



ROHDE & SCHWARZ

Test and Measurement
Division

Operating Manual

MOBILE PHONE TEST SET

UPL-B8

1117.3505.02

Version 2.02

Printed in the Federal
Republic of Germany

Contents

1 Introduction..... 3

2 Preparation 4

Required Measuring Instruments and Accessories..... 4

Installing the Software 6

Test Setup 7

Starting the Application Software 7

Configuring the Application..... 8

Setup Conversion for Firmware Updates 8

3 Operating Concept 9

4 Measurements..... 11

General..... 11

Notes on Individual Measurements 12

Sending Frequency Response and Loudness Rating 12

Sending Frequency Response 12

Sending Loudness Rating 13

Receiving Frequency Response and Loudness Rating..... 14

Receiving Frequency Response 14

Receiving Loudness Rating..... 15

Sidetone Masking Rating STMR 16

Listener Sidetone Rating LSTR 17

Echo Loss..... 18

Stability Margin 19

Sending Distortion 19

Receiving Distortion..... 20

Idle channel noise sending 21

Idle channel noise receiving 21

5 Calibration Routines 23

Calibration of artificial ear 23

Calibration of ear type 3.2 low leakage 24

Calibration of ear type 3.2 low leakage 25

Calibration of ear type 3.3 26

Calibration of ear type 3.4 27

6 Processing of Measurement Results..... 30

Printing, Storing and Displaying of Measurement Results 30

7 Terminating the Application 32

Appendix A: After the installation of the UPL-B8 software option the generator provides an additional function named RANDOM+ANLR.

Appendix B: Differences between UPL-B8 firmware versions 2.02 and 2.01



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



Safety Instructions

Rohde & Schwarz makes every effort to keep the safety standard of its products up to date and to offer its 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. This product 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, Rohde & Schwarz 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 operating manual and within its performance limits (see data sheet, documentation, the following safety instructions). Using the products requires technical skills and knowledge of English. It is therefore essential that the products 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 operating instructions	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 other parts of the documentation. In these safety instructions, the word "product" refers to all merchandise sold and distributed by Rohde & Schwarz, including instruments, systems and all accessories.

Tags and their meaning

DANGER	This tag indicates a safety hazard with a high potential of risk for the user that can result in death or serious injuries.
WARNING	This tag indicates a safety hazard with a medium potential of risk for the user that can result in death or serious injuries.
CAUTION	This tag indicates a safety hazard with a low potential of risk for the user that can result in slight or minor injuries.
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. It is therefore essential to make sure that the tags described here are always used only in connection with the associated documentation and the associated product. The use of tags in connection with unassociated products or unassociated documentation can result in misinterpretations 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 max. 2000 m. 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 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 (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. 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.
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 $V_{rms} > 30 V$, 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. Never remove the cover or part of the housing while you are operating the product. This 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 skilled 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 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. 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 are hazardous waste. Dispose of them only in specially marked containers. Observe local regulations regarding waste disposal. Do not short-circuit batteries or storage batteries.
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. Please be aware of the weight of the product. Be careful when moving it; otherwise you may injure your back or other parts of your body.
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 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



Informaciones de seguridad

Es el principio de Rohde & Schwarz de tener a sus productos siempre al día con los standards de seguridad y de ofrecer a sus 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. Este 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, deberá el usuario atenerse a todas las informaciones, informaciones de seguridad y notas de alerta. 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 maluso del producto.

Se parte del uso correcto del producto para los fines definidos si el producto es utilizado dentro de las instrucciones del correspondiente manual del uso y dentro del margen de rendimiento definido (ver hoja de datos, documentación, informaciones de seguridad que siguen). El uso de los productos hace necesarios conocimientos profundos y el conocimiento del idioma inglés. Por eso se deberá tener en cuenta de exclusivamente autorizar para el uso de los productos a personas péritas 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 manual de instrucciones del uso	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 otro capítulo de esta documentación y que también son obligatorias de seguir. En las informaciones de seguridad actuales hemos juntado todos los objetos vendidos por 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	Indica un punto de peligro con gran potencial de riesgo para el usuario. Punto de peligro que puede llevar hasta la muerte o graves heridas.
ADVERTENCIA	Indica un punto de peligro con un potencial de riesgo mediano para el usuario. Punto de peligro que puede llevar hasta la muerte o graves heridas .
ATENCIÓN	Indica un punto de peligro con un potencial de riesgo pequeño para el usuario. Punto de peligro que puede llevar hasta heridas leves o pequeñas
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 ámbito de la comunidad económica europea. Pueden existir definiciones diferentes a esta definición. Por eso se debiera tener en cuenta que las palabras de señal aquí descritas sean utilizadas siempre solamente en combinación con la correspondiente documentación 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.
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 périto 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. Despues de cada recambio de partes elementales para la seguridad deberá ser efectuado un control de

Informaciones de seguridad

- seguridad (control a primera vista, control de conductor protector, medición de resistencia de aislamiento, medición de medición de la corriente conductora, control de funcionamiento).
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 está comprometido a valorar y señalar áreas de trabajo en las que se corra un riesgo de exposición a radiaciones aumentadas de riesgo aumentado 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 ya que 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 (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. 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.
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 $U_{eff} > 30 \text{ V}$ 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. Nunca abra la tapa o parte de ella si el producto está en funcionamiento. 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, deberá la toma de corriente estar protegida de manera que los productos o los usuarios 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 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. Si las baterías o los acumuladores no son cambiados con la debida atención existirá peligro de explosión (atención celulas de Litio). Cambiar las baterías o los acumuladores solamente por los del tipo R&S correspondiente (ver lista de piezas de recambio). Baterías y acumuladores son deshechos problemáticos. Por favor tirenlos en los recipientes especiales para este fin. Por favor tengan en cuenta las prescripciones nacionales de cada país referente al tratamiento de deshechos. Nunca sometan las baterías o acumuladores a un corto circuito.
28. Tengan en consideración de que en caso de un incendio pueden escaparse gases tóxicos del producto, que pueden causar daños a la salud.
29. 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.
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 sujecion 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 y 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 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.

1 Introduction

The acoustic transmission and reproduction quality of a mobile phone is its most important characteristic in every-day use. The most visually appealing design or a wonderfully sophisticated means of operation are not much use, when the operator user hardly understand what is being said at the other end.

Instruments and procedures for measuring acoustic characteristics are therefore essential tools for determining the quality and suitability of a mobile.

The special Audio Analyzer UPL16 was developed for acoustic measurements for the type approval of GSM mobiles. It performs all audio measurements in line with chapter 30 of GSM 11.10 on special test mobiles which are provided with a digital audio interface (DAI).

There is however great interest in testing mobiles without a DAI. Trade journals, consumer test institutes, or GSM network operators are particularly interested in measuring and comparing acoustic characteristics of commercial mobiles. Network operators, for instance, must be able to check customer complaints or test the quality of supplied phones. A highly accurate test method is also required in the quality assurance of commercial mobiles and for sampling inspection in production.

Mobile Phone Test UPL-B8 of Audio Analyzer UPL is now available for these applications. With the aid of this option all the necessary audio measurements can be performed on conventional GSM mobiles without the DAI interface.

2 Preparation

Required Measuring Instruments and Accessories

The Audio Analyzer UPL with the following options is required :

- Extended Analysis Functions UPL-B6
- Universal Sequence Controller UPL-B10
- Mobile Phone Test UPL-B8 version 2.0

The GSM test mobile is driven by Digital Radiocommunication Tester CMD or CMU via the RF interface. The radiocommunication tester simulates a base station for the mobile so that a call can be set up. Depending on the required GSM band, CMD52, CMD55, CMD65 or CMU200 is used. The selected radiocommunication tester must be equipped with a real-time speech coder/decoder option.

Acoustic devices such as an artificial mouth, artificial ear and other accessories, are also required for the measurements. The following equipment from Brüel & Kjaer or G.R.A.S. is normally used:

Device	Description	Type
Telephone Test Head	Device for fixing the DUT in the prescribed position	B&K 4602B
Ear Simulator	Measuring microphone with adapters for connection to the ear piece of the DUT	B&K 4185 (type 1)
Wideband Ear Simulator	Measuring microphone with adapters for connection to the ear piece of the DUT	B&K 4195 (type 3.2)
Artificial Mouth	Special loudspeaker for simulation of the mouth	B&K 4227
Acoustic Calibrator	Sound level calibrator for measuring microphone	B&K 4231
Microphone Power Supply	Power supply and preamplifier for the measuring microphone	B&K 2690A0S2 or G.R.A.S. AA12

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 at least 20 dB. A low-noise power supply such as AA12 from G.R.A.S is preferable.*

Acoustic Measurements on GSM Mobile Phones

A cable with BNC connector and a special angled banana plug is required for connecting the artificial mouth, as the space between the mouth connector and the test rack is too small for common banana plugs.

The transformer supplied with option UPL-B8 is connected between generator output 1 of Audio Analyzer UPL and the connector of the artificial mouth. The transformer matches the impedance of the loudspeaker in the artificial mouth to that of the UPL generator. Without this transformer the available power is too low for driving the artificial mouth.

Alternatively an amplifier can be connected between generator output and mouth instead of the transformer.

A cable with male (analyzer) and female (generator) XLR connector is supplied for connection to the multi-function connector of the Digital Radiocommunication Tester CMD.

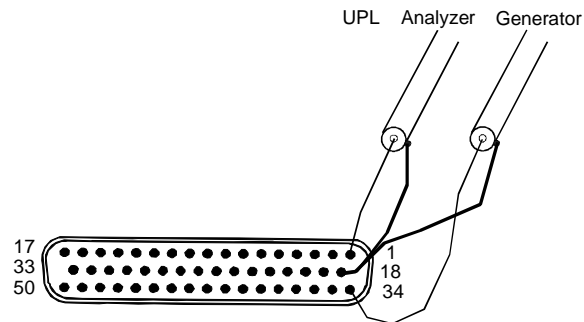


Fig. 1 Assignment of 50-contact multipoint connector at CMD front panel

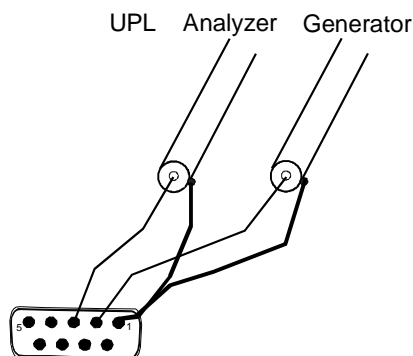


Fig. 1a Assignment of 9-contact, speech connector on CMU front panel

An external PC keyboard must also be connected to the UPL (large DIN connector). A driver for country-specific keyboards can be defined in the C:\UPL\USERKEYB.BAT file, see the UPL manual Chap. 2.15.4.

The BASIC program required for automatic sequence control and the files for generating the artificial voice are on the three floppies supplied with option UPL-B8. The audio analyzer should meet the following firmware requirements:

- UPL firmware version 2.02 or higher
- Extended Analysis Functions option UPL-B6 installed
- Universal Sequence Controller option UPL-B10 installed
- Mobile Phone Test option UPL-B8 version 2.0 installed (will be done automatically during the installation of the software)
- UPL configured with 64 Kbyte program memory and 32 Kbyte data memory for automatic sequence control (using configuration tool UPLSET setting 3).

Installing the Software

The application software be installed with the aid of the PHONINST.BAT installation program on program floppy 1. The installation number of the optional Mobile Phone Test UPL-B8 must be known.

Caution: *The software can only be installed on the specified Audio Analyzer UPL with matching serial number.*

- **Quit the measurement software by pressing the SYSTEM key on the instrument or Ctrl + F9 on the keyboard**
- **Insert floppy No. 1**
- **Select floppy disk drive (enter A:)**
- **Call the installation program (enter PHONINST)
You are requested to enter the installation number of option UPL-B8**
- **Enter the installation number supplied with option UPL-B8. If the number does not match the serial number of the UPL, the installation is aborted.**
- **Insert floppy No. 2 when asked and press any key**
- **Insert floppy No. 3 when asked and press any key**
- **Return to UPL program (enter C:\UPL)
The PHONINST program creates the C:\PHONETST directory in the audio analyzer (if it is not already available) and copies the BASIC program, the artificial voice and all setups and files required for the application into this directory.**

Test Setup

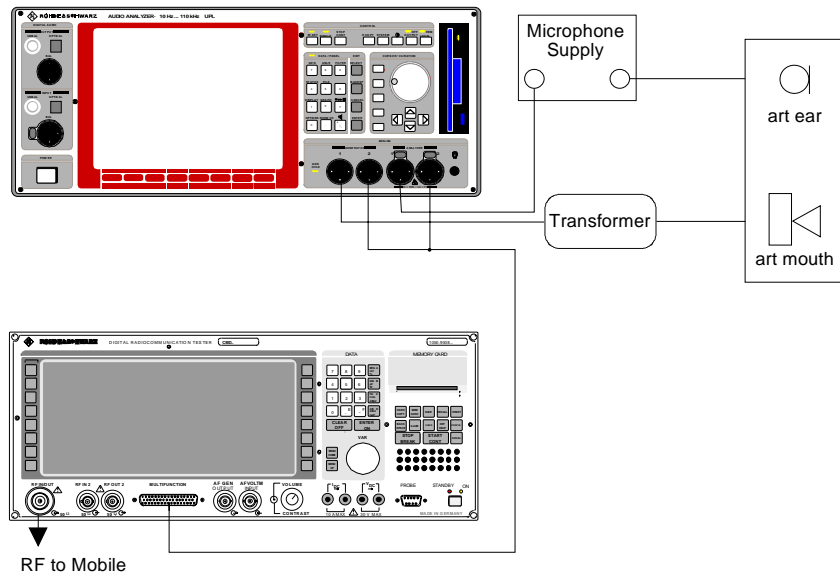


Fig. 2 Test setup and connection of external components

Starting the Application Software

The application program is executed by the automatic sequence control. The audio analyzer is switched to automatic sequence control using the F3 key (on the external keyboard).

The logging function is switched off; check set "logging off" is displayed at the bottom right of the screen; toggle logging on and off with F2. With the logging function on, all commands entered in the manual mode would be appended to the program and so use up memory.

The application programs are called from path C:\PHONETST in order to find all the required program routines and setups. The path can be changed in any of the following ways:

- in the manual mode with the "Working Dir" command in the FILE panel
- by calling one of the setups required for measurements on the mobile
- in the automatic sequence control mode with the BASIC command line
UPL OUT "MMEM:CDIR 'C:\PHONETST"
- under BASIC with the SHELL command by entering CD\PHONETST and pressing ENTER
- at DOS level by entering CD\PHONETST.

Acoustic Measurements on GSM Mobile Phones

Program floppy 1 contains the BASIC program GSM_TST.BAS for measurements on GSM mobiles. It is loaded and started by entering:

- LOAD"GSM_TST"
- RUN

The softkeys displayed at the bottom of the screen in the automatic sequence control mode can be used instead.

Configuring the Application

"Default-Printer" is factory set in the OPTION panel. This means that the printer configuration does not depend on the setup, the printer last used by the audio analyzer remains configured. New settings need not therefore be made by the user. It is useful to select the desired printout with type, format, and scaling in manual mode before the program is started. All subsequent printouts triggered with the hardcopy key will then be printed with these settings.

IMPORTANT: *Correct execution of the software cannot be guaranteed if settings in the setup are changed!*

Setup Conversion for Firmware Updates

For an update of the UPL firmware, the setups may have to be converted. This is done automatically when the setup is loaded, but the conversion delays the loading. To avoid the delay, the setups can be converted before the application software is started; at DOS level call the UPL conversion program:

```
DO_CONV \PHONETST
```

This converts all setups in the PHONETST directory.

3 Operating Concept

Softkeys are displayed at the bottom of the screen for operation and test program selection. The softkey functions are also assigned to hardkeys on the external keyboard so that the keyboard can be used for selecting program routines.

After the program has been started, the title page:

"Measurement of
GSM Mobiles
via Speech Codec
with Audio Analyzer UPL
"select Comm Tester used"

and the following softkey line are displayed:

F5	F6	F7	F8	F9	F10	F11	F12
	CMD	CMU	CRTx				

After selection of the radiocommunication tester the following softkey line is displayed:

"Selection of Ear Type used"

F5	F6	F7	F8	F9	F10	F11	F12
	TYPE 1	TYPE 3.2L	TYPE 3.2H	TYPE 3.3	TYPE 3.4		

Press F6 CONT, the following message is displayed on the screen:

"Please establish call to Mobile and set CMD to Speech Mode Handset"

Note: *In the text below CMD is assumed to be selected. With another tester selected, modified text items may be displayed.*

To do so press the MANUAL TEST key on the CMD and then switch on the mobile. After successful registration, press the CALL TO MOBILE key on the CMD or dial a number on the mobile and press the transmit key.

The following softkey line are displayed:

F5	F6	F7	F8	F9	F10	F11	F12
	CON						

Press F6 CONT, the following message is displayed:

"Measurement of GSM Mobiles via Speech Codec with Audio Analyzer UPL"

"Select Test to be performed"

Acoustic Measurements on GSM Mobile Phones

The measurements on the test mobile can now be started as all required calibration values are stored in the UPL.

During the initial installation of the test setup, the microphone in the artificial ear and the artificial mouth have to be calibrated (see "Calibration Routines" on page). In this case the message requesting a call setup to the test mobile can be skipped with CONT.

To select the individual measurements, softkeys F5 to F12 with abbreviations for the measurement names are displayed.

F5	F6	F7	F8	F9	F10	F11	F12
END	SEND	RECEIVE	STMR	LSTR	ECHO	STAB-MRG	→

A click on the respective key starts the test routine. Since there are more selection items than softkeys, the next set of softkey definitions are called with F12.

F5	F6	F7	F8	F9	F10	F11	F12
←	DIST_SND	DIST_REC	IDLE_SND	IDLE_REC			→

CALIBRATION**EXP-FILES**

F5	F6	F7	F8	F9	F10	F11	F12
←	EAR	MOUTH					DELETE

If F12 shows an arrow towards the right, press F12 to see the next set of softkey definitions. Press F5 showing an error towards the left to go back to the previous set. At the lowest level F5 shows END. After pressing F5 END the query "Do you really want to quit?" is displayed and the program can be quit.

4 Measurements

General

Special problems are encountered when measuring acoustic characteristics, caused by the GSM coder and decoder algorithms.

In type-approval tests, where highly accurate measurements are required, the coder and decoder are excluded from the measurement, as test mobiles are equipped with a digital audio interface DAI for the transmission of audio signals with linear PCM coding. Audio Analyzer UPL16 is also equipped with a DAI interface, so that direct transmission of the test signal to and from the mobile is possible. In commercial mobiles measurements during normal operation can only be performed via the air interface with the voice coder and decoder included. A so-called vocoder is used to attain the lowest possible data rate, only the filter and fundamental parameters required for signal reconstruction are transmitted, not the actual voice.

Standard measurements using sinusoidal tones cannot be performed because the static sinusoidal input signal becomes a more or less stochastic output signal as a result of coding, particularly in the medium and high audio frequency ranges. If, for instance, a tone of approx. 2.5 kHz is applied to the telephone with a constant sound pressure, the amplitude of the signal obtained at the decoder output varies by approx. 20 dB, which makes the signal unsuitable for measurements.

With frequencies up to slightly above 1 kHz, the sinusoidal tone is transmitted with sufficient stability to allow common distortion measurements to be performed at 1 kHz using a sinewave signal.

Sufficient stability throughout the transmission range can only be achieved with test signals simulating the characteristics of the human voice with tones that are harmonic multiples of the fundamental. Whether the results obtained for the fundamental are favourable depends on how far the values coincide with the clock of the coding algorithm. Through a skilful choice of fundamental frequencies, test signals with an overlapping spectral distribution can be generated giving a sufficient number of test points in subsequent measurements at different fundamental frequencies so that a practically continuous frequency response curve is obtained. Evaluation is by means of FFT analysis with a special window function and selection of result bins.

After sorting and smoothing, the result is displayed as a frequency response curve and, depending on the measurement, the sending and receiving loudness rating is calculated in line with CCITT PI79 and indicated in the graphics display. As with type-approval measurements via the DAI interface, the measured frequency response in the transmit and receive direction is checked for compliance with the limits specified by GSM 11.10, and a PASS or FAIL verdict is issued as appropriate.

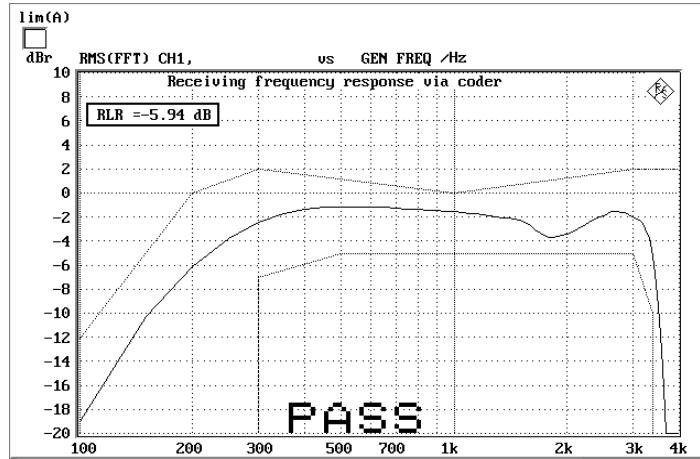


Fig. 3 Example results display with RLR values and PASS verdict

Notes on Individual Measurements

The measurements to be performed are described below in the sequence in which they are carried out.

Perform all measurements in an anechoic chamber with sufficient isolation against interfering sound. Since special distortion measurements and particularly the measurement of idle noise set high demands on measurement conditions, the A-weighted noise in the test chamber should be below 30 dB(A).

Measurements are started by pressing the corresponding softkey or function key on the external keyboard. When the measurement is completed, the results are shown and the following softkey line is displayed.

F5	F6	F7	F8	F9	F10	F11	F12
	CONT				TRC_FILE	PCX_FILE	HARDCOPY

A return to the selection level is possible with CONT or the results can be printed or saved, see section 6, Processing of Measurement Results.

Sending Frequency Response and Loudness Rating

Sending Frequency Response

The transmit frequency response is specified as the transmission ratio in dB of the voltage at the decoder output to the input noise pressure at the artificial mouth.

The mobile under test is installed in the LRGP position (loudness rating guard ring position to CCITT P.76) and the speaker is sealed to the artificial ear.

Acoustic Measurements on GSM Mobile Phones

Tones with a sound pressure of -4.7 dBPa are created with the artificial mouth at the MRP (mouth reference point) and the corresponding output voltage is measured at the CMD's voice decoder output and evaluated.

The transmit frequency response must be within the tolerances specified by GSM 11.10, table 30.1. The absolute sensitivity is not yet taken into account.

Table 1 Tolerances specified by GSM 11.10, table 30.1

Frequency (Hz)	Upper Limit (dB)	Lower Limit (dB)
100	-12	
200	0	
300	0	-12
1000	0	-6
2000	4	-6
3000	4	-6
3400	4	-9
4000	0	

The offset of the measured frequency response to the upper or lower limit curve is calculated and then the whole trace is shifted by the mean value of the maximum and minimum offset. Then another limit check is performed. If the shifted curve is now within the limit lines, a PASS is output, if not, FAIL is displayed. The limit check is performed at each measured frequency. If the measured value and the end point of the limit curve are not at the same frequency, it may happen that the trace slightly crosses a corner of the limit curve although there are no limit violations.

Sending Loudness Rating

The sending loudness rating (SLR) takes into account the absolute loudness in the transmit direction and weights the tones in compliance with the normal sensitivity of the average human ear.

To this end the frequencies of bands 4 to 17 are evaluated according to table 2 of CCITT P.79.

Table 2 Frequencies of bands 4 to 17 according to table 2 of CCITT P.79.

200	1000
250	1250
315	1600
400	2000
500	2500
630	3150
800	4000

Due to multitone analysis, the above frequencies may shift slightly. The maximum deviation of the individual frequencies from the rated values is 5 %, the resulting errors are negligible.

The sensitivity at each frequency is defined as the ratio dBV/Pa referring to the rated internal level in dBm0, and the sending loudness rating is calculated according to formula 4.19b of CCITT P.79. The result is corrected by a total of -0.3 dB according to table 3 of CCITT P.79.

Due to the inevitable input sensitivity spread of the CMD coder, there is a degree of uncertainty in the calculation of the sending loudness rating. The sensitivity of the CMD can be taken into using of a special tuning routine, if a test mobile with known SLR is used for adjustments (see calibration routines). However, this is only recommended if a verified conformance test system is available for comparison measurements, otherwise the reference value should not be changed.

According to GSM 11.10 the sending loudness rating should be between 5 and 11 dB, with lower dB values corresponding to greater loudness (5 dB maximum loudness, 11 dB minimum loudness). The measured SLR is indicated in a window in the frequency response display but not checked for compliance with limits.

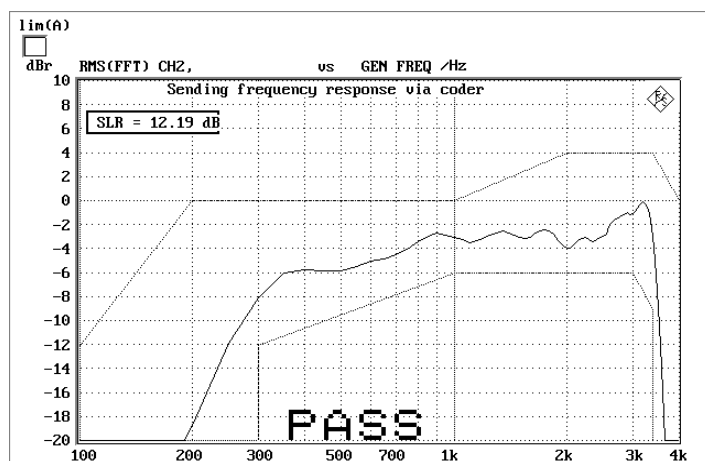


Fig. 4 Sending frequency response with SLR values

Receiving Frequency Response and Loudness Rating

Receiving Frequency Response

The input frequency response is specified as the transmission ratio in dB of the sound pressure in the artificial ear to the input voltage at the voice coder input of CMD.

The mobile under test is installed in the LRGP position (CCITT P.76) and the speaker is sealed to the artificial ear.

The voice coder is driven so that tones with an internal reference level of -16 dBm0 are obtained. The noise pressure in the artificial ear is measured and evaluated.

The receiving frequency response must be within the limit lines specified in table 30.2 of GSM 11.10. The absolute sensitivity is not yet taken into account.

Table 3 Limit lines according to GSM 11.10 table 30.2

Frequency (Hz)	Upper Limit (dB)	Lower Limit (dB)
100	-12	
200	0	
300	2	-7
500	*	-5
1000	0	-5
3000	2	-5
3400	2	-10
4000	2	

* Intermediate values are obtained when a straight line is drawn between the specified values and a logarithmic frequency scale and a linear dB scale are used.

The offset of the measured frequency response to the upper or lower limit curve is calculated and then the total curve is shifted by the mean value of the maximum and minimum offset. Then another limit check is performed. If the shifted curve is within the limit lines, PASS is output, otherwise FAIL is output. The limit check is performed at each measured frequency. If the measured value and the end point of a limit curve are not at the same frequency, it may happen that the trace slightly crosses a corner of the limit trace although there are no limit violations.

Receiving Loudness Rating

The receiving loudness rating (SLR) takes into account the absolute loudness in the receive direction and weights the tones in compliance with the normal sensitivity of the average human ear.

To this end the frequencies (Hz) of bands 4 to 17 are evaluated according to table 2 of CCITT P.79.

Table 4 Frequencies (Hz) of bands 4 to 17 according to table 2 of CCITT P.79

200	1000
250	1250
315	1600
400	2000
500	2500
630	3150
800	4000

Due to multitone analysis, the above frequencies may shift slightly. The maximum deviation of the individual frequencies from the rated values is 5 %, the resulting errors are negligible.

The sensitivity at each frequency is specified as a ratio in dBPA/V referring to the rated internal signal level, and the receiving loudness rating is calculated according to formula 4.19c of CCITT P.79 with correction of the ear sensitivity according to table 4 of CCITT P.79.

Due to the inevitable input sensitivity spread of the CMD voice coder, there is a degree of uncertainty in the calculation of the sending loudness rating. The sensitivity of the CMD can be taken into account using a special tuning routine if a test mobile with known RLR is used for adjustments (see calibration routines). However, this is only recommended if a verified conformance test system is available for comparison measurements, otherwise the reference value should not be changed.

The receiving loudness rating depends on the volume set on the test mobile and, according to GSM 10.11, should be between -1 V and +5 V at a rated volume setting, with lower dB values corresponding to a higher volume.

The RLR should not fall below -13 dB when maximum volume is set on the phone (i.e. the maximum receiving loudness should not exceed a certain value to avoid damage to the human ear). The measured SLR is indicated in a window in the frequency response display but not checked for compliance with limits.

Sidetone Masking Rating STMR

The so-called sidetone path is the desired output from the part of the signal picked up by the microphone from the phone's speaker. This should create a natural hearing impression for the person speaking on the phone as is encountered under normal call conditions, i.e. via the acoustic path between his mouth and ear.

The mobile under test is installed in the LRGP position (CCITT P.76) and the speaker is sealed to the artificial ear.

The artificial mouth generates tones with a sound pressure of -4.7 dBPa at the MRP (mouth reference point) and the sound pressure is measured in the artificial ear.

The suppression of the sidetone path is determined at each frequency according to table 2, CCITT P.79, and the side tone masking rating STMR calculated according to formula 8.4 of CCITT P.79 with the weighting factors of tables 6 and 4 of CCITT P.79 taken into account.

When the phone is set to the rated volume, the STMR should be within 8 and 18 dB.

STMR = 16.71 dB

Min 8 dB Max 18 dB

PASS

Fig. 5 Display of numeric values on the screen, e.g. for sidetone masking rating

Listener Sidetone Rating LSTR

The listener sidetone rating defines the effect of interference sound on the voice quality. The telephone microphone not only picks up the caller's voice but also any noise in the environment. The listener sidetone rating is the ratio of the wanted to the unwanted sound. For measuring the LSTR, a standard sound field is required, which is created with the aid of eight noise generators producing pink noise with a sound pressure of 70 dB(A). Provided the eight sources are adequately arranged in the test chamber, a homogeneous sound field is obtained in the center. Refer to GSM 11.10, section 30.5.2.4.2, for information on setup and levels.

Since a standard sound field is required for the LSTR measurement, the measurement is far more involved than most of the other acoustic measurements, but the complexity is necessary to test for the effects of interfering sound on the transmission quality. An automatic evaluation is included in the test program.

The sound field has to be created by means of external generators. The test program determines the listener sidetone rating on the assumption that the sound field is in compliance with the standard.

The mobile under test is installed in the LRGP position (CCITT P.76) and the speaker sealed to the artificial ear.

The setup is installed in a chamber with a standard sound field. The energy distribution in this field is defined by GSM 11.10 and therefore known.

The energy of the sound pressure in the artificial ear is measured by means of third-octave analysis in the 14 bands with center frequencies from 200 to 4000 Hz, and the suppression of the listener sidetone path is determined for each band from the known rated values of the sound field. The listener sidetone rating LSTR is then calculated with formula 8.4 of CCITT P.79 by taking into account the weighting factors of tables 6 and 4 of CCITT P.79.

The LSTR should not be less than 15 dB.

Echo Loss

The echo loss is the attenuation between the voice coder input and the voice decoder output (gain of voice coder + decoder = 1). Normally the echo loss is caused by internal acoustic coupling between the telephone receiver and the microphone. Since the echo considerably reduces the sound transmission quality, it should not exceed a certain value.

To obtain realistic results, an artificial voice is used for the echo loss test. The currently applicable GSM 11.10 standard does not take into account that the RMS value (referred to the peak level) of the stochastic signal of the artificial voice is considerably lower than that of previously used test signals with sinusoidal tones (crest factor of voice signals approx. 20 dB compared with 3 dB of sinewave signal). As a result the system can only be driven at low level and the demanded echo loss value of 46 dB corresponds to about the theoretical quantization noise of the GSM system. For this reason a PASS verdict will normally not be issued from this test. Although these measurements are of great importance from an acoustic point of view, the echo loss measurement in the type approval test of GSM mobiles is currently suspended until a new definition is available.

In version 2.0 the echo loss measurement was extended. The inherent noise of the mobile is measured and the noise power in the individual third-octave bands subtracted from the echo signal. Thus the dynamic range can be extended by up to approx. 10 dB. This test therefore yields very realistic echo loss results but it is not standardized.

The mobile under test is installed in the LRGP position (CCITT P.76) and the speaker is sealed to the artificial ear.

The artificial voice defined by CCITT P.50 is generated as a test signal and applied to the voice coder. The voice is sent for 10 seconds. During this period the spectral energy distribution of this signal is measured in the third-octave bands from 200 Hz to 4 kHz. The same part of the voice is sent again for 10 seconds and the spectral distribution in the output signal of the voice decoder is measured. After subtracting the idle-state noise in each third-octave band, the echo loss is calculated from the differences of the bands according to CCITT G.122. This measurement is performed for a male and a female voice and the final result is the mean value of the two measurements.

The actual gain of the voice coder and decoder must also be considered in the result.

GSM 11.10 specifies an echo loss of at least 46 dB which can be achieved by mobile phones using good echo cancellors. With due consideration of the inherent noise, the measurement limit of the system is at an echo loss of approx. 55 dB. Since the microphone also picks up any side noise and treats it like an echo, it is essential that the test chamber is shielded against external noise.

Stability Margin

The stability margin is measured to test the susceptibility of the phone to acoustic feedback and instability.

For the test, the telephone is placed on an even, hard board with the receiver and microphone pointing downwards.

A loop is closed in the UPL between the receive and the voice channel and an overall gain of 6 dB set. The gain of the coder is automatically taken into account (see also echo loss).

To activate the loop, a noise signal of -10 dBm₀ in line with CCITT O.131 is applied for 1 seconds and then switched off with the loop remaining closed.

Listening for whether resonances or oscillations are produced. If there are no oscillations, the minimum requirements to GSM 11.10 for a stability margin of 6 dB are complied with.

Sending Distortion

The S/N ratio in the transmit path is measured as a function of the sound level. As specified by GSM 11.10, the voice coder is excluded from the measurement, but when a standard GSM mobile is used, this measurement can only be performed with the voice coder and decoder included. For this reason the limit values to GSM 11.10 may be taken as a reference but they need not necessarily be adhered to.

A sinusoidal tone of 1015 Hz is used for the measurement. At this frequency, coding yields a sufficiently stable output signal.

The mobile under test is installed in the LRGP position (CCITT P.76) and the speaker is sealed to the artificial ear.

The test signal is generated with the artificial mouth at the MRP (mouth reference point) and the SINAD value of the received signal is measured at the CMD's decoder output.

The acoustic reference level ARL is defined as the sound pressure which creates a signal level of -10 dBm₀ in the transmit channel. An automatic routine varies the sound pressure at the artificial mouth until the desired level is attained. This value is then used as a reference for determining the SINAD value versus level.

The SINAD value is measured at sound pressures between -35 dB and +10 dB relative to the acoustic reference level ARL and compared with the limit lines specified in table 30.3 of GSM 11.10.

Table 5 Limit lines specified in table 30.3 of GSM 11.10

dB relative to ARL	Level ratio
-35 dB	17.5 dB
-30 dB	22.5 dB
-20 dB	30.7 dB
-10 dB	33.3 dB
0 dB	33.7 dB
7 dB	31.7 dB
10 dB	25.5 dB

The measurement is performed up to a maximum sound pressure of 10 dBPa at the artificial mouth so the actual trace may end at a lower pressure

If the measured trace is above the limit line, a PASS is output otherwise a FAIL is displayed. Since this measurement includes voice coding in contrast to type approval tests, a PASS verdict cannot always be expected. Typically, values approx. 3 to 5 dB lower are obtained. The spacing between the trace and the limit line may have to be visually asserted.

Receiving Distortion

The S/N ratio in the receive path is measured as a function of the acoustic signal level. As specified by GSM 11.10 the voice coder is excluded from the measurement, but when a standard GSM mobile is used, the measurement can only be performed with the voice coder and decoder included. For this reason the limit values to GSM 11.10 can be taken as a reference but they need not necessarily be adhered to.

A sinusoidal tone of 1015 Hz is used for the measurement. At this frequency, coding yields a sufficiently stable output signal.

The mobile under test is installed in the LRGP position (CCITT P.76) and the speaker is sealed to the artificial ear.

The test signal is applied to the input of the CMD voice coder and the SINAD of the sound pressure in the artificial ear is measured with psophometric weighting to CCITT G.714.

The SINAD of the sound pressure is measured at levels between -45 dBm0 and 0 dBm0 and compared with the limit lines given in table 30.4 of GSM 11.10.

Table 6 Limit lines given in table 30.4 of GSM 11.10

Level	Level ratio
-45 dBm0	17.5 dB
-40 dBm0	22.5 dB
-30 dBm0	30.5 dB
-20 dBm0	33.0 dB
-10 dBm0	33.5 dB
-3 dBm0	31.2 dB
0 dBm0	25.5 dB

The measurement is performed up to a maximum sound pressure of 10 dBPa in the artificial ear, so that the actual trace may end at a lower pressure.

If the measured trace is above the limit line, a PASS is issued otherwise a FAIL. Since this measurement includes voice coding in contrast to the type approval test, a PASS verdict cannot always be expected. Typically, values approx. 3 to 5 dB lower are obtained. The spacing between the trace and the limit line may have to be visually asserted.

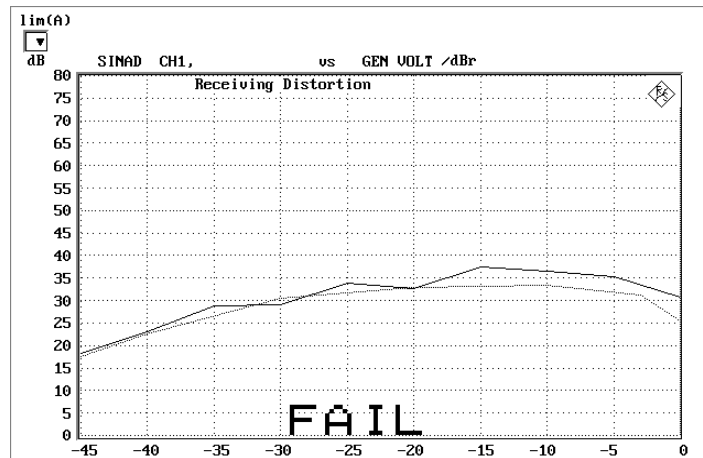


Fig. 6 Typical result of receiving distortion measurement

Idle channel noise sending

The noise voltage at the voice decoder output is measured with the telephone set up in a quiet environment (< 30 dB(A)).

The mobile under test is installed in the LRGP position (CCITT P.76) and the speaker is sealed to the artificial ear.

The decoder output voltage is measured, psophometrically weighted according to CCITT G.223 and calculated at the internal level in dBm0p.

The idle noise level should not exceed -64 dBm0p.

Idle channel noise receiving

The sound pressure in the artificial ear is measured with the phone set up in a quiet environment (<30 dB(A)).

The mobile under test is installed in the LRGP position (CCITT P.76) and the speaker is sealed to the artificial ear.

The sound pressure in the artificial ear is measured with A-weighting on.

With optimum volume set on the mobile, the sound pressure should not exceed -57 dBPa(A).

At maximum volume, the sound pressure should not exceed -54 dBPa(A).

This measurement makes high demands on the sound insulation of the test chamber and the S/N ratio of the measuring microphone including preamplifier in the artificial ear. A comparison measurement with the test mobile switched off or without a DUT shows the measurement reserves of the test equipment. Due to the inherent noise of the Audio Analyzer UPL, measurements can be made to about -80 dBPa(A) at 0 dB microphone gain, and even to lower values when a higher microphone gain is set.

Thus the compliance with the interfering noise level of below 30 dB(A) as specified by GSM 11.10 for the test chamber can be checked. 30 dB(A) corresponds to -64 dBPa(A) (1 Pa corresponds to a sound pressure level of 94 dB).

5 Calibration Routines

Calibration of artificial ear

Before a mobile can be tested, the absolute sensitivity of the microphone in the artificial ear is determined using a sound level calibrator such as 4231 from Brüel & Kjaer with a sound pressure level of 94 dB SPL or a sound pressure of 1 Pa at 1 kHz.

Note:

The calibration values of the different ear types are stored separately. So, a calibration need not be performed after a change of the ear type if the physically identical ear has been calibrated before.

Calibration of ear type 1

- After switching off the microphone power supply.

Note: The 200 V polarization voltage of the microphone may cause a slight electric shock. The current is harmless but the microphone amplifier may be damaged

- Remove the microphone from the artificial ear.
- Screw back the microphone capsule and switch on the operating voltage.
- Insert the 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 compensation.

- Select the CALIBRATION level using function key F12.

CALIBRATION						EXP-FILES	
F5	F6	F7	F8	F9	F10	F11	F12
BACK	EAR	MOUTH					DELETE

- Call calibration routines using function key EAR.

EAR TYPE1		EAR TYPE3.2L		EAR TYPE3.2H		TYPE 3.3		TYPE 3.4	
F5	F6	F7	F8	F9	F10	F11	F12		
BACK	EAR_T1	EAR_T32L	T32L_DAT	EAR_T32H	T32H_DAT	EAR_T33	EAR_T34		

➤ **Call the test routine using function key EAR_T1.**

The output voltage of the microphone is measured and the sensitivity displayed with reference to 1 Pa. With 0 dB preamplification of the microphone, the displayed sensitivity should be about the value in the calibration certificate of the microphone capsule (typical value for microphone capsule 4134 and artificial ear 4185 is approx. 12 mV/Pa). If the measured voltage is below 3 mV, an error message is displayed. Possible error sources may be a switched off microphone power supply or a disabled calibrator. In this case the program requests the test to be repeated. After switching on the microphone power supply wait for 20 seconds before restarting the measurement with RUN.

The measured reference value is stored in a nonvolatile memory and used for all subsequent measurements with the artificial ear type 1.

Calibration of ear type 3.2 low leakage

- **Connect the noise level calibrator tightly to the artificial ear using adapter DP0939 and switch on calibrator.**
- **Select the CALIBRATION level using function key F12.**

CALIBRATION						EXP-FILES	
F5	F6	F7	F8	F9	F10	F11	F12
BACK	EAR	MOUTH					DELETE

➤ **Call the calibration routines using function key EAR/MOU.**

EAR TYPE1 EAR TYPE3.2L EAR TYPE3.2H TYPE 3.3 TYPE 3.4

F5	F6	F7	F8	F9	F10	F11	F12
BACK	EAR_T1	EAR_T32L	T32L_DAT	EAR_T32H	T32H_DAT	EAR_T33	EAR_T34

➤ **Call the test routine using EAR_T32L.**

The output voltage of the microphone in the ear is measured and the sensitivity displayed with reference to 1 Pa. If the measured voltage is below 3 mV, an error message is displayed. Possible error sources may be a switched off microphone power supply or a disabled calibrator. In this case the program requests the test to be repeated. After switching on the microphone power supply wait for 20 s before restarting the measurement with RUN.

The measured reference value is stored in a nonvolatile memory and used for all subsequent measurements with ear type 3.2L.

Reading the calibration data of the artificial ear of type 3.2L:

The frequency response of the artificial ear of type 3.2L is supplied on a floppy together with the artificial ear. These data are used for transforming the measurement values from the drum reference point to the so-called ear reference point.

- **Insert the floppy supplied with the ear into the UPL drive.**
- **Call the routine using function key T32L_DAT.**

The OES_LL.ADA calibration file is automatically searched for and read. The modified data are stored on the UPL hard disk. This procedure need only be repeated after a change of calibration data, e.g. after recalibration of the ear by the manufacturer or when a physically different ear of the same type is used.

If the required file is not found on the floppy, the routine requests the user to insert the calibration floppy.

Calibration of ear type 3.2 low leakage

- **Connect the sound level calibrator tightly to the artificial ear using adapter DP0939 and switch the calibrator on.**
- **Select the CALIBRATION level using function key F12.**

CALIBRATION						EXP-FILES	
F5	F6	F7	F8	F9	F10	F11	F12
BACK	EAR	MOUTH					DELETE

- **Call the calibration routines using the EAR function key.**

EAR TYPE1		EAR TYPE3.2L		EAR TYPE3.2H		TYPE 3.3	TYPE 3.4
F5	F6	F7	F8	F9	F10	F11	F12
BACK	EAR_T1	EAR_T32L	T32L_DAT	EAR_T32H	T32H_DAT	EAR_T33	EAR_T34

- **Call the test routine using function key EAR_T32L.**

The output voltage of the microphone in the ear is measured and the sensitivity displayed with reference to 1 Pa. If the measured voltage is below 3 mV, an error message is displayed. Possible error sources may be a switched-off microphone power supply or a disabled calibrator. In this case the program requests the test to be repeated. After switching on the microphone power supply wait for 20 s before restarting the measurement with RUN.

The measured reference value is stored in a nonvolatile memory and used for all subsequent measurements with ear type 3.2L.

Reading the calibration data of the artificial ear of type 3.2H:

The frequency response of the artificial ear of type 3.2H is supplied on a floppy together with the artificial ear. These data are used for transforming the measurement values from the drum reference point to the so-called ear reference point.

- **Insert the floppy supplied with the ear into the UPL drive.**
- **Call the routine using function key T32H_DAT .**

The OES_HL.ADA calibration file is automatically searched for and read. The modified data are stored on the UPL hard disk. This procedure need only be repeated after a change of calibration data, e.g. after recalibration of the ear by the manufacturer or when a physically different ear of the same type is used.

If the required file is not found on the floppy, the routine requests the user to insert the calibration floppy.

Calibration of ear type 3.3

- **Connect the sound level calibrator tightly to the artificial ear using adapter UA-1546 and switch the calibrator on.**
- **Select the CALIBRATION level using function key F12.**

CALIBRATION						EXP-FILES	
F5	F6	F7	F8	F9	F10	F11	F12
BACK	EAR	MOUTH					DELETE

- **Call the calibration routine using the EAR function key.**

EAR TYPE1		EAR TYPE3.2L		EAR TYPE3.2H		TYPE 3.3	TYPE 3.4
F5	F6	F7	F8	F9	F10	F11	F12
BACK	EAR_T1	EAR_T32L	T32L_DAT	EAR_T32H	T32H_DAT	EAR_T33	EAR_T34

- **Call the test routine using function key EAR_T33.**

The output voltage of the microphone in the ear is measured and the sensitivity displayed with reference to 1 Pa. If the measured voltage is below 3 mV, an error message is displayed. Possible error sources may be a switched off microphone power supply or a disabled calibrator. In this case the program requests the test to be repeated. After switching on the microphone power supply wait for 20 s before restarting the measurement with RUN.

The measured reference value is stored in a nonvolatile memory and used for all subsequent measurements with ear type 3.3. The standard calibration data to ITU-T P57 are used automatically for ear type 3.3.

Calibration of ear type 3.4

- **Remove the pinna and the ear canal simulator, connect the sound level calibrator tightly to the artificial ear using the short steel adapter and switch the calibrator on.**
- **Select the CALIBRATION level using function key F12.**

CALIBRATION						EXP-FILES	
F5	F6	F7	F8	F9	F10	F11	F12
BACK	EAR	MOUTH					DELETE

- **Call the calibration routines using the EAR function key.**

EAR TYPE1		EAR TYPE3.2L		EAR TYPE3.2H		TYPE 3.3	TYPE 3.4
F5	F6	F7	F8	F9	F10	F11	F12
BACK	EAR_T1	EAR_T32L	T32L_DAT	EAR_T32H	T32H_DAT	EAR_T33	EAR_T34

- **Call the test routine using function key EAR_T34.**

The output voltage of the microphone in the ear is measured and the sensitivity displayed with reference to 1 Pa. If the measured voltage is below 3 mV, an error message is displayed. Possible error sources may be a switched-off microphone power supply or a disabled calibrator. In this case the program requests the test to be repeated. After switching on the microphone power supply wait for 20 s before restarting the measurement with RUN.

The measured reference value is stored in a nonvolatile memory and used for all subsequent measurements with ear type 3.4.

The standard calibration data to ITU-T P57 are used automatically for ear type 3.4.

Calibration of Artificial Mouth

Calibration of the artificial mouth depends on the ear type used. A recalibration is therefore not required when the ear type is changed.

Before a mobile can be tested, the absolute sensitivity and frequency response of the artificial mouth have to be measured and corrected with the aid of a previously calibrated pressure-field measuring microphone. The measuring microphone removed from artificial ear type 1 may be used for this purpose or an additional microphone capsule is screwed to the microphone amplifier. The measuring microphone is used as a reference for determining the frequency response of the mouth. The frequency response of the microphone can be ignored in the test frequency range (100 Hz to 8 kHz) (see also calibration certificate of microphone capsule).

Since interfering sound falsifies the corrections, the artificial mouth should be calibrated in a sound-proof test chamber.

Fit the microphone at right angles to the mouth at the reference point MRP using the gauge supplied with the mouth (positioning at right angles is necessary because microphone capsule 4134 of ear 4185 is pressure-calibrated).

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

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

- **Select the CALIBRATION level using function key F12.**

CALIBRATION						EXP-FILES	
F5	F6	F7	F8	F9	F10	F11	F12
BACK	EAR	MOUTH					DELETE

- **Call the calibration routines using the MOUTH function key.**

MOUTH CALIBRATION							
F5	F6	F7	F8	F9	F10	F11	F12
BACK	REF_MIC	CAL_MOU					

- **Call the test routine using function key REF_MIC.**

The output voltage of the microphone is measured and the sensitivity displayed with reference to 1 Pa. With 0 dB preamplification of the microphone, the displayed sensitivity should be about 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). If the measured voltage is below 3 mV, an error message is displayed. Possible error sources may be a switched off microphone power supply or a disabled calibrator. In this case the program requests the test to be repeated. After switching on the microphone power supply wait for 20 s before restarting the measurement with RUN.

Fit the microphone at right angles to the mouth at the mouth reference point MRP using the gauge supplied with the mouth (positioning at right angles is necessary because microphone capsule 4134, e.g. of ear 4185, is pressure-calibrated).

- **Select the CALIBRATION level using function key F12.**

CALIBRATION						EXP-FILES	
F5	F6	F7	F8	F9	F10	F11	F12
BACK	EAR	MOUTH					DELETE

- **Call the calibration routines using the MOUTH function key**

MOUTH CALIBRATION							
F5	F6	F7	F8	F9	F10	F11	F12
BACK	REF_MIC	CAL_MOU					

- **Call the test routine using function key CAL_MOU.**

First the sound pressure generated at the MRP is set to exactly -4.7 dBPa in an automatic measurement routine at 1 kHz. The required generator voltage is stored in a nonvolatile memory and used as a reference for all subsequent settings with the artificial mouth. If the sound pressure cannot be adjusted to -4.7 dBPa, an error message is displayed with a request to check the connection of the artificial mouth and to repeat the measurement. A possible error source could be that the supplied transformer is not connected between the generator and the artificial mouth.

The uncorrected frequency response of the artificial mouth is now 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 non-linearities of the speaker in the mouth are measured and considered as fine correction in the final equalization file.

To verify the results, the absolute sound pressure versus frequency is measured at a sound pressure of 4.7 dBPa (reference value for most of the measurements). The absolute sound pressure at each frequency must be within a tolerance band of -4.7 dBPa ±0.2 dB. Correct calibration without interfering sound yields an almost straight line in the middle between the two limit lines.

6 Processing of Measurement Results

Printing, Storing and Displaying of Measurement Results

The result of each measurement is graphically or numerically displayed on the screen and, if applicable, a PASS or FAIL verdict is output.

The following softkeys are displayed.

F5	F6	F7	F8	F9	F10	F11	F12
	CONT				TRC_FILE	PCX_FILE	HARDCOPY

Pressing the CONT key brings back the selection menu for the measurement.

When the TRC_FILE key is pressed, the displayed trace is saved in ASCII format in a file. This file has the name TRCxx.TRC, with xx representing a consecutive number (of max. 5 digits). This allows processing of measurement results with other programs. The TRC_FILE key has to function when the results are numerically displayed.

The screen content can be copied into a PCX file using the PCX_FILE key. This file has the fixed name PICxx.PCX, with xx representing a consecutive number (of max. 5 digits). Thus the measurement results can also be used in word processing programs, for instance. To allow also numeric values to be stored in a PCX file, the whole screen content without the softkey line is copied.

Since both the TRC and the PCX files are consecutively numbered, it is useful to copy the files of a measurement sequence, for instance, and to save them under a new name. In this case the original TRCxx.TRC and PICxx.PCX files can be cleared. Thus results can be identified more easily and a mix up between them avoided. (The files can be copied and renamed using common DOS commands.)

Call end a DOS shell called after terminating of the test program (e.g. with key F5) by entering the command SHELL <RETURN>. Entering EXIT <RETURN> brings back BASIC without the program being cleared. The program can be restarted immediately by entering RUN.

The screen content can be output to a printer by pressing the HARDCOPY key.

Printer type and desired settings are not selected by the program but the printer selected last and set in UPL manual mode will be chosen. For this reason the desired printer, scaling and format should be manually set once in the OPTION panel of UPL prior to the measurement. It is recommended to select a LOW or MEDIUM resolution and as far as possible integer scale factors for the printer output. If fractional scale factors (especially values < 1) are used, the pixels values are interpolated and the print quality could be reduced.

It may be useful to first print a test copy to check the print quality. Contrary to manual operation, no COMMENT line is printed in this case and the program automatically sends a FORM FEED after each print to throw out the hardcopy.

Acoustic Measurements on GSM Mobile Phones

Numerical values are automatically added to a result file after each measurement. This file has the name RES_GSM.LOG.

Each result is written in a separate line with the measurement in plain text, showing the value, date and time. Thus all numeric measurement results can be called again after a test sequence has been performed and evaluated.

As with TRC and PCX files, it may be useful to copy the RES_GSM.LOG file after a measurement sequence and to save it under a new name. After this the RES_GSM.LOG file can be cleared. Thus results can be identified more easily and a mix up between them avoided. To this end a DOS shell can be called after termination of the test program (e.g. with key F5) by entering the command SHELL <RETURN>. The files can be copied and saved under another name using common DOS commands.

Entering EXIT <RETURN> brings back BASIC without the program being cleared. The program can be immediately restarted with RUN.

Every frequency response measurement in the transmit and receive direction creates an exportable file in the background. This file has the designation SNDSSENS.xxx or RECSSENS.xxx, with xxx representing a consecutive number. The measured values are stored in this file with the absolute units DBPa/V or dBV/Pa in a format permitting direct export, e.g. to Excel. The absolute values can be displayed as absolute traces with the aid of the READ_SND or READ_REC program. To do so terminate the GSM_TST program and load and start the READ_SND or READ_REC program. The trace measured last is displayed.

Consecutive numbering of files is automatic. After attaining 999, counting starts again at 000 so that older files may be overwritten. Old result files of a measurement sequence may be cleared with menu item DELETE EXP-FILES in the GSM_TST program.

- **Select the CALIBRATION level using function key.**

CALIBRATION						EXP-FILES	
F5	F6	F7	F8	F9	F10	F11	F12
BACK	EAR	MOUTH					DELETE

- **Press the function key DELETE.**

A question is asked whether all result files (also RES_GSM.LOG) should really be cleared. In the affirmative, the result files are stored under SNDOLD.xxx or RECOLD.xxx and RES_GSM.OLD, i.e. they are not cleared in the first procedure. In a second clear procedure these backup copies may be overwritten.

7 Terminating the Application

As long as the arrow → is displayed below the F12 key, another set of softkeys can be called with this key. With F5 the user can return to the previous set of softkeys, so long as the arrow ← is displayed below the key. If F5 displays END, there is no previous set.

F5	F6	F7	F8	F9	F10	F11	F12
END	SEND	RECEIVE	STMR	LSTR	ECHO	STAB-MRG	→

After selecting END by pressing the F5 key, the following query is displayed:

➤ **"Do you want to terminate the program <Y><N>?"**

Upon confirmation with Y, the program is aborted but not cleared. The softkey line for BASIC is then restored.

The software can be terminated any time under BASIC with the key combination CTRL BREAK. The program can be continued with CONT and restarted with RUN.

Appendix A:

After the installation of the UPL-B8 software option the generator provides an additional function named RANDOM+ANLR.

Feedback of Analyzer Signal with Additional Noise

With the RANDOM+ANLR generator function, the feedback analyzer signal whose gain is selectable is superposed on a noise signal whose frequency can be defined. This function is required for the stability-margin measurements in the acoustic test cases.

The noise signal is defined by specifying an amplitude-frequency distribution in the frequency domain (FREQ). This noise is always white.

The superposed analyzer signal can be taken from measurement channel 1 or 2.

This special signal can only be generated if the "Volt Range" in the GENERATOR panel is set to FIX. Otherwise the loop signal is set to zero gain (muting), while the noise signal remains active.

DC Offset

See UPL Manual, section 2.5.4.1.2 Common Parameters for All Generator Functions

Spacing

Definition of the frequency grid, ie the spacing between the frequency lines.

USER DEF

ANLR TRACK

Manual setting of frequency grid. Any value entered is adjusted to match the nearest settable value. The limits and the settable frequency values depend on the sampling rate (see UPL Manual, section 2.5.1 Selecting the Generator) and the generator selected. The lower frequency limit for the digital instrument is the ratio
$$\text{system clock} / 16384$$

Units: Hz, kHz

The analysis grid value of the FFT is transferred automatically. This value is also displayed on the ANALYZER panel under "FFT:Resolution" (see UPL Manual, section 2.6.5.12 FFT). This is the optimal setting for an analysis with the rectangular window. If FFT is not selected in the analyzer, the setting is rejected (error message).

Crest Fact

Selecting the algorithm to define the phase of each of the frequency lines and so the crest factor of the total signal.

OPTIMIZED

VALUE:

Automatic *minimization of the crest factor* by internally optimizing each of the phases.

Entering the *desired crest factor*. The phases of the frequency lines are modified internally such that the resulting crest factor closely approximates the desired value. The accuracy of this method depends on the total number of lines thus spacing and frequency range

Lower Freq

Setting the lower frequency limit for the generated noise.

Range: 350 Hz to 550 Hz - 1 x spacing

Upper Freq

Setting the upper frequency limit for the generated noise.

Range: lower freq + 1 x spacing to 550 Hz

RND PEAK

Setting the peak output level of the noise signal. The value input here will *not* affect the loop signal.

VOLT PEAK and VOLT RMS are coupled via the crest factor (which is constant for a particular noise signal). Therefore, if VOLT PEAK is modified, the value of VOLT RMS will also change immediately. If the crest factor is changed, RND PEAK will remain unchanged.

Specified range: 0 to V_{\max}

digital: $V_{\max} = 1 \text{ FS}$

analog: $V_{\max} = 14,142 \text{ V for UNBAL}$

$V_{\max} = 28,284 \text{ V for BAL}$

Units:

digital: FS | %FS | dBFS | LSBs | Bits | $\Delta\%$ | dBr

analog: V | mV | μV | V/V_r | dBu | dBV | dBr | dBm |

$\Delta\%V$ | ΔV | ΔmV | $\Delta\mu\text{V}$

RND RMS

Setting the RMS output voltage (for analog generator only). The value input here will *not* affect the loop signal.

VOLT PEAK and VOLT RMS are coupled via the crest factor (which is constant for a particular noise signal). Therefore, if VOLT RMS is modified, the value of VOLT PEAK will also change immediately.

Units:

digital: FS | %FS | dBFS | LSBs | Bits | $\Delta\%$ | dBr

analog: V | mV | μV | V/V_r | dBu | dBV | dBr | dBm |

$\Delta\%V$ | ΔV | ΔmV | $\Delta\mu\text{V}$

Note: *VOLT RMS can only be entered while the generator is RUNNING. When the noise signal is being calculated (GEN BUSY), the crest factor is still not known; entries for VOLT RMS will therefore be rejected at this stage and the voltage registered as 0.0. To make sure the noise signal calculated by the generator is output at the correct (peak) amplitude, it is best to enter a value under VOLT PEAK, which can be done at any time.*

Loop Chan**OFF****1****2**

Specifying the analyzer channel whose signal is to be fed back to the generator and superposed onto the noise signal.

Feedback is switched off. Feedback amplification can be selected as a presetting even if loop is switched off.

Channel 1 is fed back.

Channel 2 is fed back.

Loop Gain

Setting the feedback gain

Range: 0 to 1000

Units: * (dimensionless factor) | dB

Note: *As soon as "Volt Range" (on the GENERATOR panel) is switched to AUTO, loop gain is automatically set to 0 by the program (muting).*

Appendix B:

Differences between UPL-B8 firmware versions 2.02 and 2.01

Measurement/selection	Modification
Stability margin	No screen erasure
Ear type 3.2 high leakage	Additional selection of ear type 3.2 high leakage
Ear type 3.3	Fixed correction table to ITU-T P57 for DRP-ERP correction, correction values are no longer queried
Calibration of ear type 3.3	Calibration could be overwritten by calibrating the reference microphone for mouth calibration
Ear type 3.4	Additional selection of ear type 3.4 Fixed correction table to ITU-T P57 for DRP-ERP correction
Receiving distortion with ear type 3.x	Correction of recorded spectrum by means of DRP-ERP correction prior to SINAD calculation
Idle noise receiving with ear type 3.x	Correction of recorded spectrum by means of DRP-ERP correction prior to noise calculation