ROHDE & SCHWARZ

Test and Measurement
Division

Operating Manual

Digital Radio Tester

for

GSM (GSM 900) -
PCN (GSM 1800 / DCS 1800) -
PCS (GSM 1900 / DCS 1900) -
Mobiles

R&S® CTS50
R&S® CTS55

1094.0006.50
1094.0006.55

Printed in Germany

Dear Customer,

Note

Digital Radio Tester CTS50 is a basic model, and options CTS-K9, CTS-K18 and CTS-K19 enable its use with operating modes GSM, PCN and PCS, respectively.

Contents

Data Sheet

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

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 ±10% shall apply to the nominal voltage and of ±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.

4. If products/components are mechanically and/or thermically 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.

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 estandards 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 estandards 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 indústria 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 uns 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 construción con peligro de carga electroestática

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

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 ususario.Punto de peligro que puede llevar hasta la muerte o graves heridas.
ADVERTENCIA	Indica un punto de peligro con un protencial 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 protencial 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 debera 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 principialmente 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 ±10% sobre el voltaje nominal y de ±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

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 producieran 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 averigurar 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, deberan 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 areas 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 prodcuto.

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 construciones o instalaciones, se deberá instalar el interruptor al nivel de la instalación.

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 Ueff > 30 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 efecutadas 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.

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 fín. 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.

ROHDE&SCHWARZ
EC Certificate of Conformity

CE

Certificate No.: 98069

This is to certify that:

Equipment type	Order No.	Designation
CTS50	1094.0006.50	Digital Radio Tester

complies with the provisions of the Directive of the Council of the European Union on the approximation of the laws of the Member States

- relating to electrical equipment for use within defined voltage limits (73/23/EEC revised by 93/68/EEC)

- relating to electromagnetic compatibility (89/336/EEC revised by 91/263/EEC, 92/31/EEC, 93/68/EEC)

Conformity is proven by compliance with the following standards:

EN61010-1 : 1993 + A2 : 1995
EN50081-1 : 1992
EN50082-2 : 1995

Affixing the EC conformity mark as from 1998

ROHDE & SCHWARZ GmbH & Co. KG
Mühldorfstr. 15, D-81671 München

Munich, 1999-02-24

Central Quality Management FS-QZ / Becker

ROHDE&SCHWARZ
EC Certificate of Conformity

Certificate No.: 960210

This is to certify that:

Equipment type	Order No.	Designation
CTS55	1094.0006.55	Digital Radio Tester
CTS-B1	1079.0809.02	OCXO Reference Oscillator
CTS-B7	1079.2101.02	Module Test and Output

complies with the provisions of the Directive of the Council of the European Union on the approximation of the laws of the Member States

- relating to electrical equipment for use within defined voltage limits (73/23/EEC revised by 93/68/EEC)

- relating to electromagnetic compatibility (89/336/EEC revised by 91/263/EEC, 92/31/EEC, 93/68/EEC)

Conformity is proven by compliance with the following standards:

EN61010-1 : 1993 + A2 : 1995
EN50081-1 : 1992
EN50082-2 : 1995

Affixing the EC conformity mark as from 1996

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Munich, 1999-02-24

Central Quality Management FS-QZ / Becker

Supplement to Data Sheet CTS
(PD757.2509.22)

Specifications supplement:

AM modulated signal at RF OUT2 GSM connector (only with CTS-K7)

Level range
(depending on modulation depth)
  GSM900 band .... -20 to -30 dBm
  GSM1800/1900 band .... -23 to -33 dBm

Modulation depth at
-23 dBm [1)]/ -26 dBm [2)] .... 0 to 90 % AM

Resolution .... 1 %

Modulation frequency .... 1 kHz

Setting error at
-23 dBm [1)]/ -26 dBm [2)]
and 83 % AM .... <10 % of reading

AM distortion at
-23 dBm [1)]/ -26 dBm [2)]
and 83 % AM .... < 5 %

1) GSM900 band
2) GSM1800/1900-band

Problems with GSM?

If you would like to enhance your knowledge about GSM and DCS1800, then there is no better way than at a ROHDE & SCHWARZ seminar. The program of seminars published every six months include the following topics dealt with at the Munich training center:

- GSM/PCN - Digital mobile phoning
  (Two-day seminar about GSM basics)
- GSM/PCN measurements on mobile stations
  (One-day seminar with emphasis on RF measurements)
- Digital modulation - Modern methods in radiotelecommunications
  (Two-day seminar all about RF modulation)

Further information can be found in our seminar program which is obtainable from your ROHDE & SCHWARZ sales office or directly from the training center. Tel. +4989-4129 3051.

Would you like to know more about GSM? Here are some tips!

Gabler, Krammling
SIGNALISIERUNGS- UND MESSVERFAHREN IM MODERNEN MOBILFUNK
Publisher: Franzis-Verlag 1993
ISBN 3-7723-4951-X

H. Preibisch
GSM-Mobilfunkübertragungstechnik
Schiele & Schön, Berlin, 1994
ISBN 3-7949-0577-6

M. Mouly, M.B. Poutet
The GSM System for Mobile Communications
France 1992
ISBN 2-9507190-0-7

1 Introduction

The tester CTS is a value-for-money instrument for automatic and fast function tests, as well as detailed service testing on digital mobiles. Two automatic and fast function tests are implemented in CTS, one being called ***Quicktest***, the other being called ***Autotest***. The detailed service test is called the ***Manual Test*** of the CTS.

1.1 Application for the Autotest

1.1.1 Overview

The main application of the Autotest is to check the operation of a mobile station upon handing it out to the customer, e.g. upon sale (to give enhanced customer confidence, by demonstrating proper functioning of equipment in the presence of the customer), before or after a repair or in the event a complaint is received. In the latter case, the customer's complaint can be verified immediately, avoiding unnecessary return of the mobile phone to a central service station, and thus saving time and expense.

With the CTS, optimum customer support can be provided even by small service shops and sales chains that have no highly-qualified service staff of their own but rely on an external service centre.

1.1.2 Test Functions in the Autotest

- location update
- set-up of speech link (call from network and from mobile)
- close-down of speech link (from network and from mobile)
- echo test (a message spoken into the mobile is sent back by the tester with a delay)
- tests and measurements on customer-defined GSM channels. It can be configured to carry out tests and measurements on one, two or three channels.
- mobile receiver sensitivity (RxLev, RxQual)
- measurement of average output power of mobile
- measurement of the power ramp and phase frequency error
- measurement of the Bit Error Rate
- change of power level on existing speech link
- change of channel on existing speech link
- Test of the mobile's keypad (by dialling a phone number)
- Testing of one or two GSM bands within a single test sequence.
- Handover between two different GSM bands.

1.2 Quicktest

Quicktest and Autotest share the same application range. However, there is a difference as regards the exhaustiveness of the test. While exhaustive tests are carried out in Autotest on one, two or three channels Quicktest consists of a fixed sequence comprising:

- location update
- set-up of speech link (call from network)
- echo test
- close-down of speech link

1.3 Application for the Manual Test

This part of the CTS is designed for service testing and other situations where the user must decide which step has to be performed next. For example which signalling sequence or which measurement (power ramp, phase frequency or bit error rate).

1.4 Application for the Module Test (Option CTS-B7)

Option "Module Test" allows to test modules of mobile phones. A RF generator emits CW or bursted signals, with modulation conforming to GSM or just a frequency offset.

Input signals can be analyzed with menu "Burst Analysis" and "IQ Spectrum" (narrowband spectrum monitor).

1.5 Remote Control (Option CTS-K6)

Option "Remote Control" allows the CTS to be controlled via an RS232 interface.

2 Preparation for Use

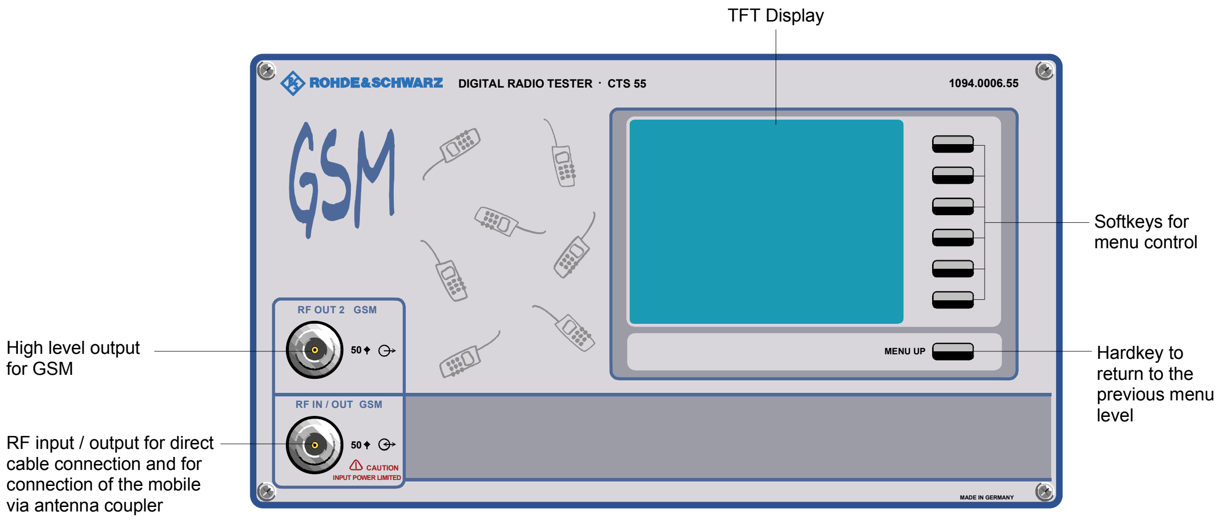
- When unpacking the instrument, don't forget the items and accessories which are included.
- When transporting the instrument in future it is strongly recommended that the protective caps included in the shipping box for protection of the front and rear panel are used. This serves to prevent damage to the protruding items on the front and rear panels.

Important note:
A rechargeable battery is installed in the CTS which allows storage of important instrument parameters when the instrument is switched off. This battery is automatically charged during operation of the instrument. For the battery to be sufficiently charged, the CTS should not remain switched off for longer than three months.

The instrument should be switched on for at least 24 hours upon its first use.

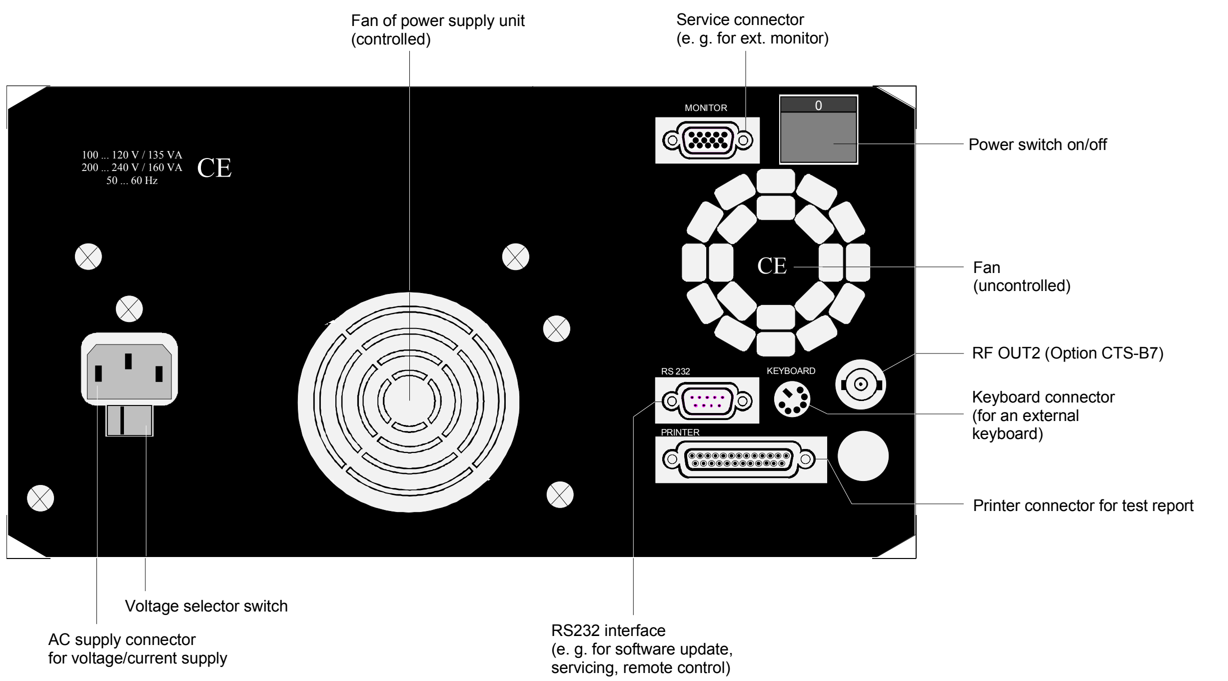
2.1 Explanation of Front and Rear View

This page shows the front and rear view of the instrument, with short explanations on the controls and connectors.

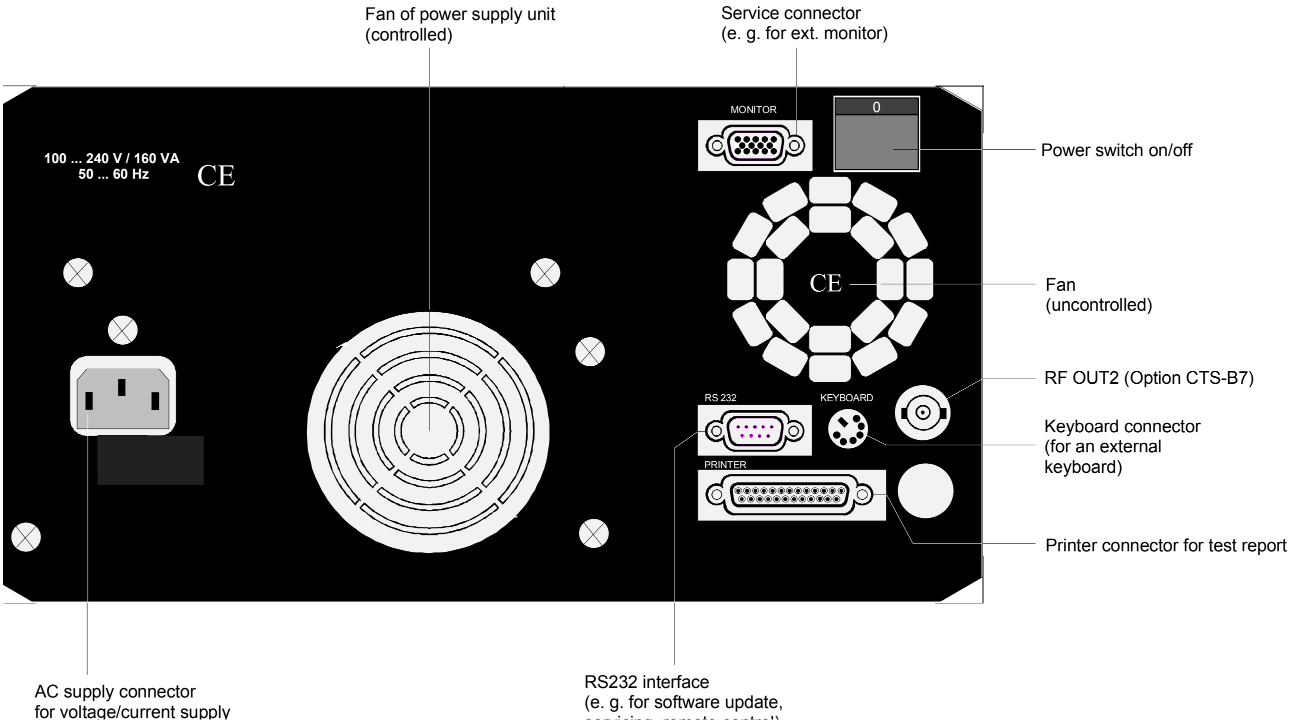


The input power may not exceed +45 dBm in pulsed mode (1:8) and +39 dBm (8 W) in CW mode!

Instrument with input voltage selector



Instrument with wide-range voltage input



2.2 Commissioning

2.2.1 Setting up the Instrument

For bench measurements, it is recommended that the fold out feet at the bottom of the instrument are used as this improves the viewing angle of the screen.

For convenient operation of the instrument note the following:

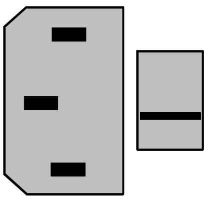
- Do not cover the ventilation openings!
- Ambient temperature +5 to +45 °C.
- Avoid moisture and condensation, if it occurs however, the instrument must be thoroughly dried before switching on.

2.2.2 Connecting the Instrument to the AC Supply

➢ Check the position of the voltage selector and set it to the local AC supply voltage if necessary.

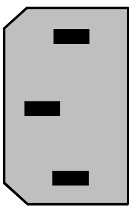
➢ Plug the supplied power cable into the rear power connector and connect the CTS to the power supply.

Instrument with input voltage selector



100 ... 120 V / 135 VA
200 ... 240 V / 160 VA
50 ... 60 Hz

Instrument with wide-range voltage input



100 ... 240 V / 160 VA
50 ... 60 Hz

2.2.3 Ensuring Electromagnetic Compliance (EMC)

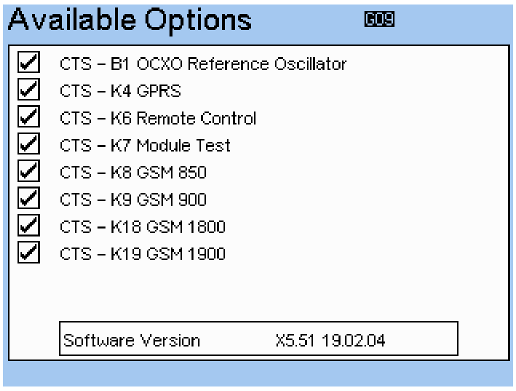
In order to avoid electromagnetic interference, the instrument may only be operated with all covers in place as they form part of the shielding for the instrument. Only appropriate shielded signal and control cables (e.g. RF connecting cables) should be used.

2.2.4 Switching on the Instrument

The CTS is switched on by means of the power switch at the rear.

2.2.5 Options List

After the instrument is switched on a start up screen is displayed while the instruments loads stored parameters and checks which options are installed. After a short time the options screen is displayed (see below). It is advisable to check the options after powering up the instrument for the first time to ensure that the purchased options are installed.



Available Options Menu

If you want to use additional available options, please contact your local Rohde & Schwarz sales representative.

2.2.6 OCXO Reference Oscillator (Option CTS-B1)

If your instrument is equipped with this option, be aware that an OCXO needs approximately 15 minutes to warm up after switching on the instrument to achieve full precision.

2.2.7 Connecting an External Keyboard

The equipment can also be operated with an external keyboard which is to be connected to the rear-panel PS-2 connector KEYBOARD.

- Function keys F1 to F6 are assigned to the 6 softkeys next to the display. F1 corresponds to the uppermost softkey.
- The ESC key is assigned to softkey MENU UP.
- Alphanumerical characters can be directly entered and edited.

2.2.8 Connecting an External Monitor

For servicing an external monitor can be connected to 15-contact VGA connector MONITOR. Switching from TFT display to monitor is described in section 1.4.2 of the service manual.

3 Getting Started With Autotest

3.1 Overview

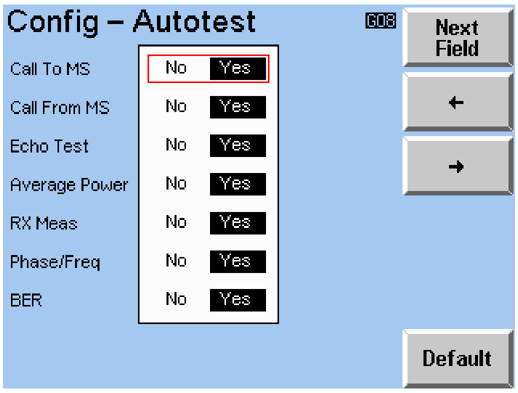
In Autotest mode the CTS for digital mobiles is easy and convenient to operate thanks to its clear-cut menu structure.

If this is your first encounter with CTS in Autotest mode, this chapter will give you a quick survey of tests performed on mobile stations. You will be guided step by step through the Autotest test sequence for mobile stations.

Each step is provided with reference numbers, e.g. circles with a number (①) which relates to further information on the facing page.

The layout and the contents of this chapter are tailored to application requirements and provide information for both the CTS and the GSM 850, GSM (GSM 900), PCN (DCS 1800, GSM 1800) and PCS (DCS 1900, GSM 1900) networks.

The autotest comprises a configurable sequence of tests which is tailored to determine whether a mobile functions or not. Any autotest step can be included or excluded from the Autotest sequence in the Config-Configure Autotest menu.



Config-Autotest menu

The tests are:

- Call to the mobile (from the CTS),
- Echo test,
- Call release by the mobile,
- Call from the mobile (to the CTS),
- Power measurements on the first user defined channel,
- Sensitivity measurements on the first user defined channel,
- Power ramp and phase frequency measurements on the first user defined channel,
- Bit Error Rate (BER) measurements on the first user defined channel,
- Power measurements on the second user defined channel,
- Sensitivity measurements on the second user defined channel,
- Power ramp and phase frequency measurements on the second user defined channel,
- Bit Error Rate (BER) measurements on the second user defined channel,
- Network release.

When a two band autotest sequence is performed, two further autotest steps may be attempted. These two steps are determined by examining the Dual Band capability of the instrument. If the instrument is configured for Dual Band handover, then the following two steps apply.

The „Handover To“ step is only performed in the starting network, where the location update occurs and the „Handover From“ step is only performed after testing has been completed in the handover band.

- Handover To the new band
- Handover From the new band

The Autotest can be carried out on one, two or three channels. In the introduction it is assumed that the test will be carried out on two channels (mode on delivery). The number of channels can be changed in the Config-Autotest menu. It is also assumed that the wide tolerances are used (see also the Config-Autotest menu).

Within this sequence there are several channel changes, which means that channel changes are also tested.

To become familiar with CTS in Autotest mode try out the functions described immediately using a CTS and a mobile station. The instructions and information given in this chapter are based on the assumption that the mobile is connected to the tester via a cable.

For further information on the individual menus and keys, refer to the detailed description of the test sequence in chapter 4 and to the menu descriptions in chapter 9.

Details of the test set-up and the use of antenna couplers are in chapter 8.

Important notes:

- In order to exclude unpredictable circumstances that may arise due to the use of a network SIM card (e.g. the SIM card prohibits the registration (Location Update) on the network simulated by CTS or it prohibits the signalling for the bit error test), it is strongly recommended that an R&S GSM test SIM card (part CRT-Z2) is used.

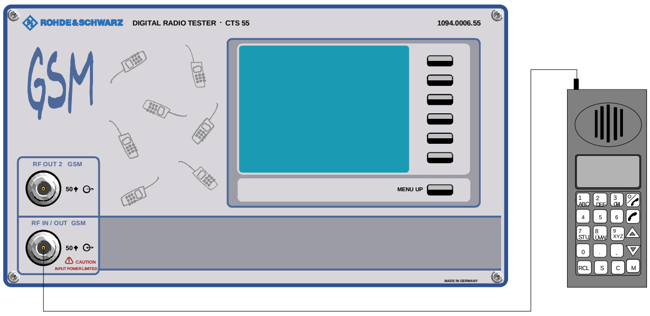
- The GSM850, GSM, PCN and PCS networks are cellular networks. The area to be covered by the network is divided up into honeycomb-shaped cells in the ideal case. The graphics on the front panel of the CTS indicates the network’s cellular structure.

  Each cell accommodates a base station transmitting the control information on a defined channel. The CTS is simulating the radio network, i.e. the base station, so that a control channel is transmitted. If the CTS is in the area of a cell make sure that the control channel of the CTS differs from that of the cell. In the case where the CTS uses the same channel as the base station of the cell, the mobile phone may try to register with the cell or the Location Update with the CTS may be disturbed.

  With the CTS in autotest or quicktest mode the control channel corresponds to the 1st channel set in the configuration.

- Special attention is required when using an antenna coupler (see chapter 8).

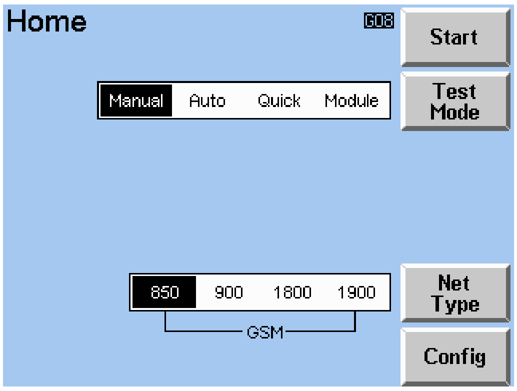
3.2 Test of Mobile



Step 1

Connect the N socket RF IN/OUT of CTS with antenna connector of mobile. ①

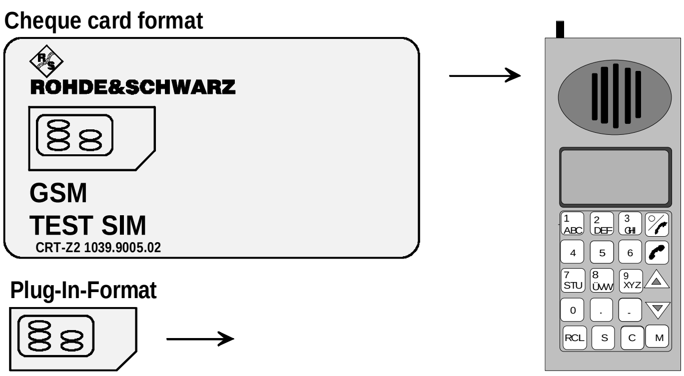
Make sure that the mobile is provided with the required supply voltage (charged battery or power supply unit). ②



Home Menu

After the CTS is switched on the Home Menu shown opposite appears after a few seconds. The instrument is now ready for testing. Use the "Test Mode" key to toggle between the Manual Test, Autotest, Quicktest and Module Test modes (select "Autotest").

Press "Start" to go to the Main Menu of the Autotest. With the "Net Type" key the network type can be selected and with the "Config" key the configuration menus can be reached. ③



Step 2

Insert test SIM card of the right format into the mobile. ④, ⑤

Note:
Network SIM cards prohibit measurement of the bit error rate. The Autotest can therefore only be carried out fully if a test SIM card is used.

Explanations:

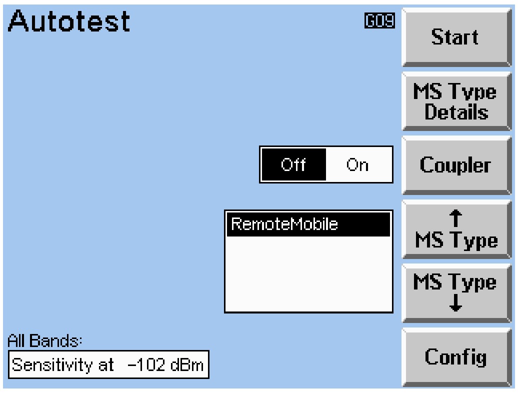
① **RF connection to mobile**
For the RF connection to the mobile station, a high-grade cable should be used with an attenuation ideally below 0.5 dB per meter. Hand held mobiles can be connected using the car installation set offered by suppliers of mobiles. The following description of "Getting Started" assumes a good RF connection so that compensation for external attenuation is not necessary. The "Coupler" key in the Main Menu of the Autotest has to be set to off.

② **Power supply of mobile**
If the mobile is supplied from an external power supply unit, make sure that this unit can provide the required peak current. Digital mobile phones generate pulsed signals at RF and thus frequently have a pulsed current drain. Problems may arise if power supplies are used that cannot provide such currents at constant voltage.

③ **Test Mode and NetType keys**
The remainder of this chapter assumes that the "Test Mode" was set to Autotest and the "Net Type" to GSM. In addition, it is assumed in this chapter that the Autotest is carried out on two channels.

④ **SIM card**
GSM specifications define two formats of SIM card: cheque card format or a considerably smaller format, the 15 x 20 mm plug-in SIM card. A mobile must have a SIM card inserted to be able to make a call. For tests on mobiles performed with CTS, the test SIM card from Rohde & Schwarz should be used.

⑤ **Test SIM card**
The Rohde & Schwarz test SIM card can be ordered as an accessory unit under the designation CRT-Z2 (Order No. 1039.9005.02). This card has cheque card format but can easily be exchanged for a plug-in card.



Autotest Start Menu

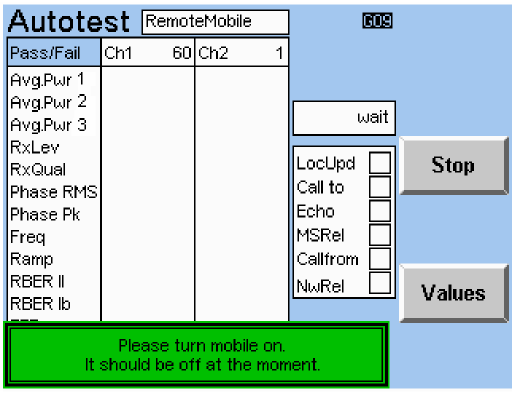
Step 3

After pressing the "Start" key in the Home Menu the Autotest Start Menu screen is displayed.

Select the mobile type from the list using the "MS Type" keys to scroll through the list. ⑥

Use the "Mode" key from within the Config menu to select step or continuous test mode. ⑦

For the following sequence the required settings are Mode = Cont and Coupler = off. Press the "Start" key to begin with the test sequence.



Autotest Running Menu

After pressing the "Start" key in the Autotest Start Menu the screen shown opposite appears. CTS is now transmitting the control channel and waits for the mobile to synchronise to the CTS (Location Update). ⑧

Switch on the Mobile and enter the PIN number when requested to do so. ⑨

As soon as the mobile is synchronised the LocUpd box will show a "✓".

Explanations:

⑥ **"MS Type" select keys**
These keys are used to scroll through the list of mobile types. Selecting a mobile type will cause the values allocated to the mobile for Input Att, Output Att and the signal level for the sensitivity measurement (RxLev/RxQual and bit error rate) to be used during the test. However, as the coupler is set to off, the attenuations are not taken into account.

⑦ **"Mode" key**
Step mode causes the CTS to stop after each test has been completed requiring the user to press the "Continue" key. Continuous mode performs all the tests one after the other with no pause between tests.

⑧ **Location update**
The mobile is requested to make a Location Update on the control channel. By the Location Update, the base station is informed that a specific mobile has been switched on in its area and is ready to make and receive calls. If the mobile is already switched on and "registered" when the test is started, it will indicate "service" and wait. In this case, the mobile is synchronised to a near-by base station. Switch the mobile off and on again. If the mobile fails to perform a Location Update within a defined time period, the test will be aborted and the LocUpd box is marked as not executed (see Autotest menu).

⑨ **PIN number**
Please be careful when entering the PIN number. The card will be locked after three failed attempts. The card will be released again upon entering the PUK number, which is either known to the user or available from the office issuing the card. It is also advisable to read the relevant section of the operating instructions of the mobile. It is convenient to use the R&S test SIM card which always responds to the number "0000". (A locked R&S SIM card can be unlocked by keying in the PUK number 12345678.)

Note 1: Display Modes

In Autotest mode the results are available in two different forms, as Pass/Fail form or as measured values. Measurement tolerances can be also be displayed. To switch between the result forms and the tolerance display the fifth softkey from the top has to be pressed. The name of the softkey changes to show what will appear next.

Note 2: Partitioning of the screen

The Test Menu screen is divided into the parts:

- Part 1
  The state of a measurement; this can be "Pass", "Fail" or the result value of the measurement.
- Part 2
  The state of a signalling procedure and the echo test. This can be a "f" or a "✓".
- Part 3
  The activity message. This is information about an error or about an action to be done by the user.

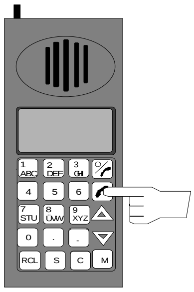
Step 4

Status message
Call to MS: run

Activity message
When mobile rings please answer.

After the Location Update the mobile is called from the test station.

Answer the call when the telephone rings. ①⓪



Status message
Call to MS: ✓

The test step has been completed successfully.

Step 5

Status message
Echo Test: run

Activity message
Please confirm "OK" or "fail"

The test comes to a stop here so that the user can speak into the mobile and evaluate the quality of the echoed message.
Press key "OK" or "FAIL" to terminate this test step. ①①

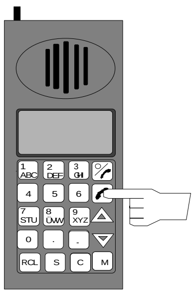
Status message
Echo Test: ✓/**f**

Step 6

Status message
MS Release: run

Activity message
Please release mobile

Now terminate the call. ①②



Status message
MS Release: ✓

The link has been cleared down correctly.

Explanations:

①⓪

CTS sends a call to the mobile. When the mobile rings, the user must press the relevant phone button. As a result, a speech link is set up on the first channel, which can be selected in the configuration menu. CTS will terminate the test step with a "✓" in the CallTo box if the mobile functions properly. If the mobile does not accepts the call within a given time period, the test will be terminated with a "f" in the CallTo box.

①①

After link set-up, CTS stores the speech signals received and sends them back to the mobile with a delay of one second. The user is thus able to speak into the microphone of the mobile with the link set up and hear the echo after approximately one second in the loudspeaker. This permits the user to evaluate the received speech quality. If it is okay, the echo test is successfully completed by pressing the "OK" key. Otherwise, the test step should be terminated with the corresponding result by pressing the "FAIL" key.

①②

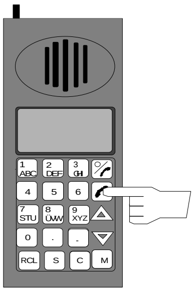
The user is requested to hang up or, if it is a handy, to press the corresponding button. The test will be terminated with "✓" if the speech link is cleared down correctly. Should the mobile fail to clear the link down within a given time period, the test will be ended with a "f" in the NwRel box.

Status message
Callfrom: run

Step 7

Activity message
Please initiate a call from the mobile

Make a call from the mobile. ①③



Status message
Callfrom : ✓

The test step has been successfully completed

Status messages
Avg. Pow 1: run
Avg. Pow 2: run
Avg. Pow 3: run

Step 8

While this status message is displayed, the average transmitter power of the mobile is being measured. ①④

Status messages
Avg. Pow 1: pass/fail
Avg. Pow 2: pass/fail
Avg. Pow 3: pass/fail

If the message "run" changes to "pass", the measurement has been successfully completed.
The result is within tolerances.

Status message
RxLev: run
RxQual: run

Step 9

In this next test step the RxLev and RxQual of the mobile is measured. ①⑤

Status message
RxLev: pass
RxQual: pass

Measurement completed. The result is within tolerances.

Explanations:

①③

When the mobile has synchronised via the broadcast channel (SERVICE is indicated on the mobile's display), the user is requested to make a call from the mobile. At this point the user may dial any number. It is however advisable to choose a number that contains all 10 digits in order to verify the proper functioning of all keys. CTS shows the dialled number on the display, so the user can see at a glance whether all numeric keys are in functioning correctly. When the speech link is successfully set up, CTS terminates the test step with a "✓".

①④

The average transmitting power of the mobile is measured at three levels. The test will be terminated with "pass" if the results are within their respective tolerance ranges. Otherwise the message "fail" will appear.

①⑤

Each GSM850/GSM/PCN/PCS mobile is capable of measuring its received level (RxLev) as well as the quality of the received signal (RxQual). The values for the two parameters are continuously transmitted to the test unit. In this "sensitivity" measurement, the signal is sent to the mobile on the speech channel at a selectable transmit level and the values obtained for RxLev and RxQual are evaluated. In general, the value transmitted for RxQual is increasing with decreasing transmitting level. The lower the transmitted RxQual value, the higher is the "sensitivity" of the mobile.

The test will be terminated with "pass" if the results for RxLev and RxQual are within their respective tolerances.

Status message
Phase RMS: run
Phase PK : run
Frequency : run
Ramp : run

Step 10

The phase and frequency errors as well as the power ramp are measured during this step. ①⑥

Status message
Phase RMS: pass
Phase PK : pass
Frequency : pass
Ramp : pass

This message shows when the test step is complete.

Status message
BER : run
RBER II : run
RBER Ib : run
FER : run

Step 11

Performing a bit error rate measurement (BER). ①⑦

Status message
BER : pass
RBER II : pass
RBER Ib : pass
FER : pass

This message shows when the test step is complete.

Step 12 to 16

This is a repetition of the tests eight to twelve for the second user defined channel.

Status message
Network Release: run

Step 17

The speech link is cleared down by CTS. ①⑧

Status message
Network Release: ✓

The link has been cleared down correctly.

Explanations:

①⑥

In this step the power ramp, the phase error (PK) phase error (RMS) and the frequency error is measured. These measurements check the quality of the transmitter of the mobile. Both the power ramp graph and the frequency error graph can be displayed at the end of the Autotest sequence.

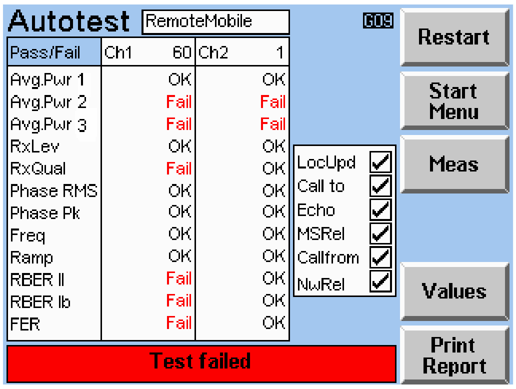
①⑦

For the BER measurement the mobile is set into the "Loop Back" mode to send any the received bits back to the CTS. The CTS compares the received bits with the bits sent out and calculates the BER.

①⑧

The test sequence ends with this test step.

Note:
The mobile can only be set to the state "loop back" (using a signalling procedure) if a test SIM card is used. Therefore measurement of the bit error rate is not possible without a test SIM card and the Autotest is aborted with a signalling error.



Autotest Result Menu

Step 18

After the test sequence has finished the menu will have new buttons as shown on the opposite side. The "Restart" key will repeat the test sequence. The "Start Menu" key will return to the Start Menu of the Autotest. The "Meas" key will go to the Power ramp Menu where the power ramp is shown graphically. The Phase Freq graph will be available for display from within the Power ramp Menu. With the "Values" key the display can be changed to show the results as either values, the tolerances or the results as pass/fail values. The text on the key will change to show the next screen in the toggle sequence. "Print Report" prints the measurement results into the printer protocol.

4 Autotest Sequence in Detail

4.1 General

The tests to be carried out in the Autotest mode are optimised to enable the user to draw a conclusion in the shortest possible time on whether the mobile is functioning correctly or not. The CTS is however not capable of checking the GSM specification in all its details. A check of this type would of course require a considerably greater expenditure in time and test equipment.

The first five test steps of the Autotest are concerned with establishing and releasing the link between the mobile and the CTS. If any one of these tests fails the link cannot be established or released properly and testing ends with the "fail" message. If the tests are successful a "✓" is placed in the box next to the test name.

The remaining tests are measurements. The results of these measurements are shown either as values or as pass/fail messages. It is possible to toggle between the displays for measured value, pass/fail and tolerance.

In Autotest the user can influence the duration of a test in several ways. Firstly he can choose to carry out the measurements on one, two or three channels. Secondly he can vary the number of frames for the bit error rate measurement. The shortest test is achieved by carrying out the test on one channel only and by setting the number of frames for the bit error rate measurement to the minimum. However, this will exclude the channel change test that is carried out when switching to the second and third channel.

Furthermore the user has the option to either freely define the tolerances for the measurements carried out in Autotest or to select one of two predefined sets of tolerances. The two predefined sets of tolerances are called "narrow" for narrow tolerances and "wide" for wide tolerances. For the freely definable tolerances the "custom" set of tolerances must be set, however in this case the tolerances are taken from the Manual Test. The table below shows the predefined tolerances for each set of tolerances and the tolerance parameters taken from the Manual Test.

Note:
The tolerances for the frequency error depend on the network (GSM850, GSM, PCN, PCS).

Measurement	wide	narrow (Rec)	Custom
Avg. Pow 1	± 5 dB	± 3 dB	Config Power Ramp : Tol highest PCL
Avg. Pow 2	± 5 dB	± 3 dB	Config Power Ramp : Tol other PCL
Avg. Pow 3	± 5 dB	± 3 dB	Config Power Ramp : Tol other PCL
RxLev	± 5 dB	± 4 dB	± 5 dB
RxQual	≤ 6.4%	≤ 3.2%	≤ 6.4%
Phase RMS	< 5°	< 5°	Config Phase/Freq : Phase Error (RMS) (current)
Phase PK	< 20°	< 20°	Config Phase/Freq : Phase Error (PK) (current)
Frequ. GSM/GSM850	90 Hz	90 Hz	Config Phase/Freq : Frequency Error (current)
PCN/PCS	180 Hz	180 Hz	
Ramp	Power Ramp Config (Template)	Power Ramp Config (Template)	Config Power Ramp (Template)
RBER II	< 5.2%	< 2.6%	Config BER : Class II
RBER Ib	< 0.8%	< 0.4%	Config BER : Class Ib
FER	< 2.0%	< 1.0%	Config FER : Frame

The user can also configure Autotest to perform either a one or two band test. A two band test sequence will allow two GSM bands to be tested within the same sequence, in addition to performing two handover tests. These being the handover to the new GSM band and the handover from the new band back to the original GSM band.

In the description of the automatic sequence below it is assumed that the measurements are carried out on two channels and that the wide tolerances are used.

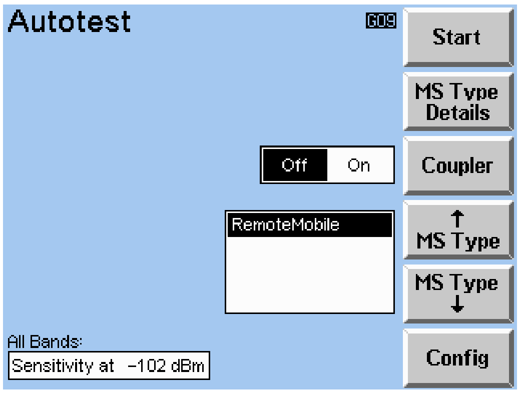
In the description of the steps of the Autotest the possible causes for an error are listed. This list cannot be regarded as complete and merely contains possible faults that are easy to eliminate e.g. flat batteries.

Before the description of the tests here are some errors common for all test steps:

- **The mobile is switched off during a running test sequence.**
  In this case the error message "Detach not expected" may appear on the screen.
- **The connection is released from the mobile in a state which the release is not expected.**
  In this case the error message "Mobile has been released during power measurement, sensitivity measurement, ..." appears on the screen.
- **There are problems with the signalling of the mobile (messages of the mobile are wrong).**
  In this case the error message "Signalling error during Location Update, Call To, ..." appears on the screen.

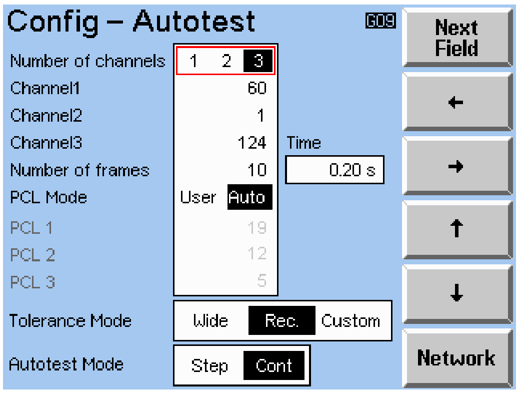
4.2 1st Step - Start

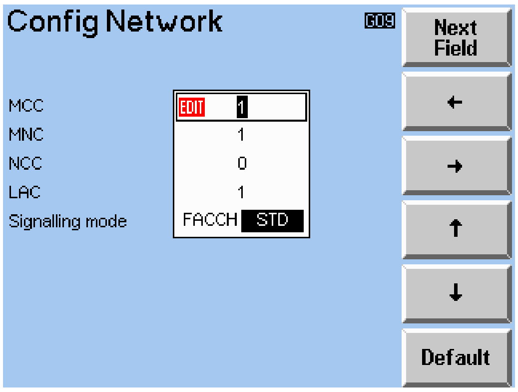
The Autotest Start Menu can be used to select the mobile type for testing and to set the coupler if one is being used. In this menu also is displayed the New External Attenuation Settings for a “low”, “mid” and “high” Band. Please see section 9.9.5 Config MS Type. The “low”, “mid” and “high” channel boundaries are dependent on the test network being used. The test is started by means of the "Start" key in the Autotest Start Menu.



Autotest Start Menu

Local configuration of Autotest parameters can be accomplished from the „Autotest Config“ menu by pressing the „Config“ softkey from the „Autotest“ Start Menu.

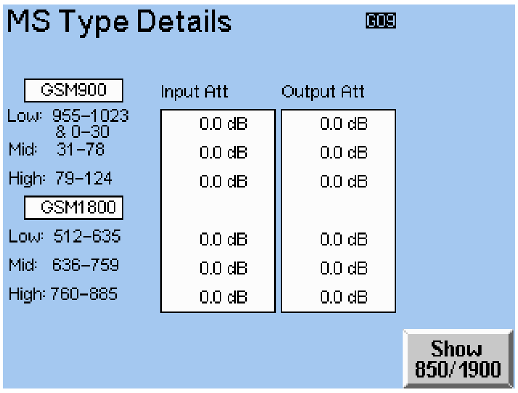


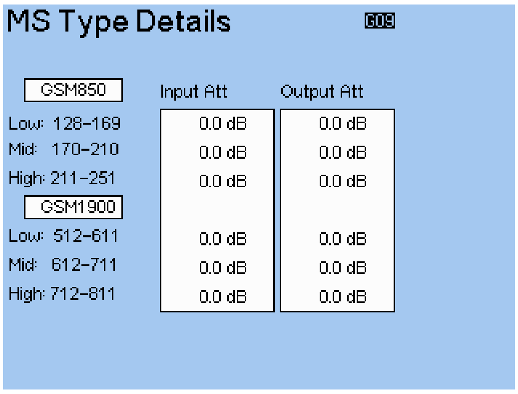


Autotest Config Menu ***Config Network Menu***

When the mobile type is selected the stored values for input and output attenuation and sensitivity level are loaded into the instrument. The sensitivity level is used as transmit level of the CTS for both the measurement of RxLev/RxQual and for the BER measurement.

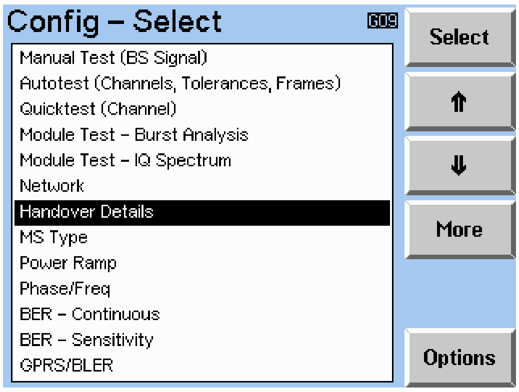
The attenuation settings for the GSM 850, GSM 900, GSM 1800 and GSM 1900 frequency bands can be displayed by pressing the „MS Type Details“ Softkey prior to starting the test sequence. First attenuation settings for GSM 900 and GSM 1800 are displayed. Press “Show 850/1900” button in order to see GSM 850 and GSM 1900 values.



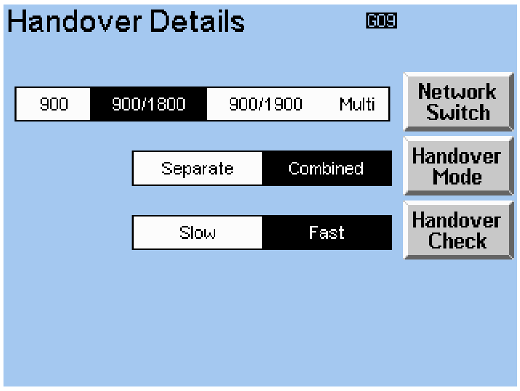


MS Type Details Menu

The „Autotest Running“ menu displayed in Autotest when the „Start“ key is pressed, is determined by the band settings of the currently selected band within the „Handover Details“ menu. This menu can be selected from within the main configuration menu.



Config – Select Menu

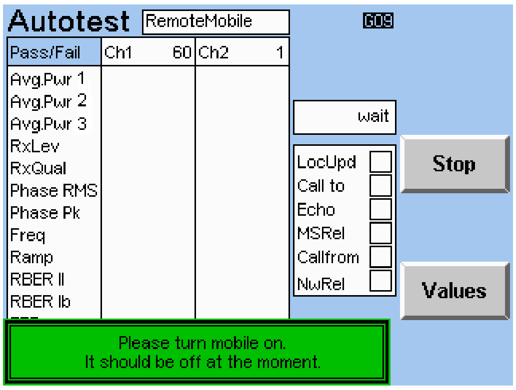


Handover Details Menu

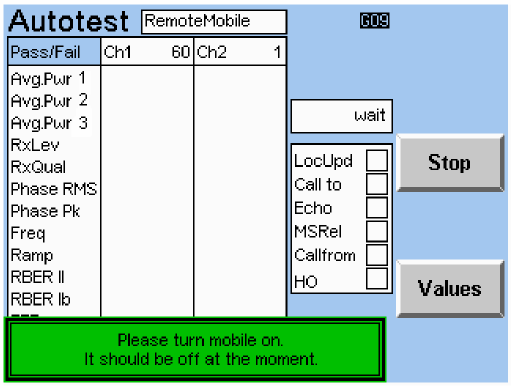
Depending on how the instrument has been configured will determine which of the two „Autotest Running“ menus will be displayed when the Autotest sequence is initiated. The above menu setting indicates that the instrument is currently configured to use the GSM 900 band as the location update band. Any handover attempt will be made to the GSM 1800 band.

Hint:
If a **single band** mobile is to be tested, then it is necessary to disable any handover steps being attempted. This can be achieved from the general “Config – Select” Menu, within "Handover Details" by changing the “Network Switch” to the single band setting.

If a single band mobile is tested with an instrument that has been configured to support handover, then Autotest will fail the handover step and ultimately fail the complete test.



Autotest Running Menu

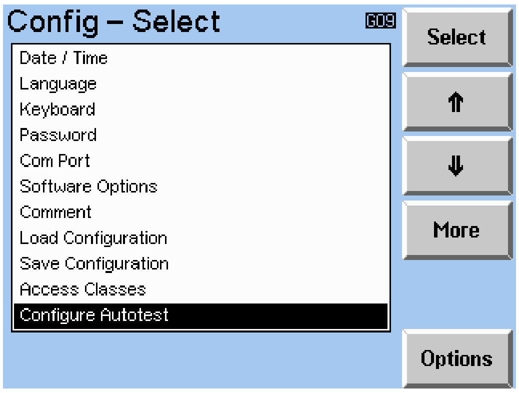


Autotest Running Menu

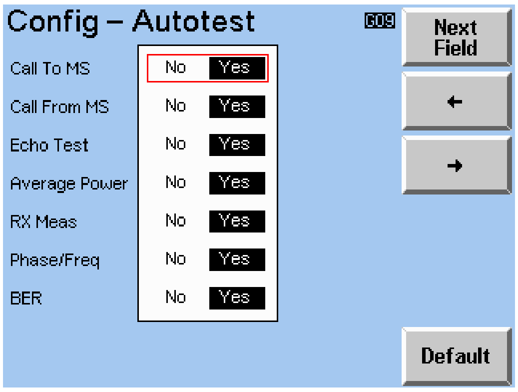
If the instrument has been configured for Dual Band handover, as in the above example, then a two band autotest sequence will be attempted. This is depicted by the HO step in the signalling box.

A single band test will contain the NwRel as the final signalling step.

If a test cycle has already taken place, it is possible to start from the Autotest Result Menu using the "Restart" key. The test sequence can be terminated at any time before it is completed by pressing the "Stop" key in the Autotest Running Menu. The "Continue" key is used in step mode of the Autotest to continue with the next step of the test sequence. The "Menu Up" hardkey returns to the previous menu regardless of the state of the test. Any test results collected will be lost when the "Menu Up" key is pressed.



Config - Select Menu



Config Autotest Menu

To skip a test from being perfomed by Autotest Choose “Config – Select ”– “”Configure Autotest” and set “No” to the tests in the “Config – Autotest” menu.

4.3 2nd Step - Location Update

The CTS sends the broadcast information on the control carrier (C0). If following a request the mobile is switched on, it will attempt to synchronise to this carrier by performing a Location Update. Should the synchronisation be successful, the CTS terminates this test step with "✓" in the LocUpd box. If the synchronisation does not take place within a given time, the test will be ended with a "f" in the LocUpd box. All subsequent tests will be skipped and the whole test sequence is terminated because it is not possible to continue without a Location Update.

Possible causes for "fail":

- **The network parameters MCC, MNC, NCC or LAC are wrong: see section 9.9.6 for information on configuring the network parameters.**
- **Missing or incorrect power supply or defective battery.**
- **Switch-on button of mobile not actuated or faulty.**
- **Missing or poor RF connection (attenuation to be considered).**
- **No test SIM card, poor contact of SIM card or card reader of mobile faulty.**
- **The control channel is disturbed by a strong base station (if necessary use R & S shielded chamber).**

In all the above cases the error message "Location Update not received" appears on the screen.

4.4 3rd Step - Call to MS

The CTS makes a call to the mobile. When the mobile is ringing, the user must answer the call by pressing the appropriate button on the mobile station. If the mobile functions properly, the speech link on channel 1 is now set up. The CTS puts a "✓" in the "Call to" box. The channels can be set in the Config Channels menu which is reached by pressing the "Config" key. If the mobile does not accept the call within a given time period, the test is then ended with a "f" in the "Call to" box. All subsequent tests will be skipped and the whole test terminated because it is not possible to perform any measurements on the mobile without establishing a link.

Possible causes for a fail:

- **Acoustic tone generator for the ringing tone is defective or too weak.**
- **The call was not accepted during ringing.**
- **The call-acceptance switch or button is defective.**

In all the above cases the error message "Call to mobile not answered" appears on the screen.

- **The mobile is switched off and on whilst a call to the mobile is in progress.**
  In this case the error message "Location Update not expected" appears on the screen.
- **An unexpected call from the mobile is started by the user.**
  In this case the error message "Call from mobile not expected" appears on the screen.

4.5 4th Step - Echo Test

With a speech link set up with the CTS, it is possible to speak into the mobile phone and to receive the speech back with a delay of 1 second. This test allows the user to assess the quality of the speech link in transmit and receive modes. The test is ended with a "✓" or a "f" when either the "OK" key or "FAIL" key is pressed.

4.6 5th Step - MS Release

The user is requested at this point to release the link by pressing the appropriate button at the mobile. After a correct clear down of the speech link, the test is concluded with a "✓" in the "MSRel" box. If this does not take place within a given time period, the test is ended and all subsequent tests are skipped. A "f" is put in the "MSRel" box and the whole test terminated.

Possible external causes for "fail":

- **The switch or button for terminating the link is defective.**
- **The mobile has not been put on hook.**

In all the above cases the error message "Time-out - no response by mobile" appears on the screen

4.7 6th Step - Call From MS

After a short wait, the user will be requested to make a call from the mobile. Any number can be selected. It is useful for the called number to contain all 10 digits (0 to 9) as this tests all numeric keys. The CTS displays the dialled number (and outputs it in the test report printout) below the test results box. The numeric keys can thus be checked for malfunctioning keys. As soon as the speech link is set up, the CTS concludes with a "✓" in the "Call from" box. If the mobile does not send out the call within a given time period, the test is ended with a "f" in the "Call from" box. All subsequent tests will be skipped and the whole test terminated because it is not possible to perform any measurements on the mobile without an established link .

Possible external causes for fail:

- **The call switch or button is defective or was not actuated.**
  In this case the error message "Call from mobile not received" appears on the screen.

4.8 7th Step - MS Average Power

The average output power of the mobile is measured at three levels. The levels which are used for the measurement depend on the configured PCL mode, see section 9.5.2. The default PCL mode is the Auto mode.

Auto mode
The first level of measurement is on the minimum allowable output power and depends on the power class of the mobile and the external attenuation set. The CTS takes the power class of the mobile into consideration automatically. The second level of measurement is an intermediate value between the maximum power level of the mobile and the minimum power level used. The third level of measurement is on the maximum output power and also depends on the power class of the mobile.

User mode
Power control levels defined by the user in the Config-Autotest (see section 9.5.2) are used for the average output power measurement.

The following tables show the power values in dBm for the power control levels for GSM, GSM 850, PCS and PCN. Included in the listing are the maximum values for the power classes and the wide tolerances.

GSM and GSM 850

Power control level	Nominal power (dBm)	Tolerance (dBm) wide	Tolerance (dBm) acc. to GSM-recommendation
15	13	8 to 18	10 to 16
14	15	10 to 20	12 to 18
13	17	12 to 22	14 to 20
12	19	14 to 24	16 to 22
11	21	16 to 26	18 to 24
10	23	18 to 28	20 to 26
9	25	20 to 30	22 to 28
8	27	22 to 32	24 to 30
7	29 (highest level for class 5)	24 to 34	27 to 31
6	31	26 to 36	29 to 33
5	33 (highest level for class 4)	28 to 38	31 to 35
4	35	30 to 40	33 to 37
3	37 (highest level for class 3)	32 to 42	35 to 39
2	39 (highest level for class 2)	34 to 44	37 to 41

PCN and PCS

Power control level	Nominal power (dBm)	Tolerance (dBm) wide	Tolerance (dBm) acc. to GSM-recommendation
13	4 (lowest level for class 2)	-1 to 9	0 to 8
12	6	1 to 11	2 to 10
11	8	3 to 13	4 to 12
10	10 (lowest level for class 1)	5 to 15	6 to 14
9	12	7 to 17	8 to 16
8	14	9 to 19	11 to 17
7	16	11 to 21	13 to 19
6	18	13 to 23	15 to 21
5	20	15 to 25	17 to 23
4	22	17 to 27	19 to 25
3	24 (highest level for class 2)	19 to 29	22 to 26
2	26	21 to 31	24 to 28
1	28	23 to 33	26 to 30
0	30 (highest level for class 1)	25 to 35	28 to 32

The test will be concluded with "pass" if all three measured values lie within their tolerances.

The tolerances have been given an appropriate wide window to allow for attenuation inaccuracies when using an antenna coupler.

Possible external causes for "fail":

- **The actual attenuation of the RF connection does not correspond to the attenuation set on the CTS.**

4.9 8th Step - Sensitivity (RxLev and RxQual)

Every GSM mobile phone is capable of measuring the power level and quality of the signals it receives. The result of these measurements are the RxLev and the RxQual values. During testing these values reported back to the CTS continuously by the mobile.

The sensitivity measurement consists of sending a selected power level (the sensitivity level of the mobile type) on the speech channel to the mobile. The measured RxLev and RxQual values are displayed on the screen.

Transmit. level (dBm) CTS	**Level tolerance (dBm) on mobile (wide)**	**RXQUAL (max. value)**	**max. bit error rate (%)**
-100 set level	-105 to <-94 (1)*	5	5.2

1)* set level -5 dB ... <set level +6 dB → Example: level = 100 dBm, tolerance = -105 ... <-94 dBm.

The test will be concluded with "pass" if all values lie within their tolerances. The tolerances have been given a wide range to allow for attenuation inaccuracies when using an antenna coupler.

Possible causes for "fail":

- **The actual attenuation of the RF connection does not correspond to the attenuation set on the CTS.**

4.10 9th Step - Phase/Frequency Error and Power Ramp

These are the transmitter measurements of the of the mobile.

Phase error RMS
The phase error RMS is calculated by comparing the power burst received from the telephone with the phase characteristic of an ideal modulator. The maximum error allowed is plus 5° (wide tolerances).

Phase error Peak
The peak phase error is calculated by comparing the phase of the power burst received from the mobile with the phase characteristic of an ideal modulator. The maximum error allowed is plus or minus 20° (wide tolerances).

Frequency error
The frequency error of the mobile is measured at this step.

Tolerances:	± 90 Hz	GSM/GSM850
(wide)	± 180 Hz	PCN/PCS

Power Ramp
This measurement compares the burst received from the mobile with a predefined tolerance window.

4.11 10th Step - Bit Error Rate

The measurement is performed at the sensitivity level defined for the mobile type. The measurement is made by sending bits to the mobile. The mobile echoes the bits back to the CTS, where the original bits are compared with those echoed back. The difference between the two values is expressed as a percentage.

The BER measurement has three results:

	Tolerance (wide)
RBER (residual bit error) of the Class II bits	5.2%
RBER (residual bit error) of the Class Ib bits	0.8%
FER (Frame erasure rate)	2.0%

For the BER measurement 250 speech frames are used.

RBER Class Ib and FER are subject to the α-evaluation; i.e, with high RBER Class Ib and low FER or with low RBER Class Ib and high FER both are evaluated "pass".

4.12 Steps 11 - 14 - Measurements on the second channel

The measurement in the steps 7 to 10 are done on the first channel defined for the Autotest. In the steps 11 to 14 the same measurement are carried out again but on the second channel defined for the Autotest. The tolerances are the same as for the measurements on the first channel.

4.13 15th Step – Handover or Network Release

During this step the CTS will either perform a network release or attempt a handover to the new band. The step action is determined by the settings within the „Handover Details“ menu. If the instrument is configured for Dual Band handover, then the CTS will attempt a handover at this point.

If the instrument is not configured for Dual Band handover, then the CTS will attempt a network release prior to concluding the test sequence. Following a correct close down of the speech link, the test is concluded with a "✓" if successful or a "f" if not.

If a handover is attempted and succeeds, then the CTS will perform an echo test in the new band. After completion of the echo test, steps 4.8 – 4.12 will be attempted in the new band. Provided that each step in the second band reaches a measured conclusion, then a further handover back to the original band will be attempted.

The final step of the two band autotest sequence is the same as a single band test and is to perform a network release.

Hint:
If a **single band** mobile is to be tested, then it is necessary to disable any handover steps being attempted. This can be achieved from the general “Config – Select” Menu, within "Handover Details" by changing the “Network Switch” to the single band setting.

If a single band mobile is tested with an instrument that has been configured to support handover, then Autotest will fail the handover step and ultimately fail the complete test."

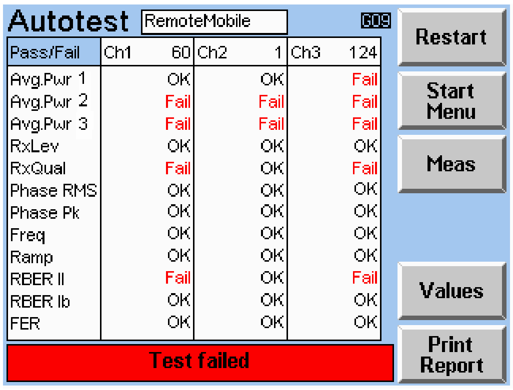
At the end of the test cycle, an overall test result is obtained on the last line of the display. More detailed results and measurements can now be output on a printer by pressing the "Print Report" key if the option CTS-B5 is installed.

4.14 Test Sequence in Single Step Mode

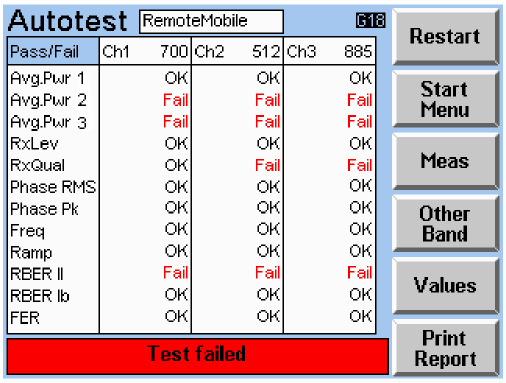
To operate in the single step mode, the "Test Mode" key in the Autotest Main Menu must be set to "Step". The test procedure is the same as described above. The CTS however stops the test after every step and waits until the "Continue" key is pressed.

4.15 Viewing the results of a two band autotest sequence

The following two menus differentiate between the results displayed after the completion of an autotest sequence and ultimately depend on whether a one or two band autotest sequence has been executed.



Autotest Results Menu



Autotest Results Menu

When a two band test sequence has completed, the results for a particular band may be displayed by pressing the „Other Band“ softkey. This provides a basic two way toggle between the results for each band. Similarly, the tolerances or signalling results can also be toggled in the same way by first selecting the signalling or tolerances menu and then pressing the „Other Band“ softkey.

In the event that a single band test has been performed, then the „Other Band“ softkey will not be present.

Displaying the power ramp display and phase frequency graphs are doubled up into the „Meas“ softkey. Pressing the „Meas“ softkey displays the „Power Ramp“ menu and the „Phase Freq“ menu can be selected from within the „Power Ramp“ menu. The Power Ramp and Phase Freq graphs that are displayed when their respective menus are selected, relate to measurements recorded in the last band of the test sequence.

A hardcopy of the measurement results can be obtained by pressing the „Print Report“ key. This will generate a pass/ fail report when the „Pass/Fail“ results menu is viewed and a values report when the „Values“ results menu is viewed.

When a two band Autotest sequence has run to conclusion, then a two page report, that has results for both test bands will be produced if requested. If the Autotest sequence has tested only a single band then only a one page report containing results for that band will be printed if requested.

5 Getting Started With Quicktest

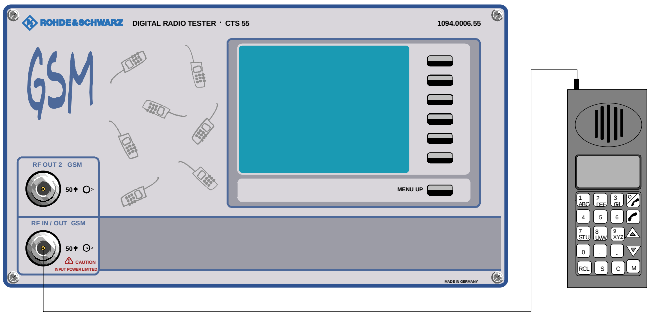
5.1 Overview

The Quicktest, in the same way as the Autotest, comprises a predefined sequence of test steps. However, in order to achieve a particularly fast function test this sequence has been reduced to the absolute minimum. The test sequence comprises the four test steps below

- Location Update (see Autotest, Chapter 3, Step 3)
- Call to Mobile (see Autotest, Chapter 3, Step 4)
- Echo Test (see Autotest, Chapter 3, Step 5)
- Network Release (see Autotest, Chapter 3, Step 17)

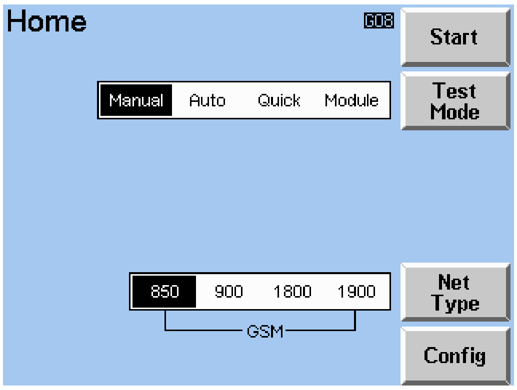
With the exception of a few insignificant exceptions these test steps match those described in the introduction for the Autotest (Chapter 3). This means that all general comments on the Autotest and all notes and additional information for these steps also apply to Quicktest. In the following only the differences in Quicktest are explained. We therefore recommend that you read Chapter 3 before you continue.

5.2 Test of Mobile



Step 1

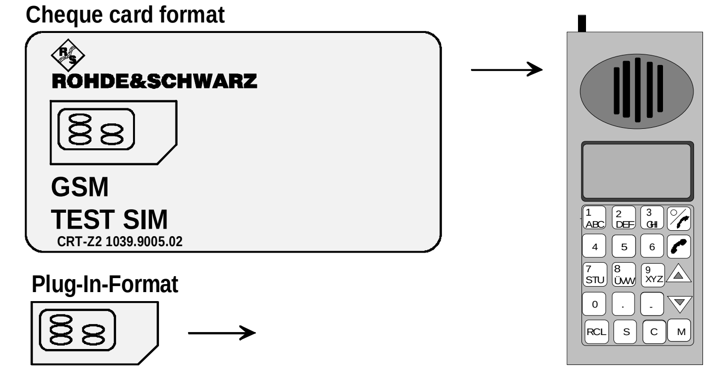
As already described in Step 1 of the Autotest the mobile must be connected to the N socket RF IN/OUT of the CTS. The mobile must also be supplied with the correct operating voltage. ①, ②.



Home Menu

After the CTS is switched on the Home Menu shown opposite appears after a few seconds. The instrument is now ready for testing. Press the "Test Mode" key to toggle between Manual Test, Autotest, Quicktest and Module Test (select "Quicktest").

Press "Start", to go to the main Quicktest menu. Press "Net Type" to select the type of network and "Config" to call up the configuration menu. The description in this chapter assumes that "GSM" has been selected as the network type.



Step 2

Insert a test SIM card of the right format into the mobile. ③, ④.

Explanations:

① **RF connection to mobile**

For the RF connection to the mobile station, a high-grade cable should be used with an attenuation ideally below 0.5 dB per meter. Hand held mobiles can be connected using the car installation set offered by suppliers of mobiles. The following description of "Getting Started" assumes a good RF connection so that compensation for external attenuation is not necessary. The "Coupler" key in the Main Menu of the Autotest has to be set to off.

② **Power supply of mobile**

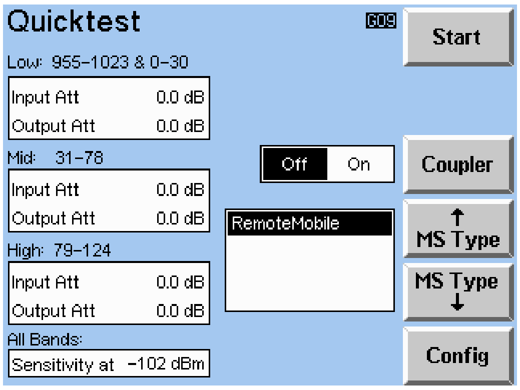
If the mobile is supplied from an external power supply unit, make sure that this unit can provide the required peak current. Digital mobile phones generate pulsed signals at RF and thus frequently have a pulsed current drain. Problems may arise if power supplies are used that cannot provide such currents at constant voltage.

③ **SIM card**

GSM specifications define two formats of SIM card: cheque card format or a considerably smaller format, the 15 x 20 mm plug-in SIM card. A mobile must have a SIM card inserted to be able to make a call. For tests on mobiles performed with CTS, the test SIM card from Rohde & Schwarz should be used.

④ **Test SIM card**

The Rohde & Schwarz test SIM card can be ordered as an accessory unit under the designation CRT-Z2 (Order No. 1039.9005.02). This card has cheque card format but can easily be exchanged for a plug-in card.



Quicktest Main Menu

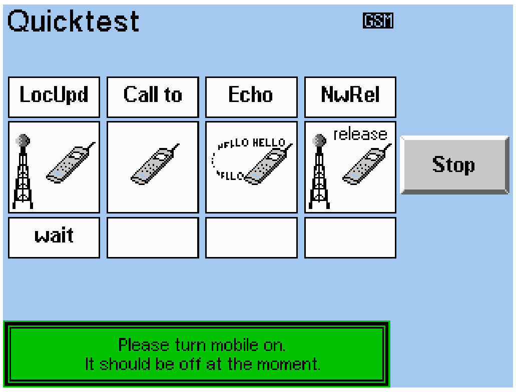
Step 3

After pressing the "Start" key in the home menu the Quicktest main menu is opened.

Select the mobile type from the list using the "MS Type" keys to scroll through the list.

In this menu are displayed the New External Attenuation Settings for a “low”, “mid” and “high” Band. Please See Section 9.9.5 Config MS Type. The “low”, “mid” and “high” channel boundaries are dependent on the test network being used.

For the Quicktest the coupler must be switched off ("off"). Press "Start" to start the test sequence. ⑤.



Quicktest Menu (Test)

After pressing the "Start" key in the Quicktest Main Menu the menu shown opposite appears. The CTS is now transmitting the control channel (BCCH) and waits for the mobile to synchronise to the signal (location update on the CTS). This process is called Location Update and is indicated by the symbol in the left window. The fact that this process is running is indicated by the yellow background.

Switch on the mobile and enter the PIN number after the prompt.

As soon as the mobile has synchronised successfully the background of the symbol changes to green. An error in the location update is indicated by a red background. ⑥, ⑦.

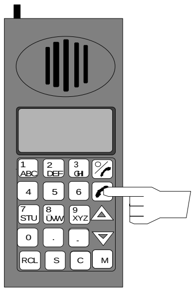
Explanations:

⑤ **"MS Type" select keys**
These keys are used to scroll through the list of mobile types. Selecting a mobile type will cause the values allocated to the mobile for Input Att, Output Att and the signal level for the sensitivity measurement (RxLev/RxQual and bit error rate) to be used during the test. However, as the coupler is set to off, the attenuations are not taken into account.

⑥ **Location update**
The mobile is requested to make a Location Update on the control channel. By the Location Update, the base station is informed that a specific mobile has been switched on in its area and is ready to make and receive calls. If the mobile is already switched on and "registered" when the test is started, it will indicate "service" and wait. In this case, the mobile is synchronised to a near-by base station. Switch the mobile off and on again. If the mobile fails to perform a Location Update within a defined time period, the test will be aborted and the LocUpd box is marked as not executed (see Autotest menu).

⑦ **PIN number**
Please be careful when entering the PIN number. The card will be locked after three failed attempts. The card will be released again upon entering the PUK number, which is either known to the user or available from the office issuing the card. It is also advisable to read the relevant section of the operating instructions of the mobile. It is convenient to use the R&S test SIM card which always responds to the number "0000". (A locked R&S SIM card can be unlocked by keying in the PUK number 12345678.)

Activity message
Answer, if the phone rings



Step 4

After the Location Update the mobile is called from the test station. The background of the second symbol changes to yellow.

Answer the call when the phone rings.

As soon as the connection is established the background of the symbol changes to green. An error is indicated by a red background. ⑧.

Activity message
Confirm “Pass” or “Fail”

Step 5

The test comes to a stop here so that the user can speak into the mobile and evaluate the quality of the echoed message.

Press "Pass" or "Fail" to terminate this test step. ⑨.

Step 6

In this final step the speech link is cleared down by the CTS. As soon as the link has been successfully cleared the background of the symbol changes to green. An error is indicated by a red background. ①⓪.

Explanations:

⑧

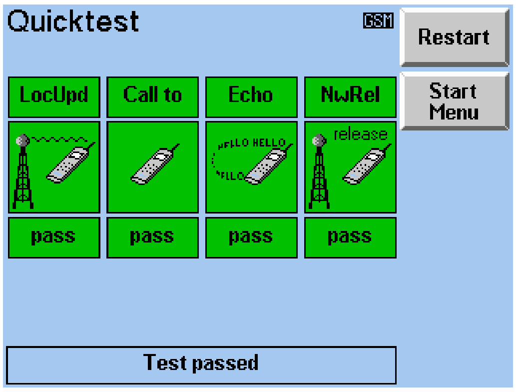
CTS sends a call to the mobile. When the mobile rings, the user must press the relevant phone button. As a result, a speech link is set up on the first channel, which can be selected in the configuration menu. CTS will terminate the test step with a "✓" in the CallTo box if the mobile functions properly. If the mobile does not accepts the call within a given time period, the test will be terminated with a "f" in the CallTo box.

⑨

After link set-up, CTS stores the speech signals received and sends them back to the mobile with a delay of one second. The user is thus able to speak into the microphone of the mobile with the link set up and hear the echo after approximately one second in the loudspeaker. This permits the user to evaluate the received speech quality. If it is okay, the echo test is successfully completed by pressing the "OK" key. Otherwise, the test step should be terminated with the corresponding result by pressing the "FAIL" key.

①⓪

The test sequence ends with this test step.



Quicktest Menu (Results)

Step 7

After the test sequence has finished the menu will have new buttons as shown opposite. Press "Restart" to start the test sequence again. Press "Start Menu" to call up the Autotest Main Menu. For an error free test all symbols must show a green background. If one of the symbols has a red background or if tests were skipped the test has detected a fault in the mobile.

6 Getting Started With Manual Test

6.1 Overview

Unlike Autotest and Quicktest the Manual Test mode does not have a fixed sequence of tests. Instead the user selects the required test using the buttons and menus.

In Manual Test mode the CTS for digital mobiles is easy and convenient to operate thanks to its clear-cut menu structure.

If this is your first encounter with CTS in Manual Test mode, this chapter will give you a quick survey of tests performed on mobile stations. You will be guided step by step through the Manual Test menus.

Each step is provided with reference numbers, e.g. circles with a number (①) relate to further information to be found below.

The layout and the contents of this chapter are tailored to application requirements and provide information both on CTS and GSM, PCS and PCN.

To become familiar with CTS in Manual Test mode and its wide variety of test functions, try out the functions described immediately using a CTS and a mobile. The instructions and information given in this chapter are based on the assumption that the mobile station is connected to the CTS via a cable.

Important notes:

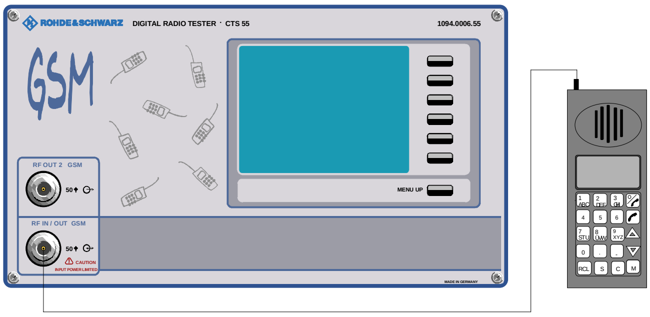
In order to exclude unpredictable circumstances that may arise due to the use of a network SIM card (e.g. the SIM card prohibits the registration (Location Update) on the network simulated by CTS or it probibits the signalling for the bit error test), it is strongly recommended that an R&S GSM test SIM card (part CRT-Z2) is used.

The GSM, PCN and PCS networks are cellular networks. The area to be covered by the network is divided up into honeycomb-shaped cells in the ideal case.

Each cell accommodates a base station transmitting the control information on a defined channel. The CTS is simulating the radio network, i.e. the base station, so that a control channel is transmitted. If the CTS is in the area of a cell make sure that the control channel of the CTS differs from that of the cell. In the case where the CTS uses the same channel as the base station of the cell, the mobile phone may try to register with the cell or the Location Update with the CTS may be disturbed.

Special attention is required when using an antenna coupler (see chapter 8).

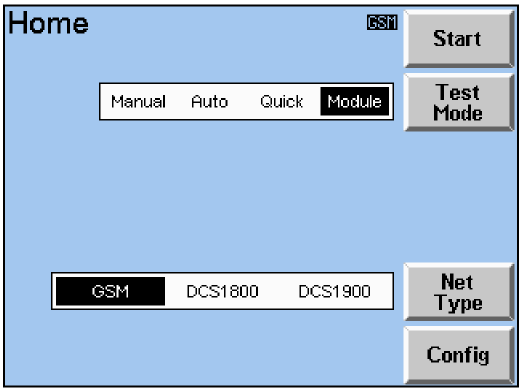
6.2 Test of Mobile



Step 1

Connect the N socket RF IN/OUT of CTS with antenna connector of mobile. ①

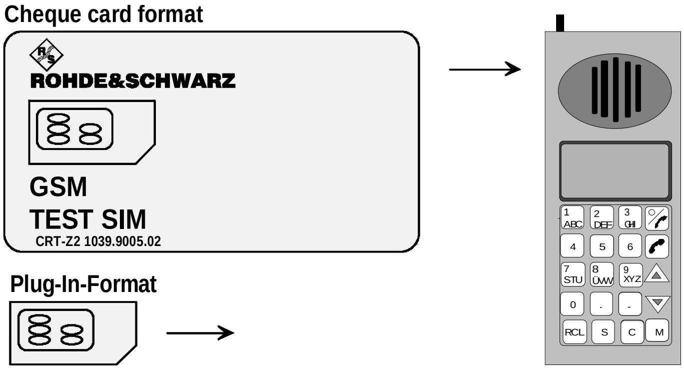
Make sure that the mobile is provided with the required supply voltage (charged battery or power supply unit). ②



Home Menu

After the CTS is switched on the Home Menu shown opposite appears after a few seconds. The instrument is now ready for testing. Use the "Test Mode" key to toggle between the Manual Test, Autotest, Quicktest and Module Test modes (must be set to Manual Test).

Press "Start" to go to the Main Menu of the first menu of the Manual Test (MS Test/Wait Sync) With the "Net Type" key the network type can be selected and with the "Config" key the configuration menus can be reached. ③



Step 2

Insert test SIM card of the right format into the mobile. ④, ⑤

Note: Network SIM cards prohibit measurement of the bit error rate. The Autotest can therefore only be carried out fully if a test SIM card is used.

Explanations:

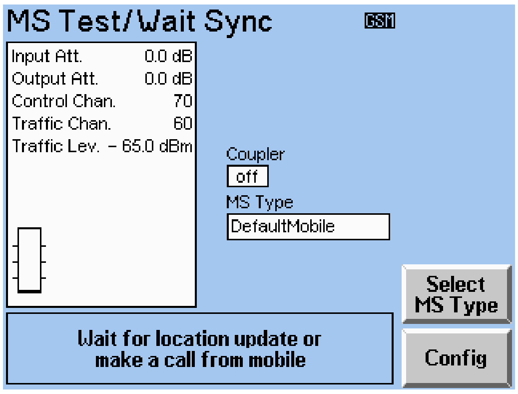
① **RF connection to mobile**
For the RF connection to the mobile station, a high-grade cable should be used with an attenuation ideally below 0.5 dB per meter. Hand held mobiles can be connected using the car installation set offered by suppliers of mobiles. The following description of "Getting Started" assumes a good RF connection so that compensation for external attenuation is not necessary. The "Coupler" key in the Main Menu of the Autotest has to be set to off.

② **Power supply of mobile**
If the mobile is supplied from an external power supply unit, make sure that this unit can provide the required peak current. Digital mobile phones generate pulsed signals at RF and thus frequently have a pulsed current drain. Problems may arise if power supplies are used that cannot provide such currents at constant voltage.

③ **Test Mode and NetType keys**
The remainder of this chapter assumes that the "Test Mode" was set to Manual Test and the "Net Type" to GSM.

④ **SIM card**
GSM specifications define two formats of SIM card: cheque card format or a considerably smaller format, the 15 x 20 mm plug-in SIM card. A mobile must have a SIM card inserted to be able to make a call. For tests on mobiles performed with CTS, the test SIM card from Rohde & Schwarz should be used.

⑤ **Test SIM card**
The Rohde & Schwarz test SIM card can be ordered as an accessory unit under the designation CRT-Z2 (Order No. 1039.9005.02). The card has cheque card format but can easily be exchanged for a plug-in card.

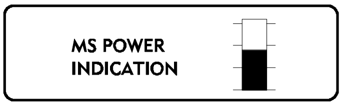


MS Test/Wait Sync Menu

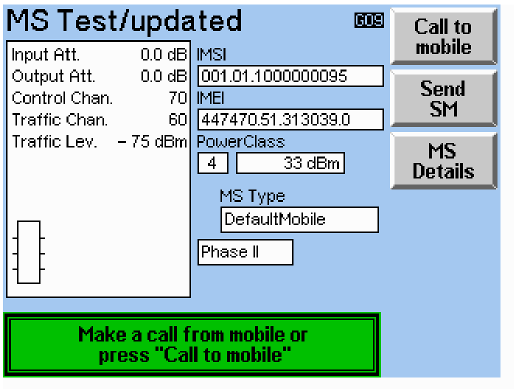
Step 3

After the start button is pressed in the Home Menu the CTS is now transmitting the control channel (BCCH) and is waiting for the mobile phone to synchronise (Text "Waiting for location update or make a call from the mobile" blinks).

After the mobile station is switched on the text changes to "Location Update in Progress" The blinking text indicates that a Location Update is taking place between the CTS and the mobile phone. ⑥



The vertical bar indicates that the CTS is receiving an RF signal from the mobile phone. ⑦



MS Test/updated Menu

As soon as a Location Update has been successfully completed, the display will change to the next menu level automatically. ⑧

At this point information from the mobile is displayed, that is the IMSI, the IMEI and the Power Class together with the maximum power the mobile can transmit. ⑨, ①⓪, ①①, ①②.

Explanations:

⑥ **Location Update**
The mobile is requested to make a Location Update on the control channel. By the Location Update, the base station is informed that a specific mobile has been switched on in its area and is ready to make and receive calls. If the mobile is already switched on and "registered" when the test is started, it will indicate "service" and wait. In this case, the mobile is synchronised to a near-by base station. Switch the mobile off and on again.

⑦ **Analogue RF Power Indicator**
The analogue bar in the CTS display indicates whether the CTS is receiving RF power of the mobile phone. The indicator features a fast reaction time and a hold function so that even short pulses are detected reliably and indicated. This is particularly useful if the mobile phone does not perform a Location Update or a call setup. In this case, it is possible to determine immediately whether the mobile is transmitting or not; e.g. there may be a problem in signalling or in the modulation.

⑧ **Location Update not Successful**
If the mobile does not attempt to perform a Location Update, it is possible that the network simulated by the CTS does not correspond to that searched for by the mobile phone according to the SIM card used. In this case, the parameters can be matched in the network menu.

⑨ **Subscriber Number**
The international subscriber number or IMSI (International Mobile Subscriber Identity) is read from the SIM card. It consists of three fields:

- A three-digit Mobile Country Code (MCC) used to indicate the "HOME" country of the card.
- A two-digit Mobile Network Code (MNC) used to indicate the "HOME" network.
- The Mobile Subscriber Identification Number (IMSI), which may be up to ten digits long, used to clearly identify a subscriber within a network.
  The values for the Rohde & Schwarz test SIM card are: 001 01 0000000001.

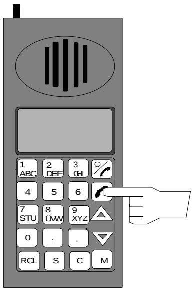
①⓪ **Equipment Id.**
The Equipment Id. or IMEI (International Mobile Equipment Identity) is stored in the mobile hardware. It consists of four fields:

- Type Approval Code (TAC), six digits, allocated by type approval authorities.
- Final Assembly Code (FAC), two digits, identifies the manufacturer.
- Serial Number (SNR), six digits, unique number within TAC and FAC.
- Spare (SP), one digit, not yet used.

①① **Mobile Power Class**
All mobile phones belong to a particular power class which indicates the maximum output power available from the GSM mobiles:

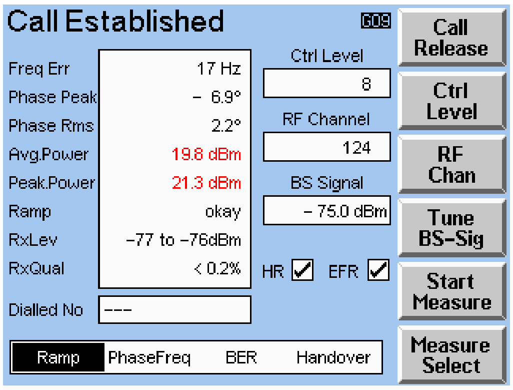
Power Class	GSM900	GSM1800 / GSM1900
1	---	30 dBm
2	39 dBm	24 dBm
3	37 dBm	36 dBm / 33 dBm
4	33 dBm	---
5	29 dBm	---

①② **Mobile Station Details**
The MS Details button will indicate to the user if the Mobile Station is capable of supporting Extended GSM frequencies and / or is Dual Band (900 / 1800 MHz).



Step 4

It is now possible to call the mobile phone by pressing the "Call to mobile" key or by dialling a number on the mobile phone.

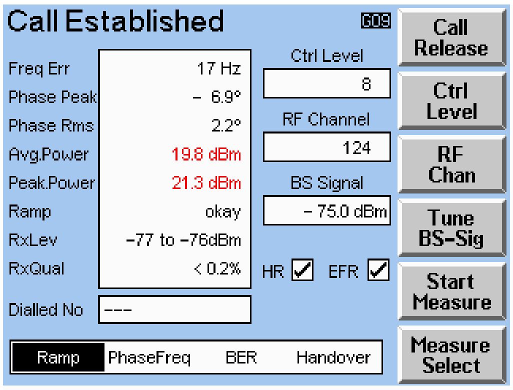


Call Established Menu

In both cases, the display will change to the Call Established Menu

This is the central measurement menu with an overview of the transmitter measurements. Detailed transmitter and receiver measurement results can be displayed by selecting and starting the appropriate measurement.

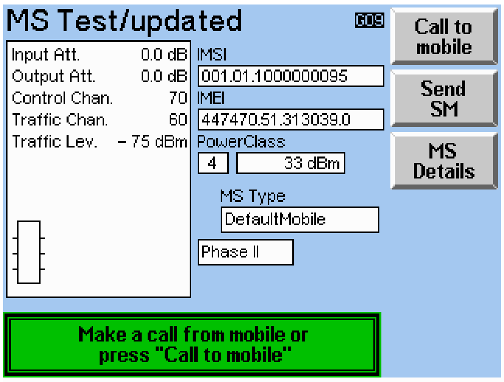
Also the mobile's power level (Ctrl Level) the RF Channel and the transmitted power of the CTS (Tune BS-Sig) can be changed.



Call Established Menu

Step 5

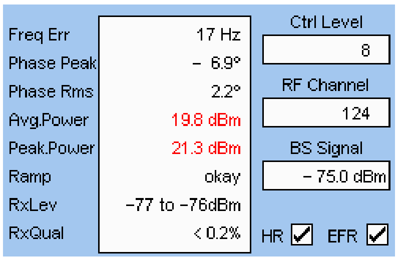
The call to the mobile is released when pressing softkey "Call Release". Menu "MS Test/updated" appears again.



MS Test/updated Menu

In the "MS Test/updated" menu is a softkey labelled "Send SM". By pressing this softkey a fixed text short message (mobile terminated) will be sent to the mobile. Mobiles which do not have SMS capability will ignore the message and the CTS will inform the user that the transfer was unsuccessful. If a short message is sent from the mobile (mobile originated) to the CTS then the text received by the CTS will be shown on the display.

6.3 Transmitter Measurements



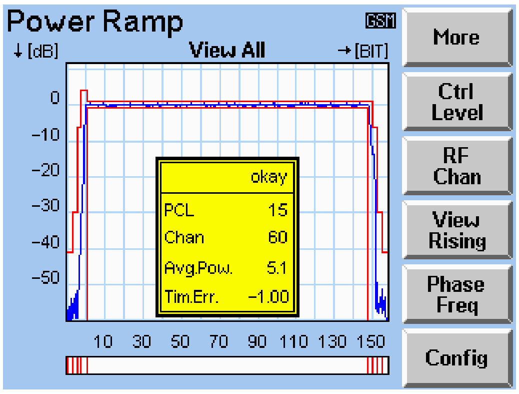
Step 1

In the Call Established Menu the currently used Power Control Level (Ctrl Level), RF channel and the transmitted power of the CTS (BS Signal) are displayed together with measurements of the phase and frequency errors. ①

Also the power reported by the mobile phone (RxLev), the average power (Avg. Power) and the peak (Pk. Power) power values measured by the CTS are displayed together with the power ramp evaluation.

In addition, the signal quality reported by the mobile (RxQual) is displayed.

If any measurements are out of tolerance they are displayed with red colour.



Power Ramp Menu

After selecting "Ramp" by pressing the "Measure Select" key and starting of the measurement ("Start Measure") in the Call Established menu the Power Ramp screen (shown opposite) will be displayed. ②

The RF burst of the mobile phone is indicated graphically.

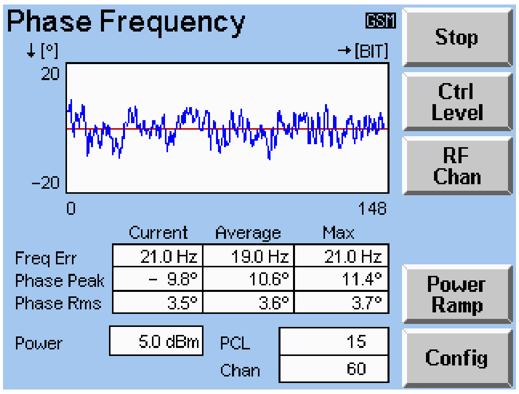
Using the "View" key a part of the curve may be expanded.

If the ramp is out of tolerance the faulty section is highlighted at the bottom of the display

Explanations:

① **Phase/Frequency Error**
GSM mobile phones synchronise themselves to the frequency of the base station. The CTS therefore measures the frequency error (frequency offset) of the mobile transmitter and not the absolute frequency. The phase error is measured by calculating the expected phase of the RF signal from the decoded bits and comparing this to the actual phase measured by the CTS. Two values are defined in GSM: the absolute maximum (peak) error in a burst and the average (RMS) error in a burst.

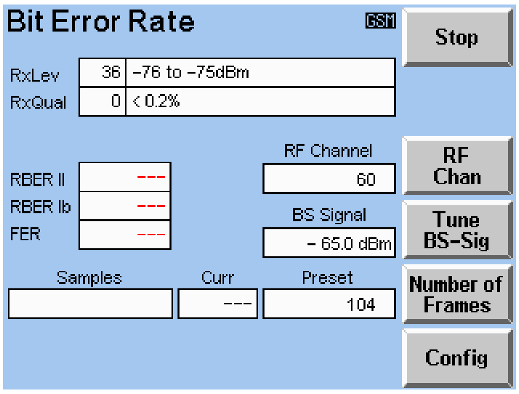
② **Power Ramp**
The power ramp is displayed with approximately 55 dB dynamic range.
Please note that it is possible for the average power during a burst to be out of tolerance whilst the power ramp is in tolerance, and vice-versa. This is because the power ramp tolerances, according to the GSM specifications, are mainly based on variations from the average power and are not absolute values.



Phase Frequency Menu

After selecting "Phase Freq" by pressing the "Measure Select" key and starting the measurement ("Start Measure") in the Call Established menu the Phase Frequency menu with the detailed measurement results will be displayed. ③

6.4 Receiver Measurements



Step 1

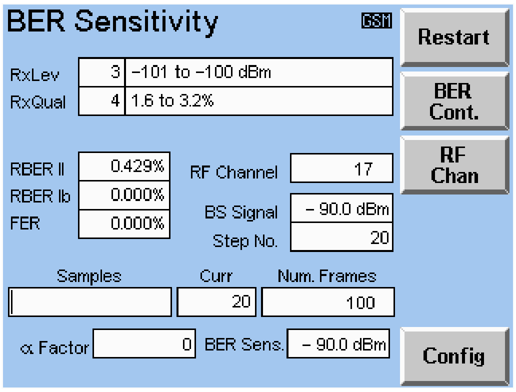
In the Call Established menu press "Measure Select" until BER is highlighted. Pressing "Start Measure" will change the screen to the one shown opposite. The RxLev and RxQual values measured by the mobile phone and reported to the CTS are displayed and continuously updated.

Also the bit rate is constantly displayed. This is the average value over the current number of samples. The RBER II, RBER Ib and FER averages are shown as percentages.

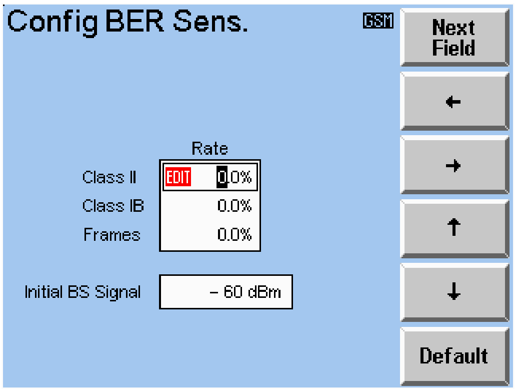
Explanation:

③ **Maximum and Average Values**
In this menu the actual, average and maximum phase and frequency measurements are displayed for a given number of bursts. The actual number of bursts used can be selected with the "Number of Samples" key.

6.4.1 BER Sensitivity measurement



BER Sensitivity Menu



Config BER Sensitivity Menu

This measurement is able to measure a mobile's receive sensitivity which is defined as the lowest "BS Signal" that allows the BER measurement results to be just within the configured tolerances.

This measurement can be started from the "Call Established" menu by activation of the BER measurement. Either the "BER Sensitivity" menu is entered directly or it can be activated by pressing the softkey labelled "BER Sens." in the "Ber Continuous" menu.

On entering the "BER Sensitivity" menu the measurement will be started automatically. The "BS Signal" will be ramped down from a configured initial value until the sensitivity level is reached and then the resulting "BS Signal" value is displayed in the "BER Sens." result field. The measurement can be made again by pressing the "Restart" softkey. A measurement can be stopped while in process by pressing the "Stop" softkey and then restarted by pressing the "Cont" softkey.

The "BER Sensitivity" configuration menu is accessible via the main configuration menu as well as via the measurement menu itself.

6.5 GPRS/BLER Measurements

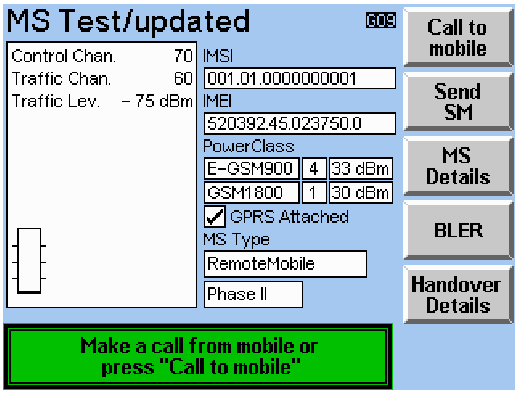
The CTS-K4 software option is required in order to perform the GPRS/BLER tests.

The CTS provides the single slot GPRS Block Error Rate measurement and the indications of the following Mobile-initiated procedures: GPRS Attach, GPRS Routing Area Update(RAU) and GPRS Detach.

The GPRS/BLER operations will be performed only if the GPRS parameter in the Config GPRS/ Block Error Rate menu is set to ON.

6.5.1 GPRS Attach

After a successful Location Update, if the GPRS parameter in Config GPRS/BLER screen is set to ON, the Mobile initiated GPRS Attach operation is performed. It is indicated by the blinking text 'GPRS Attach in Progress'. The success of the GPRS Attach procedure is indicated by the checked 'GPRS Attached' checkbox.

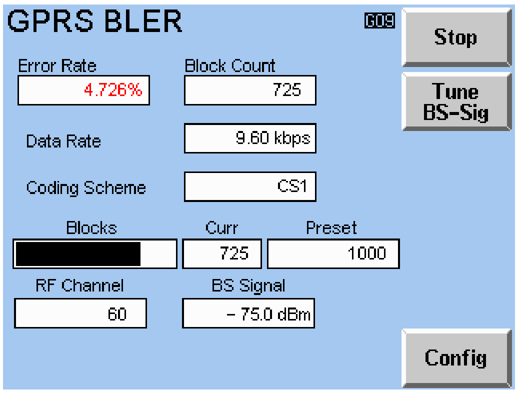


MS Test/Updated Menu after GPRS Attached

The BLER button is displayed on the MS Test/Updated screen after the GPRS Attach operation is finished.

6.5.2 GPRS Block Error Rate

After pressing the "BLER" key in the MS Test/Updated Menu the Block Error Rate screen is displayed. The Error Rate and the Data Rate values are calculated from the number of invalid blocks reported to the CTS by the MS. These values are continuously updated.



GPRS Block Error Rate Menu

6.5.3 GPRS Detach

The GPRS Detach operation is initiated by the Mobile Phone(usually when it is switching off). It is indicated by the blinking text ‘GPRS Detach in Progress’.

7 Module Test

7.1 Overview

Module test is an optional facility (option B7) for the CTS which provides a new test and an associated second RF connector. If the option is available this will be indicated on the "Available Options" menu.

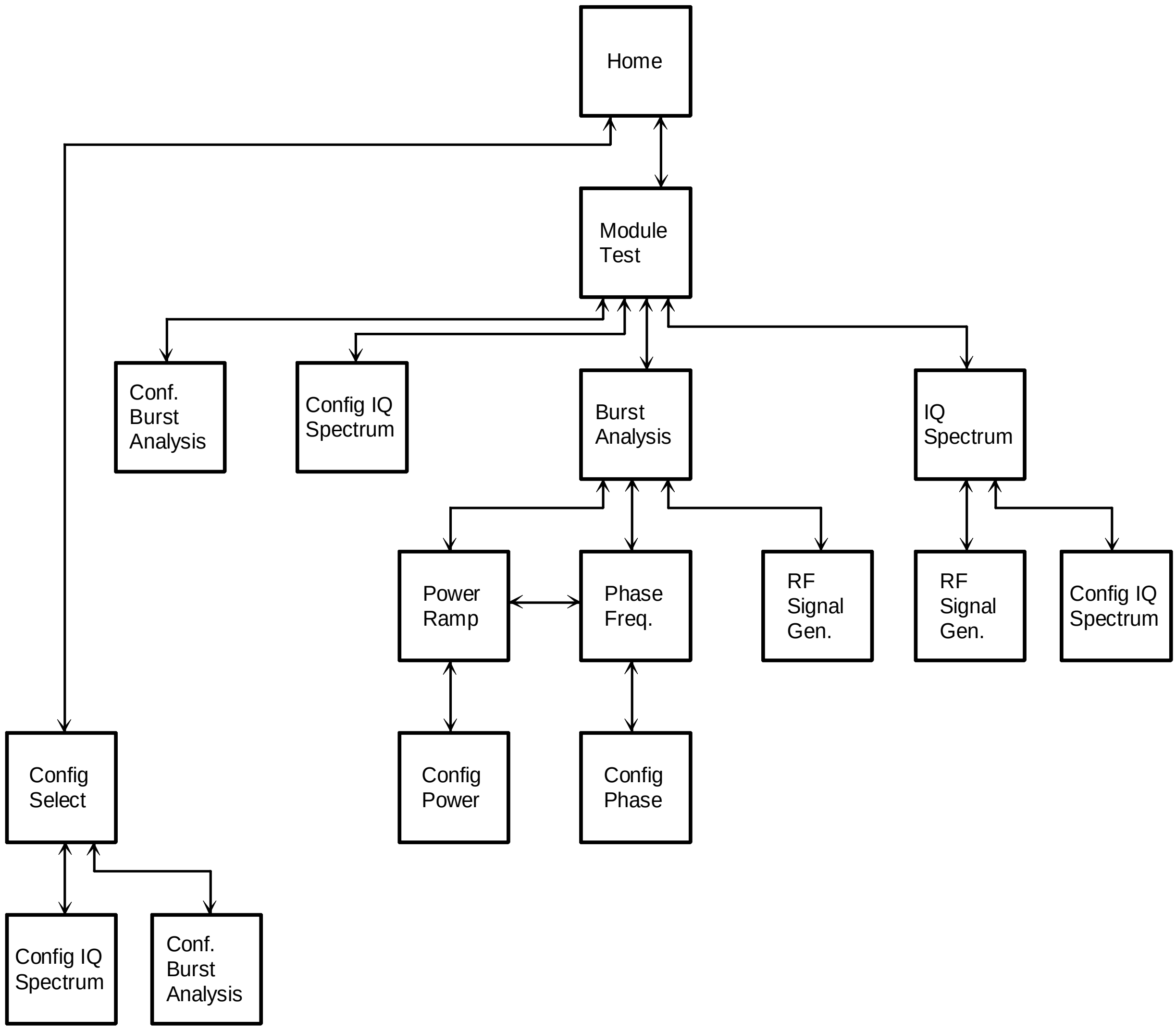
The main purpose of Module Test is to allow measurements to be made of a mobile’s transmitted signal. This is done without the associated signalling normally needed to get a mobile into a state where a call has been established. This usually needs the mobile to be in a special mode, details of which are normally only available from the mobile manufacturer.

In Module Test there is also an RF generator available which transmits an RF signal. Many of the characteristics of the signal are configurable by the user.

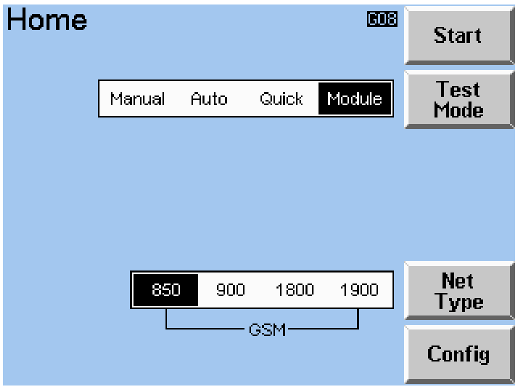
On the rear panel of the CTS there is an RF OUT connector (of type BNC). The output level at this connector is approx. 35 dB higher than the RF IN/OUT connector on the front panel. This connector is intended for use with the RF generator facility.

7.2 Menu hierarchy

The diagram below shows the menu structure of Module Test, which is in addition to the standard menus on the CTS.

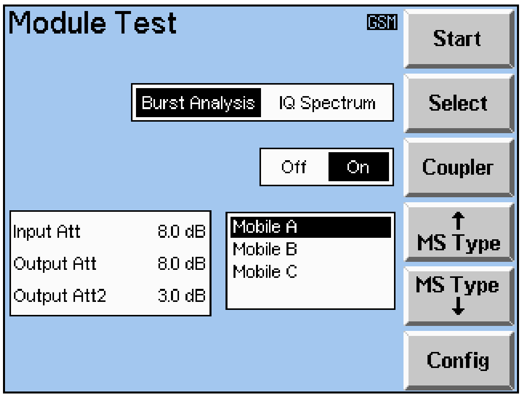


7.3 Starting Module Test



Home Menu

On entering Module Test via the test selection on the "Home" menu you are presented with a new menu, "Module Test".



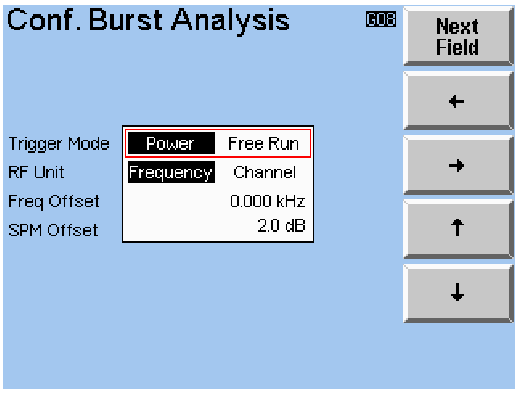
Module Test Menu

In the "Module Test" menu the selection of the MS Type to be used can be made by scrolling through the displayed list with the "MS Type" softkeys. The use of the defined attenuations may be turned on and off with the "Coupler" softkey.

The "Select" softkey selects between two sub-tests, either "Burst Analysis" or "IQ Spectrum". The "Start" softkey starts and the "Config" softkey enters the configuration menu of the selected sub-test.

7.4 Burst Analysis

7.4.1 Configuration



Conf. Burst Analysis Menu

The "Conf. Burst Analysis" menu is available via both the main configuration menu and within Module Test itself, from the "Module Test" menu. Configuration of the values is done by using the softkeys.

Trigger Mode

The CTS needs to detect when a burst occurs. This can be done either by detecting the rising edge of the burst (Power) or by synchronisation with the midamble (Free Run).

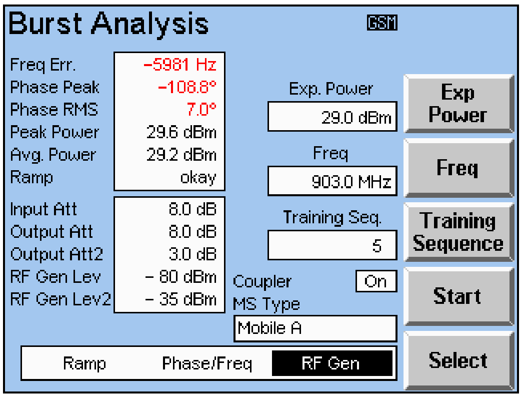
RF Unit

The receive frequency can be set on the "Burst Analysis" menu by entering it either as a channel number or as a frequency. The unit used is selected by *RF Unit*.

SPM Offset

This is a calibration parameter for the Sensitive Power Measurement. The value can be set automatically by using the Calibrate SPM button from the Burst Analysis menu. It also can be adjusted manually.

7.4.2 Running the Burst Analysis measurement



Burst Analysis Menu

Entering the "Burst Analysis" menu via the "Module Test" menu allows all the Burst Analysis measurements to be made. The mobile should be put into its special test mode, in particular the frequency of the mobile's transmitted signal and the training sequence used will need to be specified. When the mobile has been attached to the CTS and the CTS has been configured to use the same parameters as the mobile's transmitted signal the measurement results should appear.

While the CTS is searching for the mobile's signal a small symbol (AR, standing for Auto Ranging) will appear at the top of the menu. This symbol will disappear when the signal has been found and measurements are being made.

Exp. Power

The power that you expect to be received by the CTS. This value aids the system's search for the signal.

Freq/RF Chan

The receive frequency can be set either as a channel number or as a frequency (in steps of 0.2 MHz). The selection of which to use can be set up in the "Config Burst Analysis" menu. See section 7.7 for information on the frequency ranges allowed.

Training Seq.

The training sequence expected to be received by the CTS from the mobile phone.

7.4.3 The Measurement Results

Apart from *Peak Power* the following measurement results are the same as made in Manual Test.

Freq Err.
The difference between the actual and expected received frequency of the input signal.

Phase Peak
The worst case phase error in the measured burst.

Phase RMS
The average (root mean square) of the phase error in the measured burst.

Peak Power
The maximum power of a burst received at the input.

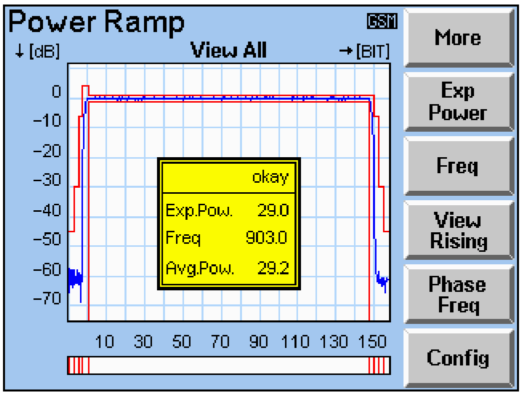
Avg. Power
The average power of a burst received at the input.

Ramp
Indicates whether the power ramp received is within specified tolerances and if not possible reasons why.

7.4.4 Other Measurements

Using the "Select" softkey followed by "Start" enters a new menu. These new menus are for the "Power Ramp" measurement, the "Phase Frequency" measurement and control of the "RF Signal Generator". The two measurements are described below. For details of the "RF Signal Generator" menu refer to section 7.6.

7.4.4.1 Power Ramp



Power Ramp Menu

The Power Ramp measurement is similar to that in Manual Test, as described in section 9.7.6. The template configuration is tied to the Manual Test values.

Exp. Power

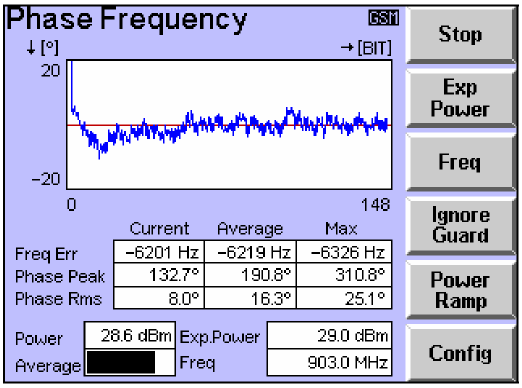
The power that you expect to be received by the CTS. This value aids the system’s search for the signal.

Freq

This defines the receive frequency to use.

While the CTS is searching for the mobile’s signal a small symbol (AR, standing for Auto Ranging) will appear at the top of the menu. This symbol will disappear when the signal has been found and measurements are being made.

7.4.4.2 Phase Frequency



Phase Frequency Menu

The Phase Frequency measurement is similar to that in Manual Test, as described in section 9.7.7. The template configuration is tied to the Manual Test values.

Exp. Power

The power that you expect to be received by the CTS. This value aids the system's search for the signal.

Freq

This defines the receive frequency to use.

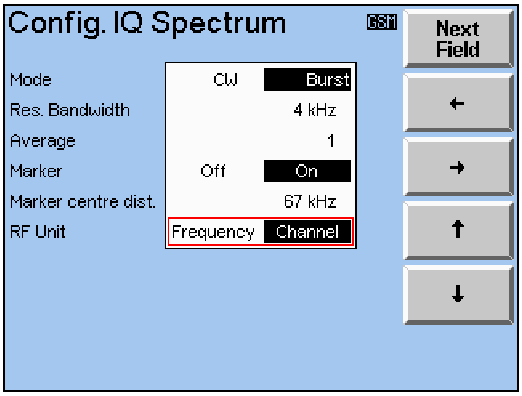
Ignore Guard/Eval Guard

A choice can be made whether Guard Bits are included in the phase frequenz evaluation.

While the CTS is searching for the mobile's signal a small symbol (AR, standing for Auto Ranging) will appear at the top of the menu. This symbol will disappear when the signal has been found and measurements are being made.

7.5 IQ Spectrum

7.5.1 Configuration



Config. IQ Spectrum Menu

The "Conf. IQ Spectrum" menu is available via both the main configuration menu and within Module Test itself, from the "Module Test" menu. Configuration of the values is done using the softkeys.

Mode

Specifies whether the received signal will be bursting or a continuous wave.

Res. Bandwidth

The bandwidth of the filter used on the signal being measured.

Average

Specifies the number of complete measurements that the IQ Spectrum measurement result is averaged over.

Marker

Spot measurements of the power level at certain marker frequencies can be made. This configuration turns these markers ON or OFF. If the markers are OFF the IQ Spectrum graph is expanded to fill more of the menu and the marker measurements are removed.

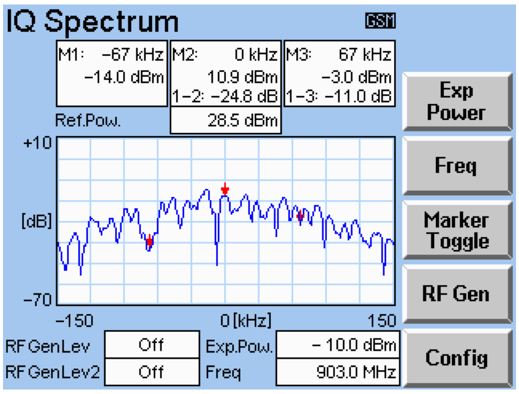
Marker centre dist*.*

The distance either side of the centre frequency of the measurement at which the spot measurements are made.

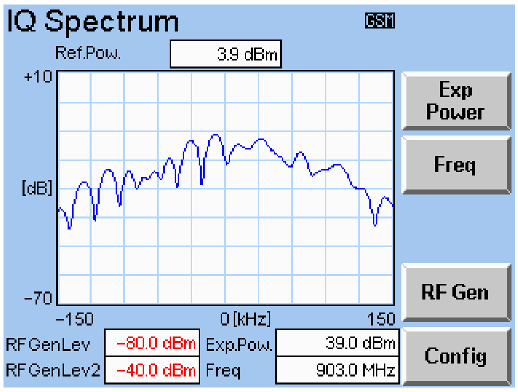
RF Unit

The receive frequency can be set on the "IQ Spectrum" menu by entering it either as a channel number or as a frequency. The unit used is selected by *RF Unit*.

7.5.2 Running the IQ Spectrum measurement



IQ Spectrum Menu (with markers)



IQ Spectrum Menu (without markers)

Entering the "IQ Spectrum" menu via the "Module Test" menu allows the IQ Spectrum measurement to be made. The mobile should be put into its special test mode, in particular the frequency of the mobile's transmitted signal needs to be specified. When the mobile has been attached to the CTS and the CTS has been configured to use the same parameters as the mobile's transmitted signal, the IQ Spectrum graph should appear.

While the CTS is searching for the mobile's signal a small symbol (AR, standing for Auto Ranging) will appear at the top of the menu. This symbol will disappear when the signal has been found and measurements are being made.

The "RF Generator" menu can be selected by pressing the "RF Gen" softkey.

Exp. Power

Enter here the power that you expect to be received by the CTS. This value aids the system's search for the signal.

Freq/RF Chan

The receive frequency can be set either as a channel number or as a frequency (in steps of 0.2 MHz). The selection of which to use can be set up in the "Config. IQ Spectrum" menu. See section 7.7 for information on the frequency ranges allowed.

Marker Toggle

To toggle between markers in left/middle position and markers in middle/right position.

7.5.3 The Measurement Results

Ref. Pow.

The absolute (reference) power level of the top (0 dB) of the IQ Spectrum measurement graph.

M2, M1 and M3

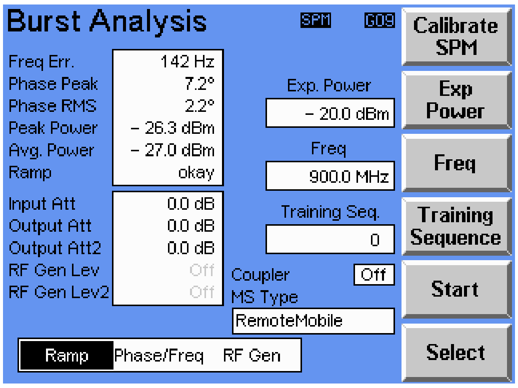
These values show the frequencies of the markers and the absolute measured power levels at the markers.

1-2, 2-3 and 1-3

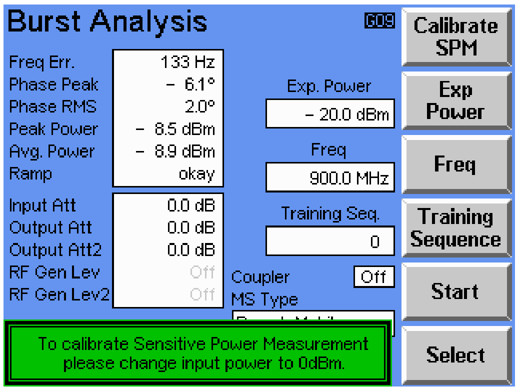
The calculated differences between the various measured power levels at the markers.

7.5.4 The Sensitive Power Measurement

In order to produce the accurate low level measurement, the SPM Calibration has been introduced. The Sensitive Power Measurement feature is activated automatically when the input signal level is lower than –10 dBm. When the measurement is active the SPM sign is displayed at the top of the menu screen. The low level power can be measured down to approximately –45 dBm. When the signal will become higher than –5 dBm the CTS will change back to the normal mode.

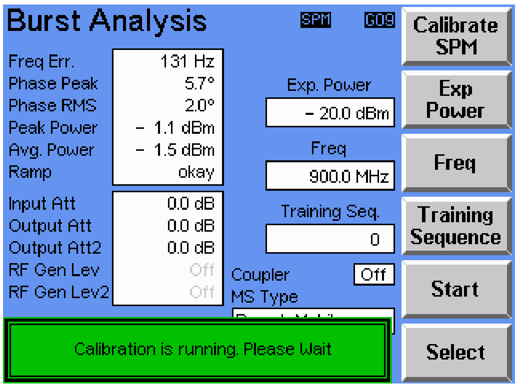


Sensitive Power Measurement is running



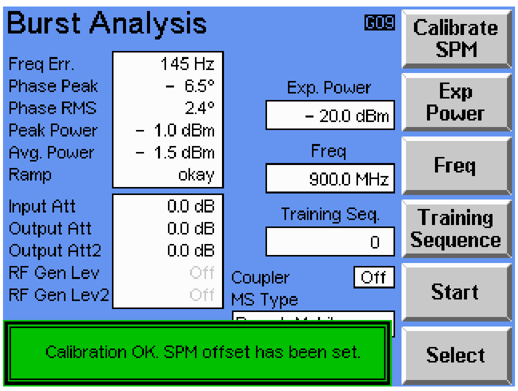
SPM Calibration started

In order to calibrate SPM, the 0 dBm signal has to be supplied to the CTS Input and the Calibrate SPM button shall be pressed.



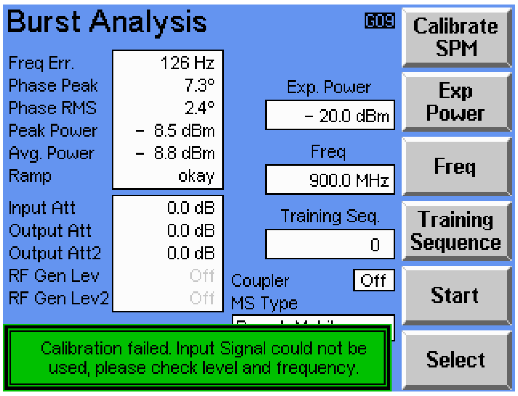
SPM Calibration is running

While SPM Calibration procedure is running the “Calibration is Running “ message is displayed.



SPM Calibration OK

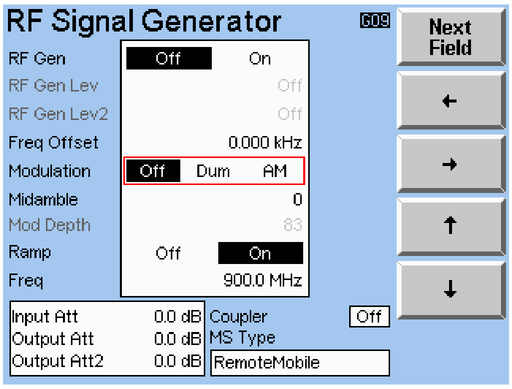
If the CTS accepted the 0dBm signal and the calibration is successful the “Calibration OK” message is displayed and SPM Offset value (see 7.4.1) is adjusted automatically.



SPM Calibration failed

If the CTS was not able to use the supplied signal for the SPM Calibration procedure, then the “Calibration failed” message is displayed.

7.6 RF Signal Generator



RF Signal Generator Menu

The "RF Signal Generator" transmits an RF signal, many of whose characteristics can be configured. This menu is accessible via both the "Burst Analysis" menu and the "IQ Spectrum" menu.

RF Gen

Enables the RF Generator to be turned ON or OFF.

RF Gen Lev

Sets the power level of the transmitted signal from the RF IN/OUT connector on the front panel of the CTS. Note that *RF Gen Lev2* will also be altered when *RF Gen Lev* is changed due to the connection between the two RF outputs. The upper and lower limits for *RF Gen Lev2* are different in AM mode.

RF Gen Lev2

Sets the power level of the transmitted signal from the RF OUT connector on the rear panel of the CTS. Note that *RF Gen Lev* will also be altered when *RF Gen Lev2* is changed due to the connection between the two RF outputs.

Freq Offset

Adjusts the frequency output away from the centre frequency of the specified channel. This value cannot be altered when the RF Generator is in the AM mode.

Bit Modulation

Specifies whether the transmitted signal is modulated with a dummy burst *(Dum)* or whether there is no modulation *(Off)* or switches RF Signal Generator to Amplitude Modulation mode *(AM)*.

Midamble

Specifies the midamble used for the transmitted signal when it is modulated with a dummy burst.

Ramp

Specifies whether the transmitted signal consists of either bursts (ON) or a continuous wave (OFF). This value cannot be altered when the RF Generator is in the AM mode.

Freq/RF Chan

The transmit frequency can be set either as a channel number or as a frequency. The selection of which to use can be set up in either the "Config Burst Analysis" or "Config IQ Spectrum" menu. See section 7.7 for information on the frequency ranges allowed.

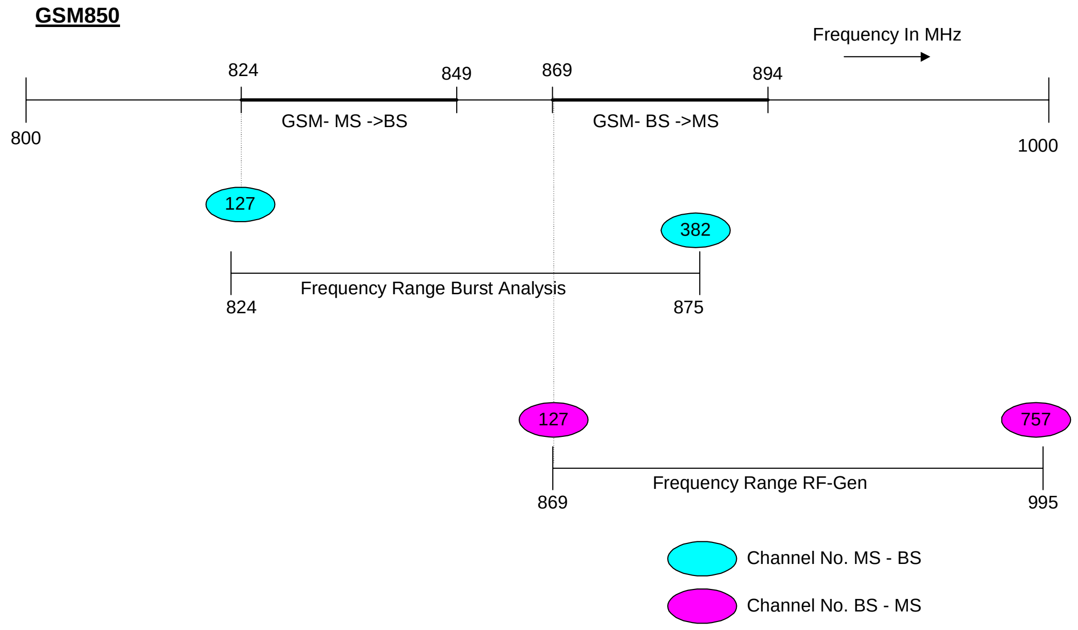
Mod. Depth

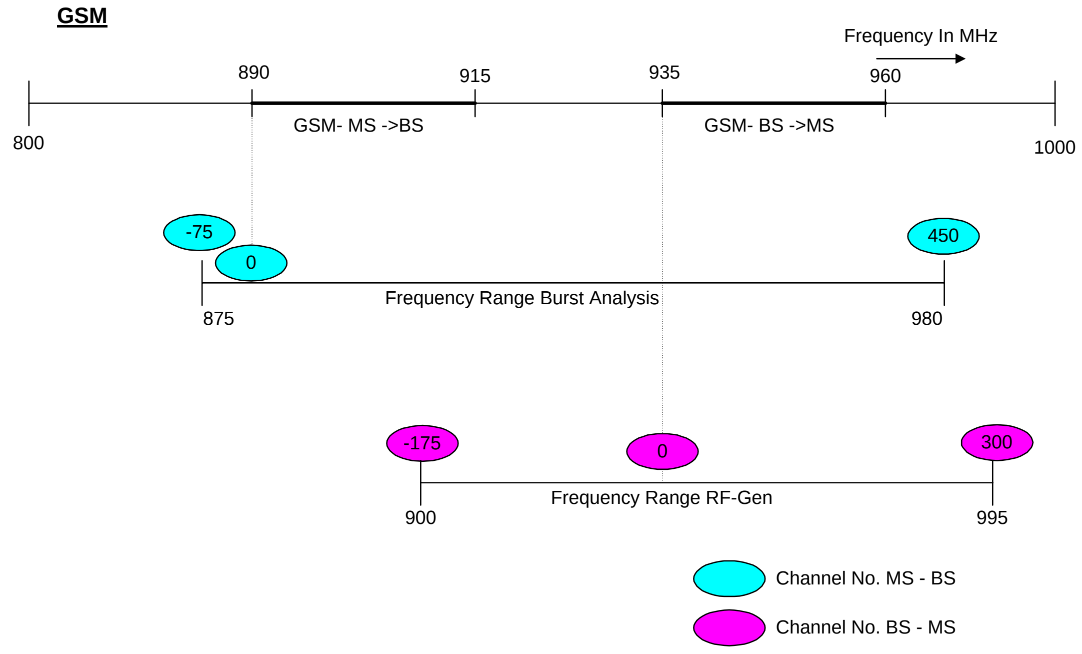
The Modulation depth parameter is only available for Amplitude Modulation.

7.7 Technical Information

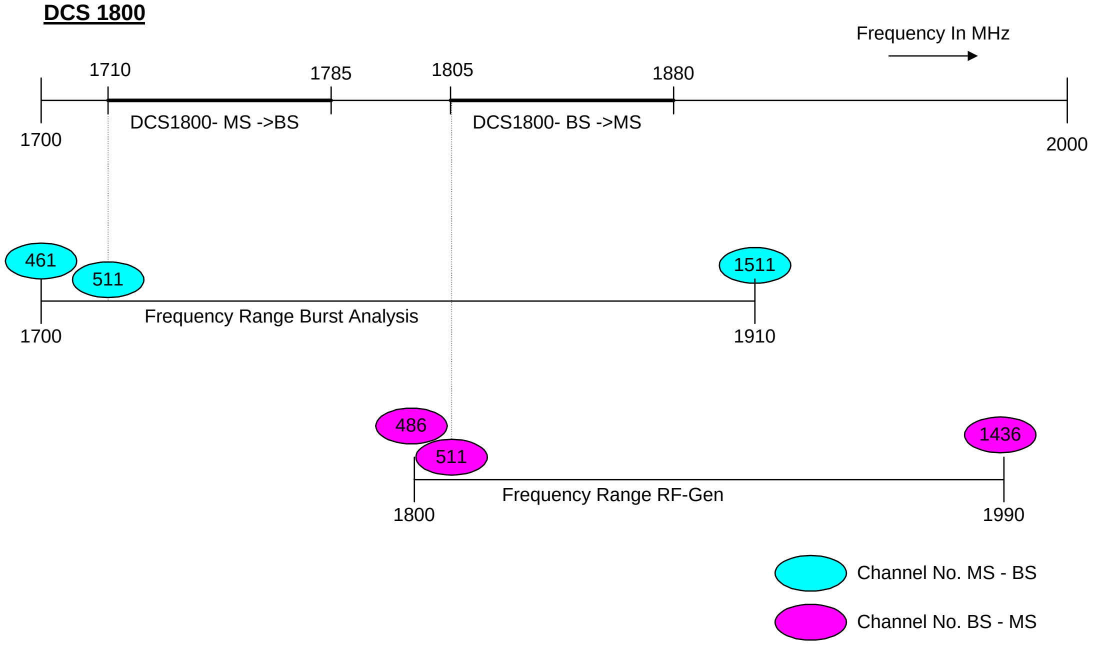
7.7.1 Frequency ranges

The following three diagrams show the frequency ranges that can be handled by Module Test. Note that the frequencies cover a wider range than the usual network frequencies. This means that some frequencies, when set as a channel number, are represented with negative channel numbers. The normal GSM channel numbers should be used when testing with the usual network frequencies.

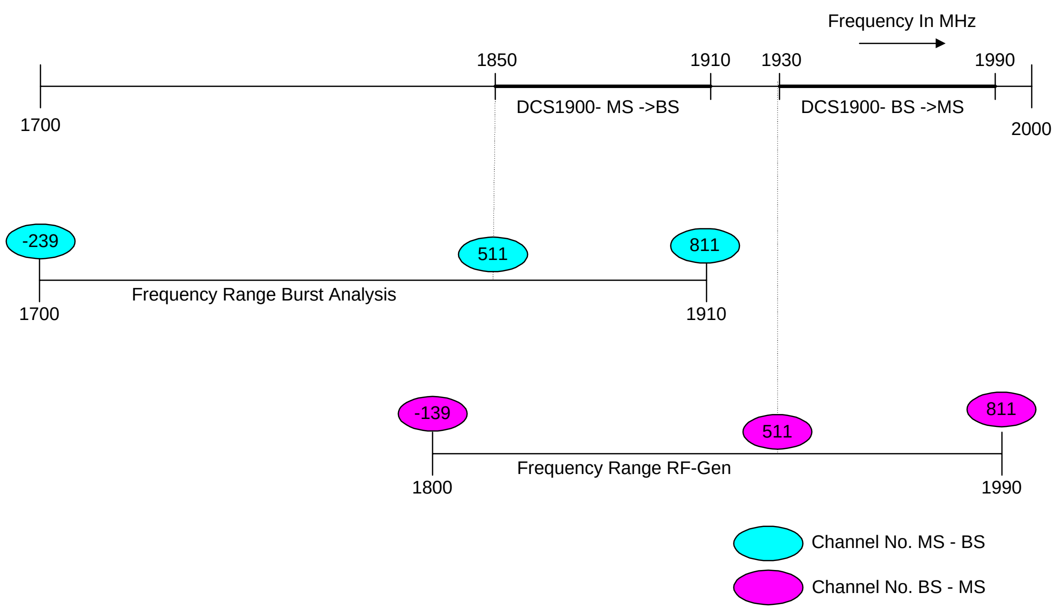




DCS 1800



DCS 1900



8 RF connection

8.1 RF Connection of the Mobile Phone Using a Cable

The RF cable used should ideally be of low-loss, high-grade quality. Manufacturers of mobiles mostly provide an RF cable that comes with a mating plug for the RF socket on the mobile. Kits for in-vehicle fitting are often offered with handies. In this case the car antenna cable can be connected to the CTS for carrying out the tests. A check should always be made to see whether all plugs and sockets used for the RF connection mate with one another. A cable connection that is not mechanically sound causes a large increase in the attenuation and thus leads to erroneous measurements at high frequencies. When working with a good cable connection (attenuation less than 0.5 dB), the "Coupler" key can be set to "off".

With the "Coupler" key set to the "off" position, all measurements will be carried out without taking the set attenuations into account, that is attenuation is zero. If the cable is of higher attenuation, it is advisable to set the toggle key for the coupler to "on" in the main menu to allow entry of the expected attenuation.

8.2 RF Connection of the Mobile Phone Using an Antenna Coupler

Operation with an antenna coupler is the not the best method of connecting to the CTS. The reason lies in the physical principles involved. The attenuation between a coupler and a mobile phone antenna strongly depends on the physical form of the antenna. Other factors affecting the attenuation are whether the antenna is bent and inadvertent movement in the coupler during testing. In order to obtain reproducible measurements on output power or sensitivity, it is necessary to work with an accurately defined attenuation.

Reproducibility can normally be guaranteed by means of a cable connection. The use of a coupler is expedient if the mobile is not provided with an RF connection. When working with an antenna coupler it is necessary to set the "Coupler" toggle key to "on" in the Home menu. Measurements are run in this case with the coupler attenuation taken into consideration. Details of setting the coupler attenuation can be found in section 9.9.5. The coupler attenuation can be set separately for the input and output attenuation with reference to the tester. R&S supply an appropriate coupler (Part CTD-Z10, 800 to 1000 MHz and CTS-Z10, 800 to 2000 MHz).

If an antenna coupler is required, the correct coupling attenuation values must be set. In order for the user not to have to re-enter the correct coupling attenuation values, when changing the type of mobile or the antenna coupler, a list is implemented in the CTS, which contains user-definable types of mobiles with their coupling attenuation values (see section 9.9.5). When changing the mobile phone or the antenna coupler, the user simply has to select the type of mobile, it's coupling attenuation values are taken from the stored list and displayed.

If no antenna coupler is used (toggle for coupler in the main menu is in the "off" position), it is nevertheless advisable to select the correct type of mobile, since the name of the mobile appears in the printer report also the level for the sensitivity and the BER measurements is defined for the mobile type.

9 Detailed Description of the Menus

9.1 Menu Structure Overview

The entire menu structure is divided into four parts:

The first part consists of the menus seen immediately after power on, that is the Logo screen, the Available Options Menu and the Home Menu. From the Home Menu any of the remaining three divisions can be reached.

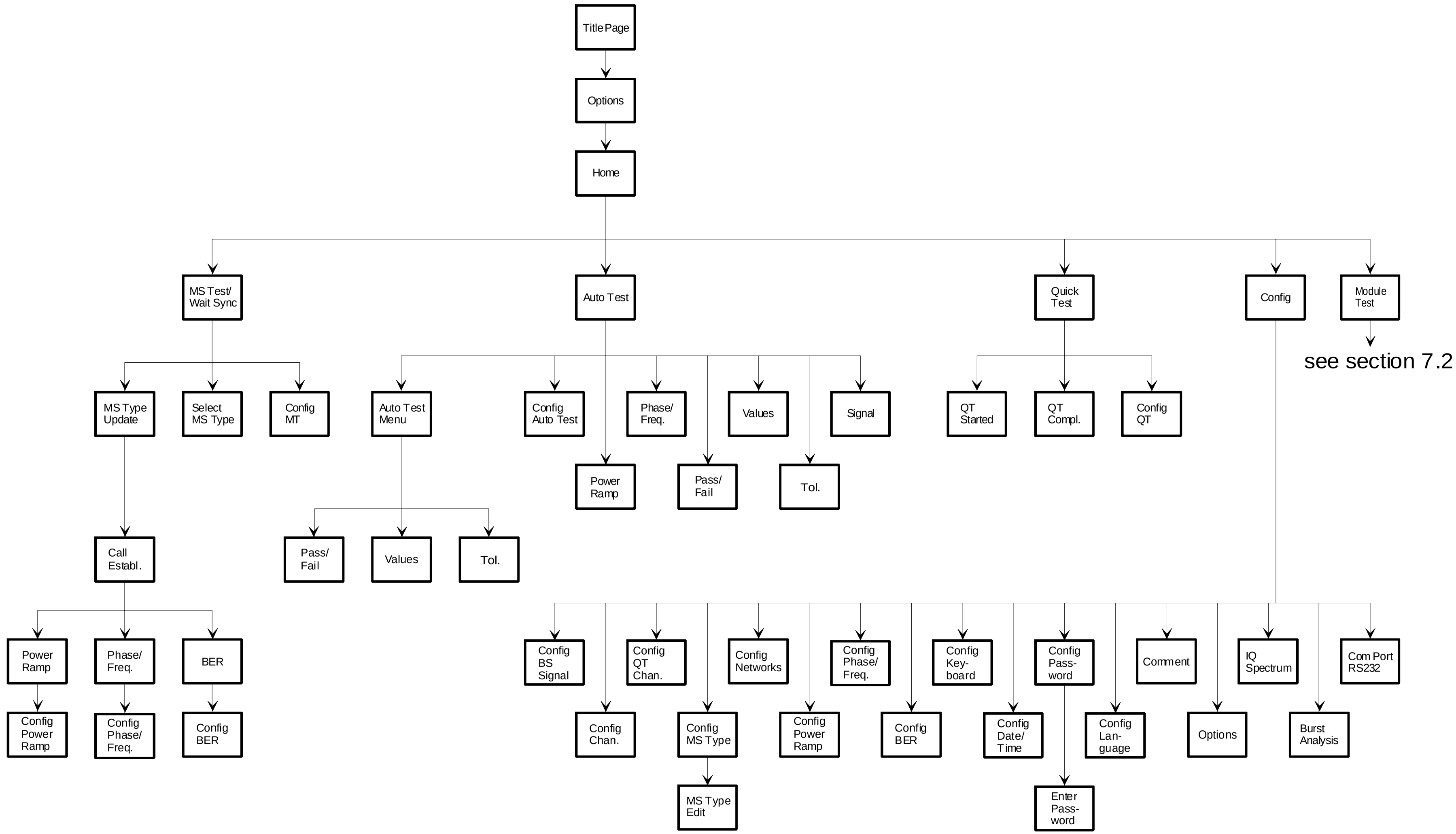
The second part consists of the menus for the Manual Test of the instrument, including local configuration menus for the Manual Test.

The third part consists of the menus for the Autotest. Also the local configuration menus can be accessed.

The last part consists of configuration menus for the whole system.

On the following diagram the four groups are labelled with numbers in circles.

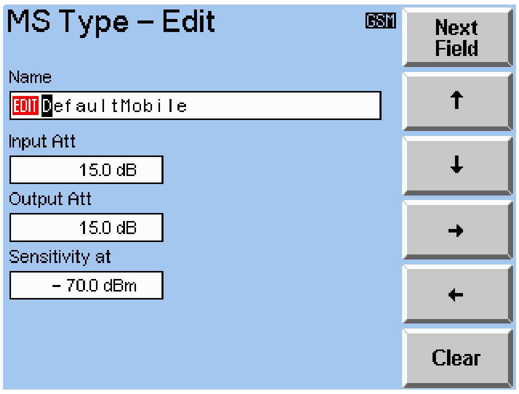
9.2 Menu Structure Graph



9.3 Some Basic Elements of the Man Machine Interface

The use of the Man Machine Interface is very straight forward. The functionality is intuitive, however the following two elements need further explanation.

9.3.1 Multi Field Editing



The above screen is an example of Multi-field editing.
The field which is active for editing is shown by the edit symbol (EDIT). The character or digit to be changed is highlighted by a cursor.

By pressing the right and the left arrows ("→", "←") the cursor is moved in the appropriate direction. The up and down arrows increase ("↑","↓") and decrease the value highlighted by the cursor. This means for alphabetic characters pushing the arrow keys selects the next or the previous character in alphabetical order. For numeric characters pushing the arrow keys selects increments or decrements the value.

Pushing the key "Next Field" selects the next field to be edited.

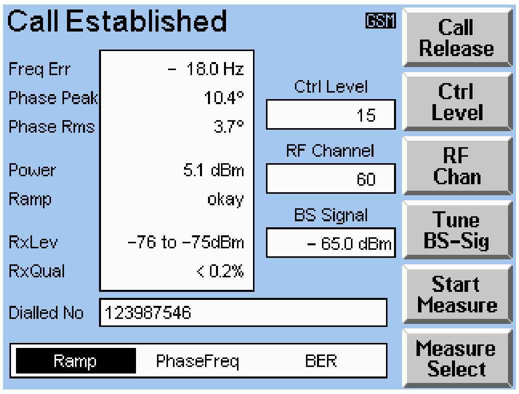
There are two versions of this element. One is with the "Clear" key and one is without.

With "Clear" key
If the "Clear" key is available the changes of all the fields within one menu are stored when the menu is left by pressing the "MENU UP" hardkey. Pressing the "Clear" key also leaves the menu but the fields remains unchanged.

Without "Clear" key
The changed value for only one field is stored immediately.

9.3.2 Single Field Editing

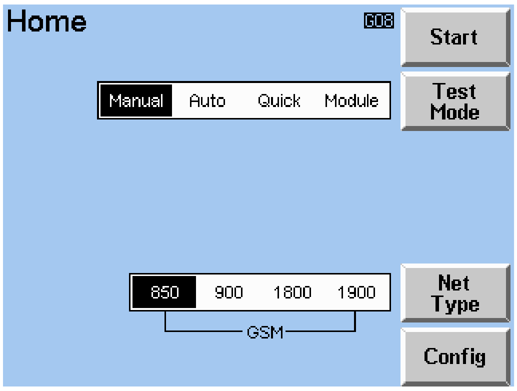
The mechanism to change the value within the field with the arrow keys is the same as for the Multi-Field editing but the accepting of the change is different. To accept the value the "Ok" key has to be pressed rather than the "Clear" key.



9.3.3 Single Field Editing with Direct Saving

The mechanism to change the value with the arrow keys is the same as for single field editing except that a change is immediately stored and updated in the hardware.

9.4 Home Menu



This is the Home Menu of the system. It is displayed after startup of the system and when either the Manual test, the Autotest, the Quicktest, the Module Test or the Configuration menus are left. From the Home Menu each part of the system can be reached (see menus Structure Graph).

Start
By pressing this key either the Manual Test, the Autotest, the Quicktest or the Module Test is activated. After this key is pressed the system changes to the appropriate menu.

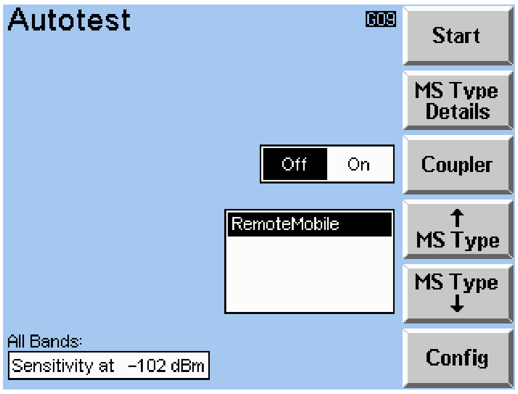
Test Mode
By pressing this key the test mode can be selected. This can either be the Manual Test, the Autotest, the Quicktest or the Module Test. The selected test is activated by pressing the Start key.

Net Type
With this key the network type is selected in which the CTS will operate.

Config
Pressing this key activates the Config-Select menu.

9.5 Auto Test Menus

9.5.1 Autotest Start Menu



Autotest Start Menu

This menu is displayed after the Autotest is activated.

On the lleft side of the menu the level chosen for the sensitivity and the BER measurement during the test sequence is indicated.

Start
Pressing this key starts the testing in the selected mode.

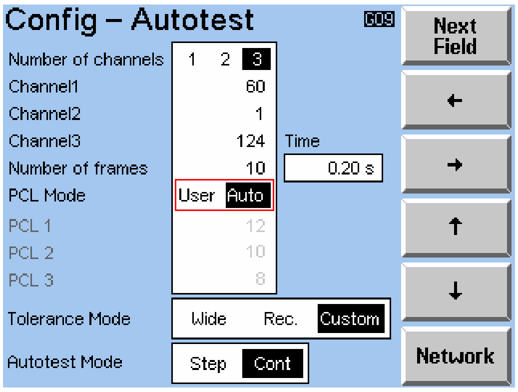
MS Type Details
Pressing this key selects the MS Type Details Menu where the attenuation values across all three GSM bands can be viewed.

Coupler
This key selects the way in which the mobile is connected to the CTS. If the key is set to "On", the input output and attenuations of the selected mobile type will be considered in the measurements. If the key is set to "off", no attenuation is considered and zero is used for both the Input and the Output attenuation.

MS Type ↑ MS Type ↓
The two keys select the type of mobile to be tested together with the corresponding coupling attenuation and the transmit level for the sensitivity and BER measurement. The keys are used to scroll up or down the list of mobile types.

Config
This key will call the autotest config menu. From this menu the user can change Autotest specific parameters.

9.5.2 Autotest Config Menu



Autotest Config Menu

This menu is used to configure the Autotest and to set the network parameters (how network parameters can be set is explained in the "Config Network Menu").

The configuration parameters of the Autotest comprise the number of channels, the number of frames for the bit error rate measurement as well as the tolerance ranges used.

Number of channels
The user has the option to carry out the Autotest measurements on one, two or three channels depending on how thorough a test is required. However, if the measurements are only carried out on one channel, channel switching will not be included in the test sequence.

Channel1/Channel2/Channel3
The required channels are set here. Depending on the number of channels the fields for the second and/or third channel may not be available.

Number of frames
This parameter is used to define the number of speech frames to be used during the bit error measurement. At the right hand side of the input field the time required for the bit error measurement is displayed.

PCL Mode
Three PCLs can be manually defined in the User Mode or these PCLs are automatically assigned in the Auto PCL mode. See also section 4.8.

Network
Network Parameters, see section 9.9.6.

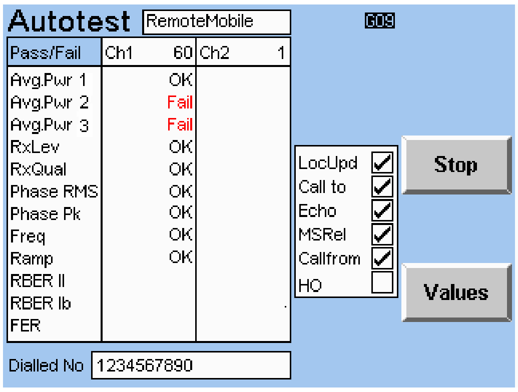
Starting Time
During the switch to the speech channel some mobiles need a short delay which is called a "starting time". In this menu the "starting time" can be switched on and off.

In case of signalling errors during the location update the "starting time" should be switched on or off.

Tolerance Mode
This field is used to define which tolerance range is used. The tolerance ranges as well as the tolerances used have already been explained in the introduction of the Autotest (see section 4.1).

Autotest Mode
Changing this setting toggles between automatic running (continue) and single stepping (step). In single step mode, testing is halted after every measurement and the user is prompted to press the „Continue“ key to continue with the measurement.

9.5.3 Autotest Running Menu (Pass/Fail)



In this menu the Autotest is running. This screen indicates the results of each step of the Autotest in the pass/fail mode.

Once the Autotest has been started the CTS carries out the signalling tests in the following order:

Location Update (LocUpd)
Call to Mobile (Callto)
Echo Test (Echo)
Mobile Release (MSRel)
Call from MS (Callfrom)

When a test is in progress the box next to the test name blinks and the state message blinks in a window above the signalling test names.

A successful test is indicated with a "✓" in the box next to the test. A failed test is indicated by a "f".

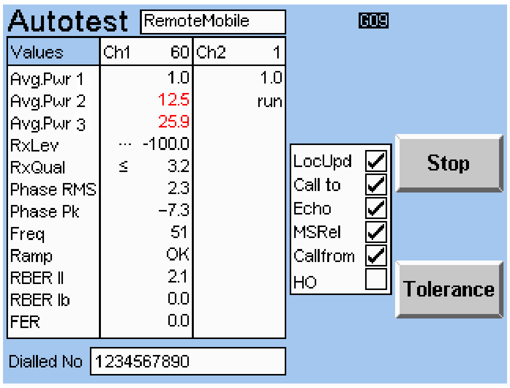
When the BER test has been completed on the last channel, the CTS will either attempt a handover (HO) to the new band or a network release (NwRel). This decision will be made on the settings within the Handover Details Menu.

If the result of the measurement within the specified tolerances the result is indicated as pass otherwise as fail.

Stop
Pressing this key stops the measurement sequence. The Autotest Result screen will be displayed.

Values
Pressing this key switches from pass/fail indications to the actual test values as shown in the following menu.

9.5.4 Autotest Running Menu (Values)

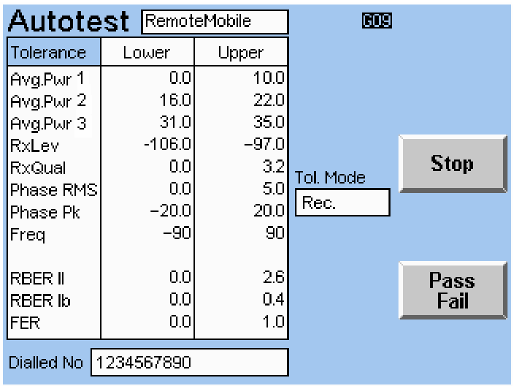


This screen indicates the results of each step of the Autotest as values.

Stop
Pressing this key stops the measurement sequence. The Autotest Result screen will be displayed.

Tolerance
Pressing this key displays the test tolerances as shown in the following menu.

9.5.5 Autotest Tolerances Menu

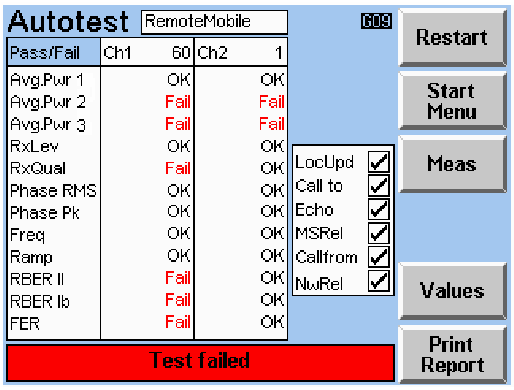


This screen indicates the tolerances of each step of the Autotest.

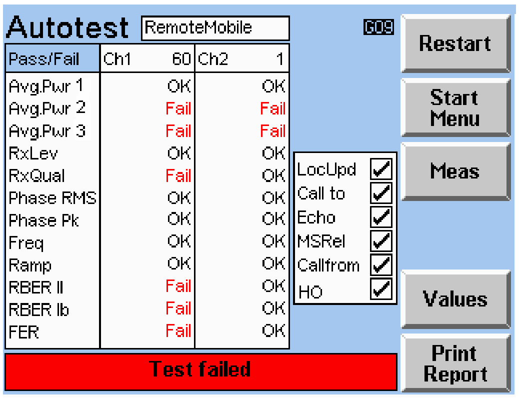
Stop
Press this key to interrupt the measurement sequence and to display the Autotest Result Screen.

Pass/Fail
Press this key to switch to the Pass/Fail screen of the Autotest.

9.5.6 Autotest Result Screen



Autotest Results Menu



Autotest Results Menu

When the measurement sequence has finished, one of the two Autotest Result screens is displayed (as shown above). If only a single band test has been completed then the „Other Band“ key will not be present and the Handover step will not have been attempted as is indicated in the first menu. From this screen it is possible to redo the measurements ("Restart" key), return to the Autotest Start menu ("Start Menu"), display the measurement results in place of the pass/fail indicators ("Values") or to print a test report ("Print Report").

Restart
Press this key to repeat the measurement sequence.

Start Menu
Press this key to return to the Autotest Start menu.

Meas
Press this key to display the Power Ramp menu. From within the Power Ramp menu the Phase Freq menu can be selected.

Other Band
This softkey is only visible after a two band autotest sequence has been attempted. Press this key to display the other GSM band that has been used for the Autotest sequence.

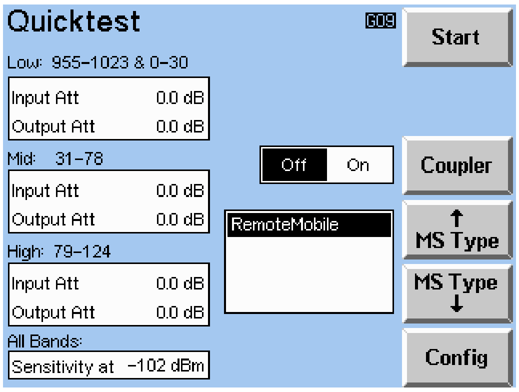
Values
Pressing this key switches from pass/fail indications to the actual test values. After the values are displayed the used tolerances can be indicated by pressing this key. If the test is carried out on three channels the signalling results (LocUpd, Call to ...) are displayed in a separate menu. This menu is also accessed using this key.

Print Report
Pressing this key will generate either a one page or two page test report. A pass/ fail report will be printed when the „Pass/Fail“ results menu is viewed and a values report when the „Values“ results menu is viewed.

When a two band Autotest sequence has run to conclusion, then a two page report, that has results for both test bands will be produced if requested. If the Autotest sequence has tested only a single band then only a one page report containing results for that band will be printed if requested.

9.6 Quicktest Menus

9.6.1 Quicktest Main Menu



This menu appears when the Quicktest is activated.

The settings are shown on the left hand side at the top of the screen. They are the input and the output attenuations for the chosen mobile type (settings for a “low”, “mid” and “high” Band). Please See Section 9.9.13. The “low”, “mid” and “high” channel boundaries are dependent on the test network being used. However, these attenuation values are only considered if the coupler is switched on. Otherwise no external attenuation is used.

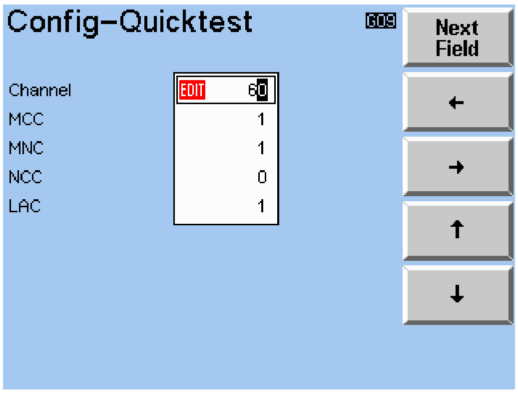
Start
Press this key to start a Quicktest.

Coupler
This key selects the way in which the mobile is connected to the CTS. If the key is set to "On", the input output and attenuations of the selected mobile type will be considered in the measurements. If the key is set to "off", no attenuation is considered and zero is used for both the Input and the Output attenuation.

MS Type ↑ MS Type ↓
The two keys select the type of mobile to be tested together with the corresponding coupling attenuation and the transmit level for the sensitivity and BER measurement. The keys are used to scroll up or down the list of mobile types.

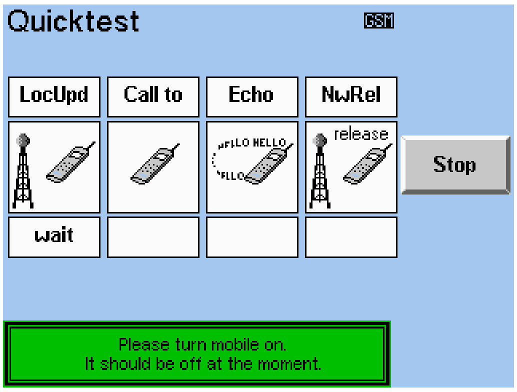
Config
This key will call the autotest config menu. From this menu the user can change Quicktest specific parameters.

9.6.2 Config-Quicktest Menu



This menu is used to set the channel on which the Quicktest is carried out and to set the network parameters. (How network parameters can be set is explained in the "Config Network Menu").

9.6.3 Quicktest - Test Menu



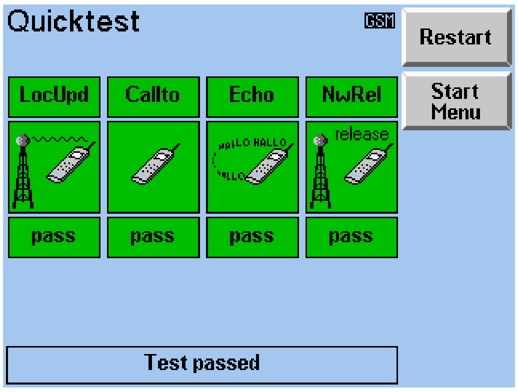
In this menu the Quicktest is running. The following test steps are executed in sequence:

Location Update (LocUpd)
Call to Mobile (Callto)
Echo Test (Echo)
Network Release (NwRel)

As soon as a test step is active the status display below the appropriate symbol starts flashing and the colour of the symbol itself changes to yellow. If a test step is completed successfully the background colour of the symbol changes to green, otherwise red. During the test instructions for the user are displayed at various places. The test can be terminated at any time by pressing the Stop key.

Stop
Press this key to stop the measurement sequence. The Quicktest Result Menu appears.

9.6.4 Quicktest - Result Menu



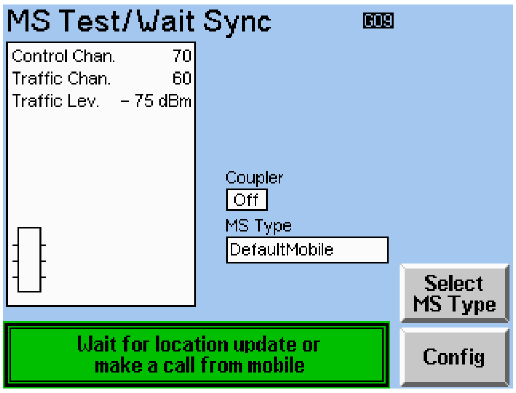
This menu appears if the Quicktest was aborted or after all test steps have been executed. A window appears at the bottom of the screen showing the total result of the Quicktest.

Restart
Press this key to restart the test.

Start Menu
Press this key to return the the Quicktest Main Menu.

9.7 Manual Test Menus

9.7.1 MS Test/Wait Sync Menu



This menu appears when the Manual Test is activated. The BCCH information is transmitted on the Control channel and the CTS waits for a Location Update or for a call from the mobile station.

On the top left side of the menu important Manual Test settings are indicated, these are:

- the external attenuation between the mobile and the CTS for the selected mobile type
- the chosen Control Channel Number and the Traffic Channel Number
- the CTS transmit level for the traffic channel

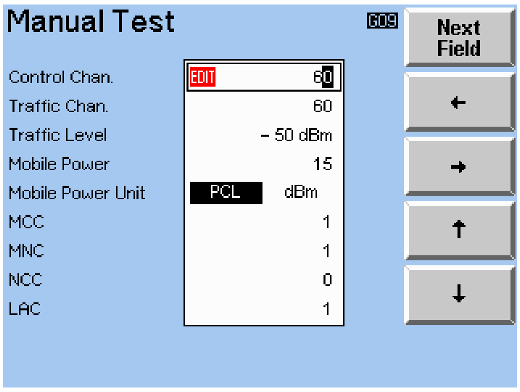
On the right hand side the selected mobile type is displayed. Above this is an indicator for the coupler state. On signifies that a coupler is used and the attenuations defined for the selected mobile type is taken into account. Off signifies that no coupler is used. Therefore the attenuations are set to zero.

When the mobile station starts a Location Update or a makes a call the power received from the mobile is indicated by the power indicator bar and an appropriate message for "Location Update in progress" or "Call from the mobile in progress" starts to blink.

Select MS Type
By pressing this key the local configuration menu for selecting the mobile type and to switch the coupler on and off can be reached.

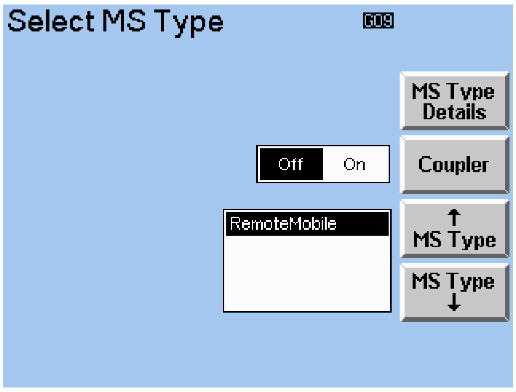
Config
By pressing this key the local configuration menu for the base station signal and the network parameters can be reached.

9.7.2 Manual Test Menu



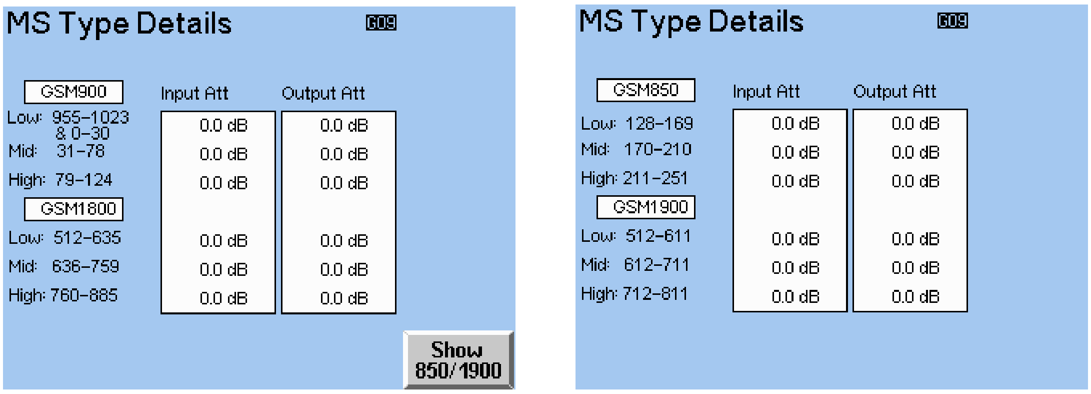
In this menu all important Manual Test specific parameters can be changed. This is the Control Channel Number and the Traffic Channel Number as well as the CTS transmit level for the traffic channel. In addition, the network parameter can also be changed. Furthermore the power used by mobile phone to call the CTS can be defined. This power value can be entered as an index (= PCL or Power Control Level) or as a power value in dBm, depending to which unit value the power has been set (PCL or dBm).

9.7.3 Select MS Type Menu



Select MS Type Menu

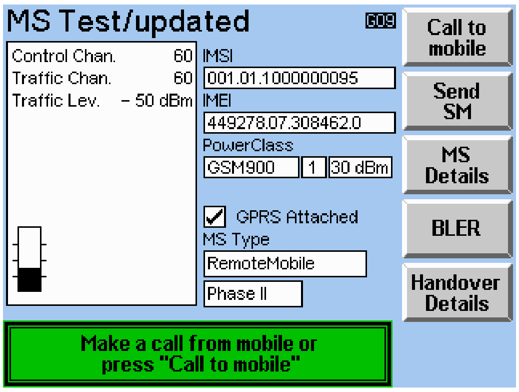
In this menu the mobile type can be selected and the coupler can be switched on or off. View the external attenuation for corresponding selected MS Type by entering the MS Type Details Menu. This now displays the attenuation settings for all 3 networks. The Remote Mobile MS Type is always first in the list and will never be sorted, it is used so that the Remote Control commands for setting the external attenuation will switch to and configure this Mobile Type only. Other Remote Control Commands will not effect this MS type.



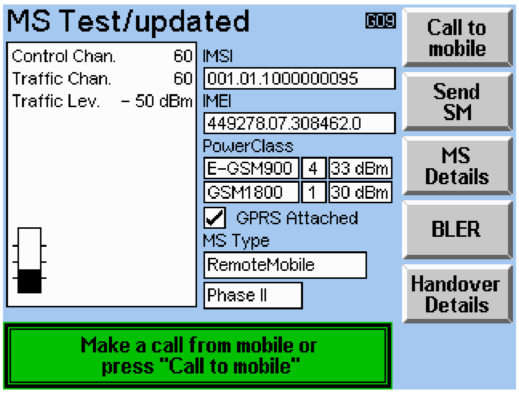
MS Type Details Menu

However, these setting are only displayed and considered in the transmitting and receiving levels if the coupler is switched ON.

9.7.4 MS Test/Updated Menu



Test/updated Menu - Single Band MS



Test/updated Menu - Dual Band MS

After a successful Location Update this screen appears. On the right side of the display essential data of the mobile is displayed. This data has been recorded during the Location Update.

- IMSI (International Mobile Subscription Identity)
  This is the phone number of the mobile station.
- IMEI (International Mobile Equipment Identity)
  This is an unique number to identify the each mobile station.
- Power Class and Frequency Capability

  The Power Class of the mobile station defines the maximum transmit level of mobile station. The according transmit level is displayed right to the Power Class. The CTS now has the ability to display Power Classes and Frequency Capability for a single and dual band MS.

P-GSM850	4	33 dBm

P-GSM900	4	33 dBm

GSM1800	1	30 dBm

The display will show the 1st power class of the originating network (network in which Location Updated) and the 2nd power class as the secondary network.

The 2nd Power Class and Frequency Capability will not be shown for single band and GSM900/1900 dual-band MS.

The frequency Capability for the MS Type will indicate the following:

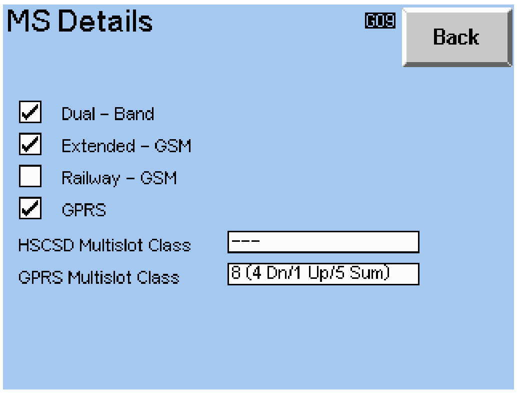
GSM850	Indicates GSM850 Frequency Capability
P-GSM900	Indicates Primary GSM900 Frequency Capability
E-GSM900	Indicates Extended and Primary GSM900 Frequency Capability
R-GSM900	Indicates R-GSM (Railway GSM) Frequency Capability
GSM1800	Indicates GSM1800 Frequency Capability
GSM1900	Indicates GSM1900 Frequency Capability

In this screen either the mobile can be called by the CTS or the CTS can be called by the mobile. To call the mobile the softkey "Call to mobile" key has to be pressed. To call the CTS the user has to dial a number at the connected mobile and has to press the call button.

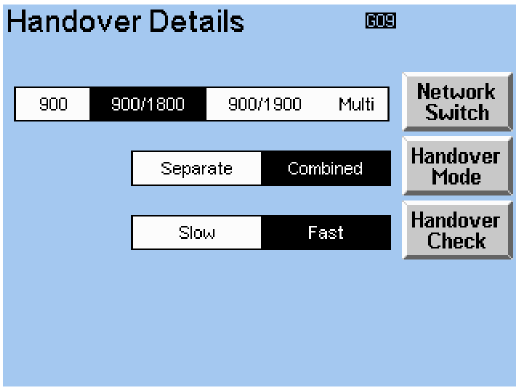
Any power received from the mobile is indicated by the power indicator bar and an appropriate message for "Call to mobile" or "Call from the mobile" starts to blink.

To send a "Short Message" to the mobile, the key "Send SM" has to be pressed.

The MS Details button will indicate to the user if the Mobile Station is capable of supporting Extended GSM frequencies and / or is Dual Band (900 / 1800 MHz).



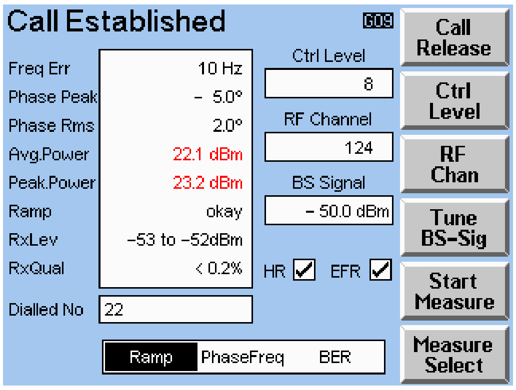
9.7.4.1 Handover Details Menu



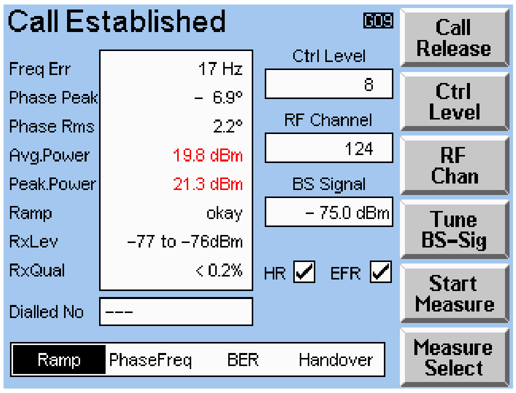
Handover Details Menu

This menu functions in the same manner as (Section 9.9.13). The Options are set to the Configured values but the user has the option to change these setting temporarily for the Call Established State.

9.7.5 Call Established Menu



Call Established Menu - In Band Only



Call Established Menu - Dual Band

The Call Established menu appears after a connection on the Traffic Channel is established between the CTS and the mobile. This menu is the central menu for the CTS in Manual Test mode.

While keeping the connection with the mobile station the CTS carries out several cyclic measurements on the signal transmitted by the mobile station and displays the results in this menu.

The following results are displayed:

- Frequency Error (Freq Err)
- max. Phase Error Peak (Phase PK)
- actual Phase Error RMS (Phase RMS)
- Measured average power transmitted by the mobile (Avg. Power)
- Measured peak power transmitted by the mobile (Pk. Power)
- Evaluation of the Power Ramp of the signal (Ramp)

Results exceeding the tolerances are shown in Red.

The Call Established Connection is always at Full Rate Coding, but the menu also indicates if the mobile station supports Enhanced Full and / or Half Rate Coding.

During an established connection the mobile station measures the level (RxLev) and the quality (RxQual) of the signal received by the mobile. Both values are reported back to the CTS. These values are also displayed in the Call Established menu.

For experiments carried out primarily on the receiver of the mobile station, the level of signal transmitted by the CTS can be varied (BS Signal). It is also possible to vary the traffic channel frequency (RF Chan) and the transmitted power of the mobile (Ctrl Level).

To get more detailed measurement results about the transmitter of the mobile the Power Ramp and Phase/Frequency Error measurement can be selected. For more detailed measurement results about the receiver of the mobile the BER measurement can be started. Furthermore this menu also allows varying the tolerances for each measurement.

At any time the connection can be cleared by a Network Release initiated by the CTS or a Mobile Release initiated by the mobile station.

If the Dual Band Options have been selected in the Handover Details Menu (See Section 9.7.4.1 and 9.9.13) then a Fourth Option Handover is available in the Ramp, Phase/Freq and BER menu bar. This option is needed to initiate a “Handover” to the selected network.

If the CTS is configured to In-Band channel changes, then NO handover option will be available in the measurement bar.

When selected the Start Measure button will display the following text:

Network GSM900	**Display Text**
GSM900/GSM1800	Handover to 1800.
GSM900/GSM1900	Handover to 1900.
Multi	Handover Option Available. If MS GSM900/GSM1800 dual band – Handover to 1800. If MS GSM900/GSM1900 dual band – Handover to 1900.
Network GSM1800	
GSM1800/GSM900	Handover to 900.
Multi	Handover Option Available - Handover to 900.
Network GSM1900	
GSM1900/GSM900	Handover Option Available. Handover to 900.
Multi	Handover Option Available - Handover to 900.

The target ARFCN channel and Power Ctrl Level will be the channel and power level set in the main configuration settings for that network (Section 9.9.2 Config BS Signal). For further subsequent handovers the last applied ARFCN and power level will be used.

Call Release
By pressing this key the connection will be released by the CTS. The CTS returns to the MS Test Updated Menu, from where a new call can be established.

Ctrl Level
By pressing this key the Power Ctrl Level of the mobile station can be changed. After the new value has been entered and confirmed the CTS forces the change of the transmitted power by signalling of the mobile station.

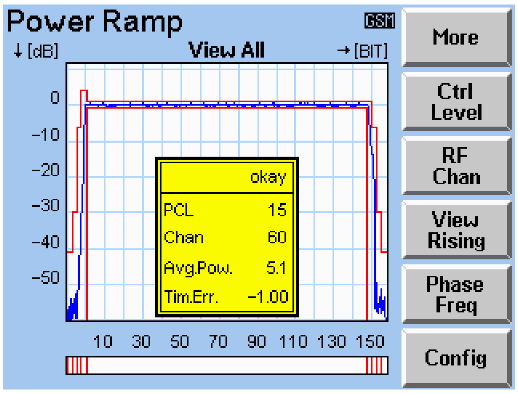
Rf Chan
By pressing this key the traffic channel number can be changed.

Tune BS-Sig
By pressing this key the power level transmitted by the CTS can be changed.

Start Measure
With this key the selected measurement (see Measure Select) can be activated.

Measure Select
With this key one of the more detailed measurements can be selected. To activate the measurement the "Start Measure" key has to be pressed.

9.7.6 Power Ramp Menu



In this screen the Power Ramp of the signal transmitted by the mobile station is displayed as a function of time. On the display there is also the tolerance mask for the power ramp which must not be exceeded by the ramp.

In addition to the power ramp the average power of the burst (Avg.Pow) and the timing error (Tim Error) are displayed. The average power is the power averaged over the useful part of the burst. The timing error given in the CTS is the difference between the transmit timing of the CTS and the timing of the burst transmitted by the mobile. If the average power exceeds the tolerance it is highlighted.

The first field of the box displayed below the ramp shows the overall judgement of the ramp. If the measured ramp exceeds the template at only one sample the burst is "incorrect". It is also incorrect if the average power is not within the predefined limits which can be set to configurable or to GSM recommendations (within Config BS Signal). The bar below the power ramp graph indicates where the ramp exceeds or stays below the template.

More
Pressing this key selects a further menu where the measurement can be started and stopped. Furthermore you can switch to full screen mode for the ramp for a better assessment of the power curve.

Ctrl Level
By pressing this key the Power Ctrl Level can be changed. After the new value has been entered and confirmed the CTS forces the change of the transmitted power by signalling the mobile station.

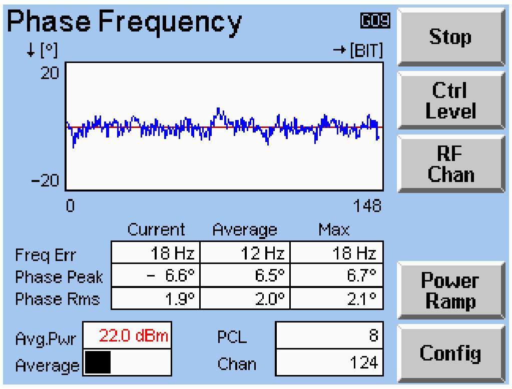
Rf Chan
By pressing this key the traffic channel number can be changed.

View Rising
By pressing this key an enlarged section of the Ramp display can be seen. The areas concerned are the useful part, the falling edge, the rising edge.

Phase Freq
With this key the phase frequency error measurement can be selected.

Config
Press this key to access the configuration menu for the power ramp.
This option is not displayed if the Ramp Tolerance is set to REC (within Config BS Signal).

9.7.7 Phase Frequency Menu



In this menu, the phase error of the signal transmitted by the mobile is displayed as a function of the time. In addition the peak phase error, the RMS phase error and the frequency error are indicated by their measured values.

The display is divided into several fields:

The upper field indicates the phase error graphically during the burst. The graphics are continuously updated, i.e. a quasi-real-time measurement is available for adjustment purposes.

Below the graph the measurement results for the frequency error, the phase error peak and the RMS phase error are indicated. The values given are those of the current burst as well as an average and the maximum over a predefined number of bursts. The tolerances can be defined in the configuration menu for this measurement. The average power of the current burst is also displayed.

Stop
With this key the measurement can be stopped and started again.

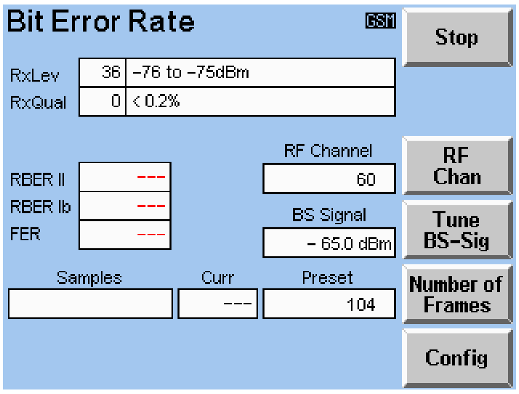
Ctrl Level
By pressing this key the Power Ctrl Level can be changed. After the new value has been entered and confirmed the CTS forces the change of the transmitted power by signalling of the mobile station.

Rf Chan
By pressing this key the traffic channel number can be changed.

Power Ramp
With this key the power ramp measurement can be selected.

Config
Press this key to access the configuration menu for the phase and frequency error measurement.

9.7.8 Bit Error Rate Menu



In this menu the bit error of the mobile is calculated and displayed. To perform this measurement a special SIM CARD (i.e. R&S GSM test SIM CRT-Z2) is required which allows the RF loop back at the mobile station.

In the RF loop back mode, bits sent by the CTS and received by the mobile station are demodulated and then modulated again by the mobile station and finally sent back to the CTS on the RF path. The CTS compares the transmitted bits with the received bits and calculates the bit error rate of the mobile station.

The following values are indicated at the display:

RxLev and RxQual
During an established connection the mobile station measures the level (RxLev) and the quality (RxQual) of the signal received by the mobile. Both values are reported back to the CTS and are displayed in this screen.

RBER II, RBER IB and FER
These contain the bit error measurement results, which are updated continuously.

On the bottom part of the screen the number of the averaged frames from the beginning of the measurement are displayed as number value and as a bar.

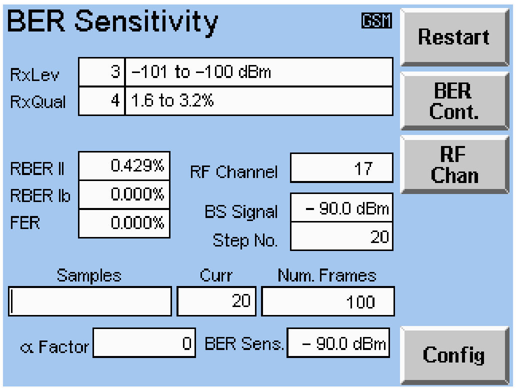
Stop
With this key the measurement can be stopped and started again.

Rf Chan
By pressing this key the traffic channel number can be changed.

Tune BS-Sig
By pressing this key the level transmitted by the CTS can be changed.

Number of Frames
By pressing this key the number of frames to average can be changed.

9.7.9 BER Sensitivity measurement



This measurement is able to measure a mobile's receive sensitivity which is defined as the lowest "BS Signal" that allows the BER measurement results to be just within the configured tolerances.

This measurement can be started from the "Call Established" menu by activation of the BER measurement. Either the "BER Sensitivity" menu is entered directly or it can be activated by pressing the softkey labelled "BER Sens." in the "Ber Continuous" menu.

On entering the "BER Sensitivity" menu the measurement will be started automatically. The "BS Signal" will be ramped down from a configured initial value until the sensitivity level is reached and then the resulting "BS Signal" value is displayed in the "BER Sens." result field. The measurement can be made again by pressing the "Restart" softkey. A measurement can be stopped while in process by pressing the "Stop" softkey and then restarted by pressing the "Cont" softkey.

The "BER Sensitivity" configuration menu is accessible via the main configuration menu as well as via the measurement menu itself.

The following value is indicated at the display:

BER Sens.
The speech channel level (TCH level), where the defined BER is reached.

Restart
To restart the sensitivity measurement routine.

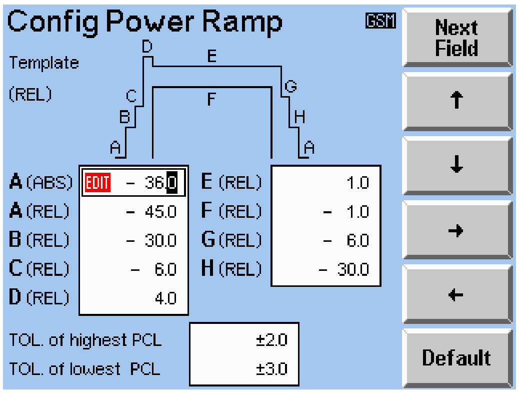
BER Cont.
To change to continuously BER measurement.

RF Chan
To change the channel number of the speech channel.

Config
To change to the configuration menu "Config BER Sens".

9.8 Measurement Configuration Menus

9.8.1 Config Power Ramp



In this menu the tolerances for the power ramp measurement are defined. These are largely identical with the relative level values for the power ramp template. The power ramp template is defined with reference to the power used by the mobile to transmit.

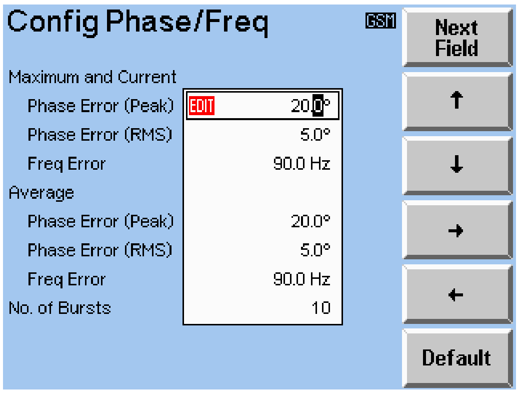
The template is shown at the top of the screen. The various ranges of the template are identified with the letters A to F. The predefined values for these ranges are shown below the template.

For range A an absolute minimum control level can also be defined.

Apart from the template the limits for the absolute power control levels of the mobile are also defined. They consist of two values, one for the highest power control level and one for all other power control levels.

Default
Press this key to reset all values to factory default values.

9.8.2 Config Phase/Freq Menu



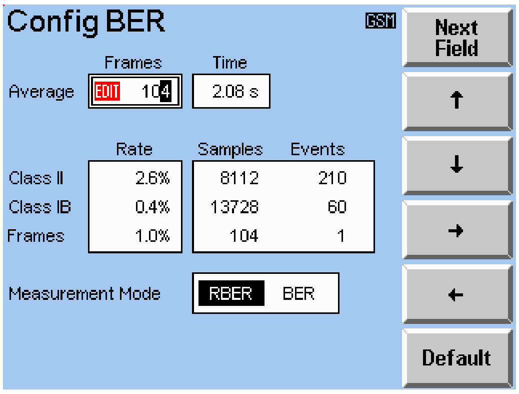
This menu is used to define the tolerances for the phase and frequency error measurement.

The phase and frequency error measurement supplies the results for the phase error (Peak), the phase error (RMS) and the frequency error, the current value as well as the maximum and average values for a predefined number of bursts.

This menu is used to define the shared tolerances for the current and the maximum values as well as the tolerances for the average values. In addition, the number of bursts which are used to calculate the average is defined.

Default
Press this key to reset all values to factory default values.

9.8.3 Config BER Menu



This menu is used to define the tolerances for the bit error rate measurement.

The following values must be defined:

Number of speech **frames**
The number of speech frames defines how many bits are used for the bit error measurement. Each speech frame contains 270 bits allocated to the classes IA, IB and II. This defines how many bits per class are used for the measurement. They are shown in the Samples column. When defining the number of frames the test time is defined simultaneously and shown in the field "Time".

Rate Class II
This value defines the percentage for the permissible maximum number of incorrect bits from class II. The maximum number of incorrect bits is shown in the Events column.

Rate Class IB
This value defines the percentage for the permissible maximum number of incorrect bits from class IB. The maximum number of incorrect bits is shown in the Events column.

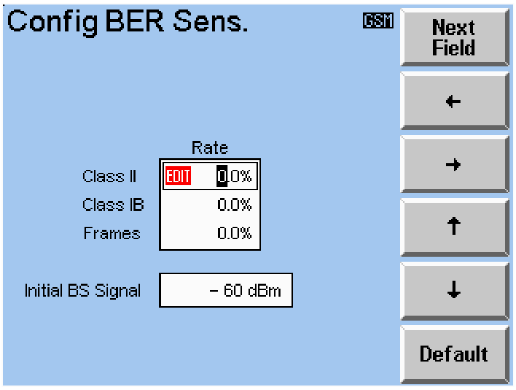
Rate Frames
This value defines the percentage for the permissible maximum number of frames. The maximum number of incorrect frames is shown in the Events column.

Measurement Mode
The bit error measurement distinguishes between two modes, BER and RBER.

BER:
In this mode all frames are used to calculate the bit errors in classe II and class IB.

RBER:
In this case only the "good" frames in class IB and class II are used. The bad frames are accounted for in the frame errors. The mobile identifies the bad frames.

9.8.4 Config BER Sensitivity



This menu is used to define the parameter for the sensitivity measurement.

Rate Class II
This value defines the percentage for the permissible maximum number of incorrect bits from class II. The maximum number of incorrect bits is shown in the Events column.

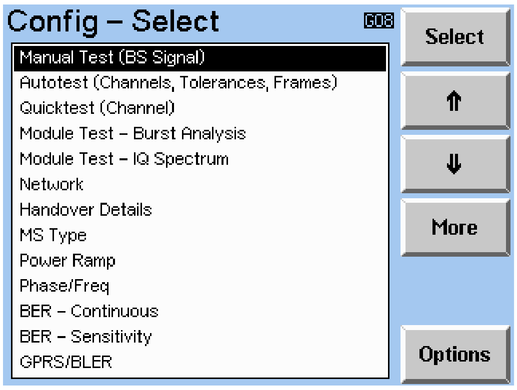
Rate Class IB
This value defines the percentage for the permissible maximum number of incorrect bits from class IB. The maximum number of incorrect bits is shown in the Events column.

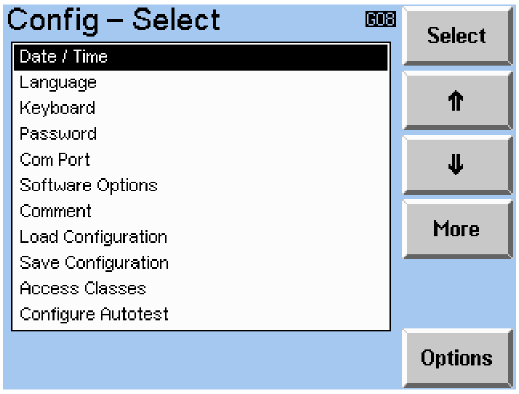
Rate Frames
This value defines the percentage for the permissible maximum number of frames. The maximum number of incorrect frames is shown in the Events column.

Initial BS Signal
Initial BS signal level (TCH level) to start the sensitivity measurement routine.

9.9 General Configuration Menus

9.9.1 Config - Select





These two menus are the selection menus of the configuration part of the CTS. The configuration menus listed in the middle of the screens can be selected directly. The available options can be displayed by pressing the Options key.

The access to the configuration menu part of the CTS can be protected by a password (see Config Password later in this chapter). If the password protection is activated, the password has to be typed in correctly before access to this menus granted.

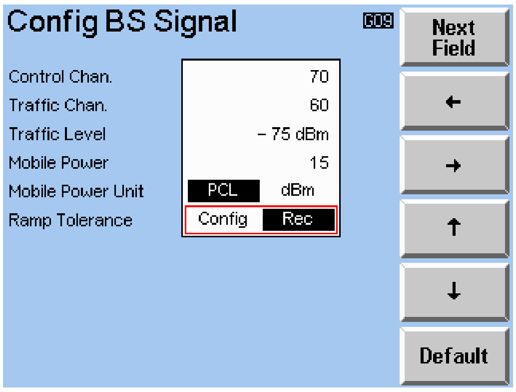
Select
After pressing this key the selected configuration menu will be displayed.

↑ ↓
With this key the configuration menu which will be selected.

More
Press this key to toggle between the two configuration menus.

Options
Pressing this key shows the available options and the software options.

9.9.2 Config BS Signal



This menu is used to change the main Parameters dedicated to the Manual Test, which are:

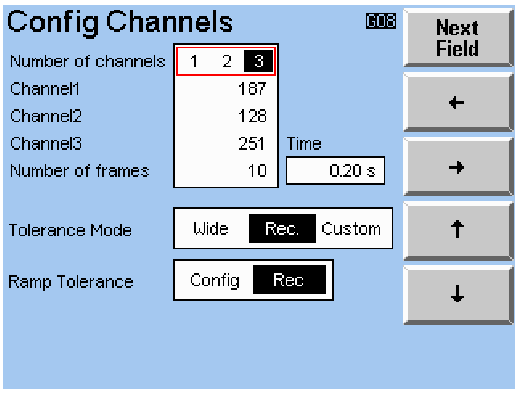
- The channel number of the Control Channel (**Control Chan**). This is the channel on which the CTS sends out the control information. The control channel is needed by the mobile to synchronise on the CTS.
- The channel number of the Traffic Channel (**Traffic Chan**). This is the channel on which the speech connection is established (see Call Established Menu).
- The level of the traffic channel (**Traffic Level**). This is the level at which the CTS transmits the traffic channel.
- The output power level of the mobile station (**Mobile Power**). This is the output level with which the mobile transmits to the CTS.

The mobile’s output power can be given in two different units (dBm or PCL). The unit is selected in the **Mobile Power Unit** field.

The Power Ramp template can be configurable where the user specifies the tolerance limits (Config Power Ramp Menu) or set the tolerances according to the GSM Recommendations. This option is selected in the **Ramp Tolerance** field.

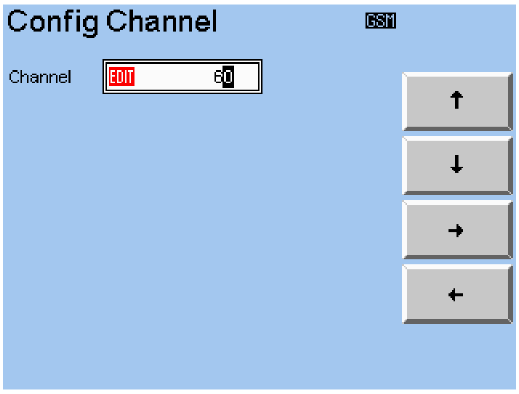
Default
With the "Default" key all fields of this menu can be reset to factory default values.

9.9.3 Config Channels



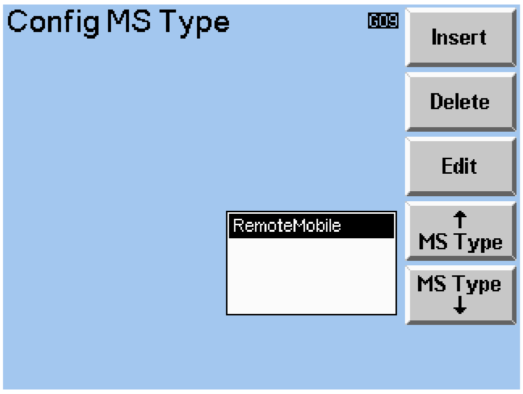
This menu is used to change the main parameters dedicated to the Autotest. For a description of the fields see section 9.5.2.

9.9.4 Config Quicktest (Channel)

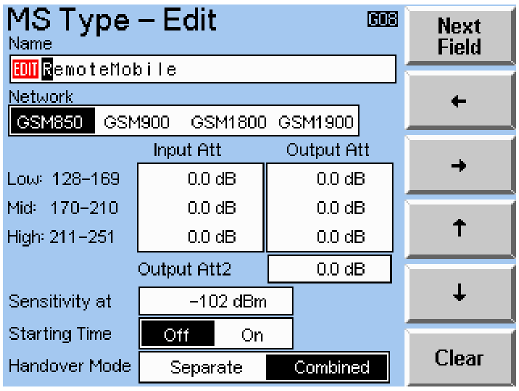


This menu is used to define the channel on which the Quicktest is to be carried out.

9.9.5 Config MS Type and MS Type Edit



Config MS Type Menu



MS Type Edit Menu

In the main menus of the Manual test, Autotest, Quicktest and Module test a mobile type can be selected.

The mobile types (100 max) are no longer network dependent and are available irrespective of network setting. This means a mobile defined in one network (e.g. GSM900) can now be selected within another network (e.g. GSM1900). Whereas pre – X2.06.3 Software will only display MS Types edited in its created network.

The input and output attenuation's are now split in to various sub-bands "low", "mid" and "high". The low, mid and high input/output attenuation values will be used during the corresponding call established ARFCN channels.

Band	**GSM850 Channel Breakdown**	**GSM900 Channel Breakdown**	**GSM1800 Channel Breakdown**	**GSM1900 Channel Breakdown**
Low	128-169	975-1023 & 0-30	512-635	512-611
Mid	170-210	31-78	636-759	612-711
High	211-251	79-124	760-885	712-810

The input/output attenuation values and ARFCN channel boundaries are applicable for Manual test, Autotest and Quicktest. For Module test the ARFCN channel configuration differs and the "mid" attenuation settings are always used irrespective of channel number.

The Sensitivity at level is for the Autotest BER and RXQual / RX Lev measurement only.
The Starting Time option initiates a small delay before initiating an ARFCN channel change.
The 2^{nd} output attenuation value is for configuring the attenuation for the 2^{nd} RF output.

The Handover mode option is a duplication of the option available within the Handover Details Configuration (see section 9.9.13). The Handover mode option within this menu will take precedence over Handover mode set in the Handover Details menu if the coupler is set to ON (see 9.7.3 Select MS Type Menu).

With these two menus all mobile type parameters can be changed (**Edit**) new mobile types can be inserted (**Insert**) or existing mobile types can be deleted (**Delete**). When inserting or editing the menu on the right hand side appears.

The mobile type to be edited or deleted has to be selected with the arrow keys in the left menu.

The various attenuation's for each network are edited by alternating the Network setting to the required network. Each input att. / output att. field can then be edited by using the arrow keys.

The Remote Mobile MS Type is always first in the list and will never be sorted, it is used so that the Remote Control Commands for setting the external attenuation will switch to configure the Mobile Type only. Other Remote Control Commands will not effect this MS type. The Remote Mobile MS Type must be selected before the CTS will actually use these values.

Installing CTS New MS Types over pre X2.06.3 CTS MS Types

Upon the first installation of the X2.06.5 Software onto a CTS with software previous to X2.06.3 then the CTS will do a simple conversion routine to retain the previous MS Type lists. The input / output attenuations associated to a MS Type will be duplicate for each „low“, „mid“ and „high“ entries.

For Example:

Old MS Type Setting for a Mobile Type defined within GSM900 only.

Name:	MS_Z10
Input Att:	5.3 dB
Output Att:	12.2 dB
Output Att2:	16.2 dB
Sensitivity at:	-102 dBm
Starting Time:	ON

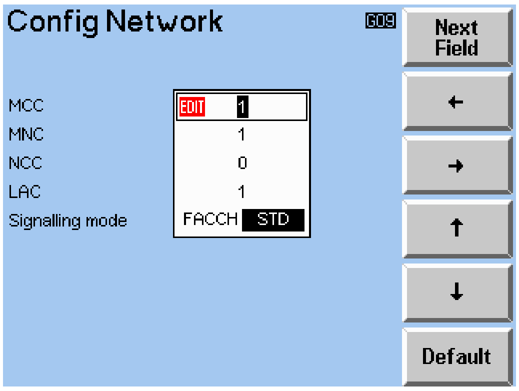
Then the corresponding X2.06.5 MS Setting will be:

Name:	Nokia2110		
GSM850		**GSM850**	
Low Input Att:	0.0 dB	**Low Output Att:**	0.0 dB
Mid Input Att:	0.0 dB	**Mid Output Att:**	0.0 dB
High Input Att:	0.0 dB	**High Output Att:**	0.0 dB
GSM900		**GSM900**	
Low Input Att:	5.3 dB	**Low Output Att:**	12.2 dB
Mid Input Att:	5.3 dB	**Mid Output Att:**	12.2 dB
High Input Att:	5.3 dB	**High Output Att:**	12.2 dB
GSM1800		**GSM1800**	
Low Input Att:	0.0 dB	**Low Output Att:**	0.0 dB
Mid Input Att:	0.0 dB	**Mid Output Att:**	0.0 dB
High Input Att:	0.0 dB	**High Output Att:**	0.0 dB
GSM1900		**GSM1900**	
Low Input Att:	0.0 dB	**Low Output Att:**	0.0 dB
Mid Input Att:	0.0 dB	**Mid Output Att:**	0.0 dB
High Input Att:	0.0 dB	**High Output Att:**	0.0 dB
Sensitivity at:	-102 dBm		
Starting Time:	ON	**Output Att2**	16.2 dB
Handover Mode:	Separate		

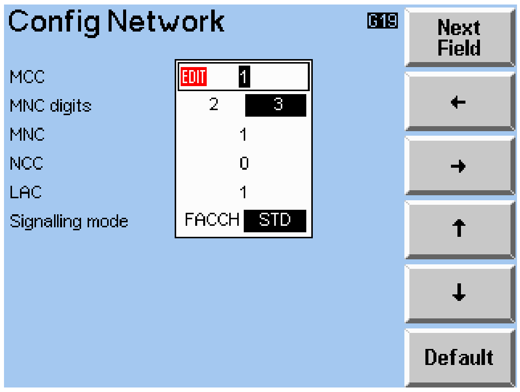
The CTS will only support a maximum of 100 MS Types.

The MS Type will transfer attenuations only for the network in which it was inserted (created). The other networks will show default settings.

9.9.6 Config Network



(GSM900/1800)



(GSM850/1900)

In this menu the main parameters of the network simulated by the CTS are defined.

These are:

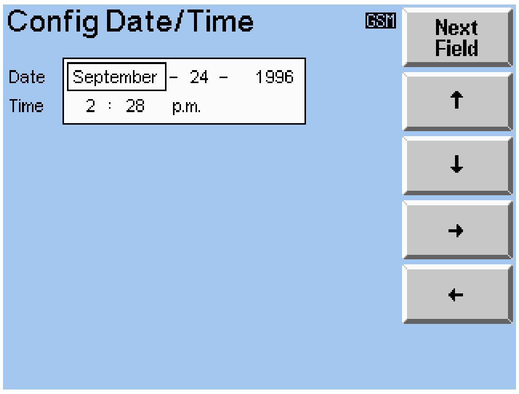
- The Mobile Country Code **(MCC)**. This parameter defines the country in which the simulated network would be located.
- The Mobile Network Code **(MNC)**. This parameter is used to distinguish network providers in the same country.

  Note: For GSM900 and GSM1800 this is only a 2 digit number. Whereas GSM1900 and GSM850 Mobile Stations will either support 2 or 3 digits.
- The Network Colour Code **(NCC)**. This parameter is used to distinguish between cells of a network.
- Location Area Code **(LAC)**. This parameter defines the location area in which the cell is located.

It is sometimes important that these parameters have the same values as those stored on the SIM card of the mobile to be tested. The reason for this is that some network providers don't allow the mobile to synchronise to networks of other network providers. This problem does not arise when using a test SIM such as R & S CRT-Z2.

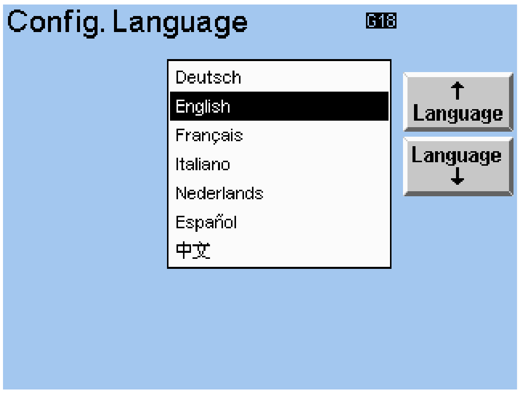
Default
With this key all fields of this menu can be reset to factory default values.

9.9.7 Config Date/Time



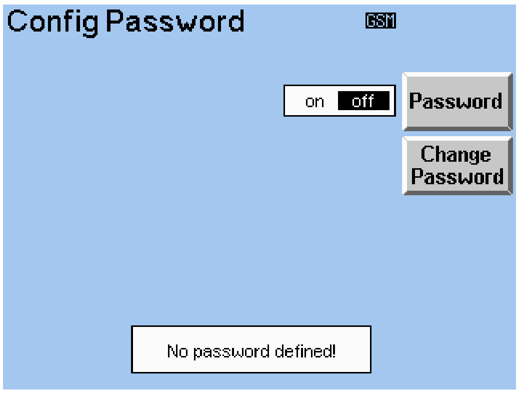
With this menu the date and time of the system can be changed.

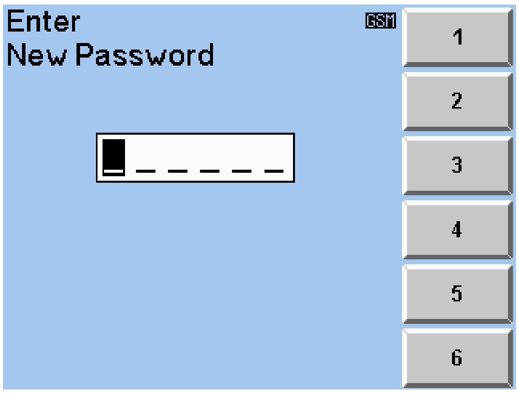
9.9.8 Config Language



With this menu the language of the system can be selected. This means all text shown in all menus is changed according to the selected language.

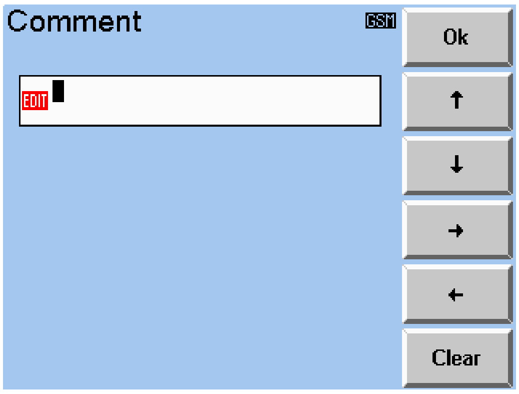
9.9.9 Config Password





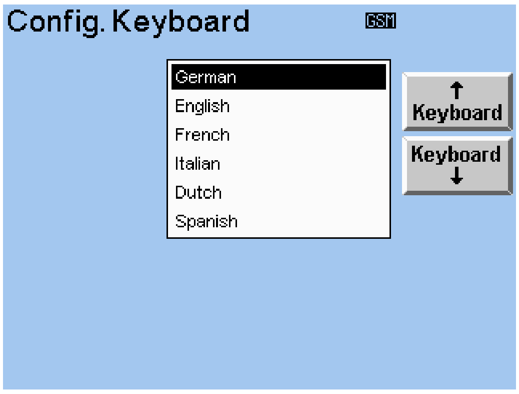
In this menu the password protection of the configuration menus can be activated and deactivated. Also by pressing the Change Password key a new password can be entered. In this case the screen on the right is displayed for password entry. The password consists of six digits. The digits are not displayed on the screen; stars are displayed instead. The menu can only be left when all six digits have been entered or when the "Menu Up" hardkey is pressed.

9.9.10 Comment Menu



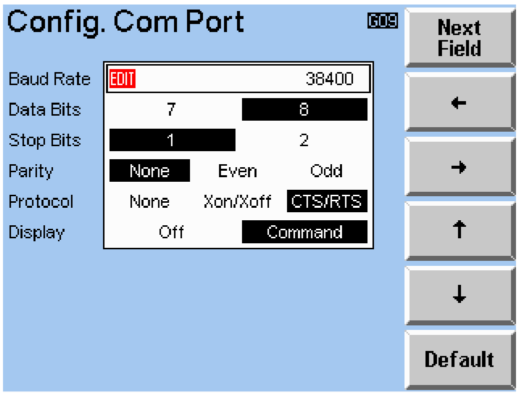
In this menu a comment can be entered which is printed into the printer protocol.

9.9.11 Config Keyboard Menu



This menu is used to define which country specific keyboard has been connected.

9.9.12 Config Com Port

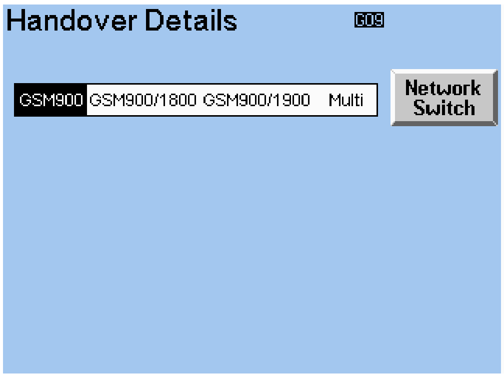


This menu allows the RS232 interface parameters to be selected:

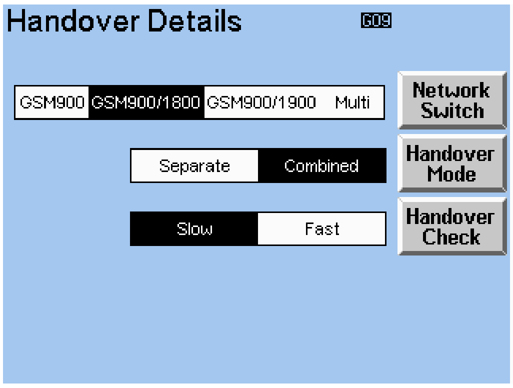
Baud Rate 1200, 2400, 4800, 9600, 19200
Data Bits 7, 8
Stop Bits 1, 2
Parity None, Even, Odd
Protocol None, Xon/Xoff, CTS/RTS
The CTS handshaking protocol for the RS232 Communication Port defaults to CTS\RTS.
Display Selects the display mode for remote-control operation:

Off: Display off
Command: The display shows the remote-control commands, the instrument and error status

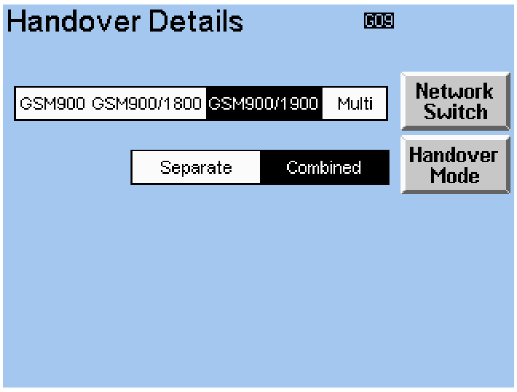
9.9.13 Config Dual Band Handover Menu



Config Handover Details Menu – GSM900 No Handover Option



Config Handover Details Menu – GSM900/GSM1800 Handover Option



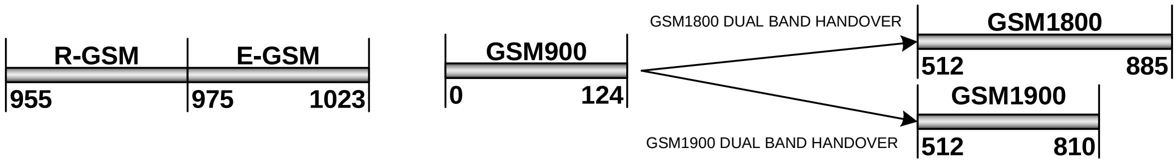
Config Handover Details Menu – GSM900/GSM1900 Handover Option

The Dual Band Option enables the user to test Dual-Band MS types. This enables the test time cycle to be improved due to the reduction in signalling time required for Location Update and to establish a call is only required once. The user can establish a call on one network, and “handover” to the other supported network to complete testing.

There are 3 softkeys which have influence to the behaviour of the handover procedure:

9.9.13.1 Handover Network

HANDOVER NETWORK represents the target network to which dual-band handover shall be done. This selection is necessary because there is no criteria on distinguishing between the networks GSM1800 and GSM1900.



The diagram above shows the difference between a GSM1800 and GSM1900 dual-band handover. Moreover, the overlap in channel numbering (512 to 810) of these networks. Specifying the desired handover network before the handover takes place removes any ambiguity.

MMI DISPLAY NAMES	Handover Options
GSM850	GSM850 Channel Availability Only
GSM850/GSM1900	GSM850and GSM1900Channel Availability – with GSM850 being the originating network
GSM900	GSM900 Channel Availability Only
GSM900/GSM1800	GSM900 and GSM1800 Channel Availability – with GSM900 being the originating network
GSM900/GSM1900	GSM900 and GSM1900 Channel Availability – with GSM900 being the originating network
GSM1800	GSM1800 Channel Availability Only
GSM1800/GSM900	GSM1800 and GSM900 Channel Availability – with GSM1800 being the originating network
GSM1900	GSM1900 Channel Availability Only
GSM1900/GSM850	GSM1900 and GSM850 Channel Availability – with GSM1900 being the originating network
GSM1900/GSM900	GSM1900 and GSM900 Channel Availability – with GSM1900 being the originating network
MULTI	This does not fix the CTS to just handover between GSM900 and GSM1800 or GSM900 and GSM1900. The CTS will use information upon location update to determine if the MS is dual band. If the MS indicates a dual band mobile then GSM900/GSM1800 handovers will be available if required. If the MS does not indicate DBHO, then GSM900/GSM1900 handovers are available.

9.9.13.2 Handover Check

If the current network selection is GSM900/1800 then the HANDOVER CHECK softkey is available. If HANDOVER_CHECK is set to SLOW then additional signalling is requested from the MS otherwise it is not requested.

9.9.13.3 Handover Mode

If the current network selection is GSM900/1800 or GSM900/1900 then the HANDOVER MODE softkey is available.

Two modes of dual-band handover are defined:

a) Separate

The Control Channel (required for location update) on the original network is dropped, leaving only the Traffic Channel (required for call established/measurements) on the new network.

b) Combined

The Control Channel (required for location update) remains on the original network, and the Traffic Channel (required for call established/measurements) is on the new network.

The Handover mode option is also used within the Config MS Type and MS Type Edit (section 9.9.5). The Handover mode option within this menu will take precedence over Handover mode set in the Config MS Type menu if the coupler is set to OFF (see 9.7.3 Select MS Type Menu).

10 Enhanced Measurement and Test Report Printout

Comment
The comment which is defined in the configuration menu.

Test station
Name and manufacturer of the mobile tester for which this test report was produced.

Date and Time
Date and time of the test.

Mobile
The designation of the mobile entered is that chosen with the "MS Type" key in either the Autotest menu or the MS Test/Wait Sync menu. This designation can be changed or a new telephone entered by using the Config MS Type menu (see section 9.9.5 for information on using the MS Type Menu).

Coupler Input Attenuation and **Coupler Output Attenuation**
Shows whether the coupler on option was set in either the Autotest menu or the MS Test/Wait Sync menu. If the coupler on option was selected the value for Input and Output attenuation for the telephone selected used during the test is printed under this heading.

Power class
Each mobile phone is assigned to a specific power class which defines the maximum and the minimum power of the mobile. The power class is read from the mobile and the result entered here.

IMSI
(International Mobile Subscriber Identity). This is the number for calling the connected mobile phone. It is read from the SIM card, and the result entered here.

IMEI
The International Mobile Equipment Identity is a hardware code or equipment identity which characterises the hardware of the mobile. It consists of four fields. The IMEI number will be read from the mobile and the result entered here.

Measurement results on channel XX
The following measurement results for the average output power and sensitivity were measured on speech channel XX.

MS Output Power
The output power of the mobile is measured at three different power levels.

- Standard — Nominal power with which the telephone should be transmitting.
- Measured — Average output power of the mobile measured by the CTS.
- Tolerance — Upper and lower tolerance levels for the measured output power.
- Evaluation — If the measured value lies within the tolerance levels, an "OK" will be entered, otherwise a "FAIL" entry is made.

MS Sensitivity
This table shows the transmit level of the CTS and the receive level measured by the mobile (RxLev). The parameter receive quality (RxQual) is also listed here. The measurement is carried out with a selectable transmit level of the mobile tester.

- Input Level — Transmit level from CTS.
- RXLEV — Input level measured by the mobile.
- Tolerance — Upper and lower tolerance levels for the measured levels.
- RXQUAL — Bit error rate of the receive signal as measured by the mobile.
- Maximum — Upper tolerance level of the bit error rate.
- Evaluation — If the result is within tolerance limits, "OK" will be output. Otherwise, "fail" will be output.

Power Ramp
Here are the results of the power ramp measurement.

- Standard — Nominal power with which the telephone should be transmitting.
- Average Power — Average power of the mobile measured by the CTS.
- Tolerance — Upper and lower tolerance levels for the measured average power.
- Ramp — Indication at which part of the template the power ramp is out of tolerance.
- Evaluation — If the result is within tolerance limits, "OK" will be entered, otherwise, "fail" will be entered.

Phase/Frequency
Here are the results of the phase/frequency measurement.

- Standard — Nominal power with which the telephone should be transmitting.
- Phase Error RMS
- Phase Error Peak — Measurement results measured by the CTS.
- Frequency Error
- Maximum — Maxima for the measurements.
- Evaluation — If the result is within tolerance limits, "OK" will be entered, otherwise, "fail" will be output.

Bit error measurement
Here are the results of the bit error measurement.

- Input Level — Transmit level from CTS.
- Number of Frames — Number of speech frames for which the BER is measured.
- RBER Class II
- RBER Class IB — Measurement results measured by the CTS.
- FER
- Maximum — Maxima for the measurements.
- Evaluation — If the result is within tolerance limits, "OK" will be entered, otherwise, "fail" will be output.

Dialled number
The telephone number selected in the test step "Call from MS" is shown here. If the CTS initiates the call this number will be the default value set in the software.

Overview of Measurement steps
The individual test steps are listed again together with the information about whether they have been correctly executed (OK) or found to be erroneous (Fail). Steps that have been left out are denoted with "skipped".

Final Conclusion
The overall result of the tests is entered here. The verdict "Test Passed" is given only if all the steps have passed (OK). The result is however band specific and in the case of a two band test, where there will be two separate reports printed, each report will have its own final conclusion.

The following two steps relate only to when a two band autotest sequence has been executed. They will both be skipped in the event of a single band test.

Handover To
Indicates the outcome of the handover attempt to the new GSM band and is only applicable to the first page of the report.

Handover From
Indicates the outcome of the handover back to the original location update GSM band and is only applicable to the second page of the report.

Test Report Printout

```
+--------------------------------------------------------------------+
| The Well Known Mobile Phone Company Limited - GSM Mobile Test       |
| Test Station:                      CTS55  Rohde & Schwarz          |
| Page:                              1                               |
| Date:                              27.09.1994                      |
| Time:                              12:06                           |
+--------------------------------------------------------------------+
| Mobile:                            Mobile 1 with R&S coupler       |
| Coupler Input Attenuation:         0.0   dB                        |
| Coupler Output Attenuation:        15.0  dB                        |
+--------------------------------------------------------------------+
| Power class:                       4                               |
| IMEI:                              490005.10.056715.0              |
| IMSI:                              123.45.67890                    |
+--------------------------------------------------------------------+
| Measurement results on channel:    1                               |
| MS Output Power:                                                   |
|   Standard [dBm]  Measured [dBm]  Tolerance [dBm]       Evaluation |
|        13             13.8           8...18                     OK |
|        23             26.5          18...28                     OK |
|        33             36.4          28...38                     OK |
|                                                                    |
| MS Sensitivity:                                                    |
| Input Level  RXLEV    Allowed     RXQUAL   Maximum      Evaluation |
|    [dBm]     [dBm]     [dBm]       [%]       [%]                   |
|    -100       -99   -105..<-95     0.1       0.4                OK |
|                                                                    |
| Power Ramp:                                                        |
|   Standard   Average Power   Tolerance       Ramp       Evaluation |
|    [dBm]         [dBm]         [dBm]    Rise/Mid./Fall             |
|      13          14.2      11.2...14.8  OK / OK / OK            OK |
|                                                                    |
| Phase/Frequency:                                                   |
|   Standard [dBm]  Phase Error [deg]   Maximum [deg]     Evaluation |
|        23             4.3 (RMS)         5.1 (RMS)               OK |
|                      11.2 (Peak)       15.6 (Peak)              OK |
|                     Freq Error [Hz]    Maximum [Hz]                |
|                         1046              1500                  OK |
|                                                                    |
| Bit Error Rate:                                                    |
| Input Level [dBm]    RBER [%]         Maximum [%]       Evaluation |
|       -100         2.3 (Class II)    5.3 (Class II)             OK |
|                    3.1 (Class IB)    7.3 (Class IB)             OK |
| Number of Frames     FER [%]          Maximum [%]                  |
|        7             9.8               10.7                     OK |
+--------------------------------------------------------------------+
| Dialled Number:      112                                           |
+--------------------------------------------------------------------+
```

```
+--------------------------------------------------------------------+
| The Well Known Mobile Phone Company Limited - GSM Mobile Test      |
| Test Station:                      CTS55  Rohde & Schwarz          |
| Page:                              2                               |
| Date:                              27.09.1994                      |
| Time:                              12:06                           |
+--------------------------------------------------------------------+
| Measurement results on channel:  124                               |
| MS Output Power:                                                   |
|   Standard [dBm]  Measured [dBm]  Tolerance [dBm]       Evaluation |
|        13             13.9            8...18                    OK |
|        23             26.3           18...28                    OK |
|        33             36.0           28...38                    OK |
|                                                                    |
| MS Sensitivity:                                                    |
| Input Level  RXLEV    Allowed     RXQUAL   Maximum      Evaluation |
|    [dBm]     [dBm]     [dBm]       [%]       [%]                   |
|    -100       -99   -105..<-95     0.1       0.4                OK |
|                                                                    |
| Power Ramp:                                                        |
|   Standard   Average Power   Tolerance        Ramp      Evaluation |
|    [dBm]         [dBm]         [dBm]     Rise/Mid./Fall            |
|      13            9.9       9.5...16.5  FAIL/ OK / OK          OK |
|                                                                    |
| Phase/Frequency:                                                   |
|   Standard [dBm]  Phase Error [deg]   Maximum [deg]     Evaluation |
|        23            2.1 (RMS)         10.6 (RMS)               OK |
|                      7.6 (Peak)        25.7 (Peak)              OK |
|                    Freq Error [Hz]    Maximum [Hz]                 |
|                         972               999                   OK |
|                                                                    |
| Bit Error Rate:                                                    |
| Input Level [dBm]    RBER [%]         Maximum [%]      Evaluation |
|        -90        11.4 (Class II)   12.3 (Class II)             OK |
|                   14.9 (Class IB)   19.8 (Class IB)             OK |
| Number of Frames     FER [%]          Maximum [%]                  |
|         7             15.0               17.8                   OK |
+--------------------------------------------------------------------+
```

```
+--------------------------------------------------------------------+
| The Well Known Mobile Phone Company Limited - GSM Mobile Test      |
| Test Station:                      CTS55  Rohde & Schwarz          |
| Page:                              3                               |
| Date:                              27.09.1994                      |
| Time:                              12:06                           |
+--------------------------------------------------------------------+
|                 Overview Of Measurement Steps:                     |
| Location Update:                                                OK |
| Call To MS:                                                     OK |
| Echo Test:                                                      OK |
| MS Release:                                                     OK |
| Call From MS:                                                   OK |
| Network Release:                                                OK |
| MS Power 1st Channel:             1                             OK |
| Sensitivity 1st Channel:          1                             OK |
| Power Ramp 1st Channel:           1                             OK |
| Phase/Frequency 1st Channel:      1                             OK |
| Bit Error Rate 1st Channel:       1                             OK |
| MS Power 2nd Channel:           124                             OK |
| Sensitivity 2nd Channel:        124                             OK |
| Power Ramp 2nd Channel:         124                             OK |
| Phase/Frequency 2nd Channel:    124                             OK |
| Bit Error Rate 2nd Channel:     124                             OK |
+--------------------------------------------------------------------+
| Final Conclusion                                       Test passed |
+--------------------------------------------------------------------+
```

```
+--------------------------------------------------------------------------+
|                                                                          |
| Test Station :CTS55 Rohde & Schwarz              Date: 02.10.2001        |
| Serial number :123456/789                        Time: 12:06             |
+------------------------------------------------------------------        |
| Type of mobile              : Model3210                        |         |
| LOW:Coupler input attenuation:           0.0    dB             |         |
| LOW:Coupler output Attenuation:          0.0    dB             |         |
| MID:Coupler input Attenuation:           0.0    dB             |         |
| MID:Coupler output Attenuation:          0.0    dB             |         |
| HIGH:Coupler input Attenuation:          0.0    dB             |         |
| HIGH:Coupler output Attenuation:         0.0    dB             |         |
+----------------------------------------------------------------+         |
| Power class: 4             Tolerance mode        :REC          |         |
| IMSI: 123.45.67890         Network               :GSM          |         |
| IMEI: 490005.10.056715.0   Phase                 :II           |         |
+----------------------------------------------------------------+         |
| LOCATION UPDATE                                                |   OK    |
| CALL TO MOBILE                                                 |   OK    |
| ECHOTEST                                                       |   OK    |
| CALL CLEARING BY MOBILE                                        |   OK    |
| CALL FROM MOBILE                                               |   OK    |
| HANDOVER TO                                                    |  skip   |
| HANDOVER FROM                                                  |  skip   |
| DIALED NUMBER                      12345678                    |         |
|                                                                |         |
| **** TX-MEASUREMENTS        CH  60                             |         |
|                                                                |         |
| PHASE ERROR  RMS              1.3                         deg  |   OK    |
| PHASE ERROR  PEAK            -4.4                         deg  |   OK    |
| FREQUENCY ERROR              -5.0                          Hz  |   OK    |
|                                                                |         |
| **** POWER RAMP MEASUREMENTS                                   |         |
|                                                                |         |
| AVG. POWER   (PCL 19)         4.8                         dBm  |   OK    |
| AVG. POWER   (PCL 12)        19.2                         dBm  |   OK    |
| AVG. POWER   (PCL 5 )        31.5                         dBm  |   OK    |
|                                                                |         |
| AMPLITUDE RISING EDGE         OK                               |   OK    |
| AMPLITUDE USEFUL PART         OK                               |   OK    |
| AMPLITUDE FALLING EDGE        OK                               |   OK    |
|                                                                |         |
| **** RX-MEASUREMENTS               CH  60                      |         |
|      measured at            -102.0                        dBm  |         |
|                                                                |         |
| RxLev                      -100.0                           %  |   OK    |
| RxQual                   <    0.2                           %  |   OK    |
| RBER CLASS IB                        0.0                    %  |   OK    |
| RBER CLASS II                        0.0                    %  |   OK    |
| FER                           0.0                           %  |   OK    |
|                                                                |         |
| CALL CLEARING BY CTS                                           |   OK    |
+------------------------------------------------------------------        |
|                                                          +------+        |
|            O V E R A L L  R E S U L T                    |  OK  |        |
|                                                          +------+        |
+--------------------------------------------------------------------------+
```

11 Remote Control

11.1 Introduction

The instrument is equipped with a serial interface (RS 232-C). The connector is located at the rear of the instrument and permits to connect a controller for remote control. The instrument supports the SCPI version 1992.0 (Standard Commands for Programmable Instruments). The SCPI standard is based on standard IEEE 488.2 and aims at the standardization of device-specific commands, error handling and the status registers (see Section 11.5.1).

This section assumes basic knowledge of SCPI conform programming and operation of the controller. A description of the interface commands is to be obtained from the relevant manuals.
The requirements of the SCPI standard placed on command syntax, error handling and configuration of the status registers are explained in detail in the respective sections. Tables provide a fast overview of the commands implemented in the instrument and the bit assignment in the status registers. The tables are supplemented by a comprehensive description of every command and the status registers.

11.2 Brief Instructions

The short and simple operating sequence given below permits fast putting into operation of the instrument and setting of its basic functions.

1. Connect CTS and controller using a serial cable (see section 2.1 and annex A).
2. Use a terminal emulation on the controller with the same paramters, as configured on the CTS.
   For example 9600 baud, no parity, 8 bits, 1 stop bit and hardware-handshake.
   The character strings must be terminated by a delimiter (linefeed).
3. Send the following strings to the CTS:

"CONF:NETW GSM <LF>"
"PROC:SEL MAN <LF>" Choose Manual test

The CTS then performs a location update if a mobile is connected and is ready to set up a call with this mobile.

4. To return to manual control, press any key at the front panel.

11.3 Switchover to Remote Control

On power-on, the instrument is always in the manual operating state ("LOCAL" state) and can be operated via the front panel. It is switched to remote control ("REMOTE" state) as soon as it receives a command from a controller. During remote control, operation via the front panel is disabled. The instrument remains in the remote state until it is reset to the manual state via pressing the key "MENU UP". Switching from manual operation to remote control and vice versa does not affect the instrument settings.

Indications during Remote Control

In the REMOTE state, the display at the CTS can be configured:

1. Nothing is indicated on the display to increase the speed.
2. The actual remote command, the state of the testset and possibly occured errors are shown.
3. The display changes to the selected menu in a fullscreen-view.

11.4 Device Messages (Commands and Device Responses)

– **Commands** are messages the controller sends to the instrument. They operate the device functions and request information.
The commands are subdivided according to two criteria:

1. According to the effect they have on the instrument:

   Setting commands cause instrument settings such as reset of the instrument or setting the output level to 1 volt.

   Queries cause data to be provided for output on the remote-control interface, e.g. for identification of the device or polling the active input.

2. According to their definition in standard IEEE 488.2:

   Common Commands are exactly defined as to their function and notation in standard IEEE 488.2. They refer to functions such as management of the standar-dized status registers, reset and selftest.

   Device-specific commands refer to functions depending on the features of the instrument such as frequency setting. A majority of these commands has also been standar-dized by the SCPI committee (cf. Section 11.5.1).

– **Device responses** are messages the instrument sends to the controller after a query. They can contain measurement results, instrument settings and information on the instrument status (cf. Section 11.5.4).

Structure and syntax of the device messages are described in Section 11.5. The commands are listed and explained in detail in Section 11.6.

11.5 Structure and Syntax of the Device Messages

11.5.1 SCPI Introduction

SCPI (Standard Commands for Programmable Instruments) describes a standard command set for programming instruments, irrespective of the type of instrument or manufacturer. The goal of the SCPI consortium is to standardize the device-specific commands to a large extent. For this purpose, a model was developed which defines the same functions inside a device or for different devices. Command systems were generated which are assigned to these functions. Thus it is possible to address the same functions with identical commands. The command systems are of a hierarchical structure. Fig. 11-1 illustrates this tree structure using a section of command system SOURce, which operates the signal sources of the devices. The other examples concerning syntax and structure of the commands are derived from this command system.
SCPI is based on standard IEEE 488.2, i.e. it uses the same syntactic basic elements as well as the common commands defined in this standard. Part of the syntax of the device responses is defined with greater restrictions than in standard IEEE 488.2 (see Section 11.5.4, Responses to Queries).

11.5.2 Structure of a Command

The commands consist of a so-called header and, in most cases, one or more parameters. Header and parameter are separated by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). The headers may consist of several key words. Queries are formed by directly appending a question mark to the header.

Note: *The commands of the SOURCE system used in the following examples are not implemented in the CTS.*

Common commands

Common commands consist of a header preceded by an asterisk "*" and one or several parameters, if any.

Examples:	`*RST`	RESET, resets the device
	`*ESE 253`	EVENT STATUS ENABLE, sets the bits of the event status enable register
	`*ESR?`	EVENT STATUS QUERY, queries the contents of the event status register.

Device-specific commands

Hierarchy**:** Device-specific commands are of hierarchical structure (see Fig. 11-1). The different levels are represented by combined headers. Headers of the highest level (root level) have only one key word. This key word denotes a complete command system.

Example: `SOURce` This key word denotes the command system `SOURce`.

For commands of lower levels, the complete path has to be specified, starting on the left with the highest level, the individual key words being separated by a colon ":".

Example: `SOURce:FM:EXTernal:COUPling AC`

This command lies in the fourth level of the SOURce system. It sets the coupling of the external signal source to AC.

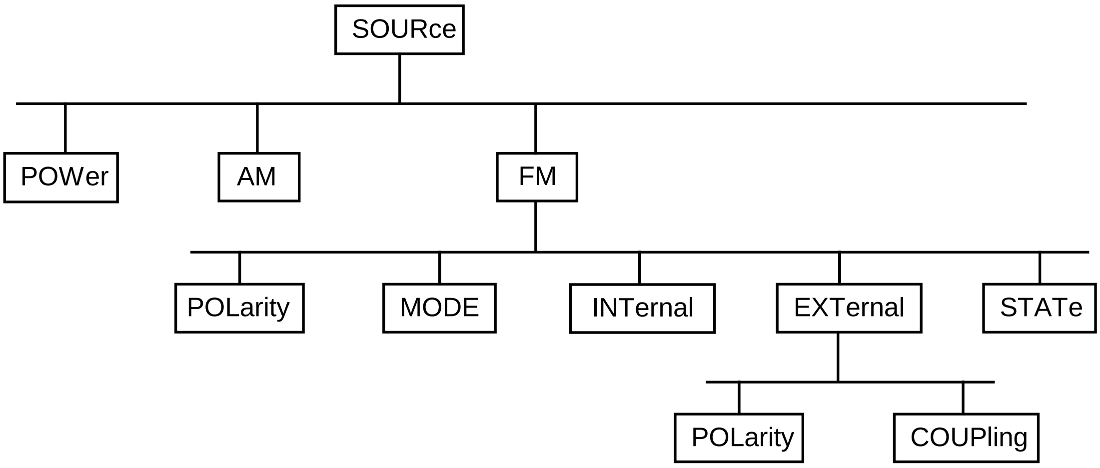


Fig. 11-1 Tree structure of the SCPI command systems using the SOURce system by way of example

Some key words occur in several levels within one command system. Their effect depends on the structure of the command, that is to say, at which position in the header of a command they are inserted.

Example: `SOURce:FM:POLarity NORMal`
This command contains key word POLarity in the third command level. It defines the polarity between modulator and modulation signal.

`SOURce:FM:EXTernal:POLarity NORMal`
This command contains key word POLarity in the fourth command level. It defines the polarity between modulation voltage and the resulting direction of the modulation only for the external signal source indicated.

Optional key words: Some command systems permit certain key words to be optionally inserted into the header or omitted. These key words are marked by square brackets in the description. The full command length must be recognized by the instrument for reasons of compatibility with the SCPI standard. Some commands are considerably shortened by these optional key words.

Example: `[SOURce]:POWer[:LEVel][:IMMediate]:OFFSet 1`
This command immediately sets the offset of the signal to 1 volt. The following command has the same effect:
`POWer:OFFSet 1`

Note: *An optional key word must not be omitted if its effect is specified in detail by a numeric suffix.*

Long and short form: The key words feature a long form and a short form. Either the short form or the long form can be entered, other abbreviations are not permissible.

Example: `STATus:QUEStionable:ENABle 1= STAT:QUES:ENAB 1`

Note: *The short form is marked by upper-case letters, the long form corresponds to the complete word. Upper-case and lower-case notation only serve the above purpose, the instrument itself does not make any difference between upper-case and lower-case letters.*

Parameter: The parameter must be separated from the header by a "white space". If several parameters are specified in a command, they are separated by a comma ",". A few queries permit the parameters MINimum, MAXimum and DEFault to be entered. For a description of the types of parameter, refer to Section 11.5.5.

Example: `SOURce:POWer:ATTenuation? MAXimum` Response: `60`
This query requests the maximal value for the attenuation.

Numeric suffix: If a device features several functions or features of the same kind, e.g. inputs, the desired function can be selected by a suffix added to the command. Entries without suffix are interpreted like entries with the suffix 1.

Example:. `SOURce:FM:EXTernal2:COUPling AC`
This command sets the coupling of the second external signal source.

11.5.3 Structure of a Command Line

A command line may consist of one or several commands. It is terminated by a <New Line>, a <New Line> with EOI or an EOI together with the last data byte. Quick BASIC automatically produces an EOI together with the last data byte.

Several commands in a command line are separated by a semicolon ";". If the next command belongs to a different command system, the semicolon is followed by a colon.

Example:
`"SOURce:POWer:CENTer MINimum;:OUTPut:ATTenuation 10"`

This command line contains two commands. The first command is part of the SOURce system and is used to specify the center frequency of the output signal. The second command is part of the OUTPut system and sets the attenuation of the output signal.

If the successive commands belong to the same system, having one or several levels in common, the command line can be abbreviated. To this end, the second command after the semicolon starts with the level that lies below the common levels (see also Fig. 11-1). The colon following the semicolon must be omitted in this case.

Example:
"SOURce:FM:MODE LOCKed;:SOURce:FM:INT:FREQuency 1kHz"

This command line is represented in its full length and contains two commands separated from each other by the semicolon. Both commands are part of the SOURce command system, subsystem FM, i.e. they have two common levels.
When abbreviating the command line, the second command begins with the level below SOURce:FM. The colon after the semicolon is omitted.

The abbreviated form of the command line reads as follows:

"SOURce:FM:MODE LOCKed;INT:FREQuency 1kHz"

However, a new command line always begins with the complete path.

Example: "SOURce:FM:MODE LOCKed"
"SOURce:FM:INT:FREQuency 1kHz"

11.5.4 Responses to Queries

A query is defined for each setting command unless explicitly specified otherwise. It is formed by adding a question mark to the associated setting command. According to SCPI, the responses to queries are partly subject to stricter rules than in standard IEEE 488.2.

1 The requested parameter is transmitted without header.
Example: `SOURce:EXTernal:COUPling?` Response: `AC`

2. Maximum values, minimum values and all further quantities, which are requested via a special text parameter are returned as numerical values.
Example: `FREQuency? MAX` Response: `10E3`

3. Numerical values are output without a unit. Physical quantities are referred to the basic units or to the units set using the Unit command.
Example: `FREQuency?` Response: `1E6` for 1 MHz

4. Truth values <Boolean values> are returned as 0 (for OFF) and 1 (for ON).
Example: `OUTPut:STATe?` Response: `1`

5. Text (character data) is returned in a short form (see also Section 11.5.5).
Example: `SOURce:FM:SOURce?` Response: `INT1`

11.5.5 Parameters

Most commands require a parameter to be specified. The parameters must be separated from the header by a "white space". Permissible parameters are numerical values, Boolean parameters, text, character strings and block data. The type of parameter required for the respective command and the permissible range of values are specified in the command description (see Section 11.6).

Numerical values

Numerical values can be entered in any form, i.e. with sign, decimal point and exponent. Values exceeding the resolution of the instrument are rounded up or down. The mantissa may comprise up to 255 characters, the exponent must lie inside the value range -32000 to 32000. The exponent is introduced by an "E" or "e". Entry of the exponent alone is not permissible. In the case of physical quantities, the unit can be entered. Permissible unit prefixes are G (giga), MA (mega), MOHM and MHZ are also permissible), K (kilo), M (milli), U (micro) and N (nano). It the unit is missing, the basic unit is used.

Example:
`SOURce:FREQuency 1.5 kHz = SOURce:FREQuency 1.5E3`

Special numerical values

The texts MINimum, MAXimum, DEFault, UP and DOWN are interpreted as special numerical values.

In the case of a query, the numerical value is provided.

Example: Setting command: `SOURce:VOLTage MAXimum`
Query: `SOURce:VOLTage?` Response: `15`

MIN/MAX — MINimum and MAXimum denote the minimum and maximum value.

DEF — DEFault denotes a preset value which has been stored in the EPROM. This value conforms to the default setting, as it is called by the *RST command

UP/DOWN — UP, DOWN increases or reduces the numerical value by one step. The step width can be specified via an allocated step command (see annex C, List of Commands) for each parameter which can be set via UP, DOWN.

INF/NINF — INFinity, Negative INFinity (NINF) Negative INFinity (NINF) represent the numerical values -9.9E37 or 9.9E37, respectively. INF and NINF are only sent as device reponses.

NAN — Not A Number (NAN) represents the value 9.91E37. NAN is only sent as device response. This value is not defined. Possible causes are the division of zero by zero, the subtraction of infinite from infinite and the representation of missing values.

Boolean Parameters

Boolean parameters represent two states. The ON state (logically true) is represented by ON or a numerical value unequal to 0. The OFF state (logically untrue) is represented by OFF or the numerical value 0. 0 or 1 is provided in a query.

Example: Setting command: `SOURce:FM:STATe ON`
Query: `SOURce:FM:STATe?` Response: `1`

Text

Text parameters observe the syntactic rules for key words, i.e. they can be entered using a short or long form. Like any parameter, they have to be separated from the header by a white space. In the case of a query, the short form of the text is provided.

Example: Setting command: `OUTPut:FILTer:TYPE EXTernal`
Query: `OUTPut:FILTer:TYPE?` Response `EXT`

Strings

Strings must always be entered in quotation marks (’ or ").

Example: `SYSTem:LANGuage "English"` or
`SYSTem:LANGuage ’English’`

Block data

Block data are a transmission format which is suitable for the transmission of large amounts of data. A command using a block data parameter has the following structure:

Example: `HEADer:HEADer #45168xxxxxxxx`

ASCII character # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. In the example the 4 following digits indicate the length to be 5168 bytes. The data bytes follow. During the transmission of these data bytes all End or other control signs are ignored until all bytes are transmitted. Data elements comprising more than one byte are transmitted with the byte being the first which was specified by SCPI command "FORMat:BORDer".

11.5.6 Overview of Syntax Elements

The following survey offers an overview of the syntax elements.

:	The colon separates the key words of a command. In a command line the colon after the separating semicolon marks the uppermost command level.
;	The semicolon separates two commands of a command line. It does not alter the path.
,	The comma separates several parameters of a command.
?	The question mark forms a query.
*	The asterix marks a common command.
"	Quotation marks introduce a string and terminate it.
#	ASCII character # introduces block data.
	A "white space (ASCII-Code 0 to 9, 11 to 32 decimal, e.g.blank) separates header and parameter.

11.6 Description of Commands

11.6.1 Notation

In the following sections, all commands implemented in the instrument are first listed in tables and then described in detail, separated according to the command system. The notation corresponds to the one of the SCPI standards to a large extent. The SCPI conformity information can be taken from the list of commands in annex C.

Note: *The commands indicated by way of example are not implemented in the CTS.*

Table of Commands

Command: In the command column, the table provides an overview of the commands and their hierarchical arrangement (see indentations).

Parameter: In the parameter column the requested parameters are indicated together with their specified range.

Unit: The unit column indicates the basic unit of the physical parameters.

Remark: In the remark column an indication is made on:
- whether the command does not have a query form,
- whether the command has only one query form ,
- whether this command is implemented only with a certain option of the instrument.

Indentations The different levels of the SCPI command hierarchy are represented in the table by means of indentations to the right. The lower the level is, the farther the indentation to the right is. Please observe that the complete notation of the command always includes the higher levels as well.

Example: `SOURce:FM:MODE` iis represented in the table as follows:

SOURce	first level
:FM	second level
:MODE	third level

In the individual description, the hierarchy is represented in the corresponding way. That is to say, for each command all key words above up to the left-hand margin must be considered. An example for each command is written out at the end of the individual description.

Upper/lower case notation Upper/lower case letters serve to mark the long or short form of the key words of a command in the description (see Section 11.5.2). The instrument itself does not distinguish between upper and lower case letters.

Special characters **|**

A selection of key words with an identical effect exists for several commands. These key words are indicated in the same line, they are separated by a vertical stroke. Only one of these key words has to be indicated in the header of the command. The effect of the command is independent of which of the key words is indicated.

Example: SOURce
:FREQuency
:CW|:FIXed

The two following commands of identical meaning can be formed. They set the frequency of the constantly frequent signal to 1 kHz:

```
SOURce:FREQuency:CW 1E3 = SOURce:FREQuency:FIXed 1E3
```

A vertical stroke in indicating the parameters marks alternative possibilities in the sense of "or". The effect of the command is different, depending on which parameter is entered.

Example: Selection of the parameters for the command
`SOURce:COUPling  AC | DC`

If parameter AC is selected, only the AC content is fed through, in the case of DC, the DC as well as the AC content.

[ ] Key words in square brackets can be omitted when composing the header (cf. Section 11.5.2, Optional Keywords). The full command length must be accepted by the instrument for reasons of compatibility with the SCPI standards.
Parameters in square brackets can optionally be incorporated in the command or omitted as well.

{ } Parameters in braces can optionally be incorporated in the command either not at all, once or several times.

11.6.2 Common Commands

The common commands are taken from the IEEE 488.2 (IEC 625-2) standard. Same commands have the same effect on different devices. The headers of these commands consist of "*" followed by three letters. Many common commands refer to the status reporting system which is described in detail in Section 11.8.

Table 11-1 Common Commands

Command	Parameter	Unit	Remark
***CLS**			no query
***ESE**	0...255		
***ESR?**			only query
***IDN?**			only query
***IST?**			only query
***OPC**			
***OPT?**			only query
***PRE**	0...255		
***PSC**	0 | 1		
***RST**			no query
***SRE**	0...255		
***STB?**			only query
***TST?**			only query
***WAI**			

***CLS**

CLEAR STATUS sets the status byte (STB), the standard event register (ESR) and the EVENt-part of the QUEStionable and the OPERation register to zero. The command does not alter the mask and transition parts of the registers. It clears the output buffer.

***ESE** 0...255

EVENT STATUS ENABLE sets the event status enable register to the value indicated. Query *ESE? returns the contents of the event status enable register in decimal form.

***ESR?**

STANDARD EVENT STATUS QUERY returns the contents of the event status register in decimal form (0 to 255) and subsequently sets the register to zero.

***IDN?**

IDENTIFICATION QUERY queries the instrument identification.
The device response is for example:

ROHDE&SCHWARZ,CTSzz,ssssss/sss,x.xx yy.yy.yy
(zz is the model no., eg 55 or 65
ssssss/sss is the serial no., eg 101183/005
x.xx is the software version, eg V 1.00
yy.yy.yy is the date, eg 18.10.93)

***IST?**

INDIVIDUAL STATUS QUERY returns the contents of the IST flag in decimal form (0 | 1). The IST-flag is the status bit which is sent during a parallel poll.

***OPC**

OPERATION COMPLETE sets bit 0 in the event status register when all preceding commands have been executed. This bit can be used to initiate a service request (cf. Section 11.7).

***OPC?**

OPERATION COMPLETE QUERY writes message "1" into the output buffer as soon as all preceding commands have been executed (cf. Section 11.7).

***OPT?**

OPTION IDENTIFICATION QUERY queries the options included in the instrument and returns a list of the options installed. The options are separated from each other by means of commas.

The responses have the following meaning:

B1	OCXO Reference
B7	Module Test
K6	Remote Control

Example of a device response: B1,,B7,,K6

***PRE 0...255**

PARALLEL POLL REGISTER ENABLE sets parallel poll enable register to the value indicated. Query *PRE? returns the contents of the parallel poll enable register in decimal form.

***PSC** 0 **|** 1

POWER ON STATUS CLEAR determines whether the contents of the ENABle registers is maintained or reset in switching on.

*PSC = 0 causes the contents of the status registers to be maintained. Thus a service request can be triggered in switching on in the case of a corresponding configuration of status registers ESE and SRE.

*PSC $\neq$ 0 resets the registers.

Query *PSC? reads out the contents of the power-on-status-clear flag. The response can be 0 or 1.

***RST**

RESET sets the instrument to a defined default status. The command essentially corresponds to pressing the [RESET] key. The default setting is indicated in the description of commands.

***SRE** 0...255

SERVICE REQUEST ENABLE sets the service request enable register to the value indicated. Bit 6 (MSS mask bit) remains 0. This command determines under which conditions a service request is triggered. Query *SRE? reads the contents of the service request enable register in decimal form. Bit 6 is always 0.

***STB?**

READ STATUS BYTE QUERY reads the contents of the status byte in decimal form.

***TST?**

SELF TEST QUERY triggers selftests of the instrument and outputs an error code in decimal form.

WAI

WAIT-to-CONTINUE only permits the servicing of the subsequent commands after all preceding commands have been executed and all signals have settled (see also section 11.7 and "*OPC").

11.7 Instrument Model and Command Processing

The instrument model shown in Fig. 11-2 has been made viewed from the standpoint of the servicing of remote-control commands. The individual components work independently of each other and simultaneously. They communicate by means of so-called "messages".

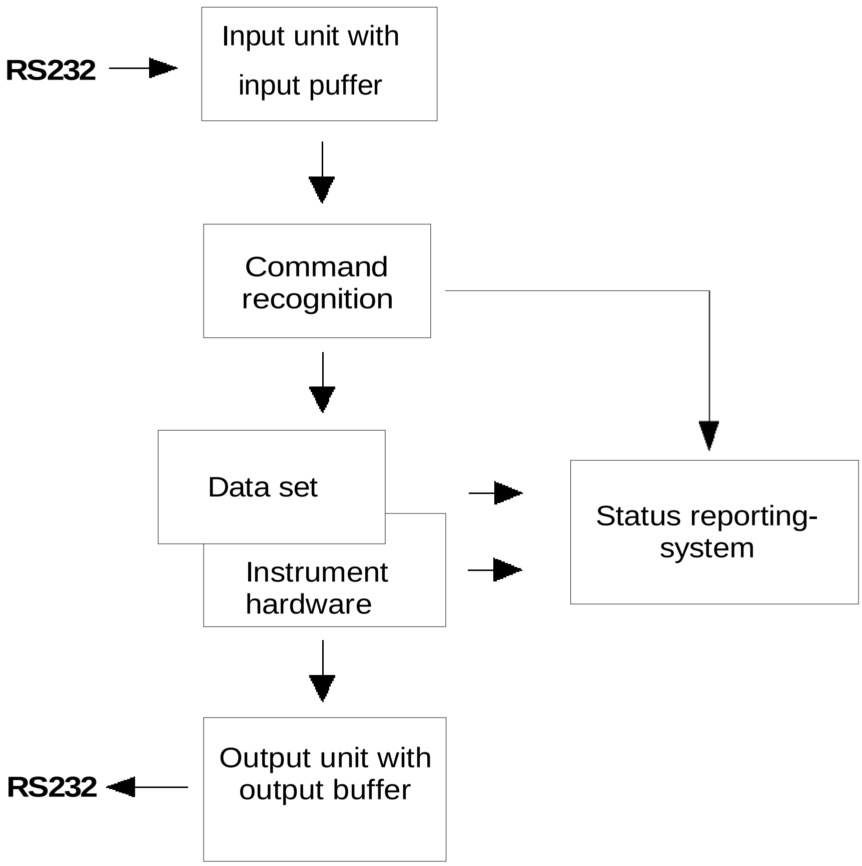


Fig. 11-2 Instrument model in the case of remote control

11.8 Status Reporting System

The status reporting system (cf. Fig. 11-4) stores all information on the present operating state of the instrument and on errors which have occurred. This information is stored in the status registers and in the error queue. The status registers and the error queue can be queried via the remote-control interface.

The information is of a hierarchical structure. The register status byte (STB) defined in IEEE 488.2 and its associated mask register service request enable (SRE) form the uppermost level. The STB receives its information from the standard event status register (ESR) which is also defined in IEEE 488.2 with the associated mask register standard event status enable (ESE) and registers STATus:OPERation and STATus:QUEStionable which are defined by SCPI and contain detailed information on the instrument.

The IST flag ("Individual STatus") and the parallel poll enable register (PPE) allocated to it are also part of the status reporting system. The IST flag, like the SRQ, combines the entire instrument status in a single bit. The PPE fulfills an analog function for the IST flag as the SRE for the service request.

The output buffer contains the messages the instrument returns to the controller. It is not part of the status reporting system but determines the value of the MAV bit in the STB and thus is represented in Fig. 11-4.

11.8.1 Structure of an SCPI Status Register

Each SCPI register consists of 5 parts which each have a width of 16 bits and have different functions (cf. Fig. 11-3). The individual bits are independent of each other, i.e. each hardware status is assigned a bit number which is valid for all five parts. For example, bit 3 of the STATus:OPERation register is assigned to the hardware status "wait for trigger" in all five parts. Bit 15 (the most significant bit) is set to zero for all parts. Thus the contents of the register parts can be processed by the controller as positive integer.

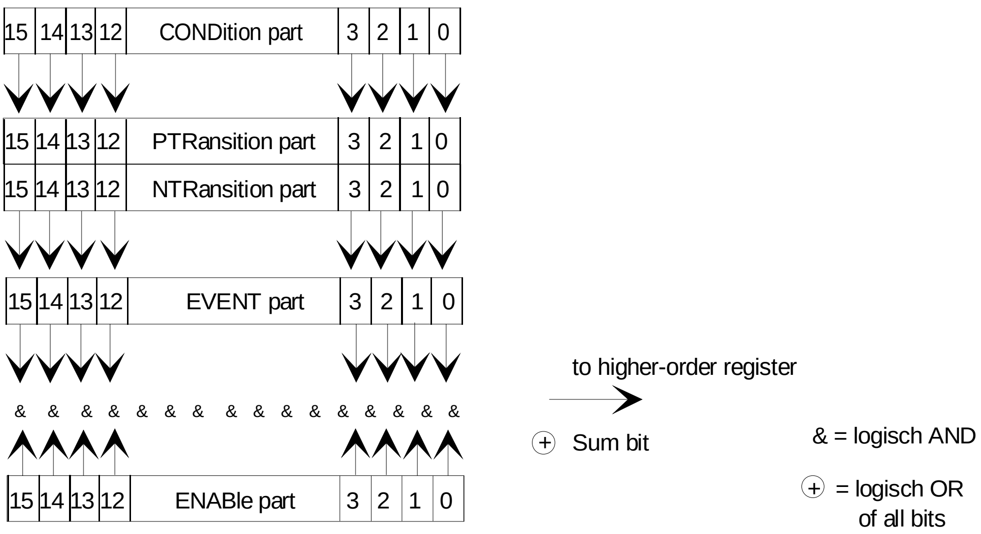


Fig. 11-3 The status-register model

CONDition part The CONDition part is directly written into by the hardware or the sum bit of the next lower register. Its contents reflects the current instrument status. This register part can only be read, but not written into or cleared. Its contents is not affected by reading.

PTRansition part The Positive-TRansition part acts as an edge detector. When a bit of the CONDition part is changed from 0 to 1, the associated PTR bit decides whether the EVENt bit is set to 1.
PTR bit =1: the EVENt bit is set.
PTR bit =0: the EVENt bit is not set.
This part can be written into and read at will. Its contents is not affected by reading.

NTRansition part The Negative-TRansition part also acts as an edge detector. When a bit of the CONDition part is changed from 1 to 0, the associated NTR bit decides whether the EVENt bit is set to 1.
NTR-Bit = 1: the EVENt bit is set.
NTR-Bit = 0: the EVENt bit is not set.
This part can be written into and read at will. Its contents is not affected by reading.

With these two edge register parts the user can define which state transition of the condition part (none, 0 to 1, 1 to 0 or both) is stored in the EVENt part.

EVENt part The EVENt part indicates whether an event has occurred since the last reading, it is the "memory" of the condition part. It only indicates events passed on by the edge filters. It is permanently updated by the instrument. This part can only be read by the user. During reading, its contents is set to zero. In linguistic usage this part is often equated with the entire register.

ENABle part The ENABle part determines whether the associated EVENt bit contributes to the sum bit (cf. below). Each bit of the EVENt part is ANDed with the associated ENABle bit (symbol ’&’). The results of all logical operations of this part are passed on to the sum bit via an OR function (symbol ’+’).
ENAB-Bit = 1: the associated EVENt bit does not contribute to the sum bit
ENAB-Bit = 0: if the associated EVENT bit is "1", the sum bit is set to "1" as well.
This part can be written into and read by the user at will. Its contents is not affected by reading.

Sum bit As indicated above, the sum bit is obtained from the EVENt and ENABle part for each register. The result is then entered into a bit of the CONDition part of the higher-order register.
The instrument automatically generates the sum bit for each register. Thus an event, e.g. a PLL that has not locked, can lead to a service request throughout all levels of the hierarchy.

Note: *The service request enable register SRE defined in IEEE 488.2 can be taken as ENABle part of the STB if the STB is structured according to SCPI. By analogy, the ESE can be taken as the ENABle part of the ESR.*

11.8.2 Overview of the Status Registers

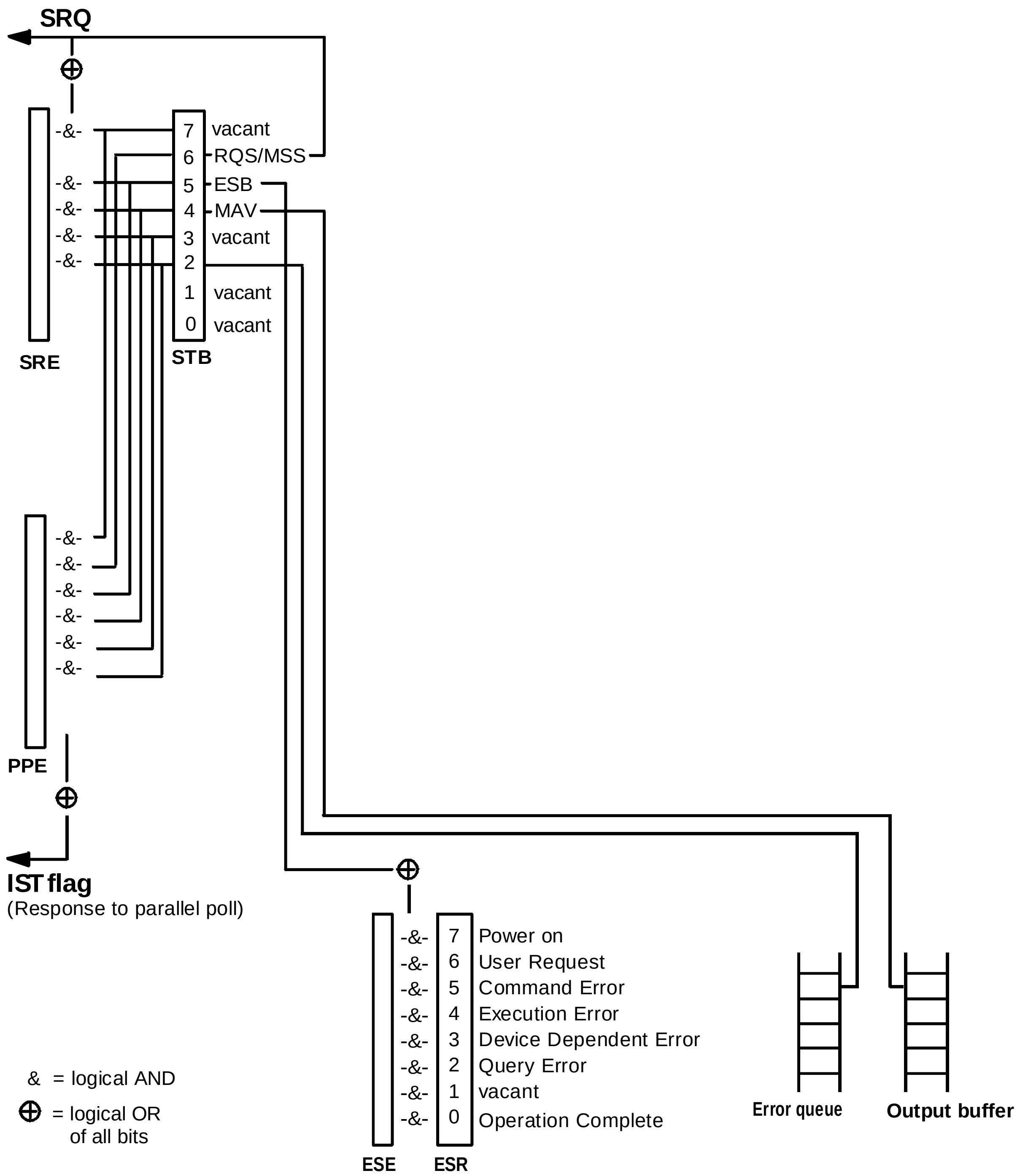


Fig. 11-4 Overview of status registers

11.8.3 Description of the Status Registers

11.8.3.1 Status Byte (STB) and Service Request Enable Register (SRE)

The STB is already defined in IEEE 488.2. It provides a rough overview of the instrument status by collecting the pieces of information of the lower registers. It can thus be compared with the CONDition part of an SCPI register and assumes the highest level within the SCPI hierarchy. A special feature is that bit 6 acts as the sum bit of the remaining bits of the status byte.
The STATUS BYTE is read out using the command "*STB?".

Table 11-2 Meaning of the bits used in the satus byte

Bit No.	Meaning
2	**Error Queue not empty** The bit is set when an entry is made in the error queue. If this bit is enabled by the SRE, each entry of the error queue generates a Service Request. Thus an error can be recognized and specified in greater detail by polling the error queue. The poll provides an informative error message. This procedure is to be recommended since it considerably reduces the problems involved with remote control.
4	**MAV bit** (message available) The bit is set if a message is available in the output buffer which can be read. This bit can be used to enable data to be automatically read from the instrument to the controller.
5	**ESB bit** Sum bit of the event status register. It is set if one of the bits in the event status register is set and enabled in the event status enable register. Setting of this bit implies a serious error which can be specified in greater detail by polling the event status register.
6	**MSS bit** (master status smmary bit) The bit is set if the instrument triggers a service request. This is the case if one of the other bits of this registers is set together with its mask bit in the service request enable register SRE.

11.8.3.2 Event-Status-Reg. (ESR) and Event-Status-Enable-Reg. (ESE)

The ESR is already defined in IEEE 488.2. It can be compared with the EVENt part of an SCPI register. The event status register can be read out using command "*ESR?".
The ESE is the associated ENABle part. It can be set using command "*ESE" and read using command "*ESE?".

Table 11-3 Meaning of the bits used in the event status register

Bit No.	Meaning
0	**Operation Complete** This bit is set on reception of the command *OPC exactly when all previous commands have been executed.
2	**Query Error** This bit is set if either the controller wants to read data from the instrument without having sent a query, or if it does not fetch requested data and sends new instructions to the instrument instead. The cause is often a query which is faulty and hence cannot be executed.
3	**Device-dependent Error** This bit is set if a device-dependent error occurs. An error message with a number between -300 and -399 or a positive error number, which denotes the error in greater detail, is entered into the error queue (cf. annex B, Error Messages).
4	**Execution Error** This bit is set if a received command is syntactically correct, however, cannot be performed for other reasons. An error message with a number between -200 and -300, which denotes the error in greater detail, is entered into the error queue (cf. annex B, Error Messages).
5	**Command Error** This bit is set if a command which is undefined or syntactically incorrect is received. An error message with a number between -100 and -200, which denotes the error in greater detail, is entered into the rror queue (cf. annex B, -Error Messages).
6	**User Request** This bit is set on pressing the LOCAL key, i. e., when the instrument is switched over to manual control.
7	**Power On** (supply voltage on) This bit is set on switching on the instrument.

11.8.4 Error-Queue Query

Each error state in the instrument leads to an entry in the error queue. The entries of the error queue are detailed plain-text error messages which can be queried via the remote control using command "SYSTem:ERRor?". Each call of "SYSTem:ERRor?" provides an entry from the error queue. If no error messages are stored there any more, the instrument responds with 0, "No error".

The error queue should be queried after every SRQ in the controller program as the entries describe the cause of an error more precisely than the status registers. Especially in the test phase of a controller program the error queue should be queried regularly since faulty commands from the controller to the instrument are recorded there as well.

11.8.5 Resetting Values of the Status Reporting System

Table 11-5 comprises the different commands and events causing the status reporting system to be reset. None of the commands, except for *RST and SYSTem:PRESet influences the functional instrument settings. In particular, DCL does not change the instrument settings.

Table 11-5 Resettting instrument functions

Event / **Effect**	**Switching on supply voltage**		***RST or SYSTem:PRESet**	**STATus:PRESet**	***CLS**
	Power-On-Status-Clear				
	0	**1**			
Clear STB,ESR	—	yes	—	—	yes
Clear ESE	—	yes	—	—	—
Clear EVENTt parts of the registers	—	yes	—	—	yes
Clear error queue	yes	yes	—	—	yes
Clear output buffer	yes	yes	1)	1)	1)
Clear command processing and input buffer	yes	yes	—	—	yes

1) Every command being the first in a command line, i.e., immediately following a <PROGRAM MESSAGE TERMINATOR> clears the output buffer.

11.9 Examples

Example 1: Call to a mobile phone with measurements

Send the following commands to the CTS via a terminal program:

Command	Comment
procedure:select?	
procedure:select MANUAL	selects the Manual Test
procedure:select?	
procedure:call:toms	Call to Mobile
procedure:select?	
procedure:set:arfcn 60	set RF frequency to chan 60 (902 MHz uplink)
procedure:set:power:ms 10	set mobile to PowerControlLevel = 10
procedure:set:arfcn?	
procedure:set:power:ms?	
read:ber:clib?	BER measurement
read:ber:clib:rber?	
read:array:burst:power?	Burst Power measurement (Power time template)
read:burst:phase:error:rms?	measurement phase error rms
read:burst:phase:error:peak?	measurement phase error peak
read:burst:frequency:error?	measurement frequency error
read:burst:timing:error?	measurement burst timing error
procedure:select?	
procedure:set:arfcn 70	change to channel 70 (904 MHz)
procedure:set:power:ms 14	change to PCL = 14 (15 dBm)
procedure:set:arfcn?	
procedure:set:power:ms?	
read:ber:clib?	Do the same measurement as above
read:ber:clib:rber?	
read:array:burst:power?	
read:burst:phase:error:rms?	
read:burst:phase:error:peak?	
read:burst:frequency:error?	
read:burst:timing:error?	
procedure:release:toms	Release Call
procedure:select?	
procedure:select NONE	
procedure:select?	

Example 2: Set RF generator in Module Test

Send the following commands to the CTS via a terminal program

Command	Comment
proc:sel modidle	go to state "MODIDLE"
proc:sel iqspec	select IQ Spectrum
proc:sel rfg	select rf generator
conf:rfg:freq 950 MHz	set rfg to 950 MHz
conf:rfg:pow -60 dBm	set rf level at RFINOUT
conf:rfg:lev on	and switch it on
conf:rfg:freq:off 67 kHz	set frequency offset
conf:rfg:dm:form 0	set midamble (training sequence) = 0
conf:rfg:dm:mode dummy	modulation = dummy bursts
conf:rfg:ramp:stat on	set ramping = on

Use a spectrum analyzer to check the output signal at connector RFINOUT.
(center = 950 MHz, span = 1 MHz, Reflev = -60 dBm)

12 Software Options

12.1 Overview

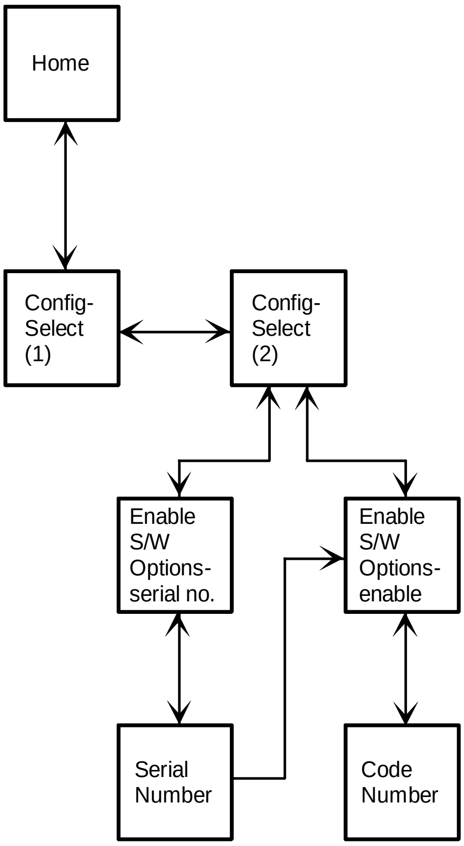
Software options is a way of turning on extra facilities of the CTS via the softkeys. An option can be enabled either permanently or for a limited period of time.

To use software options, two pieces of information are required, these being the CTS's serial number and a code number for the required software option. When this information is entered the option will be enabled.

To enter this numbers an external keyboard is recommended.

12.2 Menu hierarchy

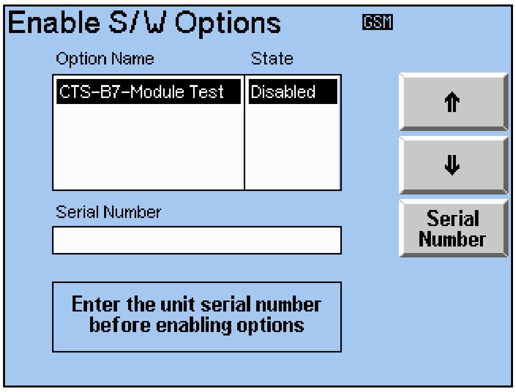
The diagram below shows the menu structure of Software Options, which is in addition to the standard menus on the CTS.



The menu entered is dependant on whether the serial number is available or not.

12.3 Setting the Serial Number

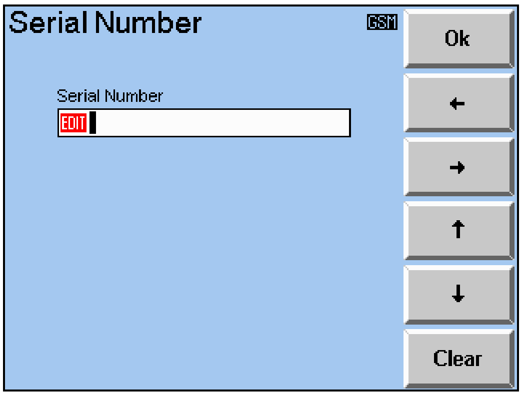
To set the serial number, firstly enter the "Enable S/W Options" menu via the main configuration menu.



Enable S/W Options Menu

The serial number is normally entered into the CTS on the production line and can be seen on the "Enable S/W Options" menu. If this is not the case there will be a softkey labelled "Serial Number" present. There is no need to enter the serial number again if it is already set.

To enter the serial number, press the "Serial Number" softkey which will move the system into the "Serial Number" menu.



Serial Number Menu

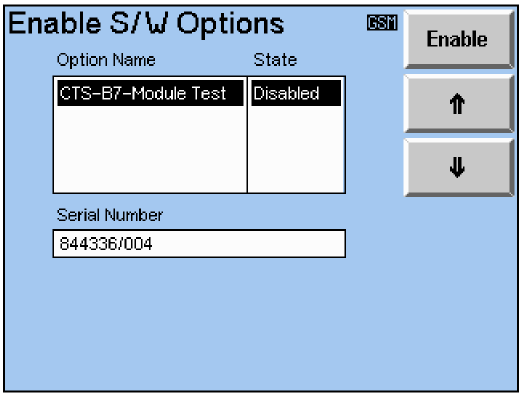
The serial number can be found on the rear panel of the CTS and uses the format of <xxxxxx/xxx>, for example <123456/789>. Enter this serial number using the softkeys. If the format of the entered serial number is wrong you will be informed via a message.

Important: The serial number can only be entered once and thereafter cannot be edited.

12.4 Setting the Code Number to enable an option

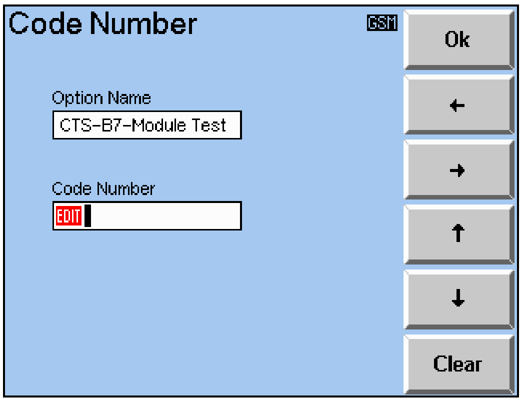
First enter the "Enable S/W Options" menu via the main configuration menu. If you have just set the serial number you will already be in this menu.

If the serial number is available then it will be shown on the menu, as below. If it is not available then you must enter it as described in section 12.3.



Enable S/W Options Menu (Test Disabled)

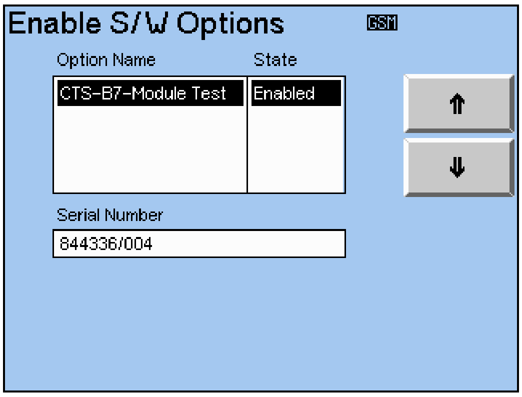
Choose the software option you want to enable using the arrow softkeys. Press the "Enable" button to enter the "Code Number" menu for that particular option.



Code Number Menu

The code number required can be obtained from your local Rohde & Schwarz sales office. The number supplied should be entered via the softkeys.

Once the code number has been successfully entered, the state of the option will be "Enabled" in the "Enable S/W Options" menu and the "Enable" button will disappear.



Enable S/W Options Menu (Test Enabled)

The new option is now available for use. If the option has been enabled for a limited period of time the option will disappear from use after the time period has elapsed.

13 Performance Test (with Service Software)

13.1 Starting the Program

- Booting in DOS:
  All service programs of CTS are only accessible under DOS. Since only part of the VGA picture is displayed on the internal LCD, an external VGA-compatible monitor has to be connected to the rear SERVICE connector before booting. An external keyboard must be connected to the CTS to enter the DOS level. After switching on the CTS, a short tone and then three short tones are heard. The keys <Alt>, <Control> and <E> must now be pressed within 1.5 seconds. Make sure not to press the key <E> before the two other keys have been pressed.

  Once the controller startup is completed, the DOS prompt is displayed on the external monitor.

  If switchover fails, switch off the CTS and repeat the procedure.

  Note:
  Files must not be modified or deleted. This would impair compliance with specifications and proper functioning of the CTS.

  SW_CRT or SW_LCD switches between external monitor and LC display.

- Change directory: cd \service <ENTER>.
- Call performance test program: check <ENTER>.

13.2 Operating the Program

The program can only be operated with the aid of an external PC keyboard. The key of the external keyboard is represented similar to a softkey and given in brackets "<>". The default key has a double margin; it can be selected with any unused key, eg <SPACE> or <ENTER>. The running test or the program can be aborted with the <ESC> key of the external keyboard.

Following the start messages the CTS status is displayed. Check whether the instrument model and all options fitted have been correctly identified.

After confirmation, the test selection menu is displayed. For selecting a menu item, position the cursor next to the desired menu item using the <Cursor up>, <Cursor down>, <Page up> and <Page down> keys, and press the <ENTER> key.

When a test point is entered it is assumed that no external measuring instrument is connected.

After a test has been selected, the user is prompted step by step through the various actions, such as:

Connecting external measuring instruments to the CTS, settings and measurements on the test equipment as well as reading CTS-internal measurement results.

When the requested action is completed, the test run is continued by pressing the default key. With a number of measurements the current or the preceding measurement can be repeated or the subsequent measurement skipped.

Some instructions are output together with additional information to simplify troubleshooting.

The program is left by switching off the instrument.

13.3 Tests To Be Performed

The test selection menu is divided into two sections:

Adjustments
Here not only adjustments are performed but also checks of the internal diagnosis facility. For some of the diagnostic voltages no trimming facility is provided. If one of these voltages is out of tolerance, the module must be replaced.

Trimming points and rated values at the corresponding test points are displayed.

Performance test
A comprehensive performance test of the CTS includes all selectable items of the test selection menu of the performance test.

In addition, a comprehensive mobile test has to be performed by means of the user software.

13.4 Remote Control of Performance Test Program

The performance test program allows not only manual checking of test points, it can also be remote-controlled via an RS-232 interface. In this case the whole hardware-supported level and frequency range can be tested. Signalling is not possible however.

Remote control is only possible under the menu item "Remote control". To simplify sequence generation, commands can also be entered via the AT keyboard and confirmed with <ENTER>. Remember, however, that keyboard entries disable RS-232 transmission which can be enabled again with the <ENTER> key. A "hung-up" RS-232 system may also be unblocked by means of the <ENTER> key.

The remote-control mode is terminated with the 'end' command (see list of commands).

13.4.1 Hardware

A null-modem cable with hardware handshake is used. The baud rate can be set with command line parameter [-bx] with x being the baud rate, eg -b4800. Rates above 9600 baud are not recommended.

13.4.2 Command syntax

The command structure is similar to that of IEEE-bus control. A command consists of a command string and, where applicable, a parameter. No difference is made between upper- and lower-case characters. Command string and parameter are separated by at least one space (20hex), the command is terminated by a carriage return (0Dhex).

Parameters in <> brackets are given as numeric values without a unit.

Numeric format: with or without decimal point, with or without exponent.

Example: 800 800.0 8.0e2 8.e2

Code words used as a parameter: code words are preset and cannot be changed.

Example: off on auto

The response consists of a string beginning with OK or ERROR. Further characters are added after a space, the whole string is terminated by a carriage return (0Dhex).

Basically, an additional string **may** be added to ERROR for detailed error description.

Measurement commands: the OK is followed by a numeric value without unit, which is the measurement result.

Numeric format: see input parameters.

Note: ERROR messages are also possible.

Responses (examples):

OK	OK 12.0
ERROR	ERROR COMMAND INVALID

ERROR strings implemented at present:

COMMAND INVALID	Command not found
COMMAND PARAMETER INVALID	Command found, but parameter invalid or wrong format
COMMAND LENGTH INVALID	Invalid characters or command string too short/long
PARAMETER RANGE INVALID	Invalid numeric value (too high/low)
PARAMETER CODE INVALID	Invalid code word
PARAMETER INCREMENT INVALID	Parameter increment must be observed
MEASUREMENT TIMEOUT	Measurement too long
MEASUREMENT INVALID	Measurement result not plausible/valid
OPTION NOT AVAILABLE	Wrong instrument/option not available
HARDWARE SETTING	Hardware settings not possible

13.4.3 Command types

There are three types of commands:

- **put** commands do **not** set the hardware, they only transfer data.
- **set** commands set the hardware.
- **meas** commands perform a measurement and return the result.

Relationship between 'put' and 'set' commands:

Data transferred by means of a put command remain valid until they are overwritten. Data are not defined prior to their first use.

Example: setting sequence for measuring the output level

```
put:s1:burst cw
put:s1:freqoff 67014
put:s1:mod off
put:s1:freq 925.2e6
put:s1:lev -50
set:s1
--- measure level ---
put:s1:freq 945.0e6
set:s1
--- measure level ---
put_s1:freq 959.8e6
set:s1
--- measure level ---
put:s1:freq 945.0e6
put:s1:lev -75
set:s1
--- measure level ---
etc
```

Example: setting sequence for measurement of input power

```
put:rx:freq 900e6
put:rx:lev 10          ; expected power
set:rx                 ; sets the local TX synthesizer and the input path
meas:pow               ; power measurement
etc
```

Example: setting sequence for diagnosis voltages

```
put:diag qpll
set:diag
meas:diag              ; measurement of control voltage of reference frequency PLL
put:s1:freq 950e6
set:s1                 ; sets TX synthesizer to 950 MHz
put:diag txpll
set:diag
meas:diag              ; measurement of control voltage of TX synthesizer PLL
etc
```

13.4.4 Special functions, device interdependencies

- reset: The hardware is set to a state where it is least like to be affected. The output level is switched off and the attenuation on the receive path set to maximum to minimize the effect of the local synthesizer.

- diag:

- diag:	qpll	control voltage of reference frequency PLL
	txpll	control voltage of TX synthesizer PLL
	rxpll	control voltage of RX synthesizer PLL
	detlev	detector voltage for level control loop
	setlev	setting voltage for level control loop
	temp	thermal voltage
	highpow	power measurement (high level)
	lowpow	power measurement (low level)

13.4.5 Command Overview (GSM Performance Test)

<table>
<tr><th>Command</th><th>GSM</th><th>Value range</th><th>Response</th></tr>
<tr><td>put:s1:freq <Frequency in Hz></td><td>x</td><td>895 to 1000 MHz, 1790 to 2000 MHz, step 0.2 MHz</td><td>(OK | ERROR [<error string>])</td></tr>
<tr><td>put:s1:lev (<Level in dBm>)</td><td>x</td><td>-110 to -50 dBm, step 0.1 dB</td><td>(OK | ERROR [<error string>])</td></tr>
<tr><td>put:s1:lev (off)</td><td>x</td><td>off</td><td>(OK | ERROR [<error string>])</td></tr>
<tr><td>put:s1:lev:unused (<Level in dBm>)</td><td>x</td><td>-110 to -50 dBm, step 0.1 dB, valid with burst only</td><td>(OK | ERROR [<error string>])</td></tr>
<tr><td>put:s1:lev:unused (off)</td><td>x</td><td>off, valid with burst only</td><td>(OK | ERROR [<error string>])</td></tr>
<tr><td>put:s1:mod (off | dummy)</td><td>x</td><td>off: CW; dummy: dummy burst with midamble 0</td><td>(OK | ERROR [<error string>])</td></tr>
<tr><td>put:s1:freqoff <Frequency offset in Hz></td><td>x</td><td>-100008 to +100008 Hz, step 33.06071 Hz</td><td>(OK | ERROR [<error string>])</td></tr>
<tr><td>put:s1:burst (cw | burst)</td><td>x</td><td>cw: no burst shaping, burst: unused, see above</td><td>(OK | ERROR [<error string>])</td></tr>
<tr><td>set:s1</td><td>x</td><td>-</td><td>(OK | ERROR [<error string>])</td></tr>
<tr><td>put:rx:freq <Frequency in Hz></td><td>x</td><td>872 to 987 MHz, 1692 to 1920 MHz, step 0.2 MHz</td><td>(OK | ERROR [<error string>])</td></tr>
<tr><td>put:rx:lev <Level in dBm></td><td>x</td><td>-15 to +45 dBm, step 0.1 dB</td><td>(OK | ERROR [<error string>])</td></tr>
<tr><td>set:rx</td><td>x</td><td>-</td><td>(OK | ERROR [<error string>])</td></tr>
<tr><td>put:pow (diode | log)</td><td>x</td><td>diode: diode (wide); log: log amp (narrow)</td><td>(OK | ERROR [<error string>])</td></tr>
<tr><td>set:pow</td><td>x</td><td>-</td><td>(OK | ERROR [<error string>])</td></tr>
<tr><td>meas:pow</td><td>x</td><td>-20 to 48 dBm, step 0.1 dB</td><td>(OK Level in dBm | ERROR [<error string>])</td></tr>
<tr><td>put:diag (qpll | txpll | rxpll | detlev | setlev | temp | highpow | lowpow)</td><td>x</td><td>see above</td><td>(OK | ERROR [<error string>])</td></tr>
<tr><td>set:diag</td><td>x</td><td>-</td><td>(OK | ERROR [<error string>])</td></tr>
<tr><td>meas:diag</td><td>x</td><td>-2.5 to +2.5 V, step 1 mV</td><td>(OK Voltage in V | ERROR [<error string>])</td></tr>
<tr><td>meas:iq:gain:i</td><td>x</td><td>0 to 100%, step 0.01%</td><td>(OK Voltage in % | ERROR [<error string>])</td></tr>
<tr><td>meas:iq:gain:q</td><td>x</td><td>0 to 100%, step 0.01%</td><td>(OK Voltage in % | ERROR [<error string>])</td></tr>
<tr><td>meas:iq:offset:i</td><td>x</td><td>-100 to 100%, step 0.01%</td><td>(OK Voltage in % | ERROR [<error string>])</td></tr>
<tr><td>meas:iq:offset:q</td><td>x</td><td>-100 to 100%, step 0.01%</td><td>(OK Voltage in % | ERROR [<error string>])</td></tr>
<tr><td>meas:iq:quad</td><td>x</td><td>0 to 180°, step 0.01°</td><td>(OK Orthogonality in ° | ERROR [<error string>])</td></tr>
<tr><td>meas:phaserr:peak</td><td>x</td><td>-25 to +25°, step 0.1°</td><td>(OK Peak phase error in ° | ERROR [<error string>])</td></tr>
<tr><td>meas:phaserr:rms</td><td>x</td><td>-25 to +25°, step 0.1°</td><td>(OK Av. phase error in ° | ERROR [<error string>])</td></tr>
<tr><td>meas:freqerr</td><td>x</td><td>-1000 to +1000 Hz, step 0.1 Hz</td><td>(OK Frequency error in kHz | ERROR [<error string>])</td></tr>
<tr><td>put:ref (tcxo | ocxo)</td><td>B1</td><td>tcxo: TCXO; ocxo: OCXO</td><td>(OK | ERROR [<error string>])</td></tr>
<tr><td>set:ref</td><td>B1</td><td>-</td><td>(OK | ERROR [<error string>])</td></tr>
<tr><td>reset</td><td>x</td><td>-</td><td>(OK | ERROR [<error string>])</td></tr>
<tr><td>end</td><td>x</td><td>Terminates remote-control mode</td><td>OK</td></tr>
</table>

Serial Interface

The instrument is equipped with a serial interface (RS-232-C) as standard. The 9-pin connector is located at the rear of the instrument. A controller for remote control can be connected via the interface. The connection is effected using a zero modem cable.

For remote control via the serial interface, an important aspect is to be noted:
Some controllers already send characters on the serial interface during booting, causing the instrument to switch to the REMOTE state as soon as it receives these characters (since no explicit addressing is possible with the serial remote control).

Characteristics of the Interface

- serial data transfer
- bidirectional data transfer
- Data transfer rate 9600 baud
- Possible length of connecting cable > 20 m
- Parameters: 9600, N, 8, 1
  XON/XOFF handshake

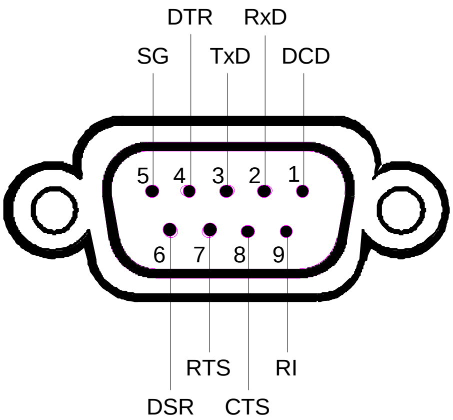


Fig. A3-1 RS232 interface

Designation		Pin (9-pin)	Pin (25-pin)
Data Carrier Detect	DCD	1	8
Receive Data	RxD	2	3
Transmit Data	TxD	3	2
Data Terminal Ready	DTR	4	20
Signal Ground	SG	5	7
Data Set Ready	DSR	6	6
Request To Send	RTS	7	4
Clear To Send	CTS	8	5
Ring Indicator	RI	9	21

Lines

1. Data lines

RxD (receive data) and **TxD** (transmit data)
The transmission is bit-serial in the ASCII code starting with the LSB.
The two lines are necessary as the minimum requirement for a transmission; however, no hardware handshake is possible, but only the XON/XOFF protocol.

2. Control lines

DCD (Data Carrier Detect),
active LOW.
Input; using this signal, the data terminal recognizes that the modem of the remote station receives valid signals with sufficient level. DCD is used to disable the receiver in the data terminal and prevent reading of false data if the modem cannot interpret the signals of the remote station.

DTR (Data Terminal Ready),
active LOW,
Output indicating that the data terminal is ready to receive data.

DSR (Data Set Ready),
active LOW,
Input indicating that the external device is ready to receive data.

RTS (Request To Send),
active LOW.
Output that can be used to indicate the readiness to receive data.

CTS (Clear To Send),
active LOW.
Input used to enable the transmission of data.

RI (Ring Indicator),
active LOW.
Input; RI is used by a modem to indicate that a remote station wants to set up a connection.

Default settings

The serial interface is set to the following values:

Table A3-1 Default setting

Parameter	**Setting value**
Baud rate	9600 baud
Data bits	8 bits
Stop bits	1 bits
Parity	none

Handshake

Software handshake

In the case of the software handshake, the data transfer is controlled using the two control characters XON / XOFF.
The CTS uses the control character XON to indicate that it is ready to receive data.
If the receive buffer is full, it sends the XOFF character via the interface to the controller. The controller then interrupts the data output until it receives another XON from the CTS.
The controller indicates to the CTS that it is ready to receive data in the same way.

Cable for local controller coupling in the case of software handshake

The connection of the CTS with a controller in the case of software handshake is effected by crossing the data lines. The following wiring diagram applies to a controller with 9-pin or 25-pin configuration.

CTS 9-pin		Controller 9-pin
1		1
2	------------RxD / TxD---------------	3
3	------------TxD / RxD---------------	2
4		6
5	------------GND / GND-------------	5
6		4
7		8
8		7
9		9

CTS 9-pin		Controller 25-pin
1		8
2	------------RxD / TxD---------------	2
3	------------TxD / RxD---------------	3
4		6
5	------------GND / GND-------------	7
6		20
7		5
8		4
9		22

Fig. A3-2 Wiring of the data lines for software handshake

Hardware handshake

In the case of the hardware handshake, the CTS indicates that it is ready to receive data via the lines DTR and RTS. A logic '0' on both lines means "ready" and a logic '1' means "not ready". The RTS line is always active (logic '0') as long as the serial interface is switched on. The DTR line thus controls the readiness of the CTS to receive data.

The readiness of the remote station to receive data is reported to the CTS via the CTS and DSR line. A logic '0' on both lines activates the data output and a logic '1' on both lines stops the data output of the CTS. The data output is effected via the TxD line.

Cable for local controller coupling in the case of hardware handshake

The connection of the CTS to a controller is effected with a so-called zero modem cable. In the case of this cable, the data, control and report lines must be crossed. The following wiring diagram applies to a controller with 9-pin or 25-pin configuration.

CTS 9-pin		Controller 9-pin
1		1
2	------------RxD / TxD---------------	3
3	------------TxD / RxD---------------	2
4	------------DTR /DSR--------------	6
5	------------GND / GND-------------	5
6	------------DSR / DTR--------------	4
7	------------RTS / CTS--------------	8
8	------------CTS / RTS--------------	7
9		9

CTS 9-pin		Controller 25-pin
1		8
2	------------RxD / TxD---------------	2
3	------------TxD / RxD---------------	3
4	------------DTR /DSR--------------	6
5	------------GND / GND-------------	7
6	------------DSR / DTR--------------	20
7	------------RTS / CTS--------------	5
8	------------CTS / RTS--------------	4
9		22

Fig. A3-3 Wiring of the data, control and report lines for hardware handshake

List of Error Messages

The following list contains all error messages for errors occurring in the instrument. The meaning of negative error codes is defined in SCPI, positive error codes mark errors specific of the instrument.

The table contains the error code in the left-hand column. In the right-hand column the error text being entered into the error/event queue or being displayed is printed in bold face. Below the error text, there is an explanation as to the respective error.

SCPI-Specific Error Messages

No Error

Error code	**Error text in the case of queue poll** Error explanation
0	**No error** This message is output if the error queue does not contain any entries.

Command Error - Faulty command; sets bit 5 in the ESR register.

Error code	**Error text in the case of queue poll** Error explanation
-100	**Command Error** The command is faulty or invalid.
-101	**Invalid Character** The command contains an invalid sign. Example: A header contains an ampersand, "SOURCE &".
-102	**Syntax error** The command is invalid. Example: The command contains block data the instrument does not accept.
-103	**Invalid separator** The command contains an impermissible sign instead of a separator. Example: A semicolon is missing after the command.
-104	**Data type error** The command contains an invalid value indication. Example: ON is indicated instead of a numeric value for frequency setting.
-105	**GET not allowed** A Group Execute Trigger (GET) is within a command line.
-108	**Parameter not allowed** The command contains too many parameters. Example: Command `CONFigure:REGen:FREQency` permits only one fraquency indication.

Contiuation: Command Error

Error code	**Error text in the case of queue poll** Error explanation
-109	**Missing parameter** The command contains too few parameters. Example: The command `CONFigure:RFGen:FREQuency` requires a frequency indication.
-111	**Header separator error** The header contains an impermissible separator. Example: the header is not followed by a "White Space", "`*ESE255`"
-112	**Program mnemonic too long** The header contains more than 12 characters.
-113	**Undefined header** The header is not defined for the instrument. Example: `*XYZ` is undefined for every instrument.
-114	**Header suffix out of range** The header contains an impermissible numeric suffix. Example: `SOURce3` does not exist in the instrument.
-120	**Numeric data error** The command contains a faulty numeric parameter.
-121	**Invalid character in number** A number contains an invalid character. Example: An "A" in a decimal number or a "9" in an octal number.
-123	**Exponent too large** The absolute value of the exponent is greater than 32000.
-124	**Too many digits** The number includes too many digits.
-128	**Numeric data not allowed** The command includes a number which is not allowed at this position. Example: The command `SOURce:RFGen:SELect` requires indication of a text parameter.
-131	**Invalid suffix** The suffix is invalid for this instrument. Example: nHz is not defined.
-134	**Suffix too long** The suffix contains more than 12 characters.
-138	**Suffix not allowed** A suffix is not allowed for this command or at this position of the command. Example: The command `*RCL` does not permit a suffix to be indicated.
-141	**Invalid character data** The text parameter either contains an invalid character or it is invalid for this command. Example: write error with parameter indication; `SOURce:RFGen:SELect STT1.`
-144	**Character data too long** The text parameter contains more than 12 characters.
-148	**Character data not allowed** The text parameter is not allowed for this command or at this position of the command. Example: The command `*RCL` requires a number to be indicated.

Continuation: Command Error

Error code	**Error text in the case of queue poll** Error explanation
-151	**Invalid string data** The command contains a faulty string. Example:An END message has been received prior to the terminating apostrophe.
-158	**String data not allowed** The command contains a valid string at a position which is not allowed. Example: A text parameter is set in quotation marks, `SOURce:RFGen:SELect "SETting1"`
-161	**Invalid block data** The command contains faulty block data. Example: An END message was received prior to reception of the expected number of data.
-168	**Block data not allowed** The command contains valid block data at an impermissible position. Example:
-171	**Invalid expression** The command contains an invalid mathematical expression. Example: the expression contains mismatching parentheses.
-178	**Expression data not allowed** The command contains a mathematical expression at an impermissible position. Example:
-180	**Macro error** A faulty macro has been defined, or an error has occurred during execution of a macro.

Execution Error - Error on execution of a command; sets bit 4 in the ESR register

Error code	**Error text in the case of queue poll** Error explanation
-200	**Execution error** Error on execution of the command.
-221	**Settings conflict** There is a conflict between setting of parameter value and instrument state. Example: External attenuation has been set in a state other than IDLE.
-222	**Data out of range** The parameter value lies out of the permissible range of the instrument. Eample: The command *RCL only permits entries in the range from 0 to 50.
-223	**Too much data** The command contains too many data. Example: The instrument does not have sufficient storage space.
-241	**Hardware missing** The command cannot be executed due to missing hardware. Example: An option is not fitted.

Device Specific Error; sets bit 3 in the ESR register

Error code	**Error test in the case of queue poll** Error explanation
-300	**Device-specific error** SM3-specific error not defined in greater detail.
-350	**Queue overflow** This error code is entered in the queue instead of the actual error code if the queue is full. It indicates that an error has occurred but not been accepted. The queue can accept 5 entries.

Query Error - Error in data request; sets bit 2 in the ESR register

Error code	**Error text in the case of queue poll** Error explanation
-400	**Query error** General error occurring when data are requested by a query.
-410	**Query INTERRUPTED** The query has been interrupted. Example: After a query, the instrument receives new data before the response has been sent completely.
-420	**Query UNTERMINATED** The query is incomplete. Example: The instrument is addressed as a talker and receives incomplete data.
-430	**Query DEADLOCKED** The query cannot be processed. Example: The input and output buffers are full, the instrument cannot continue operation.
-440	**Query UNTERMINATED after indefinite response** A query is in the same command line after a query which requests an indefinite response.

1 List of Commands / Remote Control

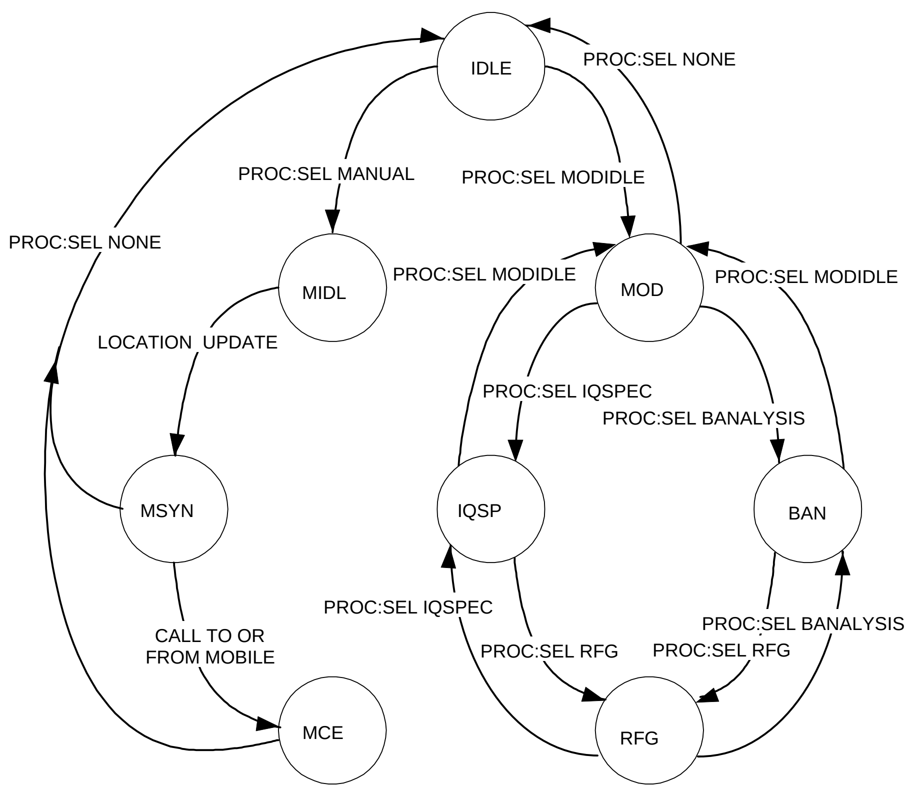
1.1 General Information

1.1.1 States

In the description of the commands, the following abbreviations are used for indication of the permissible states:

IDLE: ..Initial state of the CTS; is also achieved by means of PROCedure:SELect[:TEST] NONE.
MIDL: MS test selected (BCCH is generated)
MSYN: MS test: Synchronised (Location update is finished)
MCE: MS test: Call established
MOD: Module test in idle state
IQSP: IQ-spectrum active
RFG: RF generator active
BAN: Burst Analysis active
ALL: All states (IDLE, MIDL, MSYN, MCE, MOD, IQSP, BAN, or RFG)

The following diagram explains the individual transitions of states:



1.1.2 DCS1800 (GSM1800)

If DCS1800 is the desired network type, the switch over must be made by means of CONFigure:NETWork DCS1800 before changing the configuration set-up. After the switch over, all commands act on the DCS1800 data set, without switch over the GSM data set is used.

1.1.3 DCS1900 (GSM1900)

If DCS1900 is the desired network type, switchover using CONFigure:NETWork DCS1900 must be made prior to changing the configuration set-up.

1.1.4 GSM850

If GSM850 is the desired network type, switchover using CONFigure:NETWork GSM850 must be made prior to changing the configuration set-up

1.1.5 Note

<numeric_value> denotes a numeric value; MAXimum or MINimum can be indicated as well unless stated otherwise.
If <numeric_value> may contain a unit, indicating the unit is optional. The value is always returned without a unit.

Some commands allow ON and OFF instead of a value (for activating or deactivating the associated parameter). Specification of a value (numeric_value) implies a transition to ON. If OFF is set at the time of a query, OFF will be returned instead of the value.

<value> denotes a character from a list; only list entries are permissible.

All commands are structured analogously to the SCPI description, i.e. the upper-case letters indicate the short form of the command; the CTS only accepts this short form as an abbreviation (according to SCPI), otherwise the long form is to be used.

Commands encapulated in square brackets, [:COMMand], are optional words that do not have to be included.

1.1.6 Error Recovery

If no value is existing with queries or the value is invalid, NAN is returned instead of the value. An overflow of the value is indicated by INF, a missing input signal by means of NINF.

If the CTS is not in the right state to be able to carry out the command, SCPI error -221, "Settings conflict" is generated. No value is returned in the case of queries.
The permissible state is indicated in the following table in the column "state".

If, however, an option to execute a command is missing, SCPI error -241, "Hardware missing" is displayed. No result is returned either in the case of a query.
The option necessary to execute the command is entered in the tables under "option".

1.1.7 RESET Values

Unless otherwise specified, the values given in the column "Default:", are the factory default values of the CTS.

1.2 Settings

1.2.1 Input and Output

External attenuation at the output RF In/Out

Syntax:	SOURce1:CORRection:LOSS[:OUTPut][:MAGNitude]<numeric_value>			
Value range:	GSM850/ GSM900 / GSM1800 / GSM1900: 0.0 … +30.0 (unit: dB)			**Default:** 0.0 dB
State: Set: IDLE Query: ALL		**Option:** none	With Query	**Note:** Positive values refer to an attenuation, (N1)

For backward compatibility the old remote control command which sets a single attenuation value for the whole band (e.g. GSM900), will now set all nine output attenuation parameters (introduced in Version 3.00) with <numeric value>. Therefore this is the equivalent of typing the following Remote Control commands with <value> being the same.

	Arfcn Range:
GSM850:	
source:correction:loss:low:agsm <value>	128 – 169
source:correction:loss:mid:agsm <value>	170 – 210
source:correction:loss:high:agsm <value>	211 – 251
GSM900:	
Source:correction:loss:low:gsm <value>	975 - 1023 and 0 – 30
source:correction:loss:mid:gsm <value>	31 – 78
source:correction:loss:high:gsm <value>	79 – 124
GSM1800:	
source:correction:loss:low:pcn <value>	512 – 635
source:correction:loss:mid:pcn <value>	636 – 759
source:correction:loss:high:pcn <value>	760 – 885
GSM1900:	
source:correction:loss:low:pcs <value>	512 – 611
source:correction:loss:mid:pcs <value>	612 – 711
source:correction:loss:high:pcs <value>	712 – 810

For Query all nine output attenuation values will be returned in the following order:

GSM850
LOW
MID
HIGH

GSM900
LOW
MID
HIGH

GSM1800
LOW
MID
HIGH

GSM1900
LOW
MID
HIGH

External attenuation at the input RF In/Out

Syntax:	Sense1:CORRection:LOSS[:OUTPut][:MAGNitude]<numeric_value>				
Value range:	GSM850 / GSM900 / GSM1800 / GSM1900: 0.0 … +30.0 (unit: dB)				**Default:** 0.0 dB
State: Set: IDLE Query: ALL			**Option:** none	With Query	**Note:** Positive values refer to an attenuation, (N1)

For backward compatibility the old remote control command which sets a single attenuation value for the whole band (e.g. GSM900), will now set all nine input attenuation parameters (introduced in Version 3.00) with <numeric value>. Therefore this is the equivalent of typing the following Remote Control commands with <value> being the same.

	Arfcn Range:
GSM850:	
source:correction:loss:low:agsm <value>	128 – 169
source:correction:loss:mid:agsm <value>	170 – 210
source:correction:loss:high:agsm<value>	211 – 251
GSM900	
sense:correction:loss:low:gsm <value>	975 - 1023 and 0 – 30
sense:correction:loss:mid:gsm <value>	31 – 78
sense:correction:loss:high:gsm <value>	79 – 124
GSM1800:	
sense:correction:loss:low:pcn <value>	512 – 635
sense:correction:loss:mid:pcn <value>	636 – 759
sense:correction:loss:high:pcn <value>	760 – 885
GSM1900:	
sense:correction:loss:low:pcs <value>	512 – 611
sense:correction:loss:mid:pcs <value>	612 – 711
sense:correction:loss:high:pcs <value>	712 – 810

For Query all nine input attenuation values will be returned in the following order:

GSM850
LOW
MID
HIGH

GSM900
LOW
MID
HIGH

GSM1800
LOW
MID
HIGH

GSM1900
LOW
MID
HIGH

External attenuation at RF Out 2

Syntax:	SOURce2:CORRection:LOSS[:OUTPut][:MAGNitude] <numeric_value>			
Value range:	0.0 ... +15.0 (unit: dB)			**Default:** 0.0 dB
State: IDLE	**Option:** B7	With Query	**Note:** Positive values refer to an attenuation, (N1)	

Coupler Usage

Syntax:	SOURce:CORRection:LOSS:COUPler <value>			
Value range:	OFF ON			**Default:** OFF
State: IDLE	**Option:** none	With Query	Entered attenuations have no influence in position OFF.	

1.2.2 Signalling and RF Parameters

1.2.2.1 Signalling Parameters of the Mobile Station

International Mobile Subscriber Identity (IMSI)

Syntax:	SENSe:SIGNalling:IDENtity:IMSI?		
Return:	<string> (max. 15 characters)		
State: MSYN, MCE	**Option:** none	Query only	**Note:** (N2)

International Mobile Equipment Identity (IMEI)

Syntax:	SENSe:SIGNalling:IDENtity:IMEI?		
Return:	<string> (max. 15 characters)		
State: MSYN, MCE	**Option:** none	Query only	**Note:** (N2)

Revision level of mobile

Syntax:	SENSe:SIGNalling:IDENtity:MS:REVision:LEVel?		
Return:	PH1 PH2		
State: MSYN, MCE	**Option:** none	Query only	

Receiving level at Mobile Station (RXLEV)

Syntax:	SENSe:SIGNalling:RXLev?		
Return:	0 ... 63		
State: MCE	**Option:** none	Query only	**Note:** (N2)

Quality of Reception at Mobile Station (RXQUAL)

Syntax:	SENSe:SIGNalling:RXQual?		
Return:	0 ... 7		
State: MCE	**Option:** none	Query only	**Note:** (N2)

Dialled number

Syntax:	SENSe:SIGNalling:DNUMber?		
Return:	<string> (max. 20 digits) or "- - -"		
State: MCE	**Option:** none	Query only	**Note:** (N2)

Power Class

Syntax:	SENSe:SIGNalling:POWer:CLASs?		
Return:	GSM: 1 ... 5 GSM850 1 ... 5 DCS1800: 1 ... 2 DCS1900 1 ... 2		
State: MSYN, MCE	**Option:** none	Query only	**Note:** (N2)

Measured power of mobile (peak value)

SENSe:POWer:MS? is used to measure the transmitter power of the mobile. SENSe:SIGNalling:POWer:LEVel? indicates the nominal value.

Syntax:	SENSe:POWer:MS?		
Return:	RF In Out: (0.0 + ext. att.) ... (+39 + ext. att.) (unit: Dbm)		
State: MCE	**Option:** none	Query only	(N7)

Frequency Band

Syntax:	SENSe:SIGNalling:FREQuency:BAND:CURRent? SENSe:SIGNalling:FREQuency:BAND:SECOnd?		
Return:	GSM850(arfcn:128-251) P-GSM900 (arfcn: 0 - 124) E-GSM900 (arfcn: 975 - 1023) R-GSM900 (arfcn: 955-974) GSM1800 (arfcn: 512 - 885) GSM1900 (arfcn: 512 - 810) Invalid - No frequency information on second network available (only GSM900/GSM1800 mobiles provide frequency information).	**Default:** DUM	
State: MSYN, MCE	**Option:** none	Query only	**Note:** Current: Frequency information on current network

Power Class

<table>
<tr><td>Syntax:</td><td colspan="3">SENSe:SIGNalling:POWEr:CLASs:CURRent?
SENSe:SIGNalling:POWEr:CLASs:SECOnd?</td></tr>
<tr><td>Return:</td><td colspan="3">GSM850: 1… 5
GSM: 1… 5
GSM1800: 1… 2
GSM1900: 1… 2</td></tr>
<tr><td>State:
MSYN, MCE</td><td>Option:
none</td><td>Query only</td><td>Note:
Current: Power Class information on current network
Second: Power Class information on a second network</td></tr>
</table>

1.2.2.2 Signalling Parameters for CTS

Mobile Country Code

Syntax:	CONFigure:SIGNalling:IDENtity:MCC <numeric_value>		
Value range:	GSM850 0 ... 999 GSM 0 ... 999 DCS1800: 0 ... 999 DCS1900: 0 ... 999		**Default:** 1
State: Set: IDLE Query: ALL	**Option:** none	With Query	

Mobile Network Code

Syntax:	CONFigure:SIGNalling:DIGIts:MNC <numeric_value>		
Value range:	MNC_2 Sets the MNC to 2 Digits MNC_3 Sets the MNC to 3 Digits		**Default:** MNC_3
State: Set: IDLE Query: ALL	**Option:** none	With Query	**Note:** Will not effect GSM900 or GSM1800 MS.

Syntax:	CONFigure:SIGNalling:IDENtity:MNC <numeric_value>		
Value range:	GSM850 0 ... 99 OR 0 ... 999* GSM 0 ... 99 DCS1800: 0 ... 99 DCS1900: 0 ... 99 OR 0 ... 999*		**Default:** 1
State: Set: IDLE Query: ALL	**Option:** none	With Query	**Note:** * Depending if set to either a 2 OR 3 Digit MNC.

Network Colour Code

Syntax:	CONFigure:SIGNalling:IDENtity:NCC <numeric_value>		
Value range:	GSM850 0 ... 7 GSM 0 ... 7 DCS1800: 0 ... 7 DCS1900: 0 ... 7		**Default:** 0
State: Set: IDLE Query: ALL	**Option:** none	With Query	

Location Area Code

Syntax:	CONFigure:SIGNalling:IDENtity:LAC <numeric_value>		
Value range:	GSM850 0 ... 65535 GSM 0 ... 7 DCS1800: 0 ... 65535 DCS1900: 0 ... 65535		**Default:** 1
State: Set: IDLE Query: ALL	**Option:** none	With Query	

Channel number (ARFCN) for CCCH

Syntax:	CONFigure:CHANnel:CCCH:ARFCn <numeric_value>		
Value range:	GSM: 1 ... 124 GSM850: 128 … 251 DCS1800: 512 ... 885 DCS1900: 512 ... 810		**Default:** GSM: 70 DCS1800: 512 DCS1900: 512
State: Set: IDLE Query: ALL	**Option:** none	With Query	

Initial Channel number (ARFCN) for TCH

Syntax:	CONFigure:CHANnel[:TCH]:ARFCn <numeric_value>		
Value range:	GSM: 1 ... 124 GSM850: 128 … 251 DCS1800: 512 ... 885 DCS1900: 512 ... 810		**Default:** GSM: 60 GSM850: 187 DCS1800: 885 DCS1900: 610
State: Set: IDLE, MIDL, MSYN Query: ALL	**Option:** none	With Query	

Initial Transmitter power of the TCH in the used timeslot

Syntax:	CONFigure:CHANnel[:TCH][:POWer][:USED] <numeric_value>		
Value range:	(N3)		**Default:** -75.0 dBm
State: Set: IDLE, MIDL, MSYN Query: ALL	**Option:** none	With Query	

Basic power setting for location update and link set-up of mobile station

Syntax:	CONFigure:POWer:MS <numeric_value>			
Value range:	GSM: 13 ... 39 GSM850: 13 ... 39 DCS1800: 10 ... 30 DCS1900: 10 ... 30			**Default:** GSM: 13 GSM850: 13 DCS1800: 10 DCS1900: 10
State: ALL	**Option:** none	With Query	**Note:** Units are dBm	

Networks for dualband handover

Syntax:	CONFigure:SIGNalling:HANDover:NETWORK <value>			
Value range:	**<u>Current NetworkGSM900</u>** SING | handover not permitted, channel change in GSM900 D180 | handover possible between GSM900 & GSM1800 D190 | handover possible between GSM900 and GSM1900 MULTI | handover possible between GSM900/1800 or GSM900/1900. (MS permitting) **<u>Current Network GSM850</u>** SING | handover not permitted, channel change in GSM900 D190 | handover possible between GSM850 & GSM1900 MULTI | handover possible between GSM900/1800 or GSM900/1900. (MS permitting) **<u>Current Network GSM1800</u>** SING | handover not permitted, channel change in GSM1800 D180 | handover possible between GSM900 and GSM1800 MULTI | handover possible between GSM900/1800 or GSM900/1900. (MS permitting) **<u>Current Network GSM1900</u>** SING | handover not permitted, channel change in GSM1900 D190 | handover possible between GSM900 and GSM1900 MULTI | handover possible between GSM900/1800 or GSM900/1900. (MS permitting)			**Defaults:** **<u>GSM900</u>** D180 **<u>GSM850</u>** SING **<u>GSM1800</u>** D180 **<u>GSM1900</u>** SING
State: Set: IDLE Query: ALL	**Option:** none	With Query	**Note:**	

Checking the dualband handover with GSM900/GSM1800

Syntax:	CONFigure:SIGNalling:HANDover:CHECK <value>			
Value range:	SLOW | with handover check of the mobile FAST | without handover check of the mobile			**Default:** SLOW
State: Set: IDLE Query: ALL	**Option:** none	With Query	**Note:** The selected setting is taken into account when a handover between GSM900 and GSM1800 is selected	

Dualband handover mode

Syntax:	CONFigure:SIGNalling:HANDover:MODE <value>			
Value range:	BCCH | with control channel after handover LEVEL | without control channel after handover			**Default:** LEVEL
State: Set: IDLE Query: ALL	**Option:** none	With Query	**Note:**	

Handover is initiated by using Change of channel for TCH.

Configurable SMS message

Syntax:	configure:sms?			
Value range:	Message content or “No Message”			**Default:**
State: Set: ALL Query: ALL	**Option:** none	With Query	Returns the SMS message content sent by the MS to the CTS and resets it to “No Message”	

Syntax:	configure:user:sms[?]			
Value range:	Message content			**Default:**
State: Set: ALL Query: ALL	**Option:** none	With Query	Set the SMS message content to be sent from the MS to the CTS.	

Syntax:	procedure:set:sms:oa:length[?]			
Value range:	2 - 12			**Default:** 2
State: Set: ALL Query: ALL	**Option:** none	With Query	Set the length of the TP Originator field of the SMS message to be sent from the CTS to the MS	

1.2.3 Network and Test Mode

Network

<table>
<tr><td>Syntax:</td><td colspan="4">CONFigure:NETWork[:TYPE] <value></td></tr>
<tr><td>Value range:</td><td colspan="3">GSM | G09 |
GSM850 | G08 |
DCS1800 | G18 |
PCS1900 | G19</td><td>Default: GSM</td></tr>
<tr><td>State:
Set: IDLE
Query: ALL</td><td>Option: none</td><td>With Query</td><td colspan="2">A Query returns G09, G18 or G19</td></tr>
</table>

Test Mode

<table>
<tr><td>Syntax:</td><td colspan="4">PROCedure:SELect[:TEST] <string></td></tr>
<tr><td>Value range:</td><td colspan="3">NONE | No test mode (initial state)
MIDL | MS-test
MODidle | Module test
IQSPec | IQ-spectrum
BANalysis | Burst Analysis
RFG | Rf generator</td><td>Default: NONE</td></tr>
<tr><td>State:
(NONE): MIDL, MOD
(MIDL): NONE
(MODIDLE): IDLE, IQSP, BAN
(IQSPEC): MOD, RFG
(BANALYSIS): MOD, RFG
(RFG): IQSP, BAN</td><td>Option: none
none
B7
B7
B7
B7</td><td>With Query</td><td colspan="2">Note:
Use the command STATus:DEVice? to query the state of the CTS.</td></tr>
</table>

1.2.4 Call Set-up and Release

Call set-up from the CTS to the mobile (call)

Syntax:	PROCedure:CALL:TOMS			
State: MSYN		**Option:** none	No Query	

Call release from the CTS to the mobile (Release)

Syntax:	PROCedure:RELease:TOMS			
State: MCE		**Option:** none	No Query	

Change of channel for TCH

Syntax:	PROCedure:SET:ARFCn <numeric_value>			
Value range:	GSM: 1 ... 124 *[975 … 1023] **[955 … 974] GSM850 128 … 251 DCS1800: 512 ... 885 DCS1900: 512 ... 810			**Default:** this command takes the current value for the Initial Channel number (ARFCN) for TCH (C.7)
State: MCE		**Option:** none	With query	**Note**: * Available for Mobile Stations which support E-GSM. ** Available for Mobile Stations which support R-GSM.

Power change (Mobile Station, used timeslot only)

Syntax:	PROCedure:SET:POWer:MS <numeric_value>			
Value range:	GSM: 5 ... 15* | Power Control Level GSM850: 5 ... 15* | Power Control Level DCS1800: 0 ... 13* | Power Control Level DCS1900: 0 ... 13* | Power Control Level			
State: MCE		**Option:** none	With Query	**Note:** always returns the power control level (PCL), (N2) * Max values may change for PHASEI and PHASEII mobiles

Power change (CTS) in unused timeslot

Syntax:	CONFigure:BSSig:POWer <numeric_value> or PROCedure:SET:POWer:CMD[:USED] <numeric_value>			
Value range:	(N3)			
State: MCE		**Option:** keine	With Query	

1.3 Burst Analysis Settings

Channel number (ARFCN) and Frequency

Syntax:	CONFigure:CHANnel:BANalysis:ARFCn <numeric_value>			
Value range:	GSM: -75 ... 450 GSM850: 127…252 DCS1800: 461 ... 1511 DCS1900: -239 ... 811		**Default:**	GSM: 65 GSM850 : 252 DCS1800: 711 DCS1900: 661
State: BAN	**Option:** B7	With Query		

Syntax:	CONFigure:CHANnel:BANalysis:ARFCn:FREQuency <numeric_value>			
Value range:	GSM: 875 ... 980 (in steps of 0.2 MHz) GSM850: 824 ... 894 (in steps of 0.2 MHz) DCS1800: 1700 ... 1910 (in steps of 0.2 MHz) DCS1900: 1700 ... 1910 (in steps of 0.2 MHz)		**Default:**	GSM: 903 MHz GSM850 : 869 MHz DCS1800: 1750 MHz DCS1900: 1880 MHz
State: BAN	**Option:** B7	With Query		

Training Sequence Codes

Syntax:	CONFigure:CHANnel:BANalysis:TSC <numeric_value>		
Value range:	0 ... 8		**Default:** 0
State: BAN	**Option:** B7	With Query	

Expected power (of mobile station)

Syntax:	CONFigure:BANalysis:POWer:EXPected <numeric_value>		
Value range:	-15.0 ... +39.0 dBm		**Default:** 0.0 dBm
State: BAN, IQSP	**Option:** B7	With Query	**Note:** (N3)

Trigger mode

Syntax:	CONFigure:BANalysis:TRIGger:MODE <value>		
Value range:	POWer | Triggering on rising signal edge FREErun Triggering without edge detection		**Default:** POW
State: BAN	**Option:** B7	With Query	

1.4 RF Generator Settings

Channel number

Syntax:	CONFigure:RFGen:CHANnel[:CW| <numeric_value>			
Value range:	GSM: -175 ... 300 GSM850: 127... 252 DCS1800: 511... 1436 DCS1900: -139 ... 811			**Default:** GSM: 1 GSM850 : 127 DCS1800: 486 DCS1900: 611
State: RFG	**Option:** B7	With Query		

Frequency

Syntax:	CONFigure:RFGen:FREQuency[:CW|:FIXed] <numeric_value>			
Value range:	GSM: 900.0 ... 995.0 MHz (in steps of 0.2 MHz) GSM850 869.0 … 995.0 MHz (in steps of 0.2 MHz) DCS1800: 1800.0 ... 1990.0 MHz (in steps of 0.2 MHz) DCS1900: 1800.0 ... 1990.0 MHz (in steps of 0.2 MHz)			**Default:** GSM: 935.2 MHz GSM850 : 869.0 MHz DCS1800: 1800.0 MHz DCS1900: 1950.0 MHz
State: RFG	**Option:** B7	With Query	**Note:** The input value is adapted to the step size indicated when the parameter is set.	

Frequency offset

Syntax:	CONFigure:RFGen:FREQuency:OFFSet <numeric_value>			
Value range:	-100.009 ... 100.009 kHz			**Default:** 0.0 Hz
State: RFG	**Option:** B7	With Query		

Type of modulation

Syntax:	CONFigure:RFGen:DM:FORMat <value>			
Value range:	0 ... 7			**Default:** 0
State: RFG	**Option:** B7	With Query	**Note:** Modulation must be in state dummy.	

Modulation

Syntax:	CONFigure:RFGen:DM:MODE <value>			
Value range:	OFF No modulation DUM Dummy burst with selected midamble OFF No modulation			**Default:** DUM
State: RFG	**Option:** B7	With Query		

Ramping Mode

Syntax:	CONFigure:RFGen:RAMPing:STATe <value>			
Value range:	ON OFF	Signal with power ramping Permanent signal		**Default:** OFF
State: RFG	**Option:** B7	With Query		

Output level

Syntax:	CONFigure:RFGen:POWer <numeric_value>			
Value range:	(-110.0 - ext. att.) ... (-50.0 - ext. att.) dBm			**Default:** -50.0 dBm
State: RFG	**Option:** B7	With Query		

Output Level RFOUT2

Syntax:	CONFigure2:RFGen:POWer <numeric value>			
min. **Value range:**	(-80.0 - ext. Att.) ... (-20.0 - ext. Att.) dBm			**Default:** depending on level at RF IN/OUT
State: RFG	**Option:** B7	With Query		

RF Generator Level

Syntax:	CONFigure:RFGen:LEVel <value>			
Value range:	ON OFF	Switched on Switched off		**Default:** ON
State: RFG	**Option:** B7	With Query		

1.5 Measurement, Analysis and Result Query

1.5.1 BER

1.5.1.1 Tolerances for the BER

Value for class-Ib Rate

Syntax:	CONFigure:LIMit:BER:CLIB:RATE			
Value range:	0.0 ... 100.0			**Default:** 0.4
State: ALL	**Option:** none	With Query		

Value for class-II Rate

Syntax:	CONFigure:LIMit:BER:CLII:RATE			
Value range:	0.0 ... 100.0			**Default:** 2.6
State: ALL	**Option:** none	With Query		

Values for erased frames Rate

Syntax:	CONFigure:LIMit:BER:EFRames:RATE			
Value range:	0.0 ... 100.0			**Default:** 1.0
State: ALL	**Option:** none	With Query		

Number of frames to be sent

Syntax:	CONFigure:BER:FRAMestosend <numeric_value>			
Value range:	1 ... 499			**Default:** 100
State: ALL	**Option:** none	With Query		

Maximal number of events

Syntax:	CALCulate:LIMit:BER:CLIB:MEVents? CALCulate:LIMit:BER:CLII:MEVents? CALCulate:LIMit:BER:EFRames:MEVents?			
Return:	0 ... 65868 (Class IB) 0 ... 38922 (Class II) 0 ... 499 (Erased Frames)			
State: ALL	**Option:** none	Query only	**Note:**	The values are derived from "Frames to send" and thus cannot be set.

Maximal number of samples to be sent and test time

The maximal number of samples sent in the test is derived from the value for "Frames to send". These values are only reached in the test if the errors do not exceed the tolerances.

Syntax:	CALCulate:BER:CLIB:MSAMples? CALCulate:BER:CLII:MSAMples? CALCulate:BER:EFRames:MSAMples? CALCulate:BER:TEST:TIME?			
Return:	1320 ... 65868 (Class IB) 780 ... 38922 (Class II) 10 ... 499 (Erased Frames) 0.20 ... 9.98 (Test time, seconds)			
State: ALL	**Option:** none	Query only	**Note:**	The values are derived from "Frames to send" and thus cannot be set.

1.5.1.2 BER Measurement

Measured values of class Ib

Syntax: Execute new measurement and signal result Read result only	READ[:SCALar]:BER:CLIB[:BER]? READ[:SCALar]:BER:CLIB:RBER? FETCh[:SCALar]:BER:CLIB[:BER]? FETCh[:SCALar]:BER:CLIB:RBER?		
Return:	BER and RBER: 0 ... 100 (Unit: %)		
State: MCE	**Option:** none	Query only	**Note:** No default values, (N4), (N7) If a read is performed on BER, all subsequent fetches will return BER values until a RBER read is carried out. The same applies for RBER

Measured values of class II

Syntax: Execute new measurement and signal result Read result only	READ[:SCALar]:BER:CLII[:BER]? READ[:SCALar]:BER:CLII:RBER? FETCh[:SCALar]:BER:CLII[:BER]? FETCh[:SCALar]:BER:CLII:RBER?		
Return:	BER and RBER: 0 ... 100 (Unit: %)		
State: MCE	**Option:** none	Query only	**Note:** No default values, (N4), (N7) If a read is performed on BER, all subsequent fetches will return BER values until a RBER read is carried out. The same applies for RBER

Measured values of erased frames

Syntax: Execute new measurement and signal result Read result only	READ[:SCALar]:BER:EFRames[:FER]? FETCh[:SCALar]:BER:EFRames[:FER]?		
Return:	BER and RBER: 0 ... 100 (Unit: %)		
State: MCE	**Option:** none	Query only	**Note:** No default values, (N4), (N7)

1.5.2 Power

1.5.2.1 Tolerances for Power

Setting Power Template to Configurable or Recommendations

Syntax:	CALCulate:LIMit:POWer[:TEMPlate]:SET?		
Return:	REC | GSM Recommendations CONFIG| Configurable		
State: Set: IDLE Query: ALL	**Option:** none	With Query	**Default:** CONFIG

Resetting to default values

Syntax:	CALCulate:LIMit:POWer[:TEMPlate]:CLEar		
State: ALL	**Option:** none	No Query	**Note:** Resets the GSM, GSM850,DCS1800 and DCS1900 tolerances

Tolerances for average power in the power time template

Syntax:
CALCulate:LIMit:POWer[:TEMPlate]:TOLerance1[:DATA] <numeric_value>
CALCulate:LIMit:POWer[:TEMPlate]:TOLerance2[:DATA] <numeric_value>

Value range:

		Deviation from expected value
GSM:		
CALC:LIM:POW:TOL1	0.0 ... +9.9 dB	with maximum power control level
CALC:LIM:POW:TOL2	0.0 ... +9.9 dB	with all other power control levels
GSM850:		
CALC:LIM:POW:TOL1	0.0 ... +9.9 dB	with maximum power control level
CALC:LIM:POW:TOL2	0.0 ... +9.9 dB	with all other power control levels
DCS1800 and DCS1900:		
CALC:LIM:POW:TOL1	0.0 ... +9.0 dB	with maximum power control level
CALC:LIM:POW:TOL2	0.0 ... +9.0 dB	up to power control level 8

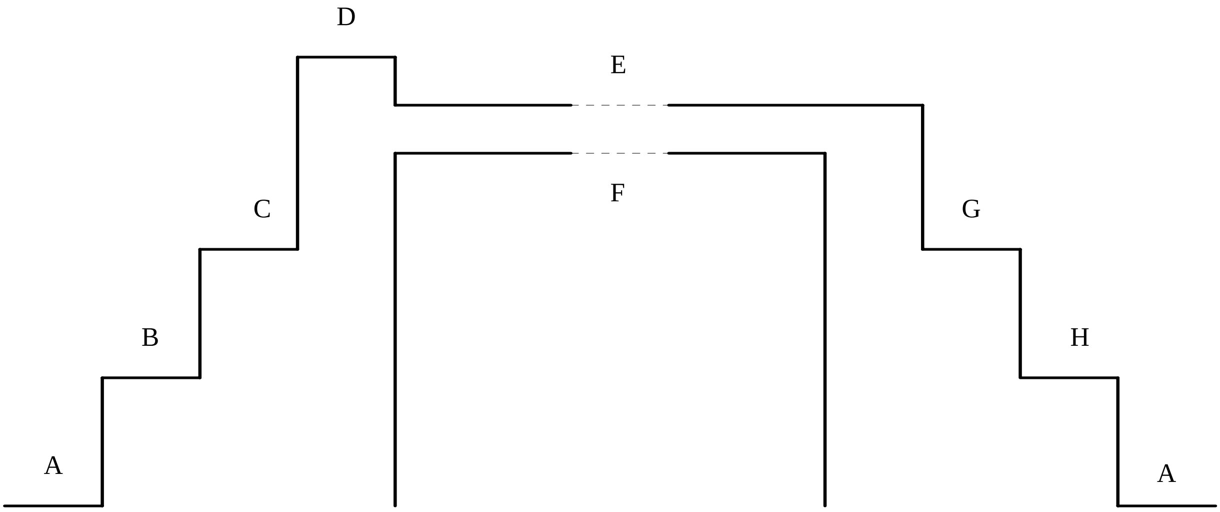
Default:

GSM:	TOL1	+2.0 dB
	TOL2	+3.0 dB
GSM850:	TOL1	+2.0 dB
	TOL2	+3.0 dB
DCS1800:	TOL1	+3.0 dB
	TOL2	+3.0 dB
DCS1900:	TOL1	+3.0 dB
	TOL2	+4.0 dB

State: ALL	**Option:** none	With Query	**Note:** The deviations always apply symmetrically about the expected value

Tolerances for power time template

The level designations used in the power time template for the command CALCulate:LIMit:POWer[:TEMPlate][:DATA] can be obtained from the following illustration:



Syntax:	CALCulate:LIMit:POWer[:TEMPlate][:DATA] <numeric_value>, <numeric_value>, <numeric_value>, <numeric_value>, <numeric_value>, <numeric_value>, <numeric_value>, <numeric_value>, <numeric_value>		
Value range:	-100.0 ... 0.0 dBm -100.0 ... 0.0 dB -100.0 ... 0.0 dB -100.0 ... 0.0 dB 0.0 ... +20.0 dB 0.0 ... +5.0 dB -5.0 ... 0.0 dB -100.0 ... 0.0 dB -100.0 ... 0.0 dB	Absolute level at A Relative level at A Relative level at B Relative level at C Relative level at D Relative level at E Relative level at F Relative level at G Relative level at H	**Default:** GSM: -36.0 dBm GSM850: -36.0 dBm DCS1800: -47.0 dBm DCS1900: -47.0 dBm -45.0 dB -30.0 dB -6.0 dB +4.0 dB +1.0 dB -1.0 dB -6.0 dB -30.0 dB
State: ALL	**Option:** none	With Query	

Query for observance of the tolerances for average power

Syntax:	CALCulate:LIMit:POWer[:TEMPlate]:TOLerance:MATChing?		
Return:	(MATC | NMAT | INV)		
State: MCE	**Option:** none	Query only	**Note:** returns the result from the last measurement, (N5), (N6)

Query for observance of the tolerances of the power/time template

Syntax:	CALCulate:LIMit:POWer[:TEMPlate]:MATChing?		
Return:	MATC | in Tolerance NMAT | out of Tolerance INV | no measurement result available NRAM | no ramping NTSC | no valid TSC found OUT | Out of dynamic range TEAR | falling edge of ramp too early THIG | value of Phase/Frequency error too high TLAT | rising edge of ramp too late TLON | Burst too long TSH Burst too short		
State: MCE, RFG, BAN	**Option:** none	Query only	**Note:** returns the result from the last measurement, (N5), (N6)

1.5.2.2 Power Measurement

Average power of the burst

Syntax: Execute new measurement and signal result Read result only	READ[:SCALar]:BURSt:POWer:AVERage? FETCh[:SCALar]:BURSt:POWer:AVERage?		
Return:	<value> (unit: dBm)		
State: MCE, RFG, BAN	**Option:** none	Query only	**Note:** No default values, (N5), (N7)

Power values of the burst

Syntax: Execute new measurement and signal result Read result only	READ:ARRay:BURSt:POWer? FETCh:ARRay:BURSt:POWer?		
Return:	<value> {, <value>} (unit: dB)		
State: MCE, RFG, BAN	**Option:** none	Query only	**Note:** No default values, (N5)

Peakvalue of the power

Syntax: Execute new measurement and signal result	SENSe:POWer:PEAK?		
Return:	<value> (unit: dBm)		
State: MCE, RFG, BAN	**Option:** none	Query only	**Note:** No default values, (N5), (N7)

Power Measurement Mode Status

Syntax:	SENse:MODuletest:MEASurement:MODE?		
Value range:	"SENSITIVE" "NORMAL"		**Default:** "NORMAL"
State: MOD	**Option:**	Only query	**Note**:

Sensitive Power Measurement Offset

Syntax:	CONFigure:MODuletest:SPM:OFFSet[?]		
Value range:	-10 dB +10 dB		**Default:** 2 dB
State: MOD	**Option:**		**Note**: This value can also be adjusted automatically by the SPM calibration routine.

Calibration Routine Start

Syntax:	PROCedure:CALibrate:SPM?		
Value range:	"CALIBRATION_OK", "CALIBRATION_FAILED_WRONG_FREQUENCY", "CALIBRATION_FAILED_INVALID_SIGNAL", "CALIBRATION_FAILED_UNSTABLE_SIGNAL"		**Default:**
State: MOD	**Option:**	Only query	**Note**: This command starts the SPM calibration routine.

1.5.3 Phase and Frequency Errors

1.5.3.1 Tolerances for Phase and Frequency Errors

Resetting to default values

Syntax:	CALCulate:LIMit:PHFR:CLEar		
State: ALL	**Option:** none	No Query	**Note:** Sets the GSM, DCS1800 or DCS1900 tolerances

Tolerances for phase and frequency error

Syntax:	CALCulate:LIMit:PHFR:TOLerance[:DATA] <numeric_value>, <numeric_value>, <numeric_value>		
Value range:	0.0 ... 100.0 deg (Peak phase error) 0.0 ... 25.0 deg (RMS phase error) GSM: 0 ... 200 Hz (Frequency error) GSM850: 0 ... 200 Hz (Frequency error) DCS1800: 0 ... 400 Hz DCS1900: 0 ... 400 Hz		**Default:** 20.0 deg 5.0 deg GSM: 90 Hz GSM850: 90 Hz DCS1800: 180 Hz DCS1900: 180 Hz
State: ALL	**Option:** none	With Query	

Query for observance of tolerances

Syntax:	CALCulate:LIMit:PHFR:TOLerance:MATChing?		
Return:	(MATC | NMAT | INV), (Peak phase error) (MATC | NMAT | INV), (RMS phase error) (MATC | NMAT | INV) (Frequency error)		
State: MCE, RFG, BAN	**Option:** none	Query only	**Note:** Supplies the result for the last measurement, (N5), (N6)

Query for observance of the tolerances (average and maximum value measurement)

Syntax:	CALCulate:LIMit:PHFR:TOLerance:MATChing:AVERage? CALCulate:LIMit:PHFR:TOLerance:MATChing:MAXimum?		
Return:	(MATC | NMAT | INV), (Peak phase error) (MATC | NMAT | INV), (RMS phase error) (MATC | NMAT | INV) (Frequency error)		
State: MCE, RFG, BAN	**Option:** none	Query only	**Note:** Supplies the result for the last measurement, (N5), (N6)

1.5.3.2 Test Parameters for Phase and Frequency Error Measurements

Number of bursts for average- and maximum-value measurements

Syntax:	CALCulate:LIMit:PHFR:AVERage		
Value range:	1 ... 999		**Default:** 10
State: ALL	**Option:** none	With Query	

1.5.3.3 Phase Error Measurement

Total phase error of a burst

Syntax: Execute new measurement and signal result Read result only	RMS: READ[:SCALar]:BURSt:PHASe:ERRor:RMS? Peak: READ[:SCALar]:BURSt:PHASe:ERRor:PEAK? RMS: FETCh[:SCALar]:BURSt:PHASe:ERRor:RMS? Peak: FETCh[:SCALar]:BURSt:PHASe:ERRor:PEAK?		
Return:	<value> (current, unit: °) <value> (average, unit: °) <value> (maximum, unit: °)		
State: MCE, RFG, BAN	**Option:** none	Query only	**Note:** No default values, (N5), (N7)

Phase error values of the burst

Syntax: Execute new measurement and signal result Read result only	READ:ARRay:BURSt:PHASe:ERRor? FETCh:ARRay:BURSt:PHASe:ERRor?		
Return:	<value> {, <value>} (unit: °)		
State: MCE, RFG, BAN	**Option:** none	Query only	**Note:** No default values, (N5)

1.5.3.4 Frequency Error Measurement

Total frequency error of a burst

Syntax: Execute new measurement and signal result Read result only	READ[:SCALar]:BURSt:FREQuency:ERRor? FETCh[:SCALar]:BURSt:FREQuency:ERRor?			
Return:	<value> <value> <value>	(current, unit: Hz) (average, unit: Hz) (maximum, unit: Hz)		
State: MCE, RFG, BAN	**Option:** none	Query only	**Note:** No default values, (N5), (N7)	

1.5.4 Timing Measurement

Syntax: Execute new measurement and signal result Read result only	READ[:SCALar]:BURSt:TIMing:ERRor? FETCh[:SCALar]:BURSt:TIMing:ERRor?			
Return:	<value>	(unit: Bit)		
State: MCE	**Option:** none	Query only	**Note:** No default values, (N5), (N7)	

1.5.5 IQ Spectrum Measurement

1.5.5.1 Settings for IQ Spectrum Measurement

Channel number (ARFCN) and Frequency

Syntax:	CONFigure:CHANnel:IQSPectrum:ARFCn <numeric_value>		
Value range:	GSM: -74 ... 449 GSM850: 128 ... 251 DCS1800: 462 ... 1510 DCS1900: -238 ... 810	**Default:**	GSM: 50 GSM850: 251 DCS1800: 711 DCS1900: 661
State: ALL	**Option:** B7	With Query	

Syntax:	CONFigure:CHANnel:IQSPectrum:ARFCn:FREQuency <numeric_value>		
Value range:	GSM: 875.2 ... 989.8 (in steps of 0.2 MHz) GSM850: 824.2 ... 893.8 (in steps of 0.2 MHz) DCS1800: 1800.2 ... 1989.8 (in steps of 0.2 MHz) DCS1900: 1700.2 ... 1909.8 (in steps of 0.2 MHz)	**Default:**	GSM: 903 MHz GSM850: 893 MHz DCS1800: 1750 MHz DCS1900: 1880 MHz
State: ALL	**Option:** B7	With Query	

Signal setting

Syntax:	CONFigure:IQSPectrum:MODE <value>		
Value range:	CW | Continuous signal BURSt Pulsed signal	**Default:** BURSt	
State: IDLE, MOD	**Option:** B7	With Query	

Bandwidth

Syntax:	CONFigure:IQSPectrum:BANDwidth[:RESolution] <value>		
Value range:	B4 | Bandwidth 4 kHz B10 | Bandwidth 10 kHz B20 | Bandwidth 20 kHz B50 | Bandwidth 50 kHz B100 Bandwidth 100 kHz	**Default:** B4	
State: IDLE, MOD	**Option:** B7	With Query	

Average value

Syntax:	CONFigure:IQSPectrum:AVERage[:COUNt] <value>		
Value range:	<value> 1 … 50	**Default:** 1	
State: IDLE, MOD	**Option:** B7	With Query	

1.5.5.2 Measurements

Spectrum measurement

Syntax: Execute new measurement and signal result Read result only	READ:ARRay:IQSPectrum? FETCh:ARRay:IQSPectrum?		
Return:	<value> {, <value>} (unit: dB; maximum 300 values, -150 kHz -> +150 kHz)		
State: IQSP	**Option:** B7	Query only	**Note:** No default value

Measurement of reference power

Syntax: Execute new measurement and signal result Read result only	READ[:SCALar]:IQSPectrum:POWer[:REFerence]? FETCh[:SCALar]:IQSPectrum:POWer[:REFerence]?		
Return:	<value> (unit: dBm)		
State: IQSP	**Option:** B7	Query only	**Note:** No default value

1.5.6 GPRS BLER Measurement

Enable/disable GPRS

Syntax:	CONFigure:GPRS:STATe?		
Value range:	ON, OFF		**Default: OFF**
State: IDLE	**Option:** K4	With query	**Note**:

GPRS Signalling State

Syntax:	SENSe:GPRS:SIGNalling:STATe?			
Value range:	ATTACHED, NOT ATTACHED			**Default:**
State: MSYN		**Option:** K4	Only query	**Note**:

Configure Uplink State Flag (USF)

Syntax:	CONFigure:SIGNalling:IDENtity:USF?			
Value range:	0 - 7			**Default:0**
State: IDLE,MSYN		**Option:** K4	With query	**Note**:

Configure Routing Area Code (RAC)

Syntax:	CONFigure:SIGNalling:IDENtity:RAC?			
Value range:	0 - 255			**Default: 0**
State: IDLE,MSYN		**Option:** K4	With query	**Note**:

Configure GPRS Coding Scheme

Syntax:	CONFigure:GPRS:BLER:CODIngscheme[?]			
Value range:	CS1 CS2 CS3 CS4			**Default:** CS1
State: IDLE,MSYN		**Option:** K4	With query	**Note**:

Configure number of blocks for the BLER measurement

Syntax:	CONFigure:GPRS:BLER:BLOCkstosend[?]		
Value range:	10 - 9999		**Default: 1000**
State: IDLE,MSYN	**Option:** K4	With query	**Note**:

GPRS BLER measurement on/off

Syntax:	CONFigure:GPRS:BLER:State[?]		
Value range: ON,OFF			**Default:**
State: MSYN	**Option:** K4	With query	**Note**: This command does establish and release TBF and changes the state of the instrument to BLER.

Measured values of the error rate

Syntax: Execute new measurement and signal result Read result only	READ:GPRS:BLER:ERROrrate[?] FETCh:GPRS:BLER:ERROrrate[?]		
Value range:	0 ... 100 (Unit: %)		**Default:**
State: BLER	**Option:** K4	With query	**Note**: If a read is performed on BLER, all subsequent fetches will return error rate value until a BLER read is carried out.

Measured values of the data rate

Syntax: Execute new measurement and signal result Read result only	READ:GPRS:BLER:DATArate[?] FETCh:GPRS:BLER:DATArate[?]		
Value range:			**Default:**
State: BLER	**Option:** K4	With query	**Note**: If a read is performed on BLER, all subsequent fetches will return data rate value until a BLER read is carried out.

1.6 Miscellaneous

1.6.1 Internal Instrument State

Current instrument state

Syntax:	STATus:DEVice?			
Return:	IDLE | Idle (initial state) MIDL | MS test: Idle MSYN | MS test: Synched MCE | MS test: Call established MOD | Module test Idle IQSP | IQ-spectrum BAN | Burst Analysis RFG RF generator			**Default:** IDLE
State: ALL	**Option:** none	Query only		

1.6.2 Mobile Station Details

Query for Mobile Stations Extended GSM capabilities

Syntax:	CALCulate:MOBILE:EGSM:STATus?		
Return:	NSUP Not Supported SUPP Supported		
State: MSYN or MCE	**Option:** none	Query only	**Default:** NSUP

Query for Mobile Stations Dual Band capabilities

Syntax:	CALCulate:MOBILE:DBHO:STATus?		
Return:	NSUP Not Supported SUPP Supported		
State: MSYN or MCE	**Option:** none	Query only	**Note:** Capability for 900 / 1800MHz only. **Default:** NSUP

Query for Mobile Stations Enhanced Full Rate capabilities

Syntax:	CALCulate:MOBILE:EFRC:STATus?		
Return:	NSUP Not Supported SUPP Supported		
State: MCE	**Option:** none	Query only	**Default:** NSUP

Query for Mobile Stations Half Rate capabilities

Syntax:	CALCulate:MOBILE:HRC:STATus?		
Return:	NSUP Not Supported SUPP Supported		
State: MCE	**Option:** none	Query only	**Default:** NSUP

MS HSCSD multislot capabilities

Syntax:			
Value range:	"-" - parameter is not available "A(B Dn/C Up/D Sum" , where A is a number of uplink slots B is a number of downlink slots C is a multislot class number D is maximum available number of slots		**Default:**
State: MSYN	**Option:** K4	Only query	**Note**:

MS GPRS multislot capabilities

Syntax:	SENSe:GPRS:GPRS: CLASs?		
Value range:	"-" - parameter is not available "A(B Dn/C Up/D Sum", where A is a number of uplink slots B is a number of downlink slots C is a multislot class number D is maximum available number of slots		**Default:**
State: MSYN	**Option:** K4	Only query	**Note**:

MS RGSM status

Syntax:	CALCulate:MOBIle:RGSM:STATus?			
Value range:	NSUP – not supported SUPP – supported			**Default:**
State: MSYN		**Option:** none	Only query	**Note**:

1.6.3 Write to Hard Disk

Write Settings to Hard Disk

Syntax:	PROCedure:SET:WRIte:HD?			
Return:	ON All changes are saved to hard disk OFF No new changes are saved to hard disk			
State: ALL		**Option:** none	With Query	**Note:** Not effected by *RST. **Default:** ON

1.7 Specified Commands

1.7.1 Mandatory Commands

Clear Status

Syntax:	*CLS		
State: ALL	**Option:** none	No Query	

Standard Event Status Enable

Syntax:	*ESE <numeric_value>			
Value range:	0 ... 255			**Default:** 0
State: ALL	**Option:** none	With Query	**Note:** MAXimum and MINimum impermissible	

Standard Event Status Register

Syntax:	*ESR?		
Return:	0 ... 255		
State: ALL	**Option:** none	Query only	

Identification Query

Syntax:	*IDN?		
Return:	ROHDE&SCHWARZ, CTSzz, .ssssss/sss, xx.xx yy.yy.yy (zz is the model no., eg 55, 60 or 65 ssssss/sss is the serial number of the testset, eg 123456/789 xx.xx is the software version, eg V 1.00 yy.yy.yy is the date, eg 18.10.93)		
State: ALL	**Option:** none	Query only	

Individual Status Query

Syntax:	*IST?		
Return:	0 | 1		
State: ALL	**Option:** none	Query only	

Operation Complete

Syntax:	*OPC			
Return:	1 (return only in the case of query)			
State: ALL	**Option:** none	With Query	**Note:** Also influences the OPC bit in the event status register	

Parallel Poll Enable Register Enable

Syntax:	*PRE <numeric_value>			
Value range:	0 ... 255			**Default:** 0
State: ALL	**Option:** none	With Query	**Note:** MAXimum and MINimum impermissible	

Power-on Status Clear

Syntax:	*PSC <numeric_value>			
Value range:	-32767 ... 32767			**Default:** 1
State: ALL	**Option:** none	With Query	**Note:** MAXimum and MINimum impermissible	

Service Request Enable

Syntax:	*SRE <numeric_value>			
Value range:	0 ... 255			**Default:** 0
State: ALL	**Option:** none	With Query	**Note:** MAXimum and MINimum impermissible	

Status Byte Query

Syntax:	*STB?		
Return:	0 ... 255		
State: ALL	**Option:** none	Query only	

Wait-to-Continue

Syntax:	*WAI		
State: ALL	**Option:** none	No Query	

1.8 Remarks

1.8.1 (N1)

-) The transmitter power is adapted, if necessary (see also (N3)).

-) The input may be overdriven if an external amplifier is connected.

-) The settings have only influence on the <default mobile>. It should be selected previously.

1.8.2 (N2)

During signalling, RXLEV, RXQUAL and POWER LEVEL are automatically polled by the mobile at regular intervals and thus updated.
The measurement for SENSe:POWer:MS? also runs automatically as soon as the connection is set up.

1.8.3 (N3)

-) The value is valid irrespective of the output and is automatically adapted to the output on transition to the MIDL state, which may cause the value range to be shifted.

-) The value applies to the currently set timeslot of the TCH.

-) For the value range see Manual Operation, section 2.

1.8.4 (N4)

Using a READ command, a new measurement is started and the desired value(s) returned. The result of this measurement can be repeatedly read by using a FETCh query without performing a new measurement. The FETCh command should only be used after a read has been executed otherwise initialisation values will be returned.

1.8.5 (N5)

After calling of a READ command, all scalar measurement results (average power, RMS and peak phase error and frequency error) are calculated and the desired value is returned; the remaining measurement results can be fetched using FETCh or CALCulate. However, if the measurement is made via READ:ARRay, the scalar values are available in addition to the selected field values. The measurement of the field values of the power (READ:ARRay:BURSt:POWer?) and phase error (READ:ARRay:BURSt:PHASe:ERRor?) are mutually exclusive, i.e. after READ:ARRay:BURSt:POWer? it is **not** possible to fetch the phase errors by means of FETCh:ARRay:BURSt:PHASe:ERRor?. The timing is measured when the power field values are measured, but **not** when the phase error is measured.

1.8.6 (N6)

The results of the tolerance query have the following meaning:

MATC: The measurement result observes the configured limit values
NMAT: The measurement result does not observe the configured limit values

INV: No measurement result is available

1.8.7 (N7)

If a READ measurement command cannot be performed, the CTS will return NAN (Not A Number), to indicate a non-valid result. A FETCh command will also return NAN either after a non-valid measurement or if no measurement has been performed previously.

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*

C

MS Power Charts

Mobile Power Classes

	GSM 850		GSM 900		DCS 1800		PCS 1900	
Power Class	**Max. Peak Power (W)**	**dBm**	**Max. Peak Power (W)**	**dBm**	**Max. Peak Power (W)**	**dBm**	**Max. Peak Power (W)**	**dBm**
1	20	+43	20	+43	1	+30	1	+30
2	8	+39	8	+39	0.25	+24	0.25	+24
3	5	+37	5	+37	---	---	2	+33
4	2	+33	2	+33	---	---	---	---
5	0.8	+29	0.8	+29	---	---	---	---

Mobile Power Control Levels

	Peak Power (dBm)			
Power Control Level	**GSM 850**	**GSM 900**	**DCS 1800**	**PCS 1900**
0	+43	+43	+30	+30
1	+41	+41	+28	+28
2	+39	+39	+26	+26
3	+37	+37	+24	+24
4	+35	+35	+22	+22
5	+33	+33	+20	+20
6	+31	+31	+18	+18
7	+29	+29	+16	+16
8	+27	+27	+14	+14
9	+25	+25	+12	+12
10	+23	+23	+10	+10
11	+21	+21	+8	+8
12	+19	+19	+6	+6
13	+17	+17	+4	+4
14	+15	+15	+2	+2
15	+13	+13	0	0
16 to 29				reserved
30				+33
31				+32

Rx_LEV Values

The reported Rx_LEV values for received signal level are as follows:

Rx_LEV	Received Signal Level	Rx_LEV	Received Signal Level
0	Less than -110 dBm	33	-78 dBm to -77 dBm
1	-110 dBm to -109 dBm	34	-77 dBm to -76 dBm
2	-109 dBm to -108 dBm	35	-76 dBm to -75 dBm
3	-108 dBm to -107 dBm	36	-75 dBm to -74 dBm
4	-107 dBm to -106 dBm	37	-74 dBm to -73 dBm
5	-106 dBm to -105 dBm	38	-73 dBm to -72 dBm
6	-105 dBm to -104 dBm	39	-72 dBm to -71 dBm
7	-104 dBm to -103 dBm		
8	-103 dBm to -102 dBm	40	-71 dBm to -70 dBm
9	-102 dBm to -101 dBm	41	-70 dBm to -69 dBm
		42	-69 dBm to -68 dBm
10	-101 dBm to -100 dBm	43	-68 dBm to -67 dBm
11	-100 dBm to -99 dBm	44	-67 dBm to -66 dBm
12	-99 dBm to -98 dBm	45	-66 dBm to -65 dBm
13	-98 dBm to -97 dBm	46	-65 dBm to -64 dBm
14	-97 dBm to -96 dBm	47	-64 dBm to -63 dBm
15	-96 dBm to -95 dBm	48	-63 dBm to -62 dBm
16	-95 dBm to -94 dBm	49	-62 dBm to -61 dBm
17	-94 dBm to -93 dBm		
18	-93 dBm to -92 dBm	50	-61 dBm to -60 dBm
19	-92 dBm to -91 dBm	51	-60 dBm to -59 dBm
		52	-59 dBm to -58 dBm
20	-91 dBm to -90 dBm	53	-58 dBm to -57 dBm
21	-90 dBm to -89 dBm	54	-57 dBm to -56 dBm
22	-89 dBm to -88 dBm	55	-56 dBm to -55 dBm
23	-88 dBm to -87 dBm	56	-55 dBm to -54 dBm
24	-87 dBm to -86 dBm	57	-54 dBm to -53 dBm
25	-86 dBm to -85 dBm	58	-53 dBm to -52 dBm
26	-85 dBm to -84 dBm	59	-52 dBm to -51 dBm
27	-84 dBm to -83 dBm		
28	-83 dBm to -82 dBm	60	-51 dBm to -50 dBm
29	-82 dBm to -81 dBm	61	-50 dBm to -49 dBm
		62	-49 dBm to -48 dBm
30	-81 dBm to -80 dBm	63	Greater than -48 dBm
31	-80 dBm to -79 dBm		
32	-79 dBm to -78 dBm		

Rx_QUAL Values

The reported Rx_QUAL values for received signal level are as follows:

Rx_QUAL Value	Bit Error Rate Range	Mean Value
0	< 0.2 %	0.14 %
1	0.2 to 0.4 %	0.28 %
2	0.4 to 0.8 %	0.57 %
3	0.8 to 1.6 %	1.13 %
4	1.6 to 3.2 %	2.26 %
5	3.2 to 6.4 %	4.53 %
6	6.4 to 12.8 %	9.05 %
7	> 12.8 %	18.10 %

Reference Sensitivity Levels

MS Reference Sensitivity	dBm
GSM mobile class 1, 2, 3	-104
GSM handportable class 4 & 5	-102
DCS 1800 class 1 & 2	-100
DCS 1800 class 3	-102
PCS 1900 all classes	-102

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V

Test and
Measurement Division

Windows® Application CTSgo

to

CTS-K6

(Version 1.81)

1079.2001.01

Printed in the Federal
Republic of Germany

1079.2001.01 (Edition 3)

1 Contents

2 Introduction

We are very pleased to be able to present CTSgo for Windows to you. This program offers comprehensive capabilities for the remote control of Digital Radio Testers CTS50, CTS55 or CTS65. It offers in addition an autotest with versatile configurations for GSM and DECT and an interactive module test for GSM mobile phones. Autotest results are documented in an informative report, which can be stored and printed.

All brand names and product names in this manual are registered trademarks of the respective manufacturer or enterprise.

2.1 First Steps with CTSgo

The best way to get familiar with a program is learning by doing, ie to utilize the functions and practice their application. New users of CTSgo are advised to read carefully through the manual or to use the online help provided by the program. A section of this manual also gives practical hints and examples on the use of CTSgo.

2.2 Basic Knowledge Required

Before using CTSgo, you should be familiar with the basic operation of Microsoft Windows. This means that you should be able to open and close a Windows application program and know how to use the mouse. For more detailed information on Windows refer to the Microsoft Windows user manual.

2.3 Preconditions for System Use

The CTSgo program comes in a version for use under Windows 95, Windows 98 or Windows NT 4.0.

The program may be installed in German or English as desired. More information is given in the Program Installation Section.
To ensure unimpaired functioning of CTSgo, your system should meet the following basic requirements. For a more convenient use of CTSgo, particularly the presentation of measurement reports, the employed graphics card should have a better resolution than the one specified below.

Platform:	Windows 95 / Windows 98 / Windows NT 4.0
Processor:	Pentium 166
RAM:	16 MByte
Display:	VGA 640x480 pixels
Hard-disk storage:	5 MByte
Peripherals:	Mouse, one free serial interface

CTS30, CTS50, CTS55 or CTS65 is also required. To be able to make full use of all the program capabilities, software version 2.00 or higher should be installed on the CTS. The autotest can be performed as of software version 1.25 of the CTS. A test SIM card (eg Rohde & Schwarz CRT-Z2, Order Number 1039.9005.02) is also required.

A serial cable should be used for connecting your PC to the CTS. Suitable cables are described in the following section.

2.4 Suitable Serial Cables

The CTSgo program and the CTS allow for various settings of data transmission. Depending on the handshake method used, different conditions have to be met by the cable. Handshake means that the devices inform each other whether they are ready to receive data. Disabling the handshake function by setting NONE is not recommended. In the description it is assumed that a 9-contact connector is fitted at both cable ends.

Pin	Designation
1	DCD (Data Carrier Detect)
2	RxD (Receive Data)
3	TxD (Transmit Data)
4	DTR (Data Terminal Ready)
5	GND (Ground)
6	DSR (Data Set Ready)
7	RTS (Request To Send)
8	CTS (Clear To Send)
9	RI (Ring Indicator)

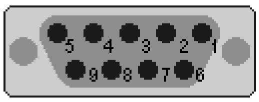
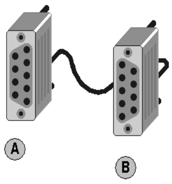


Fig.: Pin assignment of RS-232-C interface

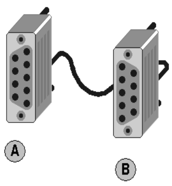
2.4.1 Cable for Xon/Xoff Protocol

Cable end A	Cable end B
Pin 2 (RxD)	Pin 3 (TxD)
Pin 3 (TxD)	Pin 2 (RxD)
Pin 5 (GND)	Pin 5 (GND)



2.4.2 Cable for Hardware Protocol RTS/CTS

Cable end A	Cable end B
Pin 2 (RxD)	Pin 3 (TxD)
Pin 3 (TxD)	Pin 2 (RxD)
Pin 7 (RTS)	Pin 8 (CTS)
Pin 8 (CTS)	Pin 7 (RTS)
Pin 5 (GND)	Pin 5 (GND)



2.5 Equipment Supplied for CTS-K6

The GSM Remote Control Option CTS-K6 (Rohde & Schwarz Order No. 1079.2001.01) comprises the following software components as well as a document with the CTS unblocking code.

- Data record “CTSgo for Windows 95 / 98 /NT 4.0 “ German version
- Data record “CTSgo for Windows 95 / 98 /NT 4.0 “ English version

3 Installation

This section describes the installation of CTSgo. The appearance of Windows is slightly different on your PC because of the various possible configurations, but the program contents and function of control elements are identical.

3.1 Preparation

Take the set of floppies for the CTSgo variant to be installed.

3.2 Procedure

3.2.1 Step 1

Insert the first floppy into the disk drive.

3.2.2 Step 2

Select the disk drive where the floppy is inserted. With Windows 95 / 98 / NT4.0, click on the My Computer icon on the Windows desktop.

3.2.3 Step 3

Click on “Setup“ to call the execution file.

3.2.4 Step 4

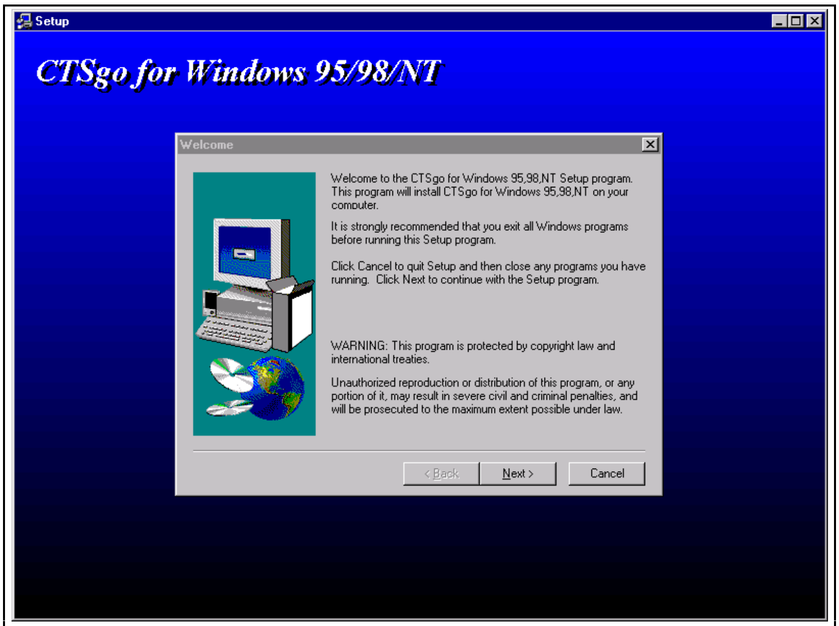


Fig.: Dialog of installation step 4

The program will guide you step by step through the installation. The following welcome screen is displayed on your PC.

Press “Next” to call the next step.

3.2.5 Step 5

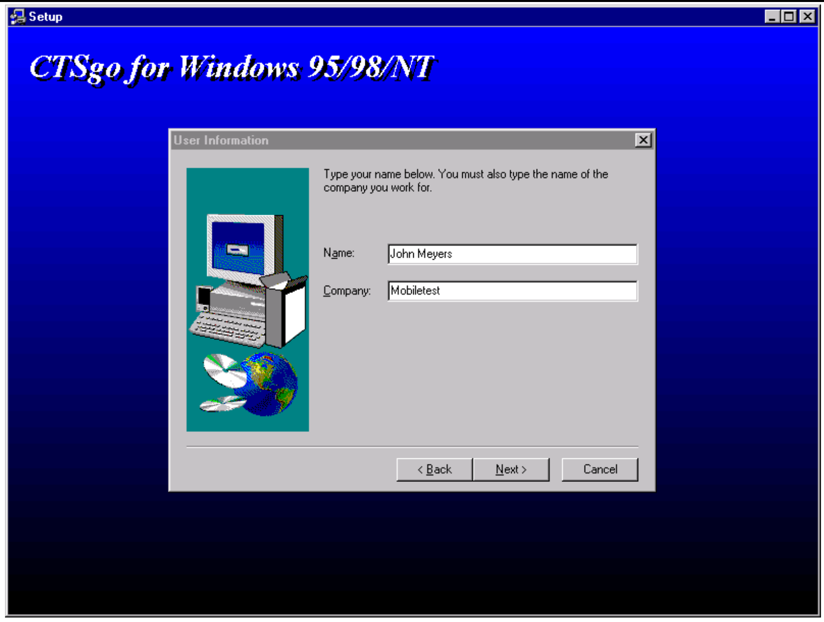


Fig.: Dialog of installation step 5

Enter your name and the name of your company in the dialog fields. After the entry continue with “Next”. Return to the last step is possible at any time by pressing “Back”.

3.2.6 Step 6

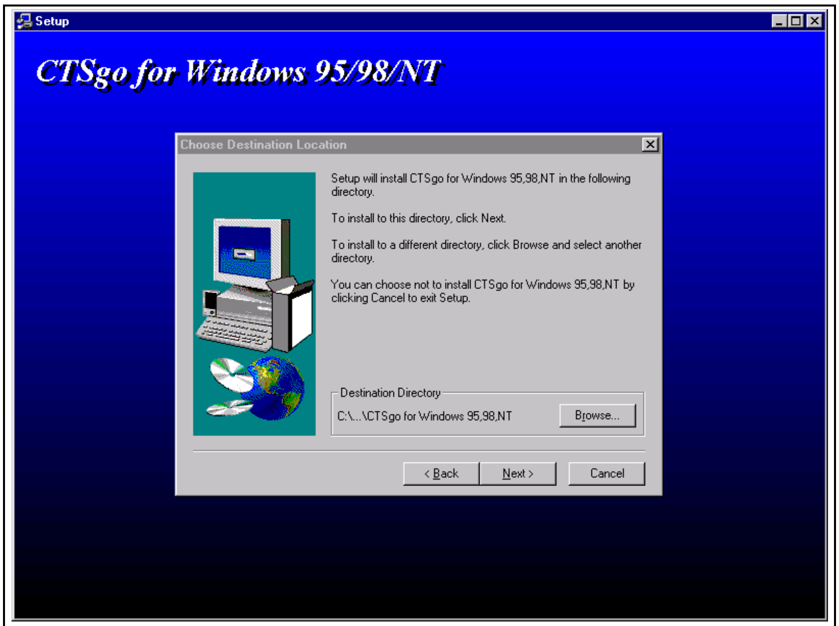


Fig.: Dialog of installation step 6

The installation software now asks for the target directory where the CTSgo software is to be installed. Press “Browse” if you do not wish to use the proposed directory. The software can be copied into any directory. The next step is again called with the “Next” button.

3.2.7 Step 7

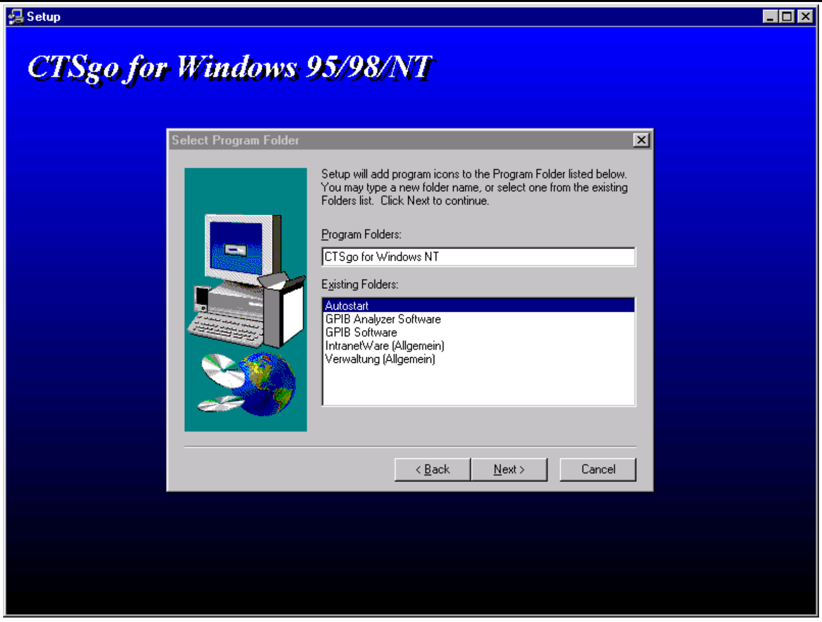


Fig.: Dialog of installation step 7

Select the folder into which the program icon is to be placed. You may create a new folder or put the icon into an already existing folder.

3.2.8 Step 8

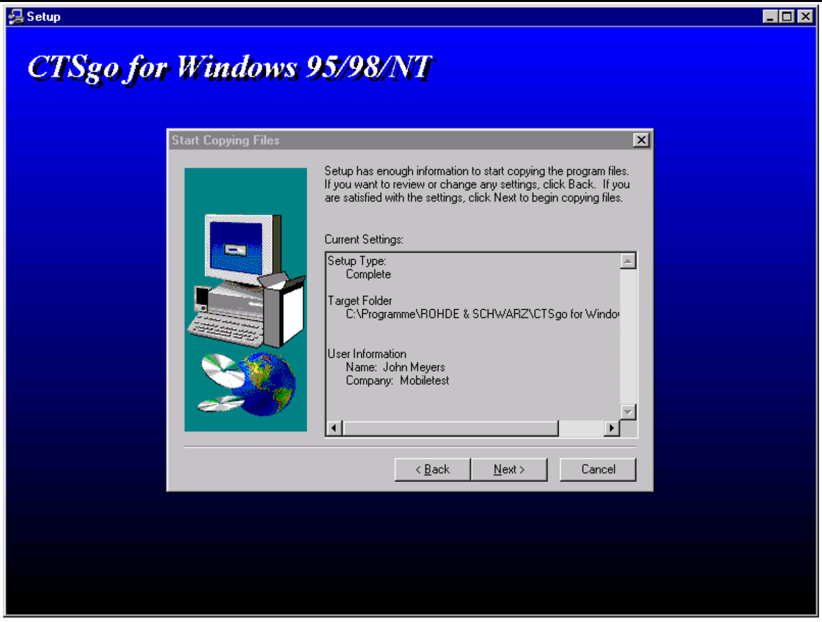


Fig.: Dialog of installation step 8

The installation software now displays all the settings made before it starts to copy the software components. Press “Back” if you wish to make further changes, otherwise press “Next”.

3.2.9 Step 9

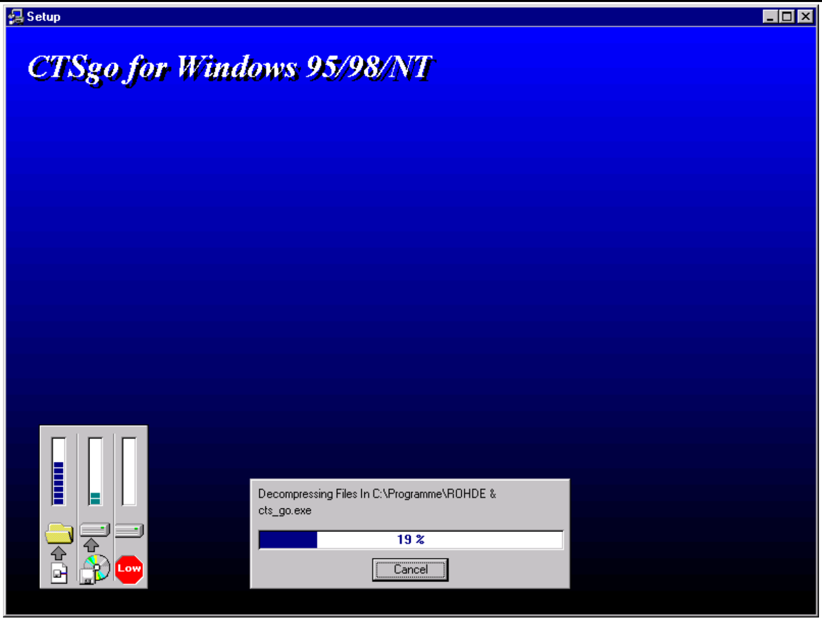


Fig.: Dialog of installation step 9

The installation software now starts to copy the software components. If desired, the installation procedure can be terminated before completion with “Cancel”. A progress bar informs you on the current installation state.

3.2.10 Step 10

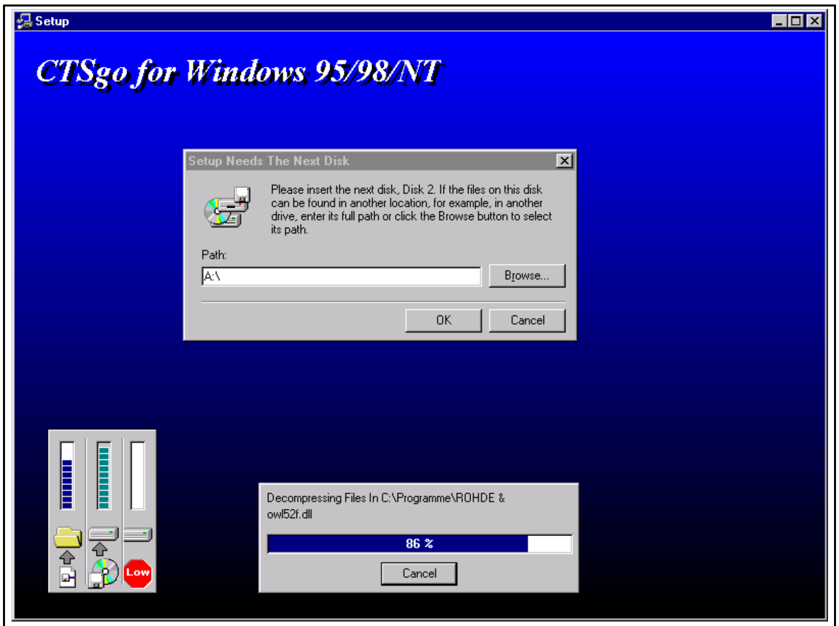


Fig.: Dialog of installation step 10

During the installation the program may prompt you to insert the next floppy. In this case remove the first floppy from the disk and insert the next one as requested.

3.2.11 Step 11

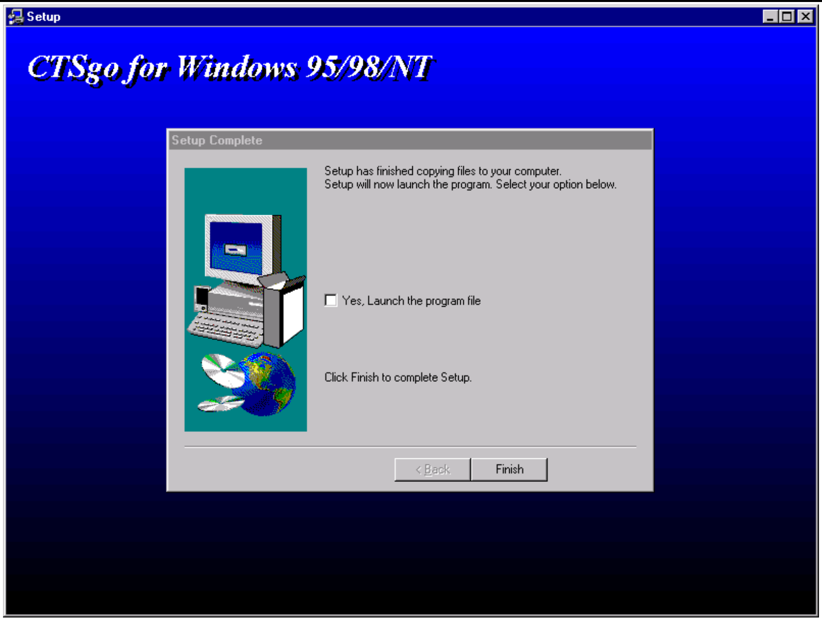


Fig.: Dialog of installation step 11

The installation was successfully completed. With the installation terminated, the program can be called up.

4 Software Components

The installation program installs the following components. To simplify deinstallation of the program, the components should preferably not be copied into the Windows directory. If further applications are to be used and copied to the Windows system directory by the runtime libraries below, these libraries may be cleared from the installation directory. This should only be done if problems occur with the remaining hard disk memory.

4.1 Installation Components

Directory (example)	Component	Function
C:\CTSGO\	CTS_GO.EXE	Program
C:\CTSGO\	CTS_GO.HLP	Online help
C:\CTSGO\	CTS_GO.INI	Initialization file
C:\CTSGO\	CTS_GO.ULV	Definition of user level
C:\CTSGO\	BDS52F.DLL	32-bit runtime library
C:\CTSGO\	CW3230.DLL	32-bit runtime library
C:\CTSGO\	OWL52F.DLL	32-bit runtime library
C:\CTSGO\	_DEISREG32.ISR	Deinstallation file
C:\CTSGO\	_ISREG32.DLL	Deinstallation file
C:\CTSGO\	DELSL1.ISU	Deinstallation file
C:\CTSGO\AUTOSAVE	SAMPLE.MRP	Example of measurement report

4.2 Other Components

During your work with the CTSgo software, configurations can be stored and called again. This allows test limits and the extent of tests to be specified for the different types of mobile phones. Test results can also be stored.

Directory	Component	Function
any	*.MRP	Measurement reports
any	*.CFG	Saved configurations
C:\CTSGO\	CTS_GO.DS1	User-defined hints under GSM
C:\CTSGO\	CTS_GO.DS2	User-defined hints under DECT

5 Deinstallation of Program CTSgo

Deinstallation is basically automatic on all platforms. The automatic deinstallation clears all files that have been stored in the controller during the installation. Other files like configuration files or measurement reports are not cleared. If required, these files must be manually removed.

5.1 Deinstallation under Windows 95/Windows 98 / Windows NT 4.0

To deinstall CTSgo go to the Windows system control level and click on “Software”. A list of the software will be displayed that can be automatically cleared. The list contains the entry “CTSgo for Windows“. Select this entry and then press the “Add/Remove” button.

6 Getting Familiar with CTSgo

6.1 Explanation of Terms

If you are familiar with other Windows programs, associated terms and concepts will be known to you. However, to simplify your working with this manual and for the sake of clarity we recommend to briefly read through the terms used in the manual.

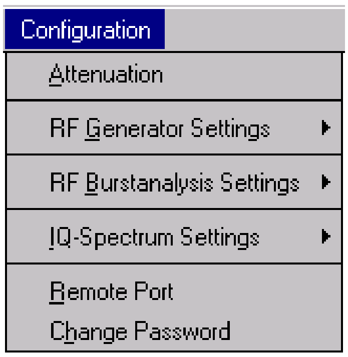
6.1.1 Title Bar

This is the horizontal bar at the top of the display. In this bar the title of the window is displayed. After a click on the bar and drawing the mouse, the CTSgo window can be shifted on the screen. By clicking the icons at the left and right end of the title bar, the CTSgo window can be reduced to an icon in the task bar, displayed at full size or closed.

6.1.2 Menu Bar

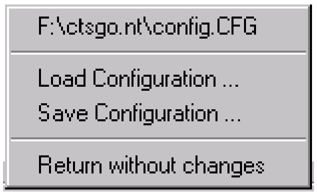
This is the line below the title bar, where the menu names are displayed. A click on a menu name opens a pulldown menu with a list of commands for the selection of CTSgo functions.

6.1.3 Pulldown Menu



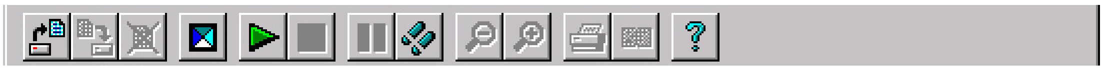
This is a command line which is pulled down after clicking on a menu name in the menu bar. Move the mouse cursor through the list and select the desired command by a click on the left mouse key. A pulldown menu may contain further menus, the so-called submenus. You can recognize these submenus by the arrows that point to the left or right. If you move the mouse to such a menu item the submenu will be opened.

6.1.4 Popup Menu



This menu contains commands and is displayed in the main menu at the position of the mouse cursor when the righthand mouse key is pressed. Move the cursor through the commands and release the righthand mouse key on the desired command. Popup menus are context-sensitive, ie they contain the main commands of the currently chosen program level.

6.1.5 Toolbar



This is the line below the menu bar where icons are displayed for the main commands. These icons correspond to the commands in the pulldown menus. Click on one of the icons to call the respective CTSgo function.

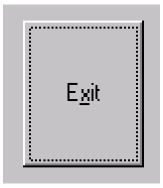
6.1.6 Status Bar

This is the horizontal bar at the bottom of the screen. In the status bar, general information is displayed, eg information on function keys pressed on the keyboard, time and program status. When a menu command is selected, a brief explanation of this command is given in this line.

6.1.7 Scrollbars

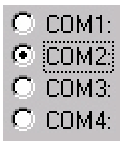
There are vertical and horizontal scrollbars. They are displayed when the current window cannot be shown completely on the screen. An arrow is displayed at the end of each scrollbar. The arrows indicate the direction into which the window can be shifted. A brief click with the left mouse key shifts the window by one step in the desired direction. By clicking on an arrow and holding the mouse key down, the displayed window can be shifted at higher speed. A slider is displayed inside the scrollbar. To go to the desired display area, this slider can be moved with the left mouse key held down. A click into the area between slider and arrow will move the slider a great step towards the arrow.

6.1.8 Buttons



Buttons are part of dialog windows. Click on a button with the left mouse key to execute the desired function.

6.1.9 Option Boxes

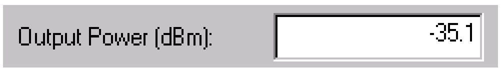


Option boxes permit to select one of several different options. The selected option is filled in by a point.

6.1.10 Check Boxes

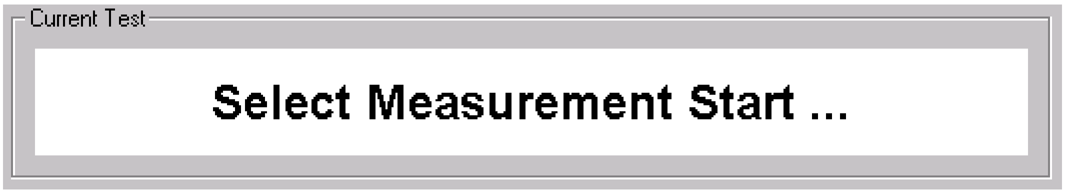
With these boxes an option can be activated or deactivated. The option is activated when an X or hook is displayed in the box. It is deactivated when the box is empty.

6.1.11 Input Boxes



Text or numerals can be entered in these fields. If it is necessary to check the range of the input value, press the OK button in the dialog. In this case you are prompted to repeat the entry with permissible values.

6.1.12 Information Boxes

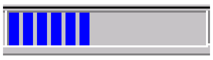


Some dialog windows contain a user info box where information in plain text or graphics on the program status or on selection or setting results is displayed.

6.1.13 Output Boxes

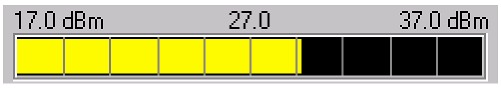
Output boxes look like info boxes, but they cannot be activated.

6.1.14 Progress Bars



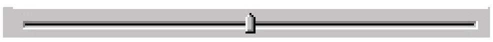
Progress bars indicate the current status of an action.

6.1.15 Graphics Result Display



Measurement results are reproduced graphically in the form of a bargraph. Vertical range markers are part of the display.

6.1.16 Slider



Similar to the use in audio mixers, the slider serves for making settings. Move the slider with the left mouse key held down to obtain the desired setting. A click in the area between slider and range end will move the slider a great step towards the range end.

6.2 CTSgo Program Structure

CTSgo uses five main operating modes:

- GSM autotest dialog. The GSM autotest can be started in this mode for generating new measurement reports.
- GSM module test dialog. This is an interactive mode where generator settings can be made on the CTS, a GSM burst analysis performed and the IQ spectrum viewed.
- GSM report display. In this mode, recorded GSM measurement reports can be loaded, viewed, saved or printed.
- DECT autotest dialog. In this mode, the DECT autotest can be started for generating new measurement reports.
- DECT report display. In this mode, recorded DECT measurement reports can be loaded, viewed, saved or printed.

6.3 GSM Autotest Dialog

After the first start, the CTSgo program is in the GSM autotest mode. The sequence control of the autotest is in the stop mode at this point in time. If you wish to change settings for the autotest, you should do it now. The individual menus and associated commands are described in the following sections.

The autotest dialog comprises four main windows:

- “Message” window where the progress of the tests is indicated. If required, user prompts can also be displayed. So, for instance, the instruction to switch the mobile off and on again to initiate a location update.
- “Current Test” window where the currently performed autotest step is described.
- Progress bars informing on the state of the current test and of the total test to allow the user to estimate the remaining test time.
- Result window for indicating the number of performed tests with a distinction made between tests passed and tests failed.

The dialog also comprises a button for terminating the program.
In the status bar, the time and information on keyboard settings are displayed.

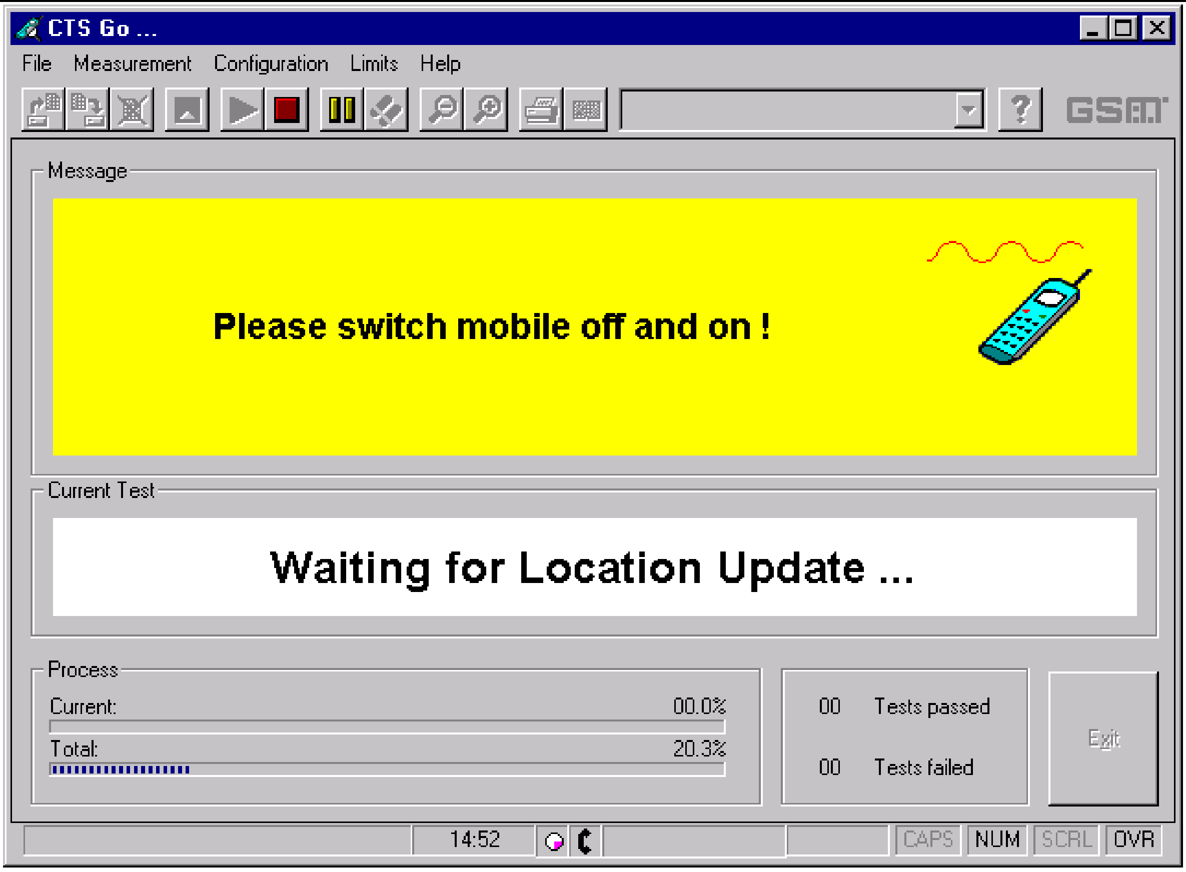


Fig.: CTSgo in GSM autotest mode

The following elements are displayed to the right of the time of the day:

 Status indication of program sequence. The status check in the sequence control is made periodically. With each performed cycle the icon is rotated by 90°. Events on the serial interface also cause the icon to move. If the icon does not rotate, the Windows system is overloaded. In this case terminate all other programs, if required, also terminate and restart CTSgo.

 Status information on CTS operating status. In some sequences of the autotest, the sequence control queries the CTS operating status. Each icon corresponds to a specific status of CTS. The device states shown below are described in the remote-control section of the CTS manual. The red lamp indicates an undefined device status.

 IDLE (switch-on status of CTS).

 MIDL (BCCH being generated).

 MSYN (Location Update terminated).

 MCE (call set up).

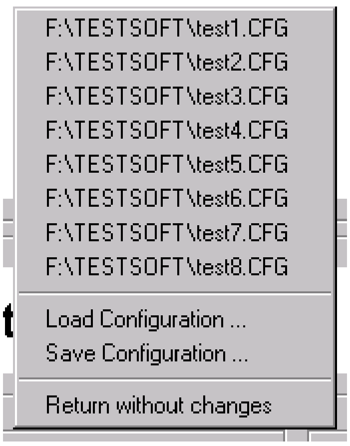


Fig.: Popup menu in GSM autotest dialog

A progress bar to the right of the CTS status icon informs the user on the status of the serial interface. At each write and read event the bar is started from the left side. The end position of the bar at the right is reached when a timeout of the remote-control interface occurs. This maximum waiting time for an interface response can be configured by the user.

Pressing the righthand mouse key in the autotest dialog window opens a popup menu , where previously entered parameter sets can be stored as configuration files for reloading later on. The paths of up to eight stored configuration files are displayed. Move to the desired entry with the righthand mouse key held down and then release the key. The selected file is loaded and the name of the selected configuration file is displayed in the title bar.

The interaction of the mobile phone and autotest is indicated in the Message field. The following animated icons are used:

 The test expects the mobile to synchronize to the base station signal of the CTS.

 The mobile rings and waits for call pick-up. This status is shown by a to and fro movement of the displayed handy.

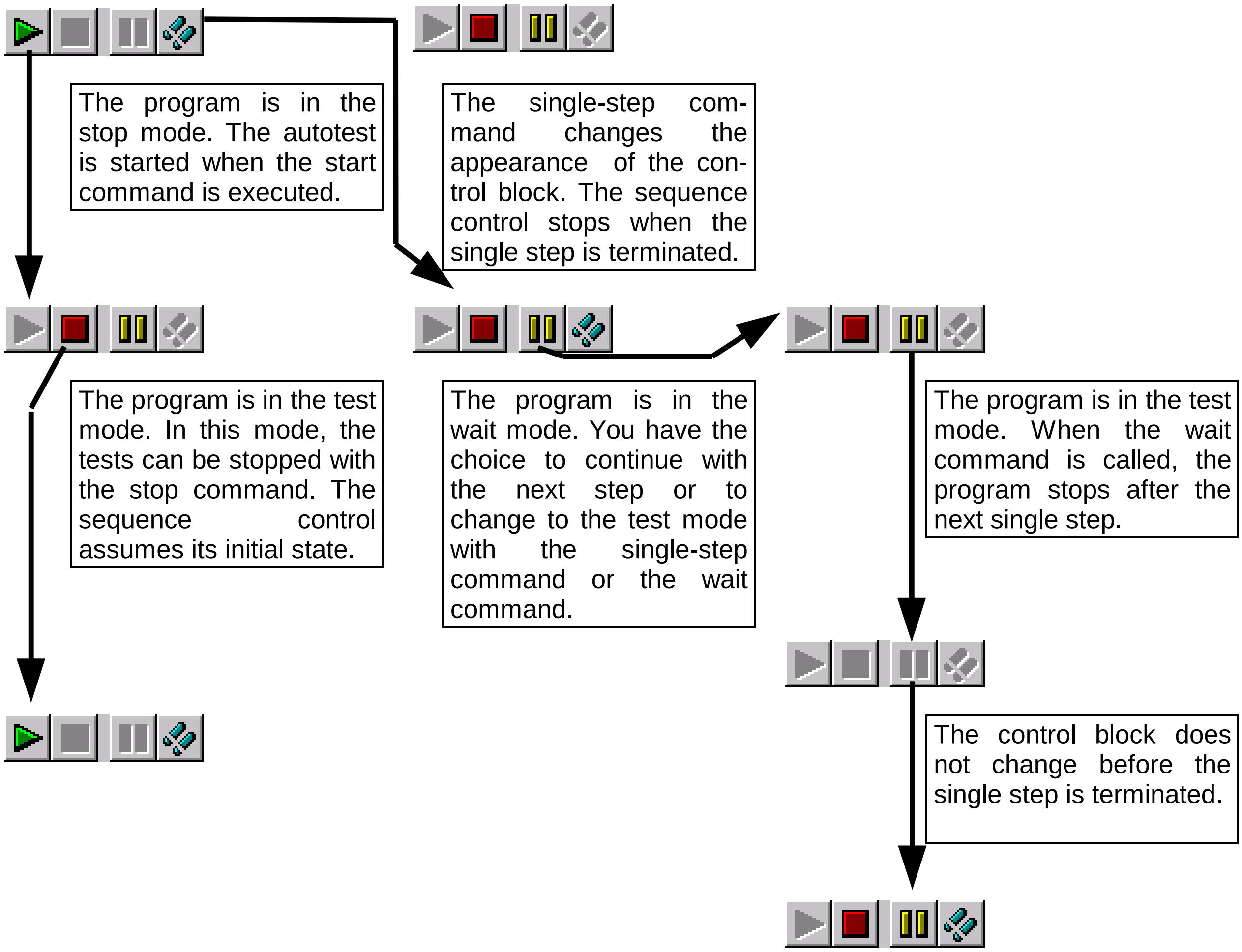
 The transmitter and receiver tests are in progress.

 You are requested to terminate the call. The left key on the mobile shown in red flashes during animation.

You are requested to set up a call. The righthand key on the mobile shown in green flashes.

6.3.1 Sequence Control of Autotest

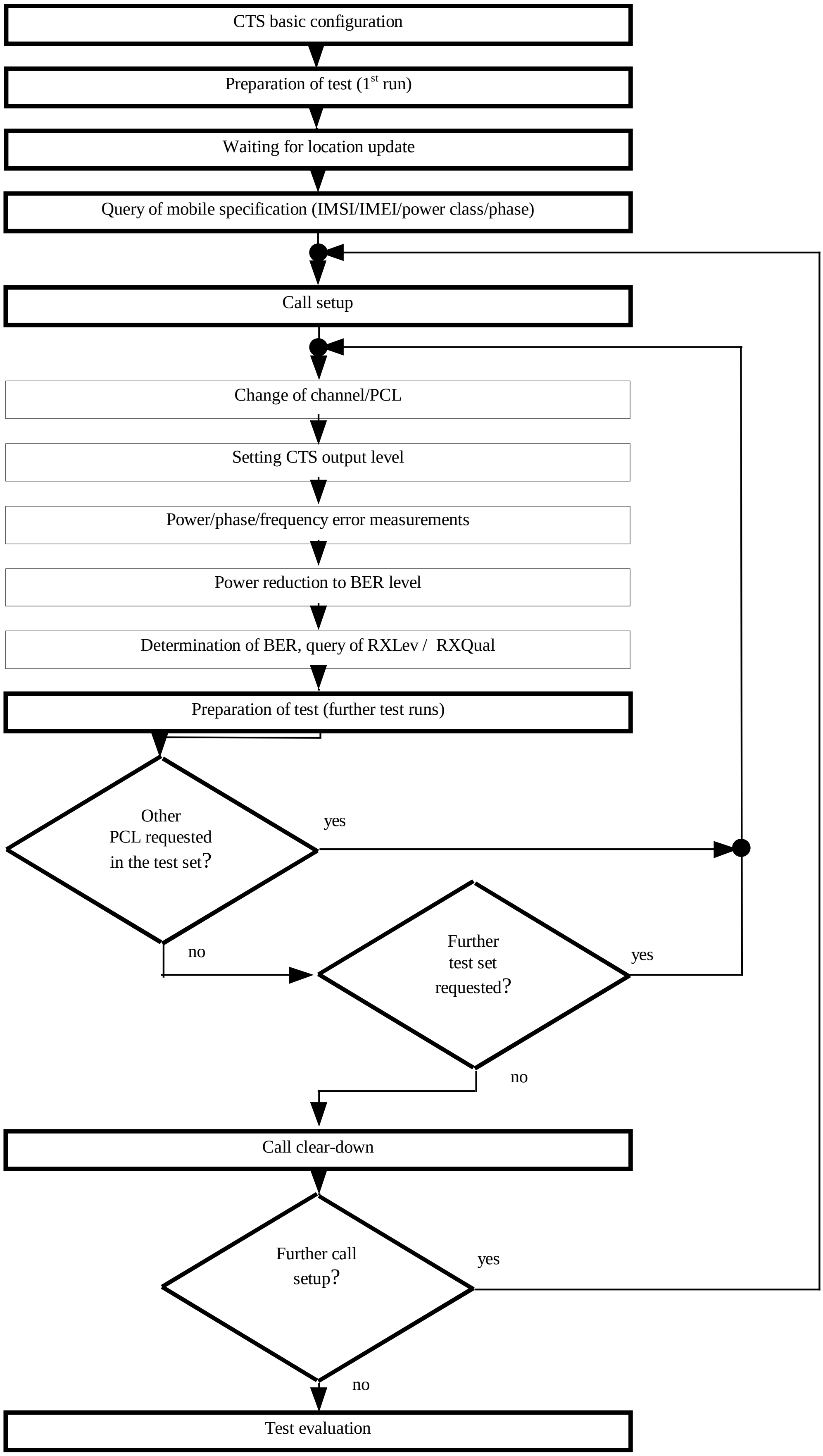
With the CTSgo program, the autotest mode is called. The sequence control is in the stop mode so that you can perform the configurations that are still needed. In this mode, you may choose between the following possibilities:



Observe the appearance of the described block in the toolbar during autotest control.

Note:
Commands of the menu bar can only be called in stop mode. After the change to the stop mode, the sequence control is reset. Restarting the sequence control restarts the autotest.

6.3.2 Structure of GSM Autotest



6.4 GSM Module Test Dialog

The GSM module test comprises three functions: operation of the CTS as generator, burst analysis using the CTS and IQ spectrum display. The module test and thus data transmission between CTS and CTSgo start in generator mode. The left block in the dialog window indicates which of the ten generator sets has been activated. A generator set includes the channel, the associated frequency offset, and the output level of the generator. The set level applies to connector RF In/Out or RF Out 2 of the CTS, depending on the setting. This setting can be seen under the option Used RF connector. The boxes of the block indicate whether the generator is switched on, whether the output signal contains a bit modulation or whether a ramped or continuous signal is used. The midamble used is indicated in another box of the window. To simplify the use of dual-band or triple-band mobiles, the network definition and the RF attenuation value between mobile and measuring instrument CTS are also part of the generator set. The network and the attenuation value of the current generator set can be seen in the right block.

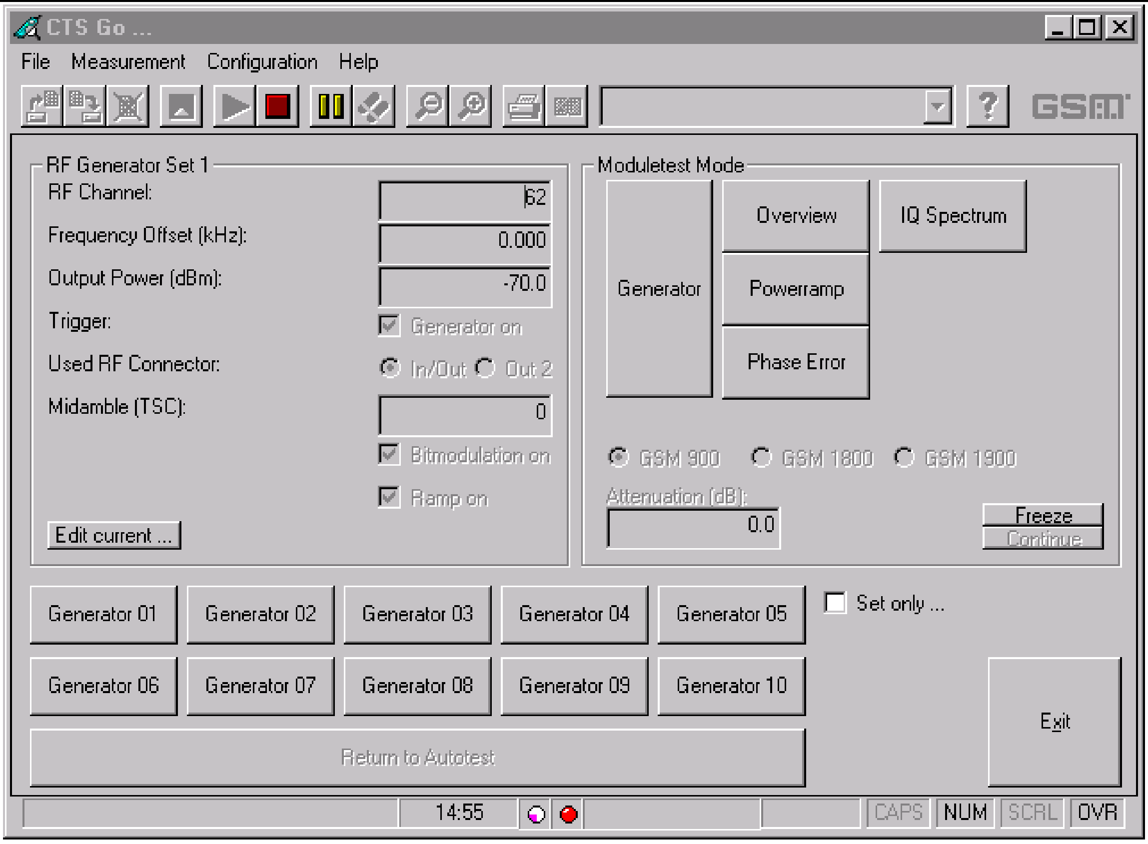


Fig.: CTSgo in GSM module test mode

Important:
With bit modulation switched off, the displayed training sequence is of no importance. All other settings are ineffective when the generator is switched off.

One of the ten generator sets can be selected using the buttons Generator 01 to „Generator 10“. The CTSgo program will act differently depending on whether the Set only box is activated or not. With this box activated, new generator settings are immediately active. When the box is empty, the user is requested in a dialog to enter the desired generator settings. Terminating the dialog with OK sets the entries.

The RF generator dialog can also be terminated with Cancel. In this case, the generator settings are not changed. If required, the channel and the frequency offset can be converted to a frequency with the aid of this dialog. For further information refer to the dialog description.

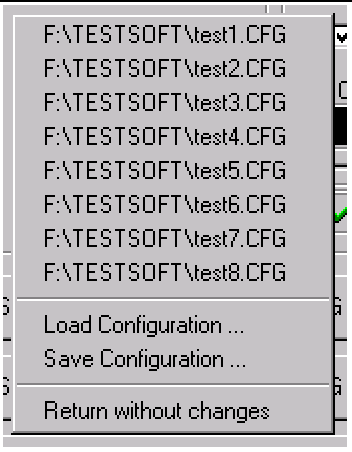


Fig.: Popup menu in GSM module test dialog

Like in the autotest, the user can load parameters or store the current setting with the aid of a popup menu. In this case, the generator settings are overwritten. This enables the user to define more than ten generator sets by including configurations in the definitions of the required generator sets. This popup menu can only be activated with a click on the righthand mouse key when the sequence control is in the stop mode. Loading of configuration files also changes the autotest settings as well as the burst analysis parameters and the IQ spectrum. The burst analysis mode can be selected by pressing one of the buttons Overview, Power ramp or Phase error. Depending on the key selected, a different popup window for the result display will appear. The appearance in the left frame of the module test dialog window is also changed. The parameter set of the burst analysis is now displayed. It comprises the selected channel, the expected power at the input of the CTS, the trigger mode and the training sequence of the signal to be measured. The keypad now contains the ten buttons Analyzer 01 to Analyzer 10 for activating one of the ten parameter sets for burst analysis. As with generator mode, the network selected GSM900, GSM1800 or GSM1900 and the attenuation are part of the parameter set, the associated values are indicated at the right of the module test dialog.

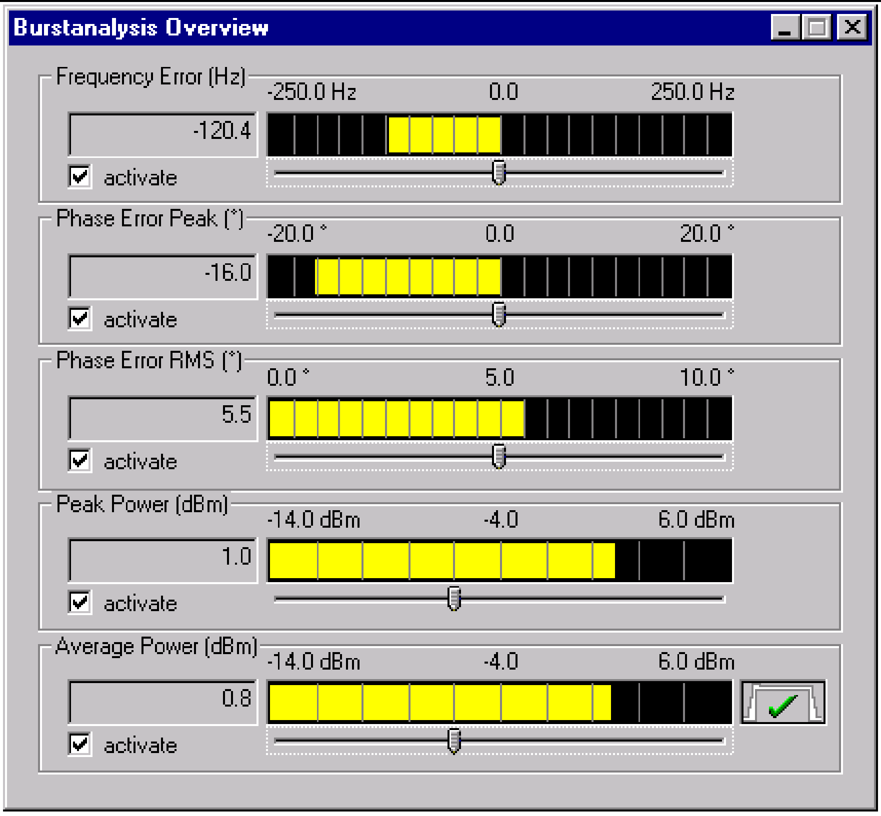
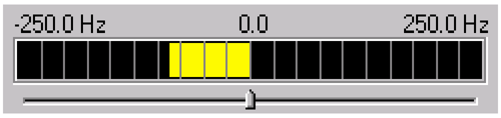


Fig.: Popup menu in GSM module test dialog

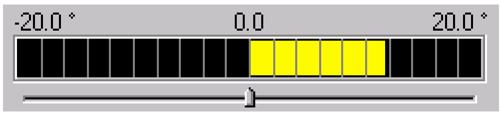
The results of the burst analysis are displayed in the popup window Burst Analysis Overview" . The desired measurement can be activated by means of the boxes. The associated numerical result is displayed in the respective field. The measurement result is also displayed as bargraph in the graphics result display . The measurement range can be varied using the slider below the bargraph . Moving the slider to the left reduces the measurement range, moving it to the right extends the range. The bargraphs for the different measurements with range limits are shown below:

Frequency error



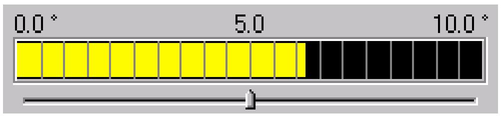
Measurement range	Lower limit	Bar center	Upper limit
Default	-250 Hz	0 Hz	+250 Hz
Minimum	-125 Hz	0 Hz	+125 Hz
Maximum	-500 Hz	0 Hz	+500 Hz

Phase error (Peak)



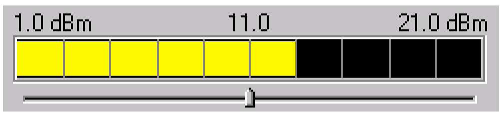
Measurement range	Lower limit	Bar center	Upper limit
Default	-20 °	0 °	+20 °
Minimum	-10 °	0 °	+10 °
Maximum	-40 °	0 °	+40 °

Phase error (RMS)



Measurement range	Lower limit	Bar center	Upper limit
Default	0 °	5 °	10 °
Minimum	0°	2,5°	5°
Maximum	0°	10°	20°

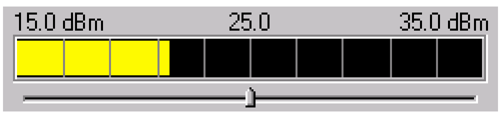
Peak power



Measurement range	Lower limit	Bar center	Upper limit
Default	x - 10 dB	x	x + 10 dB
Minimum	x - 30 dB	x	x - 10 dB
Maximum	x + 10 dB	x	x + 30 dB

x = expected power

Average power

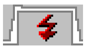


Measurement range	Lower limit	Bar center	Upper limit
Default	x - 10 dB	x	x + 10 dB
Minimum	x - 30 dB	x	x - 10 dB
Maximum	x + 10 dB	x	x + 30 dB

x = expected power

The graphics display next to the display of the average power informs the user on whether the measured values are within the GSM tolerance mask.

 Measured values within tolerance mask.

 Measured values outside tolerance mask.

 Tolerance mask not evaluated.

CTSgo will not evaluate tolerances in the module test when the peak power measurement is the only one active. The expected power for the power measurement and other parameters influencing the burst analysis can be entered in a dialog which is displayed when the Burst analysis button is pressed. With the Freeze button, the numeric and the graphics result display are frozen, ie the displayed values are not updated. Remote control is however not interrupted. This status is terminated with the Continue button.

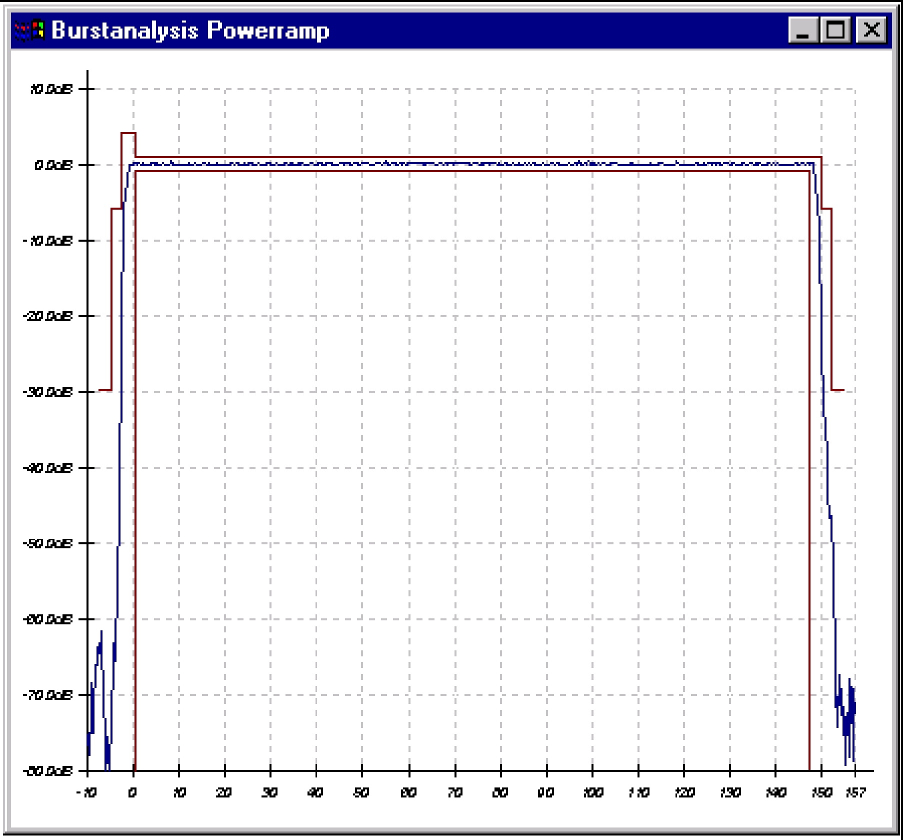


Fig.: Popup menu in GSM module test dialog

The Power ramp button permits to display a popup window with the display of the power ramp. The graph shows the power versus the bit position. The CTS measures the power with fourfold oversampling so that four measured values (quarter bits) are recorded within the time frame for one bit. Next to the power ramp that is shown as a blue curve, the tolerance mask is displayed as red curve. Since no PCL is known in the module test, the display may slightly differ compared with the autotest measurement. If the average power is not measured in parallel, the lowest tolerance lines are not displayed.

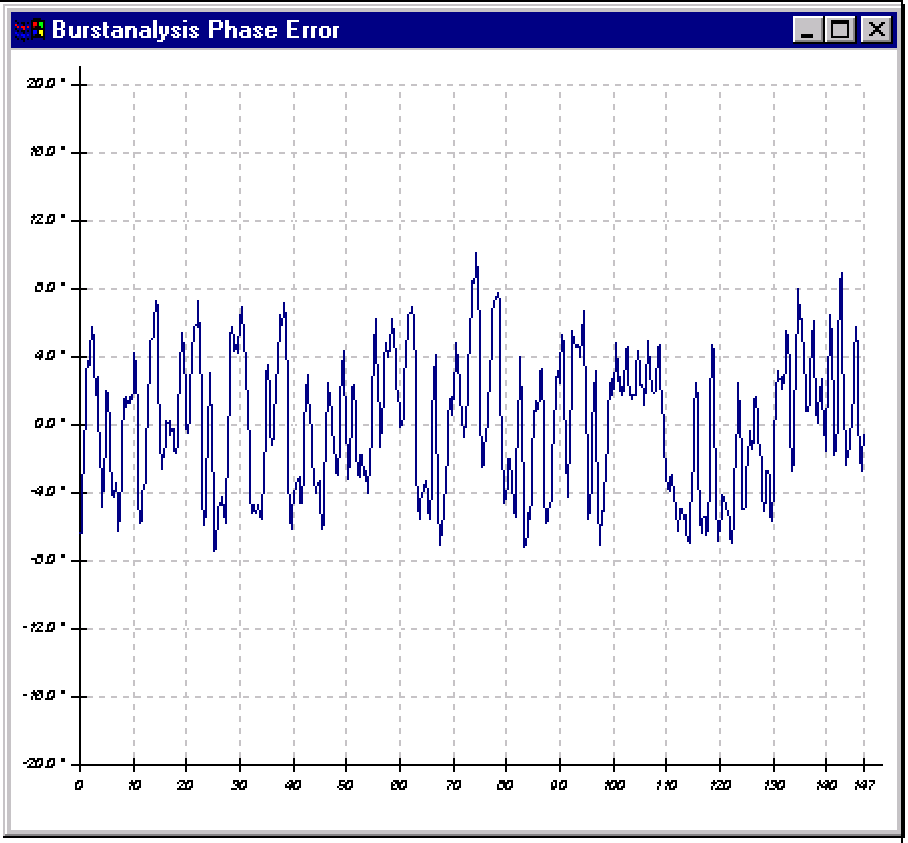


Fig.: Popup menu in GSM module test dialog

The Phase error button displays a popup window with the display of the phase curve versus the bit position within the ramp. The CTS also measures the phase with fourfold oversampling.

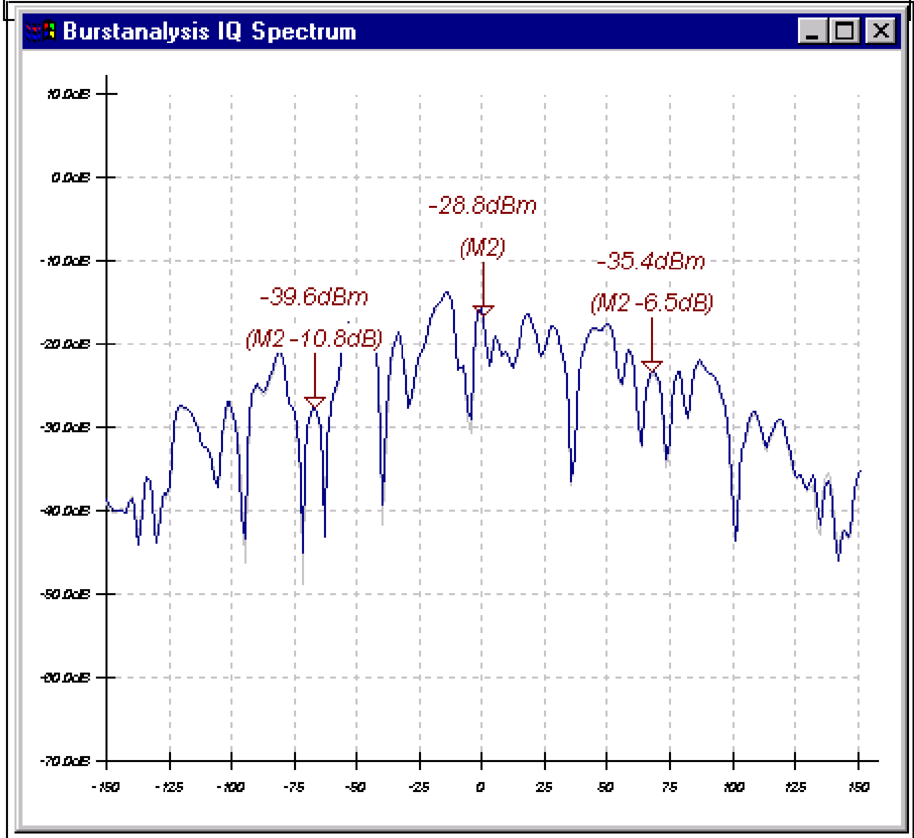


Fig.: Popup menu in GSM module test dialog

By pressing the IQ spectrum button, you can select the operating mode for viewing the spectrum within a GSM channel, which is also called “Narrow Spectrum” or “IQ spectrum“ . As with burst analysis or generator mode, 10 parameter sets are available. The keypad contains ten buttons IQ Spectrum 01 to IQ Spectrum 10, the left block displays the channel, the averaging factor, the expected power at the input of the CTS, the expected waveform and the selected filter bandwidth.

Typically, an output signal of a mobile modulated with a 0s or 1s sequence is measured without signaling in this operating mode. In this case, the signal carrier features a 67.7-kHz offset from the middle of the channel due to the GMSK modulation. The RF signal on the suppressed carrier and on the other sideband should be as low as possible.

Three markers (M1 to M3) are displayed at the points that are typical for this measurement; in addition to the absolute level, the differences from the marker with the highest level are also displayed below. The level scale is relative to the reference level of the tester, the reference level itself is indicated at the top left of the window.

The window with the graphics display of the phase and power ramp within a burst or the IQ spectrum can be increased or reduced at will.

When the program is in stop mode, CTSgo can be terminated by pressing the End button or the operating mode of the CTSgo program changed by pressing the Return to Autotest button.

The operating status of CTS is indicated in the status bar. The icons have the following meaning:

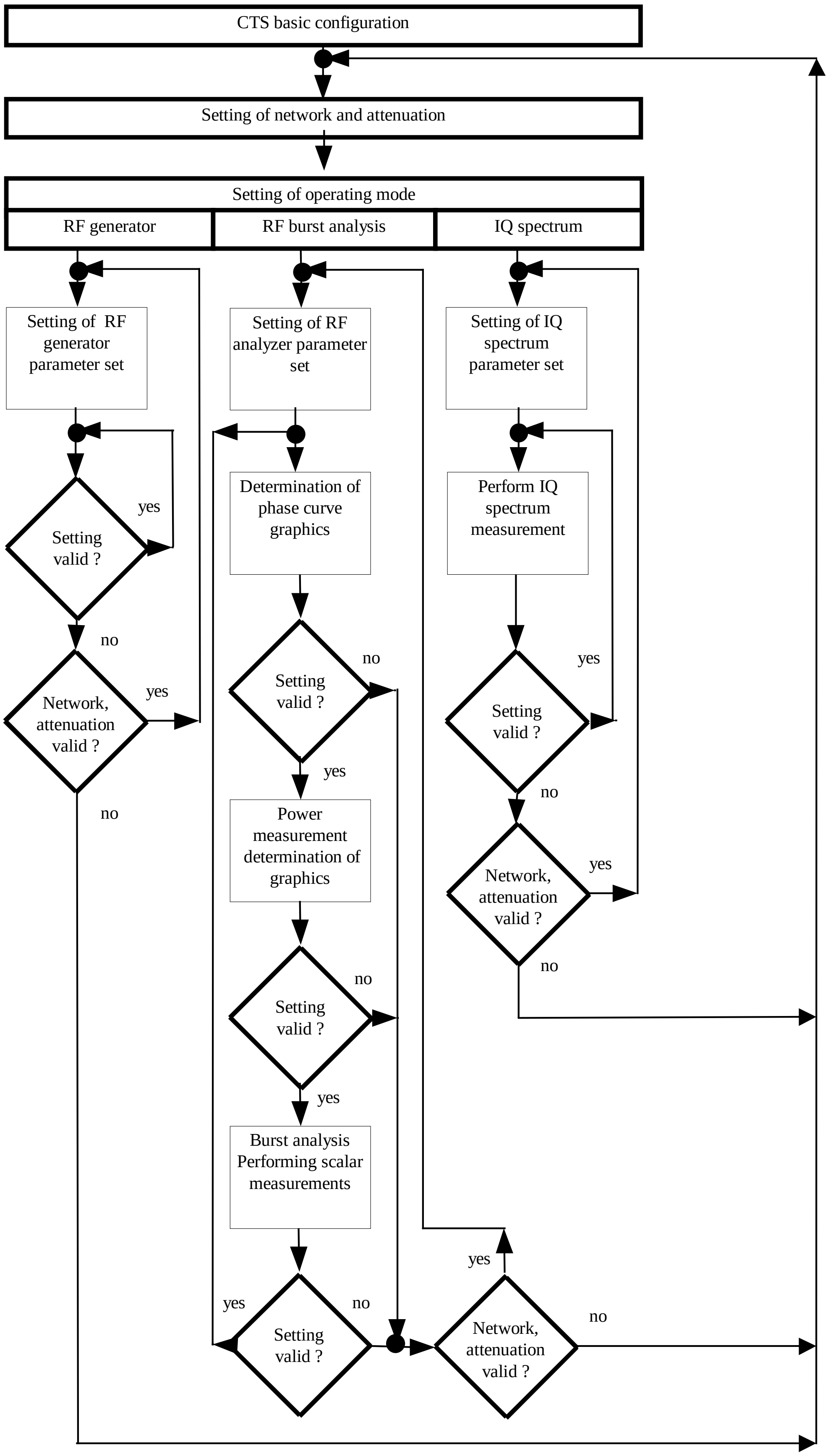

“Red lamp“. Parameter setting is not yet terminated, generator setting and burst analysis are not correctly performed.


„Green lamp“. Parameter setting is terminated, generator settings are valid and the burst analysis or IQ spectrum measurement is in progress.

6.4.1 Sequence Control of Module Test

When the module test is called, the sequence control is automatically started. The configurations for RF generator and burst analysis can be entered in parallel and are considered in the program when the entries are confirmed. You may also influence the sequence control in the same way as described for the sequence control in the autotest.

6.4.2 Structure of Module Test



6.5 GSM Report Display

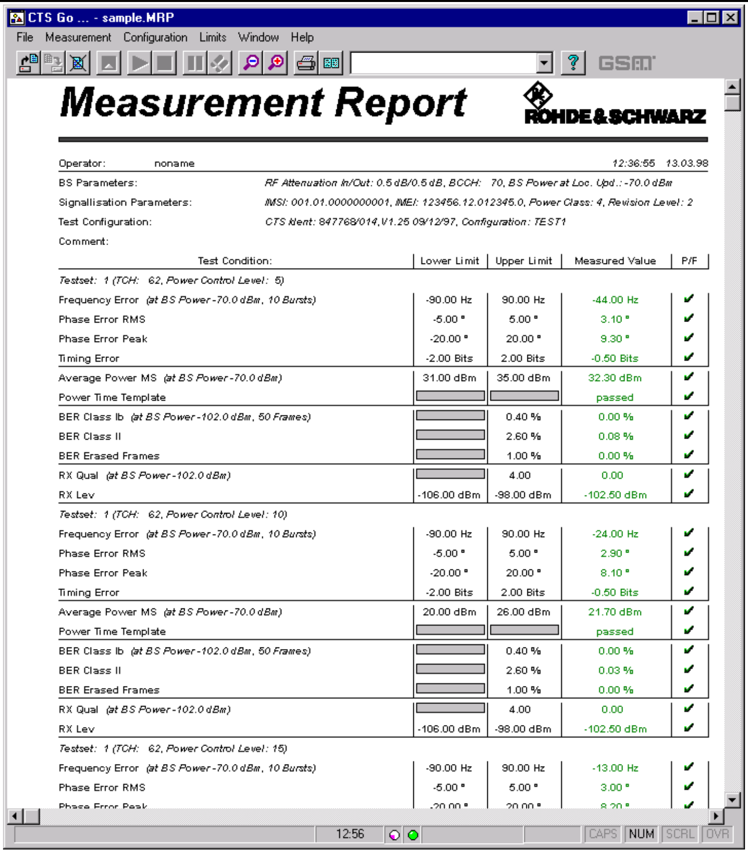


Fig.: GSM report display

In the GSM report display mode, GSM measurement results are displayed like on a hardcopy. However, contrary to the print preview, paging is not shown. Depending on the length of the measurement report and the resolution of your graphics card, the displayed section may have to be moved through the report display with the aid of the horizontal and vertical scrollbars. To optimize the displayed section, the size of the report can be reduced or expanded. To do so use a zoom command in the report display or select the command via the popup menu of the report display. This mode of CTSgo is used to display recorded measurement reports. For this reason, the sequence control is not active and the program is in the stop mode. The report mode is selected by opening a stored measurement report in the File menu by Drag & Drop, ie by drawing the icon of a measurement report into the CTSgo window with the left mouse key held down and then releasing the key. The drag & drop function will be described in a separate section.

CTSgo does not support “OLE“, ie the display of a measurement report within another application, eg word processing. Measurement results may however be exported for further processing. The displayed measurement report can also be output to a printer.

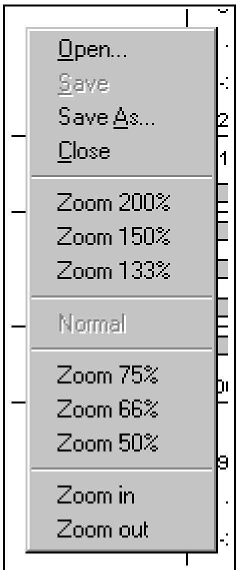


Fig.: Popup menu in report display

Note:
Only one measurement report can be displayed at a time.

6.6 DECT Autotest Dialog

The autotest dialog in DECT mode does not considerably differ from the one in GSM mode. Depending on the operating mode previously used, the operating mode GSM autotest or DECT autotest will be active with the next program start of CTSgo. For the structure of the autotest dialog refer to the section GSM Autotest. The DECT autotest comprises the test of the **F**ixed **P**art, FP for short, and the test of the **P**ortable **P**art , PP for short. The Fixed Part test is started with, since the RFPI can be requested from the base station in this test. For testing the Portable Part, the RFPI must already be known. The **R**adio **F**ixed **P**art **I**dentity is the unambiguous identification number of the fixed part. As the CTS plays the role of the Fixed Part in the Portable Part Test, it must know the RFPI to be able to address the Portable Part.

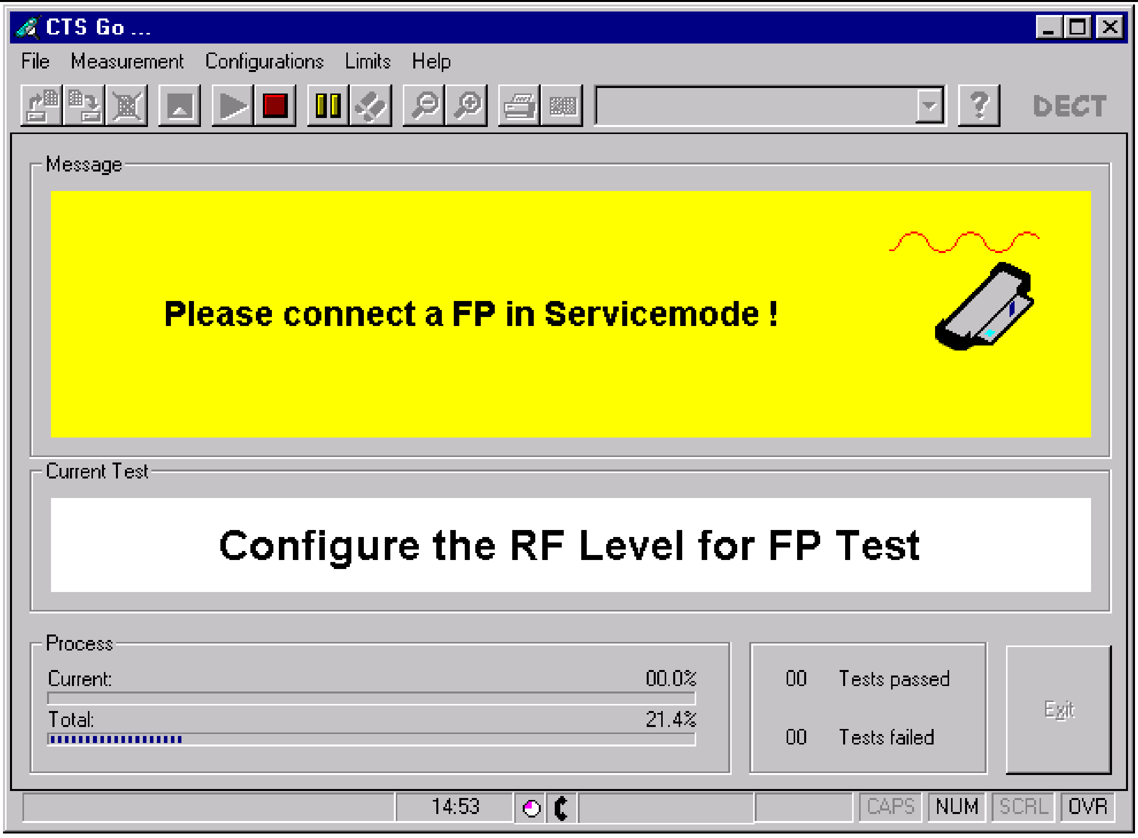
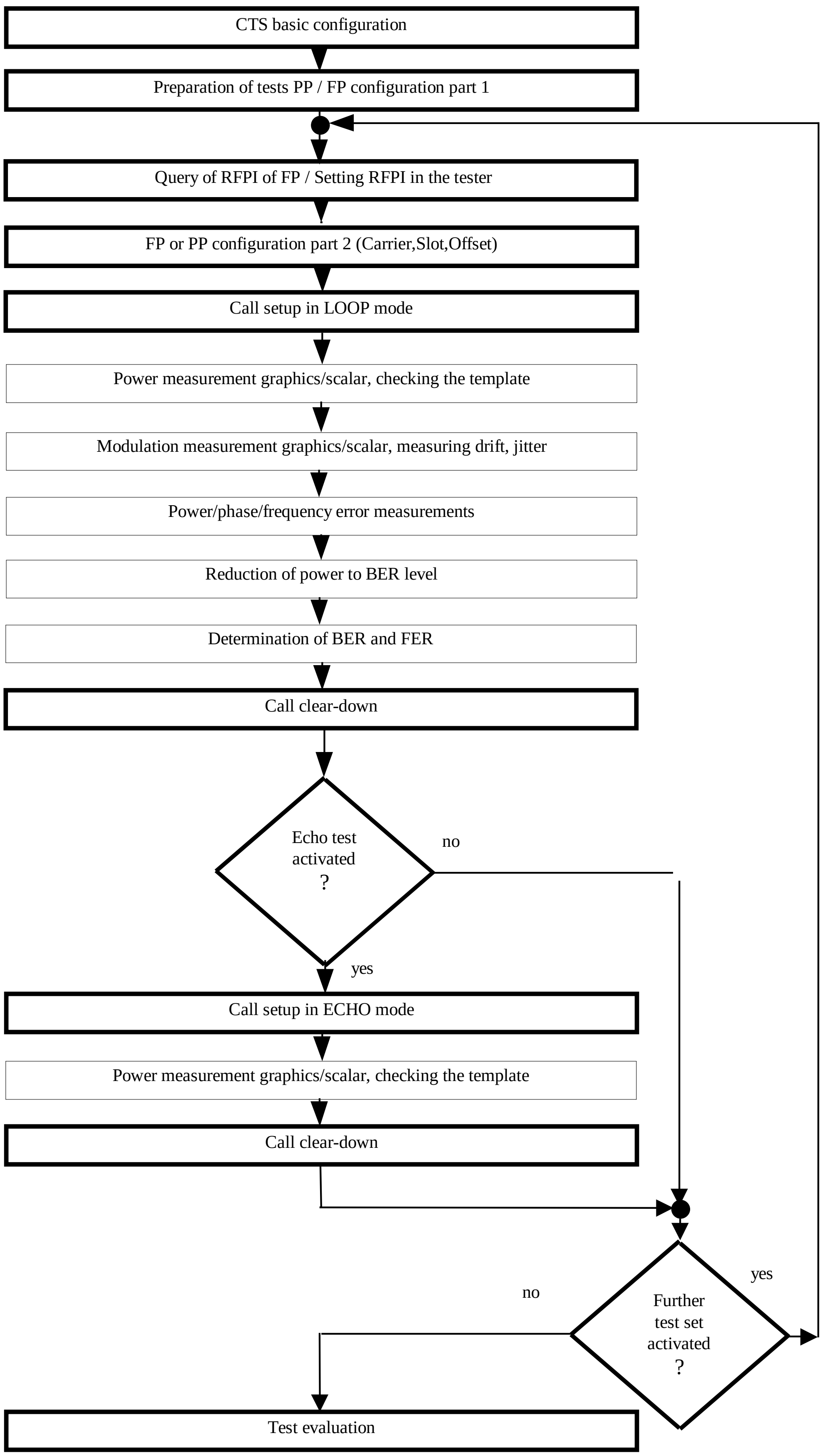


Fig.: CTSgo in GSM Module Test Mode

6.6.1 Structure of DECT Auto Test



6.7 DECT Report Display

The DECT report display mode indicates the DECT measurement results. The DECT report display corresponds to the GSM report display concerning the popup menu and the other characteristics.

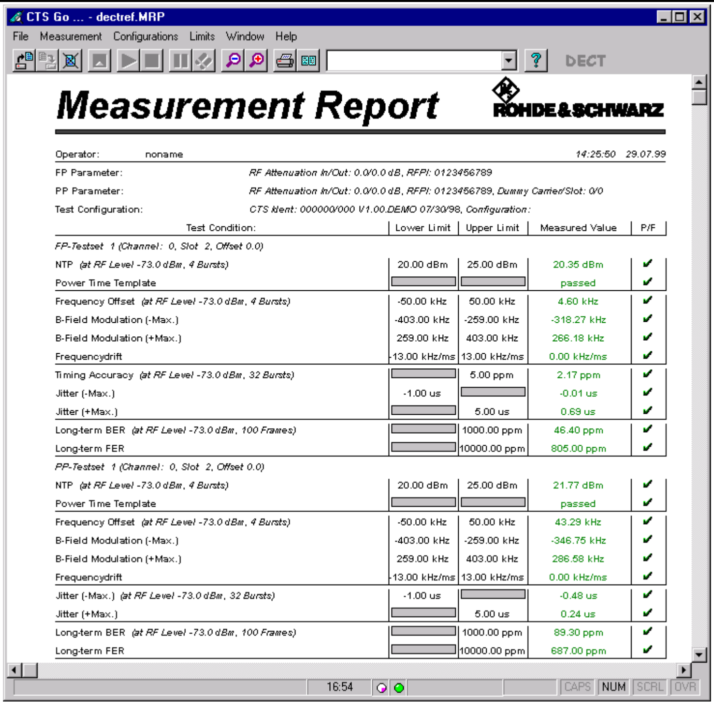


Fig.: DECT report display mode

Note:
Depending on whether GSM report or DECT report is loaded, CTSgo will change the type of display accordingly.

7 Program Menus

This section describes the commands available in the CTSgo menus. If a command can also be called via the toolbar, its icon is displayed below the headline. A command can also be called via a popup menu when the following line is displayed below the headline.

Popup menu Autotest | Popup menu Module test | Popup menu Report display

Popup menus are context-sensitive, ie they only contain commands that are relevant to the current program status.

7.1 File Menu

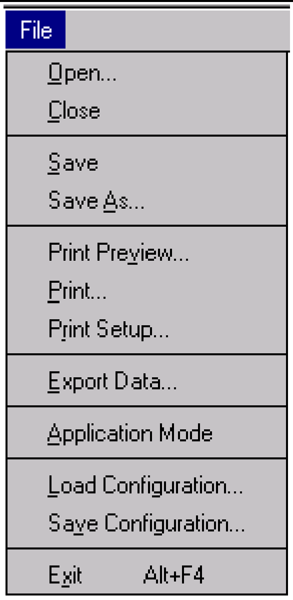


Fig.: File menu

7.1.1 Open

 Popup menu Report display

With this command, a stored measurement report is opened. A dialog is displayed where the desired file can be selected. You may have to change the directory in this dialog window. After the selection of a measurement report, the program changes to the report display mode. Measurement reports are normally stored in files with the extension .MRP on the hard disk or any other storage medium. The program automatically differentiates between DECT measurement reports and GSM measurement reports.

7.1.2 Close

 Popup Menu Report display

This command permits to return from the report display mode to the autotest or module test mode. If the displayed measurement report is not yet stored, the user will be prompted to do so.

7.1.3 Save

 Popup menu Report display

This command can be used to store a measurement report. A dialog window is opened where the directory can be selected and the report stored under the desired name.

7.1.4 Save As

Popup menu Report display

This command is similar to the Save command. It allows a saved report to be stored under another name.

7.1.5 Print Preview

This command is used to open the print preview dialog window in the report display. In this window, the measurement report is displayed in hardcopy format. Use the arrow keys to scroll between the pages. Icons are provided for switchover between single-page and double-page display. The displayed pages are indicated in the field to the right of the icons. Printing is started by a click on the respective icon. Click on Close to close the dialog and return to the report display mode.

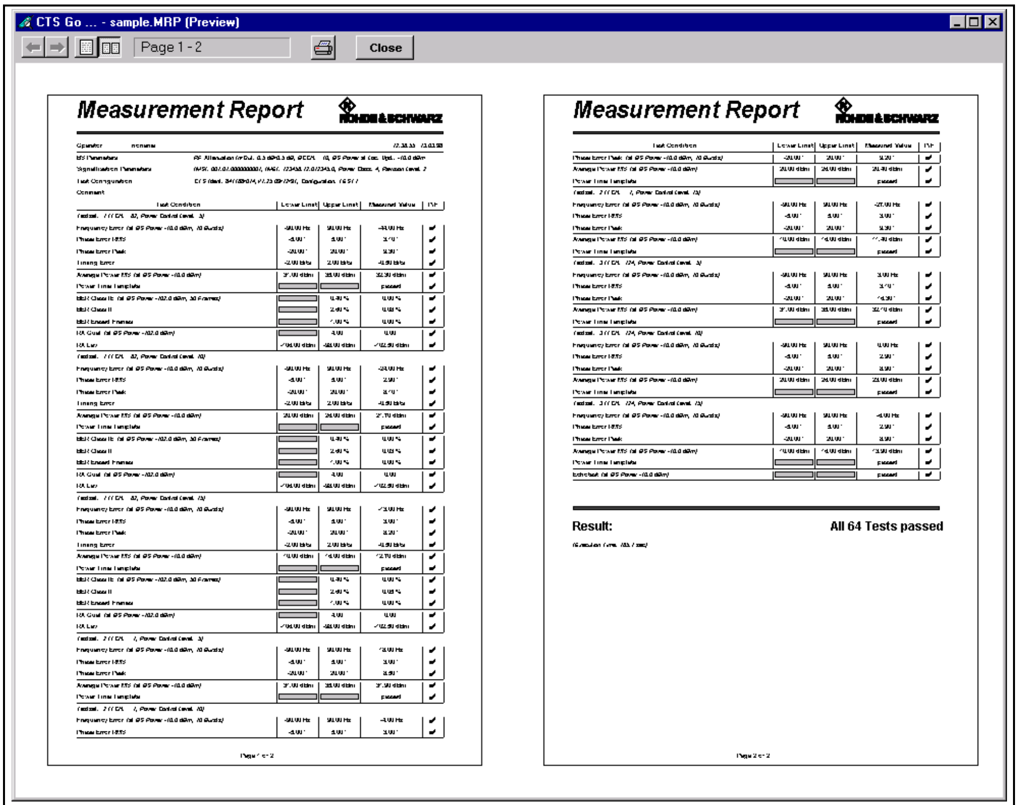


Fig.: Print preview window

7.1.6 Print

In the report display mode, the measurement report can be output to a printer. A dialog is opened where the user can select the printer to be used, the pages to be printed and the number of copies to be made. Use the print preview command to view the pages to be printed.

7.1.7 Print Setup

This command opens a dialog window at the system control level of your PC where a printer can be installed. Refer to the Windows manual for more information.

7.1.8 Export Data

The user may want to work with a measurement report in another Windows application.
To do so, select this command to open a dialog window where the desired directory can be selected and the file assigned a new name. The standard extension of export data is .DAT. Data are stored in tabulated form. Columns are separated by a tabulator, rows by carriage return (CR). Since the number format may differ from country to country, numerals are stored in the format selected in your operating system. The measurement reports can thus be read as a word file but also by spreadsheet programs or data bases.

Note:
If the number format is set incorrectly in the system control, problems may occur when data are imported. In this case, decimal points are interpreted as commas at 1000s digits. So, measured values will be incorrect by several orders of magnitude. This should be borne in mind particularly when transferring data from German-speaking to English-speaking countries.

7.1.9 Application Mode

This command opens a dialog window where the GSM autotest and GSM module test or the DECT autotest can be selected. Click on Cancel to remain in the presently active mode.

Fig.: Application mode dialog window

Note:
The report display mode is activated by selecting the Open command in the File menu.

7.1.10 Load Configuration

Popup menu Autotest   Popup menu Module test

All set configurations can be saved for subsequent use. With this command, saved configuration files can be loaded. Configuration files are assigned the extension .CFG.

Note
The previously used configurations can also be selected in the popup menu using the righthand mouse key.

7.1.11 Save Configuration

Popup menu Autotest Popup menu Module test

This command saves the set configuration. A dialog window is opened where the directory can be selected and the configuration stored under the desired file name. Configuration files are assigned the extension .CFG.

7.1.12 Exit

This command is used to terminate the CTSgo program.

7.2 Measurement Menus

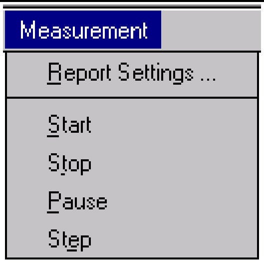


Fig.: Measurements menu in the GSM autotest, DECT autotest

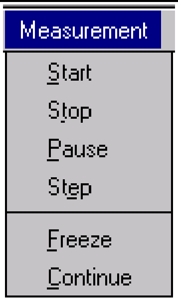


Fig.: Measurements menu in the GSM module test

7.2.1 Report Settings

This command opens the following dialog window:

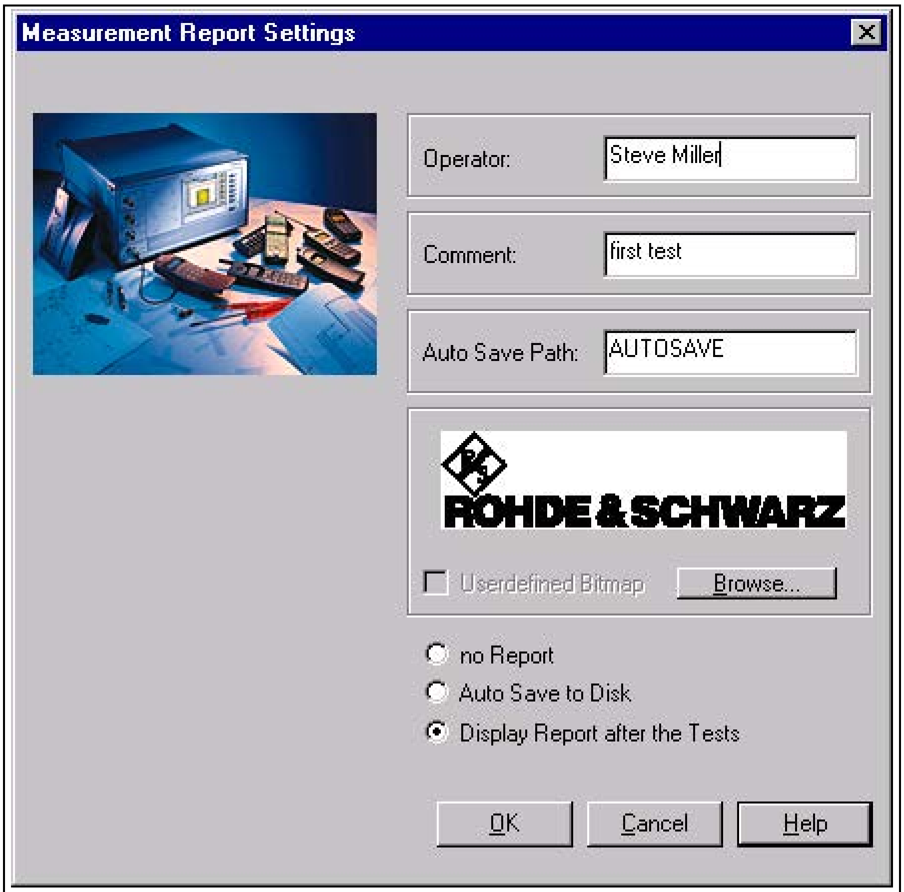


Fig.: Report settings dialog window

Enter the operator name in the first input field. The name will be stored and displayed in the header of the measurement report. A comment can be optionally included in the measurement report. It can be entered in the second input field. Three scenarios are possible when the measurement is terminated:

- Display: All tests passed – Some tests failed. A measurement report is not generated as standard. After termination of the autotest, a small dialog window is opened where you can decide on whether to continue with the next test run or view another measurement report. Use this option for short tests only where only the All tests passed – Some tests failed statement is of importance.

- Automatic generation of a measurement report. After the measurement, the program remains in the autotest dialog mode. “All tests passed – Some tests failed.” is displayed. A measurement report is saved in a user-selected directory. Measurement reports are stored with consecutive numbers „00000001.MRP“ „00000002.MRP“ etc. Like in the preceding mode, a small dialog window appears, where a measurement report can be displayed or the tests continued.
- At the end of the measurements, the CTSgo program automatically changes to the report display mode. The name and directory for storing the measurement report are then defined by the user in the File menu. This menu also contains the command for printing the measurement report.

Select the desired setting by choosing the respective option.
Enter the path for automatic storage of measurement reports in the associated input field. During program installation, the subdirectory AUTOSAVE is created as standard.

A graph is displayed at the right in the header of the measurement report. You may use the logo of your company instead of the Rohde & Schwarz logo. Within certain limits, the program tries to adapt your logo to the header of the measurement report. Optimum results can be obtained with graphics files with the following characteristics:

- Width: 900 pixels
- Height: 220 pixels
- Black/white
- Format: Windows bit map (BMP)

A file is selected in the dialog window opened with “Browse”. The “User-defined Bit Map” box“ is checked and the graph is displayed in the preview field above.

Important:
To keep the measurement report file as small as possible, the picture file is not stored in the report but merely its name. Depending on the directory in which the picture file has been stored, the file name is stored independently or with reference to the CTSgo directory. For copying measurement report files from one computer (A) to another (B), the following examples should be observed.

Storage using a relative path:

The path of the picture file is considered relative when the file is stored in the current directory or in a subdirectory of CTSgo.

Example:
The measurement report is stored in computer A:

Current directory:	C:\CTSGO\
Picture file:	C:\CTSGO\BITMAPS\USER.BMP

To display the measurement report on Computer B:

Current directory:	C:\MYWORKS\CTSGO\
Picture file:	C:\MYWORKS\CTSGO\BITMAPS\USER.BMP

Storage using an absolute path:

The path of the picture file is considered absolute when the current directory of CTSgo is not part of the picture file path.

Example:
The measurement report is stored in computer A:

Current directory:	C:\CTSGO\
Picture file:	C:\BITMAPS\USER.BMP

To display the measurement report on computer B:

Current directory:	C:\MYWORKS\CTSGO\
Picture file:	C:\BITMAPS\USER.BMP

These settings concern both the GSM and the DECT autotest.

7.2.2 Start

The Start command is used to start a new measurement.

7.2.3 Stop

The Stop command is used to stop the current measurement. The program returns to the beginning of the autotest. The previously performed test is not output. All obtained measurement results are lost.

7.2.4 Pause

The Pause command permits to interrupt the program run. The currently performed step of the autotest is completed before the sequence control stops the test. Another click on Pause continues the measurement.

7.2.5 Step

This command permits to check the sequence control of the autotest step by step. After each single step, the program automatically goes to the pause mode.

7.2.6 Freeze

The Freeze command permits to freeze the numeric and graphics result display in the module test, ie displayed values are not updated. This does not interrupt remote control.

7.2.7 Continue

With this command, freezing of the result display in the module test is cancelled. The displayed values are continuously updated again.

7.3 Configuration Menu in the GSM Autotest

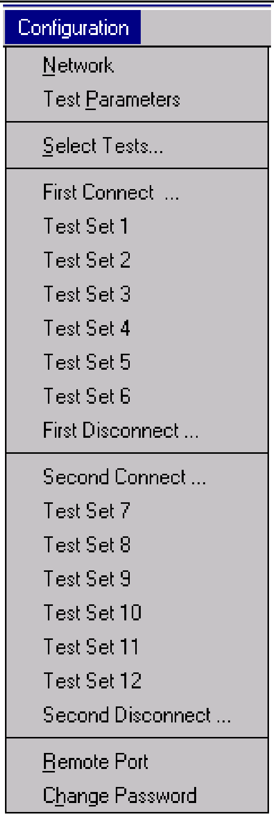


Fig.: Configuration menu in the GSM Autotest

7.3.1 Network

This command opens the Configure Network dialog window. In this window, the measurements can be adapted to the network of your mobile. The base station power at which the mobile performs a location update is also set here.

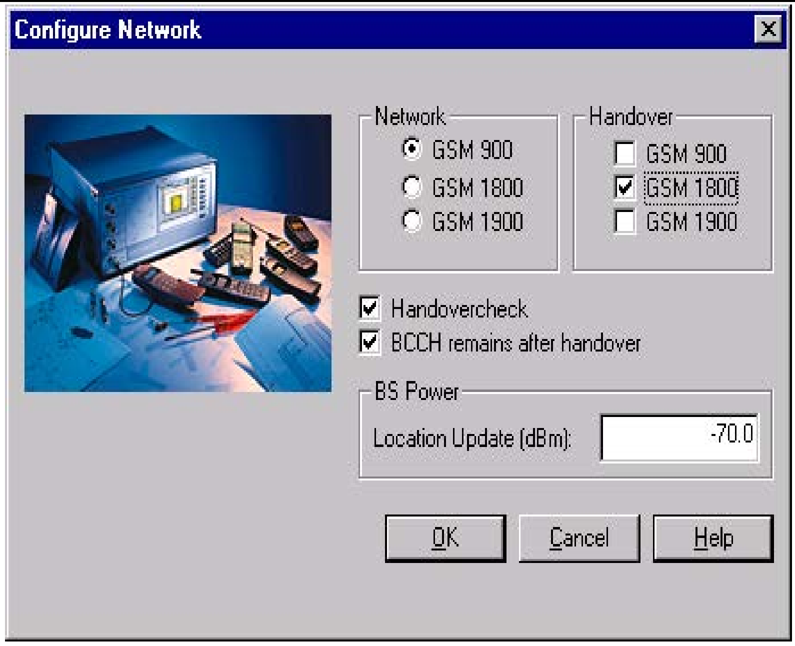


Fig.: Configure Network dialog window

After switching on, the mobile searches in all channels for a base-station carrier, also called C0 carrier. A component of the C0 carrier is the broadcast channel, also called BCCH. The mobile synchronizes to this carrier and compares the decoded data from the base station with the data on the SIM card. It then registers with the base station. This registration is called location update. If the output power is too low, your mobile may not register with the base station simulated by the CTS. Changing from GSM 900 to GSM 1800 or GSM 1900 may cause PCL steps 16 to 19 to be cleared from the test set and replaced by PCL step 15. In this case, a warning is output by CTSgo.

Fig.: Warning of network configuration

Dualband-Mobiles are able to use channels of the GSM 900 band as well as channels of the GSM 1800 band. You decide the primary network and the handover network. The primary network is the one, which is used for the BCCH generation. This means, that the network is used for location update and the call process. A channel change from one band to another band is called dualband handover. Check the box "Handovercheck", if you want the testset to use the signalisation for checking the dualband handover capabilities of your mobile. You have to check the box "BCCH remains after handover", if your mobile needs a remaining BCCH signal in the primary network, when changing to the secondary band. A missing BCCH signal will result in a higher frequency error after dualband handover. There are some mobiles, which have the capability to handover between GSM 900 and GSM 1900. Due to the geographical distance, there is no existing GSM 900 / 1900 dualband handover implemented in the network. On some mobile it can be used for test purposes. The method is the same, as it is for GSM 900 / 1800 dualband handover.

Note:
The choice of networks depends on the options available in your CTS!
It is advisable to configure the network first and then make test configurations.

7.3.2 Test Parameters

The Test Parameters command opens the dialog window shown below. This window permits to set the BCCH of the base station, the path attenuation between mobile and CTS, the number of frames used for the bit-error-rate measurement and the number of bursts for the phase and frequency-error measurement.

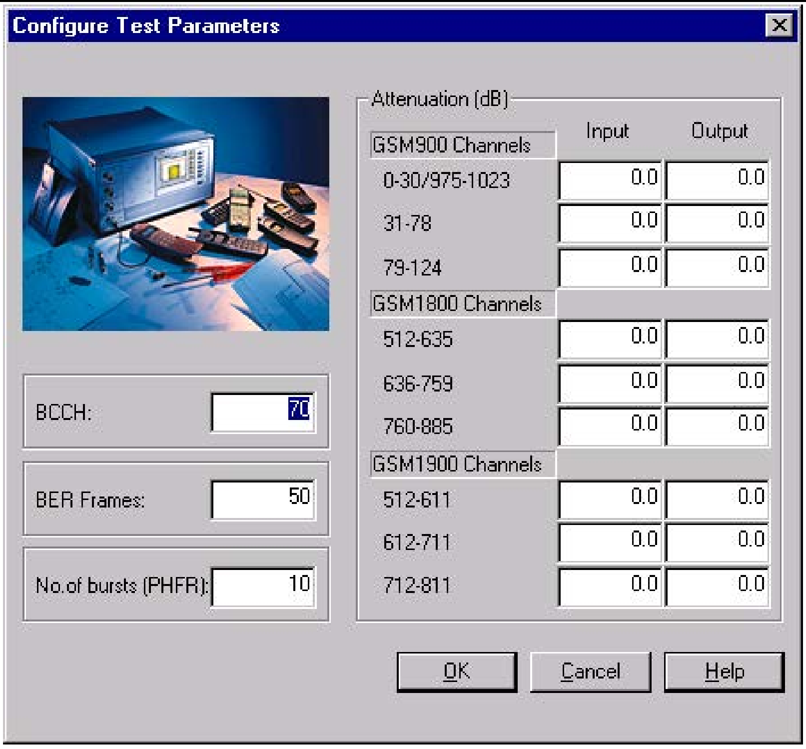


Fig.: Configure Test Parameters dialog window

The input of correct attenuation values has a decisive influence on the measurement accuracy. In the ideal case, an antenna cable should be used, which is directly connected to the mobile, eg as found in the car kit of the mobile. An attenuation between 0.5 and 2 dB is normally obtained in this case. Problems will however arise when using antenna couplers. The attenuation of the mobile types may differ considerably, and it may vary depending on the frequency channel used. If you do not know the attenuation of your antenna coupler proceed as described below:

- Establish a connection to your mobile in the manual mode of CTS.
- Set a power of eg –70 dBm for the traffic channel TCH.
- Measure RXLev. This is the power the mobile receives, which is signaled to the base station at regular intervals in so-called measurement reports.
- Compare the measured RXLev with the TCH power of the CTS.
- Select an average power control level (PCL) on the CTS.
- Compare the measured output power of the mobile with the rated value of the selected PCL.

The input of the attenuation values happens independently for each band. The attenation values for each band are separated for low, mid and high channels.

Bear in mind that, in addition to the measurement inaccuracy of the tester, the production tolerance of the mobile has to be taken into account to estimate the total error. This method requires the mobile to be fully operational.
The BER measurement is the only way to determine the receiving quality and particularly the sensitivity of the mobile. The measurement itself is a statistical evaluation of the sent bits and the errored bits.

More reliable results are obtained by increasing the frames and thus the number of bits, but this extends the measurement time.

Note:
The measurement time for the phase/frequency error measurement also depends on the number of bursts to be considered.

7.3.3 Select Tests

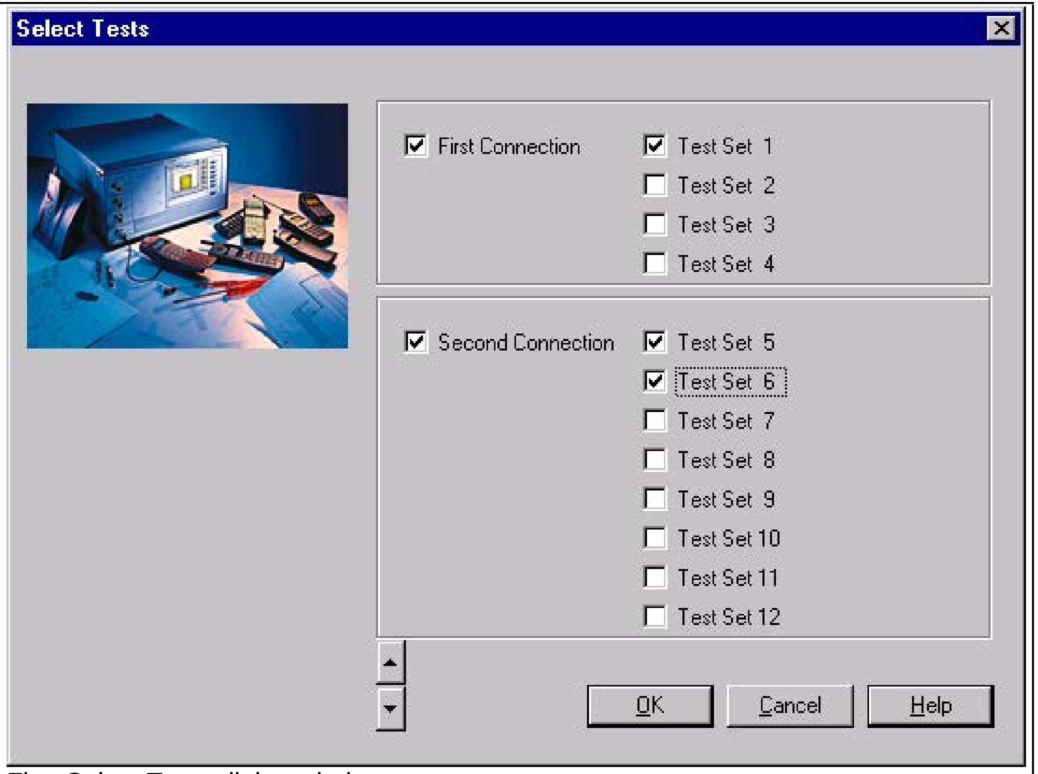


Fig.: Select Tests dialog window

This command opens the Select Tests dialog window. By checking the respective boxes you decide whether the call is set up and cleared down once or twice during the test. You also select the number of test sets used. By default up to six test sets can be selected for each connection. Using the up / down arrow buttons, you can change the position for the second connection inside the testplan.

7.3.4 First Connect

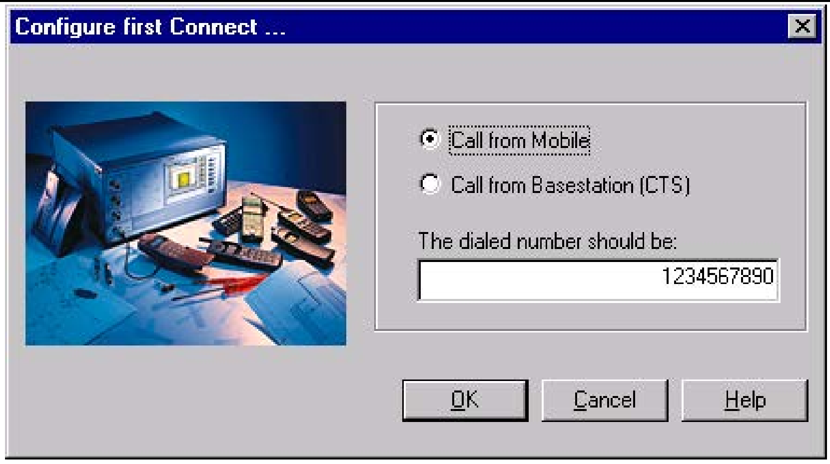


Fig.: Configure first Connect dialog window

This command permits to define the method for the first call setup. To this end, select whether the CTSgo program expects a call from the mobile or whether the call should be set up by the CTS. In the case of a mobile call, you can define an expected numerical entry, which will then be compared with the call number received and evaluated in the test report. Thus the number keys of the mobile can also be easily checked.

Note:
This command can only be selected if the first connection is activated for the test.

7.3.5 Test Set 1

You can decide for each test set which measurements should be performed in a traffic channel (TCH). To do so enter the TCH to be used in the first entry field. Select the measurements to be performed from the list at the right. Enter the RF output power of the CTS (BS power) for the individual tests in the entry fields “Standard“ and “BER“.

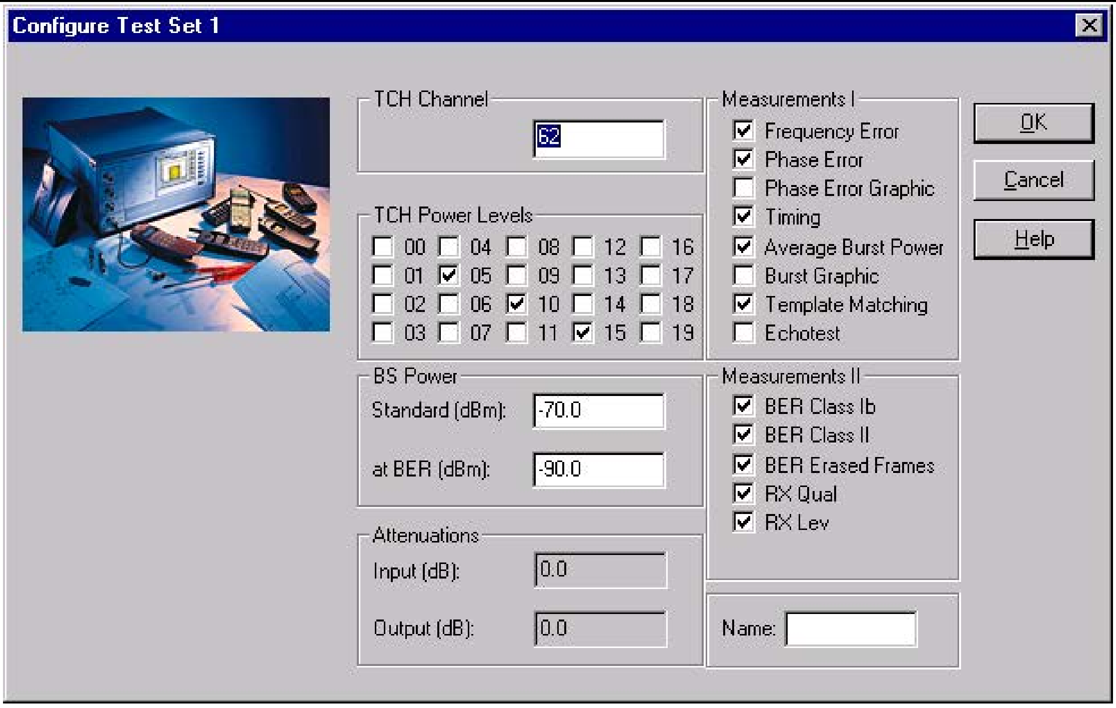


Fig.: Configure Test Set dialog window

The standard BS output power is used for the following measurements:

- Frequency error
- Phase error (RMS and peak value are determined numerically)
- Phase error (phase error curve within burst)
- Bit timing
- Average burst power
- Graphics display of power ramp
- Echo test

The BER base-station power is used for the remaining measurements:

- BER class Ib
- BER class II
- BER EFR (Erased Frames)
- RXQual
- RXLev

The measurements are repeated at all power levels (PCLs) selected in the boxes.
As an option, the test set can be assigned a short name, which will also be displayed in the menu.
The graphics display of power ramp and phase error is shown in the appendix when the measurement report is generated. E-GSM channels are part of network GSM900. The attenuation values shown in this dialog are channel depending. These values are only shown for your information.

Note:
This command can only be selected if test set 1 is activated for the test.

7.3.6 Test Set 2

You can determine the measurements to be performed in the selected TCH channels. For details refer to the description under Test set 1.

Note:
This command can only be selected if Test set 2 is activated for the test.

7.3.7 Test Set 3

You can determine the measurements to be performed in the selected TCH channels. For details refer to the description under Test set 1.

Note:
This command can only be selected if Test set 3 is activated for the test.

7.3.8 Test Set 4

You can determine the measurements to be performed in the selected TCH channels. For details refer to the description under Test set 1.

Note:
This command can only be selected if Test set 4 is activated for the test.

7.3.9 Test Set 5

You can determine the measurements to be performed in the selected TCH channels. For details refer to the description under Test set 1.

Note:
This command can only be selected if Test set 5 is activated for the test.

7.3.10 Test Set 6

You can determine the measurements to be performed in the selected TCH channels. For details refer to the description under Test set 1.

Note:
This command can only be selected if Test set 6 is activated for the test.

7.3.11 First Disconnect

Using this command you can determine the procedure for the first call clear-down. Select by a click on the respective box whether a call release is expected from the mobile or whether the call should be cleared down by the CTS.

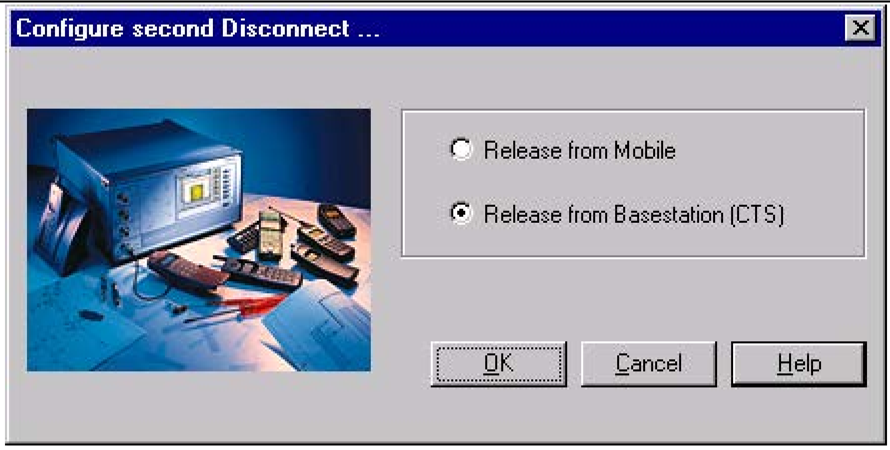


Fig.: Configure Disconnect dialog window

Note:
This command can only be selected if the first connection is activated for the test.

7.3.12 Second Connect

This command permits to select the procedure for the second call clear-down. Select by a click on the respective box whether the CTSgo program expects a call from the mobile or whether the call should be set up by the CTS.

Note:
This command can only be selected if the second connection is activated for the test.

7.3.13 Test Set 7

You can determine the measurements to be performed in the selected TCH channel. For details refer to the description under Test set 1.

Note:
This command can only be selected if test set 7 is activated for the test.

7.3.14 Test Set 8

You can determine the measurements to be performed in the selected TCH channel. For details refer to the description under Test set 1.

Note:
This command can only be selected if test set 8 is activated for the test.

7.3.15 Test Set 9

You can determine the measurements to be performed in the selected TCH channel. For details refer to the description under Test set 1.

Note:
This command can only be selected if test set 9 is activated for the test.

7.3.16 Test Set 10

You can determine the measurements to be performed in the selected TCH channel. For details refer to the description under Test set 1.

Note:
This command can only be selected if test set 10 is activated for the test.

7.3.17 Test Set 11

You can determine the measurements to be performed in the selected TCH channel. For details refer to the description under Test set 1.

Note:
This command can only be selected if test set 11 is activated for the test.

7.3.18 Test Set 12

You can determine the measurements to be performed in the selected TCH channel. For details refer to the description under Test set 1.

Note:
This command can only be selected if test set 12 is activated for the test.

7.3.19 Second Disconnect

Using this command you can determine the procedure for the second call clear-down. Select by a click on the respective box whether a call release is expected from the mobile or whether the call should be cleared down by the CTS.

Note:
This command can only be selected if the second connection is activated for the test.

7.3.20 Remote Port

To ensure error-free functioning of the CTSgo software, the settings made for the remote control interface (RS232) should match the settings on the CTS.
The parameters of the serial interface such as baud rate, data bits used, stop bits, parity used and the protocol can be selected on the CTS. Adapt the settings of CTSgo to those of CTS by checking the respective box. The serial interface of your PC and the command line terminator should also be set. <CR>+<LF> should normally be used.

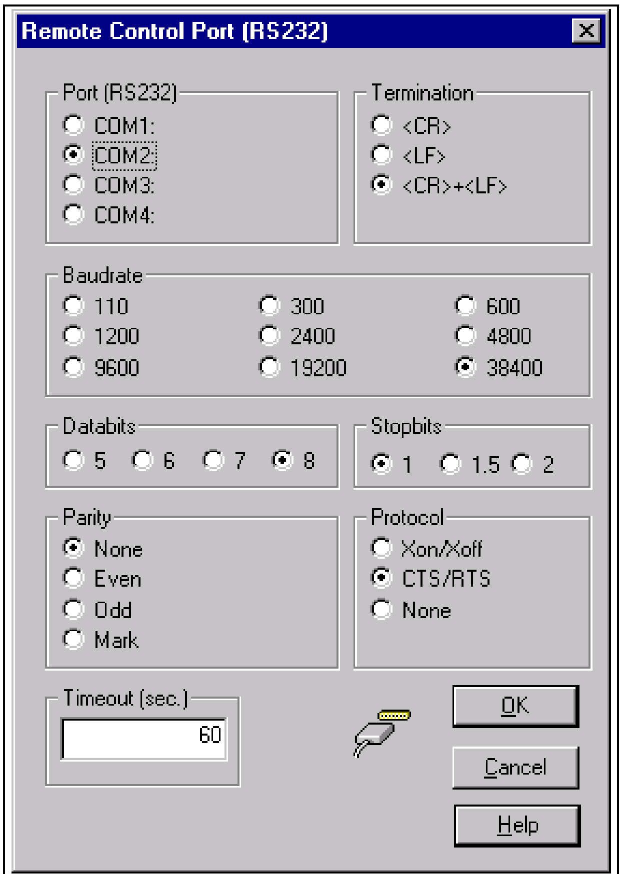


Fig.: Remote port dialog window

The timeout of the CTS for responding to a query should now be defined. This parameter depends on the configuration of the individual tests. See also the note for the Test Parameters command.

Note:
In the case of a CTS30 the parameters of the serial interface are set as follows:

- Baud rate 38400
- 8 data bits
- 1 stop bit
- Parity None
- Protocol CTS/RTS

7.3.21 Change Password

Your configuration can be protected against unauthorized changes. To this end, enter a password in the first field and repeat it in the next. The password function is activated by selecting the “Activate” box.

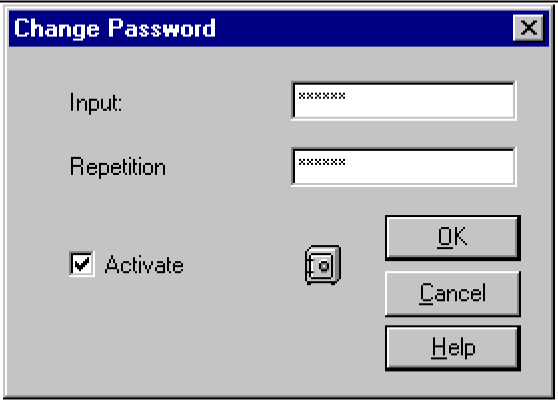


Fig.: Change Password dialog window

Each time a configuration command of the program menus is selected, you will then be prompted to enter this password. After entering a correct password, changes can be made in the configuration until the sequence control of the program is started.

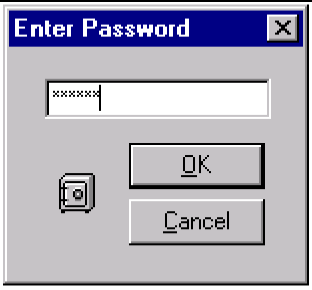


Fig.: Enter Password dialog window

The password mainly serves for preventing inadvertent changes being made to your data and does not provide 100% protection. In case you have forgotten the password, clear the entry in the initialization file ”CTS_GO.INI“

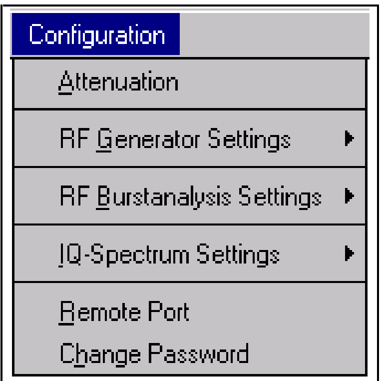


Fig.: Configuration menu in GSM module test

7.4 Configuration Menu in the GSM Module Test

7.4.1 Attenuation

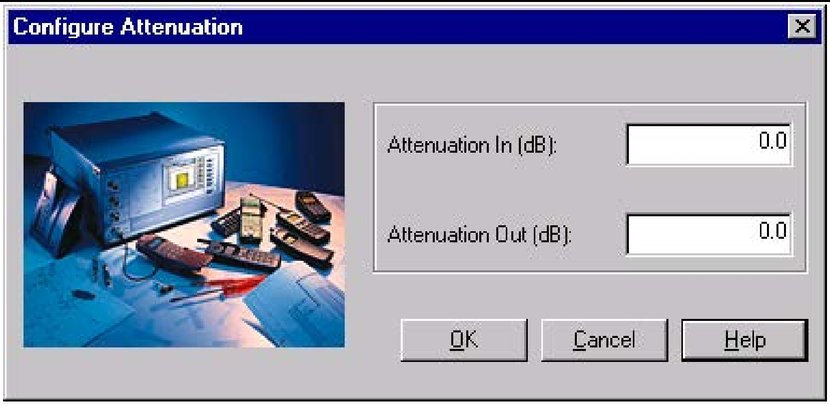


Fig.: Configure Test Parameters dialog window

In the module test, this dialog permits to standardize the attenuation values of the parameter sets in generator, burst analysis and IQ spectrum mode. After entering the input attenuation and output attenuation, close the dialog window by clicking on OK. In another dialog window, you will be prompted whether you really want to overwrite all parameter sets with these values. Click on Yes if you are really sure about it, otherwise select No.

7.4.2 Generator Settings

The Configurations menu includes the Generator Settings submenu, where the menu items “RF Generator 1” to “RF Generator 10” can be found. Select one of these commands in order to edit the desired generator parameter set.
The CTS provides an RF signal. The parameters of this RF signal are set in this dialog window. In the first field, the transmission channel of the CTS is entered, in the second the frequency offset to the fixed GSM frequency grid of 200 kHz. The CTS output power can be set in the third field. This power is present at the selected RF connector “RF In/Out“ or “RF Out 2“. A click on “Generator on“ decides whether the RF generator sends the set signal or not. With “Bitmodulation on” you can decide whether a midamble is included in the signal or not. In the fourth field, the training sequence (TSC) of the midamble is defined. With “Ramp on” you can decide whether the RF signal is with or without a burst.

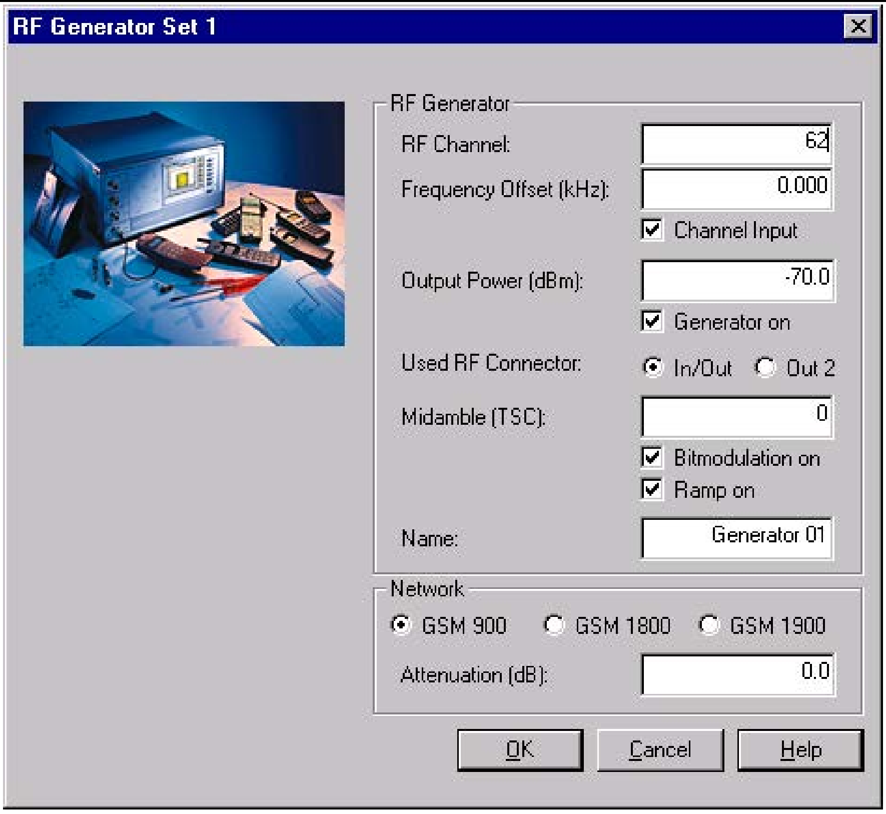
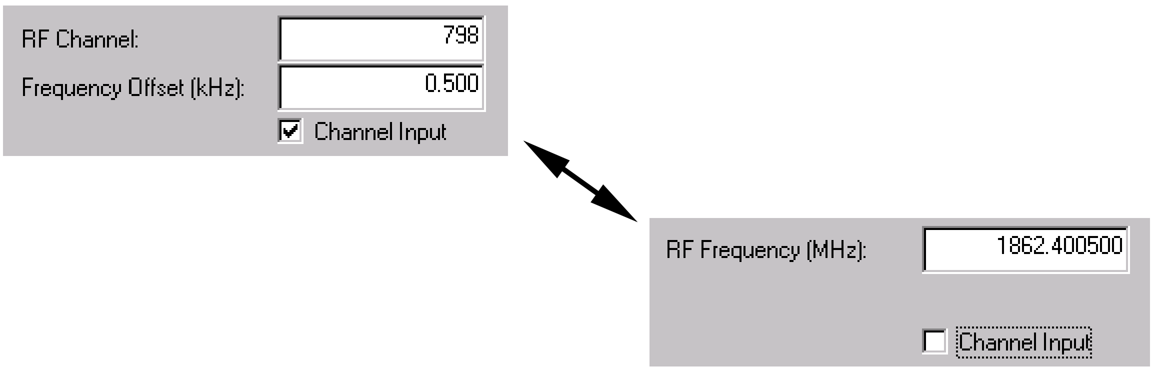


Fig.: RF Generator Settings dialog window

Whether the channel or the frequency is entered is selected with the Channel Input box. If frequency is entered, it is adapted to the channel and frequency offset.



The entered channel or the conversion to the respective frequency also depends on the currently active network. Channels and associated frequencies are listed in the tables below. Channels outside the currently used band are displayed on a dark background.

Channel (GSM900)	Frequency
-175	875.0 MHz
-174	875.2 MHz
...	...
0	935.0 MHz...
1	935.2 MHz
2	935.4 MHz
...	...
123	959.6 MHz
124	959.8 MHz
...	...
299	994.8 MHz
300	995.0 MHz

GSM 900 channel
Fictitious channel

Channel (GSM1800)	Frequency
486	1800.0 MHz
487	1800.2 MHz
...	...
512	1805.2 MHz...
513	1805.4 MHz
...	...
884	1879.6 MHz
885	1879.8 MHz
...	...
1435	1989.8 MHz
1436	1990.0 MHz

GSM 1800 channel
Fictitious channel

Channel (GSM1900)	Frequency
-139	1800.0 MHz
-138	1800.2 MHz
...	...
0	1827.8 MHz...
...	...
512	1930.2 MHz...
513	1930.4 MHz
...	...
809	1989.6 MHz
810	1989.8 MHz
811	1990.0 MHz

GSM 1900 Channel
Fictitious channel

The generator parameter set can be assigned a short name in the input field “Name”. This short name appears both in the submenu and in the labeling of the buttons of the module test dialog. The associated network for the parameter set is determined by clicking on “GSM900“, “GSM1800“ and “GSM1900“. The output attenuation is also included in the parameter set and can be varied in the respective field.

When the configurations are completed, press OK to send the settings to the CTS. If the current RF signal of the CTS generator should not be changed, press the Cancel button.

7.4.3 Burst Analysis Settings

The Configurations menu includes the Burst Analysis Settings submenu, where the menu items “RF Analyzer 1” to “RF Analyzer 10” can be found. Select one of these commands for editing the respective burst analysis parameter set.
This command permits to set the module test parameters in the Configure Burst Analysis dialog window. In the first field, enter the channel of the signal to be evaluated, in the second the expected training sequence of the midamble. With GSM, the training sequences are used for time synchronization of the received bit sequence. Since this sync bit sequence is in the middle of the burst it is called midamble.
In the third field, the expected power can be entered. This setting is signaled to the CTS. The dynamic range of the graphics result display for power measurements also depends on these settings. The trigger mode can be selected by a click on the desired option.

Power:
The signal must be a burst signal with a midamble. It is triggered on the incoming power.

Freerun:
The signal to be measured must contain a midamble to allow the CTS to synchronize.

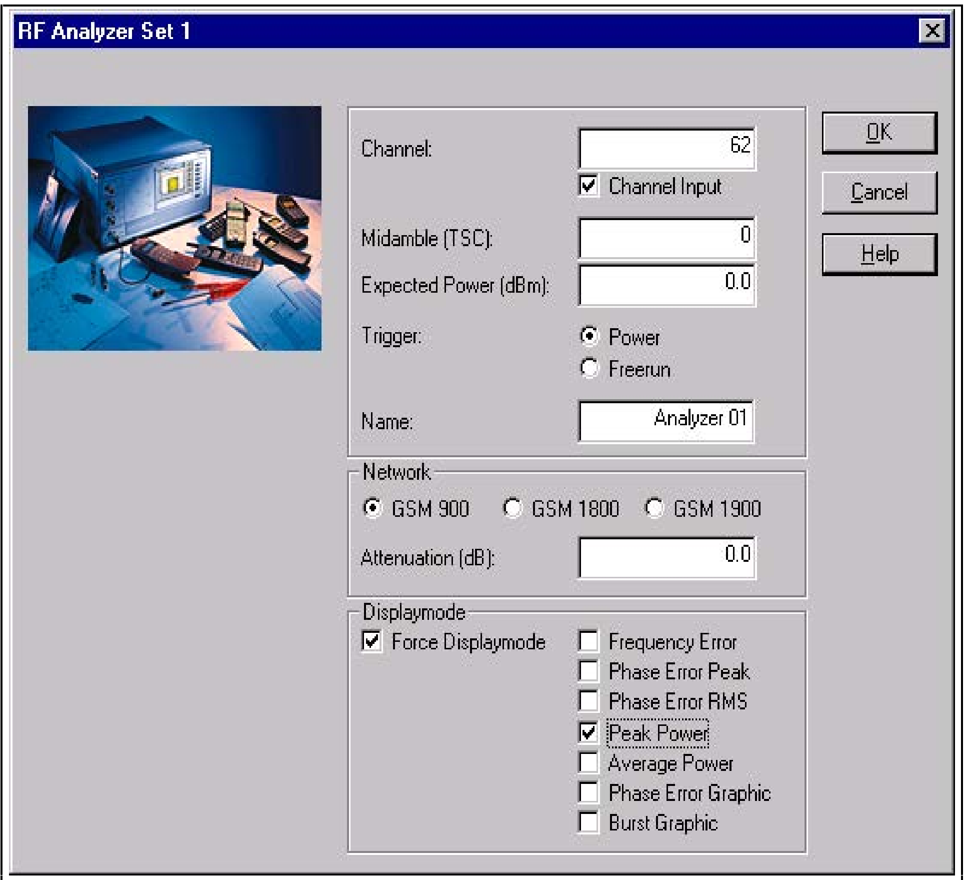
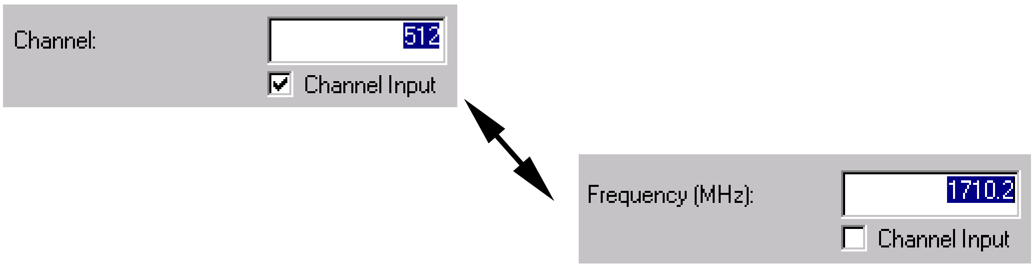


Fig.: Configure Burst Analysis dialog window

By activating the Channel Input box, you can change between channel and frequency input. If the frequency is entered, it it adapted to the GSM channel spacing.



The entered channel or the conversion to its frequency also depends on the currently active network. Channels and associated frequencies are listed in the tables below. Channels outside the currently used band are displayed on a dark background.

Channel (GSM900)	Frequency
-75	875.0 MHz
-74	875.2 MHz
...	...
0	890.0 MHz...
1	890.2 MHz
2	890.4 MHz
...	...
123	914.6 MHz
124	914.8 MHz
...	...
449	979.8 MHz
450	980,0 MHz

GSM 900 Kanal
Fictitious channel

Channel (GSM1800)	Frequency
461	1700.0 MHz
462	1700.2 MHz
...	...
512	1710.2 MHz...
513	1710.4 MHz
...	...
884	1784.6 MHz
885	1784.8 MHz
...	...
1510	1909.8 MHz
1511	1910.0 MHz

GSM 1800 Kanal
Fictitious channel

Channel (GSM1900)	Frequency
-239	1700.0 MHz
-238	1700.2 MHz
...	...
0	1747.8 MHz...
...	...
512	1850.2 MHz...
513	1850.4 MHz
...	...
809	1909.6 MHz
810	1909.8 MHz
811	1910.0 MHz

GSM 1900 channel
Fictitious channel

The burst analysis parameter set can be assigned a short name in the Name field. This short name appears both in the submenu and in the labeling of the buttons of the module test dialog. The associated network for the parameter set is determined by clicking on “GSM900“, “GSM1800“ and “GSM1900“. The input attenuation is also included in the parameter set and can be varied in the respective field.

As a particular feature of the configuration dialog for burst analysis, you can force a certain display mode. When this configuration set is called later on, the popup windows of burst analysis will be opened or closed, certain measurements marked or some marking cleared. Select the desired display mode and make a mark the “Force Displaymode” box in this dialog window.

After completing all the configurations, press OK to send the settings to the CTS. If you do not want to change the currently active burst analysis settings of the CTS click on Cancel.

7.4.4 IQ Spectrum Settings

The Configurations menu includes the submenu “IQ Spectrum Settings”. This submenu contains the menu items “IQ Spectrum 1” to “IQ Spectrum 10”. Select one of these commands to edit an IQ spectrum parameter set.
This command permits to set module test parameters in the dialog window “IQ Spectrum Settings“ . In the first field enter the channel of the signal to be evaluated, in the second the averaging factor, ie the number of burst for averaging. The expected power is entered in the third field and then signaled to the CTS. Besides, the dynamic range of the graphics result display for the power measurements depends on the selected setting. In the first field of the dialog window, you can enter whether a ramped or a continuous input signal is expected.

CW:
„Continuous Wave“, ie a signal with continuous power and without power ramp.

Burst:
The signal to be measured has a power ramp.

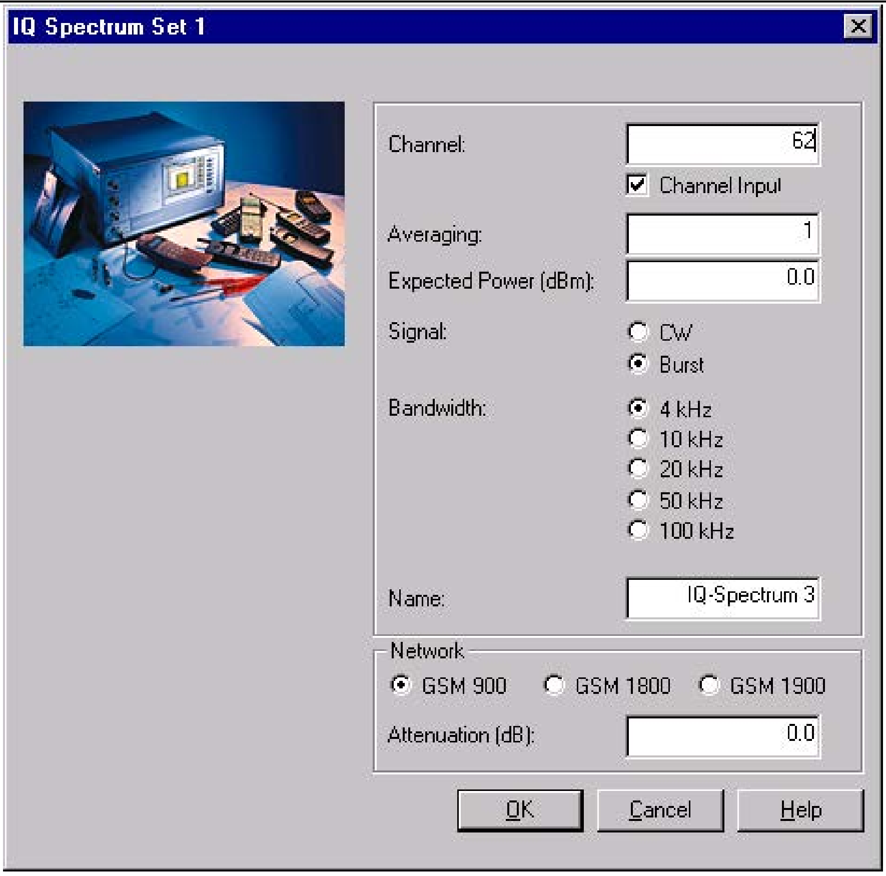
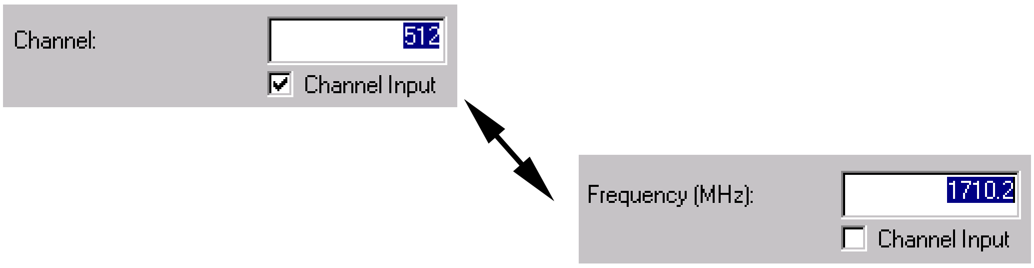


Fig.: Configure IQ Spectrum dialog window

In the second field of the dialog, the used bandwidth of the input filter is entered. The following settings are available:

- 4 kHz
- 10 kHz
- 20 kHz
- 50 kHz
- 100 kHz

By activating the Channel Input box, you can change between channel input and frequency input. If the frequency is entered, it is adapted to the GSM channel spacing.



The entered channel or the conversion to its frequency also depends on the currently active network. Channels and associated frequencies are listed in the tables below. Channels outside the currently used band are displayed on a dark background.

Channel (GSM900)	Frequency
-75	875.0 MHz
-74	875.2 MHz
...	...
0	890.0 MHz...
1	890.2 MHz
2	890.4 MHz
...	...
123	914.6 MHz
124	914.8 MHz
...	...
449	979.8 MHz
450	980.0 MHz

GSM 900 channel
Fictitious channel

Channel (GSM1800)	Frequency
461	1700.0 MHz
462	1700.2 MHz
...	...
512	1710.2 MHz...
513	1710.4 MHz
...	...
884	1784.6 MHz
885	1784.8 MHz
...	...
1510	1909.8 MHz
1511	1910.0 MHz

GSM 1800 channel
Fictitious channel

Channel (GSM1900)	Frequency
-239	1700.0 MHz
-238	1700.2 MHz
...	...
0	1747.8 MHz...
...	...
512	1850.2 MHz...
513	1850.4 MHz
...	...
809	1909.6 MHz
810	1909.8 MHz
811	1910.0 MHz

GSM 1900 channel
Fictitious channel

The IQ spectrum parameter set can be assigned a short name in the Name field. This short name appears both in the submenu and in the labeling of the buttons of the module test dialog window. The associated network is determined for the parameter set by clicking on “GSM900“, “GSM1800“ and “GSM1900“ in the respective field. The parameter set also includes the input attenuation which can be varied in the respective field.

After completing all configurations press OK to send the settings to the CTS. If you do not want to change the current IQ spectrum settings of the CTS press Cancel.

7.4.5 Remote Port

The same dialog window as for the GSM autotest is displayed. For further information refer to the respective chapter of the GSM autotest.

7.4.6 Change Password

The same dialog window as for the GSM autotest is displayed. For further information refer to the respective chapter of the GSM autotest.

7.5 Configuration Menu in the DECT Autotest

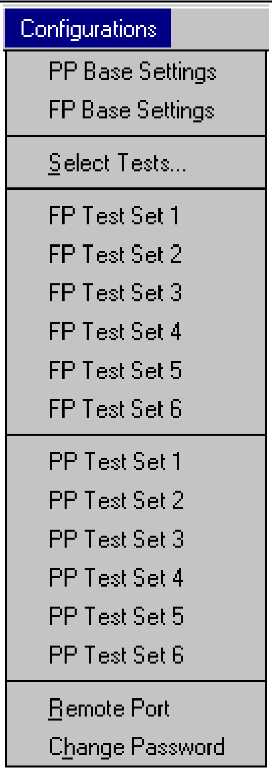


Fig.: Configuration menu in the DECT autotest

7.5.1 PP Base Settings

This command permits to call the “PP Base Settings“ dialog window. Use this dialog to adapt the test mode to the parameters of your portable part. The portable part can only be tested if the RFPI of the DUT is known. Enter this RFPI in the respective field. In order to test a set consisting of portable part and fixed part the RFPI from the FP test can be used. To do so, note the description of the FP base settings in this manual. In the two following fields, you can enter the channel and the slot of the dummy bearer generated by the CTS. The dummy bearer is the carrier to which a portable part is synchronized after it has been switched on. The Q-packages of the MAC level are sent from the CTS during the PP test. These are three binary packages Q0, Q3 and Q6. The associated values can be entered as hexadecimal values. The QMUX indicates the transmission sequence of the packages. A value of “03060306“ means that first a Q0, then a Q3, a further Q0 and then a Q6 package, etc. are sent. Further information on Q-package messages can be obtained from the ETSI standard ETS 300-175 Part 3. Finally, for compensation of RF losses, you can enter attenuation values for the input and output in the respective. The CTS will then convert its output level and the measured output power of the mobile accordingly.

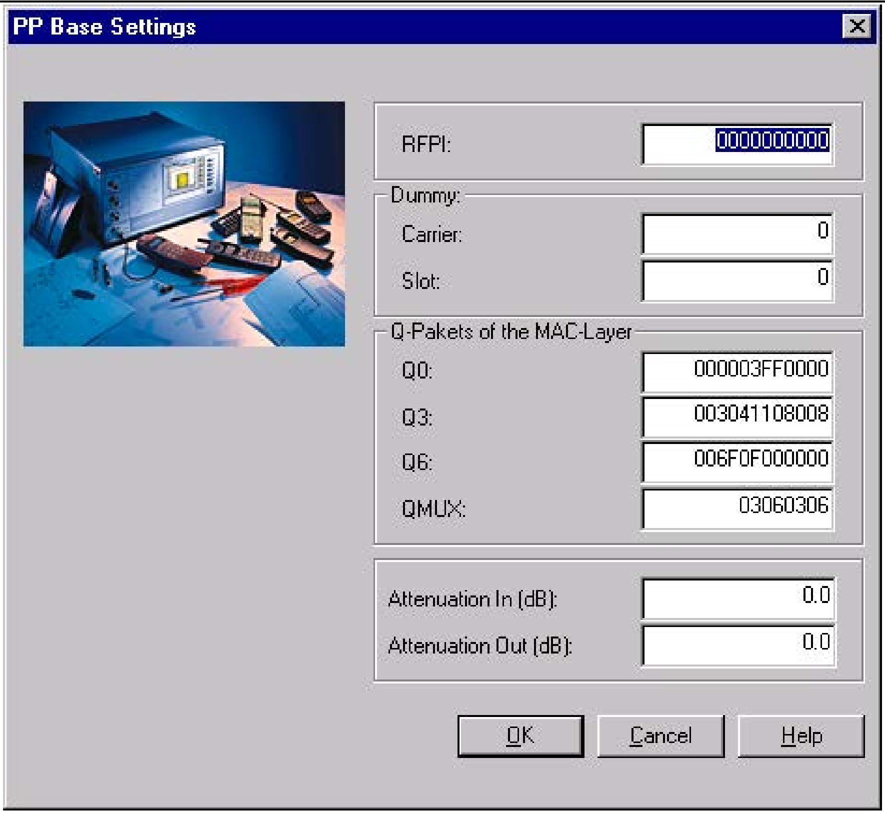


Fig.: PP Base settings dialog window

Note:
For information about how to switch the portable part to service mode contact your manufacturer.
It is very difficult to determine the attenuation to be set for DECT devices empirically. On the one hand, fixed parts or portable parts have no antenna connectors, which is why antenna couplers must be used. On the other hand, neither portable parts nor fixed parts signal the power received at the antenna to the tester as in the case of GSM mobiles. If there are no empirical values for PP or FP or the coupler, they can only be derived from the two values NTP and BER. The NTP of portable part and fixed part is typically 24 dBm. If no attenuation is entered on the CTS, the input attenuation can be approximately determined from the difference between the measured NTP and the typical NTP. The output attenuation is obtained via the BER, the bit error rate typically increases considerably starting from a certain receiving level on the DUT. If the sensitivity of the DUT and thus the associated output level of the CTS is known, the attenuation can again be approximately determined from the difference between the expected output level and the set output level. In general, large limits should be selected for the tests for determination of power and bit error rate in order to take into account the inaccurate determination of the attenuation.

7.5.2 FP Base Settings

This command is used to call the dialog window “FP Base Settings“. Use this dialog window to adapt the tester to the settings of your fixed part. After your fixed part has been switched to service mode, it continuously transmits the dummy bearer with a typical RFPI. The CTS can detect the RFPI of the strongest dummy bearer. If you wish automatic use of this RFPI, click on the respective box. You can as well enter the RFPI manually in the RFPI field. In this case, make sure that there is no mark in the respective box. By means of the box “Use detected RFPI in PP Test”, you can automatically use a detected RFPI in the subsequent portable part test. This is particularly useful if you want to measure both the fixed part and the portable part, but do not know the RFPI of this set. Enter the MAC identity of the portable part expected from your fixed part in the PMID field. In the FP test, the CTS behaves like a portable part. During the test, the fixed part queries this PMID. Normally, fixed parts accept any PMID in service mode, however, it is also possible that it accepts only certain PMIDs , eg only PMIDs starting with “Exxxx“. In case of doubts, you can look up the PMID of the portable part in manual CTS mode in the menu “Call set up” of the Portable Part Test.

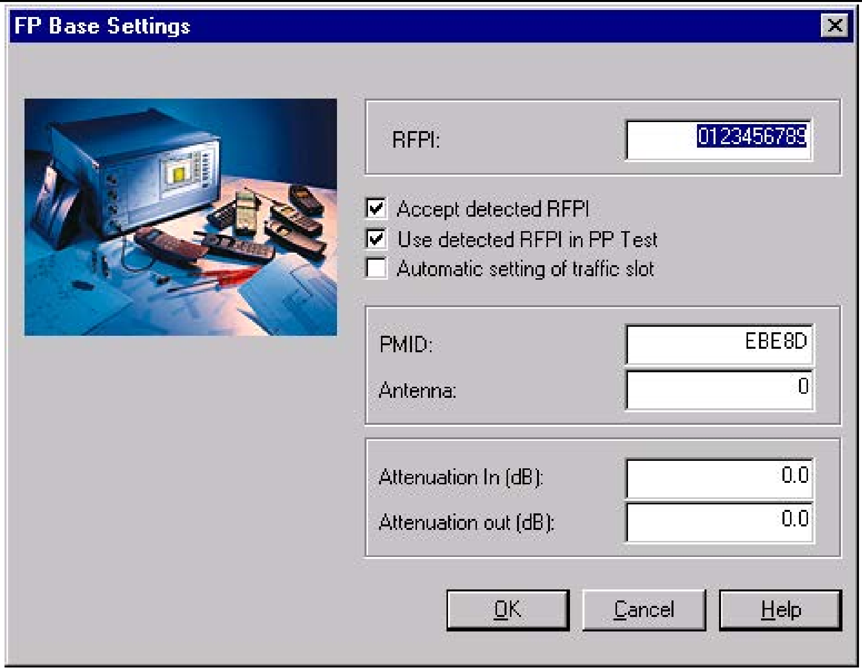


Fig.: FP Base settings dialog window

The antenna to be used can be entered in the input field below. The input and output attenuation are entered in two further fields.

Note:
For information about how to switch the portable part to service mode contact your manufacturer.
It is very difficult to determine the attenuation to be set for DECT devices empirically. On the one hand, fixed parts or portable parts have no antenna connectors, which is why antenna couplers must be used. On the other hand, neither portable parts nor fixed parts signal the power received at the antenna to the tester as in the case of GSM mobiles. If there are no empirical values for PP or FP or the coupler, they can only be derived from the two values NTP and BER. The NTP of portable part and fixed part is typically 24 dBm. If no attenuation is entered on the CTS, the input attenuation can be approximately determined from the difference between the measured NTP and the typical NTP. The output attenuation is obtained via the BER, the bit error rate typically increases considerably starting from a certain receiving level on the DUT. If the sensitivity of the DUT and thus the associated output level of the CTS is known, the attenuation can again be approximately determined from the difference between the expected output level and the set output level. In general, large limits should be selected for the tests for determination of power and bit error rate in order to take into account the inaccurate determination of the attenuation.

7.5.3 Select Tests

This command opens the dialog window below. The number of test sets for the fixed part test and the number of test sets for the portable part test are selected using the respective boxes. If you do not want to perform a fixed part test or a portable part test, clear the respective mark in the box. Up to six FP test sets and six PP test sets are provided.

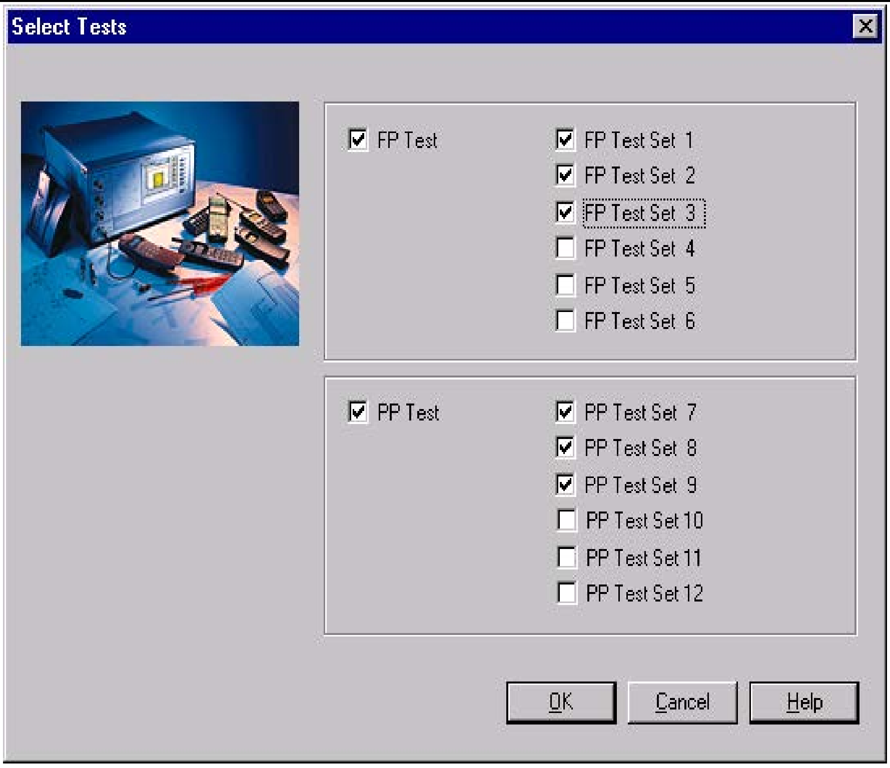


Fig.: Select Tests dialog window

7.5.4 FP Test Set 1

Within the test sets, you can determine the measurements to be performed for a traffic bearer. To this end, enter the carrier of the traffic bearer to be used in the first input field. You may as well enter the carrier offset. In addition, the slot to be used can also be defined in the respective field. Select the tests to be performed within the frames “RX Measurements” and “TX Measurements” by checking the respective boxes.

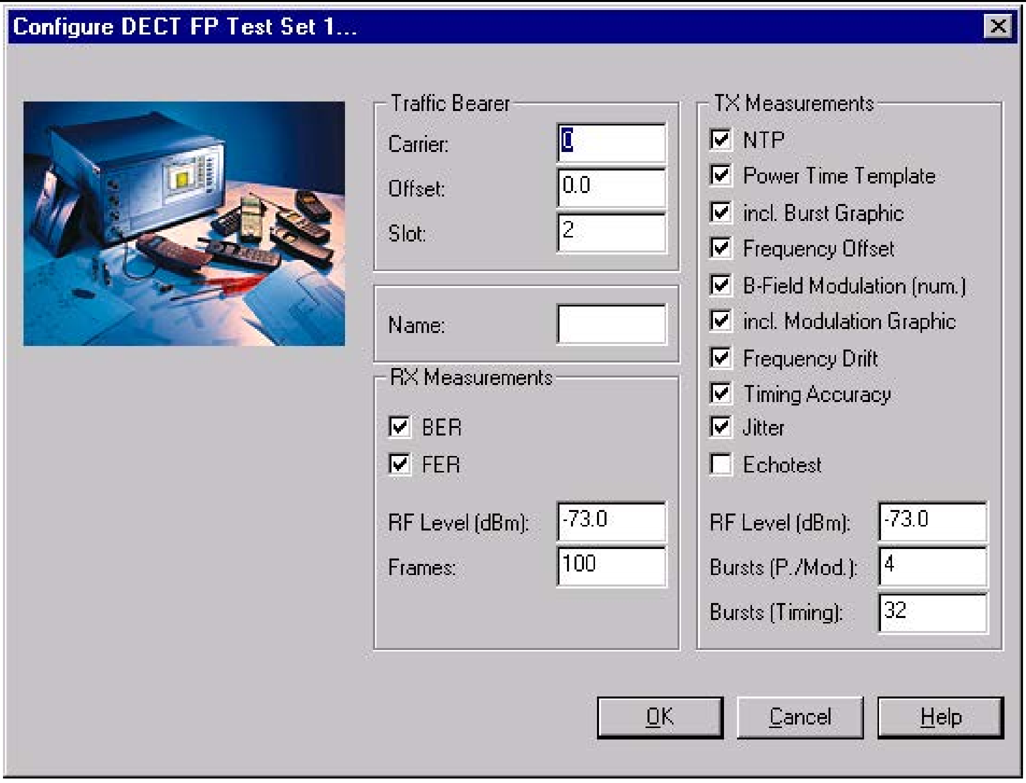


Fig.: Configure DECT FP Test Set 1 dialog

The assignment of frequencies and channel and offset values can be obtained from the table below:

Chan-nel		**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Offset	**-3**	1902.528	1900.800	1899.072	1897.344	1895.616	1893.888	1892.160	1890.432	1888.704	1886.976
	-2.5	1901.664	1899.936	1898.208	1896.480	1894.752	1893.024	1891.296	1889.568	1887.840	1886.112
	-2	1900.800	1899.072	1897.344	1895.616	1893.888	1892.160	1890.432	1888.704	1886.976	1885.248
	-1.5	1899.936	1898.208	1896.480	1894.752	1893.024	1891.296	1889.568	1887.840	1886.112	1884.384
	-1	1899.072	1897.344	1895.616	1893.888	1892.160	1890.432	1888.704	1886.976	1885.248	1883.520
	-0,5	1898.208	1896.480	1894.752	1893.024	1891.296	1889.568	1887.840	1886.112	1884.384	1882.656
	0	**1897.344**	**1895.616**	**1893.888**	**1892.160**	**1890.432**	**1888.704**	**1886.976**	**1885.248**	**1883.520**	**1881.792**
	0,5	1896.480	1894.752	1893.024	1891.296	1889.568	1887.840	1886.112	1884.384	1882.656	1880.928
	1	1895.616	1893.888	1892.160	1890.432	1888.704	1886.976	1885.248	1883.520	1881.792	1880.064
	1.5	1894.752	1893.024	1891.296	1889.568	1887.840	1886.112	1884.384	1882.656	1880.928	1879.200
	2	1893.888	1892.160	1890.432	1888.704	1886.976	1885.248	1883.520	1881.792	1880.064	1878.336
	2.5	1893.024	1891.296	1889.568	1887.840	1886.112	1884.384	1882.656	1880.928	1879.200	1877.472
	3	1892.160	1890.432	1888.704	1886.976	1885.248	1883.520	1881.792	1880.064	1878.336	1876.608

The following RX measurements are available:

- BER (Bit Error Rate)
- FER (Frame Error Rate)

The RF output level of the CTS for these measurements is to be determined in the RF Level field of RX Measurements. Besides, the number of frames to be sent is determined.

The following TX measurements are available:

- NTP (Normal Transmit Power)
- Power ramp (Template)
- Graphics burst display in the appendix to the measurement report
- Frequency offset
- B-field modulation
- Graphics display of the modulation in the appendix to the measurement report
- Frequency drift
- Time accuracy
- Jitter
- Acoustic echo test

For these measurements, the RF output level of the CTS is to be entered in the RF Level field of TX Measurements. Besides, the number of bursts to be sent is determined for the power and modulation measurement or the number of bursts to be sent for the timing measurement.

Note:
This command can only be called if FP test set 1 is activated for the test.

7.5.5 FP Test Set 2

You can determine the tests to be performed for the Traffic Bearer. For details refer to the description of FP Test set 1.

Note:
This command can only be called if FP Test set 2 is activated for the test.

7.5.6 FP Test Set 3

You can determine the tests to be performed for the Traffic Bearer. For more details refer to the description of FP test set 1.

Note:
This command can only be called if FP test set 3 is activated for the test.

7.5.7 FP Test Set 4

You can determine the tests to be performed for the Traffic Bearer. For more details refer to the description of FP test set 1.

Note:
This command can only be called if FP test set 4 is activated for the test.

7.5.8 FP Test Set 5

You can determine the number of tests for the Traffic Bearer. For more details refer to the description of FP test set 1.

Note:
This command can only be called if FP test set 5 is activated for the test.

7.5.9 FP Test Set 6

You can determine the tests to be performed for the Traffic Bearer. For more details refer to the description of FP test set 1.

Note:
This command can only be called if FP test set 6 is activated for the test.

7.5.10 PP Test Set 1

Within the test sets, you can determine the tests to be performed for a traffic bearer. To do so, enter the carrier of the traffic bearer to be used in the first input field. You can as well enter the carrier offset. In addition, you can define the used slot in the respective field. Select the tests to be performed for the RF measurements and the TX measurements by checking the respective boxes.

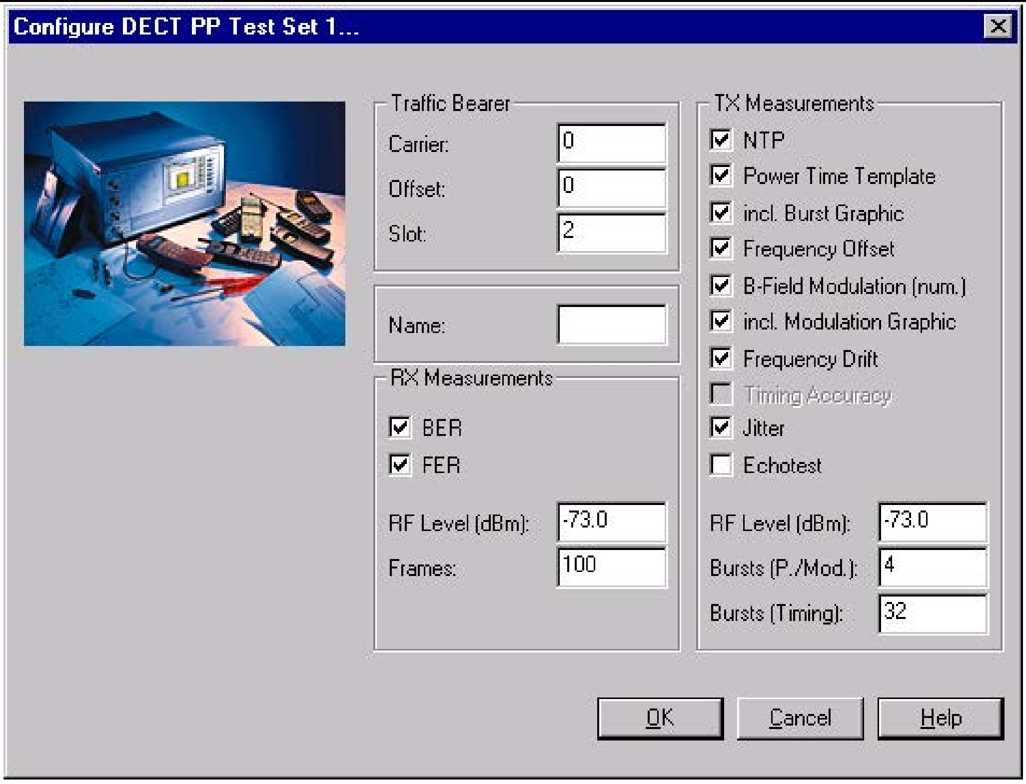


Fig.: Configure DECT PP Test Set 1 dialog

The assignment of frequencies to channel and offset values can be obtained from the table below. Bear in mind that only integral offset values are permissible when testing a portable part.

Chan-nel		0	1	2	3	4	5	6	7	8	9
Offset	**-3**	1902.528	1900.800	1899.072	1897.344	1895.616	1893.888	1892.160	1890.432	1888.704	1886.976
	-2	1900.800	1899.072	1897.344	1895.616	1893.888	1892.160	1890.432	1888.704	1886.976	1885.248
	-1	1899.072	1897.344	1895.616	1893.888	1892.160	1890.432	1888.704	1886.976	1885.248	1883.520
	0	**1897.344**	**1895.616**	**1893.888**	**1892.160**	**1890.432**	**1888.704**	**1886.976**	**1885.248**	**1883.520**	**1881.792**
	1	1895.616	1893.888	1892.160	1890.432	1888.704	1886.976	1885.248	1883.520	1881.792	1880.064
	2	1893.888	1892.160	1890.432	1888.704	1886.976	1885.248	1883.520	1881.792	1880.064	1878.336
	3	1892.160	1890.432	1888.704	1886.976	1885.248	1883.520	1881.792	1880.064	1878.336	1876.608

The following RX measurements are available:

- BER (Bit error rate)
- FER (Frame error rate)

For these measurements, the RF output level of the CTS is defined in the RF Level field for RX measurements. Besides, the number of frames to be sent is entered.

The following TX measurements are available:

- NTP (Normal Transmit Power)
- Power ramp (Template)
- Graphics burst display in the appendix to the measurement report
- Frequency offset
- B-field modulation
- Graphics display of modulation in the appendix to the measurement report
- Frequency drift
- Jitter
- Acoustic echo test

For these measurements, the RF output level of the CTS is to be entered in the RF Level field for the TX measurements. Besides, the number of bursts to be sent is defined for power and modulation measurements or the number of bursts to be sent for the timing measurements.

Note:
This command can only be called if PP test set 1 is activated for the tests.

7.5.11 PP Test Set 2

You can determine the tests to be performed for the specified TCH channel. For more details refer to the description of test set 1.

Note:
This command can only be called if PP test set 2 is activated for the tests.

7.5.12 PP Test Set 3

You can determine the tests to be performed for the specified TCH channel. For more details refer to the description of test set 1.

Note:
This command can only be called if PP test set 3 is activated for the tests.

7.5.13 PP Test Set 4

You can determine the tests to be performed for the specified TCH channel. For more details refer to the description of test set 1.

Note:
This command can only be called if PP test set 4 is activated for the tests.

7.5.14 PP Test Set 5

You can determine the tests to be performed for the specified TCH channel. For more details refer to the description of test set 1.

Note:
This command can only be called if PP test set 5 is activated for the tests.

7.5.15 PP Test Set 6

You can determine the tests to be performed for the specified TCH channel. For more details refer to the description of test set 1.

Note:
This command can only be called if PP test set 6 is activated for the tests.

7.5.16 Remote Port

The same dialog window appears as for the GSM autotest, for more information refer to the respective chapter of the GSM autotest.

7.5.17 Change Password

The same dialog window appears as for the GSM autotest, for more information refer to the respective chapter of the GSM autotest.

7.6 Limits Menu in the GSM Autotest

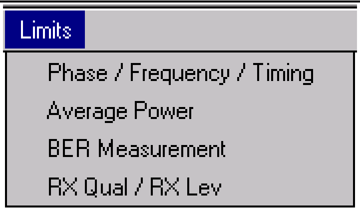


Fig.: Limits menu in the GSM autotest

With the items in the Limits menu, the upper and lower limits for the results are set. The settings made here influence all subsequently generated measurement reports. Tolerances of already stored measurement reports will not be influenced by these settings. Set limits are displayed in the second and third column of the measurement report.

Note:
It is recommended to store the settings in the form of a configuration file.

7.6.1 Phase / Frequency / Timing

This dialog window permits to define tolerances for frequency error, RMS phase error, peak phase error and timing error measurements. The frequency error is entered for GSM900, the values for GSM1800 and GSM1900 are automatically two times the entered value. Entered values are set by pressing OK. If newly entered limit values should not be set, terminate the dialog with Cancel.

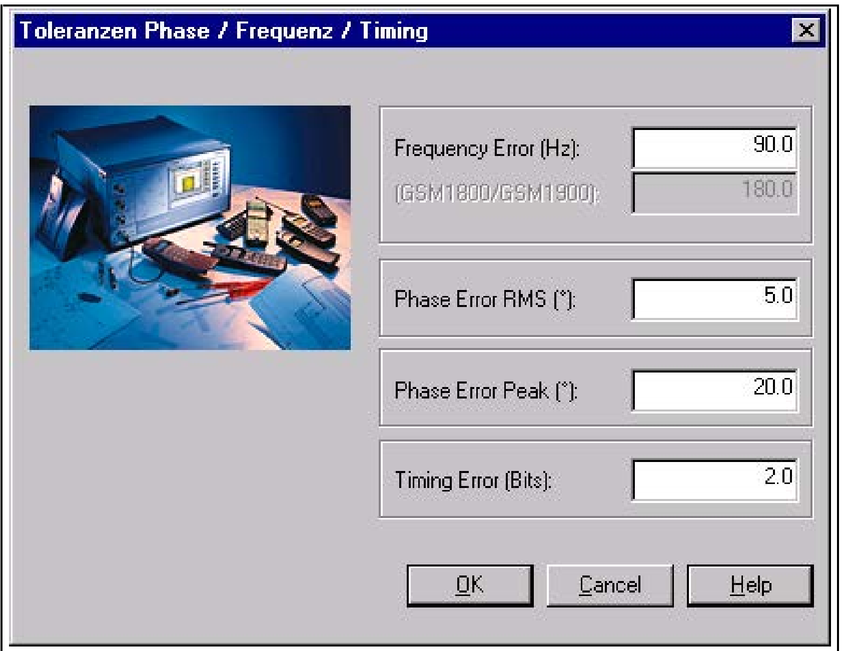


Fig.: Limits Phase / Frequency / Timing Errors dialog window

Set limits are indicated in the second and third column of the measurement report. Refer to the report section shown below.

Frequency Error *(at BS Power -70.0 dBm, 10 Bursts)*	-90.00 Hz	90.00 Hz	-44.00 Hz	✔
Phase Error RMS	-5.00 °	5.00 °	3.10 °	✔
Phase Error Peak	-20.00 °	20.00 °	9.30 °	✔
Timing Error	-2.00 Bits	2.00 Bits	-0.50 Bits	✔

Fig.: Extract from Phase / Frequency / Timing Error measurement report

7.6.2 Average Power

You may specify your own tolerances for the average power measurement. According to GSM specifications, the limits depend on the power control level (PCL) used by the mobile for transmission to the base station (CTS). Tolerances at the highest level are narrower than those at the other levels. Enter the value for the highest level in the Tolerance 1 field, tolerances for the other PCLs in the Tolerance 2 field. The lowest power level, which was introduced with GSM phase II, is compared with the value entered for Tolerance 3. Tolerances specified for GSM900 are listed in the table below:

Power Control Level	expected output power	Tolerance
0-2	39 dBm	± 2.0 dB
3	37 dBm	± 3.0 dB
4	35 dBm	± 3.0 dB
5	33 dBm	± 3.0 dB
6	31 dBm	± 3.0 dB
7	29 dBm	± 3.0 dB
8	27 dBm	± 3.0 dB
9	25 dBm	± 3.0 dB
10	23 dBm	± 3.0 dB
11	21 dBm	± 3.0 dB
12	19 dBm	± 3.0 dB
13	17 dBm	± 3.0 dB
14	15 dBm	± 3.0 dB
15	13 dBm	± 3.0 dB
16	11 dBm	± 5.0 dB
17	9 dBm	± 5.0 dB
18	7 dBm	± 5.0 dB
19	5 dBm	± 5.0 dB

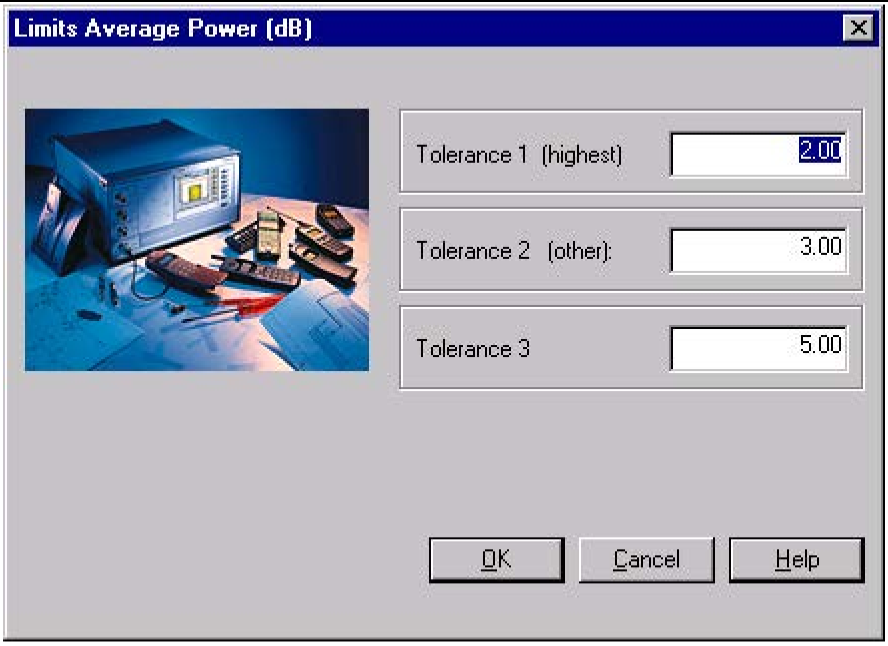


Fig.: Limits Average Power GSM900 dialog

The maximum output power of a mobile is specified by its power class (Mobile Power Class). This information is queried by the sequence control from the DUT and influences the choice of tolerance.

Power class GSM 900	maximum output power
1	43 dBm (see note)
2	39 dBm
3	37 dBm
4	33 dBm
5	29 dBm

Originally, power class 1 and PCL 0 were fixed at 43 dBm. Since no mobiles operate in this power class, the maximum output power of a GSM900 mobile is limited to 39 dBm.

Example:
A mobile of power class 4 is to be measured. The maximum mobile output power corresponds to 33 dBm or PCL 5. The ± 2.0 dB tolerance of PCL 5 is therefore used in this case.

With GSM1800 and GSM1900, four PCL-specific tolerances can be specified. They are entered in the four fields of the Limits Average Power dialog window. The modified dialog window is displayed when one of the two networks is selected in the Configure Network dialog window.

Power control level (PCL)	expected output power	Tolerance
0	30 dBm	± 2.0 dB
1	28 dBm	± 3.0 dB
2	26 dBm	± 3.0 dB
3	24 dBm	± 3.0 dB
4	22 dBm	± 3.0 dB
5	20 dBm	± 3.0 dB
6	18 dBm	± 3.0 dB
7	16 dBm	± 3.0 dB
8	14 dBm	± 3.0 dB
9	12 dBm	± 4.0 dB
10	10 dBm	± 4.0 dB
11	8 dBm	± 4.0 dB
12	6 dBm	± 4.0 dB
13	4 dBm	± 4.0 dB
14	2 dBm	± 5.0 dB
15	0 dBm	± 5.0 dB

PCLs 29, 30 and 31 defined by GSM1800 are not supported by the CTSgo program.

29	36 dBm	± 2.0 dB
30	34 dBm	± 2.0 dB
31	32 dBm	± 2.0 dB

PCLs 30 and 31 defined in GSM1900 are not supported by the CTSgo program.

30	33 dBm	± 2.0 dB
31	32 dBm	± 2.0 dB

As with GSM900, the highest mobile power level is weighted with Tolerance 1.
Power classes of GSM1800 and GSM1900 can be obtained from the two tables below. Power classes which are not supported appear on a dark background.

Power class GSM 1800	maximum output power
1	30 dBm
2	24 dBm
3	36 dBm

Power class GSM 1900	maximum output power
1	30 dBm
2	24 dBm
3	33 dBm

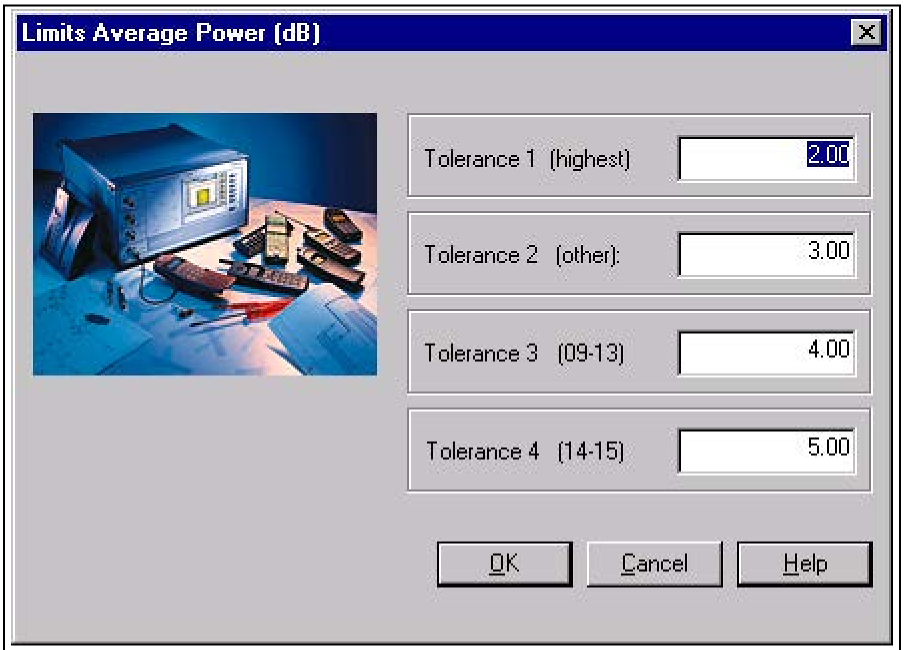


Fig.: Limits Average Power dialog window GSM1800/GSM1900

Entered values are set by pressing OK. If the entered limit values should not be set, terminate the dialog with Cancel.

Set limits are indicated in the second and third column of the measurement report. This can be seen in the following extract from a measurement report.

Average Power MS (at BS Power -70.0 dBm)	31.00 dBm	35.00 dBm	32.30 dBm	✔
Power Time Template			passed	✔

Fig.: Extract from measurement report: Average power / power ramp

Since power ramp tolerance evaluation is performed according to GSM specifications, the values cannot be changed by CTSgo. The finding of CTS is transferred to the PC as a Passed or Failed message.

7.6.3 BER Measurements

This command opens the Limits BER dialog window where the tolerances for the bit error rate (BER) are set. BER measurements are receiver measurements in which bits from a random generator sent by the CTS are received by the mobile, demodulated and looped back at the RF. The CTS compares the received bit sequence with the sent one. The bit sequence is channel-coded to GSM, ie the bits are assigned to different classes.

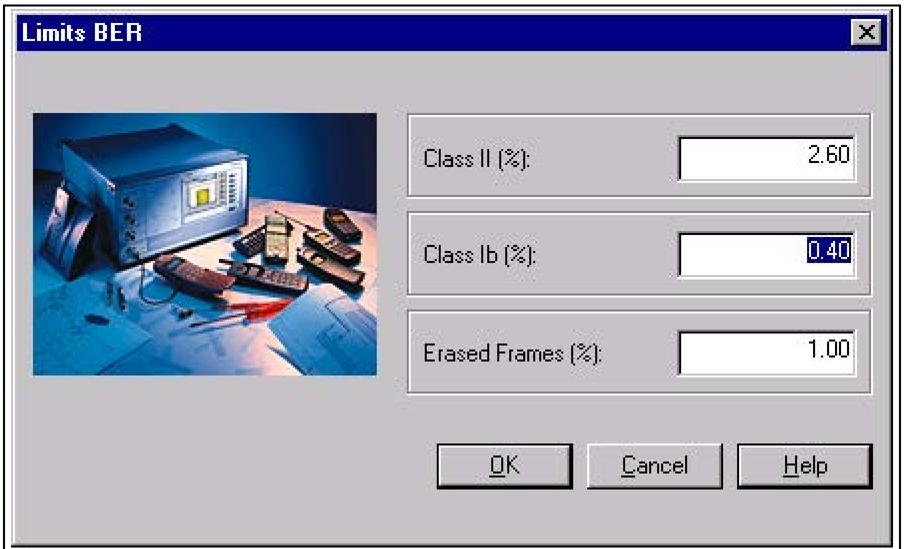


Fig.: Limits BER dialog window

Class II, the maximum permissible BER of which is to be specified in the first input field, contains unprotected bits. These bits normally transfer data that do not seriously impair transmission when the bits are lost. Bits of class Ib are protected, ie they can be restored by means of error correction. Enter the maximum permissible BER of class Ib in the second field. The bits are organized in frames for the employed BER measurement. This test method is also called residual bit error rate (RBER). If large errors occur within a frame, the respective frames are erased. The tolerance for frame erasure (EFR) can be entered in the third field.
The BER largely depends on the CTS output power used for this measurement. The output power can be set in the Configure Test Set window. You may have to know and enter the path attenuation between CTS and DUT, as even minor variations of the mobile input level may cause considerable changes of BER near the maximum sensitivity of the mobile. the number of frames used for the BER measurement should be entered in the Test Parameters dialog window.

BER Class Ib *(at BS Power -102.0 dBm, 50 Frames)*		0.40 %	0.00 %	✔
BER Class II		2.60 %	0.08 %	✔
BER Erased Frames		1.00 %	0.00 %	✔

Fig.: Extract from measurement report: BER measurements

The selected upper limits for the BER are indicated in the third column of the measurement report (see above).

7.6.4 RXQual /RXLev

RXQual and RXLev are measurements performed by the mobile. Measurement results are sent cyclically to the base station (CTS) in the form of measurement reports. The RXQual measurement informs on the receive quality of the mobile. Enter the maximum permissible RXQual in the first input field. Each RXQUal corresponds to a specific BER which can be seen from the table below.

Value of RXQual	Receive quality of signal (BER)
0	< 0.2%
1	> 0.2% to <0.4%
2	> 0.4% to <0.8%
3	> 0.8% to <1.6%
4	> 1.6% to <3.2%
5	> 3.2% to <6.4%
6	> 6.4% to <12.8%
7	> 12.8%

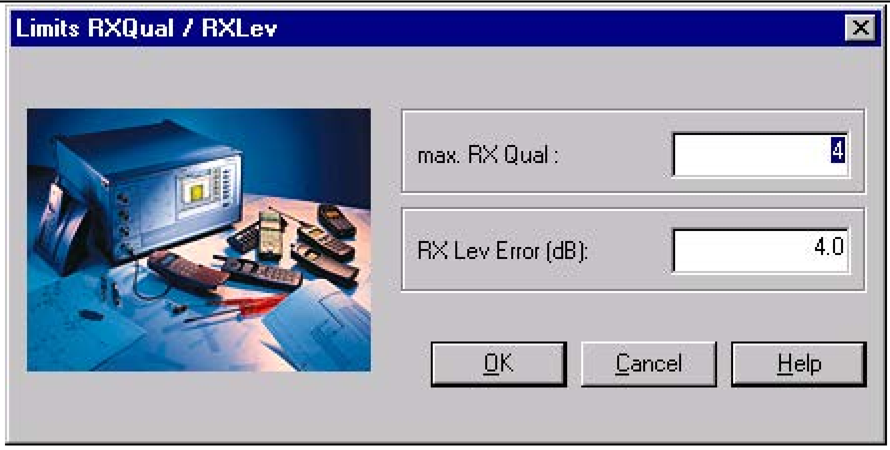


Fig.: Limits RXQual / RXLev dialog window

RXLev is the power received by the mobile and signaled to the base station as values from 0 to 63.

RXLev value	Signal strength (dBm)
63	> -48 dBm
62	-49 dBm to -48 dBm
61	-50 dBm to -49 dBm
...	...
...	...
2	-109 dBm to -108 dBm
1	-110 dBm to -109 dBm
0	below -110 dBm

The RXLev test evaluates the deviation of RXLev from the RF output power of CTS specified in the test set window. To give an example, a received RXLev value of 8 is interpreted as -102.5 dBm. Tolerances should not be too narrow because of the low resolution of this measurement.

RX Qual (at BS Power -102.0 dBm)		4.00	0.00	✔
RX Lev	-106.00 dBm	-98.00 dBm	-102.50 dBm	✔

Fig.: Extract from measurement report: RXQual / RXLev

To allow symmetrical tolerance evaluation, the base-station power for BER should be specified to 0.5 dB. An example is given below:

BS power for BER:	-89.5 dBm
Tolerance:	2.0 dB
Upper tolerance limit:	-87.5 dBm (RXLev =23)
Lower tolerance limit:	-91.5 dBm (RXLev =19)

7.7 Limits Menu in the DECT Autotest

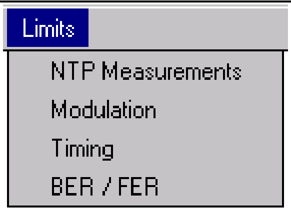


Fig.: Limits menu in the DECT autotest

With the items in the Limits menu, the upper and lower limits for the results are set. The settings made here influence all subsequently generated measurement reports. Tolerances of already stored measurement reports will not be influenced by these settings. Set limits are displayed in the second and third column of the measurement report.

Note:
It is recommended to store the settings in the form of a configuration file.

7.7.1 NTP Measurements

This dialog window permits to define tolerances for Normal Transmit Power (NTP) measurements. The NTP is the average power in the active part of the burst. Entered values are set by pressing OK. If newly entered limit values should not be set, terminate the dialog with Cancel.

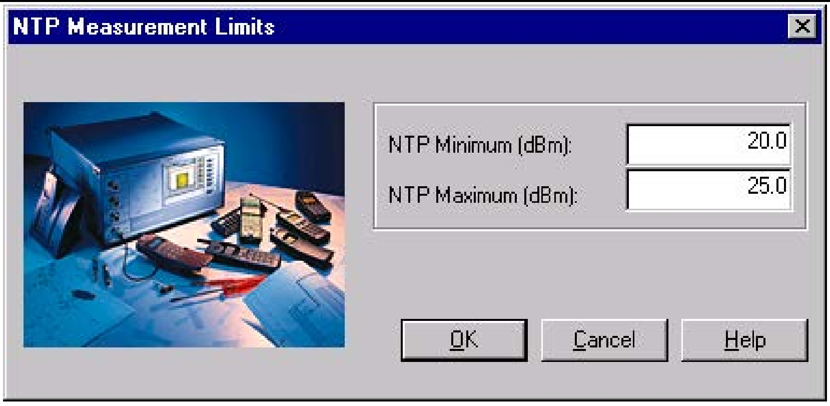


Fig.: NTP Measurement dialog window

Set limits are indicated in the second and third column of the measurement report. Refer to the report section shown below.

Fig.: Extract from the NTP measurement report

7.7.2 Modulation

This dialog permits to define the tolerance limits for the B-field modulation, the frequency offset and the frequency drift. Entered values are set by pressing OK. If newly entered limit values should not be set, terminate the dialog with Cancel.

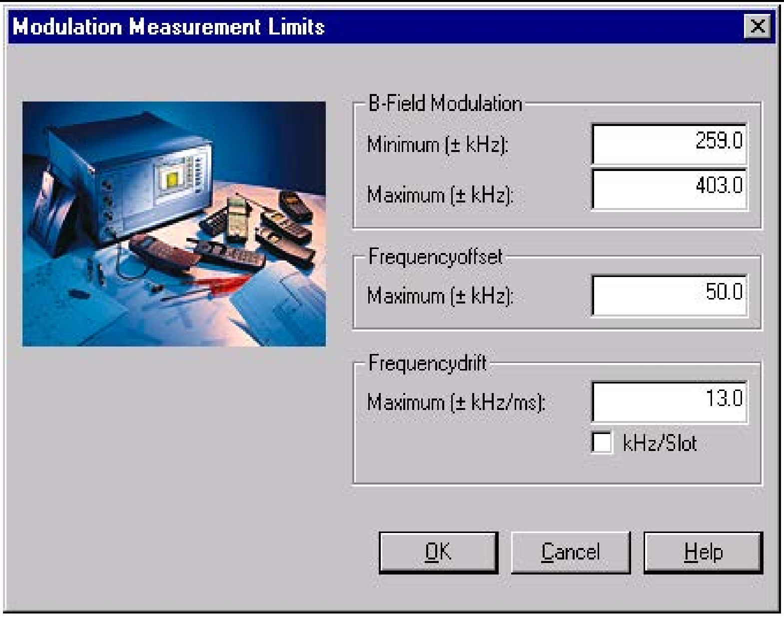


Fig.: Limits Modulation dialog

Set limits are indicated in the second and third column of the measurement report. Refer to the report section shown below.

Frequency Offset *(at RF Level -73.0 dBm, 4 Bursts)*	-50.00 kHz	50.00 kHz	9.32 kHz	✔
B-Field Modulation (-Max.)	-403.00 kHz	-259.00 kHz	-338.87 kHz	✔
B-Field Modulation (+Max.)	259.00 kHz	403.00 kHz	370.26 kHz	✔
Frequencydrift	-13.00 kHz/ms	13.00 kHz/ms	0.00 kHz/ms	✔

Fig.: Extract from the Modulation measurement report

Notes:
Data type Fig31 is always used for the CTSgo measurements. Within the B-field, this implies a number of 0/1s bit sequences, then a number of set bits (1s bits), followed by a number of set bits (0s bits) and a final 0/1s bit sequence. On the average, this figure contains as many bits that are set as bits that are not set in the B-field. If the arithmetic mean of the frequency offsets was generated, the result would correspond to the center frequency in the ideal case. The deviation is the frequency offset measured. Starting from this frequency offset, the maximum and the minimum deviation in the B-field will then be measured, with no differentiation being made between positive and negative deviation.
The unit of the frequency drift can be entered in the respective box in kHz/slot. Otherwise, the output will be in kHz/ms.

7.7.3 Timing

This dialog permits to define the tolerance limits for the jitter and timing measurements. The entered values are set by pressing OK. If newly entered values should not be set, terminate the dialog with Cancel.

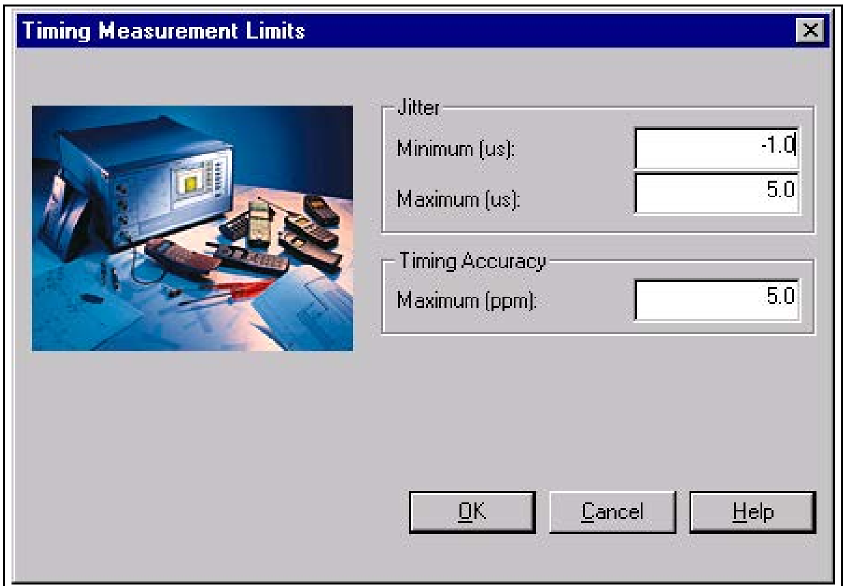


Fig.: Limits Timing dialog window

Set limits are indicated in the second and third column of the measurement report. Refer to the report section shown below.

Timing Accuracy *(at RF Level -73.0 dBm, 32 Bursts)*		5.00 ppm	4.81 ppm	✔
Jitter (-Max.)	-1.00 us		-0.72 us	✔
Jitter (+Max.)		5.00 us	1.59 us	✔

Fig.: Extract from the Timing measurement report

Note:
Theoretically, the interval between two transmit bursts of a fixed part is ten milliseconds. The measured deviation from this ideal value constitutes the timing. To be able to perform this measurement correctly, it is necessary to average over several bursts. In parallel to the average-value generation, the minimum and maximum time interval between two bursts is determined. The difference between minimum/maximum and average value is referred to as negative/positive jitter.

7.7.4 BER / FER

This dialog permits to define the upper limit for the bit error rate (BER) and frame error rate (FER) measurements. Note that the entry is made in parts per million (ppm). The entered values are set by pressing OK. If the newly entered tolerance values should not be set, terminate the dialog with Cancel.

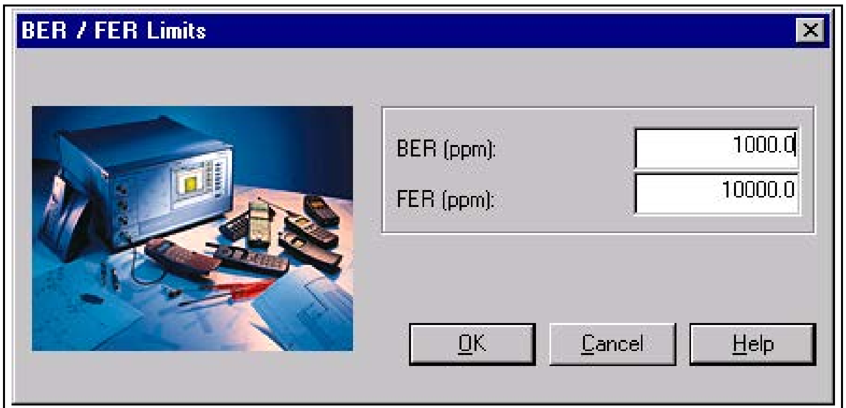


Fig.: Limits BER / FER dialog window

Set limits are indicated in the second and third column of the measurement report. Refer to the report section shown below.

Long-term BER *(at RF Level -73.0 dBm, 100 Frames)*		1000.00 ppm	46.40 ppm	✔
Long-term FER		10000.00 ppm	805.00 ppm	✔

Fig.: Extract from the BER / FER measurement report

Note:
The bit error rate is measured in loop mode of the fixed part or portable part. Sent and received bits are compared with each other. If more than 25% of the bits of a frame are faulty, this frame is declared to be invalid. These invalid frames are taken into account in the **F**rame **E**rror **R**ate and not in the BER.

7.8 Window Menu

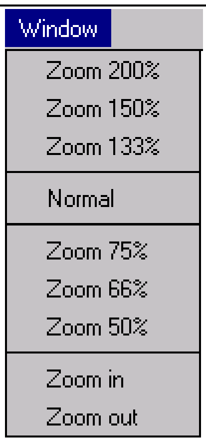


Fig.: Window menu

The Windows menu is only active in the report display mode. In this window, the display can be adapted to your requirements. The current size of the display is indicated in the status bar.

7.8.1 Zoom 200%

Popup menu Report display

This command expands the result display to 200% of the standard size.

7.8.2 Zoom 150%

Popup menu Report display

This command expands the result display to 150% of the standard size.

7.8.3 Zoom 133%

Popup menu Report display

This command expands the result display to 133% of the standard size.

7.8.4 Normal

Popup menu Report display

With this command, the result window is displayed in its normal size (100%).

7.8.5 Zoom 75%

Popup menu Report display

This command reduces the result display to 75% of the standard size.

7.8.6 Zoom 66%

Popup menu Report display

This command reduces the result display to 66% of the standard size.

7.8.7 Zoom 50%

Popup menu Report display

This command reduces the result display to 50% of the standard size.

7.8.8 Zoom in

Popup Menu Report display

With this command, the size of the current result display is expanded by 10%.

7.8.9 Zoom out

Popup menu Report display

With this command, the current result display is reduced by 10%.

7.9 Help Menu

Fig.: Help menu

7.9.1 Contents

This command calls the online help of CTSgo. You can obtain information on CTSgo by means of the online help without having to refer to this manual. Information is provided in a Windows-typical form and available as a separate file in the program directory of CTSgo. The online help can be accessed without having to call CTSgo. Individual pages of the help information may be printed if required.

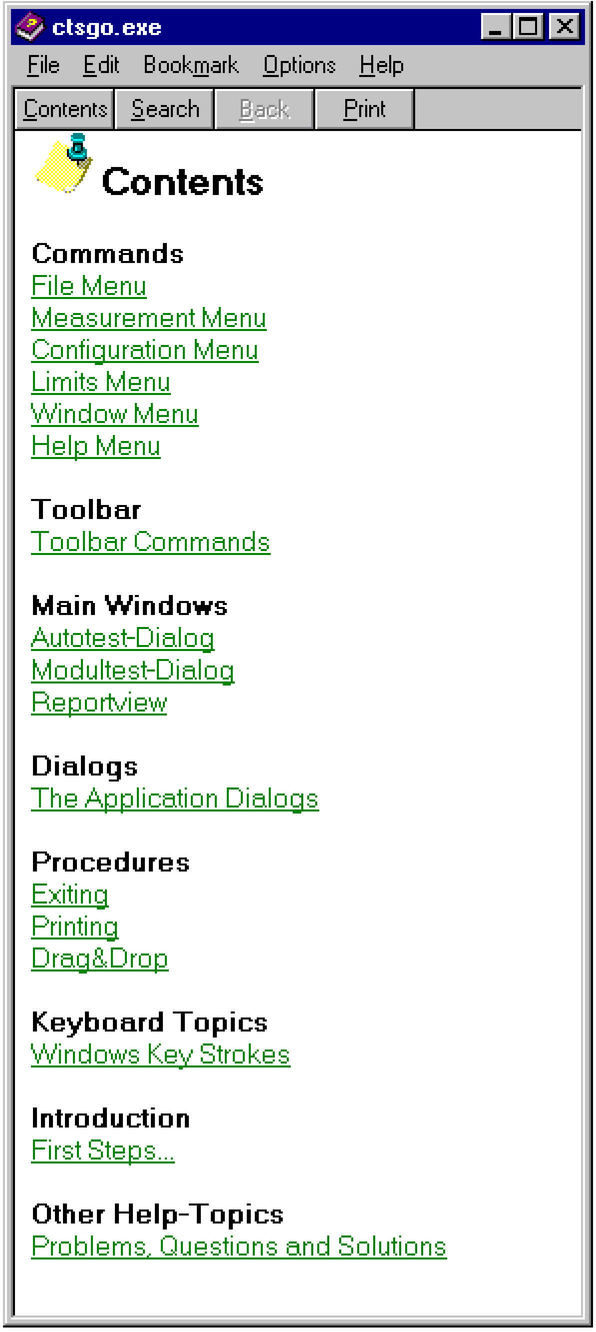


Fig.: CTSgo help window

7.9.2 Using the Online Help

This command calls the online help of the employed operating system. The help is platform-specific and depends on the installation of the operating system. It also includes instructions on the use of the help files. General help topics of Windows can also be called.

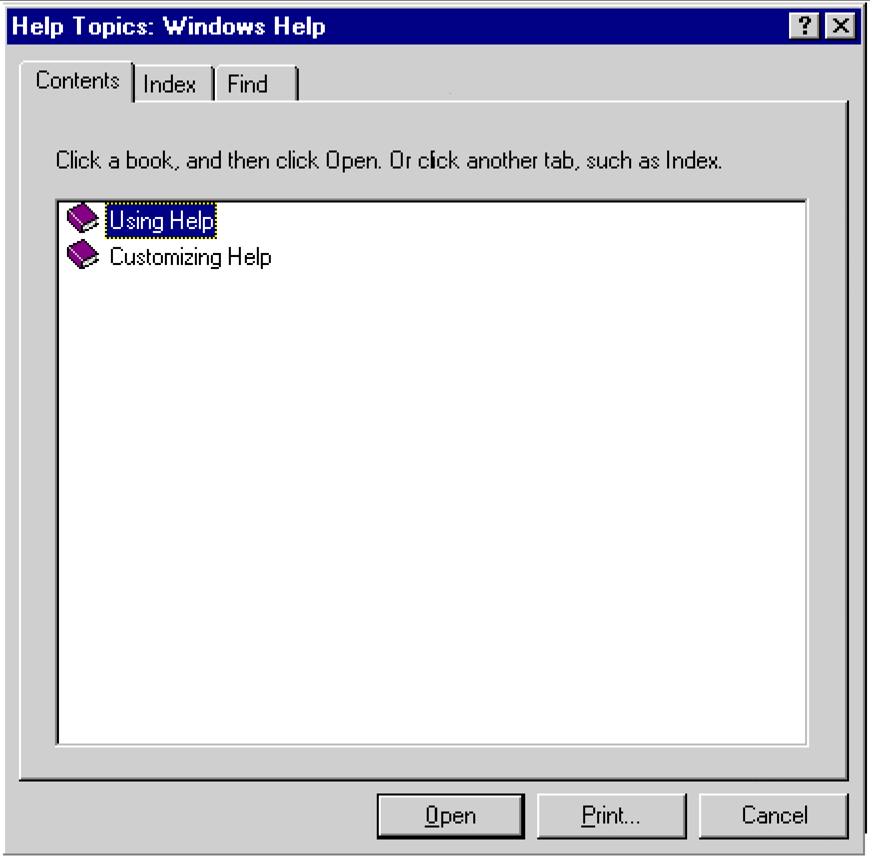


Fig.: Help topics of operating system

7.9.3 Info About

This command opens a small dialog window where the current CTSgo version is displayed. The platform-specific version of the program is also indicated.

Fig.: Info about CTSgo dialog window

8 GSM Measurement Report

The measurement reports generated by the autotest provide a clear overview of measurement results. This section describes the layout of the measurement reports.

8.1 Header of Measurement Report

The header of the measurement report contains all static settings of the measurement, eg set input and output attenuation, CTS output power during location update and the selected BCCH channel. Below this line are signaling parameters like the IMSI (**I**nternational **M**obile **S**ubscriber **I**dentity) of the SIM card used, the IMEI (**I**nternational **M**obile **E**quipment **I**dentity) of the measured mobile, power class of the mobile and its revision level. The CTS identification is indicated in another line. Its purpose is to facilitate the assignment of the measurement report to the instrument used. The configuration used for the measurement is also indicated.

Measurement Report ROHDE&SCHWARZ

Operator: noname	*12:36:55 13.03.98*
BS Parameters:	*RF Attenuation In/Out: 0.5 dB/0.5 dB, BCCH: 70, BS Power at Loc. Upd.: -70.0 dBm*
Signallisation Parameters:	*IMSI: 001.01.0000000001, IMEI: 123456.12.012345.0, Power Class: 4, Revision Level: 2*
Test Configuration:	*CTS Ident: 847768/014,V1.25 09/12/97, Configuration: TEST1*
Comment:	

Fig.: Report header

The header also contains general information such as date and time of completion of the measurement, the operator’s name and a comment line. The top of the header shows the title Measurement Report and next to it at the right a logo. In contrast to all other information, these two elements are also printed on the subsequent pages. The Rohde & Schwarz logo printed at the right can be replaced by another one. When items in the report are to be changed for further measurements, select Report Settings in the Measurement menu.

8.2 Output of Measurement Information in the Report

When a call is set up by the mobile, the call number is entered in the measurement report. You can implement a simple keyboard test.

Dialed Number *(1. Connect)*		1234567890	✔

Fig.: Display of call number

The information on the individual measurements is indicated in five columns. The first column describes the measurement and, if required, certain measurement conditions, eg the number of bursts or frames or the CTS output power used.

Test Condition:	Lower Limit	Upper Limit	Measured Value	P/F
Testset: 1 (TCH: 62, Power Control Level: 5)				
Frequency Error *(at BS Power -70.0 dBm, 10 Bursts)*	-90.00 Hz	90.00 Hz	-44.00 Hz	✔
Phase Error RMS	-5.00 °	5.00 °	3.10 °	✔
Phase Error Peak	-20.00 °	20.00 °	9.30 °	✔
Timing Error	-2.00 Bits	2.00 Bits	-0.50 Bits	✔
Average Power MS *(at BS Power -70.0 dBm)*	31.00 dBm	35.00 dBm	32.30 dBm	✔
Power Time Template			passed	✔
BER Class Ib *(at BS Power -102.0 dBm, 50 Frames)*		0.40 %	0.00 %	✔
BER Class II		2.60 %	0.08 %	✔
BER Erased Frames		1.00 %	0.00 %	✔
RX Qual *(at BS Power -102.0 dBm)*		4.00	0.00	✔
RX Lev	-106.00 dBm	-98.00 dBm	-102.50 dBm	✔

Fig.: Output of measurement information in the report

Limits used for obtaining the decision Passed / Failed are indicated in the next two columns. A gray bar is shown if there is no upper or lower limit for the measurement. For instance, setting a lower limit for a BER measurement would not make sense. The measured value is indicated in column four. Values for passed tests are displayed in green and a hook appears in the last column. Red values indicate that the test failed and a red bar is displayed in column five. Tests not performed are displayed in blue in column four. This may happen when synchronization is lost during the measurement. Information on the power control level (PCL) and employed channel or the associated test set are indicated in the first column instead of the modified parameters. This additional information is written in italics.

You can include a simple echo test in the measurement, the result of which is indicated below.

Echotest *(at BS Power -70.0 dBm)*			passed	✔

Fig.: Display of echo test

8.3 Summary of Results in the Measurement Report

A summary of test results is given on the last page of each measurement report together with the number of passed or failed tests. The total measurement time including the waiting times for operator actions is also specified. Any loss of synchronization is also indicated here together with the name of the measurement in which the loss occurred.

Result: **All 64 Tests passed**

(Execution Time: 165.1 sec)

Fig.: Summary of measurement report

8.4 Appendix to Measurement Report

The graphics display of the power ramp and the phase curve within the burst are appended to the measurement report.

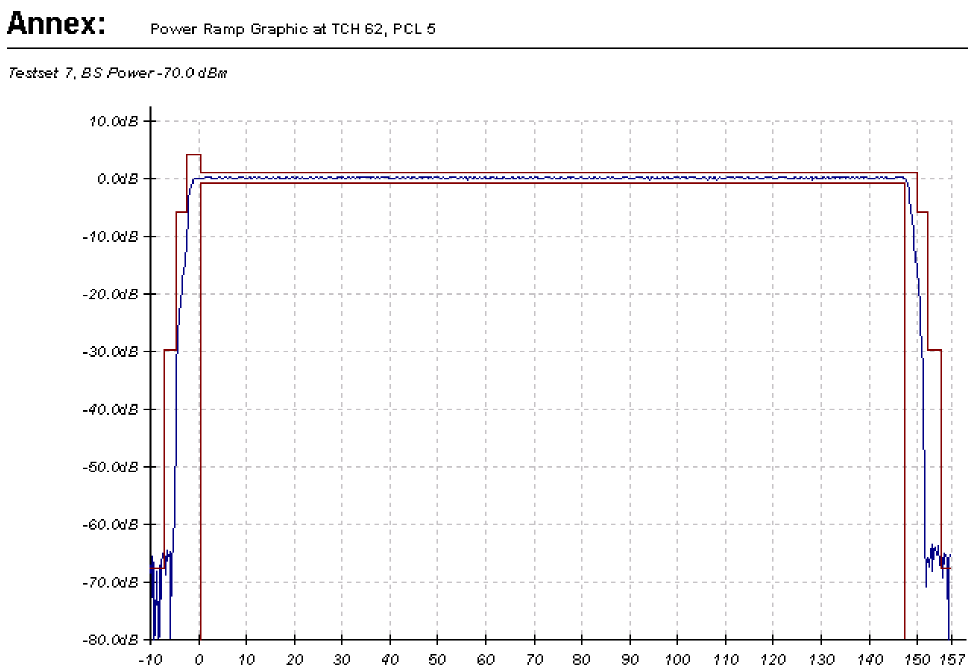


Fig.: Appendix to measurement report: power ramp

The curve is shown in blue, the tolerance mask is recorded in red.

Notes:
The tolerance mask is defined at various points A to H. In the case of GSM900, different criteria are valid in point A for the rising and falling edge. The points depend on network and power control level. Some points are assigned both relative and absolute values. The relative values are relative to the average power in the useful part of the ramp. In GSM, the criterion that can be met more easily is always valid.

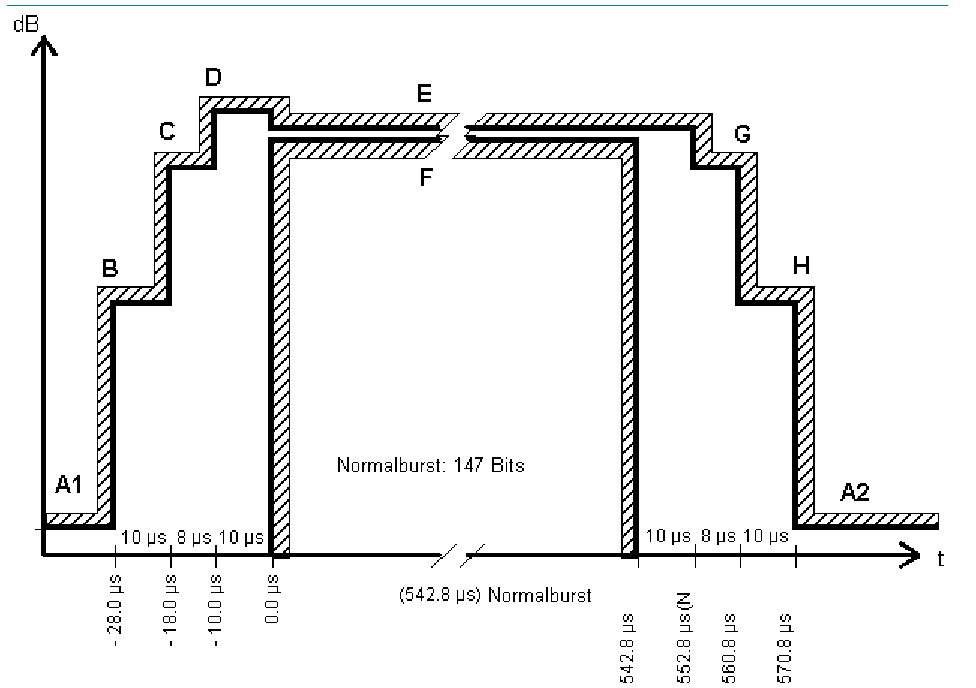


Fig.: GSM Power Time Template

The limit lines used by CTSgo in the display of the power time template can be obtained from the following tables. According to GSM specifications, the reference point (0.0 µs) is positioned in the middle of the bit length of bit 0. The evaluation of the tolerance mask is always performed by the CTS and not by CTSgo. The tolerance lines only serve for information.

Point	relative	absolute
A1	-59.0 dB	-36.0 dBm
B	-30.0 dB	-17.0 dBm
C	-6.0 dB	
D	4.0 dB	
E	1.0 dB	
F	-1.0 dB	
G	-6.0 dB	
H	-30.0 dB	-17.0 dBm
A2	-59.0 dB	-54.0 dBm

GSM 900 PCL 5-15

Point	relative	absolute
A1	-59.0 dB	-36.0 dBm
B	-30.0 dB	-17.0 dBm
C	-4.0 dB	
D	4.0 dB	
E	1.0 dB	
F	-1.0 dB	
G	-4.0 dB	
H	-30.0 dB	-17.0 dBm
A2	-59.0 dB	-54.0 dBm

GSM 900 PCL 16

Point	relative	absolute
A1	-59.0 dB	-36.0 dBm
B	-30.0 dB	-17.0 dBm
C	-2.0 dB	
D	4.0 dB	
E	1.0 dB	
F	-1.0 dB	
G	-2.0 dB	
H	-30.0 dB	-17.0 dBm
A2	-59.0 dB	-54.0 dBm

GSM 900 PCL 17

Point	relative	absolute
A1	-59.0 dB	-36.0 dBm
B	-30.0 dB	-17.0 dBm
C	-1.0 dB	
D	4.0 dB	
E	1.0 dB	
F	-1.0 dB	
G	-1.0 dB	
H	-30.0 dB	-17.0 dBm
A2	-59.0 dB	-54.0 dBm

GSM 900 PCL 18 and 19

Point	relative	absolute
A1	-48.0 dB	-48.0 dBm
B	-30.0 dB	-20.0 dBm
C	-6.0 dB	
D	4.0 dB	
E	1.0 dB	
F	-1.0 dB	
G	-6.0 dB	
H	-30.0 dB	-20.0 dBm
A2	-48.0 dB	-48.0 dBm

GSM 1800/1900 PCL 0-10

Point	relative	absolute
A1	-48.0 dB	-48.0 dBm
B	-30.0 dB	-20.0 dBm
C	-4.0 dB	
D	4.0 dB	
E	1.0 dB	
F	-1.0 dB	
G	-4.0 dB	
H	-30.0 dB	-20.0 dBm
A2	-48.0 dB	-48.0 dBm

GSM 1800/1900 PCL 11

Point	relative	absolute
A1	-48.0 dB	-48.0 dBm
B	-30.0 dB	-20.0 dBm
C	-2.0 dB	
D	4.0 dB	
E	1.0 dB	
F	-1.0 dB	
G	-2.0 dB	
H	-30.0 dB	-20.0 dBm
A2	-48.0 dB	-48.0 dBm

GSM 1800/1900 PCL 12

Point	relative	absolute
A1	-59.0 dB	-36.0 dBm
B	-30.0 dB	-17.0 dBm
C	-2.0 dB	
D	4.0 dB	
E	1.0 dB	
F	-1.0 dB	
G	-2.0 dB	
H	-30.0 dB	-17.0 dBm
A2	-59.0 dB	-54.0 dBm

GSM 1800/1900 PCL 13 to 15

The second graphics of the measurement report shows the phase error for each quarter bit in the useful part of

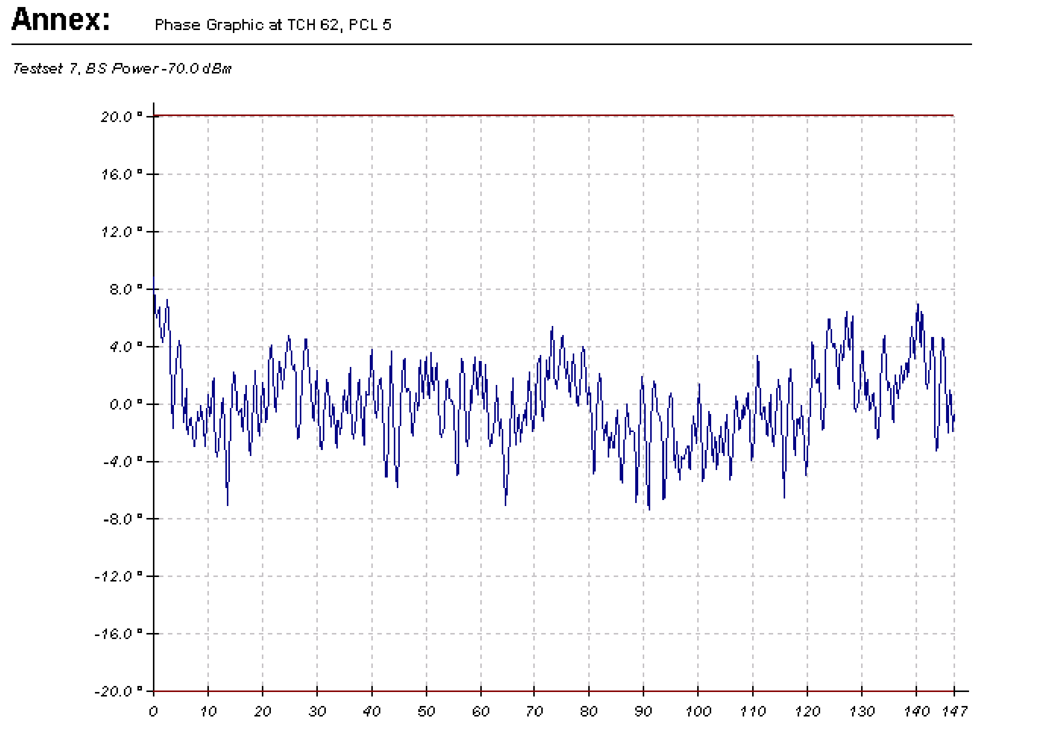


Fig.: Appendix to measurement report: phase curve

the GSM burst. Depending on the upper limit of the phase error selected in the CTSgo configuration, a red tolerance line is drawn in at this point.

9 DECT Measurement Report

The measurement reports generated by the autotest provide a clear overview of measurement results. This section describes the layout of measurement reports.

9.1 Header of Measurement Report

The header of the measurement report contains all static settings of the measurement, eg set input and output attenuation, channel and slot of dummy carrier for the PP test and the selected RFPI (**R**adio **F**ixed **P**art **I**dentity) for the fixed part and the portable part test. The CTS identification is output in another line. Its purpose is to facilitate the assignment of the measurement report to the instrument used. The configuration used for the measurement is also indicated.

Measurement Report ROHDE&SCHWARZ

Operator:	noname	*14:25:50 29.07.99*
FP Parameter:	*RF Attenuation In/Out: 0.0/0.0 dB, RFPI: 0123456789*	
PP Parameter:	*RF Attenuation In/Out: 0.0/0.0 dB, RFPI: 0123456789, Dummy Carrier/Slot: 0/0*	
Test Configuration:	*CTS Ident: 000000/000 V1.00.DEMO 07/30/98, Configuration:*	

Fig.: Report header

The header also contains general information such as date and time of completion of the measurement, the operator’s name and a comment line. The top of the header shows the title Measurement Report and next to it at the right a logo. In contrast to all other information, these two elements are also printed on the subsequent pages. The Rohde & Schwarz logo printed at the right can be replaced by another one. When items in the report are to be changed for further measurements, select Report Settings in the Measurement menu.

9.2 Output of Measurement Information in the Report

The information on the individual measurements is indicated in five columns. The first column describes the measurement and, if required, certain measurement conditions, eg the number of bursts or frames or the CTS output power used.

Test Condition:	Lower Limit	Upper Limit	Measured Value	P/F
FP-Testset 1 (Channel: 0, Slot 2, Offset 0.0)				
NTP *(at RF Level -73.0 dBm, 4 Bursts)*	20.00 dBm	25.00 dBm	20.35 dBm	✔
Power Time Template			passed	✔
Frequency Offset *(at RF Level -73.0 dBm, 4 Bursts)*	-50.00 kHz	50.00 kHz	4.60 kHz	✔
B-Field Modulation (-Max.)	-403.00 kHz	-259.00 kHz	-318.27 kHz	✔
B-Field Modulation (+Max.)	259.00 kHz	403.00 kHz	266.18 kHz	✔
Frequencydrift	-13.00 kHz/ms	13.00 kHz/ms	0.00 kHz/ms	✔
Timing Accuracy *(at RF Level -73.0 dBm, 32 Bursts)*		5.00 ppm	2.17 ppm	✔
Jitter (-Max.)	-1.00 us		-0.01 us	✔
Jitter (+Max.)		5.00 us	0.69 us	✔
Long-term BER *(at RF Level -73.0 dBm, 100 Frames)*		1000.00 ppm	46.40 ppm	✔
Long-term FER		10000.00 ppm	805.00 ppm	✔

Fig.: Output of measurement information in the report

Limits used for obtaining the decision Passed / Failed are indicated in the next two columns. A gray bar is shown if there is no upper or lower limit for the measurement. For instance, setting a lower limit for a BER measurement would not make sense. The measured value is indicated in column four. Values for passed tests are displayed in green and a hook appears in the last column. Red values indicate that the test failed and a red bar is displayed in column five. Tests not performed are displayed in blue in column four. This may happen when synchronization is lost during the measurement. Information on used slot), employed channel and the channel offset or the associated test set are indicated in the first column instead of the modified parameters. This additional information is written in italics.

You can include a simple echo test in the measurement, the result of which is indicated below.

Echotest *(at RF Level -73.0 dBm)* passed ✔

Fig.: Output of echo test in the measurement report

9.3 Summary of Measurements in the Measurement Report

A summary of test results is given on the last page of each measurement report together with the number of passed or failed tests. The total measurement time including the waiting times for operator actions is also specified. Any loss of synchronization is also indicated here together with the name of the measurement in which the loss occurred.

Result: **All 21 Tests passed**
(Execution Time: 57.4 sec)

Fig.: Summary of measurements in the measurement report

9.4 Appendix to Measurement Report

Annex: Power Ramp Graphic at Channel 0, Slot 2, Offset 0.0

FP Testset 1, RF Level -73.0 dBm

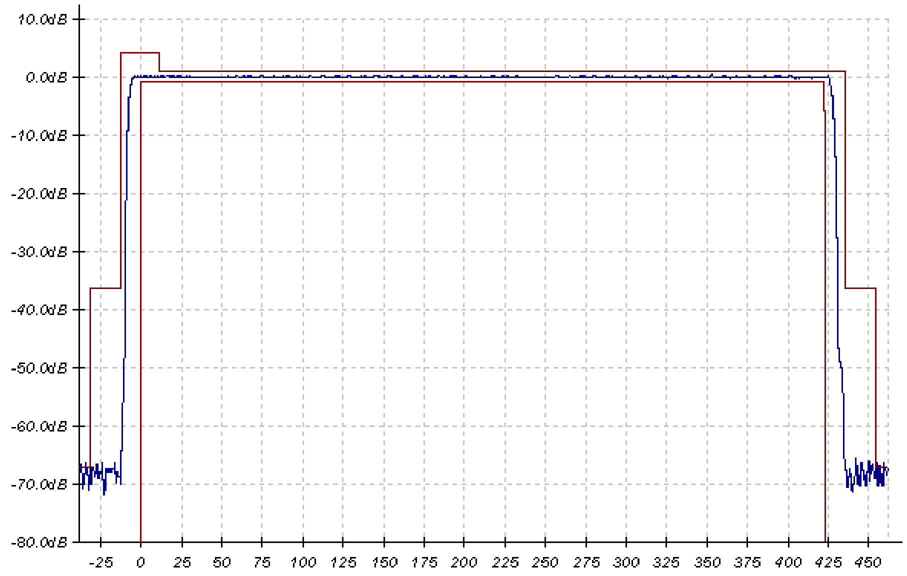
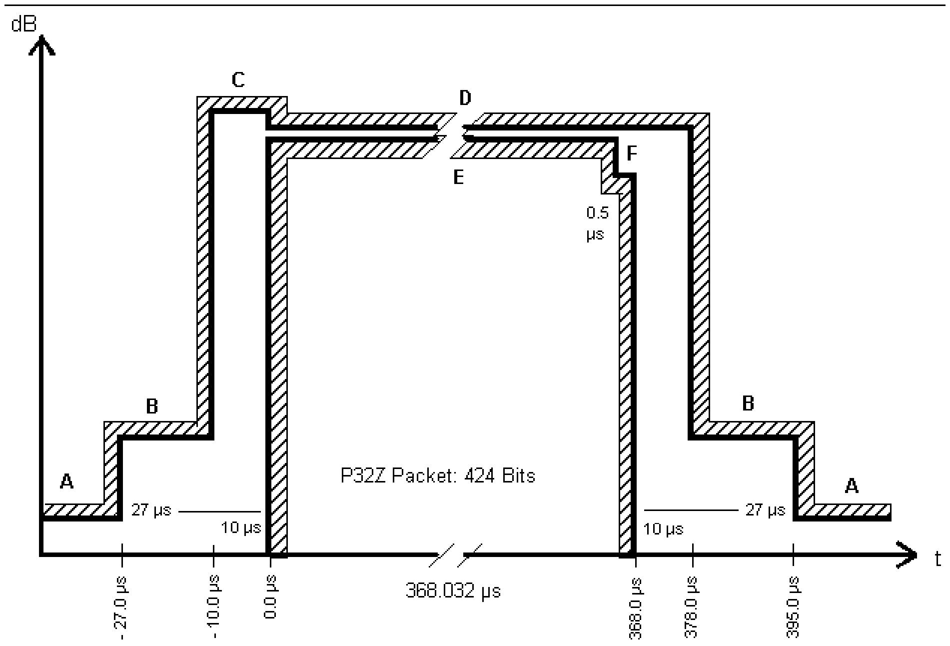


Fig.: Appendix to measurement report: power ramp

The graphics display of power ramp and modulation within the burst is appended to the measurement report.

The curve display is shown in blue. The tolerance mask is recorded in red.

Note:
The tolerance mask is defined at various points A to F.



DECT Power Time Template

The limit lines used by CTSgo in the display of the DECT power time template can be obtained from the following table.

Point	relative	absolute
A		20.0 nW
B		25.0 uW
C	4.0 dB	
D	1.0 dB	
E	-1.0 dB	
F	-6.0 dB	

The evaluation of the tolerance mask is always performed by CTS and not by CTSgo. The tolerance lines only serve for information.

The second graphics display of the measurement report shows the modulation within the burst. The modulation used during the measurement is always Fig31. Recording starts at bit position -38. It can be clearly seen that still no burst is being received by the tester. Then follows the sync field including the preamble for time synchronization between FP and PP. This field is followed by the A-field, which differs from the surrounding fields in longer 0s and 1s sequences. The longest part is the B-field with the long 1s and 0s bit sequence in its middle that is typical for Fig31. The burst is terminated by the X-field (CRC). The end of the burst is reached at bit position 424. However, recording only stops at bit position 462.
The frequency offset signaled by the CTS is displayed with a yellow line in the graphics. The tolerance fields for the B-field modulation are marked by two red lines.

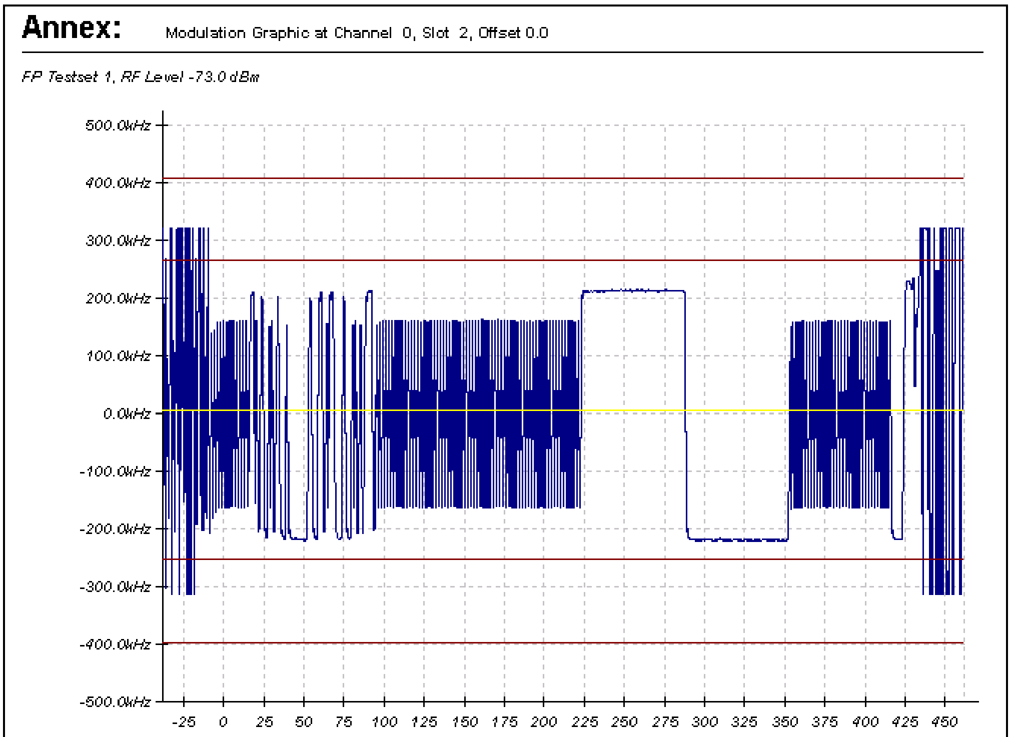


Fig.: Appendix to measurement report: phase curve

10 Drag & Drop Support

The program supports the implemented drag & drop function of Windows in two ways. Drag & drop allows the user to move a selected file of a folder across the main window of an application with the left mouse key held down and to release the key when the desired position is attained.

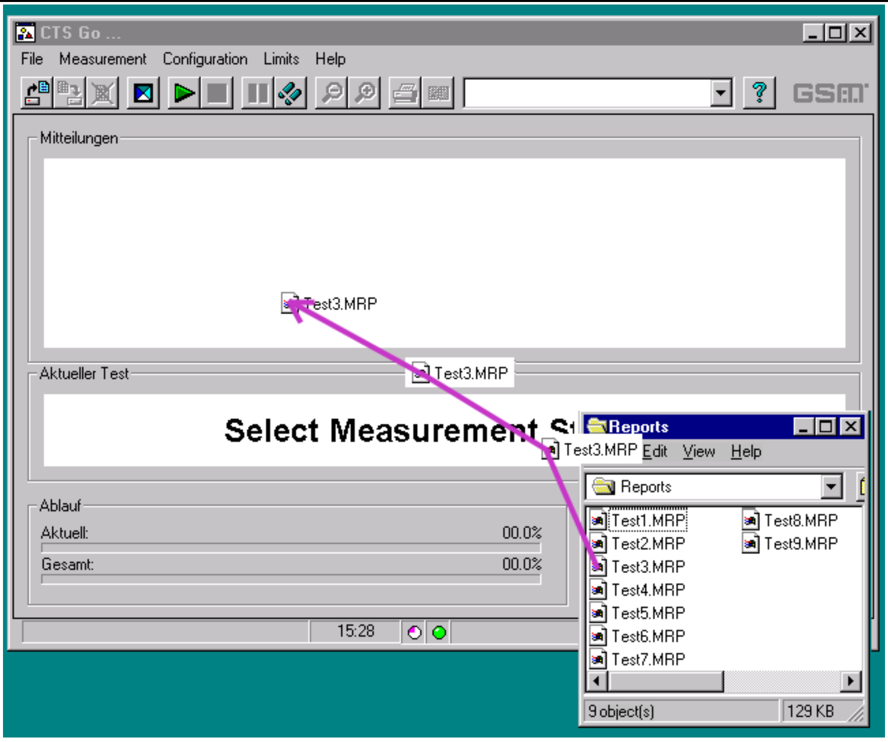


Fig.: Drag & Drop

The measurement report files (.MRP) can be moved to the main window. After this the measurement report is loaded provided the sequence control is in the stop mode. This function is available in all operating modes of CTSgo.
Configuration files (*CFG) can also be loaded in this way. Drag & drop may be a great help particularly when several files should be viewed in succession.

11 Exchanging Measurement Report Data

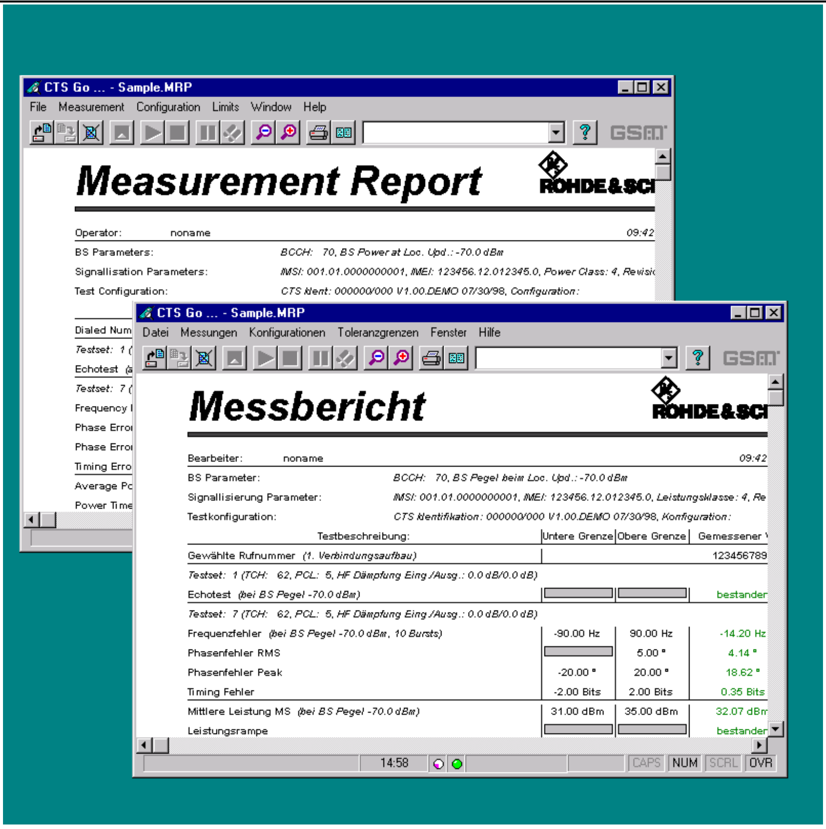


Fig.: English and German report display

CTSgo does not store country-specific information or texts in the measurement report files. If you have performed measurements with the English version of CTSgo and want to view the test results with the German version, window labeling as well as the information on date and time will be adapted to the desired language.

During the export of measurement results, the number format will be adapted to the country-specific standard. The transfer of these files may cause problems when the data are imported to spreadsheet programs, for instance. If data are to be transferred across country borders, it is advisable to send the measurement report and export the data on the target platform.

12 Examples of Application

The procedure for configuring the autotest will be explained with the aid of two examples. Read through these examples if you are still not at ease with the operation of CTSgo.

Before starting the examples, the following steps should be performed:

- Open the Configuration menu and select the Remote Port option. Enter remote-control parameters in the Remote Control Port (RS232) dialog window according to the settings in the CTS.
- Open the Measurement menu and select Report Settings. Enter your name and, if required, a comment in the Measurement Report Settings window. Activate the option “Display Report after the Tests”. If necessary, change the logo displayed on the measurement reports.

12.1 Simple GSM Echo Test

During this measurement, a call should be set up and an echo test performed. The CTS should set up a call to the GSM-1800 mobile. The call should be cleared down by the user. The mobile is connected to the CTS via an antenna coupler, the attenuation of the coupler is approx. 7 dB in both directions.

- Open the Configuration menu and select Network. Activate GSM1800 in the Configure Network dialog window. Enter a power of –70 dBm for the location update. Close the window with OK.
- Select the Test Parameters command in the Configuration menu. The Configure Test Parameters dialog window is opened. Enter 512 for the BCCH. Enter 7.0 dB for input and output attenuation according to the settings of the antenna coupler. Close the dialog window with OK.
- Open the Select Tests dialog window by choosing Select Tests in the Configuration menu. Check First Connection and Test Set 1. All other boxes should be empty. Confirm your settings with OK.
- Open the Configuration menu, select First Connect and activate Call from Base Station (CTS) in the Configure First Connect dialog window. Confirm the settings with OK.
- Open the Configuration menu and select Test Set 1. Enter 62 for the TCH channel in the Configure Test Set 1 window. Activate 10 in the TCH Power Levels field. Enter –70.0 dBm for the Standard BS Power. Activate Echotest in the Measurements field. Close the dialog window with OK.
- Select First Disconnect in the Configuration menu and activate Release from Mobile in the Configure First Disconnect dialog window. Confirm the settings with OK.
- Move your mouse to the center of the autotest window, press the righthand mouse key and hold it down. With the key held down place the mouse cursor on Save Configuration in the popup menu and release the key. Enter a name, eg ECHOTEST.CFG in the Save Configuration dialog window and select the directory for the file to be stored.
- Start the measurement by a click on the Start icon in the toolbar.

12.2 Extended GSM Test

In our second example, and extended test of a GSM900 mobile is to be performed. After a first call has been set up by CTS, all kind of GSM transmitter measurements are to be performed in channels 1, 62 and 124 at the PCLs 5, 10 and 15. Statistical averaging over several bursts should not be performed and the CTS output level should be –70 dBm. With these measurements terminated, the call is to be cleared down by the CTS. The second call should be set up by the user and an echo test performed on channel 62. The CTS output level of –60 dBm should be reduced for the subsequent BER measurement over 50 frames. RXLev and RXQual of the mobile should also be checked. The call should be released again by the user. The mobile is connected to the CTS by means of an RF cable taken from a vehicle installation set; the cable loss is 0.5 dB.

- Open the Configuration menu and select Network. Activate GSM900 in the Configure Network dialog window. enter a power of –70 dBm for the location update. Terminate the dialog with OK.
- Select the Test Parameters command in the Configuration menu. The Configure Test Parameters dialog window is opened. Enter 31 for the BCCH. Enter 0.5 dB for input and output attenuation according to the settings of the antenna coupler. Close the dialog window with OK.
- Open the Select Tests dialog window by choosing Select Tests in the Configuration menu. Check First Connection, Test Set 1, Test Set 2, Test Set 3. All other boxes should be empty. Confirm your settings with OK.
- Open the Configuration menu, select First Connect and activate Call from Base Station (CTS) in the Configure First Connect dialog window. Confirm the settings with OK.
- Open the Configuration menu and select Test Set 1. Enter 2 as TCH channel in the Configure Test Set 1 window. Activate the boxes “5“, “10“ and “15“ in the TCH Power Levels fields. Enter –70.0 dBm for BS Power Standard. Check the boxes Frequency Error, Phase Error, Timing, Average Burst Power and Power Ramp in the Measurements field. All other boxes in the Measurement field should be empty. Close the dialog window by pressing OK.
- Repeat this step for Test Set 2 but enter 62 for the TCH channel.
- The procedure for Test Set 3 is the same as described for test set 1 but enter TCH channel 124.
- Select First Disconnect in the Configuration menu. Activate Release from Basestation (CTS) in the Configure first Disconnect dialog window. Confirm the selection with OK.
- Open the Configuration menu, select the Second Connect item and activate Call from Mobile in the Configure second Connect dialog window. Confirm the settings with OK.
- Open the Configuration menu and select Test Set 7. Enter 62 as TCH channel. Check box 10 in the TCH Power Level field and enter –70.0 dBm for BS Power Standard. Enter –102.5 dBm for BS POWER BER. Check BER class Ib, BER class II, BER EFR, RXQual, RXLev and Echotest in the Measurement field. All other boxes of the Measurement field should be empty. Close the dialog window with OK.
- Select Second Disconnect in the Configuration menu and activate Release from Mobile in the Configure second Connect dialog window. Confirm the settings with OK.
- Open the windows for the commands in the Limits menu one after the other; check and change the limits for the individual measurements if you are not satisfied with the default values.

- Open the File menu and select Save Configuration. Enter a name, eg ENDTEST.CFG in the Save Configuration dialog window and select the directory where the file should be stored.
- Open the Measurement menu and click on Start.

12.3 DECT Test

In our third example, a DECT set consisting of a fixed part and a portable part is to be measured. The RFPI of the set is not known. It is completely sufficient to check one channel in our measurement. Neither RF connectors nor an antenna coupler is available. Therefore, we cut off an RF cable where an N-type connector is connected at one end. There, we uncover about 4 centimeters of the inner conductor and strengthen it by soldering. This cable end is attached to the fixed part or portable part at the place where the antenna is positioned using adhesive tape. We do not open the casing, since we only want to get a rough idea about whether this set works or not. A measurement of the normal transmit power in manual CTS mode resulted in an attenuation of approx. 10 dB at the portable part and approx. 12 dB at the fixed part.

- Open the Configuration menu and call PP Base settings, enter an input and output attenuation of 10 dB each. 0 is entered for the carrier and slot of the dummy bearer. For the Q-packages we keep the default values of “000003FF0000“ for Q0, „003041108008“ for Q3, „006F0F000000“ for Q6 and „03060306“ for QMUX. Then terminate the dialog by pressing OK.
- Open the Configuration menu and call FP Base Settings. Enter an input and output attenuation of 12 dB each. Check the boxes “Accept detected RFPI” and “Use detected RFPI in PP Test“. For the PMID we keep the default value of “EBE8D“. Enter 0 as antenna. Close the dialog window by pressing OK.
- Open the Configuration menu and the Select Tests dialog window. Activate the boxes FP Test, FP Test Set 1, PP Test and PP Test Set 1. All other boxes must be empty. Confirm your settings by means of OK.
- Open the Configuration menu and call FP Test Set 1. Enter the carrier 0, slot 2 and offset 0.0. Enter an RF Level of –70.0 dBm in the RX Measurements field. Select the BER and FER measurement using the boxes. Enter 100 for the number of frames. Enter an RF Level of –65.0 dBm in the TX Measurements field. The number of bursts for power and modulation measurements must be 4, the number of bursts in the timing measurement 32. Select all boxes of the TX Measurements field except Echotest. Close the dialog with OK.
- Open the Configuration menu and call PP Test Set 1. Enter carrier 0, slot 2 and offset 0.0. Enter an RF level of –70.0 dBm in the RX Measurements field. Select BER and FER measurement using the boxes. Enter 100 for the number of frames. Enter an RF level of –65.0 dBm in the TX Measurements field. The number of bursts for power and modulation measurements should be 4, the number of bursts in the timing measurement 32. Select all boxes of the TX Measurements field except Echotest. Close the dialog window using OK.
- Call the commands of the Limits menu one after the other and vary the tolerance limits of the individual measurements if you are not satisfied with the default values.
- Open the File menu and select Save Configuration. Enter a name, eg DECTTEST.CFG in the Save Configuration dialog window and select the directory where the file is to be stored.
- Open the Measurement menu and click on Start.

13 Working with Different User Profiles

CTSgo allows for two different user profiles, the configurator and the operator profile. The operator mainly focuses on loading configurations and then starting the test. In order to prevent surrounding base stations from disturbing the measurements, the operator can change the settings of the BCCH and TCH channels. In the DECT test, he can enter the RFPI. In the case of configurations starting with the letters “UNIV“ he can as well change the attenuations, provided these configuration files are part of the current directory of CTSgo. In general, both the DECT and GSM parameters are stored or loaded simultaneously in the case of configuration files.

13.1 The Configurator Profile

The configurator is entitled to overwrite all configurations, set tolerance limits and define the extent of the tests. When configuration files are loaded they are not checked for changes. If CTSgo is to be used by a configurator, the directory, where the executable CTS_GO.EXE file is stored, must also contain a valid file “CTS_GO.ULV“ .

13.2 The Operator Profile

The operator is only entitled to overwrite channel entries of the test sets, enter his name into the measurement reports and determine the directory for automatic storage of the measurement reports. He is not entitled to set tolerance limits and define the extent of the tests. When configuration files are loaded, they are checked for modifications. If the contents of the configuration file does not correspond to the version defined by the configurator, the configuration file cannot be loaded and a warning is output on the screen. The input fields and the menu items that must not be changed are displayed as inactive. The operator profile is automatically set if the directory, where the executable CTS GO.EXE file is stored, does not contain a valid “CTS_GO.EXE“ file.

14 Integrating Operator-specific Hints

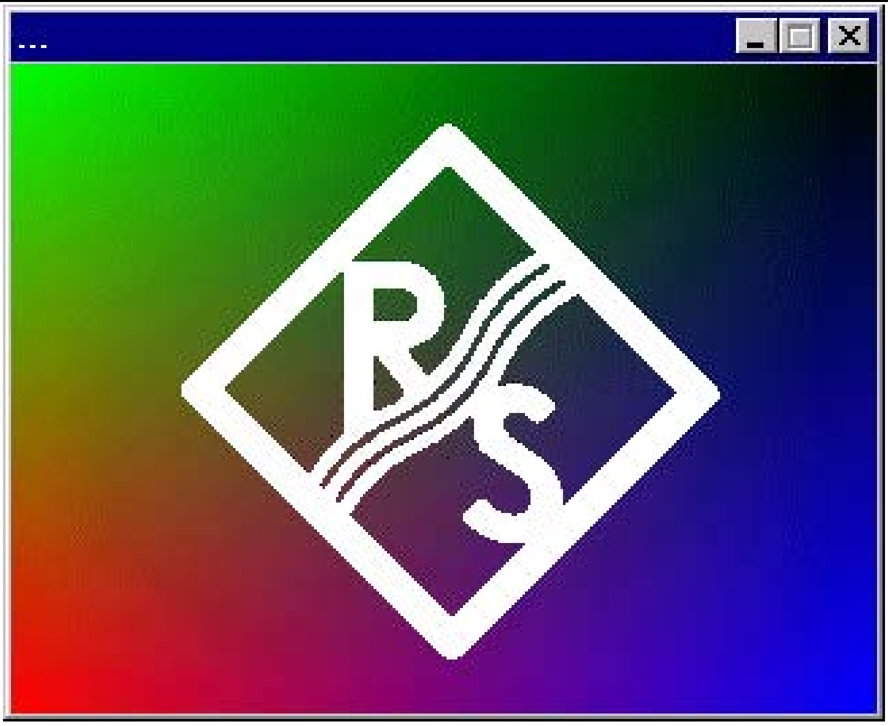


Fig.: Popup window with graphics loaded

When it is called up for the first time, CTSgo generates two further configuration files “CTS_GO.DS1“ and “CTS_GO.DS2“ . The file “CTS_GO.DS1“ refers to the GSM autotest, “CTS_GO.DS2“ to the DECT autotest. These configuration files permit to integrate the output of additional information in the test run. In general, a differentiation is to be made between popup windows for text display and popup windows for graphics display. The graphics should not be too large, a size of 200x200 to 320x240 pixels is recommended. The graphics should not be overwritten in each test point, as this would reduce the measurement rate. The graphics display remains active until a new entry is found in the sequence or the test run terminated. The input of an invalid file name is ignored. If the word HINT is entered under Filename, the output window will also be cleared. Normally, the entry “Animated“ is followed by 0. However, you can also create a bitmap with an animation consisting of four partial pictures. If you wish a partial picture size of 320x240 pixels, your file must have 1280x240 pixels. The first partial picture displayed will then be loaded with an offset of 0 pixel and a width of 320 pixels, the second partial picture with an offset of 320 pixels and the same width, the third one with an offset of 640 and the last partial picture with an offset of 960 pixels.

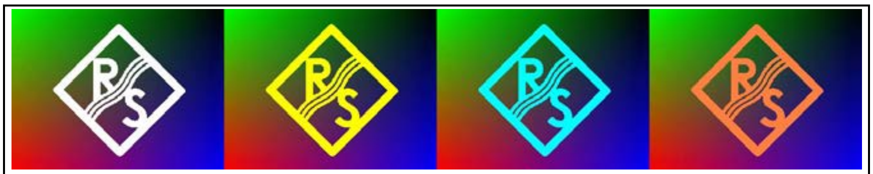


Fig.: Animation sequence


Fig.: Single picture of sequence

14.1 The Section Everytime

This section contains 9 entries. The individual entries are displayed shortly after the start of the autotest in the order Text1/Filename1, Text2/Filename2 and Text3/Filename3. If several graphics displays are to be shown one after the other, it is recommended to define the popup window for text as well, since otherwise the second graphics, for instance, would immediately overwrite the first one. Only the popup windows of the text entry can stop the sequence control. These popup windows appear each time the autotest has been started.

[Everytime]	
Text1	Text
Filename1	Path to graphics file in BMP format
Animated1	1 = Graphics animated, 0 = Graphics not animated
Text2	Text
Filename2	Path to graphics file in BMP format
Animated2	1 = Graphics animated, 0 = Graphics not animated
Text3	Text
Filename3	Path to graphics file in BMP format
Animated3	1 = Graphics animated, 0 = Graphics not animated

14.2 The Section Daily

This section contains 9 entries. The individual entries are displayed shortly after the start of the autotest in the order Text1/Filename1, Text2/Filename2 and Text3/Filename3. If several graphics displays are to be indicated one after the other, it is recommended to define the popup window for text as well, since otherwise the second graphics, for instance, would immediately overwrite the first one. Only the popup windows of the test entry can stop the sequence control. These popup windows appear only once a day after the start of the autotest; no further output will be made on this day.

[Daily]	
Text1	Text
Filename1	Path to graphics file in BMP format
Animated1	1 = Graphics animated, 0 = Graphics not animated
Text2	Text
Filename2	Path to graphics file in BMP format
Animated2	1 = Graphics animated, 0 = Graphics not animated
Text3	Text
Filename3	Path to graphics file in BMP format
Animated3	1 = Graphics animated, 0 = Graphics not animated

14.3 The Section Monthly

This section contains 9 entries. The individual entries are displayed shortly after the start of the autotest in the order Text1/Filename1, Text2/Filename2 and Text3/Filename3. If several graphics displays are to be indicated one after the other, it is recommended to define the popup window for text as well, since otherwise the second graphics, for instance, would immediately overwrite the first one. Only the popup windows of the text entry can stop the sequence control. These popup windows appear only once a month after the autotest has been started for the first time in this month; no further outputs will be made in this month.

[Monthly]	
Text1	Text
Filename1	Path to graphics file in BMP format
Animated1	1 = Graphics animated, 0 = Graphics not animated
Text2	Text
Filename2	Path to graphics file in BMP format
Animated2	1 = Graphics animated, 0 = Graphics not animated
Text3	Text
Filename3	Path to graphics file in BMP format
Animated3	1 = Graphics animated, 0 = Graphics not animated

14.4 The Section Topic

This section contains three entries. The entry „Description“ corresponds to the output in the output field of the autotest. This only serves for identification and cannot be overwritten. The graphics display in the respective popup window does not influence the sequence control. The graphics is displayed until a new entry is found in the sequence or the test run is terminated. If an invalid file name is entered, the output window will also be cleared.

[Topic00] etc.	
Description	Name of single step in sequence control
Filename	Path to graphics file in BMP format
Animated	1 = Graphics animated, 0 = Graphics not animated

14.5 The Section TestsPassed

This section contains 2 entries. If all tests are passed, the respective graphics is displayed. It is recommended not to combine this mode with the display mode “Display Report after the Tests“.

[TestsPassed]	
Filename	Path to graphics file in BMP format
Animated	1 = Graphics animated, 0 = Graphics not animated

14.6 The Section TestsFailed

This section contains 2 entries. If at least one test has failed, the respective graphics is displayed. It is recommended not to combine this mode with the display mode “Display Report after the Tests“.

[TestsFailed]	
Filename	Path to graphics file in BMP format
Animated	1 = Graphics animated, 0 = Graphics not animated

15 Adapting the Appearance of CTSgo

The user-defined graphics integration described before is also possible in a large display field of the main dialog instead of in a popup window. For this purpose, bit 15 must be set in the initialization file “CTS_GO.INI“ in the Application Settings section for Options.

[Application Settings]	
Options	Bit 15 = 1 (corresponds to 08000_{hex})

Since the size of the main dialog can be varied, the ideal size of the graphics file cannot be specified in greater detail. The graphics display is always increased or reduced to a size that fits exactly into the output window. The graphics should not be overwritten in each test point, as otherwise the measurement rate would be reduced. The graphics display remains active until a new entry is found in the sequence or the test run is terminated.
If the dialog window is not increased, kindly use the values for the resolution 640x480 pixels. Approximate reference values can be obtained from the following table.

Screen size	BMP Graphics
640x480 pixels	496x139 pixels
800x600 pixels	756x215 pixels
1024x768 pixels	980x327 pixels

16 Problems, Questions and Solutions

16.1 Components Missing Signaled upon Program Startup

In addition to executable EXE files, the program contains runtime libraries ("DLLs") which are loaded upon program start. These runtime libraries are first searched for in the specified current directory of CTSgo and then, if required, in the Windows system directory. Check whether the files specified in section Software Components are available in your PC. If necessary, install the CTSgo software again.

16.2 Serial Interface Cannot be Opened

The serial interface specified in your configuration is opened when CTSgo is started. This interface must not be used for other programs or the mouse.

16.3 CTS Cannot be Remote-Controlled

Compare settings of CTSgo and CTS. Check whether the employed cable meets the specified requirements.

16.4 Program Signals Timeout

When setting the remote-control interface you can specify how long the CTSgo program is to wait for a message from the CTS before it signals a timeout. with long measurements, eg a BER measurement with a large number of frames, this waiting period may have to be extended.

Abb.: Timeout warning

16.5 Serial Data Transmission Impaired by Mouse Movements

Problems may occur when the serial mouse is connected for instance to COM1 and CTSgo operated via serial interface COM3. PCs often use the same hardware interrupt for COM1 and COM3 or COM2 and COM4. Interactions between these two interfaces cannot be excluded in this case. Check the constellation of your PC with the aid of the Windows system control. Refer to the Windows manual for more detailed information on the responsible device manager.

16.6 Location Update Cannot be Performed

For a correct location update, the C0 carrier power received by the mobile must be sufficiently high. Increase the base-station power (CTS) for the location update in the Configure Network dialog. A test SIM card should be used in addition. Check also whether the mobile to be tested complies with the network setting.

16.7 Synchronization Lost

The user-selected CTS output power may be too low and outside the sensitivity of your mobile. Increase the CTS output power for the respective test step. The output power is entered in the Configure Test Set dialog window. It is also possible that the user-defined attenuation values are not correct.

16.8 Level Measurements Frequently out of Tolerance

The CTS considers the set attenuation in the level calculation. For this reason, the attenuation must be accurately set.

16.9 Measurement Report Cannot be Loaded

The format of the selected measurement report is illegal. The file is either invalid or the report has been saved with a previous version of CTSgo. In this case, the measurement report has to be converted.

16.10 Drag & Drop not Working

Check that CTSgo is in the stop mode.

16.11 Program Cannot be Configured

Check that CTSgo is in the stop mode.

16.12 Generator Settings are not Immediately Performed

The CTSgo program requires a certain time period for settings in the module test. Observe the indication in the CTSgo status bar. A change from the “red lamp“ to the “green lamp“ indicates that the settings are completed.

16.13 Can Several CTSs be Controlled from a PC ?

Several CTSs can be controlled from a PC if a sufficient number of free serial interfaces is available. To avoid interactions of the individual interfaces, a separate interrupt has to be used by each interface. With CTSgo a selection can only be made between the serial interfaces COM1 to COM4. Proper functioning of the individual CTSgo sessions largely depends on the capacity of the PC used. Note that during each session the initialization file CTS_GO.INI in the current directory is overwritten. To avoid this, CTSgo should be copied into several directories and these copies started only once.

16.14 Can CTSgo be Performed in the Background?

CTSgo can be performed in the background without problems. It may happen, however, that the other programs require so much computing power that serial data transmission is impaired.

16.15 Can Configuration Files be Read or Printed?

Configuration files have the format of Windows 3.x initialization files. Thus they can be read and if necessary printed. All configuration files are of identical format and available in English irrespective of the CTSgo version used. Each entry consists of a section designation in square brackets and entries with values after an equals sign. As is shown in the following example, the values can be directly read.

```
[Test Set 1]

GSM 900 TCH Channel=62
```

In the case of some entries, different options are determined by numerical entries.

[Application Settings] Mode=	GSM Autotest 1	GSM Module test 2	DECT Autotest 3
[Network] Type=	GSM 900 1	GSM 1800 2	GSM 1900 3
[Connect 1] / [Connect 2] Type=	Call from mobile 1	Call from base station (CTS) 2	
[Disconnect 1] / [Disconnect 2] Type=	Call release from mobile 1	Call release from base station (CTS) 2	

Other entries are available in coded form. Such entries are described in the following. Individual entries are OR-linked bit by bit and stored (eg $40_{hex} + 80_{hex} = C0_{hex}$).

[Selected Tests]	Key=
First Connect	0001_{hex}
Test Set 1	0002_{hex}
Test Set 2	0004_{hex}
Test Set 3	0008_{hex}
Test Set 4	0010_{hex}
Test Set 5	0020_{hex}
Test Set 6	0040_{hex}
Second Connect	0080_{hex}
Test Set 7	0100_{hex}
Test Set 8	0200_{hex}
Test Set 9	0400_{hex}
Test Set 10	0800_{hex}
Test Set 11	1000_{hex}
Test Set 12	2000_{hex}

[Test Set x]	Measurements=
Frequency error	00001_{hex}
Phase error	00002_{hex}
Timing	00004_{hex}
Average burst power	00008_{hex}
Power ramp	00010_{hex}
BER class Ib	00020_{hex}
BER class II	00040_{hex}
BER EFR	00080_{hex}
RX Qual	00100_{hex}
RX Lev	00200_{hex}
Echo test	00400_{hex}
Graphics Template	00800_{hex}
Graphics Phase	01000_{hex}

[Test Set x]	TCH Power Levels =
PCL 0	00001_{hex}
PCL 1	00002_{hex}
PCL 2	00004_{hex}
PCL 3	00008_{hex}
PCL 4	00010_{hex}
PCL 5	00020_{hex}
PCL 6	00040_{hex}
PCL 7	00080_{hex}
PCL 8	00100_{hex}
PCL 9	00200_{hex}
PCL 10	00400_{hex}
PCL 11	00800_{hex}
PCL 12	01000_{hex}
PCL 13	02000_{hex}
PCL 14	04000_{hex}
PCL 15	08000_{hex}
PCL 16	10000_{hex}
PCL 17	20000_{hex}
PCL 18	40000_{hex}
PCL 19	80000_{hex}

[DECT Selected Tests]	Key=
FP Tests	0001_{hex}
FP Test Set 1	0002_{hex}
FP Test Set 2	0004_{hex}
FP Test Set 3	0008_{hex}
FP Test Set 4	0010_{hex}
FP Test Set 5	0020_{hex}
FP Test Set 6	0040_{hex}
PP Tests	0080_{hex}
PP Test Set 7	0100_{hex}
PP Test Set 8	0200_{hex}
PP Test Set 9	0400_{hex}
PP Test Set 10	0800_{hex}
PP Test Set 11	1000_{hex}
PP Test Set 12	2000_{hex}

[DECT Test Set x]	Measurements=
NTP	00001_{hex}
Power ramp	00002_{hex}
Graphics Template	00004_{hex}
Frequency offset	00008_{hex}
B-field Modulation	00010_{hex}
Graphics Modulation	00020_{hex}
Frequency drift	00040_{hex}
Timing	00080_{hex}
Jitter	00100_{hex}
Echo test	00200_{hex}
BER	00400_{hex}
FER	00800_{hex}

It is not recommended to change the values manually as in this case the CTSgo software may not run correctly.

16.16 Can Configuration Overwriting be Avoided?

Stored configuration files should be protected against overwriting. The best thing to do so is to write-protect these files in the operating system. To this end, open the Windows Explorer or the file manager, click on the file and select Properties. Check the Read only box.

16.17 Can Default Values be Loaded?

Terminate CTSgo and delete the initialization file “CTS_GO.INI“. When the program is started again, default values will be loaded. Note that thus all values are reset, even your own settings.

17 Other Features

17.1 Debugging

CTSgo can prepare a protocol for all the data transferred via the serial interface. To activate this features, the command line for program call can be extended to “CTS_GO.EXE /SERPROT“.
To this end, add “/SERPROT” to the entry in the Destination field of the link. When Windows 95 / 98 / NT is used, click on the program icon and select Properties via a popup menu using the right mouse key.

Note:
Program icons of the start menu bar for Windows 95 / 98 / NT 4.0 are displayed when the Windows directory is changed. Open the Profiles folder and then the Start Menu folder. Lower-level folders have the same format as the Start menu bar. For more detailed information refer to the Windows manual.

As an alternative, Debug=1 can be entered in the [Remote] section of initialization file CTS_GO.INI with the aid of an editor.

17.2 Demo Feature

CTSgo can simulate a measurement without a CTS being connected. Measured values are generated in a random generator. To activate this feature, the command line for program call-up can be extended to CTS_GO.EXE /DEMO.

As an alternative, Demo=1 can be entered in the [Remote] section of initialization file CTS_GO.INI.

17.3 Generate Code Feature

CTSgo can also save the command sequence to be sent to the CTS in the file GENERATE.IEE. To do so, Generate Code=1 can be entered in the [Remote] section of initialization file CTS_GO.INI with the aid of an editor.

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