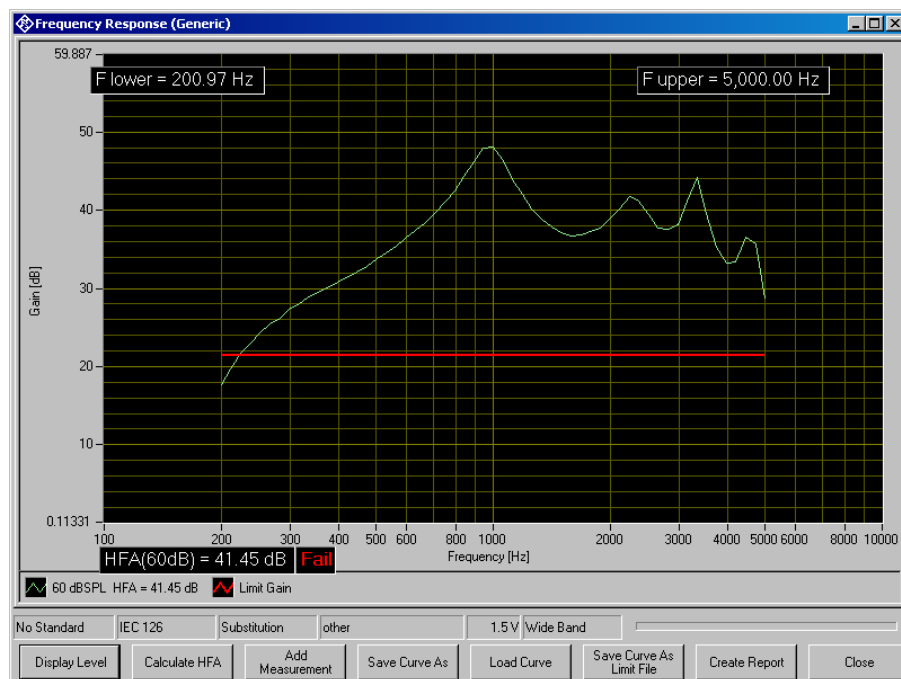


Fig. 19 Example of a measurement window

When a measurement macro is started, e.g. from the “Measurement” menu, the standardized measurement is immediately executed. With a single measurement, the window of the measurement macro stays open after the measurement is terminated. At that time, the following functionality is available:

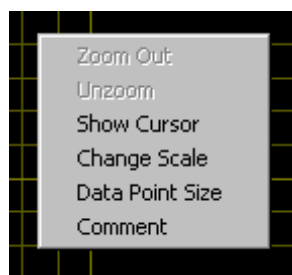


Fig. 20 Context menu of the graph window

Zooming

When the “Shift” key on the keyboard is pressed, the mouse cursor changes to the zoom cursor. When the left mouse button is pressed, a rectangle can be marked in the graph. As soon as the left mouse button is released, the graph is zoomed into the area of the marked rectangle

“Zoom Out” in the graph context menu reverses the last zooming step. “Unzoom” zooms completely out to the original scaling.

Changing the Scale of the Graph

“Change Scale” in the context menu opens a window in which the upper and lower bounds of both axes can be entered by numbers.

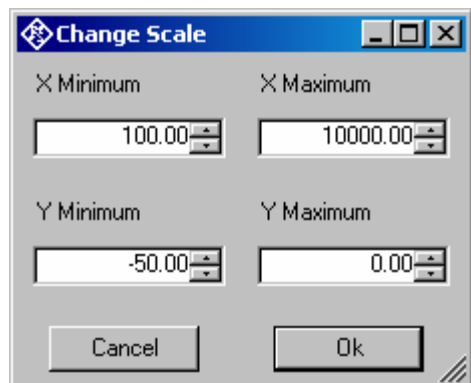


Fig. 21 Window for changing the scale of the graph

Cursor

When the item “Show Cursor” is marked in the graph context menu, a cursor is displayed which can be dragged along the graph with the mouse. X and Y values of the data points below the cursor are displayed.

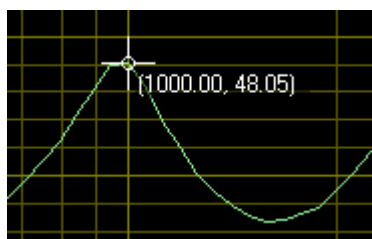


Fig. 22 Cursor with data display

Data Point Size

“Data Point Size” in the graph context menu opens a window in which the size of marks at the measured data points can be specified. Moving the mouse cursor over one of the marks causes the associated X and Y values to be displayed.

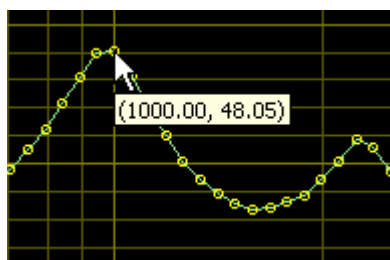


Fig. 23 Data points with data display

Making Additional Measurements

The softkey “Add Measurement” triggers another measurement according to the specification of the test. Loudness ratings and noise values are

calculated and displayed in the legend. However, limits are not checked. This function can e.g. be used to compare different settings in a device under test.

If the item “Store results of further measurements” is activated in the “Options” menu, graphs and result values obtained with this functionality are added to the results database and will appear later in reports on this measurement. All curves obtained within the same measurement will appear in the report in the same graph.

Storing and Loading Curves

All measured curves in the graph can be stored to an ASCII file, and stored curves can be loaded back into the graph. The softkey “Store Curve” opens a window in which a combo box offers choice between the legends of all measured curves in the graph. The curve associated in which the selected entry is stored to the file at the specified location.

Storing Curves as Limit Curves

With “Store As Limit Curve” a curve can be selected and stored into a R&S UPV format limit file with a specified shift in Y axis direction. This functionality can be used to generate limit curves from “golden” devices for evaluation purpose. Regarding the use of such limit curves see section “Customizing Measurements” below.

Entering a Comment

With the softkey “Enter Comment” or the item “Comment” in the graph context menu, a comment can be entered and edited which will appear in the report about the respective measurement.

Creating a Report

The softkey “Create Report” causes a report to be prepared. The report preview window (see below) opens and shows the preview of the report. Buttons in the preview window allow to print the report or to export it to PDF, WORD, EXCEL or Rich Text format. For details see section “Preview Window” below.

Closing the Measurement Window

The softkey “Close” closes the measurement window. The control is returned to the R&S UPV-K7 main window. All relevant data associated with the measurement is imported to the results database. A new entry appears for the measurement as new row on the bottom of the overview data grid in the main window.

Customizing Measurements

The first item in the “Measurement” menu which is called “Settings” opens a sub-menu with all available measurements in it. Clicking on a measurement in this sub-menu opens a window which allows to change parameters of the selected measurement.

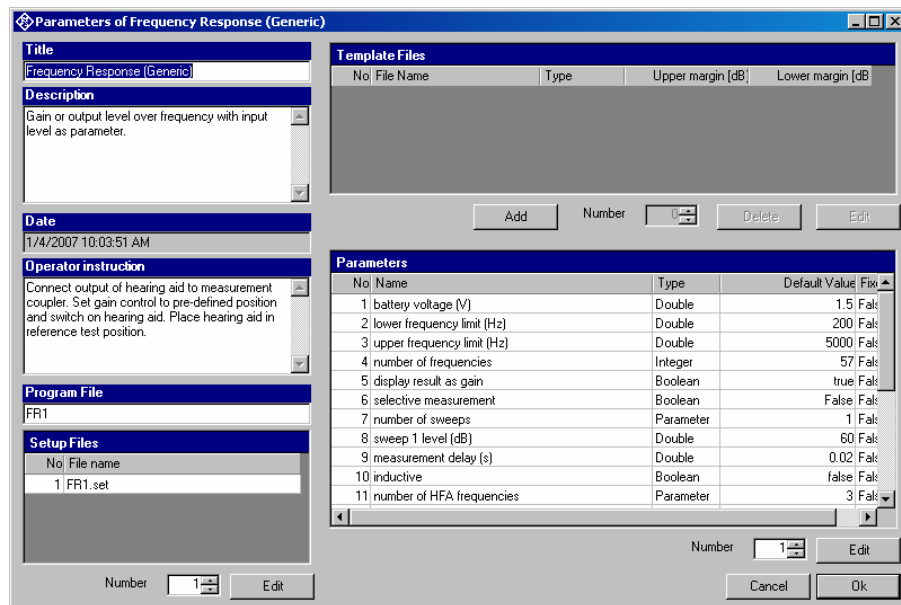


Fig. 24 Measurement setup window

The “Title” appears in the measurement menu and forms the heading of the report.

The “Description” can be chosen to be included into the report.

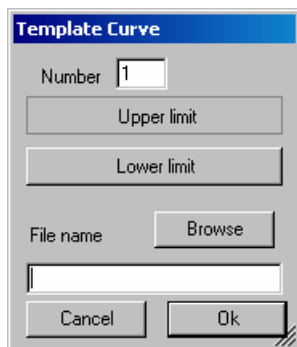
“Date” shows the date of the last change to this measurement definition.

“Operator instruction” is the text displayed before the start of each measurement, provided that the item “Show operator instructions” is activated in the “Options” menu.

The entry in the field “Program File” designates the measurement type and must not be changed.

The field “Setup Files” specifies the R&S UPV setups used by the measurement. The specified file can be replaced by a user defined file but the number of setups is defined by the measurement type. The customized setup file must be stored in folder D:\Hearing. It is recommended to generate customized setups by copying existing ones. Note that changes in the setup like changing the analysis function or generator signal may cause malfunction of the measurement. Some parameters of the setup might be overwritten by the macro during the measurement run.

The field “Template files” specifies limit template curves for the response curve. The buttons “Add” or “Edit” produce the following input window:



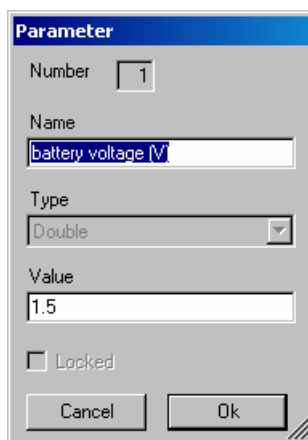
The 'Template Curve' dialog box contains the following elements:

- Number:** A text input field containing the value '1'.
- Upper limit:** A radio button.
- Lower limit:** A radio button.
- File name:** A text input field.
- Browse:** A button next to the 'File name' field.
- Cancel:** A button at the bottom left.
- Ok:** A button at the bottom right.

Fig. 25 Input window for limit template curve

The radio buttons allow to determine whether the given curve should be used as upper limit, lower limit or for information only (no limit check). The field "File name" must contain the path name of the file. To generate a new limit curve file, use the softkey "Save as limit curve" of the respective measurement window or copy and edit an existing limit file using a text editor.

All other available parameters of a measurement definition are shown in the "Parameters" data grid. The rightmost column with the headline "Fixed" displays whether the respective parameter can be changed by the operator or not. In "generic" measurements all parameters may be changed. In measurements which follow standards, only parameters which are not determined by the standard may be changed by the operator. The "Edit" button opens an input window for the parameter in the line specified in "Number":



The 'Parameter' dialog box contains the following elements:

- Number:** A text input field containing the value '1'.
- Name:** A text input field containing the value 'battery voltage IV'.
- Type:** A dropdown menu currently showing 'Double'.
- Value:** A text input field containing the value '1.5'.
- Locked:** An unchecked checkbox.
- Cancel:** A button at the bottom left.
- Ok:** A button at the bottom right.

Fig. 26 Input window for parameter value

"Name" appears in the report and explains the meaning of the parameter. "Type" is determined by the measurement routine and cannot be changed. In the field "Value" a value must be entered which conforms with the syntax rules of the selected data type. The syntax is checked automatically when the text box is left. However there is no check for the allowable range of the value. Entering inadequate values (e.g. too high levels, negative frequencies) may cause malfunction of the measurement.

Notes on Individual Measurements

Frequency Response Measurement

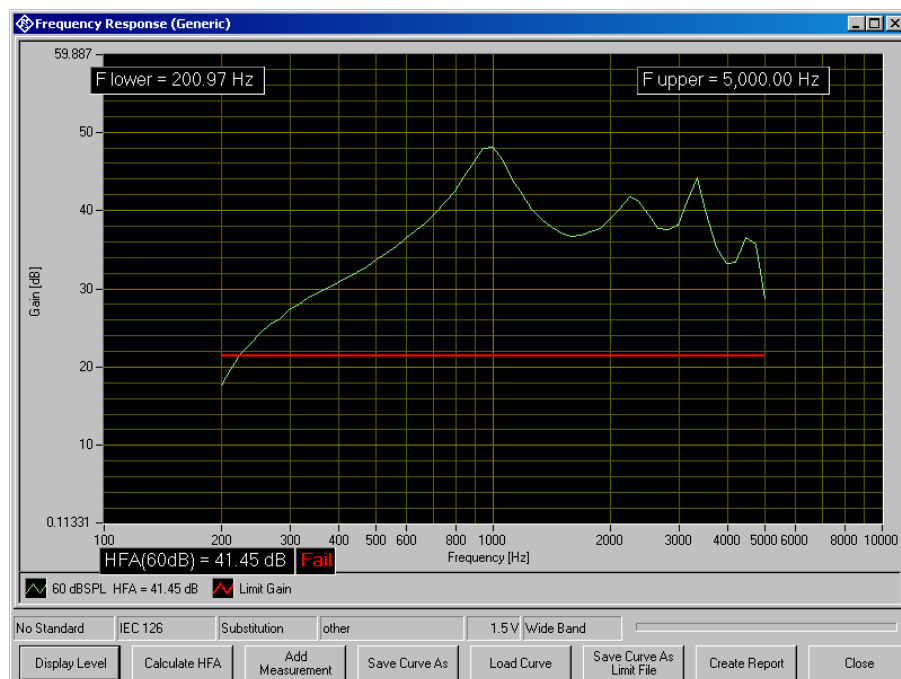


Fig. 27 Display window of frequency response measurement

The softkey “Display Level” or “Display Gain”, respectively, allows to toggle between gain and level in the Y axis of the graph. The button “Calculate HFA” allows to calculate a high frequency average or special frequency average from one of the displayed curves:

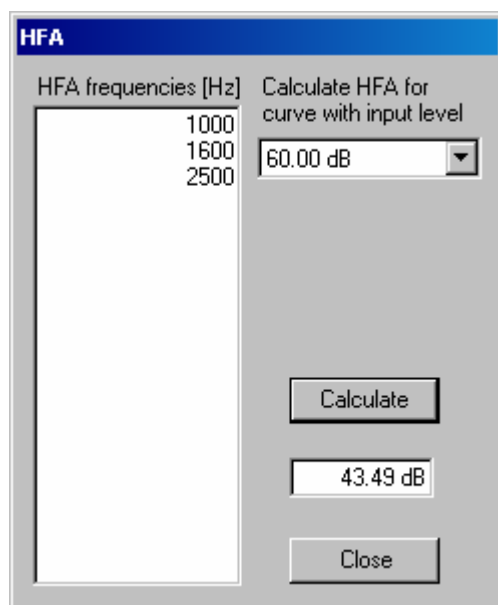


Fig. 28 Input window for HFA calculation

Acoustic Measurements on Hearing Aids

In the text box on the left side the HFA frequencies are entered in separate lines. In the combo box top right, one of the existing curves is chosen. When the button "Calculate" is clicked, the text box below shows the associated HFA value.

The following table lists all available parameters in the generic frequency response measurement.

Name	Type	Value	Explanation
battery voltage (V)	Double	0	Supply voltage provided at ANLG AUX OUT. Overrides the general setting. "0 V " means "use voltage from general setting".
lower frequency limit (Hz)	Double	200	Start frequency of sweep
upper frequency limit (Hz)	Double	5000	Stop frequency of sweep
number of frequencies	Integer	57	Number of sweep points
display result as gain	Boolean	True	„True“: Gain on Y axis, „False“: SPL on Y axis
selective measurement	Boolean	false	„True“: Selective measurement with fast 3rd octave filter
number of sweeps	Parameter count	1	Number of sweeps with level as parameter
sweep 1 level (dB)	Double	60	Sweep level for each sweep (dBSPL or dB re 1 mA/m)
measurement delay (s)	Double	0.02	Pre-delay between sweep Step and measurement trigger, allows for settling of the DUT (e.g. AGC)
inductive	Boolean	false	"False": Acoustic input, "True": Inductive input
number of HFA frequencies	Parameter count	3	Number of frequencies averaged in the high frequency average
HFA frequency 1 (Hz)	Double	1000	
HFA frequency (Hz)	Double	1600	
HFA frequency (Hz)	Double	2500	
HFA upper limit (dB)	Double	30	Upper limit for limit check
HFA lower limit (dB)	Double	10	Lower limit for limit check
check limit for sweep no.	Byte	1	"0" means: "don't check"
calc. freq. range for swp. no	Byte	1	"0" means: "don't calculate"
level difference (dB)	Double	20	Level difference between HFA level and frequency response limit points
check frequency range limits	Boolean	True	Determines whether the frequency range is checked against the limits given below
max. lower frequency (Hz)	Double	500	
min. upper frequency (Hz)	Double	3500	
display curve maximum	Boolean	True	Stipulates whether the absolute curve maximum should be determined
lower limit of max. (dB)	Double	0	
upper limit of max. (dB)	Double	40	
check max limits for swp. no	Byte	1	"0" means: "don't check"

Table 1 Available parameters for frequency response measurements

If for example only an upper limit should be checked but not the corresponding lower one, select the lower limit low enough to be always passed.

The following standard conformal tests are based on the frequency response measurement routine:

- Frequency Response @ 60 dB SPL (IEC-0)
- Frequency Response (ANSI)
- Field of Frequency Response Curves (IEC-0)
- Frequency Response (IEC-7)
- Frequency Response Induction (ANSI)
- Frequency Response Induction (IEC-1)
- Full-On Gain 50 dB (IEC-0)
- Full-On Gain 60 dB (IEC-0)
- Full-On Gain (IEC-7)
- Response Curve at Maximum Gain (IEC-1)
- Full-On Gain (ANSI)
- Output SPL at Maximum Gain, Induction (IEC-1)
- OSPL90 (ANSI)
- OSPL90 (IEC-7)
- OSPL 90 (IEC-0)

Saturation Sound Pressure Level Measurement



Fig. 29 Display window of saturation sound pressure level measurement

The saturation sound pressure level measurement performs the specified number of level sweeps and records the maximum level obtained in each sweep.

Acoustic Measurements on Hearing Aids

The following table lists all available parameters in the generic saturation sound pressure level measurement.

Name	Type	Value	Explanation
battery voltage (V)	Double	1.5	Supply voltage provided at ANLG AUX OUT. Overrides the general setting. "0 V" means "use voltage from general setting".
lower frequency limit (Hz)	Double	200	Start frequency of sweep
upper frequency limit (Hz)	Double	8000	Stop frequency of sweep
number of frequencies	Integer	65	Number of sweep points
lowest input level (dB)	Double	60	Start level of sweep (dBSPL or dB re 1 mA/m)
highest input level (dB)	Double	90	Stop level of sweep (dBSPL or dB re 1 mA/m)
number of levels	Integer	31	Number of level steps in sweep
selective measurement	Boolean	false	„True“: Selective measurement with fast 3rd octave filter
measurement delay (s)	Double	0.02	Pre-delay between sweep Step and measurement trigger, allows for settling of the DUT (e.g. AGC)
inductive	Boolean	false	“False“: Acoustic input, “True“: Inductive input
display curve maximum	Boolean	True	Stipulates whether the absolute curve maximum should be determined
lower limit of max. (dB)	Double	130	
upper limit of max. (dB)	Double	150	
check max limits	Boolean	true	Stipulates whether pass / fail check takes place

Table 2 Available parameters for saturation SPL measurements

The only standard conformal test based on the saturation SPL measurement routine is Saturation SPL (IEC-0).

Harmonic Distortion Measurement

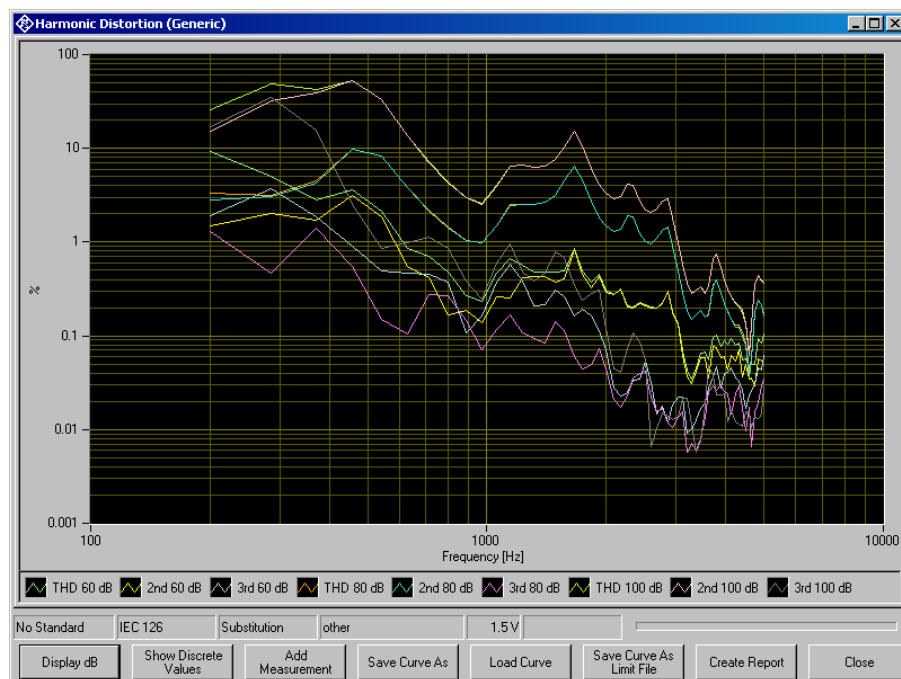


Fig. 30 Curve display of harmonic distortion measurement

The softkey “Display dB” or “Display %”, respectively, allows to toggle between both Y axis units. The softkey “Show Discrete Values” or “Show Curves”, respectively, allows to toggle between curve display and result data table provided that discrete values or curves, respectively, have been measured.

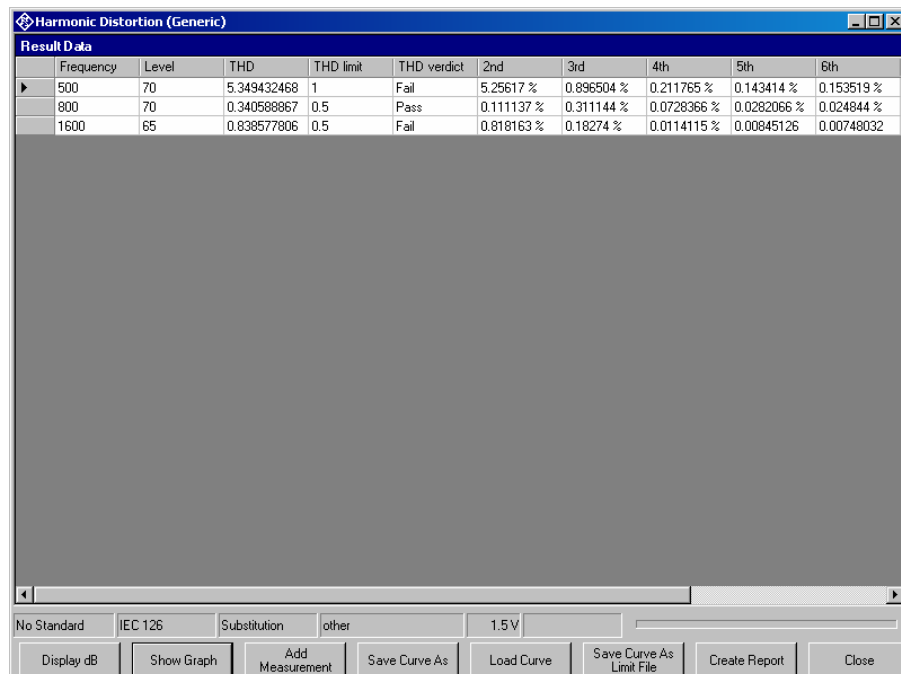


Fig. 31 Data table display of harmonic distortion measurement

Acoustic Measurements on Hearing Aids

The following table lists all available parameters in the generic frequency response measurement:

Name	Type	Value	Explanation
battery voltage [V]	Double	0	Supply voltage provided at ANLG AUX OUT. Overrides the general setting. "0 V" means "use voltage from general setting".
lower frequency limit [Hz]	Double	200	Start frequency of sweep
upper frequency limit [Hz]	Double	5000	Stop frequency of sweep
number of frequencies	Integer	57	Number of sweep points
display result in dB	Boolean	false	"False": Y axis and values in %, "True": Y axis and values in dB
number of sweeps	Parameter count	3	Number of sweeps with level as parameter
sweep 1 level [dB]	Double	60	(dBSPL or dB re 1 mA/m)
sweep 2 level [dB]	Double	80	(dBSPL or dB re 1 mA/m)
sweep 3 level [dB]	Double	100	(dBSPL or dB re 1 mA/m)
measurement delay [s]	Double	0.01	Pre-delay between sweep Step and measurement trigger, allows for settling of the DUT (e.g. AGC)
induction	Boolean	false	"False": Acoustic input, "True": Inductive input
show thd	Boolean	true	Stipulates whether the thd curve is displayed
show 2nd	Boolean	true	Stipulates whether curve of 2 nd harmonic is displayed
show 3rd	Boolean	true	Stipulates whether curve of 3 rd harmonic is displayed
show 4th	Boolean	false	Etc.
show 5th	Boolean	false	
show 6th	Boolean	false	
show 7th	Boolean	false	
show 8th	Boolean	false	
show 9th	Boolean	false	
check limit for sweep no.	Byte	0	Stipulates whether limit curve is checked. "0" means no limit check
number of discrete points	Parameter count	3	Number of discrete measured values
point 1 [Hz], [dB], limit	String	500, 70, 1	Value triples specifying measurements and upper limits
point 2 [Hz], [dB], limit	String	800, 70, 0.5	
point 3 [Hz], [dB], limit	String	1600, 65, 0.5	
check limits	Boolean	true	Stipulates whether limits are checked in discrete measurements

Table 3 Available parameters for harmonic distortion measurements

The following standard conformal tests are based on the harmonic distortion measurement routine:

- Harmonic Distortion (ANSI)
- Harmonic Distortion (IEC-7)
- Harmonic Distortion (IEC-0)

Measurement of Dynamic Behaviour (AGC Settling)

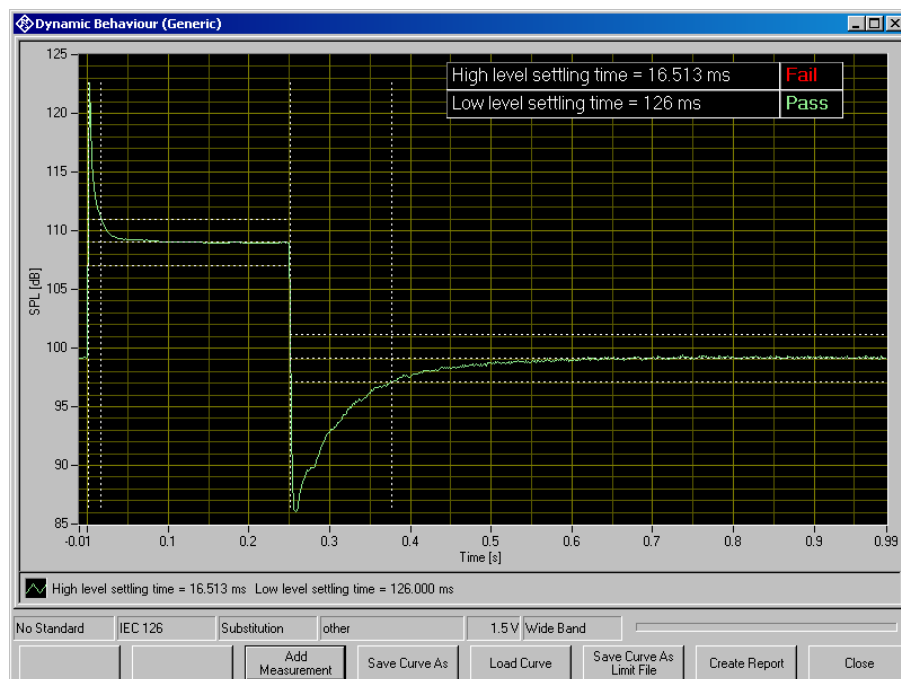


Fig. 32 Measurement window for dynamic behaviour

The following table lists all available parameters in the generic dynamic behaviour measurement:

Name	Type	Value	Explanation
battery voltage (V)	Double	0	Supply voltage provided at ANLG AUX OUT. Overrides the general setting. "0 V" means "use voltage from general setting".
test frequency (Hz)	Double	2000	Frequency of sine burst tone
high level (dB)	Double	80	High level of sine burst (dBSPL or dB re 1 mA/m)
low level (dB)	Double	55	Low level of sine burst (dBSPL or dB re 1 mA/m)
on time (s)	Double	0.25	Duration of high level
interval (s)	Double	1	Period duration of sine burst
selective measurement	Boolean	False	"True": Signal filtered with one octave width around test tone frequency
induction	Boolean	false	"False": Acoustic input, "True": Inductive input
store diagram	Boolean	true	"False": Only values are stored in the database (saves disk space), "True" compressed curve is stored in the database

Acoustic Measurements on Hearing Aids

Name	Type	Value	Explanation
display dB	Boolean	true	"False": Sound pressure on Y axis, "True": SPL on Y axis
attack tolerance (dB)	Double	2	Settling time is determined as the time after which the curve approaches the steady value closer than this difference
attack time lower limit (ms)	Double	20	Lower limit of high settling time for limit check
attack time upper limit (ms)	Double	150	Upper limit of high settling time for limit check
release tolerance (dB)	Double	2	Settling time is determined as the time after which the curve approaches the steady value closer than this difference
release time lower limit (ms)	Double	50	Lower limit of low settling time for limit check
release time upper limit (ms)	Double	300	Upper limit of low settling time for limit check
check limits	Boolean	true	Stipulates whether limits of settling times are checked

Table 4 Available parameters for dynamic behaviour measurements

The following standard conformal tests are based on the dynamic behaviour measurement routine:

- Dynamic Behaviour (ANSI)
- Dynamic Behaviour at High Level (IEC-2)
- Dynamic Behaviour at Speech Level (IEC-2)
- Dynamic Behaviour (IEC-7)

Measurement of Input-Output Characteristics

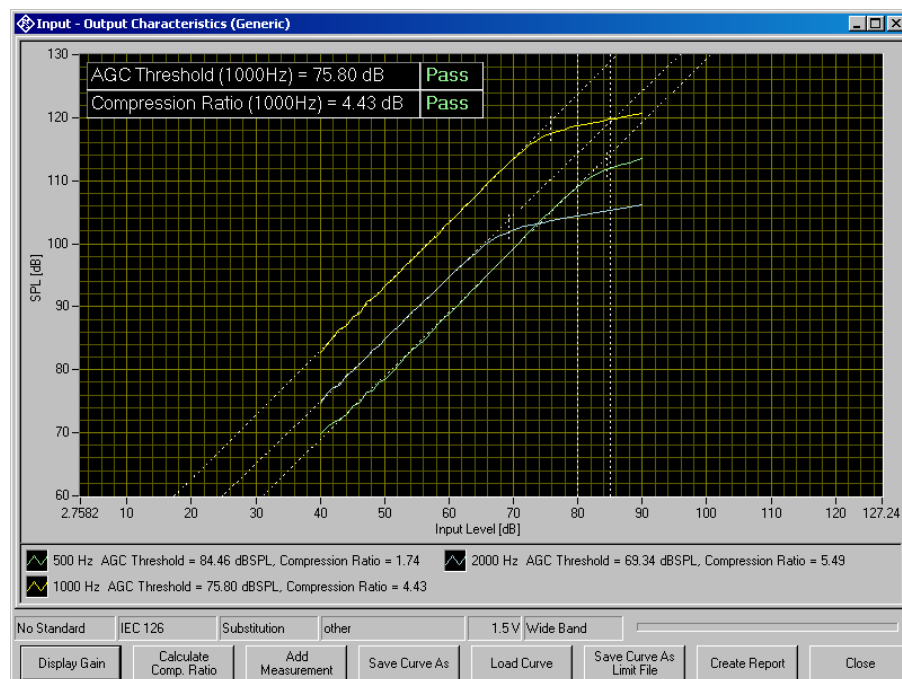


Fig. 33 Measurement window for input-output characteristics

The softkey “Display Gain” or “Display Level”, respectively, toggles the Y axis data between gain and sound pressure level. With the softkey “Calculate Comp. Ratio” a compression ratio may be calculated for any of the measured curves.

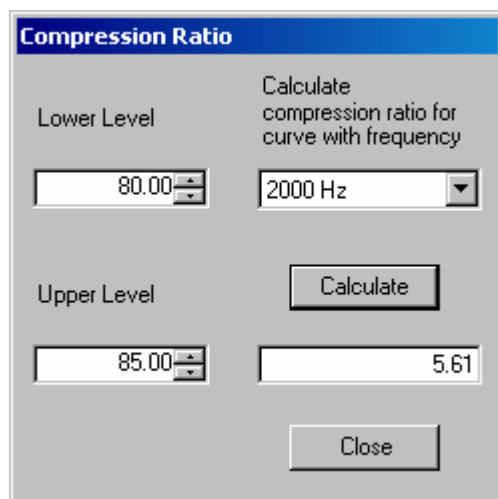


Fig. 34 Window for calculation of compression ratio

With “Lower Level” and “Upper Level” the input levels for the compression ratio calculation are determined. The combo box top right selects one of the measured curves. When the button “Calculate” is clicked, the compression ratio is calculated and displayed in the text box below.

The following table lists all available parameters in the generic input-output measurement:

Name	Type	Value	Explanation
battery voltage (V)	Double	0	Supply voltage provided at ANLG AUX OUT. Overrides the general setting. “0 V ” means “use voltage from general setting”.
lowest input level (dB)	Double	40	Start level of sweep (dB SPL or dB re 1 mA/m)
highest input level (dB)	Double	90	Stop level of sweep (dB SPL or dB re 1 mA/m)
number of level steps	Integer	50	Number of level steps in sweep
display result as gain	Boolean	false	“False”: Level on the Y axis, “True”: Gain on the Y axis
selective measurement	Boolean	False	“True”: selective measurement with fast 3 rd octave filter
number of sweeps	Parameter count	3	Number of sweeps with frequency as parameter
sweep 1 frequency (Hz)	Double	500	
sweep 2 frequency (Hz)	Double	1000	
sweep 3 frequency (Hz)	Double	2000	
measurement delay (s)	Double	0.05	Pre-delay between sweep Step and measurement trigger, allows for settling of the DUT (e.g. AGC)
induction	Boolean	false	“False”: Acoustic input, “True”: Inductive input
calculate values	Boolean	true	“True”: AGC threshold and compression ratio are determined for each curve
AGC threshold upper limit (dB)	Double	80	Upper limit for limit check of AGC threshold

Name	Type	Value	Explanation
AGC threshold lower limit (dB)	Double	60	Lower limit for limit check of AGC threshold
compression input level 1 (dB)	Double	80	Lower input level for compression ratio calculation (dBSPL or dB re 1 mA/m)
compression input level 2 (dB)	Double	85	Higher input level for compression ratio calculation (dBSPL or dB re 1 mA/m)
compression ratio upper limit	Double	8	Upper limit for limit check of compression ratio
compression ratio lower limit	Double	4	Lower limit for limit check of compression ratio
check limit for curve no.	Byte	2	"0" means "don't check"

Table 5 Available parameters for input-output measurements

The following standard conformal tests are based on the measurement routine for input-output characteristics:

- Input-Output characteristics (ANSI)
- Input-Output characteristics (IEC-2)
- Input-Output characteristics (IEC-7)

Measurement of Equivalent Input Noise

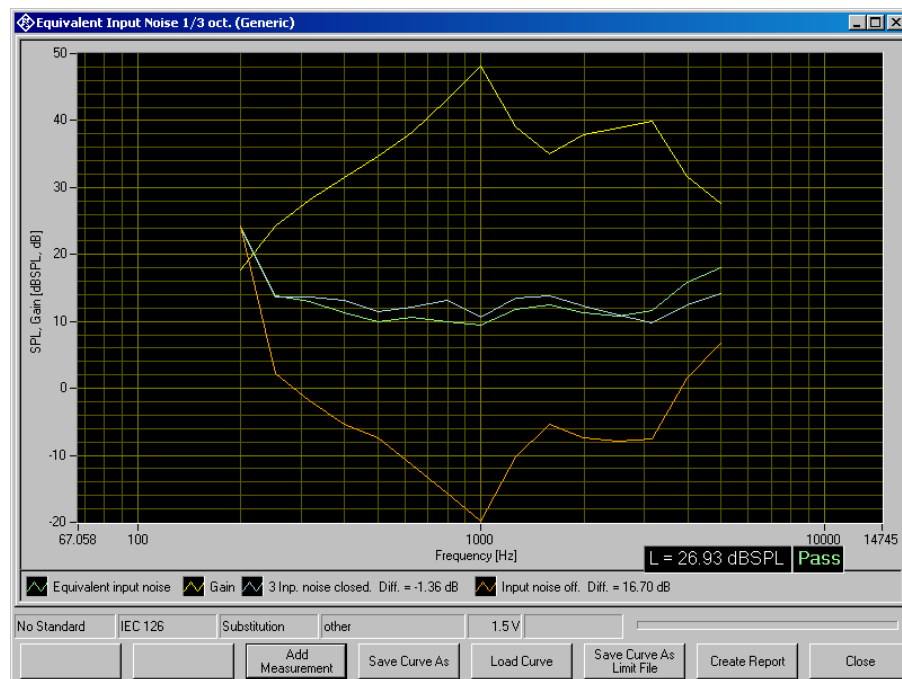


Fig. 35 Measurement window for equivalent input noise

Acoustic Measurements on Hearing Aids

The following table lists all available parameters in the generic measurement of equivalent input noise:

Name	Type	Value	Explanation
battery voltage (V)	Double	0	Supply voltage provided at ANLG AUX OUT. Overrides the general setting. "0 V" means "use voltage from general setting".
lower cutoff freq. (Hz)	Double	175	Lower band limit for wideband noise measurement
upper cutoff frequency (Hz)	Double	5650	Upper band limit for wideband noise measurement
gain test input level (dB)	Double	60	Level for measurement of gain (dBSPL or dB re 1 mA/m)
integration time (s)	Double	1	Integration time for noise measurement
pre-delay (s)	Double	0	Pre-delay between sweep Step and measurement trigger, allows for settling of the DUT (e.g. AGC)
induction	Boolean	False	"False": Acoustic input, "True": Inductive input
number of HFA frequencies	Parameter count	1	Number of frequencies averaged for gain measurement
HFA frequency 1 (Hz)	Double	1600	
check closed input	Boolean	True	"True": Repeat noise measurement with sealed input and check level difference
max level difference (dB)	Double	1	Maximum acceptable noise level difference between input open and input sealed
check off	Boolean	True	"True": Repeat noise measurement with hearing aid switched off
min. level difference (dB)	Double	10	Minimum acceptable noise difference between hearing aid switched of and hearing aid switched on with input open
maximum noise level (dBSPL)	Double	40	Maximum noise level for pass/fail check
check limits	Boolean	True	Stipulates whether limit should be checked
display spectrum	Boolean	True	"True": Noise spectrum is measured with a sweep of a fast 3 rd octave filter
lower frequency (Hz)	Double	200	Lowest 3 rd octave center frequency
upper frequency (Hz)	Double	5000	Highest 3 rd octave center frequency
number of frequencies	Double	15	Number of 3 rd octaves measured, must match the number of 3 rd octaves including the lowest and highest one

Table 6 Available parameters for equivalent input noise measurements

The following standard conformal tests are based on the measurement routine for equivalent input noise:

Equivalent Input Noise (ANSI)
 Equivalent Input Noise 1/3 oct. (IEC-0)
 Equivalent Input Noise (IEC-7)

Battery Current Measurement

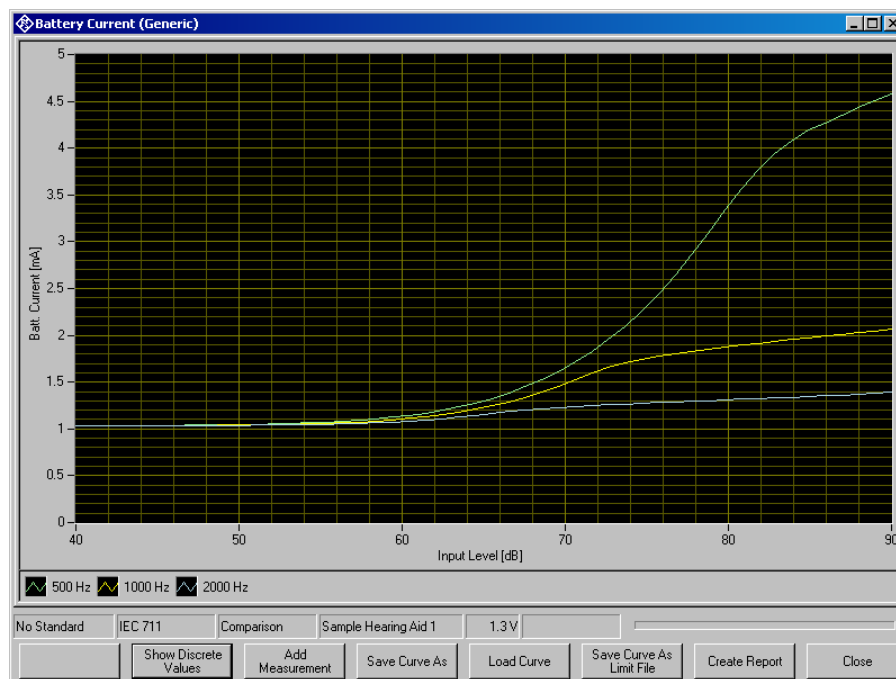


Fig. 36 Graphic display of battery current measurement

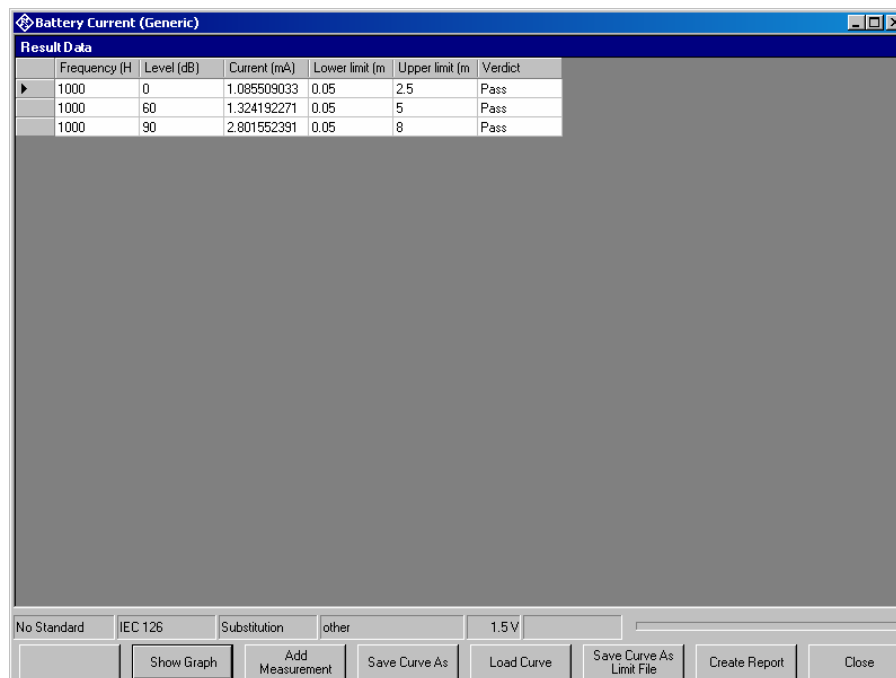


Fig. 37 Value table display of battery current measurement

The softkey "Show Discrete Values" or "Show Graph", respectively, toggles between the graph view and the data table view of the measurement window.

Acoustic Measurements on Hearing Aids

The following table lists all available parameters in the generic battery current measurement:

Name	Type	Value	Explanation
battery voltage (V)	Double	0	Supply voltage provided at ANLG AUX OUT. Overrides the general setting. "0 V" means "use voltage from general setting".
lowest input level (dB)	Double	40	Start level of sweep (dBSPL or dB re 1 mA/m)
highest input level (dB)	Double	90	Stop level of sweep (dBSPL or dB re 1 mA/m)
number of level steps	Integer	50	Number of level steps in sweep
number of sweeps	Parameter count	3	Number of sweeps with frequency as parameter
sweep 1 frequency (Hz)	Double	500	
sweep 2 frequency (Hz)	Double	1000	
sweep 3 frequency (Hz)	Double	2000	
measurement delay (s)	Double	0.05	Pre-delay between generator setting and measurement trigger, allows for settling of the DUT (e.g. AGC)
induction	Boolean	false	"False": Acoustic input, "True": Inductive input
check limits for curve no	Byte	2	"0" means "don't check"
number of discrete points	Parameter count	3	Number of discrete measured values
point 1 (Hz), (dB), lower limit, upper limit	String	1000, 0, 0.05, 2.5	Value triples specifying measurements and upper limits
point 2 (Hz), (dB), lower limit, upper limit	String	1000, 60, 0.05, 5	
point 3 (Hz), (dB), lower limit, upper limit	String	1000, 90, 0.05, 8	
check limits	Boolean	true	Stipulates whether limits are checked in discrete measurements

Table 7 Available parameters for battery current measurements

The following standard conformal tests are based on the battery current measurement routine:

- Battery Current (ANSI)
- Battery Current (IEC-0)
- Battery Current (IEC-7)

Routine for Reference Test Gain Setting

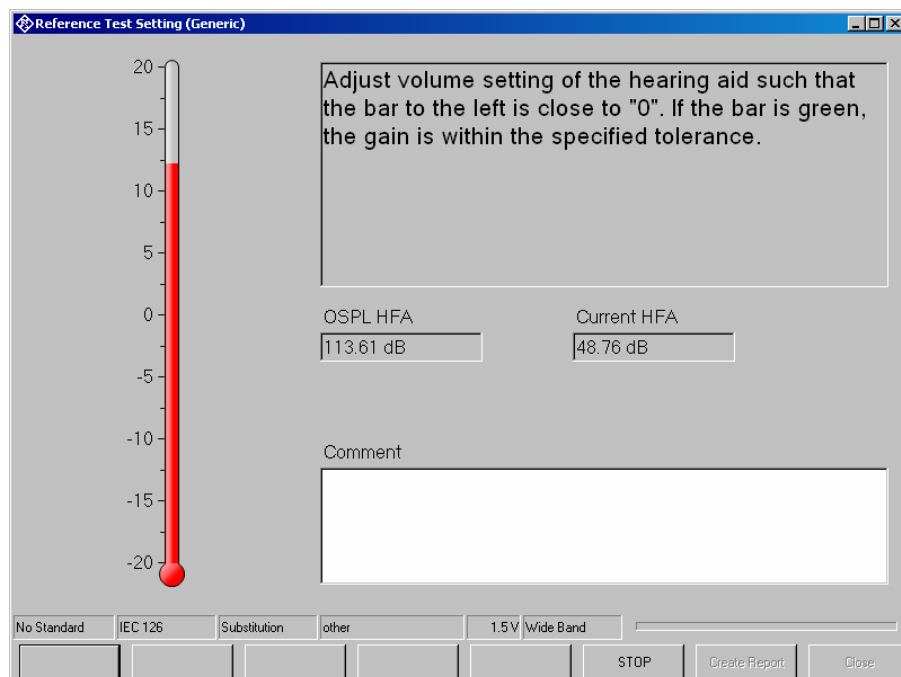


Fig. 38 Initial display of the routine for reference test gain setting

At start of the macro, the full-on gain or output SPL is measured and averaged at the specified HFA frequencies. From this value a target level is calculated.

The gain of the hearing aid at the specified frequencies is repeatedly measured until the “STOP” button is clicked. The thermometer shows the deviation from the target value. If the deviation becomes smaller than 3 dB, the scale is enlarged. The colour of the thermometer is red as long as the deviation is higher than the allowed tolerance and turns green as soon as the deviation is within tolerance.

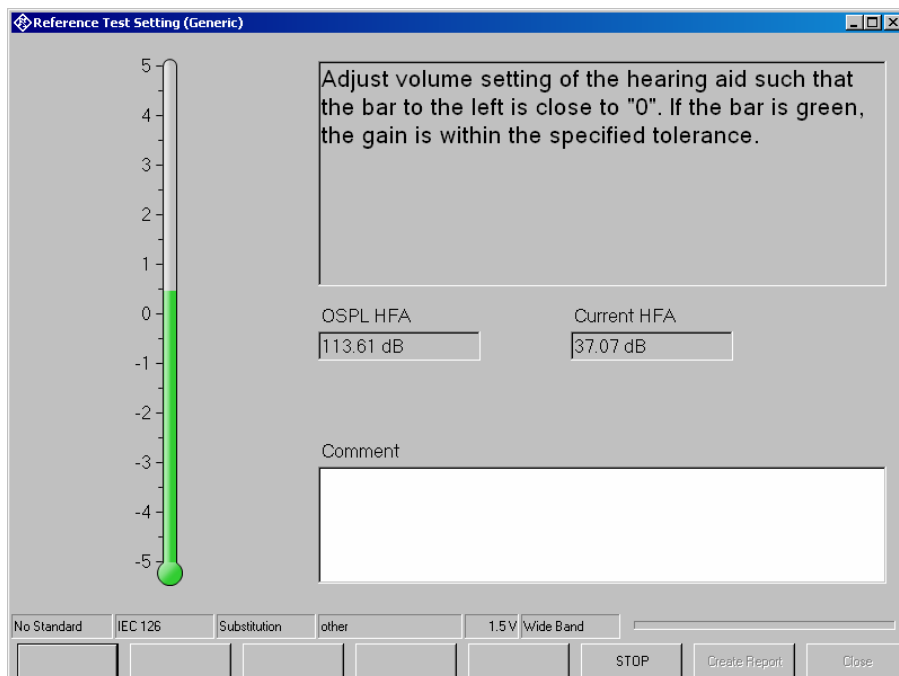


Fig. 39 Display of the routine for reference test gain setting, adjusted

A comment to be printed with the report (e.g. setting of the gain control) may be entered in the “Comment” field.

The following table lists all available parameters for reference test gain setting:

Name	Type	Value	Explanation
battery voltage (V)	Double	0	Supply voltage provided at ANLG AUX OUT. Overrides the general setting. “0 V” means “use voltage from general setting”.
selective measurement	Boolean	false	“True”: selective measurement with fast 3 rd octave filter
OSPL as gain	Boolean	false	Stipulates whether the full-on value is measured as gain or as level
OSPL (dB)	Double	90	Input level for the full-on measurement
RTS as gain	Boolean	true	Stipulates whether the value during adjustment is measured as gain or as level
RTS level (dB)	Double	60	Input level during adjustment (dBSPL or dB re 1 mA/m)
measurement delay (s)	Double	0	Pre-delay between generator setting and measurement trigger, allows for settling of the DUT (e.g. AGC)
induction	Boolean	false	“False”: Acoustic RTS input, “True”: Inductive RTS input, OSPL measurement is always acoustic
number of HFA frequencies	Parameter count	3	Number of frequencies averaged for gain measurement
HFA frequency 1 (Hz)	Double	1000	
HFA frequency 2 (Hz)	Double	1600	
HFA frequency 3 (Hz)	Double	2500	
level difference (dB)	Double	-77	Difference between target value and full-on value

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Name	Type	Value	Explanation
upper tolerance (dB)	Double	1.5	Maximum allowed difference between value during adjustment and target value
lower tolerance (dB)	Double	-1.5	Minimum allowed between value during adjustment and target value

Table 8 Available parameters for the reference test gain setting

The following standard conformal tests are based on the reference test gain setting routine:

Reference Test Setting (ANSI)
Reference Test Setting (IEC-0)
Reference Test Setting (IEC-7)

7 Automatic Test Sequences



Fig. 40 Sequence menu

Creating and Editing a Sequence

The menu item “Sequence → New” first produces a window where a name for the new sequence has to be entered. Subsequently the sequence window opens.

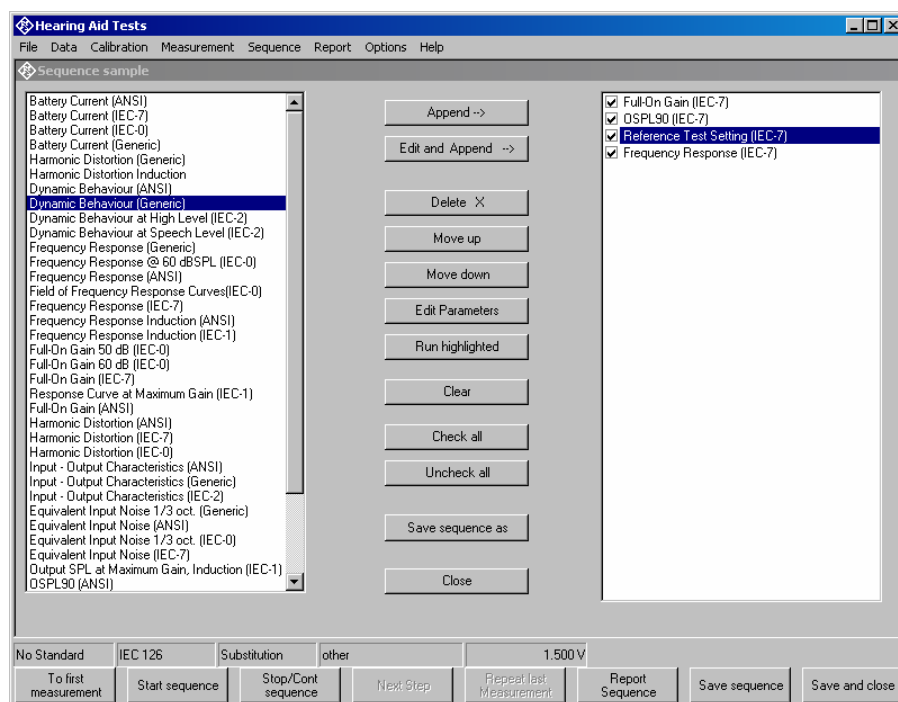


Fig. 41 Sequence window

Initially the right checked list box is empty. The list box on the left side displays all available measurement definitions. A measurement is appended to the sequence by highlighting it in the list box on the left side and clicking the “Append” button. Subsequently a measurement, which is highlighted in the checked list box on the right side, can be moved within the sequence using the buttons “Move up” and “Move down” and deleted from the sequence with the “Delete X” button. It is possible to edit parameters which are not defined by the standard before appending the measurement to the sequence. This is done by clicking the button “Edit and append”. It is for example possible to assemble a test sequence which repeats a certain test with different battery voltages.

Opening an Existing Sequence

The menu item “Sequence → Open ...” opens a file selector for specifying the sequence to be loaded. The sequence window opens with the specified sequence loaded. The sequence can then be edited and/or run.

Running a Sequence

When the softkey “Start sequence” is pressed, all checked measurements in the right list box are executed in sequence. The state of the checkboxes may be altered by marking a measurement and then clicking on the checkbox.

Running a Single Measurement within a Sequence

When the softkey “Run highlighted” is pressed, the measurement currently selected in the right checked list box is executed regardless of its checked state. Results are added to the result database, however the measurement started this way will not appear in the sequence report. This allows to use sequences as customized sets of measurements which can be stored and opened later again.

Reporting on Sequence Results

A report on all executed measurements of the last run sequence is prepared and displayed after the “Report Sequence” softkey has been pressed. After the sequence window has been closed, a report on the last sequence can be obtained by pressing the “Report last sequence” softkey in the main window.

8 Reporting, Storing, Loading and Deleting Results

Result Files

Measurement results are stored together with all associated data in XML files. Separate files can be used for different projects or operators. They can be archived together with other project data and re-opened later for generating reports.

It is recommended to keep result files small and to generate backups at frequent intervals.

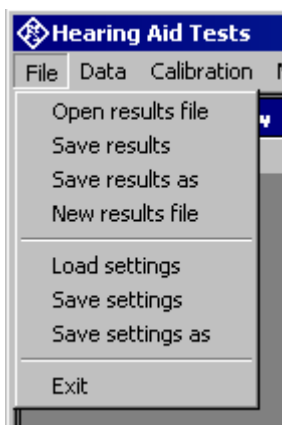


Fig. 42 File menu

A new (empty) result file can be created with “File → New Result File” from the main menu.

An existing result file can be opened with “File → Open Result File” from the main menu.

A currently opened result file can be stored under a new name with “File → Save results as” from the main menu.

Report Settings

With “Report → Settings” or “Options → Report settings”, a selection can be made of data which should appear in the reports. Thus, information which is the same for a larger number of measurements does not have to be printed with every report again.

Generating a Single Report

A report on a single measurement result can be generated from the window of a measurement macro by clicking or pressing the softkey “Generate report”.

From the result overview of the main window, a report on a single measurement can be generated by marking the row with the selected result by clicking on the row header to the left, right-clicking into the data grid and selecting “Generate report” from the context menu.

Subsequently data associated with the selected measurement is assembled, a graph for existing curve data is generated, and the preview

window is opened. Depending on the amount of measurement data, this may take a few seconds.

Generating a Sequence Report

A report on a sequence of measurements can be generated from the sequence window by clicking or pressing the softkey "Report sequence".

Once the sequence window has been closed, a report on the last executed sequence can be generated by selecting "Report → Last sequence" from the main menu. Reports about previous sequences can be generated as single reports on the measurements of this sequence, as all results appear in the overview data grid in the main window.

Preview Window

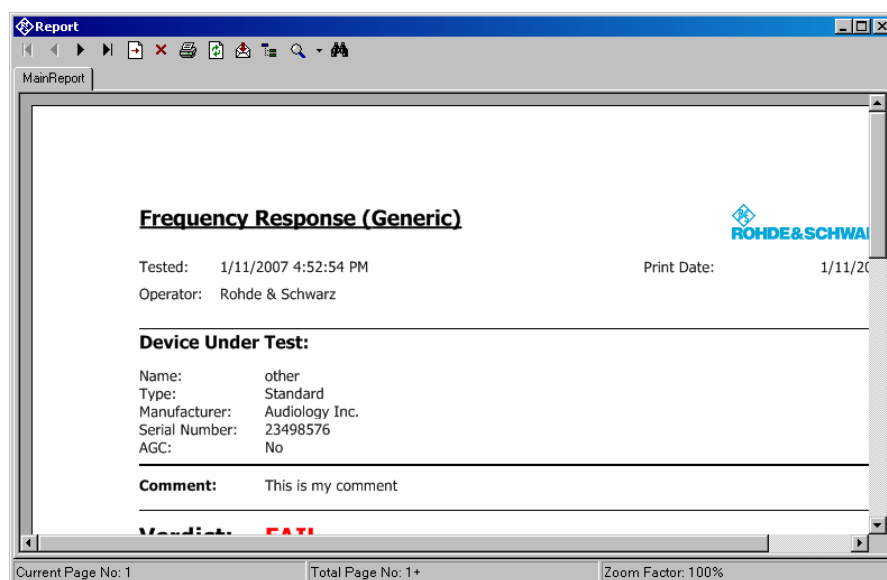


Fig. 43 Report preview window

The main area of the preview window shows a preview of the report as it will be printed or appear in an exported PDF file. If the report comprises more than one page, the pages can be browsed using the buttons



To open the print dialog for installed windows printers click



To open a file selector for export of the report to PDF, WORD, EXCEL or Rich Text format, click



The scale of the document in the preview can be adjusted with

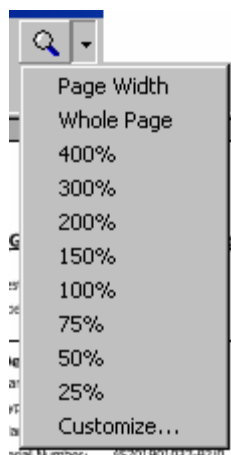


Fig. 44 Scale menu of the preview window

Storing and Loading Curves

Measured curves can be stored from and loaded into the graph of a measurement macro (see above). This allows easy import into spreadsheets as well as direct comparison of curves measured at different times or places. Measured curves can also be stored in a R&S UPV limit file for use as a limit curve either in a R&S UPV sweep graph or in the graph of a R&S UPV-K7 window. This allows e.g. to derive tolerance schemes from “golden devices”. The measured curve can be arbitrarily shifted before being stored.

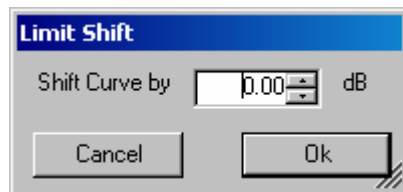


Fig. 45 Input window for defining a shift of a measured curve for storage as limit curve

Deleting Results

It may be desirable to delete results of selected measurements from the result file, e.g. because the measurement was repeated due to the hearing aid being switched off, a wrong setting etc. To delete the result of a particular measurement, mark the row for the selected measurement in the data grid of the main window by clicking on the row header to the left, right-click into the data grid and select “Delete result” from the context menu. After confirmation by the operator, the selected row of the result overview will be deleted from the result file together with all associated data (except data also associated with other measurement results).

Automatic Backup and Restoration of the Results File

In order to speed up the execution of sequences, the result file is only saved when the program is closed. However, backups of the result file called “*.xml~1” and “*.xml~2” are stored alternately after termination of each single measurement and after termination of each sequence (“*” stands for the name of the results file without extension). If the program is ended without closing it properly, or if the result file is not existing anymore, the R&S UPV-K7 will by the time of its next start offer to restore the result file from the latest backup file:

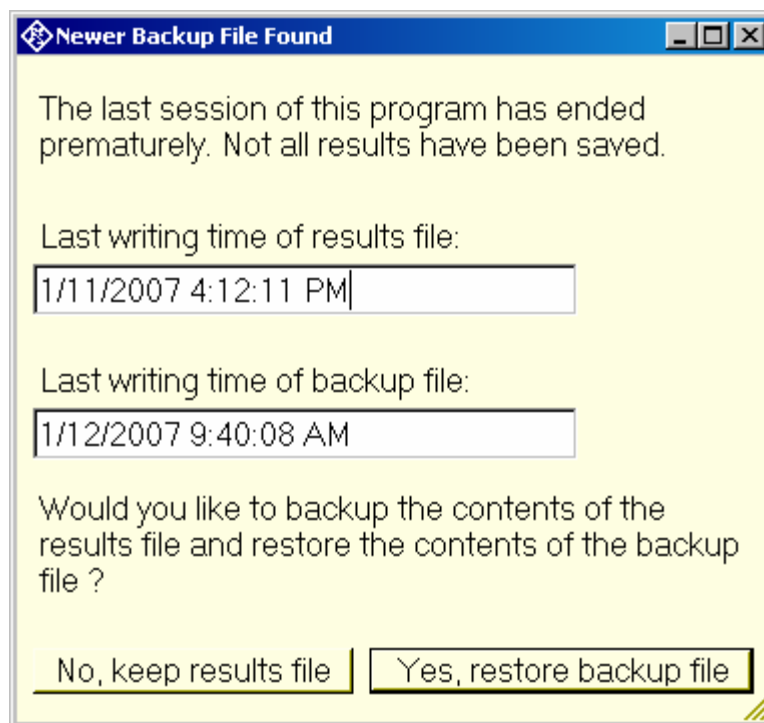


Fig. 46 Restoration of data from backup file

If it is chosen to restore the result file from the backup, the supposedly damaged result file is copied to “*.xml~3” before the backup file is copied to the original name of the results file.

9 Terminating the Application

The measurement can be terminated from the main window with the “Exit” softkey. This causes the result file to be written to the hard disk.