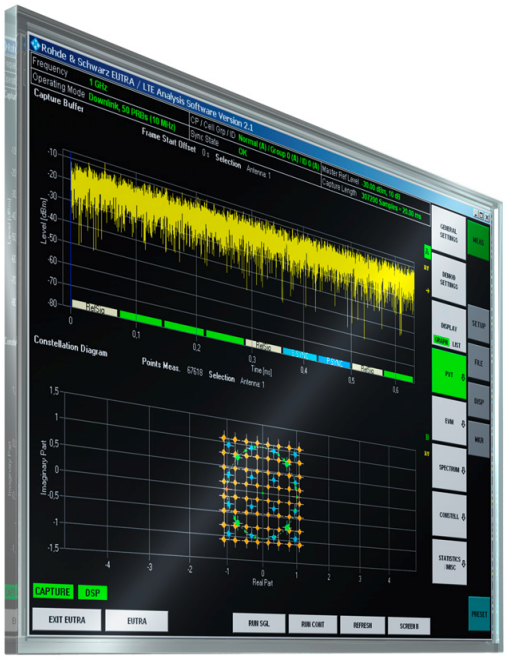
R&S®FSQ-K101 / -K105
R&S®FSV-K101 / -K105
EUTRA / LTE Uplink
Software Manual



1308.9135.42 – 06

Test & Measurement

Software Manual

ROHDE&SCHWARZ

The Software Manual describes the following software applications:

- R&S® FSQ-K101 (1308.9058.02)
- R&S® FSQ-K105 (1309.9516.02)
- R&S® FSV-K101 (1310.9100.02)
- R&S® FSV-K105 (1309.9780.02)

The contents of this manual correspond to software version 2.50.

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The following abbreviations are used throughout this manual:

The software applications R&S®FSQ-K101 and R&S®FSQ-K105 are abbreviated as R&S FSQ-K101 / -K105.
The software applications R&S®FSV-K101 and R&S®FSV-K105 are abbreviated as R&S FSV-K101 / -K105.
The signal analyzer R&S®FSQ is abbreviated as R&S FSQ.
The signal analyzer R&S®FSV is abbreviated as R&S FSV.
The R&S®AFQ, AMU, SMATE, SMJ and SMU vector signal generators are referred to as R&S Signal Generator.

Basic Safety Instructions

Always read through and comply with the following safety instructions!

All plants and locations of the Rohde & Schwarz group of companies make every effort to keep the safety standards of our products up to date and to offer our customers the highest possible degree of safety. Our products and the auxiliary equipment they require are designed, built and tested in accordance with the safety standards that apply in each case. Compliance with these standards is continuously monitored by our quality assurance system. The product described here has been designed, built and tested in accordance with the attached 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, you must observe all instructions and warnings provided in this manual. If you have any questions regarding these safety instructions, the Rohde & Schwarz group of companies will be happy to answer them.

Furthermore, it is your responsibility to use the product in an appropriate manner. This product is designed for use solely in industrial and laboratory environments or, if expressly permitted, also 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 any intention other than its designated purpose or in disregard of the manufacturer's instructions. The manufacturer shall assume no responsibility for such use of the product.

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

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 and when using the product. It is also absolutely essential to observe the additional safety instructions on personal safety, for example, that appear in relevant parts of the product documentation. In these safety instructions, the word "product" refers to all merchandise sold and distributed by the Rohde & Schwarz group of companies, including instruments, systems and all accessories.

Symbols and safety labels

							
Notice, general danger location Observe product documentation	Caution when handling heavy equipment	Danger of electric shock	Warning! Hot surface	PE terminal	Ground	Ground terminal	Be careful when handling electrostatic sensitive devices

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

Tags and their meaning

The following signal words are used in the product documentation in order to warn the reader about risks and dangers.

indicates a hazardous situation which, if not avoided, will result in death or serious injury.

indicates a hazardous situation which, if not avoided, could result in death or serious injury.

indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

indicates the possibility of incorrect operation which can result in damage to the product.
In the product documentation, the word ATTENTION is used synonymously.

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

Operating states and operating positions

The product may be operated only under the operating conditions and in the positions specified by the manufacturer, without the product's ventilation being obstructed. If the manufacturer's specifications are not observed, this can result in electric shock, fire and/or serious personal injury or death. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed.

1. Unless otherwise specified, the following requirements apply to Rohde & Schwarz products: predefined operating position is always with the housing floor facing down, IP protection 2X, pollution severity 2, overvoltage category 2, use only indoors, max. operating altitude 2000 m above sea level, max. transport altitude 4500 m above sea level. A tolerance of ±10 % shall apply to the nominal voltage and ±5 % to the nominal frequency.
2. 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). An installation that is not carried out as described in the product documentation could result in personal injury or death.
3. Do not place the product on heat-generating devices such as radiators or fan heaters. The ambient temperature must not exceed the maximum temperature specified in the product documentation or in the data sheet. Product overheating can cause electric shock, fire and/or serious personal injury or death.

Electrical safety

If the information on electrical safety is not observed either at all to the extent necessary, electric shock, fire and/or serious personal injury or death may occur.

1. Prior to switching on the product, always ensure 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.
2. In the case of products of safety class I with movable power cord and connector, operation is permitted only on sockets with an earthing contact and protective earth connection.
3. 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.
4. If the product does not have a power switch for disconnection from the AC supply network, the plug of the connecting cable is regarded as the disconnecting device. In such cases, always ensure that the power plug is easily reachable and accessible at all times (corresponding to the length of connecting cable, approx. 2 m). Functional or electronic switches are not suitable for providing disconnection from the AC supply network. If products without power switches are integrated into racks or systems, a disconnecting device must be provided at the system level.
5. Never use the product if the power cable is damaged. Check the power cable on a regular basis to ensure that it is in proper operating condition. By taking appropriate safety measures and carefully laying the power cable, you can ensure that the cable will not be damaged and that no one can be hurt by, for example, tripping over the cable or suffering an electric shock.
6. The product may be operated only from TN/TT supply networks fused with max. 16 A (higher fuse only after consulting with the Rohde & Schwarz group of companies).
7. Do not insert the plug into sockets that are dusty or dirty. Insert the plug firmly and all the way into the socket. Otherwise, sparks that result in fire and/or injuries may occur.
8. Do not overload any sockets, extension cords or connector strips; doing so can cause fire or electric shocks.
9. 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.
10. Ensure that the connections with information technology equipment, e.g. PCs or other industrial computers, comply with the IEC60950-1/EN60950-1 or IEC61010-1/EN 61010-1 standards that apply in each case.
11. Unless expressly permitted, never remove the cover or any part of the housing while the product is in operation. Doing so will expose circuits and components and can lead to injuries, fire or damage to the product.
12. 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 licensed electrician.
13. 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 anyone who has access to the product, as well as the product itself, is adequately protected from injury or damage.

14. Use suitable overvoltage protection to ensure that no overvoltage (such as that caused by a bolt of lightning) can reach the product. Otherwise, the person operating the product will be exposed to the danger of an electric shock.
15. Any object that is not designed to be placed in the openings of the housing must not be used for this purpose. Doing so can cause short circuits inside the product and/or electric shocks, fire or injuries.
16. Unless specified otherwise, products are not liquid-proof (see also section "Operating states and operating positions", item 1. Therefore, the equipment must be protected against penetration by liquids. If the necessary precautions are not taken, the user may suffer electric shock or the product itself may be damaged, which can also lead to personal injury.
17. Never use the product under conditions in which condensation has formed or can form in or on the product, e.g. if the product has been moved from a cold to a warm environment. Penetration by water increases the risk of electric shock.
18. Prior to cleaning the product, disconnect it completely from the power supply (e.g. AC supply network or battery). Use a soft, non-linting cloth to clean the product. Never use chemical cleaning agents such as alcohol, acetone or diluents for cellulose lacquers.

Operation

1. Operating the products requires special training and intense concentration. Make sure that persons who use the products are physically, mentally and emotionally fit enough to do so; otherwise, injuries or material damage may occur. It is the responsibility of the employer/operator to select suitable personnel for operating the products.
2. Before you move or transport the product, read and observe the section titled "Transport".
3. As with all industrially manufactured goods, the use of substances that induce an allergic reaction (allergens) such as nickel cannot be generally excluded. If you develop an allergic reaction (such as a skin rash, frequent sneezing, red eyes or respiratory difficulties) when using a Rohde & Schwarz product, consult a physician immediately to determine the cause and to prevent health problems or stress.
4. Before you start processing the product mechanically and/or thermally, or before you take it apart, be sure to read and pay special attention to the section titled "Waste disposal", item 1.
5. Depending on the function, certain products such as RF radio equipment can produce an elevated level of electromagnetic radiation. Considering that unborn babies require increased protection, pregnant women must be protected by appropriate measures. Persons with pacemakers may also be exposed to risks from electromagnetic radiation. The employer/operator must evaluate workplaces where there is a special risk of exposure to radiation and, if necessary, take measures to avert the potential danger.
6. Should a fire occur, the product may release hazardous substances (gases, fluids, etc.) that can cause health problems. Therefore, suitable measures must be taken, e.g. protective masks and protective clothing must be worn.
7. If a laser product (e.g. a CD/DVD drive) is integrated into a Rohde & Schwarz product, absolutely no other settings or functions may be used as described in the product documentation. The objective is to prevent personal injury (e.g. due to laser beams).

Repair and service

1. The product may be opened only by authorized, specially trained personnel. Before any work is performed on the product or before the product is opened, it must be disconnected from the AC supply network. Otherwise, personnel will be exposed to the risk of an electric shock.
2. Adjustments, replacement of parts, maintenance and repair may be performed only by electrical experts 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). This helps ensure the continued safety of the product.

Batteries and rechargeable batteries/cells

If the information regarding batteries and rechargeable batteries/cells is not observed either at all or to the extent necessary, product users may be exposed to the risk of explosions, fire and/or serious personal injury, and, in some cases, death. Batteries and rechargeable batteries with alkaline electrolytes (e.g. lithium cells) must be handled in accordance with the EN 62133 standard.

1. Cells must not be taken apart or crushed.
2. Cells or batteries must not be exposed to heat or fire. Storage in direct sunlight must be avoided. Keep cells and batteries clean and dry. Clean soiled connectors using a dry, clean cloth.
3. Cells or batteries must not be short-circuited. Cells or batteries must not be stored in a box or in a drawer where they can short-circuit each other, or where they can be short-circuited by other conductive materials. Cells and batteries must not be removed from their original packaging until they are ready to be used.
4. Keep cells and batteries out of the hands of children. If a cell or a battery has been swallowed, seek medical aid immediately.
5. Cells and batteries must not be exposed to any mechanical shocks that are stronger than permitted.
6. If a cell develops a leak, the fluid must not be allowed to come into contact with the skin or eyes. If contact occurs, wash the affected area with plenty of water and seek medical aid.
7. Improperly replacing or charging cells or batteries that contain alkaline electrolytes (e.g. lithium cells) can cause explosions. Replace cells or batteries only with the matching Rohde & Schwarz type (see parts list) in order to ensure the safety of the product.
8. Cells and batteries must be recycled and kept separate from residual waste. Rechargeable batteries and normal batteries that contain lead, mercury or cadmium are hazardous waste. Observe the national regulations regarding waste disposal and recycling.

Transport

1. The product may be very heavy. Therefore, the product must be handled with care. In some cases, the user may require a suitable means of lifting or moving the product (e.g. with a lift-truck) to avoid back or other physical injuries.

2. Handles on the products are designed exclusively to enable personnel to transport the product. It is therefore not permissible to use handles to fasten the product to or on transport equipment such as cranes, fork lifts, wagons, etc. The user is responsible for securely fastening the products to or on the means of transport or lifting. Observe the safety regulations of the manufacturer of the means of transport or lifting. Noncompliance can result in personal injury or material damage.
3. If you use the product in a vehicle, it is the sole responsibility of the driver to drive the vehicle safely and properly. The manufacturer assumes no responsibility for accidents or collisions. Never use the product in a moving vehicle if doing so could distract the driver of the vehicle. Adequately secure the product in the vehicle to prevent injuries or other damage in the event of an accident.

Waste disposal

1. If products or their components are mechanically and/or thermally processed in a manner that goes beyond their intended use, hazardous substances (heavy-metal dust such as lead, beryllium, nickel) may be released. For this reason, the product may only be disassembled by specially trained personnel. Improper disassembly may be hazardous to your health. National waste disposal regulations must be observed.
2. If handling the product releases 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. The improper disposal of hazardous substances or fuels can cause health problems and lead to environmental damage.

Informaciones elementales de seguridad

Es imprescindible leer y observar las siguientes instrucciones e informaciones de seguridad!

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

Además queda en la responsabilidad del usuario utilizar el producto en la forma debida. Este producto está destinado exclusivamente al uso en la industria y el laboratorio o, si ha sido expresamente autorizado, para aplicaciones de campo y de ninguna manera deberá ser utilizado de modo que alguna persona/cosa pueda sufrir daño. El uso del producto fuera de sus fines definidos o sin tener en cuenta las instrucciones del fabricante queda en la responsabilidad del usuario. El fabricante no se hace en ninguna forma responsable de consecuencias a causa del mal uso del producto.

Se parte del uso correcto del producto para los fines definidos si el producto es utilizado conforme a las indicaciones de la correspondiente documentación del producto y dentro del margen de rendimiento definido (ver hoja de datos, documentación, informaciones de seguridad que siguen). El uso del producto hace necesarios conocimientos técnicos y ciertos conocimientos del idioma inglés. Por eso se debe tener en cuenta que el producto solo pueda ser operado por personal especializado o personas instruidas en profundidad con las capacidades correspondientes. Si fuera necesaria indumentaria de seguridad para el uso de productos de Rohde & Schwarz, encontraría la información debida en la documentación del producto en el capítulo correspondiente. Guarde bien las informaciones de seguridad elementales, así como la documentación del producto, y entréguelas a usuarios posteriores.

Tener en cuenta las informaciones de seguridad sirve para evitar en lo posible lesiones o daños por peligros de toda clase. Por eso es imprescindible leer detalladamente y comprender por completo las siguientes informaciones de seguridad antes de usar el producto, y respetarlas durante el uso del producto. Deberán tenerse en cuenta todas las demás informaciones de seguridad, como p. ej. las referentes a la protección de personas, que encontrarán en el capítulo correspondiente de la documentación del producto y que también son de obligado cumplimiento. En las presentes informaciones de seguridad se recogen todos los objetos que distribuye el grupo de empresas Rohde & Schwarz bajo la denominación de "producto", entre ellos también aparatos, instalaciones así como toda clase de accesorios.

Símbolos y definiciones de seguridad

							
Aviso: punto de peligro general Observar la documentación del producto	Atención en el manejo de dispositivos de peso elevado	Peligro de choque eléctrico	Adver-tencia: superficie caliente	Conexión a conductor de protección	Conexión a tierra	Conexión a masa	Aviso: Cuidado en el manejo de dispositivos sensibles a la electrostática (ESD)

					
Tensión de alimentación de PUESTA EN MARCHA / PARADA	Indicación de estado de espera (Standby)	Corriente continua (DC)	Corriente alterna (AC)	Corriente continua / Corriente alterna (DC/AC)	El aparato está protegido en su totalidad por un aislamiento doble (reforzado)

Palabras de señal y su significado

En la documentación del producto se utilizan las siguientes palabras de señal con el fin de advertir contra riesgos y peligros.

PELIGRO identifica un peligro inminente con riesgo elevado que provocará muerte o lesiones graves si no se evita.

ADVERTENCIA identifica un posible peligro con riesgo medio de provocar muerte o lesiones (graves) si no se evita.

ATENCIÓN identifica un peligro con riesgo reducido de provocar lesiones leves o moderadas si no se evita.

AVISO indica la posibilidad de utilizar mal el producto y, como consecuencia, dañarlo.
En la documentación del producto se emplea de forma sinónima el término CUIDADO.

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

Estados operativos y posiciones de funcionamiento

El producto solamente debe ser utilizado según lo indicado por el fabricante respecto a los estados operativos y posiciones de funcionamiento sin que se obstruya la ventilación. Si no se siguen las indicaciones del fabricante, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte. En todos los trabajos deberán ser tenidas en cuenta las normas nacionales y locales de seguridad del trabajo y de prevención de accidentes.

1. Si no se convino de otra manera, es para los productos Rohde & Schwarz válido lo que sigue: como posición de funcionamiento se define por principio la posición con el suelo de la caja para abajo, modo de protección IP 2X, grado de suciedad 2, categoría de sobrecarga eléctrica 2, uso solamente en estancias interiores, utilización hasta 2000 m sobre el nivel del mar, transporte hasta 4500 m sobre el nivel del mar. Se aplicará una tolerancia de ±10 % sobre el voltaje nominal y de ±5 % sobre la frecuencia nominal.
2. No sitúe el producto encima de superficies, vehículos, estantes o mesas, que por sus características de peso o de estabilidad no sean aptos para él. Siga siempre las instrucciones de instalación del fabricante cuando instale y asegure el producto en objetos o estructuras (p. ej. paredes y estantes). Si se realiza la instalación de modo distinto al indicado en la documentación del producto, pueden causarse lesiones o incluso la muerte.
3. No ponga el producto sobre aparatos que generen calor (p. ej. radiadores o calefactores). La temperatura ambiente no debe superar la temperatura máxima especificada en la documentación del producto o en la hoja de datos. En caso de sobrecalentamiento del producto, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte.

Seguridad eléctrica

Si no se siguen (o se siguen de modo insuficiente) las indicaciones del fabricante en cuanto a seguridad eléctrica, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte.

1. Antes de la puesta en marcha del producto se deberá comprobar siempre que la tensión preseleccionada en el producto coincida con la de la red de alimentación eléctrica. Si es necesario modificar el ajuste de tensión, también se deberán cambiar en caso dado los fusibles correspondientes del producto.
2. Los productos de la clase de protección I con alimentación móvil y enchufe individual solamente podrán enchufarse a tomas de corriente con contacto de seguridad y con conductor de protección conectado.
3. Queda prohibida la interrupción intencionada del conductor de protección, tanto en la toma de corriente como en el mismo producto. La interrupción puede tener como consecuencia el riesgo de que el producto sea fuente de choques eléctricos. Si se utilizan cables alargadores o regletas de enchufe, deberá garantizarse la realización de un examen regular de los mismos en cuanto a su estado técnico de seguridad.
4. Si el producto no está equipado con un interruptor para desconectarlo de la red, se deberá considerar el enchufe del cable de conexión como interruptor. En estos casos se deberá asegurar que el enchufe siempre sea de fácil acceso (de acuerdo con la longitud del cable de conexión, 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 bastidores o instalaciones, se deberá colocar el interruptor en el nivel de la instalación.
5. No utilice nunca el producto si está dañado el cable de conexión a red. Compruebe regularmente el correcto estado de los cables de conexión a red. Asegúrese, mediante las medidas de protección y de instalación adecuadas, de que el cable de conexión a red no pueda ser dañado o de que nadie pueda ser dañado por él, p. ej. al tropezar o por un choque eléctrico.
6. Solamente está permitido el funcionamiento en redes de alimentación TN/TT aseguradas con fusibles de 16 A como máximo (utilización de fusibles de mayor amperaje solo previa consulta con el grupo de empresas Rohde & Schwarz).
7. 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. La no observación de estas medidas puede provocar chispas, fuego y/o lesiones.
8. No sobrecargue las tomas de corriente, los cables alargadores o las regletas de enchufe ya que esto podría causar fuego o choques eléctricos.
9. En las mediciones en circuitos de corriente con una tensión U_{eff} > 30 V se deberán tomar las medidas apropiadas para impedir cualquier peligro (p. ej. medios de medición adecuados, seguros, limitación de tensión, corte protector, aislamiento etc.).
10. Para la conexión con dispositivos informáticos como un PC o un ordenador industrial, debe comprobarse que éstos cumplan los estándares IEC60950-1/EN60950-1 o IEC61010-1/EN 61010-1 válidos en cada caso.
11. A menos que esté permitido expresamente, no retire nunca la tapa ni componentes de la carcasa mientras el producto esté en servicio. Esto pone a descubierto los cables y componentes eléctricos y puede causar lesiones, fuego o daños en el producto.

12. Si un producto se instala en un lugar fijo, se deberá primero conectar el conductor de protección fijo con el conductor de protección del producto antes de hacer cualquier otra conexión. La instalación y la conexión deberán ser efectuadas por un electricista especializado.
13. En el caso de dispositivos fijos que no estén provistos de fusibles, interruptor automático ni otros mecanismos de seguridad similares, el circuito de alimentación debe estar protegido de modo que todas las personas que puedan acceder al producto, así como el producto mismo, estén a salvo de posibles daños.
14. Todo producto debe estar protegido contra sobretensión (debida p. ej. a una caída del rayo) mediante los correspondientes sistemas de protección. Si no, el personal que lo utilice quedará expuesto al peligro de choque eléctrico.
15. No debe introducirse en los orificios de la caja del aparato ningún objeto que no esté destinado a ello. Esto puede producir cortocircuitos en el producto y/o puede causar choques eléctricos, fuego o lesiones.
16. Salvo indicación contraria, los productos no están impermeabilizados (ver también el capítulo "Estados operativos y posiciones de funcionamiento", punto 1). Por eso es necesario tomar las medidas necesarias para evitar la entrada de líquidos. En caso contrario, existe peligro de choque eléctrico para el usuario o de daños en el producto, que también pueden redundar en peligro para las personas.
17. No utilice el producto en condiciones en las que pueda producirse o ya se hayan producido condensaciones sobre el producto o en el interior de éste, como p. ej. al desplazarlo de un lugar frío a otro caliente. La entrada de agua aumenta el riesgo de choque eléctrico.
18. Antes de la limpieza, desconecte por completo el producto de la alimentación de tensión (p. ej. red de alimentación o batería). Realice la limpieza de los aparatos con un paño suave, que no se deshilache. No utilice bajo ningún concepto productos de limpieza químicos como alcohol, acetona o diluyentes para lacas nitrocelulósicas.

Funcionamiento

1. El uso del producto requiere instrucciones especiales y una alta concentración durante el manejo. Debe asegurarse que las personas que manejen el producto estén a la altura de los requerimientos necesarios en cuanto a aptitudes físicas, psíquicas y emocionales, ya que de otra manera no se pueden excluir lesiones o daños de objetos. El empresario u operador es responsable de seleccionar el personal usuario apto para el manejo del producto.
2. Antes de desplazar o transportar el producto, lea y tenga en cuenta el capítulo "Transporte".
3. Como con todo producto de fabricación industrial no puede quedar excluida en general la posibilidad de que se produzcan alergias provocadas por algunos materiales empleados, los llamados alérgenos (p. ej. el níquel). Si durante el manejo de productos Rohde & Schwarz se producen reacciones alérgicas, como p. ej. irritaciones cutáneas, estornudos continuos, enrojecimiento de la conjuntiva o dificultades respiratorias, debe avisarse inmediatamente a un médico para investigar las causas y evitar cualquier molestia o daño a la salud.
4. Antes de la manipulación mecánica y/o térmica o el desmontaje del producto, debe tenerse en cuenta imprescindiblemente el capítulo "Eliminación", punto 1.

5. Ciertos productos, como p. ej. las instalaciones de radiocomunicación RF, pueden a causa de su función natural, emitir una radiación electromagnética aumentada. Deben tomarse todas las medidas necesarias para la protección de las mujeres embarazadas. También las personas con marcapasos pueden correr peligro a causa de la radiación electromagnética. El empresario/operador tiene la obligación de evaluar y señalizar las áreas de trabajo en las que exista un riesgo elevado de exposición a radiaciones.
6. Tenga en cuenta que en caso de incendio pueden desprenderse del producto sustancias tóxicas (gases, líquidos etc.) que pueden generar daños a la salud. Por eso, en caso de incendio deben usarse medidas adecuadas, como p. ej. máscaras antigás e indumentaria de protección.
7. En caso de que un producto Rohde & Schwarz contenga un producto láser (p. ej. un lector de CD/DVD), no debe usarse ninguna otra configuración o función aparte de las descritas en la documentación del producto, a fin de evitar lesiones (p. ej. debidas a irradiación láser).

Reparación y mantenimiento

1. El producto solamente debe ser abierto por personal especializado con autorización para ello. Antes de manipular el producto o abrirlo, es obligatorio desconectarlo de la tensión de alimentación, para evitar toda posibilidad de choque eléctrico.
2. El ajuste, el cambio de partes, el mantenimiento y la reparación deberán ser efectuadas solamente por electricistas autorizados por Rohde & Schwarz. Si se reponen partes con importancia para los aspectos de seguridad (p. ej. el enchufe, los transformadores o los fusibles), solamente podrán ser sustituidos por partes originales. Después de cada cambio de partes relevantes para la seguridad deberá realizarse un control de seguridad (control a primera vista, control del conductor de protección, medición de resistencia de aislamiento, medición de la corriente de fuga, control de funcionamiento). Con esto queda garantizada la seguridad del producto.

Baterías y acumuladores o celdas

Si no se siguen (o se siguen de modo insuficiente) las indicaciones en cuanto a las baterías y acumuladores o celdas, pueden producirse explosiones, incendios y/o lesiones graves con posible consecuencia de muerte. El manejo de baterías y acumuladores con electrolitos alcalinos (p. ej. celdas de litio) debe seguir el estándar EN 62133.

1. No deben desmontarse, abrirse ni triturarse las celdas.
2. Las celdas o baterías no deben someterse a calor ni fuego. Debe evitarse el almacenamiento a la luz directa del sol. Las celdas y baterías deben mantenerse limpias y secas. Limpiar las conexiones sucias con un paño seco y limpio.
3. Las celdas o baterías no deben cortocircuitarse. Es peligroso almacenar las celdas o baterías en estuches o cajones en cuyo interior puedan cortocircuitarse por contacto recíproco o por contacto con otros materiales conductores. No deben extraerse las celdas o baterías de sus embalajes originales hasta el momento en que vayan a utilizarse.
4. Mantener baterías y celdas fuera del alcance de los niños. En caso de ingestión de una celda o batería, avisar inmediatamente a un médico.
5. Las celdas o baterías no deben someterse a impactos mecánicos fuertes indebidos.

6. En caso de falta de estanqueidad de una celda, el líquido vertido no debe entrar en contacto con la piel ni los ojos. Si se produce contacto, lavar con agua abundante la zona afectada y avisar a un médico.
7. En caso de cambio o recarga inadecuados, las celdas o baterías que contienen electrolitos alcalinos (p. ej. las celdas de litio) pueden explotar. Para garantizar la seguridad del producto, las celdas o baterías solo deben ser sustituidas por el tipo Rohde & Schwarz correspondiente (ver lista de recambios).
8. Las baterías y celdas deben reciclarse y no deben tirarse a la basura doméstica. Las baterías o acumuladores que contienen plomo, mercurio o cadmio deben tratarse como residuos especiales. Respete en esta relación las normas nacionales de eliminación y reciclaje.

Transporte

1. El producto puede tener un peso elevado. Por eso es necesario desplazarlo o transportarlo con precaución y, si es necesario, usando un sistema de elevación adecuado (p. ej. una carretilla elevadora), a fin de evitar lesiones en la espalda u otros daños personales.
2. Las asas instaladas en los productos sirven solamente de ayuda para el transporte del producto por personas. Por eso no está permitido utilizar las asas para la sujeción en o sobre medios de transporte como p. ej. grúas, carretillas elevadoras de horquilla, carros etc. Es responsabilidad suya fijar los productos de manera segura a los medios de transporte o elevación. Para evitar daños personales o daños en el producto, siga las instrucciones de seguridad del fabricante del medio de transporte o elevación utilizado.
3. Si se utiliza el producto dentro de un vehículo, recae de manera exclusiva en el conductor la responsabilidad de conducir el vehículo de manera segura y adecuada. El fabricante no asumirá ninguna responsabilidad por accidentes o colisiones. No utilice nunca el producto dentro de un vehículo en movimiento si esto pudiera distraer al conductor. Asegure el producto dentro del vehículo debidamente para evitar, en caso de un accidente, lesiones u otra clase de daños.

Eliminación

1. Si se trabaja de manera mecánica y/o térmica cualquier producto o componente más allá del funcionamiento previsto, pueden liberarse sustancias peligrosas (polvos con contenido de metales pesados como p. ej. plomo, berilio o níquel). Por eso el producto solo debe ser desmontado por personal especializado con formación adecuada. Un desmontaje inadecuado puede ocasionar daños para la salud. Se deben tener en cuenta las directivas nacionales referentes a la eliminación de residuos.
2. En caso de que durante el trato del producto se formen sustancias peligrosas o combustibles que deban tratarse como residuos especiales (p. ej. refrigerantes o aceites de motor con intervalos de cambio definidos), deben tenerse en cuenta las indicaciones de seguridad del fabricante de dichas sustancias y las normas regionales de eliminación de residuos. Tenga en cuenta también en caso necesario las indicaciones de seguridad especiales contenidas en la documentación del producto. La eliminación incorrecta de sustancias peligrosas o combustibles puede causar daños a la salud o daños al medio ambiente.

Customer Support

Technical support – where and when you need it

For quick, expert help with any Rohde & Schwarz equipment, contact one of our Customer Support Centers. A team of highly qualified engineers provides telephone support and will work with you to find a solution to your query on any aspect of the operation, programming or applications of Rohde & Schwarz equipment.

Up-to-date information and upgrades

To keep your instrument up-to-date and to be informed about new application notes related to your instrument, please send an e-mail to the Customer Support Center stating your instrument and your wish. We will take care that you will get the right information.

USA & Canada

Monday to Friday 8:00 AM – 8:00 PM	(except US public holidays) Eastern Standard Time (EST)
Tel. from USA From outside USA Fax	888-test-rsa (888-837-8772) (opt 2) +1 410 910 7800 (opt 2) +1 410 910 7801
E-mail	CustomerSupport@rohde-schwarz.com

East Asia

Monday to Friday 8:30 AM – 6:00 PM	(except Singaporean public holidays) Singapore Time (SGT)
Tel. Fax	+65 6 513 0488 +65 6 846 1090
E-mail	CustomerSupport@rohde-schwarz.com

Rest of the World

Monday to Friday 08:00 – 17:00	(except German public holidays) Central European Time (CET)
Tel. Fax	+49 89 4129 13774 +49 (0) 89 41 29 637 78
E-mail	CustomerSupport@rohde-schwarz.com

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Qualitätszertifikat
Certificate of quality
Certificat de qualité

Certified Quality System
ISO 9001

Certified Environmental System
ISO 14001

Sehr geehrter Kunde,
Sie haben sich für den Kauf eines Rohde&Schwarz-Produktes entschieden. Hiermit erhalten Sie ein nach modernsten Fertigungsmethoden hergestelltes Produkt. Es wurde nach den Regeln unseres Qualitätsmanagementsystems entwickelt, gefertigt und geprüft. Das Rohde&Schwarz-Qualitätsmanagementsystem ist u.a. nach ISO 9001 und ISO 14001 zertifiziert.

Der Umwelt verpflichtet
- Energie-effiziente, RoHS-konforme Produkte
- Kontinuierliche Weiterentwicklung nachhaltiger Umweltkonzepte
- ISO 14001-zertifiziertes Umweltmanagementsystem

Dear Customer,
You have decided to buy a Rohde&Schwarz product. You are thus assured of receiving a product that is manufactured using the most modern methods available. This product was developed, manufactured and tested in compliance with our quality management system standards. The Rohde&Schwarz quality management system is certified according to standards such as ISO 9001 and ISO 14001.

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Vous avez choisi d'acheter un produit Rohde&Schwarz. Vous disposez donc d'un produit fabriqué d'après les méthodes les plus avancées. Le développement, la fabrication et les tests respectent nos normes de gestion qualité. Le système de gestion qualité de Rohde&Schwarz a été homologué, entre autres, conformément aux normes ISO 9001 et ISO 14001.

Engagement écologique
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- Amélioration continue de la durabilité environnementale
- Système de gestion de l'environnement certifié selon ISO 14001

75 Years of Driving Innovation

ROHDE&SCHWARZ

1171.0200.11 V 04.00

Table of Contents

Conventions Used in the Documentation

The following conventions are used throughout the R&S FSQ / FSV-K101 / K105 Software Manual:

Typographical conventions

Convention	Description
"Graphical user interface elements"	All names of graphical user interface elements both on the screen and on the front and rear panels, such as dialog boxes, softkeys, menus, options, buttons etc., are enclosed by quotation marks.
"KEYS"	Key names are written in capital letters and enclosed by quotation marks.
Input	Input to be entered by the user is displayed in italics.
`File names, commands, program code`	File names, commands, coding samples and screen output are distinguished by their font.
"Links"	Links that you can click are displayed in blue font.
"References"	References to other parts of the documentation are enclosed by quotation marks.

Other conventions

- **Remote commands**: Remote commands may include abbreviations to simplify input. In the description of such commands, all parts that have to be entered are written in capital letters. Additional text in lower-case characters is for information only.
- The terms "**select**" and "**press**" may refer to any of the described methods, i.e. using a finger on the touchscreen, a mouse pointer in the display, or a key on the device or on a keyboard.

1 Introduction

The R&S FSQ / FSV-K101 / K105 EUTRA/LTE uplink PC analysis software application uses the I/Q capture functionality of the R&S FSQ / FSV spectrum analyzer to enable EUTRA/LTE TX measurements in line with the EUTRA specification using PC-based software.

This manual supports the user in working with this software. It describes how to prepare, execute, and evaluate a measurement and gives many helpful hints and examples.

1.1 EUTRA / LTE

Currently, UMTS networks worldwide are being upgraded to high speed downlink packet access (HSDPA) in order to increase data rate and capacity for downlink packet data. In the next step, high speed uplink packet access (HSUPA) will boost uplink performance in UMTS networks. While HSDPA was introduced as a 3GPP Release 5 feature, HSUPA is an important feature of 3GPP Release 6. The combination of HSDPA and HSUPA is often referred to as HSPA.

However, even with the introduction of HSPA, the evolution of UMTS has reached its end. HSPA+ will bring significant enhancements in 3GPP Release 7. The objective is to enhance the performance of HSPA-based radio networks in terms of spectrum efficiency, peak data rate and latency, and to exploit the full potential of WCDMA-based 5 MHz operation. Important features of HSPA+ are downlink multiple input multiple output (MIMO), higher order modulation for uplink and downlink, improvements of layer 2 protocols, and continuous packet connectivity.

In order to ensure the competitiveness of UMTS for the next 10 years and beyond, concepts for UMTS long-term evolution (LTE) are being investigated. The objective is a high-data-rate, low-latency and packet-optimized radio-access technology. Therefore, a study item was launched in 3GPP Release 7 on evolved UMTS terrestrial radio access (E-UTRA) and evolved UMTS terrestrial radio access network (E-UTRAN). LTE/E-UTRA will then form part of 3GPP Release 8 core specifications.

This introduction focuses on LTE/E-UTRA technology. In the following, the terms LTE or E-UTRA are used interchangeably.

In the context of the LTE study item, 3GPP work first focused on the definition of requirements, e.g. targets for data rate, capacity, spectrum efficiency, and latency. Also commercial aspects such as costs for installing and operating the network were considered. Based on these requirements, technical concepts for the air interface transmission schemes and protocols were studied. Notably, LTE uses new multiple access schemes on the air interface: orthogonal frequency division multiple access (OFDMA) in downlink and single carrier frequency division multiple access (SC-FDMA) in uplink. Furthermore, MIMO antenna schemes form an essential part of LTE. In an attempt to simplify protocol architecture, LTE brings some major changes to the existing UMTS protocol concepts. Impact on the overall network architecture including the core network is being investigated in the context of 3GPP system architecture evolution (SAE).

1.1.1 Requirements for UMTS Long term Evolution

LTE is focusing on optimum support of packet-switched (PS) services. Main requirements for the design of an LTE system are documented in 3GPP TS 25.913 [1] and can be summarized as follows:

- **Data rate**: Peak data rates target 100 Mbps (downlink) and 50 Mbps (uplink) for 20 MHz spectrum allocation, assuming two receive antennas and one transmit antenna are at the terminal.
- **Throughput**: The target for downlink average user throughput per MHz is three to four times better than Release 6. The target for uplink average user throughput per MHz is two to three times better than Release 6.
- **Spectrum efficiency**: The downlink target is three to four times better than Release 6. The uplink target is two to three times better than Release 6.
- **Latency**: The one-way transit time between a packet being available at the IP layer in either the user equipment (UE) or radio access network and the availability of this packet at IP layer in the radio access network/UE shall be less than 5 ms. Also C-plane latency shall be reduced, e.g. to allow fast transition times of less than 100 ms from camped state to active state.
- **Bandwidth**: Scaleable bandwidth of 5 MHz, 10 MHz, 15 MHz, 20 MHz shall be supported. Also bandwidths smaller than 5 MHz shall be supported for more flexibility.
- **Interworking**: Interworking with existing UTRAN/GERAN systems and non-3GPP systems shall be ensured. Multimode terminals shall support handover to and from UTRAN and GERAN as well as inter-RAT measurements. Interruption time for handover between E-UTRAN and UTRAN/GERAN shall be less than 300 ms for realtime services and less than 500 ms for non-realtime services.
- **Multimedia broadcast multicast services (MBMS)**: MBMS shall be further enhanced and is then referred to as E-MBMS.
- **Costs**: Reduced CAPEX and OPEX including backhaul shall be achieved. Cost-effective migration from Release 6 UTRA radio interface and architecture shall be possible. Reasonable system and terminal complexity, cost, and power consumption shall be ensured. All the interfaces specified shall be open for multi-vendor equipment interoperability.
- **Mobility**: The system should be optimized for low mobile speed (0 to 15 km/h), but higher mobile speeds shall be supported as well, including high-speed train environment as a special case.
- **Spectrum allocation**: Operation in paired (frequency division duplex / FDD mode) and unpaired spectrum (time division duplex / TDD mode) is possible.
- **Co-existence**: Co-existence in the same geographical area and co-location with GERAN/UTRAN shall be ensured. Also, co-existence between operators in adjacent bands as well as cross-border co-existence is a requirement.
- **Quality of Service**: End-to-end Quality of Service (QoS) shall be supported. VoIP should be supported with at least as good radio and backhaul efficiency and latency as voice traffic over the UMTS circuit switched networks.
- **Network synchronization**: Time synchronization of different network sites shall not be mandated.

1.1.2 Long-Term Evolution Uplink Transmission Scheme

1.1.2.1 SC-FDMA

During the study item phase of LTE, alternatives for the optimum uplink transmission scheme were investigated. While OFDMA is seen optimum to fulfil the LTE requirements in downlink, OFDMA properties are less favourable for the uplink. This is mainly due to weaker peak-to-average power ratio (PAPR) properties of an OFDMA signal, resulting in worse uplink coverage.

Thus, the LTE uplink transmission scheme for FDD and TDD mode is based on SC-FDMA with a cyclic prefix. SC-FDMA signals have better PAPR properties compared to an OFDMA signal. This was one of the main reasons for selecting SC-FDMA as LTE uplink access scheme. The PAPR characteristics are important for cost-effective design of UE power amplifiers. Still, SC-FDMA signal processing has some similarities with OFDMA signal processing, so parameterization of downlink and uplink can be harmonized.

There are different possibilities how to generate an SC-FDMA signal. DFT-spread-OFDM (DFT-s-OFDM) has been selected for EUTRA. The principle is illustrated in Figure 1-1.

For DFT-s-OFDM, a size-M DFT is first applied to a block of M modulation symbols. QPSK, 16QAM and 64 QAM are used as uplink EUTRA modulation schemes, the latter being optional for the UE. The DFT transforms the modulation symbols into the frequency domain. The result is mapped onto the available sub-carriers. In EUTRA uplink, only localized transmission on consecutive sub-carriers is allowed. An N point IFFT where N>M is then performed as in OFDM, followed by addition of the cyclic prefix and parallel to serial conversion.

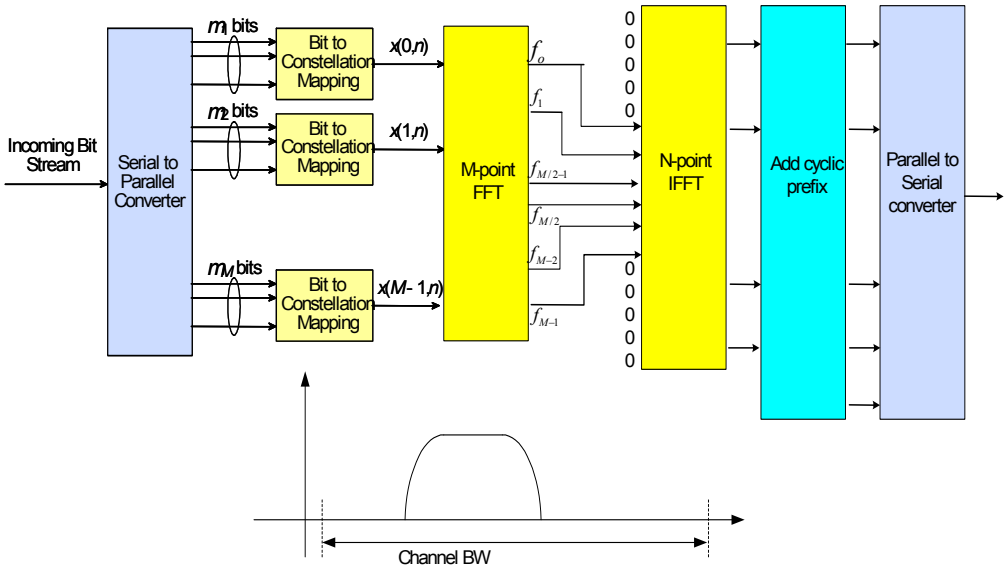


Figure 1-1: Block Diagram of DFT-s-OFDM (Localized Transmission)

The DFT processing is therefore the fundamental difference between SC-FDMA and OFDMA signal generation. This is indicated by the term DFT-spread-OFDM. In an SC-FDMA signal, each sub-carrier used for transmission contains information of all transmitted modulation symbols, since the input data stream has been spread by the DFT transform over the available sub-carriers. In contrast to this, each sub-carrier of an OFDMA signal only carries information related to specific modulation symbols.

1.1.2.2 SC-FDMA Parameterization

The EUTRA uplink structure is similar to the downlink. An uplink radio frame consists of 20 slots of 0.5 ms each, and 1 subframe consists of 2 slots. The slot structure is shown in Figure 1-2.

Each slot carries $N_{\text{symb}}^{\text{UL}}$ SC-FDMA symbols, where $N_{\text{symb}}^{\text{UL}}$ = 7 for the normal cyclic prefix and $N_{\text{symb}}^{\text{UL}}$ = 6 for the extended cyclic prefix. SC-FDMA symbol number 3 (i.e. the 4th symbol in a slot) carries the reference signal for channel demodulation.

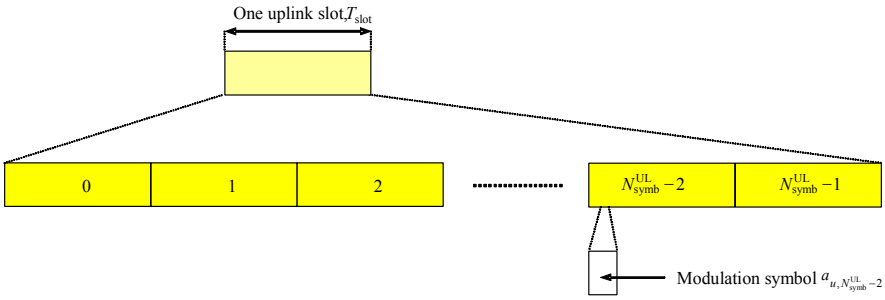


Figure 1-2: Uplink Slot Structure

Also for the uplink, a bandwidth agnostic layer 1 specification has been selected.

Table 1 shows the configuration parameters in an overview table.

Table 1: Parameters for Uplink Generic Frame Structure

Configuration	Number of symbols $N_{\text{symb}}^{\text{UL}}$	Cyclic Prefix length in samples	Cyclic Prefix length in µs
Normal cyclic prefix Δf=15 kHz	7	160 for first symbol 144 for other symbols	5.2 µs for first symbol 4.7 µs for other symbols
Extended cyclic prefix Δf=15 kHz	6	512	16.7 µs

1.1.2.3 Uplink Data Transmission

In uplink, data is allocated in multiples of one resource block. Uplink resource block size in the frequency domain is 12 sub-carriers, i.e. the same as in downlink. However, not all integer multiples are allowed in order to simplify the DFT design in uplink signal processing. Only factors 2, 3, and 5 are allowed.

The uplink transmission time interval (TTI) is 1 ms (same as downlink).

User data is carried on the Physical Uplink Shared Channel (**PUSCH**) that is determined by the transmission bandwidth NTx and the frequency hopping pattern k0.

The Physical Uplink Control Channel (**PUCCH**) carries uplink control information, e.g. CQI reports and ACK/NACK information related to data packets received in the downlink. The PUCCH is transmitted on a reserved frequency region in the uplink.

1.1.2.4 Uplink Reference Signal Structure

Uplink reference signals are used for two different purposes: on the one hand, they are used for channel estimation in the eNodeB receiver in order to demodulate control and data channels. On the other hand, the reference signals provide channel quality information as a basis for scheduling decisions in the base station. The latter purpose is also called channel sounding.

The uplink reference signals are based on CAZAC (Constant Amplitude Zero Auto-Correlation) sequences.

1.1.2.5 Uplink Physical Layer Procedures

For EUTRA, the following uplink physical layer procedures are especially important:

Non-synchronized random access:
Random access may be used to request initial access, as part of handover, when transiting from idle to connected, or to re-establish uplink synchronization. The structure is shown in Figure 1-3.

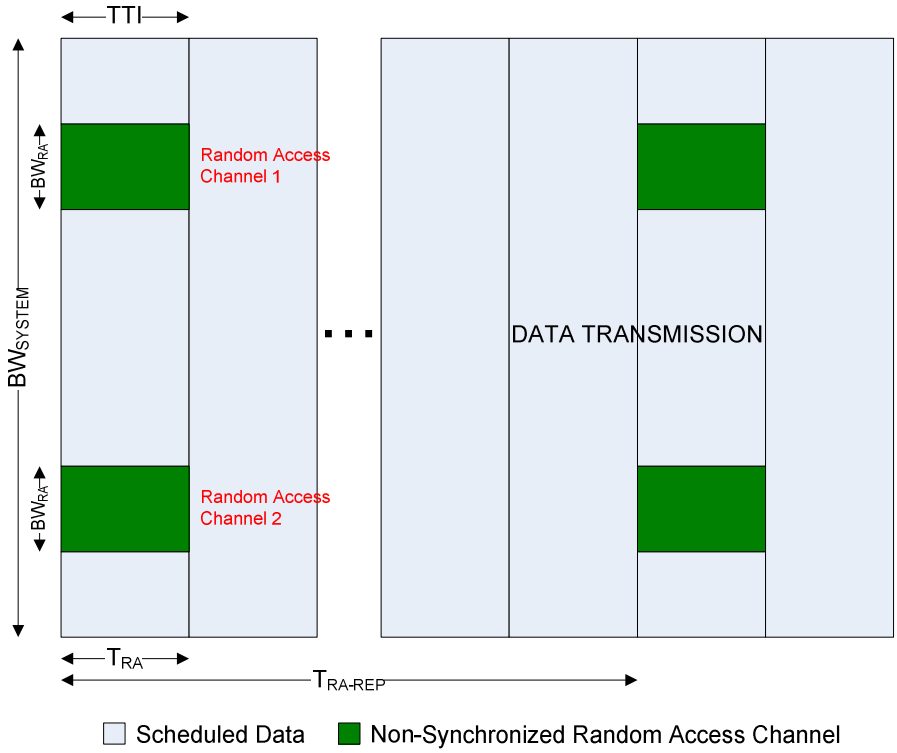


Figure 1-3: Random Access Structure, Principle

Multiple random access channels may be defined in the frequency domain within one access period T_{RA} in order to provide a sufficient number of random access opportunities.

For random access, a preamble is defined as shown in Figure 1-4. The preamble sequence occupies T_{PRE} = 0.8 ms and the cyclic prefix occupies T_{CP} = 0.1 ms within one subframe of 1 ms. During the guard time T_{GT}, nothing is transmitted. The preamble bandwidth is 1.08 MHz (72 sub-carriers). Higher layer signalling controls in which sub-frames the preamble transmission is allowed, and the location in the frequency domain. Per cell, there are 64 random access preambles. They are generated from Zadoff-Chu sequences.

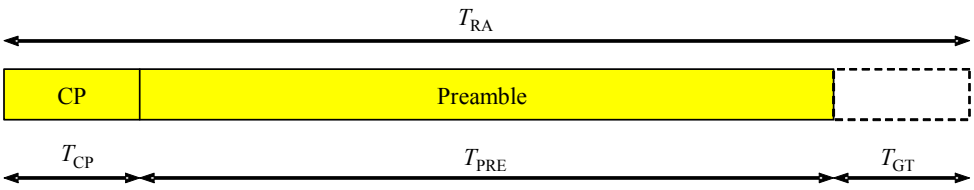


Figure 1-4: Random Access Preamble

The random access procedure uses open loop power control with power ramping similar to WCDMA. After sending the preamble on a selected random access channel, the UE waits for the random access response message. If no response is detected then another random access channel is selected and a preamble is sent again.

Uplink scheduling:

Scheduling of uplink resources is done by eNodeB. The eNodeB assigns certain time/frequency resources to the UEs and informs UEs about transmission formats to use. Scheduling decisions affecting the uplink are communicated to the UEs via the Physical Downlink Control Channel (PDCCH) in the downlink. The scheduling decisions may be based on QoS parameters, UE buffer status, uplink channel quality measurements, UE capabilities, UE measurement gaps, etc.

Uplink link adaptation:

As uplink link adaptation methods, transmission power control, adaptive modulation and channel coding rate, as well as adaptive transmission bandwidth can be used.

Uplink timing control:

Uplink timing control is needed to time align the transmissions from different UEs with the receiver window of the eNodeB. The eNodeB sends the appropriate timing-control commands to the UEs in the downlink, commanding them to adapt their respective transmit timing.

Hybrid automatic repeat request (ARQ):

The Uplink Hybrid ARQ protocol is already known from HSUPA. The eNodeB has the capability to request retransmissions of incorrectly received data packets.

1.2 EUTRA/LTE Test & Measurement Assumptions made by Rohde & Schwarz

This section describes working assumptions for EUTRA/LTE test and measurement solutions that cannot yet be derived from 3GPP specifications. These assumptions are valid for all current implementations on R&S signal analyzers.

1.2.1 OFDMA Parameterization

In order to configure the bandwidth of the signal to be generated and analyzed, the desired number of resource blocks can be specified in a range from 6 to 110 resource blocks with a granularity of 1. This results in bandwidths from 1.08 MHz…19.8 MHz.

The resulting FFT size is derived from the following formula:

$$N_{FFT} = 2^{nextpow2(\lceil 1.4 \cdot (12n+1) \rceil)}$$

n is the selected number of resource blocks

NEXTPOW2(N) returns the first P such that 2^P >= abs(N)

$\lceil \ \rceil$ rounds up to the next highest integer

1.2.2 Demodulation Reference Signal for PUSCH

For additional flexibility, it is possible to upload an IQ File for the demodulation reference signal with arbitrary modulation format. For more information, please refer to "Import and Export of Data".

If the data allocation changes from one TTI to another, the demodulation reference signal is parameterized again accordingly.

1.3 References

[1] 3GPP TS 25.913: Requirements for E-UTRA and E-UTRAN (Release 7)
[2] 3GPP TS 36.211 v8.7.0: Physical Channels and Modulation (Release 8)

2 Installation and Test Setup

2.1 Software Installation

Please refer to the release notes for detailed instructions on the installation process.

2.2 Connection to the Instrument

In order to be able to communicate with the instruments, the PC must be connected to the R&S FSQ / FSV using either an IEEE bus or LAN connection.

2.2.1 R&S FSQ/FSV Requirements

To capture IQ data, any available R&S FSQ / FSV can be used.
If you want to connect the instrument using TCP/IP, make sure to use firmware version 3.65 or higher or to have the RSIB Passport driver installed on your PC. The driver can be downloaded from this website: http://www.rohde-schwarz.com/appnote/1EF47.

2.2.2 Configuration Settings

The R&S FSQ / FSV address (either GPIB or LAN address) has to be set in the R&S FSQ / FSV-K101 / K105 EUTRA/LTE analysis software. Please refer to section "MIMO Analyzer Configuration" for details about this setting.

The description about the GPIB and LAN Address is separated for the R&S FSQ and the R&S FSV.

2.2.2.1 How to Obtain the GPIB or LAN Address in the R&S FSQ Instrument

In this section it is described how to obtain the GPIB or LAN address of the R&S FSQ instrument.

GPIB address

1. Press the "SETUP" key.

   The Setup menu opens.
2. Press the "General Setup" softkey.
3. Press the "GPIB" softkey.

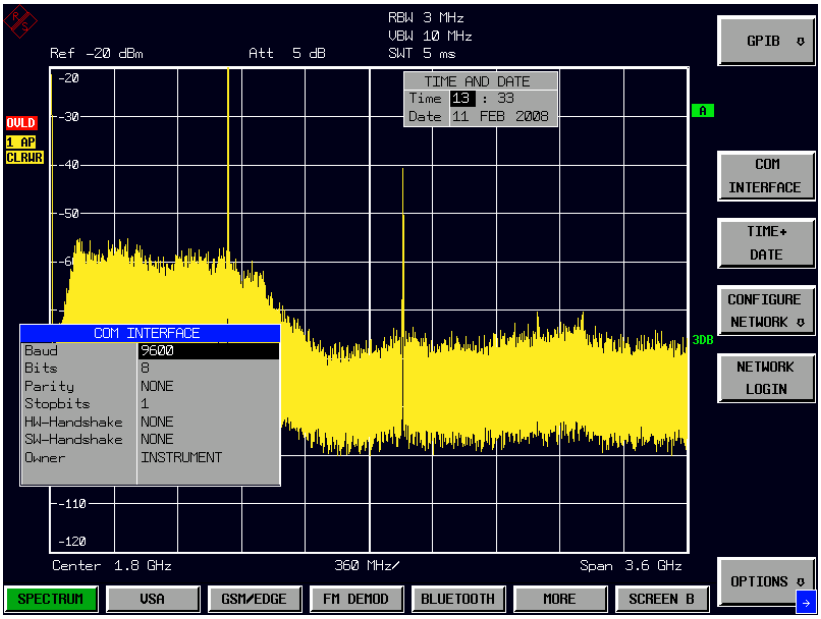


Figure 2-1: Softkey: GPIB Address

LAN address

1. Press the "SETUP" key.

   The Setup menu opens.

2. Press the "General Setup" softkey.

3. Press the "Configure Network" softkey.

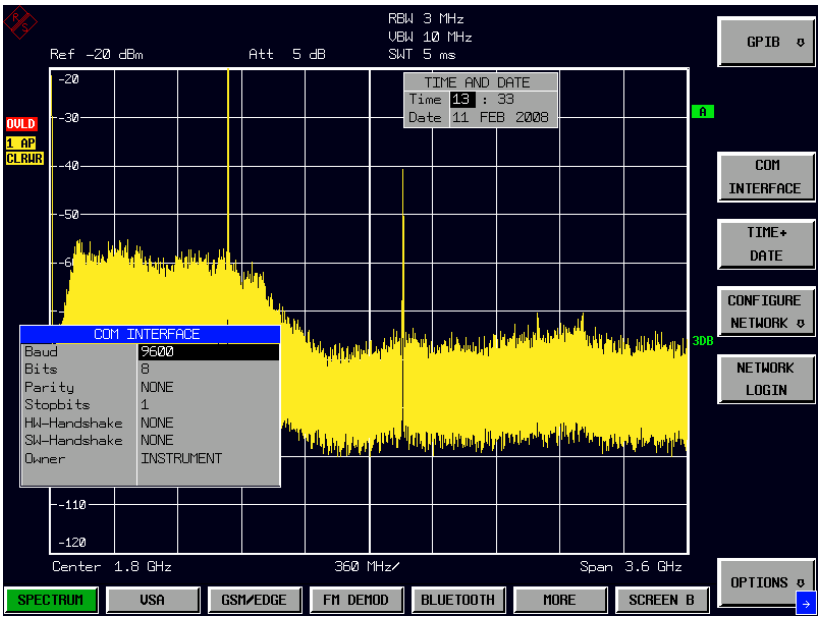


Figure 2-2: Softkey: Configure Network

4. Select "Local Area Connection" and press ENTER.

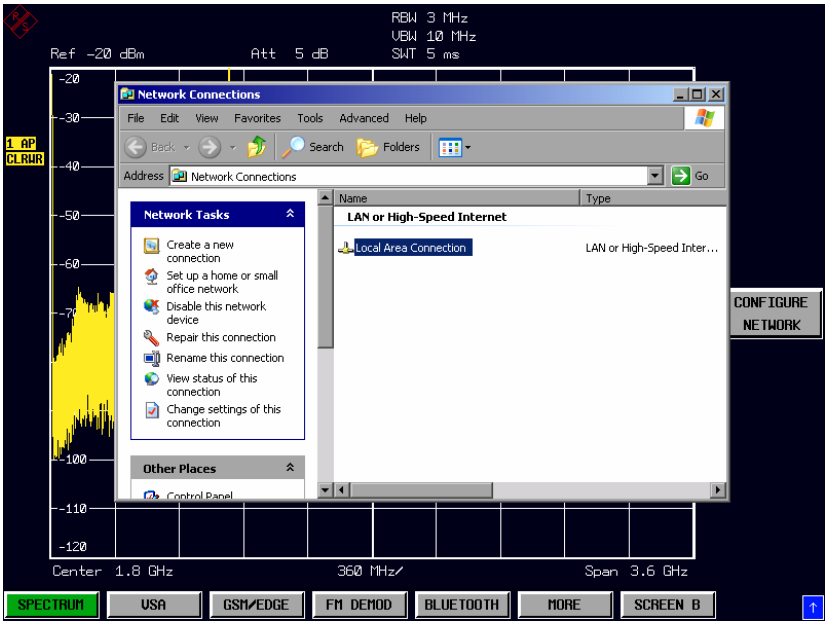


Figure 2-3: Local Area Connection

5. Click on the "Support" tab of the "Local Area Connection Status" dialog.

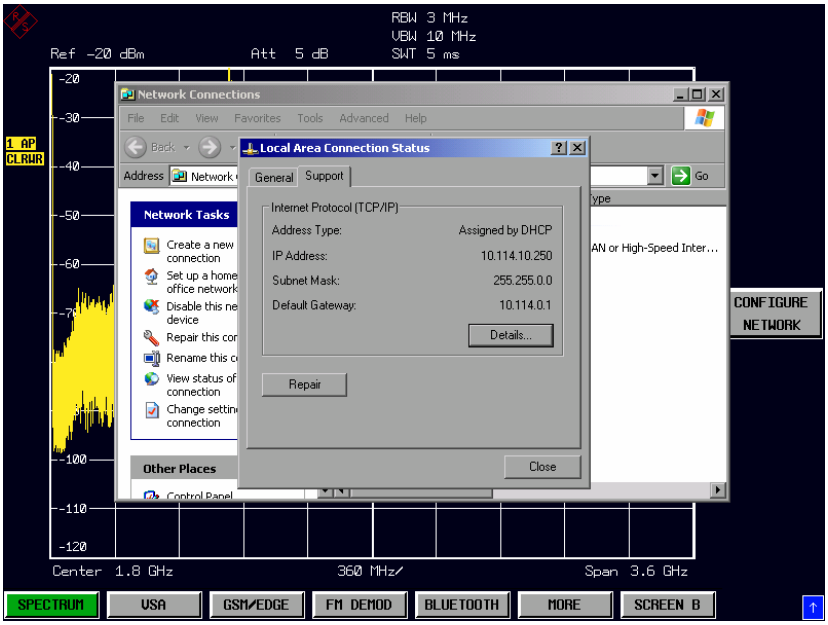


Figure 2-4: Local Area Connection: Support Tab

2.2.2.2 How to Obtain the GPIB or LAN Address in the R&S FSV Instrument

In this section it is described how to obtain the GPIB or LAN address of the R&S FSV instrument.

GPIB address

1. Press the "SETUP" key.

   The Setup menu opens.

2. Press the "General Setup" softkey

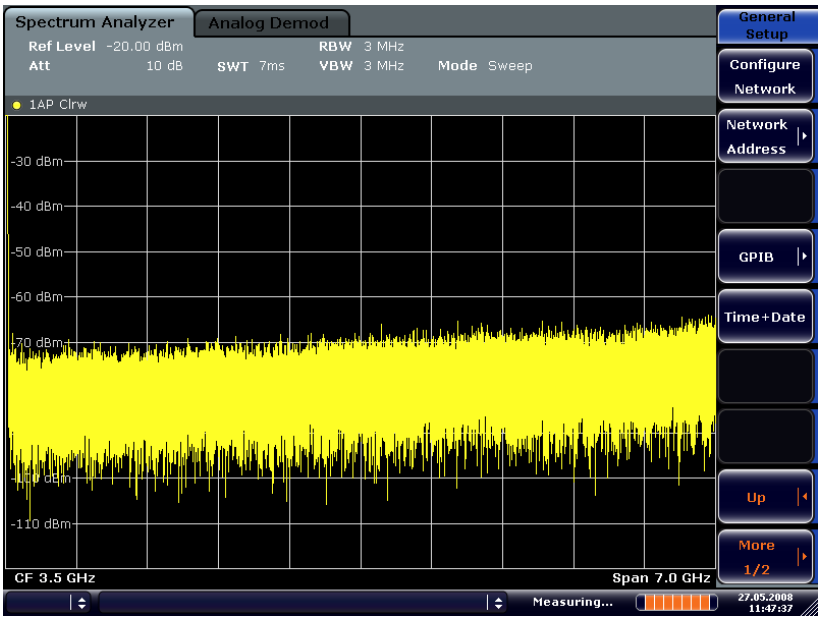
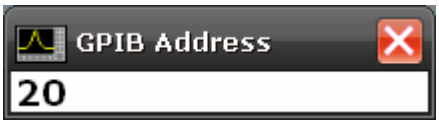


Figure 2-5: General Setup menu

3. Press the "GPIB" softkey.
4. Press the "GPIB" Address softkey.

   The GPIB dialog input box opens. Query or change the GPIB address.

Figure 2-6: Input Dialog Box: GPIB Address



LAN address

1. Press the "SETUP" key

   The Setup menu opens

2. Press the "General Setup" softkey

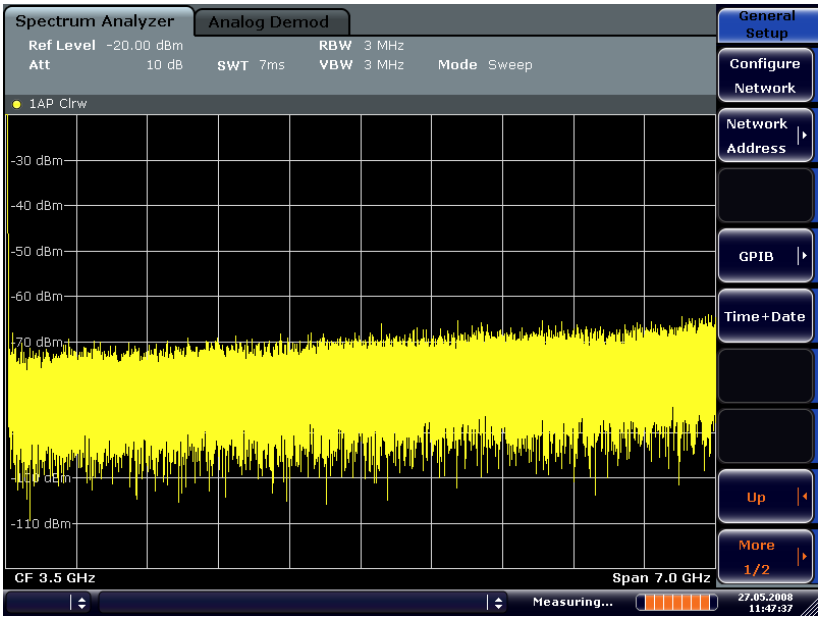


Figure 2-7: The General Setup menu

3. Press the "Network Address" softkey

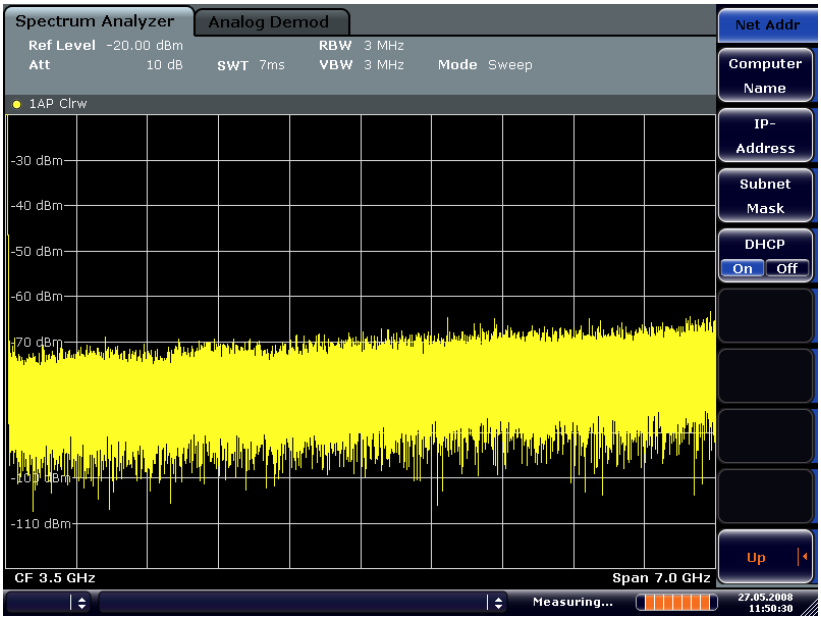


Figure 2-8: The Net Addr menu

4. Press the "IP Address" softkey to query the IP address

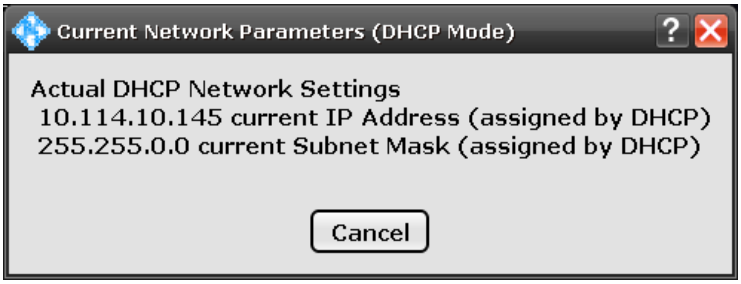


Figure 2-9: Current Network Parameters (DHCP mode)

3 Quick Start Guide

This section will help you to quickly become familiar with R&S FSQ / FSV-K101 / K105 (refer to section "Operating the Software" for detailed operating instructions).

3.1 Setting up the Measurement

Start the R&S FSQ / FSV-K101 / K105 application and press "PRESET" (if you are running the software on an analyzer you will have to restart the R&S FSQ / FSV-K101 / K105 application afterwards).

3.1.1 General Setup (Frequency, Level, etc.)

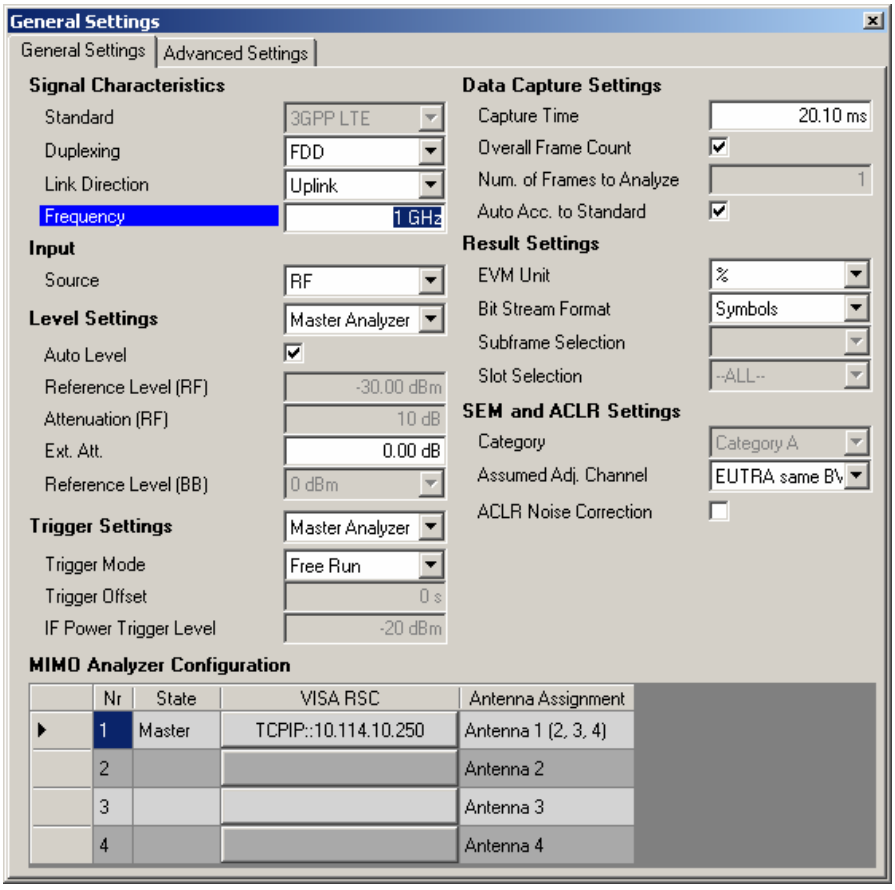


Figure 3-1: General Setup Dialog

1. Press the "General Settings" softkey to open the corresponding dialog box.
2. Enter the frequency you want to measure in the "Frequency" field.
3. Enter the VISA RSC of the R&S FSQ / FSV "MIMO Analyzer Configuration" table.
4. All other settings in this dialog box are sufficient for this example.

3.1.2 Demodulation Setup (Tracking Modes, etc.)

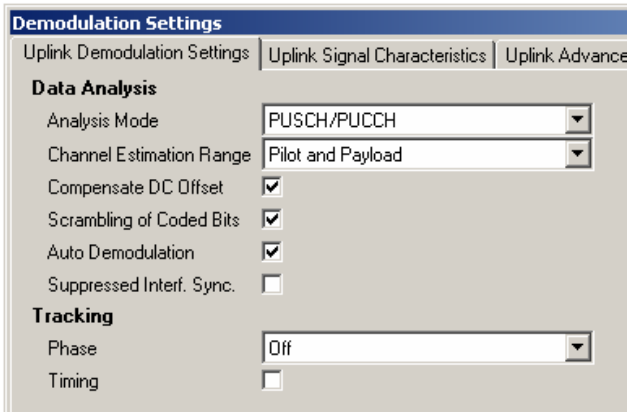


Figure 3-2: General Setup Dialog

► Press the "Demod Settings" softkey to open the "Demodulation Settings" dialog box.

Make sure that the "Auto Demodulation" feature is enabled. All other settings in this dialog box are sufficient for this example.

3.2 Performing the Main Measurement

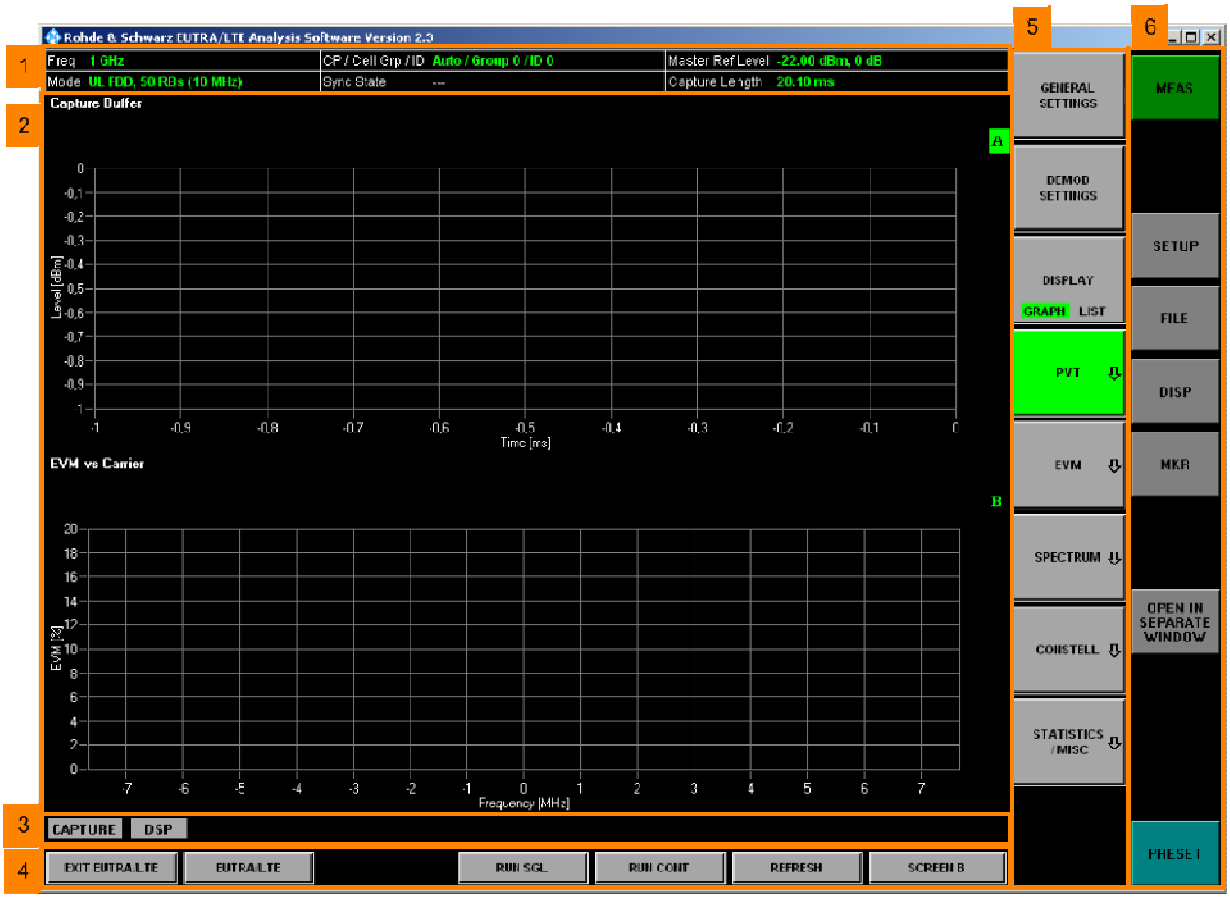
► Start the measurement by pressing "*RUN SGL*".

Measurement results are updated once the measurement has been completed. The results are displayed in graphical form. The display can be toggled to a tabular list of measurement points by pressing "DISPLAY".

4 Operating the Software

4.1 Starting the Software

Use the desktop shortcut or the shortcut from the Start menu to start the R&S FSQ / FSV-K101 / K105 EUTRA/LTE analysis software. The following window opens:



The software user interface consists of six main elements:

- **Header table** (1)

  Showing basic information such as measurement frequency or sync state.

- **Hotkeys** (4)

  The hotkeys control the measurement process (e.g. running a measurement).

  Pressing a hotkey will be referred to as "*Hotkey*" in this manual, e.g. "*RUN SGL*".

- **Results display (2)**

Here, all measurement results are displayed in full or split screen style.

Results displays are always separated into

- Header (showing title, etc) and
- Display (showing data) section.

- **Status bar (3)**

The status bar shows "live" information on the measurement progress and displays software messages and errors.

- **Softkeys (5)**

The softkeys are used to open configuration windows and to select the desired measurement result style. The softkeys may change when operating the software (e.g. clicking a hardkey). Pressing a softkey will be referred to as "Softkey" in this manual, e.g. "Spectrum".

- **Hardkeys (6)**

The hardkeys provide the same functions as those known from the R&S FSQ/FSV (load/store data, configure the display, etc).

Pressing a hardkey will be referred to as "HARDKEY CAPTION" in this manual, e.g. "MEAS".

4.2 Loading a Frame Setup

Before starting the measurement, a frame setup, which describes the frame to be analyzed, can be loaded. Use "FILE", "Load Demod Settings" to open a standard file dialog to select the demodulation setup to load.

4.3 Preparing for Instrument Connection

In order to be able to communicate with the instruments, the R&S FSQ / FSV must be connected with the PC using either an IEEE bus or LAN connection. The type of connection and the address can be selected inside the software. Refer to section "Installation and Test Setup" for a detailed description.

4.4 Performing Measurements

You can either use the R&S FSQ/FSV hardware to capture I/Q data or load the I/Q data from a file. The data source can be switched by using the "SETUP", "Data Source" keys.

Refer to section "Import and Export of Data" for details on the file format.

4.4.1 Running the Measurement

Use the hotkeys of the EUTRA/LTE software displayed at the bottom of the screen to start a single or continuous measurement with newly acquired data or the already captured I/Q data.

	RUN SGL | RUN CONT | REFRESH
RUN SGL	Executes a single measurement with data capturing and signal processing and stops after it has finished. ➡ Remote: `INIT`
RUN CONT	Executes subsequent measurements with data capturing and signal processing until you press "*Run Cont*" again.
REFRESH	Executes a single measurement as with "*RUN SGL*", but using already captured I/Q data for processing. This can be used to e.g. observe the changes of different demodulation settings to the results. ➡ Remote: `INIT:REFR`

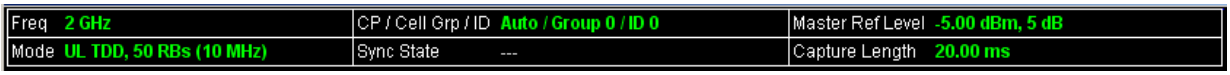
4.4.2 Events during a Measurement

While running the measurement, certain events may cause the measurement execution to fail. The corresponding error message is displayed in the status bar and stored in the error log.

4.4.3 Measurement Header Table

The tabular section below the title bar shows the overall measurement settings and specific results used to obtain the current measurement results.

Figure 4-1: Overall measurement settings summary



The settings summary includes the following information

- **Freq** The analyzer RF frequency.
- **Mode** Link direction, duplexing and maximum number of physical resource blocks.
- **CP / Cell Grp / ID** Cyclic prefix length (Normal or Extended), physical layer cell identity group and physical layer identity. If "AUTO" is selected in the "Demodulation Settings" dialog box, (Auto) is shown, otherwise (Manual).
- **Sync State** Current synchronization status.

- **Master Ref Level** RF input: RF reference level and RF attenuation settings of the master analyzer
  Baseband (BB) input: Reference level of the master analyzer
- **Capture Length** Capture length in ms and samples

4.5 Evaluating the Results – Operating the Graph

4.5.1 Context Menu (Marker, Zoom, Pan, Copy Image to Clipboard, Show Data Points)

Using the right mouse button on the graphical displays, you can select several options to perform a more detailed measurement on the displayed graphics.

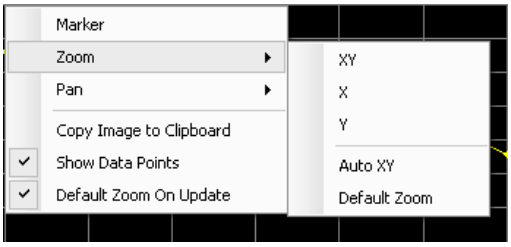


Figure 4-2: Context Menu: Zoom

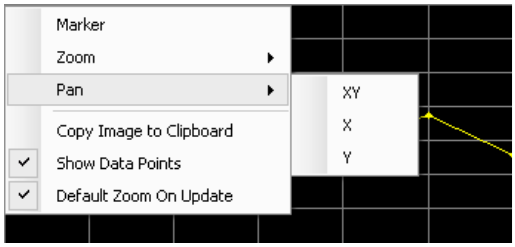


Figure 4-3: Context Menu: Pan

4.5.1.1 Marker

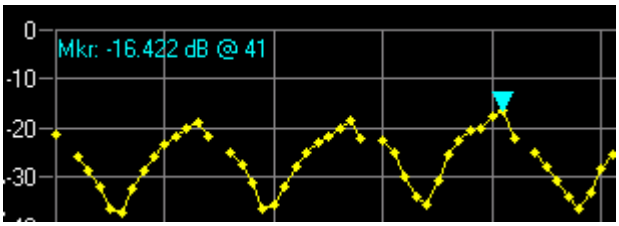


Figure 4-4: Example: Marker

- The marker is activated via the context menu. If activated it is set on the absolute maximum of the trace menu.

Setting the marker to the trace maximum

If you have shifted the marker and want to put it back on the absolute maximum, click "Marker" twice in the context menu (deactivates and activates the marker again).

- The text which appears in the upper left corner of the screen consists of: Mkr: [y value] [unit of y axis] @ [x value] [unit of x axis]
- If the marker is moved with the mouse, it jumps to the point closest to the cursor.

Move the mouse above the curve to hop between the local maxima or below the curve to hop between the local minima.

4.5.1.2 Zoom

XY

Click and hold the left mouse button in the graph to select an X and Y area to zoom in on.

X

Click and hold the left mouse button in the graph to select a range on the X area to zoom in on.

Y

Click and hold the left mouse button in the graph to select a range on the Y area to zoom in on.

Auto XY

Scales the X and Y axes automatically to display the complete trace data.

Alternatively double-click on the display area.

Default Zoom

Scales the X and Y axes to the default axis values.

4.5.1.3 Pan

XY

Click and hold the left mouse button in the graph to move the graph in the X and Y direction.

X

Click and hold the left mouse button in the graph to move the graph in the X direction.

Y

Click and hold the left mouse button in the graph to move the graph in the Y direction.

4.5.1.4 Copy Image to Clipboard

Copies the displayed image to the operating system clipboard.

4.5.1.5 Show Data Points

Displays small dots at each data point of the linear interpolated trace.

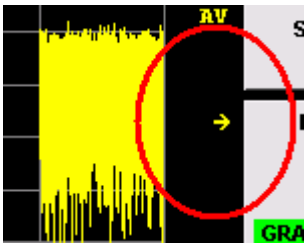
4.5.1.6 Default Zoom On Update

Resets the Zoom to the default zoom on each display update.

4.5.2 Arrows Indicating Data out of Display Range

Parts or all of the data may be out of the display range. For this purpose, arrow indicators on the right side of the graph show a status in each direction (up, down, left, right). The arrow is displayed in yellow if only parts of the data are outside the visual area. If all data is outside the visual area, the arrow turns red.

Figure 4-5: "Data out of Display" indication on the screen



The yellow arrow indicates that parts of the data are outside to the right of the visible area (the arrow points to the right).

5 Measurements

This section contains a detailed description of all measurement modes, settings and results.

5.1 Numerical Results

5.1.1 EVM Measurements

EVM (DMRS) PUSCH QPSK/16QAM

EVM for all PUSCH resource elements which are either QPSK or 16QAM modulated. The EVM is given for the PUSCH resource elements and the DMRS PUSCH resource elements.

- Remote: `FETC:SUMM:EVM:USQP?`
- Remote: `FETC:SUMM:EVM:SDQP?`
- Remote: `FETC:SUMM:EVM:USST?`
- Remote: `FETC:SUMM:EVM:SDST?`

EVM (DMRS) PUCCH

EVM for all PUCCH resource elements. The EVM is given for the PUCCH resource elements and the DMRS PUCCH resource elements.

- Remote: `FETC:SUMM:EVM:UCCH?`
- Remote: `FETC:SUMM:EVM:UCCD?`

EVM PRACH

EVM for all PRACH resource elements.

- Remote: `FETC:SUMM:EVM:UPRA?`

EVM Phys. Channel

EVM for all physical channel resource elements.

- Remote: `FETC:SUMM:EVM:PCH?`

EVM Physical Signal

EVM for all physical signal resource elements.

- Remote: `FETC:SUMM:EVM:PSIG?`

EVM All.

EVM for all resource elements.

➥ Remote: `FETC:SUMM:EVM:ALL?`

5.1.2 I/Q Constellation Measurements

Frequency Error

Difference between measured and reference center frequency.

➥ Remote: `FETC:SUMM:FERR?`

Sampling Error

Difference between measured and reference symbol clock relative to the system sampling rate.

➥ Remote: `FETC:SUMM:SERR?`

IQ Offset

Power at spectral line 0 normalized to the total transmitted power.

➥ Remote: `FETC:SUMM:IQOF?`

IQ Gain Imbalance

Logarithm of the 'Q-Channel to I-Channel gain ratio'.

➥ Remote: `FETC:SUMM:GIMB?`

IQ Quadrature Error

Measure of the 'phase angle between Q-Channel and I-Channel' deviating from the ideal 90 degrees.

➥ Remote: `FETC:SUMM:QUAD?`

5.1.3 Power Measurement

Power

Average time domain power of the analyzed signal.

➥ Remote: `FETC:SUMM:POW?`

- Crest Factor

Peak-to-average power ratio of captured signal.

➥ Remote: `FETC:SUMM:CRES?`

5.2 Graphical Results

5.2.1 Power vs Time Measurements

Capture Buffer

Power profile of the capture buffer data being analyzed.

Remote: `CALC1:FEED 'PVT:CBUF'`

5.2.2 EVM Measurements

EVM vs. Carrier

EVM versus the physical carriers of the analyzed frame.

➥ Remote: `CALC1:FEED 'EVM:EVCA'`

EVM vs. Symbol

EVM versus the symbols of the analyzed frame.

➥ Remote: `CALC1:FEED 'EVM:EVSY'`

EVM vs. Subframe

EVM versus the subframes of the analyzed frame.

➥ Remote: `CALC1:FEED 'EVM:EVSU'`

5.2.3 Spectrum Measurements

Spectrum Emission Mask

Spectrum Emission Mask measurement according to the 3GPP standard.

➥ Remote: `CALC1:FEED 'SPEC:SEM'`

ACLR (Relative)

Adjacent Channel Leakage Power Ratio measurement according to the 3GPP standard.

➥ Remote: `CALC1:FEED 'SPEC:ACPR'`

ACLR (Absolute)

Absolute Adjacent Channel Power measurement.

➥ Remote: `CALC1:FEED 'SPEC:ACPA'`

Power Spectrum

Power density spectrum of the complete capture buffer in dBm/Hz.

➥ Remote: `CALC1:FEED 'SPEC:PSPE'`

Inband Emission

Relative power of the unused resource blocks.

➥ Remote: `CALC1:FEED 'SPEC:IE'`

Channel Flatness

Amplitude of the channel transfer function.

➥ Remote: `CALC1:FEED 'SPEC:FLAT'`

Channel Flatness SRS

Amplitude of the channel transfer function based on the sounding reference signal.

➥ Remote: `CALC1:FEED 'SPEC:FSRS'`

Channel Group Delay

Group delay of each single carrier, averaged over all OFDM symbols.

➥ Remote: `CALC1:FEED 'SPEC:GDEL'`

Channel Flatness Difference

Absolute difference of adjacent carriers.

➥ Remote: `CALC1:FEED 'SPEC:FDIF'`

5.2.4 Constellation Measurements

Constellation Diagram

Complex constellation diagram of the modulation symbols. The different modulation formats are assigned unique colors. With the "Constell Selection" softkey it is possible to suppress unwanted information.

➥ Remote: `CALC1:FEED 'CONS:CONS'`

DFT Precoding Constellation

Complex constellation diagram of the modulation symbols without applied DFT precoding

➥ Remote: `CALC1:FEED 'CONS:DFTC'`

5.2.5 Statistic / Misc. Measurements

CCDF (Complementary Cumulative Distribution Function)

Complementary cumulative probability distribution for the capture buffer samples relative to the average power.

➥ Remote: `CALC1:FEED 'STAT:CCDF'`

Allocation Summary

Provides information about the allocations from the analyzed frame, i.e. PRB offset, PRB count and EVM of the allocation.

➥ Remote: `CALC1:FEED 'STAT:ASUM'`

Bit Stream

Demodulated data stream for each data allocation.

➥ Remote: `CALC1:FEED 'STAT:BSTR'`

5.3 IQ Measurements

This section contains a detailed description of the IQ measurements.

5.3.1 Capture Buffer

To display the Capture Buffer PVT (power versus time) results select "PVT", then "Capture Buffer".

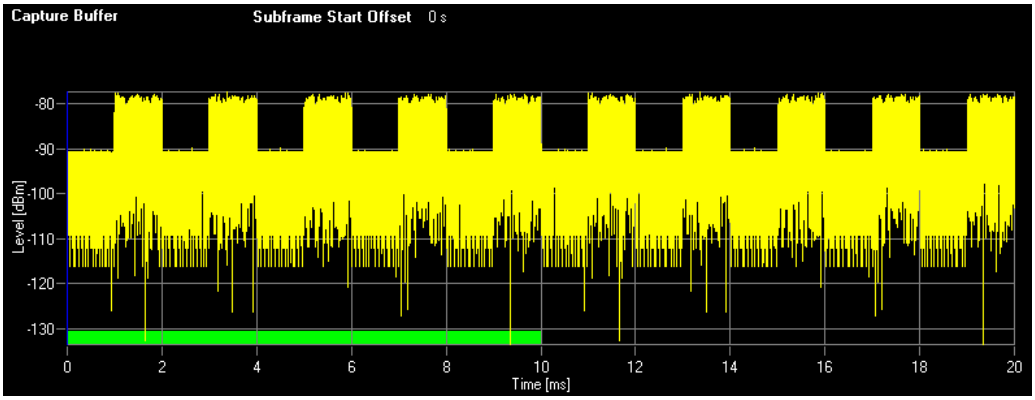


Figure 5-1: Capture Buffer Display

The Capture Buffer display shows the complete range of captured data for the last sweep. It shows the amplitude of the captured IQ data in dBm.

The green bar in the bottom of the data shows the analyzed area.

A blue vertical line at the beginning of the bar at the bottom of the Capture Buffer display marks the subframe start. Additionally, the display header includes the Subframe Start Offset value. This value is the time difference between the subframe start and capture buffer start.

➥ Remote: `CALC1:FEED 'PVT:CBUF'`

5.3.2 EVM vs. Carrier

To display the EVM vs. Carrier measurement results select "EVM", then "EVM vs. Carrier".

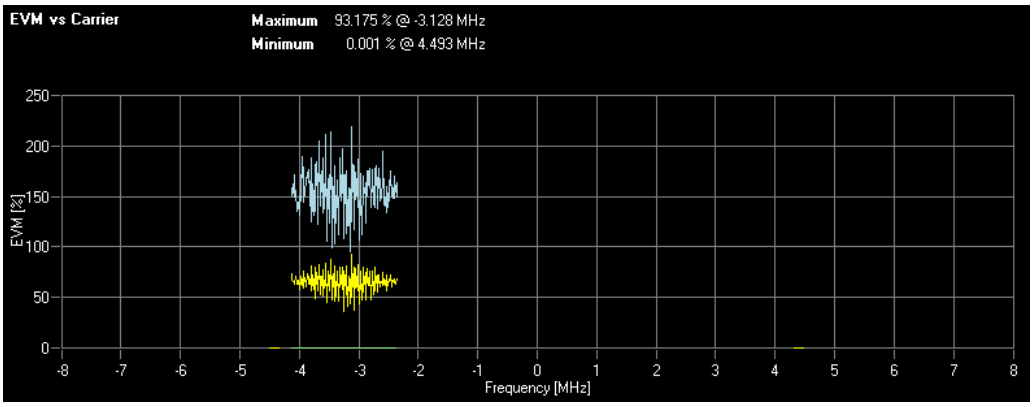


Figure 5-2: EVM vs. Carrier Display

The EVM vs. Carrier display shows the EVM of each carrier, averaged over all available OFDM symbols.

➥ Remote: `CALC1:FEED 'EVM:EVCA'`

5.3.3 EVM vs. Symbol

To display the EVM vs. Symbol measurement results select "EVM", then "EVM vs. Symbol".

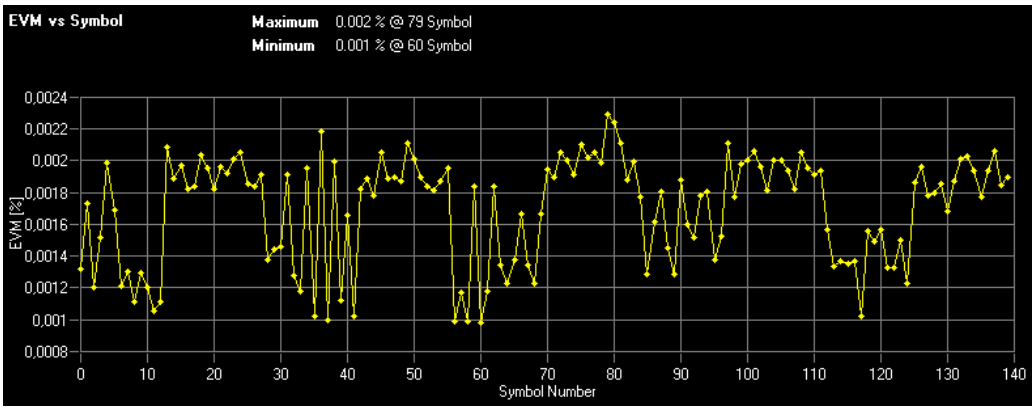


Figure 5-3: EVM vs. Symbol Display

The EVM vs. Symbol results display shows the EVM of each symbol, averaged over all OFDM data carriers. The results are displayed on a per-symbol basis.

➥ Remote: `CALC1:FEED 'EVM:EVSY'`

5.3.4 EVM vs. Subframe

To display the EVM vs. Subframe measurement results select "EVM", then "EVM vs. Subframe".

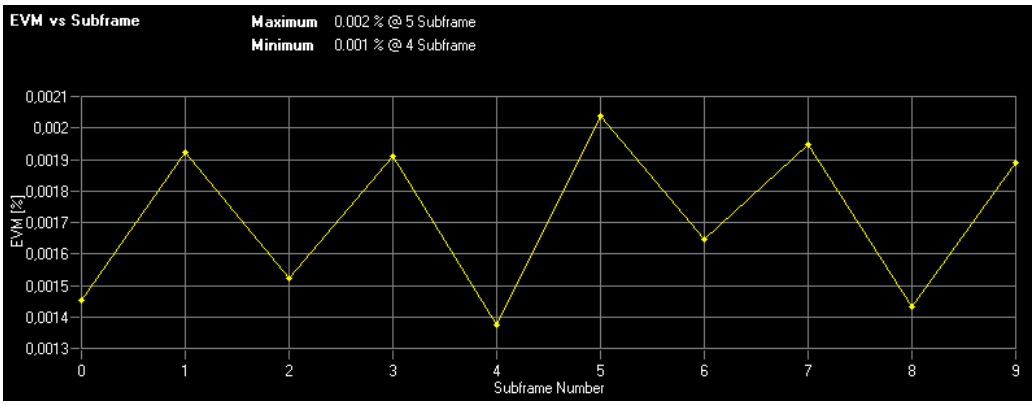


Figure 5-4: EVM vs. Subframe Display

The EVM vs. Subframe results display shows the EVM of each subframe, averaged over all OFDM data carriers. The results are displayed on a per-subframe basis.

➡ Remote: `CALC1:FEED 'EVM:EVSU'`

5.3.5 Power Spectrum

To display the Power Spectrum measurement results select "Spectrum", then "Power Spectrum".

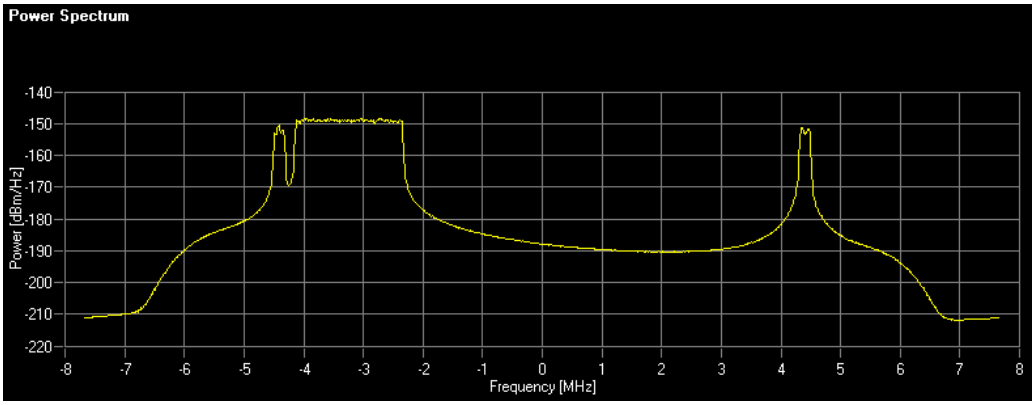


Figure 5-5: Power Spectrum Display

The Power Spectrum display shows the power density spectrum of the complete capture buffer in dBm/Hz.

➡ Remote: `CALC1:FEED 'SPEC:PSPE'`

5.3.6 Inband Emission

To display the Inband Emission measurement results select "Spectrum", then "Inband Emission".

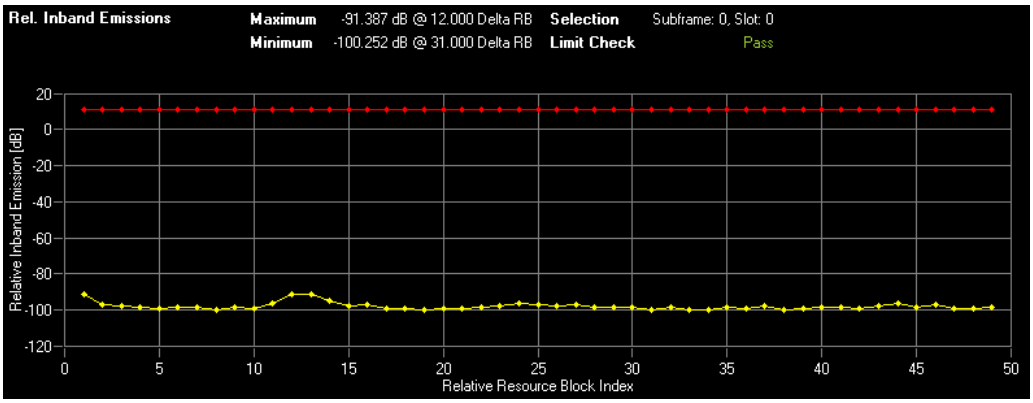


Figure 5-6: Inband Emission Display

The Inband Emission display shows the relative power of the unused resource blocks (yellow graph) and the inband emission limit lines specified by the LTE standard document 3GPP TS36.10. The measurement is evaluated over the currently selected slot in the currently selected subframe. The slot and subframe selection may be changed in the general settings menu.

The measurement results are only available if the subframe selection is not set to ---All--- (see "Subframe Selection"). In case of invalid settings a warning will be shown.

➡ Remote: `CALC1:FEED 'SPEC:IE'`

5.3.7 Channel Flatness

To display the Channel Flatness measurement results select "Spectrum", then "Channel Flatness Flat".

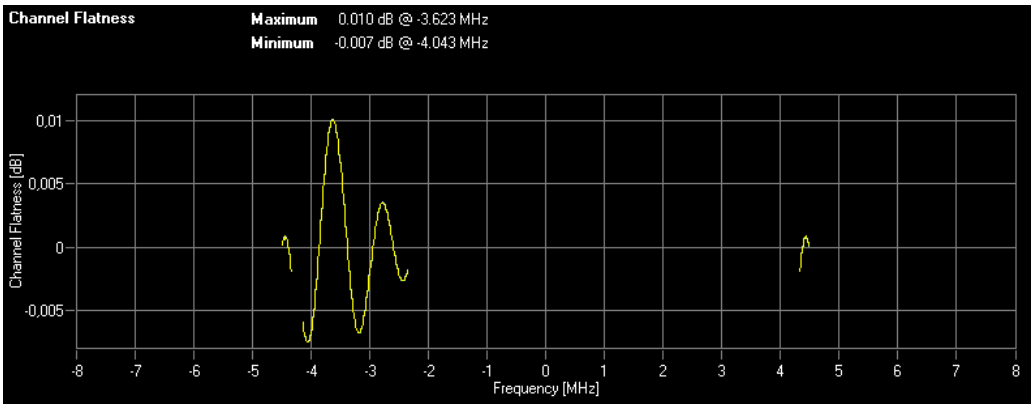


Figure 5-7: Channel Flatness Display

The Channel Flatness display shows the amplitude of the channel transfer function.

The measurement is evaluated over the currently selected slot in the currently selected subframe. The slot and subframe selection may be changed in the general settings menu.

➥ Remote: `CALC1:FEED 'SPEC:FLAT'`

5.3.8 Channel Flatness SRS

To display the Channel Flatness SRS measurement results select "Spectrum", then "Channel Flatness Flat".

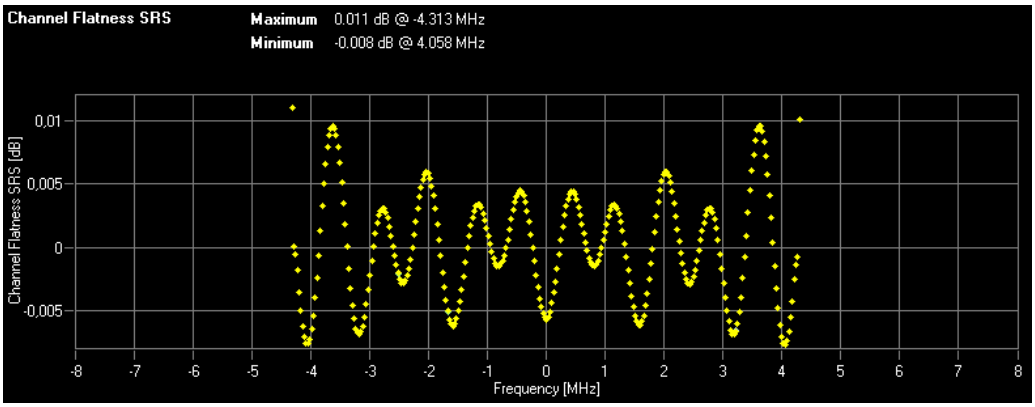


Figure 5-8: Channel Flatness SRS Display

The Channel Flatness SRS display shows the amplitude of the channel transfer function based on the sounding reference signal.

The measurement is evaluated over the currently selected slot in the currently selected subframe. The slot and subframe selection may be changed in the general settings menu.

➥ Remote: `CALC1:FEED 'SPEC:FSRS'`

5.3.9 Channel Group Delay

To display the Channel Group Delay measurement results select "Spectrum", then "Channel Flatness GRDEL".

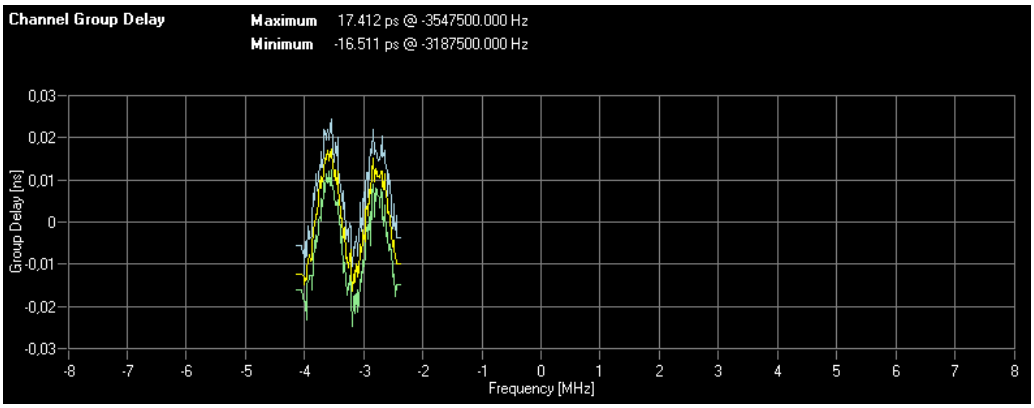


Figure 5-9: Channel Group Delay Display

The Channel Group Delay display shows the group delay of each single carrier. The measurement is evaluated over the currently selected slot in the currently selected subframe. The slot and subframe selection may be changed in the general settings menu.

➥ Remote: `CALC1:FEED 'SPEC:GDEL'`

5.3.10 Channel Flatness Difference

To display the Channel Flatness Difference results select "Spectrum", then "Channel Flatness Difference".

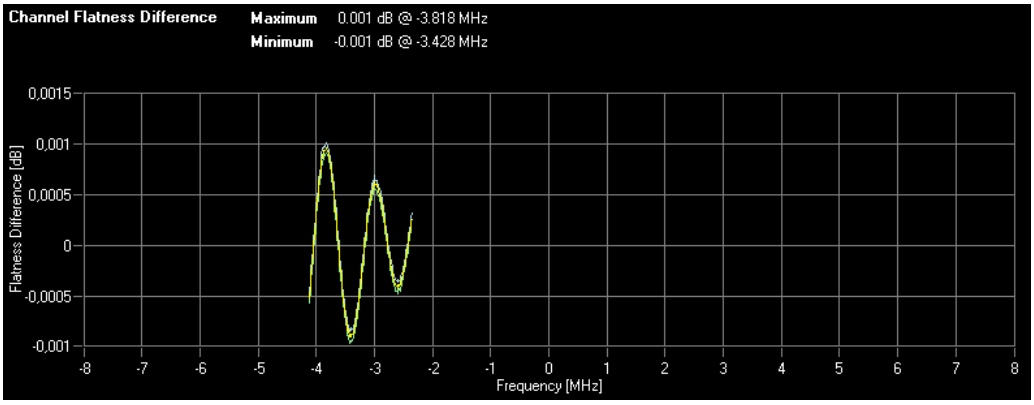


Figure 5-10: Channel Flatness Difference Display

The Channel Flatness Difference display shows the level difference in the channel flatness result between two adjacent physical carriers.

The measurement is evaluated over the currently selected slot in the currently selected subframe. The slot and subframe selection may be changed in the general settings menu.

➥ Remote: `CALC1:FEED 'SPEC:FDIF'`

5.3.11 Constellation Diagram

To display the Constellation Diagram select "Constell", then "Constell".

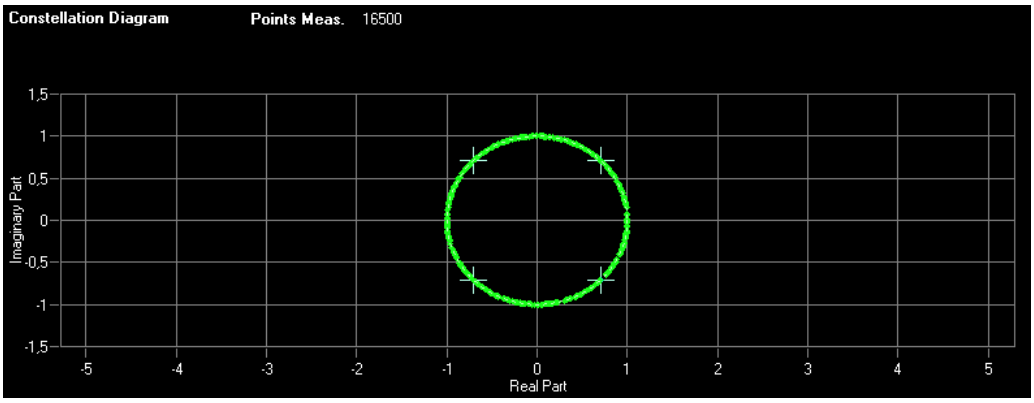


Figure 5-11: Constellation Diagram Display

The Constellation Diagram display shows the inphase and quadrature phase results over the full range of the measured input data. The ideal points for the selected modulation scheme are displayed with cross-hairs for reference purposes.

➡ Remote: `CALC1:FEED 'CONS:CONS'`

5.3.12 Constellation Selection

The "Constell Selection" softkey displays a pop-up dialog that allows the displayed results to be filtered. The results may be filtered by any combination of modulation, symbol or carrier. The results are updated as soon as any change to the constellation selection parameters is made.

The fields "Allocation" and "Location" are not available in uplink direction.

Note that if you use a split screen and have the constellation display on each of these screens, it is NOT possible to have two different filters for the different screens.

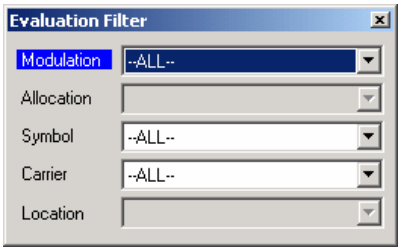


Figure 5-12: Constellation Evaluation Filter Panel

5.3.13 DFT Precoding Constellation

To display the DFT Precoded Constellation Diagram select "CONSTELL", then "DFT Precod Constell".

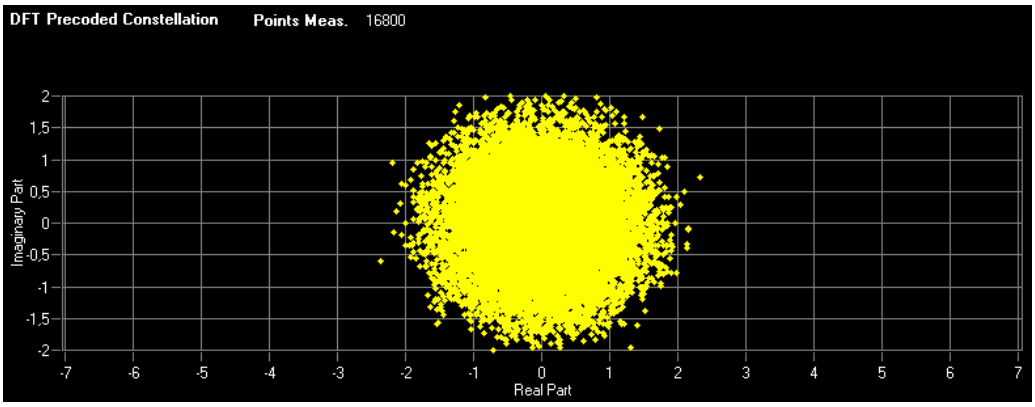


Figure 5-13: DFT Precod Constellation Diagram Display

The DFT Precod Constellation Diagram display shows the inphase and quadrature phase results over the full range of the measured input data. The data is shown without the DFT precoding.

With the "Constell Selection" softkey you can open the "Evaluation Filter" dialog box to filter the results as described on the previous page. Available filtering options are Symbol and Carrier.

➥ Remote: `CALC1:FEED 'CONS:DFTC'`

5.3.14 CCDF (Complementary Cumulative Distribution Function)

To display the CCDF measurement results select "Statistics/Misc", then "CCDF".

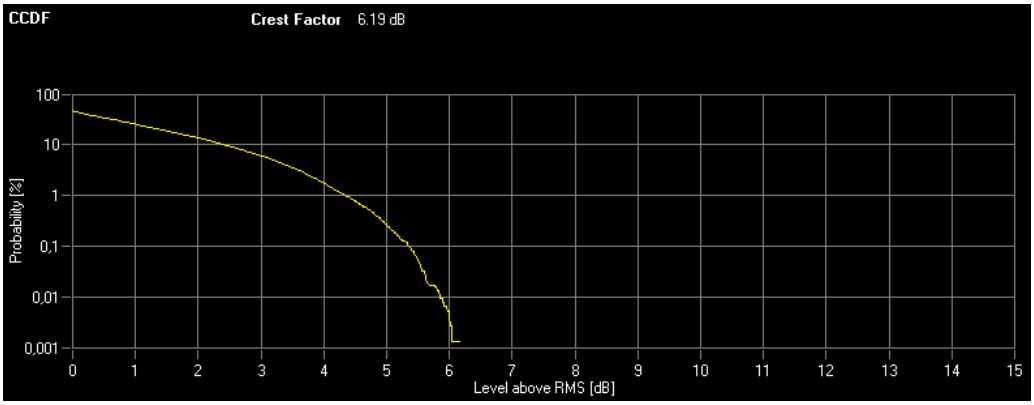


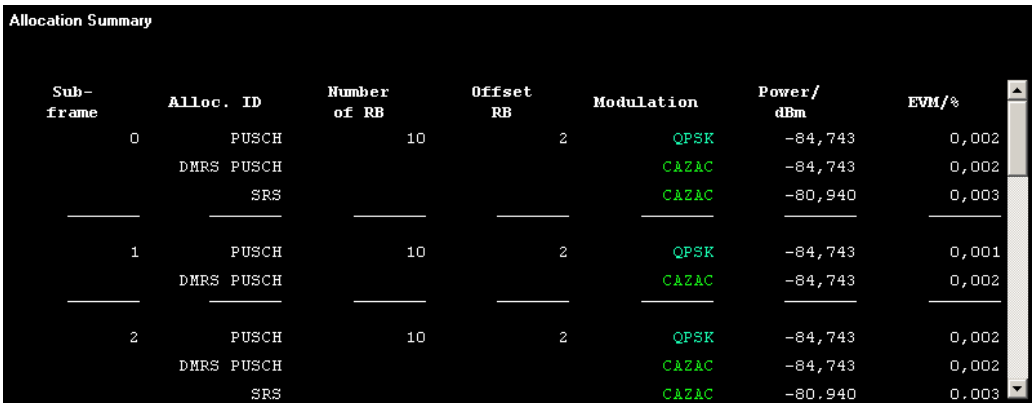
Figure 5-14: CCDF Display

The CCDF results display shows the probability of an amplitude exceeding the mean power. The X axis displays power relative to the measured mean power.

➥ Remote: `CALC1:FEED 'STAT:CCDF'`

5.3.15 Allocation Summary

To display the Allocation Summary measurement results select "Statistics / Misc", then "Allocation Summary".


Allocation Summary

Sub-frame	Alloc. ID	Number of RB	Offset RB	Modulation	Power/ dBm	EVM/%
0	PUSCH	10	2	QPSK	-84,743	0,002
	DMRS PUSCH			CAZAC	-84,743	0,002
	SRS			CAZAC	-80,940	0,003
1	PUSCH	10	2	QPSK	-84,743	0,001
	DMRS PUSCH			CAZAC	-84,743	0,002
2	PUSCH	10	2	QPSK	-84,743	0,002
	DMRS PUSCH			CAZAC	-84,743	0,002
	SRS			CAZAC	-80,940	0,003

Figure 5-15: Allocation Summary Display

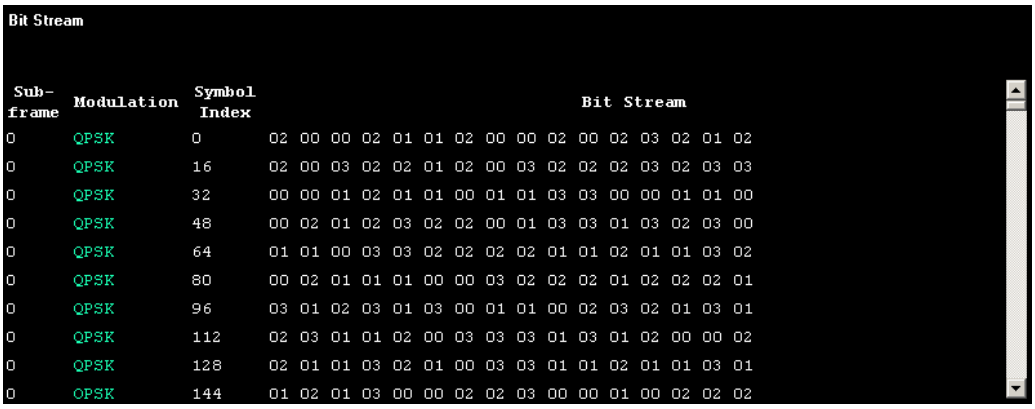
The Allocation Summary list displays detailed results on the measured allocations.

The EVM unit can be changed in the General Settings dialog.

➥ Remote: `CALC1:FEED 'STAT:ASUM'`

5.3.16 Bit Stream

To display the Bit Stream measurement results select "Statistics / Misc", then "Bitstream".


Bit Stream

Sub-frame	Modulation	Symbol Index	Bit Stream
0	QPSK	0	02 00 00 02 01 01 02 00 00 02 00 02 03 02 01 02
0	QPSK	16	02 00 03 02 02 01 02 00 03 02 02 02 03 02 03 03
0	QPSK	32	00 00 01 02 01 01 00 01 01 03 03 00 00 01 01 00
0	QPSK	48	00 02 01 02 03 02 02 00 01 03 03 01 03 02 03 00
0	QPSK	64	01 01 00 03 03 02 02 02 02 01 01 02 01 01 03 02
0	QPSK	80	00 02 01 01 01 00 00 03 02 02 02 01 02 02 02 01
0	QPSK	96	03 01 02 03 01 03 00 01 01 00 02 03 02 01 03 01
0	QPSK	112	02 03 01 01 02 00 03 03 03 01 03 01 02 00 00 02
0	QPSK	128	02 01 01 03 02 01 00 03 03 01 01 02 01 01 03 01
0	QPSK	144	01 02 01 03 00 00 02 02 03 00 00 01 00 02 02 02

Figure 5-16: Bit Stream Display

The bit stream results display shows the demodulated data stream for each data allocation.

➥ Remote: `CALC1:FEED 'STAT:BSTR'`

5.4 Frequency Sweep Measurements

The following measurements results are obtained in frequency sweep mode:

- "Spectrum Emission Mask"
- "Spectrum ACLR"

The frequency sweep measurements use different signal data to IQ measurements and as such it is not possible to run an IQ measurement and then view the results in the frequency sweep measurements and vice-versa. Also because each of the frequency sweep measurement use different settings to obtain signal data it is not possible to run a frequency sweep measurement and view the results in another frequency sweep measurement.

Frequency sweep measurements are only available when RF input is selected.

The frequency sweep measurements settings can be found in the “SEM and ACLR Settings” section of the “General Settings” dialog box.

5.4.1 Spectrum Emission Mask

The Spectrum Emission Mask measurement results are selected by pressing the "Spectrum" softkey in the main measurement softkey menu followed by the "Spectrum Mask" softkey.

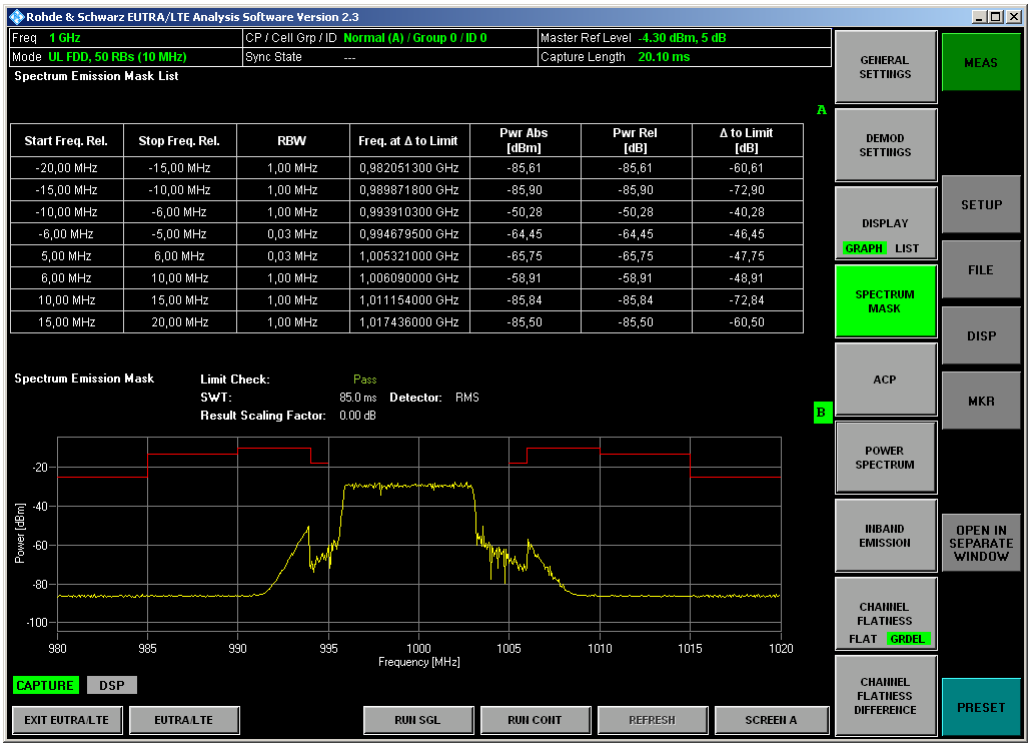


Figure 5-17: Spectrum Emission Mask Results

The Spectrum Mask results display shows power against frequency. The span of the results is related to the specified LTE Channel Bandwidth. A limit line representing the spectrum mask is displayed and an overall pass/fail status is displayed for the obtained results against this limit line.

➥ Remote: `CALC1:FEED 'SPEC:SEM'`

5.4.2 Spectrum ACLR

The Spectrum ACLR measurement results are selected by pressing the "Spectrum" softkey in the main measurement softkey menu followed by the "ACLR" softkey.

Figure 5-18: Spectrum ACLR Results

The Spectrum ACLR (Adjacent Channel Leakage Power Ratio) is similar to the Spectrum Mask measurement, and provides information about leakage into adjacent channels. The results show the relative or absolute power measured in the nearest channels either side of the measured channel. This measurement is the same as the Adjacent Channel Power measurement provided by the Spectrum Analyzer.

By default the ACLR Settings are derived from the LTE Channel Bandwidth setting of the Demodulation Settings Panel. The assumed adjacent channel carrier type may be changed in the General Settings menu.

➥ Remote: `CALC1:FEED 'SPEC:ACPR'`

➥ Remote: `CALC1:FEED 'SPEC:ACPA'`

5.4.3 Result Summary

To display the Result Summary results select "Display List".

Result Summary **Symbols Meas.** 140

Frame Results 1/1	Min	Mean	Mean Limit	Max	Max Limit	Unit
EVM PUSCH QPSK		0,10	17,50			%
EVM PUSCH 16QAM			12,50			%
EVM DMRS PUSCH QPSK		0,10	17,50			%
EVM DMRS PUSCH 16QAM			12,50			%
EVM PUCCH			17,50			%
EVM DMRS PUCCH			17,50			%
Results for Selection	**Subframes ALL**			**Slots ALL**		**Frame 1/1**
EVM All	0,00	0,00		0,00		%
EVM Phys. Channel	0,00	0,00		0,00		%
EVM Phys. Signal	0,00	0,00		0,00		%
Frequency Error	0,07	0,08		0,09		Hz
Sampling Error	0,00	0,00		0,00		ppm
IQ Offset	-141,97	-127,15		-121,23		dB
IQ Gain Imbalance						dB
IQ Quadrature Error						°
Power	-84,74	-84,53		-83,95		dBm
Crest Factor	5,60	6,19		6,19		dB

Figure 5-19: Result Summary Display for PUSCH/PUCCH analysis mode

Result Summary

3GPP EVM Results	Min	Mean	Mean Limit	Max	Max Limit	Unit
EVM PRACH		5,77	17,50			%
Results for Selection	**Preamble ALL**					
EVM All	5,77	5,77		5,77		%
Frequency Error	-0,40	-0,40		-0,40		Hz
Sampling Error						ppm
IQ Offset	-79,42	-79,42		-79,42		dB
IQ Gain Imbalance						dB
IQ Quadrature Error						°
Power	-20,39	-20,39		-20,39		dBm
Crest Factor	4,48	4,48		4,48		dB

Figure 5-20: Result Summary Display for PRACH analysis mode

The Result Summary table is displayed for I/Q measurements when the display mode is set to LIST. This table shows the overall measurement results and optionally provides limit checking for result values in accordance with the selected standard.

The limits can be loaded via an XML file. Please refer to section "Limits" for details on the import format. The results are evaluated in the table, and pass or fail verdicts are displayed in green and red, respectively.

In some cases it is not possible to measure the IQ Gain Imbalance and IQ Quadrature Error. Try to step through the subframes by using the subframe selection in general settings to find a subframe where the measurement is available. If subframe selection is set to ---All---, only a measurement result is available if there are valid results in all subframes.

➡ Remote: Use the "FETCh Subsystem" to get the results of the Result Summary via remote control.

6 Settings

6.1 General Settings

This section describes the "General Settings" dialog, where all settings related to the overall measurement (i.e. Signal Characteristics, Input, Level, Trigger, Result, SEM and ACLR settings) can be modified.

The "General Settings" softkey opens the "General Settings" dialog box with two tabs: General Settings and Advanced Settings. To see the content of the tabs as shown below click on one of the tabs.

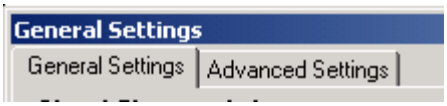


Figure 6-1: Tabs in General Settings dialog box

For a detailed description of the General and Advanced Settings see the following chapters.

6.1.1 General Settings

The "General Settings" dialog box opens displaying the "General Settings" tab.

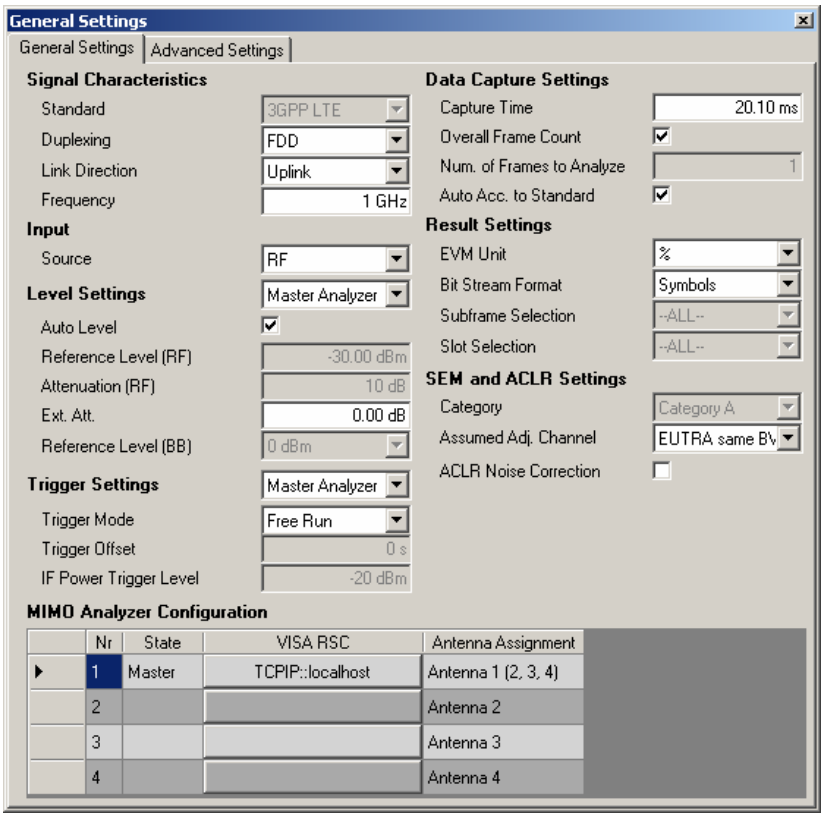


Figure 6-2: General Settings dialog box

6.1.1.1 Signal Characteristics

The Signal Characteristics settings are the general settings concerning the physical attributes of the signals to be measured.

Standard

Sets the standard version to use for this measurement.

At the moment, only the preliminary EUTRA/LTE standard version is supported. Therefore, this configuration is disabled.

➥ Remote: Not supported yet.

Duplexing

Sets the duplexing type to use for this measurement. Frequency Division Duplex (FDD) and Time Division Duplex (TDD) are supported.

➥ Remote: `CONF:DUPL FDD`

Link Direction

Sets the link direction to use for this measurement.

Choose Uplink. The downlink option is supported by the R&S K100/K102/K104 software.

➥ Remote: `CONF:LDIR UL`

Frequency

Specifies the Center Frequency of the signal to be measured.

The maximum frequency depends on the hardware configuration of your R&S FSQ/FSV.

➥ Remote: `SENS:FREQ:CENT 1GHZ`

6.1.1.2 Input

The Input settings group contains settings related to the input source of the signal to be measured.

Source

Selects whether the RF input, Baseband (BB) input or Digital I/Q is used.

The "Source" drop-down combo box is used to specify the I/Q data source. Data can either be captured from the R&S FSQ/FSV instrument (select RF, Baseband (BB) or Digital IQ) or read from file (select FILE). If FILE is selected, each time the user presses the "*RUN SGL*" or "*Run Cont*" hotkey, a dialog is shown where the user can specify the full name and path of the I/Q data file to be used. Pressing "ENTER" loads the specified I/Q data file and displays the results.

If the specified file cannot be found or is not a valid I/Q data file, an error message will be displayed indicating that the I/Q data could not be imported.

➥ Remote: `SENS:INP RF`

6.1.1.3 Level Settings

The Level settings group contains settings related to the reference level and the RF attenuation.

Chooses to which instrument the Level/Attenuation settings are applied. This concerns the settings

- Auto Level
- Reference Level (RF)
- Attenuation (RF)
- Reference Level (BB)

➥ Remote: Not available.

Auto level

Selects whether the reference level for measurements is measured automatically (ON) or entered manually by the user (OFF).

When Auto Level is set to ON, the R&S FSQ/FSV-K101/-K105 EUTRA/LTE analysis software will measure the reference level automatically at the start of each measurement sweep. This ensures that the reference level is always set at the optimal level for obtaining accurate results but will lead to slightly increased measurement times.

The Auto Level setting is only available for RF input.

➥ Remote: `SENS:POW:AUTO2 ON`

Reference level (RF)

Specifies the RF Reference Level to use when running measurements, or displays the reference level when Auto Level is enabled.

The Reference Level parameter will only take effect if RF input is selected and Auto Level is disabled.

➥ Remote: `CONF:POW:EXP:RF3 -30`

Attenuation (RF)

RF Attenuation specifies the mechanical attenuation to be applied to the input RF signal.

The available values depend on the type of measurement hardware. If the current value is not supported by the hardware, the value will be corrected and a warning is shown.

The RF Attenuation parameter will only take effect if RF input is selected and Auto Level is disabled.

➥ Remote: `INP:ATT2 10`

Ext Att

Ext Att specifies the external attenuation or gain applied to the RF signal. A positive value indicates attenuation, a negative value indicates gain.
All displayed power level values will be shifted by this value.

➥ Remote: `DISP:WIND:TRAC:Y:RLEV:OFFS 10`

Reference level (BB)

Specifies the Baseband Reference Level to use when running measurements.

Available values:
-20 dBm to 25 dBm in steps of 5 dBm.

The Reference Level parameter will only take effect if Baseband input is selected.

➥ Remote: `CONF:POW:EXP:IQ2 -10`

6.1.1.4 Trigger Settings

The Trigger settings group contains all the settings related to the triggering of a measurement sweep.

Trigger Mode

Trigger Mode is the source of the trigger for the measurement sweep.

The possible values for the Trigger Mode are:

Free Run: The measurement sweep starts immediately.

External: The measurement sweep starts when the external trigger signal meets or exceeds the specified external trigger level at the input connector EXT TRIGGER/GATE on the rear panel.

IF Power: The measurement sweep starts when the signal power meets or exceeds the specified power trigger level.

➥ Remote: `TRIG:MODE IMM`

Trigger Offset

Trigger Offset specifies the time offset between the trigger signal and the start of the sweep. A negative value indicates a pre-trigger.

The Trigger Offset parameter is not editable when Trigger Mode is set to Free Run because this indicates that the measurement sweep should trigger immediately and as such a trigger delay or pre-trigger would not be appropriate.

➥ Remote: `TRIG:HOLD 1MS`

IF Power Trigger Level

Trigger Level (RF) Specifies the trigger level when a power trigger is selected.

The IF Power Trigger Level is only available for the trigger mode IF Power.

➥ Remote: `TRIGger:LEV1:POW -20`

6.1.1.5 Data Capture Settings

The Data Capture settings specify how much data is to be captured and measured..

Capture Time

Capture Time specifies the time (and therefore the amount of data) to be captured in a single measurement sweep.

➥ Remote: `SENS:SWE:TIME 30MS`

Overall Frame Count

Overall Frame Count specifies whether a specified number of frames are to be captured and analyzed.

When Overall Frame Count is set to OFF then data analysis shall be performed on a single measurement sweep. When Overall Frame Count is set to ON then data analysis may be performed over a number of consecutive sweeps until the required number of frames has been captured and analyzed.

➥ Remote: `SENS:LTE:FRAM:COUN:STAT ON`

Num. of Frames to Analyze

Number of Frames to Analyze specifies the number of frames to be measured.

If the number of frames of the specified type are not contained in a single measurement sweep then the measurement application will continue to perform measurement sweeps until the requested number of frames have been captured.

The Number of Frames to Analyze parameter is not editable when either Overall Frame Count is set to OFF or Auto Acc. to Standard is set to ON.

➥ Remote: `SENS:LTE:FRAM:COUN 1`

Auto Acc. to Standard

If Auto Acc. to Standard is set to ON, the Number of Frames to Analyze parameter will be set in accordance to the EUTRA/LTE standard.

The Auto Acc. to Standard parameter is not editable when Overall Frame Count is set to OFF.

➥ Remote: `SENS:LTE:FRAM:COUN:AUTO ON`

6.1.1.6 Result Settings

The Result Settings set parameters for post-processing of the acquired data.

EVM Unit

The EVM Unit setting allows you to display EVM results in the graphs and the numerical results in [dB] or [%].

➥ Remote: `UNIT:EVM DB`

Bit Stream Format

The Bit Stream Format setting allows you to display the bit stream as symbols (the bits belonging to one symbol are shown as hexadecimal numbers, always with two digits) or raw bits.

➥ Remote: `UNIT:BSTR SYM`

Example:

Bit stream output if Bit Stream Format is set to Symbols:

Bit Stream

Sub-frame	Modulation	Symbol Index	Bit Stream
0	QPSK	0	01 01 02 03 00 00 01 02 02 00 00 02 02 03 02 00
0	QPSK	16	00 00 01 00 00 01 03 02 03 00 01 02 02 01 02 01
0	QPSK	32	03 00 03 01 01 01 01 02 02 02 01 03 02 03 01 02

Bit stream output if Bit Stream Format is set to Bits:

Bit Stream

Sub-frame	Modulation	Bit Index	Bit Stream
0	QPSK	0	01011011000001101000001010111000000001000001111 0
0	QPSK	48	11000110100110011100110101010110101001111011011 0
0	QPSK	96	11000101010010111111010011000010110000101010101 1

Subframe Selection

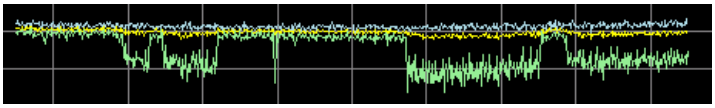
With the Subframe Selection, subframe-specific measurement results can be selected. This setting applies to the following measurements: Result Summary, EVM vs Carrier, EVM vs Symbol, Inband Emission, Channel Flatness, Channel Flatness SRS, Channel Group Delay, Channel Flatness Difference, Constellation diagram, DFT Precoded Constellation diagram, Allocation Summary list and Bit Stream. If ---All--- is selected, either the results from all subframes are displayed at once or a statistic is calculated over all analyzed subframes.

The Subframe Selection is not available in PRACH analysis mode.

➥ Remote: `SENS:SUBF:SEL ALL`

Example:

Min/mean/max statistic is shown if ---All--- is selected:



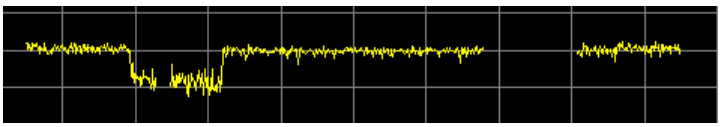
where

PK are the peak values,

AV is the average and

MI are the minimum values.

If a specific subframe is selected, only the current results of the selected subframe are shown:



Slot Selection

With the Slot Selection, slot-specific measurement results can be selected. This setting applies to the following measurements: Result Summary, EVM vs Carrier, EVM vs Symbol, Inband Emission, Channel Flatness, Channel Flatness SRS, Channel Group Delay, Channel Flatness Difference, Constellation diagram and DFT Precoded Constellation diagram.

The Slot Selection is not available in PRACH analysis mode.

➥ Remote: `SENS:SLOT:SEL 1`

Preamble Selection

With the Preamble Selection, preamble-specific measurement results can be selected.

The Preamble Selection is only available in PRACH analysis mode.

Remote: `SENS:PRE:SEL 1`

6.1.1.7 SEM and ACLR Settings

The SEM and ACLR Settings are parameters for configuring the Spectrum Emission Mask measurement and the Adjacent Channel Leakage Power Ratio measurement.

Assumed Adjacent Channel Carrier

Selects the assumed adjacent channel carrier for the ACLR measurement. The supported types are EUTRA of same bandwidth, 1.28 Mcps UTRA, 3.84 Mcps UTRA and 7.68 Mcps UTRA.

Note that not all combinations of LTE Channel Bandwidth settings and Assumed Adj. Channel Carrier settings are defined in the 3GPP standard.

➥ Remote: `SENS:POW:ACH:AACH UTRA384`

ACLR Noise Correction

Noise Correction - when selected enables noise reduction to be performed on the signal.

➥ Remote: `SENS:POW:NCOR ON`

6.1.1.8 MIMO Analyzer Configuration

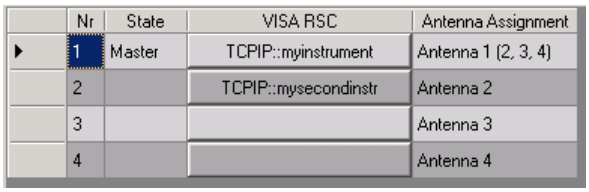


Figure 6-3: MIMO Analyzer Configuration

► Clicking on one of the buttons in the VISA RSC column opens the "Instrument Connection Configuration" dialog box.

➥ Remote: `CONF:ADDR2 'TCPIP::192.168.0.1::INST0'`

Configure analyzer connection

In order to be able to communicate with the instruments, the R&S FSQ / FSV must be connected with the PC using either an IEEE bus or LAN connection. For information how to obtain the GPIB or LAN address see section "How to Obtain the GPIB or LAN Address in the R&S FSQ Instrument" or "How to Obtain the GPIB or LAN Address in the R&S FSV Instrument".

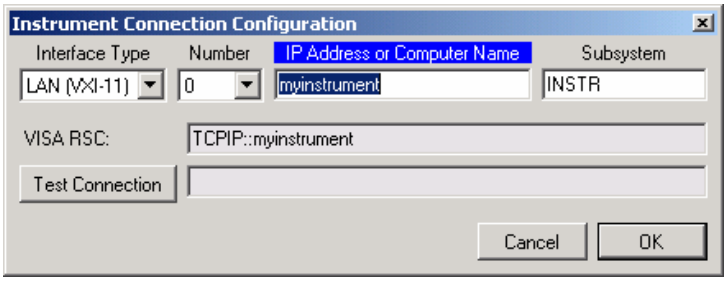


Figure 6-4: Instrument Connection Configuration

If more than one interface is available on the PC (e.g. because two LAN cards are installed), please select the appropriate interface Number. The Subsystem does not need to be changed.

Depending on the Interface Type, different types of addresses must be entered:

Interface	Description	Address equivalent to …
GPIB Instrument	IEEE bus system using the IEEE 488 protocol	Instrument primary GPIB address (0…31). Default value is 20 for the R&S FSQ/FSV.
LAN VXI-11 protocol	LAN bus system using the VXI-11 protocol (supported with R&S FSQ/FSV firmware version 3.65 or later)	Host address as TC/IP address or computer name. Contact your local IT support if you are not sure what to enter here.
LAN RSIB protocol	LAN bus system using a Rohde & Schwarz-specific protocol (supported with all R&S FSQ/FSV firmware versions)	Host address as TC/IP address or computer name. Contact your local IT support if you are not sure what to enter here.

6.1.2 Advanced Settings

In the "General Settings" dialog box click on the "Advanced Settings" tab to display the advanced settings.

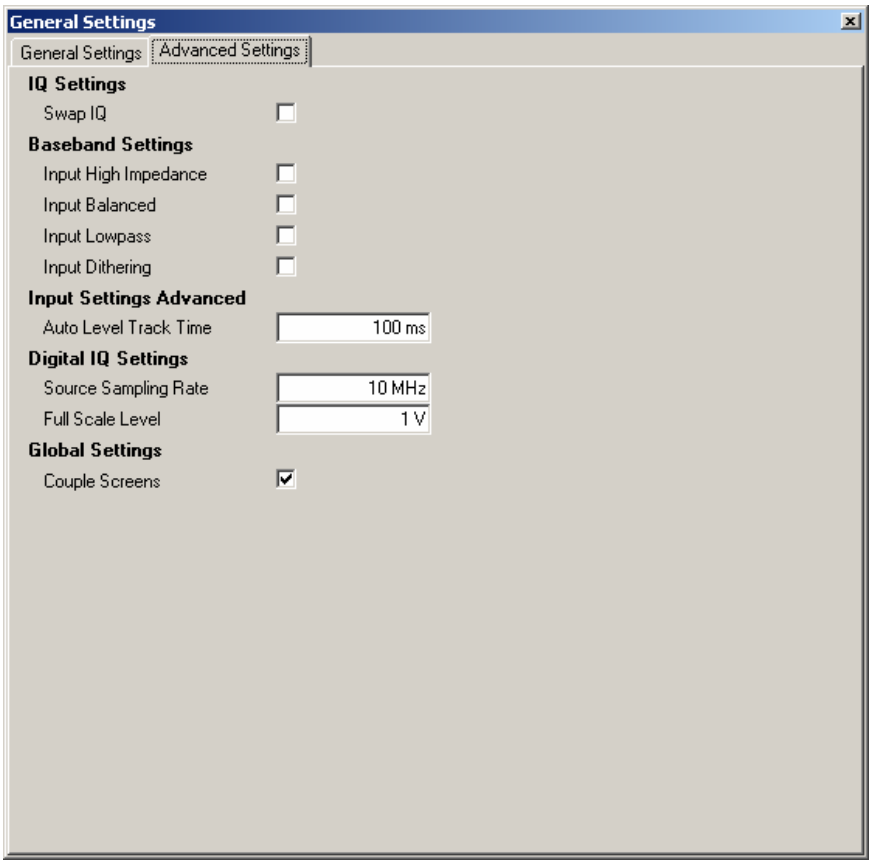


Figure 6-5: Advanced Settings dialog box

6.1.2.1 IQ Settings

The IQ Settings are the general settings concerning the signal to be measured.

Swap IQ

Swap IQ applies to both hardware I/Q data and file I/Q data.

➥ Remote: `SENS:SWAP ON`

6.1.2.2 Baseband Settings

The Baseband Settings group contains settings related to the baseband input source.

Input High Impedance

Input High Impedance allows the selection of the impedance of the Baseband inputs. If this parameter is not enabled, the impedance is 50 Ω; otherwise the impedance is 1 kΩ or 1 MΩ (depending on the instrument configuration).

The Input High Impedance parameter is editable only if Baseband input is selected.

➥ Remote: `INP:IQ:IMP LOW`

Input Balanced

Input Balanced switches the Baseband inputs between symmetrical (balanced) and asymmetrical (unbalanced).

The Input Balanced parameter is editable only if Baseband input is selected.

➥ Remote: `INP:IQ:BAL ON`

Input Lowpass

When enabled, the Lowpass parameter specifies that a filter is applied from 36 MHz for the I/Q inputs.

The Lowpass parameter is editable only if Baseband input is selected.

➥ Remote: `SENS:IQ:LPAS ON`

Input Dithering

When enabled, the Dither parameter specifies that a 2 MHz-wide noise signal at 42.67 MHz is injected into the signal path of the Baseband input. It appears in the spectrum at 38.92 MHz.

The Dither parameter is editable only if Baseband input is selected.

➥ Remote: `SENS:IQ:DITH ON`

6.1.2.3 Input Settings Advanced

The Input Settings Advanced group contains settings related to the RF input source.

Auto Level Track Time

Auto Level Track Time specifies the sweep time used for the auto level measurements.

This parameter is editable only if RF input is selected and Auto Level is enabled.

➥ Remote: `SENS:POW:AUTO:TIME 0.1`

6.1.2.4 Digital IQ Settings

The Digital IQ Settings group contains settings related to the Digital IQ input source.

Source Sampling Rate

Specifies the Source Sampling Rate of the digital IQ input signal.

The Source Sampling Rate parameter is editable only if Digital IQ input is selected.

➥ Remote: `INP:DIQ:SRAT 10MHz`

Full Scale Level

Specifies the Full Scale Level of the digital IQ input signal.

The Full Scale Level parameter is editable only if Digital IQ input is selected.

➥ Remote: `INP:DIQ:RANG 1`

6.1.2.5 Global Settings

The Global Settings group contains settings related to the settings which apply in a global scope.

Couple Screens

If Couple Screens is enabled, the markers on the top and bottom screen which have the same unit (e.g., frequency or symbol index) are coupled. For the constellation diagram, the constellation selection is coupled with the marker.

➥ Remote: Not supported yet.

6.2 Demodulation Settings

This section describes the demodulation settings of the software for running a correct measurement by means of logical channel mapping and demodulation configuration.

Figure 6-6: Tabs in the Demodulation Settings Dialog

The "Demod Settings" softkey opens the "Demodulation Settings" dialog box with three tabs: "Uplink Demodulation Settings", "Uplink Signal Characteristics" and "Uplink Advanced Signal Characteristics". To see the content of the tabs as shown below click on one of the tabs.

For a detailed description of the Demodulation and Signal Characteristics Settings see the following chapters.

➥ Remote: Not available.

6.2.1 Uplink Demodulation Settings

The "Demodulation Settings" dialog box opens displaying the "Uplink Signal Characteristics" tab. Click on the "Uplink Demodulation Settings" tab to display the uplink demodulation settings.

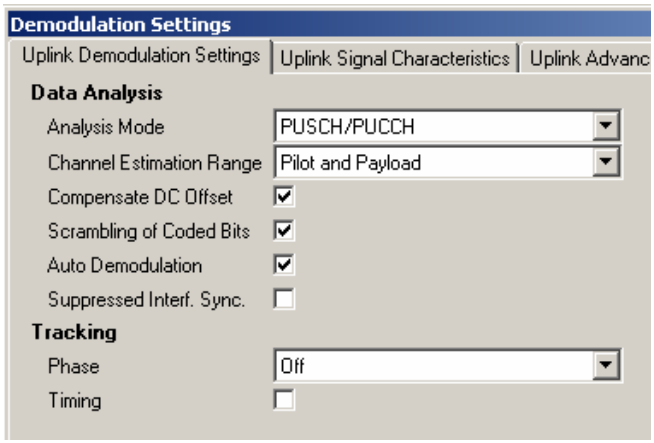
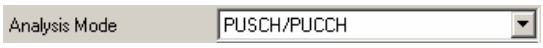


Figure 6-7: Uplink Demodulation Settings Tab

The "Uplink Demodulation Settings" tab sets the signal processing configuration with respect to how the signal is to be measured. It does not contain any description of the signal structure.

6.2.1.1 Data Analysis Settings

Analysis Mode



Specifies the analysis mode.

PUSCH/PUCCH	In this analysis mode the PUSCH/PUCCH channels are analyzed. This is the standard operation mode of the user equipment.
PRACH	In this analysis mode only the PRACH is analyzed.

Note that in PRACH mode only the Result Summary table is available. No graphical results are supported yet.

➞ Remote: `SENS:UL:DEM:MODE PUSC`

Channel Estimation Range

Specifies how channel estimation is performed for the signal.

Pilot only	Only the pilot carriers are used.
Pilot and Payload	Both pilot and payload carriers are used.

➞ Remote: `SENS:UL:DEM:CEST PIL`

Compensate DC Offset

Specifies whether or not the measurement results should be compensated for DC Offset.

➞ Remote: `SENS:UL:DEM:CDCO ON`

Scrambling of Coded Bits

Specifies whether the scrambling for coded bits shall be used or not.

➞ Remote: `SENS:UL:DEM:CBSC ON`

Auto Demodulation

Specifies whether or not the auto demodulation feature shall be used. If auto demodulation is enabled, the resource allocation is automatically detected by analyzing the received signal.

➥ Remote: `SENS:UL:DEM:AUTO ON`

Suppressed Interference Synchronization

Specifies whether or not the suppressed interference synchronization feature shall be used. If this synchronization mode is enabled, it is possible to synchronize on signals containing more than one user equipment (UE). Note that Auto Demodulation is not supported in this synchronization mode.

➥ Remote: `SENS:UL:DEM:SISY ON`

6.2.1.2 Tracking Settings

Contains settings concerning phase or timing tracking.

Phase

Specifies whether or not the measurement results should be compensated for common phase error.

Off	Common phase tracking is not applied.
Pilot only	Only the pilot carriers are used.
Pilot and Payload	Both pilot and payload carriers are used.

➥ Remote: `SENS:UL:TRAC:PHAS OFF`

Timing

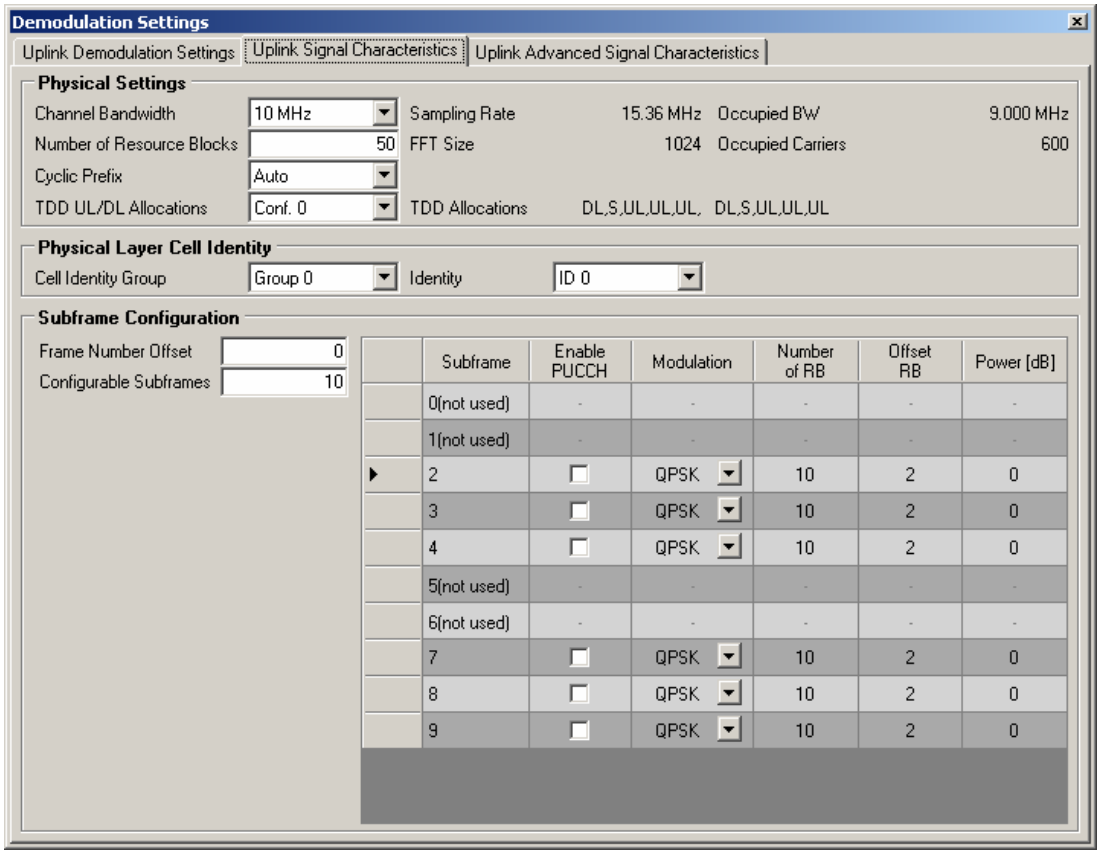
Specifies whether or not the measurement results should be compensated for timing error.

➥ Remote: `SENS:UL:TRAC:TIME ON`

6.2.2 Uplink Signal Characteristics

The "Uplink Signal Characteristics" tab describes the structure of the signal to be analyzed.

Figure 6-8: Uplink Signal Characteristics dialog box



The physical settings are the general settings concerning the physical attributes of the signal to be measured.

6.2.2.1 Physical Settings

Channel Bandwidth

Channel Bandwidth or alternatively the Number of Resource Blocks specify the bandwidth of the channel to be measured. If a channel bandwidth is selected, the number of resource blocks is automatically set according to the definitions in the standard.

➥ Remote: `CONF:UL:BW BW10_00`

➥ Remote: `CONF:UL:NORB 50`

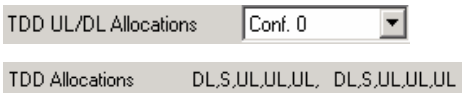
The Sampling Rate, FFT Size, Occupied BW and Occupied Carriers are read-only parameters which depend on the Channel Bandwidth / Number of Resource Blocks setting.

Cyclic prefix

Cyclic Prefix specifies the cyclic prefix type. The types Normal and Extended are supported. If Auto is selected, the cyclic prefix type is detected automatically.

➥ Remote: `CONF:UL:CYCP AUTO`

TDD UL/DL Allocations



TDD UL/DL Allocations specifies the uplink-downlink allocation configuration.

The details of the current selected configuration is shown as a comma separated list of a complete LTE frame containing the following elements:

- DL: downlink subframe
- UL: uplink subframe
- S: special subframe with the three fields DwPTS. GPUqPTS

The TDD UL/DL Allocations setting is available only if Duplexing is set to TDD.

➥ Remote: `CONF:UL:TDD:UDC 2`

6.2.2.2 Physical Layer Cell Identity

There are 504 unique physical-layer cell identities. The physical-layer cell identities are grouped into 168 unique physical-layer cell-identity groups, each group containing three unique identities. A physical-layer cell identity $N_{ID}^{cell} = 3N_{ID}^{(1)} + N_{ID}^{(2)}$ is uniquely defined by a number $N_{ID}^{(1)}$ in the range of 0 to 167, representing the physical-layer cell-identity group, and a number $N_{ID}^{(2)}$ in the range of 0 to 2, representing the physical-layer identity within the physical-layer cell-identity group.

Cell Identity Group

Cell Identity Group specifies the physical-layer cell-identity group.

➥ Remote: `CONF:UL:PLC:CIDG 0`

Identity

Identity specifies the physical-layer identity.

➞ Remote: `CONF:UL:PLC:PLID 0`

6.2.2.3 Subframe Configuration

The Resource Allocation settings allow you to configure the OFDMA resource allocations. If Auto Demodulation is enabled, these settings are automatically detected from the received signal.

Frame Number Offset

Frame Number Offset specifies the frame number offset which is used for demodulating the captured frame..

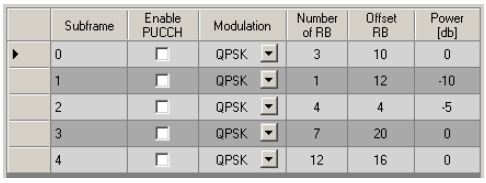
➞ Remote: `CONF:UL:SFNO 0`

Configurable Subframes

Configurable Subframes specifies the number of subframes which can be configured in the subframe configuration table.

➞ Remote: `CONF:UL:CSUB 10`

Subframe Configuration Table



	Subframe	Enable PUCCH	Modulation	Number of RB	Offset RB	Power [db]
▶	0	☐	QPSK	3	10	0
	1	☐	QPSK	1	12	-10
	2	☐	QPSK	4	4	-5
	3	☐	QPSK	7	20	0
	4	☐	QPSK	12	16	0

The Subframe Configuration Table specifies the properties of each subframe used. Each subframe is assigned an ID which counts from 0 to the number of subframes minus one. For each subframe, the following settings are provided:

- Enable PUCCH: Mark the selected subframe as physical uplink control channel.

➞ Remote: `CONF:UL:SUBF3:ALL:CONT PUCC`

- Modulation: Modulation type (not available if PUCCH is enabled)

➞ Remote: `CONF:UL:SUBF3:ALL:MOD QAM64`

- Number of RB: Sets the size of the selected allocation in resource blocks (not available if PUCCH is enabled)

➞ Remote: `CONF:UL:SUBF2:ALL:RBC 25`

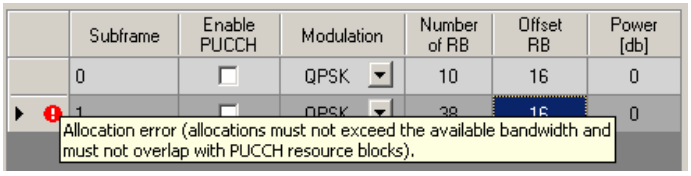
- Offset RB: Sets the start resource block of the selected allocation (not available if PUCCH is enabled)

➞ Remote: `CONF:UL:SUBF5:ALL:RBO 10`

- Power: Sets the power of the selected subframe in dB

➞ Remote: `CONF:UL:SUBF5:ALL:POW 0`

If Auto Demodulation in the Uplink Demodulation Settings dialog is not enabled, the Subframe Configuration Table has to be filled out manually according to the signal sent by the signal generator.



For the table, conflict detection is integrated. In case of an error, a red circle containing an exclamation mark is shown in the row of the subframe causing the conflict. In the tool tip (the tool tip can be shown by moving the mouse pointer over the red circle), additional information about the conflict is provided.

Conflicts must be solved before a measurement can be started.

6.2.3 Uplink Advanced Signal Characteristics

The Uplink Advanced Signal Characteristics tab describes the structure of the signal to be analyzed.

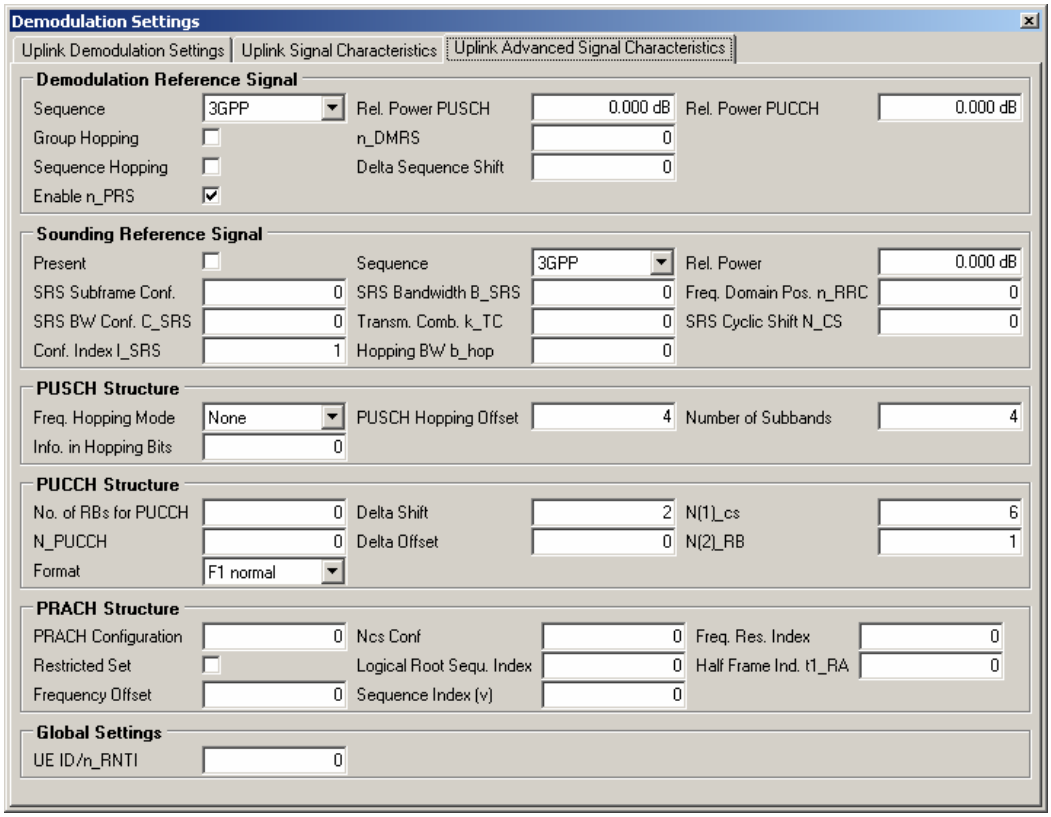


Figure 6-9: Uplink Advanced Signal Characteristics

6.2.3.1 Demodulation Reference Signal

The Demodulation Reference Signal settings are the settings concerning the configuration of the reference signal which aids the demodulation of the PUSCH.

Sequence

Sequence specifies which modulation is used for the reference signal.

Available choices are 3GPP and I/Q File.

If 3GPP is used, the parameters in the 3GPP configuration section have to be set. They have to be the same as defined in the signal generator.

Use I/Q-File if you want to apply a customized reference signal. The definition of this signal has to be loaded to the default directory (see "Import and Export of Data").

➥ Remote: `CONF:UL:DRS:SEQ TGPP`

Group Hopping

Indicates whether group hopping for the uplink reference signals demodulation reference signal (DMRS) and sounding reference signal (SRS) is activated or not.

17 different hopping patterns and 30 different sequence shift patterns are used for group hopping. PUSCH and PUCCH use the same group hopping pattern that is calculated if the Group Hopping is enabled. The group hopping pattern is generated by a pseudo-random sequence generator.

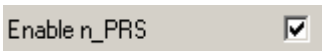
➥ Remote: `CONF:UL:DRS:GRPH ON`

Sequence Hopping

Indicates whether sequence hopping is activated or not.

➥ Remote: `CONF:UL:DRS:SEQH ON`

Enable n_PRS



Enables the use of the pseudo-random sequence n_PRS in the calculation of the demodulation reference signal (DMRS) index as defined in 3GPP TS 36.211, chapter 5.5.2.1.1.

If n_PRS is disabled, it is possible to set the cyclic shift to 0 for all subframes.

This parameter has to be enabled in order to generate a 3GPP compliant uplink signal.

➥ Remote: `CONF:UL:REFS:ENPR ON`

Relative power PUSCH

Sets the power offset of the Demodulation Reference Signal (DRS) relative to the power level of the PUSCH allocation of the corresponding subframe. The selected DRS power offset (PDRS_Offse) applies for all subframes. Depending on the allocation of the subframe, the effective power level of the DRS is calculated as following:

$$P_{DRS}=P_{UE}+P_{PUSCH}+P_{DRS\_Offset}$$

The PUSCH Power level (P_{PUSCH}) can vary per subframe.

➥ Remote: `CONF:UL:DRS:POW -1.2`

n_DMRS

The n_DMRS parameter can be found in 3GPP TS36.211 V8.5.0, 5.5.2.1.1 Reference signal sequence. Currently, n_DMRS is defined as n_DMRS = $n_{DMRS}^{(1)} + n_{DMRS}^{(2)}$.

➥ Remote: Not supported yet.

Delta Sequence Shift

Delta Sequence Shift specifies the parameter Δ_{SS}.

This parameter can be found in 3GPP TS 36.211 V8.5.0, 5.5.1.3 Group hopping. A sequence shift function f_ss is defined for the PUCCH. The corresponding function for the PUSCH is derived by applying this Delta Sequence Shift.

➥ Remote: `CONF:UL:DRS:DSSH 3`

Relative Power PUCCH

Sets the power offset of the Demodulation Reference Signal (DRS) relative to the power level of the PUCCH allocation of the corresponding subframe. The selected DRS power offset (P_{DRS_Offset}) applies for all subframes. Depending on the allocation of the subframe, the effective power level of the DRS is calculated as following:

$P_{DRS}=P_{UE}+P_{PUCCH}+P_{DRS\_Offset}$ (for PUCCH allocation)

The PUCCH Power level (P_{PUCCH}) can vary per subframe.

➥ Remote: `CONF:UL:DRS:PUCCH:POW -1.2`

6.2.3.2 Sounding Reference Signal

The Sounding Reference Signal settings are the general settings concerning the physical attributes of the sounding reference signal.

Present

Indicates whether the sounding reference signal is present or not.

➥ Remote: `CONF:UL:SRS:STAT ON`

Sequence

Sequence specifies which modulation is used for the sounding signal.

Available choices are 3GPP and I/Q File.

Use I/Q-File if you want to apply a customized reference signal. The definition of this signal has to be loaded to the default directory (see "Import and Export of Data").

➥ Remote: Not available

Rel. Power

Relative Power of the sounding reference signal.

➥ Remote: `CONF:UL:SRS:POW -1.2`

SRS Subframe Conf.

Sets the cell specific parameter SRS subframe configuration. The UEs will send shortened PUSCH/PUCCH in these cell-specific subframes, regardless whether the UEs are configured to send a SRS in the according subframe or not..

➥ Remote: `CONF:UL:SRS:SUC 0`

SRS BW Conf. C_SRS

Sets the cell specific parameter SRS Bandwidth Configuration (C_{SRS}).

The SRS Bandwidth Configuration C_{SRS}, the SRS Bandwidth B_{SRS} and the UL Channel Bandwidth determine the length of the sounding reference signal sequence, calculated according to 3GPP TS 36.211.

➥ Remote: `CONF:UL:SRS:CSRS 0`

Conf. Index I_SRS

Sets the UE specific parameter SRS configuration index I_{SRS}. Depending on the selected Duplexing Mode, this parameter determines the parameters SRS Periodicity T_{SRS} and SRS Subframe Offset T_{offset} as defined in the 3GPP TS 36.213, Table 8.2-1 (FDD) and 8.2-2 (TDD) respectively.

Remote: `CONF:UL:SRS:ISRS 1`

SRS Bandwidth B_SRS

Sets the UE specific parameter SRS Bandwidth B_{SRS}, as defined in the 3GPP TS 36.211, chapter 5.5.3.2.

The SRS can spans the entire frequency bandwidth or can employ frequency hopping where several narrowband SRSs cover the same total bandwidth.

There are up to four SRS bandwidths defined in the standard. The most narrow SRS bandwidth (B_SRS = 3) spans four resource blocks and is available for all channel bandwidths; the other three values of the parameter B_SRS define more wideband SRS bandwidths, available depending on the channel bandwidth.

The SRS transmission bandwidth is determined additionally by the SRS Bandwidth Configuration C_{SRS}.

Remote: `CONF:UL:SRS:BSRS 0`

Transm. Comb. k_TC

Sets the UE specific parameter transmission comb k_{TC}, as defined in the 3GPP TS 36.211, chapter 5.5.3.2.

Remote: `CONF:UL:SRS:TRC 0`

Hopping BW b_hop

Sets the UE specific parameter frequency hopping bandwidth b_{hop}, as defined in the 3GPP TS 36.211, chapter 5.5.3.2.

SRS frequency hopping is enabled, if $b_{HOP}<B_{SRS}$.

Remote: `CONF:UL:SRS:BHOP 0`

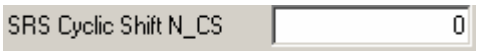
Freq. Domain Pos. n_RRC

Sets the UE specific parameter Freq. Domain Position n_{RRC} , as defined in the 3GPP TS 36.211, chapter 5.5.3.2.

This parameter determines the starting physical resource block of the SRS transmission.

Remote: `CONF:UL:SRS:NRRC 0`

SRS Cyclic Shift N_CS



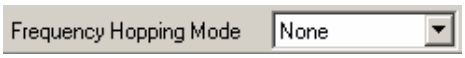
Sets the cyclic shift n_CS used for the generation of the sounding reference signal CAZAC sequence.

Since the different shifts of the same Zadoff-Chu sequence are orthogonal to each other, applying different SRS cyclic shifts can be used to schedule different users to transmit simultaneously their sounding reference signal.

Remote: `CONF:UL:SRS:CYCS 0`

6.2.3.3 PUSCH Structure

Frequency Hopping Mode



Frequency Hopping Mode specifies the hopping mode which is applied to the PUSCH. Available choices are NONE, Inter Subframe and Intra Subframe.

➥ Remote: `CONF:UL:PUSC:FHM INTR`

Info. in Hopping Bits

Sets the information in hopping bits according to the PDCCH DCI format 0 hopping bit definition. This information determines whether type 1 or type 2 hopping is used in the subframe, and - in case of type 1 - additionally determines the exact hopping function to use.

Frequency hopping is applied according to 3GPP TS36.213.

Remote: `CONF:UL:PUSC:FHOP:IIHB 0`

PUSCH Hopping Offset

Sets the PUSCH Hopping Offset N_{RB}^{HO}.

The PUSCH Hopping Offset determines the first physical resource block and the maximum number of physical resource blocks available for PUSCH transmission if PUSCH frequency hopping is used.

Remote: `CONF:UL:PUSC:FHOF 4`

Number of Subbands

Number of Subbands specifies the number of subbands for PUSCH.

This parameter can be found in 3GPP TS36.211 V8.5.0, 5.5.3.2 Mapping to physical resources.

➥ Remote: `CONF:UL:PUSC:NOSM 2`

6.2.3.4 PUCCH Structure

Number of RBs for PUCCH

Number of RBs for PUCCH configures the number of resource blocks for PUCCH.

The resource blocks for PUCCH are always allocated at the edges of the LTE spectrum. If an even number of PUCCH resource blocks are specified, half of the available number of PUCCH resource blocks are allocated on the lower and upper edge of the LTE spectrum (outermost resource blocks). In case an odd number of PUCCH resource blocks are specified, the number of resource blocks on the lower edge is one resource block larger than the number of resource blocks on the upper edge of the LTE spectrum.

➥ Remote: `CONF:UL:PUCC:NORB 10`

N_PUCCH

Sets the resource index for PUCCH format 1/1a/1b respectively 2/2a/2b.

➥ Remote: `CONF:UL:PUCC:NPAR 2`

Format

Configures the physical uplink control channel format. Formats 2a and 2b are only supported for normal cyclic prefix length.

This parameter can be found in 3GPP TS36.211 V8.5.0, Table 5.4-1 Supported PUCCH formats.

➥ Remote: `CONF:UL:PUCC:FORM F1N`

Delta Shift

Sets the delta shift parameter, i.e. the cyclic shift difference between two adjacent PUCCH resource indices with the same orthogonal cover sequence (OC).

The delta shift determinates the number of available sequences in a resource block that can be used for PUCCH formats 1/1a/1b.

This parameter can be found in 3GPP TS36.211 V8.5.0, 5.4 Physical uplink control channel.

➥ Remote: `CONF:UL:PUCC:DESH 2`

Delta Offset

Sets the PUCCH delta offset parameter, i.e. the cyclic shift offset. The value range depends on the selected Cyclic Prefix.

This parameter can be found in 3GPP TS36.211 V8.5.0, 5.4 Physical uplink control channel.

➥ Remote: `CONF:UL:PUCC:DEOF 2`

N(1)_cs

Sets the number of cyclic shifts used for PUCCH format 1/1a/1b in a resource block used for a combination of the formats 1/1a/1b and 2/2a/2b.

Only one resource block per slot can support a combination of the PUCCH formats 1/1a/1b and 2/2a/2b.

The number of cyclic shifts available for PUCCH format 2/2a/2b N(2)_cs in a block with combination of PUCCH formats is calculated as follow:

N(2)_cs = 12 - N(1)_cs -2

This parameter can be found in 3GPP TS36.211 V8.5.0, 5.4 Physical uplink control channel.

➥ Remote: `CONF:UL:PUCC:N1CS 2`

N(2)_RB

Sets bandwidth in terms of resource blocks that are reserved for PUCCH formats 2/2a/2b transmission in each subframe.

Since there can be only one resource block per slot that supports a combination of the PUCCH formats 1/1a/1b and 2/2a/2b, the number of resource block(s) per slot available for PUCCH format 1/1a/1b is determined by N(2)_RB.

This parameter can be found in 3GPP TS36.211 V8.5.0, 5.4 Physical uplink control channel.

➥ Remote: `CONF:UL:PUCC:N2RB 2`

6.2.3.5 PRACH Structure

PRACH Configuration

Sets the PRACH configuration index as defined in the 3GPP TS 36.211, i.e. defines the subframes in which random access preamble transmission is allowed.

The preamble format is automatically derived form the PRACH Configuration.

➥ Remote: `CONF:UL:PRAC:CONF 0`

Restricted Set

Selects whether a restricted preamble set (high speed mode) or the unrestricted preamble set (normal mode) will be used.

➥ Remote: `CONF:UL:PRAC:RSET ON`

Frequency Offset

For preamble formats 0-3, sets the PRACH Frequency Offset as defined in the 3GPP TS 36.211, i.e. determines the first physical resource block available for PRACH expressed as a physical resource block number.

➥ Remote: `CONF:UL:PRAC:FOFF 1`

Ncs Conf

Selects the Ncs configuration, i.e. determines the Ncs value set according to TS 36.211, table 5.7.2.-2 and 5.7.2-3.

➥ Remote: `CONF:UL:PRAC:NCSC 0`

Logical Root Sequ. Index

Selects the logical root sequence index.

➥ Remote: `CONF:UL:PRAC:RSEQ 0`

Sequence Index (v)

Selects the sequence index v, i.e. selects which one of the 64 preambles available in a cell will be used.

➥ Remote: `CONF:UL:PRAC:SIND 0`

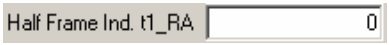
Freq. Res. Index

Sets the frequency resource index f_{RA}.

The Freq. Res. Index setting is available only if Duplexing is set to TDD.

➥ Remote: `CONF:UL:PRAC:FRIN 0`

Half Frame Ind. t1_RA



Sets the half frame indicator $t1_{RA}$.

The Half Frame Ind. t1_RA setting is available only if Duplexing is set to TDD.

➥ Remote: `CONF:UL:PRAC:HFIN 0`

6.2.3.6 Global Settings

UE ID/n_RNTI

➥ Sets the radio network temporary identifier (RNTI) of the UE.Remote:
`CONF:UL:UEID 2`

6.3 Display Settings

The layout of the display can be controlled using the display menu.

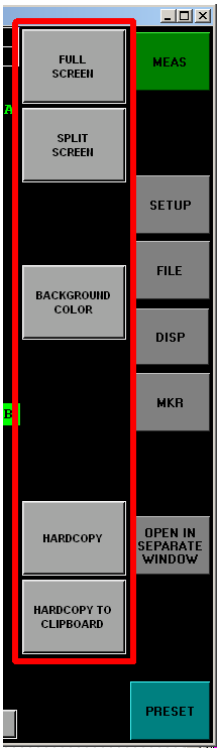


Figure 6-10: Display Menu

The "DISP" hardkey opens the display softkey menu.

The display menu allows the display to be changed between split and full screen mode.

➥ Remote: Not available.

The active screen can be selected by pressing the "*Screen A / Screen B*" hotkey. In full screen mode the "*Screen A / Screen B*" hotkey also toggles which screen is displayed.

➥ Remote: `DISP:WIND2:SEL`

The background color of the software can be changed by pressing the "Background Color" softkey and selecting a color in the "Color Selection" dialog box.

➥ Remote: Not available.

With the "Hardcopy" softkey a screenshot of the application window can be saved in the following formats:

- BMP Uncompressed pixel format
- GIF: Color compressed pixel format with 256 colors (platform independent)
- JPEG: Compressed pixel format
- PNG: Looseless compressed pixel format
- TIFF: Format for high color depth images

The "Hardcopy To Clipboard" softkey sends a screenshot of the application window to the operating system clipboard.

➥ Remote: Not supported yet.

6.4 File Management

This section describes the file management of demodulation settings, global settings and I/Q data.

The "FILE" hardkey opens the file management softkey menu.

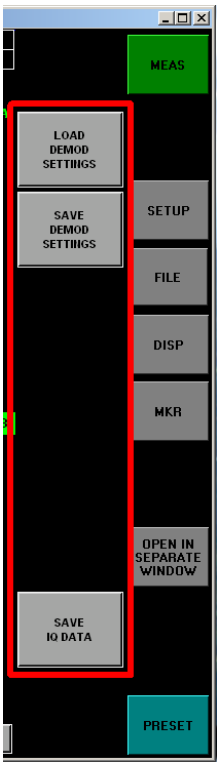


Figure 6-11: File Management Menu

Use "Load Demod Settings" to open a standard file dialog to select which demodulation setup will be loaded.

➥ Remote: `MMEM:LOAD:DEM 'D:\USER\Settingsfile.allocation'`

Use "Save Demod Settings" to open a standard file dialog to save the current demodulation setup to a file.

➥ Remote: `MMEM:STOR:DEM 'D:\USER\Settingsfile.allocation'`

Use "Save IQ Data" to open a standard file dialog to save the current I/Q data in the capture buffer.

➥ Remote: Not supported yet.

Please refer to section "Import and Export of Data" for details on the file format.

6.5 Software Setup

This section describes the software setup of the demodulation settings, global settings and I/Q data.

The "SETUP" hardkey opens the software setup softkey menu. It also closes any settings dialogs that are open.

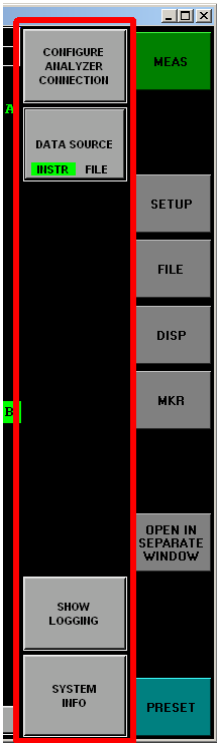


Figure 6-12: Software Setup menu

6.5.1 Configure Analyzer Connection

This softkey opens the "General Settings" dialog box. For more information how to change the analyzer connection see "MIMO Analyzer Configuration".

➥ Remote: Not available.

6.5.2 Data Source (Instrument or File)

This softkey changes the data source from instrument to file. It is advisable to change this setting only in the combo box "Source" under Input in the "General Settings" dialog box.

➥ Remote: Not available.

6.5.3 Show Logging

The "Show Logging" softkey is used to display an error messages history.

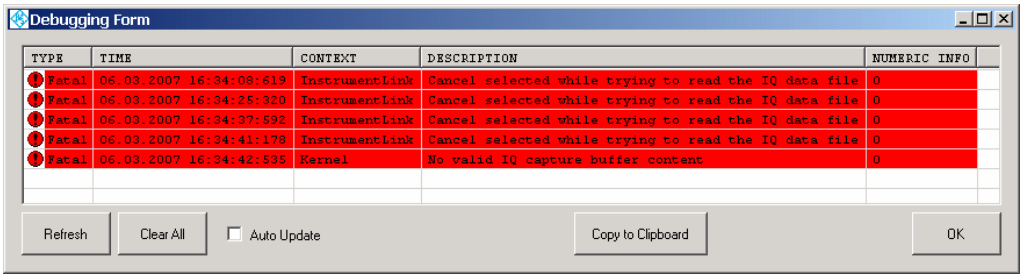


Figure 6-13: Debugging Form dialog box

The message history can be refreshed and cleared, and the contents can be copied to the operating system clipboard.

➥ Remote: Not supported yet.

6.5.4 System Info

The "System Info" softkey opens a dialog containing system information about the version numbers of used drivers and utility software. This information can be useful in case the analyzer software does not work properly.

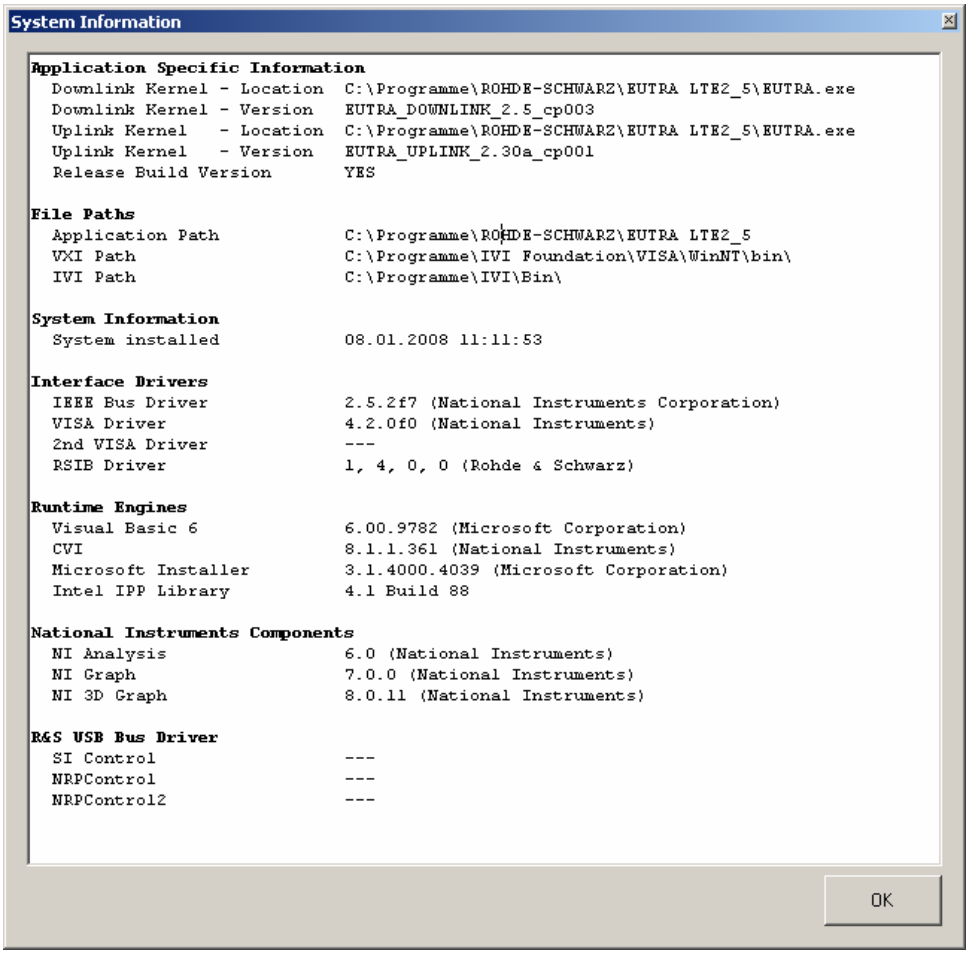


Figure 6-14: System information

➥ Remote: Not supported.

6.6 Marker

The "MARKER" hardkey has the same functionality as the "Marker" entry in the context menu of the graph display. For an explanation how to use the "MARKER" hardkey, see section "Evaluating the Results – Operating the Graph".

Note on Marker behaviour

The "MARKER" hardkey acts on the actual selected graph. If the graph contains more than one trace, nothing happens, see section "Evaluating the Results – Operating the Graph".

➥ Remote: Not supported yet.

6.7 Open in separate window

The "OPEN IN SEPARATE WINDOW" hardkey creates a copy of the currently selected screen and displays it in additional windows. This functionality makes it possible to watch more than two results simultaneously.

The "OPEN IN SEPARATE WINDOW" hardkey is not available if the software is running directly on an analyzer.

➥ Remote: Not supported yet.

6.8 Preset

When the PRESET hardkey is pressed the LTE software is preset. If the input source is not set to File and a valid R&S FSQ / FSV address is configured, this instrument is also preset.

If the LTE software is installed on a R&S FSQ / FSV, the LTE software is exited and a preset will be performed after pressing the PRESET hardkey.

➥ Remote: *RST

7 Remote Control

7.1 Description of commands

This section specifies all the remote control commands specific to the R&S FSQ/FSV-K101/-K105 option. Only those commands provided for this option are specified. For details of remote control commands provided by the host analyzer please refer to the analyzer user manual.

7.1.1 Notation

In the following sections, all commands implemented in the software are first listed in tables and then described in detail, arranged according to the command subsystems. The notation is adapted to the SCPI standard. The SCPI conformity information is included in the individual description of the commands.

7.1.1.1 Table of Commands

Command:

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

Parameter:

The parameter column indicates the requested parameters together with their specified range.

Unit:

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

Comment:

In the comment column an indication is made on:

- whether the command does not have a query form,
- whether the command has only one query form
- whether the 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, the further the indentation to the right. Please note that the complete notation of the command always includes the higher levels as well.

Example: `SENSe:FREQuency:CENTer` is represented in the table as follows:

`SENSe`	first level
`:FREQuency`	second level
`:CENTer`	third level

Individual description

The individual description contains the complete notation of the command. An example for each command, the *RST value and the SCPI information are included as well.

Upper/lower case notation

Upper/lower case letters are used to mark the long or short form of the key words of a command in the description. 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 keywords are indicated in the same line; they are separated by a vertical stroke. Only one of these keywords needs to be included in the header of the command. The effect of the command is independent of which of the keywords is used.

Example: `SENSe:FREQuency:CW|:FIXed`

The two following commands with identical meaning can be created. They set the frequency of the fixed frequency signal to 1 kHz:

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

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

Example: Selection of the parameters for the command

```
DISPlay:FORMat FULL | SPLit
```

If parameter FULL is selected, full screen is displayed, in the case of SPLit, split screen is displayed.

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

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

Description of parameters

Due to the standardisation, the parameter section of SCPI commands consists always of the same syntactical elements. SCPI has therefore specified a series of definitions, which are used in the tables of commands. In the tables, these established definitions are indicated in angled brackets (<...>) and will be briefly explained in the following.

<Boolean>

This keyword refers to parameters which can adopt two states, "on" and "off". The "off" state may either be indicated by the keyword OFF or by the numeric value 0, the "on" state is indicated by ON or any numeric value other than zero. Parameter queries are always returned the numeric value 0 or 1.

<numeric value>,<num>

These keywords mark parameters which may be entered as numeric values or are set using specific keywords (character data).The following keywords given below are permitted:

MINimum	This keyword sets the parameter to the smallest possible value.
MAXimum	This keyword sets the parameter to the largest possible value.
DEFault	This keyword is used to reset the parameter to its default value.
UP	This keyword increments the parameter value.
DOWN	This keyword decrements the parameter value.

The numeric values associated to MAXimum/ MINimum/DEFault can be queried by adding the corresponding keywords to the command. They must be entered following the quotation mark.

Example: `SENSe:FREQuency:CENTer? MAXimum`

returns the maximum possible numeric value of the center frequency as result.

<arbitrary block program data>

This keyword is provided for commands the parameters of which consist of a binary data block.

7.2 CALCulate Subsystem

List of Commands

- CALCulate<1|2>:FEED[?]
- CALCulate<1|2>:LIMit<1>:ACPower:ACHannel:RESult?
- CALCulate<1|2>:LIMit<1>:ACPower:ALTernate:RESult?
- CALCulate<1|2>:MARKer<1>:FUNCtion:POWer:RESult[:CURRent]?

CALCulate<1|2>:FEED[?]

Select display type for screen A and B. The suffix is used to select screen A (=1) or B (=2).

Example

```
"CALC2:FEED 'PVT:CBUF'"
```

Select Capture-Buffer to be displayed on screen B.

Parameters

PVT:CBUF	Capture Buffer
EVM:EVCA	EVM versus Carrier
EVM:EVSY	EVM versus Symbol
EVM:EVSU	EVM versus Subframe
SPEC:PSPE	Power Spectrum
SPEC:IE	Inband Emission
SPEC:FLAT	Channel Flatness
SPEC:FSRS	Channel Flatness SRS
SPEC:GDEL	Channel Group Delay
SPEC:FDIF	Flatness Difference
CONS:CONS	Constellation Diagram
CONS:DFTC	DFT Precoded Constellation Diagram
STAT:CCDF	CCDF
STAT:ASUM	Allocation Summary
STAT:BSTR	Bit stream
SPEC:ACPR	ACLR (Relative)
SPEC:ACPA	ACLR (Absolute)
SPEC:SEM	Spectrum Mask

Characteristics

SCPI: device-specific

Mode

UL, DL (some measurements are only available in either UL or DL)

CALCulate<1|2>:LIMit<1>:ACPower:ACHannel:RESult?

This command queries the limit check results of the Adjacent Channels in the relative ACLR measurement. The two values for the lower and upper adjacent channels are returned.

Example

```
"CALC:LIMI:ACPO:ACHA:RESU?"
```

Queries the limit check result.

Characteristics

SCPI: device-specific

Mode

UL, DL

CALCulate<1|2>:LIMit<1>:ACPower:ALTernate:RESult?

This command queries the limit check results of the Alternate Channels in the relative ACLR measurement. The two values for the lower and upper alternate channels are returned.

Example

```
"CALC:LIMI:ACPO:ALTE:RESU?"
```

Queries the limit check result.

Characteristics

SCPI: device-specific

Mode

UL, DL

CALCulate<1|2>:MARKer<1>:FUNCtion:POWer:RESult[:CURRent]?

This command queries the current result values of the adjacent channel power measurement. An ACPR (Adjacent channel power relative) measurement must have previously been run for there to be summary data available.

Results are output separated by commas in the following order:

1. Power of main channel in dBm
2. Rel. Power of lower adjacent channel in dB

3. Rel. Power of upper adjacent channel in dB
4. Rel. Power of lower alternate adjacent channel 1 in dB
5. Rel. Power of upper alternate adjacent channel 1 in dB

Adjacent channel power values are output in dB. The returned list is variable length depending on the number of channels to be measured, i.e. if the number of channels is 2 then the list will contain 5 results (main channel plus two results each for each adjacent channel specified).

Example

```
"CALC1:MARK:FUNC:POW:RES?"
```

Returns the current ACLR measurement results.

Characteristics

SCPI: device-specific

Mode

UL, DL

7.3 CONFigure Subsystem

The CONFigure subsystem contains commands for configuring complex measurement tasks. The CONFigure subsystem is closely linked to the functions of the FETCH subsystem, where the measurement results of the measurements are queried.

List of commands

- CONFigure[:LTE]:LDIRection[?]
- CONFigure[:LTE]:UL:BW[?]
- CONFigure[:LTE]:UL:PLCI:CIDGroup[?]
- CONFigure[:LTE]:UL:PLCI:PLID[?]
- CONFigure[:LTE]:UL:NORB[?]
- CONFigure[:LTE]:UL:CYCPrefix[?]
- CONFigure[:LTE]:UL:CSUBframes [?]
- CONFigure[:LTE]:UL:SUBFrame<0…9>:ALLoc:CONT[?]
- CONFigure[:LTE]:UL:SUBFrame<0…9>:ALLoc:POWer[?]
- CONFigure[:LTE]:UL:SUBFrame<0…9>:ALLoc:RBCount[?]
- CONFigure[:LTE]:UL:SUBFrame<0…9>:ALLoc:RBOFfset[?]
- CONFigure[:LTE]:UL:SUBFrame<0…9>:ALLoc:MODulation[?]
- CONFigure[:LTE]:UL:DRS:DSSHift[?]
- CONFigure[:LTE]:UL:DRS:ENPR[?]
- CONFigure[:LTE]:UL:DRS:GRPHopping[?]
- CONFigure[:LTE]:UL:DRS:SEQuence[?]
- CONFigure[:LTE]:UL:DRS:SEQHopping[?]
- CONFigure[:LTE]:UL:DRS[:PUSCh]:POWer[?]
- CONFigure[:LTE]:UL:DRS:PUCCh:POWer[?]
- CONFigure[:LTE]:UL:PRACh:CONF[?]
- CONFigure[:LTE]:UL:PRACh:RSET[?]
- CONFigure[:LTE]:UL:PRACh:FOFFset[?]
- CONFigure[:LTE]:UL:PRACh:NCSC[?]
- CONFigure[:LTE]:UL:PRACh:RSEQ[?]
- CONFigure[:LTE]:UL:PRACh:SINDex[?]
- CONFigure[:LTE]:UL:PRACh:FRINdex[?]
- CONFigure[:LTE]:UL:PRACh:HFINdicator[?]
- CONFigure[:LTE]:UL:PUSCh:FHMode[?]
- CONFigure[:LTE]:UL:PUSCh:NOSM[?]
- CONFigure[:LTE]:UL:PUCCh:DESHift[?]
- CONFigure[:LTE]:UL:PUCCh:DEOFfset[?]
- CONFigure[:LTE]:UL:PUCCh:FORMat[?]
- CONFigure[:LTE]:UL:PUCCh:N1CS[?]
- CONFigure[:LTE]:UL:PUCCh:N2RB[?]
- CONFigure[:LTE]:UL:PUCCh:NORB[?]
- CONFigure[:LTE]:UL:PUCCh:NPAR[?]
- CONFigure[:LTE]:UL:PUSCh:FHOP:IIHB[?]
- CONFigure[:LTE]:UL:PUSCh:FHOFfset[?]
- CONFigure[:LTE]:UL:SFNO[?]
- CONFigure[:LTE]:UL:SRS:POWer[?]
- CONFigure[:LTE]:UL:SRS:STAT?
- CONFigure[:LTE]:UL:SRS:BHOP[?]

- CONFigure[:LTE]:UL:SRS:BSRS[?]
- CONFigure[:LTE]:UL:SRS:CSRS[?]
- CONFigure[:LTE]:UL:SRS:CYCS[?]
- CONFigure[:LTE]:UL:SRS:ISRS[?]
- CONFigure[:LTE]:UL:SRS:NRRC[?]
- CONFigure[:LTE]:UL:SRS:SUConfig[?]
- CONFigure[:LTE]:UL:SRS:TRComb[?]
- CONFigure[:LTE]:UL:TDD:UDConf[?]
- CONFigure[:LTE]:UL:UEID
- CONFigure[:LTE]:DUPLexing[?]
- CONFigure:POWer:EXPected:RF<1..4>[?]
- CONFigure:POWer:EXPected:IQ<1..4>[?]
- CONFigure:PRESet
- CONFigure:ADDRess<1..4>[?]

CONFigure[:LTE]:LDIRection[?]

Configures the current link direction.

Example

```
"CONF:LDIR DL"
```

EUTRA/LTE option is configured to analyze downlink data.

Parameters

DL	Downlink
UL	Uplink

Characteristics

*RST value: -

SCPI: device-specific

Mode

UL, DL

CONFigure[:LTE]:UL:BW[?]

Configures the bandwidth of the LTE uplink signal.

Example

```
"CONF:UL:BW BW1_40"
```

Sets a signal bandwidth of 1.4 MHz in uplink.

Parameters

BW1_40 | BW2_50 | BW3_00 | BW5_00 | BW10_00 | BW15_00 | BW20_00

Characteristics

*RST value: BW10_00

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:PLCI:CIDGroup[?]

Configures the current cell identity group for UL.

Example

```
"CONF:UL:PLCI:CIDG 10"
```

Cell identity group number 10 is selected.

Parameters

0…167

Characteristics

*RST value: 0

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:PLCI:PLID[?]

Configures the current cell identity for UL.

Example

```
"CONF:UL:PLCI:PLID 2"
```

Sets the physical layer identity to 2.

Parameters

0…2

Characteristics

*RST value: 0

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:NORB[?]

Configures the number of resource blocks for UL.

Example

```
"CONF:UL:NORB 25"
```

Sets the number of resource blocks to 25.

Parameters

Numeric value

Characteristics

*RST value: 50

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:CYCPrefix[?]

Configures the cyclic prefix type for UL.

Example

```
"CONF:UL:CYCP EXT"
```

Sets cyclic prefix type to extended.

Parameters

NORM	Normal cyclic prefix length
EXT	Extended cyclic prefix length
AUTO	Automatic cyclic prefix length detection

Characteristics

*RST value: AUTO

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:CSUBframes [?]

Configures the number of configurable subframes for UL.

Example

```
"CONF:UL:CSUB 5"
```

Sets the number of configurable subframes to 5.

Parameters

1…10

Characteristics

*RST value: 1

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:SUBFrame<0…9>:ALLoc:CONT[?]

Defines if a subframe contains a physical uplink control channel or a physical uplink shared channel. The suffix is used to select the subframe to be configured.

Example

```
"CONF:UL:SUBF2:ALL:CONT PUCC"
```

Enables PUCCH for subframe 2.

Parameters

PUCC|PUSC

Characteristics

*RST value: PUSC

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:SUBFrame<0…9>:ALLoc:POWer[?]

Configures the relative power of the selected UL subframe. The suffix is used to select the subframe to be configured.

Example

```
"CONF:UL:SUBF2:ALL:POW -5dB"
```

Sets the relative power of UL subframe 2 to -5dB.

Parameters

Numeric value

Characteristics

*RST value: 0

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:SUBFrame<0…9>:ALLoc:RBCount[?]

Configures the number of resource blocks for an allocation in a specific UL subframe. The suffix is used to select the subframe to be configured.

Example

```
"CONF:UL:SUBF2:ALL:RBC 25"
```

Sets the number of resource blocks for subframe number 2 to 25.

Parameters

Numeric value

Characteristics

*RST value: 11

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:SUBFrame<0…9>:ALLoc:RBOFfset[?]

Configures the resource block offset for an allocation in a specific UL frame. The suffix is used to select the subframe to be configured.

Example

```
"CONF:UL:SUBF5:ALL:RBOF 10"
```

Sets the resource block offset for subframe number 5 to 10.

Parameters

Numeric value

Characteristics

*RST value: 2

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:SUBFrame<0…9>:ALLoc:MODulation[?]

Configures the modulation type of an allocation in a specific UL frame. The suffix is used to select the subframe to be configured.

Example

```
"CONF:UL:SUBF3:ALL:MOD QAM64"
```

Sets the modulation type of subframe number 3 to QAM64.

Parameters

QPSK	QPSK modulation
QAM16	16QAM modulation
QAM64	64QAM modulation

Characteristics

*RST value: QPSK

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:DRS:DSSHift[?]

Configures the delta sequence shift in the 3GPP configuration for UL.

Example

```
"CONF:UL:DRS:DSSH 3"
```

Sets the delta sequence shift to 3.

Parameters

Numeric value

Characteristics

*RST value: 0

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:DRS:ENPR[?]

Enables or disables n_PRS in the demodulation reference signal configuration for UL.

Example

```
"CONF:UL:DRS:ENPR ON"
```

Activates n_PRS.

Parameters

ON|OFF

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:DRS:GRPHopping[?]

Enables or disables group hopping in the 3GPP configuration for UL.

Example

```
"CONF:UL:DRS:GRPH ON"
```

Activates the group hopping.

Parameters

ON|OFF

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:DRS:SEQuence[?]

Configures the sequence type of the demodulation reference signal.

Example

```
"CONF:UL:DRS:SEQ TGPP"
```

Sets sequence type to 3GPP.

Parameters

IQF|TGPP

Characteristics

*RST value: TGPP

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:DRS:SEQHopping[?]

Enables or disables sequence hopping in the 3GPP configuration for UL.

Example

```
"CONF:UL:DRS:SEQH ON"
```

Activates the sequence hopping.

Parameters

ON|OFF

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:DRS[:PUSCh]:POWer[?]

Configures the relative power of the physical uplink shared channel.

Example

```
"CONF:UL:DRS:POW 1"
```

Sets the relative PUSCH power to 1 dB.

Parameters

Numeric value in dB

Characteristics

*RST value: 0

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:DRS:PUCCh:POWer[?]

Configures the relative power of the physical uplink control channel.

Example

```
"CONF:UL:DRS:PUCC:POW 1"
```

Sets the relative PUCCH power to 1 dB.

Parameters

Numeric value in dB

Characteristics

*RST value: 0

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:PRACh:CONF[?]

Configures the PRACH configuration index.

Example

```
"CONF:UL:PRAC:CONF 0"
```

Sets the PRACH configuration index to 0.

Parameters

Numeric value

Characteristics

*RST value: 0

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:PRACh:RSET[?]

Selects whether a restricted preamble set (high speed mode) or the unrestricted preamble set (normal mode) will be used.

Example

```
"CONF:UL:PRAC:RSET ON"
```

Enabled the high speed mode.

Parameters

ON|OFF

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:PRACh:FOFFset[?]

Configures the PRACH Frequency Offset.

Example

```
"CONF:UL:PRAC:FOFF 1"
```

Sets the PRACH Frequency Offset to 1.

Parameters

Numeric value

Characteristics

*RST value: 0

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:PRACh:NCSC[?]

Selects the Ncs configuration.

Example

```
"CONF:UL:PRAC:NCSC 1"
```

Sets the Ncs configuration to 1.

Parameters

Numeric value

Characteristics

*RST value: 0

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:PRACh:RSEQ[?]

Configures the logical root sequence index.

Example

```
"CONF:UL:PRAC:RSEQ 0"
```

Sets the logical root sequence index to 0.

Parameters

Numeric value

Characteristics

*RST value: 0

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:PRACh:SINDex[?]

Configures the sequence index v.

Example

```
"CONF:UL:PRAC:SIND 1"
```

Sets the sequence index v to 1.

Parameters

Numeric value

Characteristics

*RST value: 0

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:PRACh:FRINdex[?]

Configures the PRACH frequency resource index $f_{RA.}$

Example

```
"CONF:UL:PRAC:FRIN 0"
```

Sets the frequency resource index to 0.

Parameters

Numeric value

Characteristics

*RST value: 0

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:PRACh:HFINdicator[?]

Configures the half frame indicator $t1_{RA.}$

Example

```
"CONF:UL:PRAC:HFIN 1"
```

Sets the half frame indicator to 1.

Parameters

Numeric value

Characteristics

*RST value: 0

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:PUSCh:FHMode[?]

Configures the frequency hopping mode in the PUSCH structure settings for UL.

Example

```
"CONF:UL:PUSC:FHM INTR"
```

Sets frequency hopping mode to intra subframe hopping.

Parameters

NONE	No hopping
INTer	Inter subframe hopping
INTRa	Intra subframe hopping

Characteristics

*RST value: NONE

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:PUSCh:NOSM[?]

Configures the number of subbands/M in the PUSCH structure settings for UL.

Example

```
"CONF:UL:PUSC:NOSM 2"
```

Sets number of subbands to 2.

Parameters

Numeric value

Characteristics

*RST value: 0

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:PUCCh:DESHift[?]

Configures the physical uplink control channel delta shift.

Example

```
"CONF:UL:PUCC:DESH 2"
```

Sets the delta shift to 2.

Parameters

Numeric value

Characteristics

*RST value: 2

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:PUCCh:DEOFfset[?]

Configures the physical uplink control channel delta offset.

Example

```
"CONF:UL:PUCC:DEOF 2"
```

Sets the delta offset to 2.

Parameters

Numeric value

Characteristics

*RST value: 0

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:PUCCh:FORMat[?]

Configures the PUCCH format.

Example

```
"CONF:UL:PUCC:FORM F1AN"
```

Sets PUCCH format to F1a normal. Formats 2a and 2b are only supported for normal cyclic prefix length.

Parameters

F1N	F1 normal
F1S	F1 shortened
F1AN	F1a normal
F1AS	F1a shortened
F1BN	F1b normal
F1BS	F1b shortened
F2	F2
F2A	F2a
F2B	F2b

Characteristics

*RST value: F1N

SCPI: device-specific

Mode:

UL

CONFigure[:LTE]:UL:PUCCh:N1CS[?]

Configures the physical uplink control channel N(1)_cs parameter.

Example

```
"CONF:UL:PUCC:N1CS 5"
```

Sets N(1)_cs to 5.

Parameters

Numeric value

Characteristics

*RST value: 6

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:PUCCh:N2RB[?]

Configures the physical uplink control channel N(2)_RB parameter.

Example

```
"CONF:UL:PUCC:N2RB 5"
```

Sets N(2)_RB to 5.

Parameters

Numeric value

Characteristics

*RST value: 1

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:PUCCh:NORB[?]

Configures the number of resource blocks for PUCCH.

Example

```
"CONF:UL:PUCC:NORB 10"
```

Sets the number of resource blocks to 10.

Parameters

Numeric value

Characteristics

*RST value: 4

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:PUCCh:NPAR[?]

Configures the N_PUCCH parameter in the PUCCH structure settings.

Example

```
"CONF:UL:PUCC:NPAR 5"
```

Sets the N_PUCCH parameter to 5.

Parameters

Numeric value

Characteristics

*RST value: 0

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:PUSCh:FHOP:IIHB[?]

Sets the information in hopping bits according to the PDCCH DCI format 0 hopping bit definition. This information determines whether type 1 or type 2 hopping is used in the subframe, and - in case of type 1 - additionally determines the exact hopping function to use.

Example

```
"CONF:UL:PUSC:FHOP:IIHB 1"
```

Sets the information in hopping bits to type 1.

Parameters

Numeric value

Characteristics

*RST value: 0

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:PUSCh:FHOFfset[?]

Sets the PUSCH Hopping Offset NRBHO.

Example

```
"CONF:UL:PUSC:FHOF 5"
```

Sets the hopping offset to 5.

Parameters

Numeric value

Characteristics

*RST value: 4

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:SFNO[?]

Specifies the frame number offset which is used for demodulating the captured frame.

Example

```
"CONF:UL:SFNO 5"
```

Sets the frame number offset to 5.

Parameters

Numeric value

Characteristics

*RST value: 0

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:SRS:POWer[?]

Configures the relative power of the sounding reference signal.

Example

```
"CONF:UL:SRS:POW -1.2"
```

Sets the relative power to -1.2dB.

Parameters

Numeric value

Characteristics

*RST value: 0

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:SRS:STAT?

Activates or deactivates the sounding reference signal.

Example

```
"CONF:UL:SRS:STAT ON"
```

Activates the sounding reference signal.

Parameters

ON|OFF

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:SRS:BHOP[?]

Sets the UE specific parameter frequency hopping bandwidth b_{hop},.

Example

```
"CONF:UL:SRS:BHOP 1"
```

Sets the frequency hopping bandwidth to 1.

Parameters

Numeric value

Characteristics

*RST value: 0

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:SRS:BSRS[?]

Sets the UE specific parameter SRS Bandwidth B_{SRS}.

Example

```
"CONF:UL:SRS:BSRS 1"
```

Sets the SRS bandwidth to 1.

Parameters

Numeric value

Characteristics

*RST value: 0

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:SRS:CSRS[?]

Sets the cell specific parameter SRS Bandwidth Configuration (C_{SRS}).

Example

```
"CONF:UL:SRS:CSRS 2"
```

Sets the SRS bandwidth configuration to 2.

Parameters

Numeric value

Characteristics

*RST value: 0

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:SRS:CYCS[?]

Sets the cyclic shift n_CS used for the generation of the sounding reference signal CAZAC sequence.

Example

```
"CONF:UL:SRS:CSRS 2"
```

Sets the cyclic shift to 2.

Parameters

Numeric value

Characteristics

*RST value: 0

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:SRS:ISRS[?]

Sets the UE specific parameter SRS configuration index I_{SRS}.

Example

```
"CONF:UL:SRS:ISRS 2"
```

Sets the configuration index to 2.

Parameters

Numeric value

Characteristics

*RST value: 0

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:SRS:NRRC[?]

Sets the UE specific parameter Freq. Domain Position $n_{RRC.}$

Example

```
"CONF:UL:SRS:NRRC 1"
```

Sets the frequency domain position to 1.

Parameters

Numeric value

Characteristics

*RST value: 0

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:SRS:SUConfig[?]

Sets the cell specific parameter SRS subframe configuration.

Example

```
"CONF:UL:SRS:SUC 4"
```

Sets the subframe configuration to 4.

Parameters

Numeric value

Characteristics

*RST value: 0

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:SRS:TRComb[?]

Sets the UE specific parameter transmission comb k_{TC}.

Example

```
"CONF:UL:SRS:TRC 12"
```

Sets the transmission comb to 12.

Parameters

Numeric value

Characteristics

*RST value: 0

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:TDD:UDConf[?]

Configures the TDD UL/DL Allocations for UL.

Example

```
"CONF:UL:TDD:UDC 4"
```

Selects allocation configuration number 4.

Parameters

Numeric value

Characteristics

*RST value: 0

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:UL:UEID[?]

Sets the radio network temporary identifier (RNTI) of the UE

Example

```
"CONF:UL:UEID 4"
```

Sets the temporary identifier to 4..

Parameters

Numeric value

Characteristics

*RST value: 0

SCPI: device-specific

Mode

UL

CONFigure[:LTE]:DUPLexing[?]

Configures the duplexing mode.

Example

```
"CONF:DUPL TDD"
```

Activates time division duplex.

Parameters

TDD	Time division duplex
FDD	Frequency division duplex

Characteristics

*RST value: FDD

SCPI: device-specific

Mode

UL,DL

CONFigure:POWer:EXPected:RF<1..4>[?]

Configures the reference level of the analyzers used in RF mode. The suffix <1..4> specifies to which analyzer the setting applies to.

Example

```
"CONF:POW:EXP:RF3 -20"
```

Sets the radio frequency reference level used by analyzer 3 to -20 dBm.

Parameters

Numeric value in dBm

Characteristics

*RST value: 30 dBm

SCPI: device-specific

Mode

RF, UL and DL

CONFigure:POWer:EXPected:IQ<1..4>[?]

Configures the reference level of the analyzers used in BB-mode. The suffix <1..4> specifies to which analyzer the setting applies to.

Example

```
"CONF:POW:EXP:IQ2 -10"
```

Sets the baseband-reference level used by analyzer 2 to -10 dBm.

Parameters

Numeric value in dBm. Values from -25 to +20 in steps of 5 are supported.

Characteristics

*RST value 0 dBm

SCPI: device-specific

Mode

BB, UL and DL

CONFigure:PRESet

Presets the software. In contrast to the *RST or the SYST:PRES command, this command will not close the LTE software after the preset even if it is running on an analyzer.

Example

```
"CONF:PRES"
```

Presets the LTE software.

Characteristics

*RST value: -

SCPI: device-specific

Mode

UL, DL

CONFigure:ADDRess<1..4>[?]

Specifies the addresses and the connection type of the instruments to be used as string.

Example

```
"CONF:ADDR2 'TCPIP::192.168.0.1::INSTR0'"
```

Configures the connection used for instrument 2 as type TCPIP with an address of 192.168.0.1

Parameters

String containing information about connection type and address.

Characteristics

*RST value: -

SCPI: device-specific

Mode

UL, DL

7.4 DISPlay Subsystem

List of commands

- DISPlay:TRACe:Y:RLEVel:OFFSet
- DISPlay[:WINDow<1|2>]:SELect

DISPlay:TRACe:Y:RLEVel:OFFSet

Sets the external attenuation.

Example

```
"DISP:TRAC:Y:RLEV:OFFS 5 DB"
```

Sets an external attenuation of 5 dB.

Characteristics

*RST value: 0

Mode

UL, DL

This command is an event and therefore has no query.

DISPlay[:WINDow<1|2>]:SELect

Selects the active measurement window. WINDow1 corresponds to SCREEN A, WINDow2 to SCREEN B.

Example

```
"DISP:WIND2:SEL"
```

Selects SCREEN B.

Characteristics

*RST value: SCREEN A active

Mode

UL and DL

This command is an event and therefore has no query.

7.5 FETCh Subsystem

List of commands

- FETCh:SUMMary:EVM:USQP[:AVERage]?
- FETCh:SUMMary:EVM:SDQP[:AVERage]?
- FETCh:SUMMary:EVM:USST[:AVERage]?
- FETCh:SUMMary:EVM:SDST[:AVERage]?
- FETCh:SUMMary:EVM:UCCH[:AVERage]?
- FETCh:SUMMary:EVM:UCCD[:AVERage]?
- FETCh:SUMMary:EVM:UPRA[:AVERage]?
- FETCh:SUMMary:EVM:PCHannel[:AVERage]?
- FETCh:SUMMary:EVM:PCHannel:MAXimum?
- FETCh:SUMMary:EVM:PCHannel:MINimum?
- FETCh:SUMMary:EVM:PSIGnal[:AVERage]?
- FETCh:SUMMary:EVM:PSIGnal:MAXimum?
- FETCh:SUMMary:EVM:PSIGnal:MINimum?
- FETCh:SUMMary:EVM[:ALL][:AVERage]?
- FETCh:SUMMary:EVM[:ALL]:MAXimum?
- FETCh:SUMMary:EVM[:ALL]:MINimum?
- FETCh:SUMMary:FERRor[:AVERage]?
- FETCh:SUMMary:FERRor:MAXimum?
- FETCh:SUMMary:FERRor:MINimum?
- FETCh:SUMMary:GIMBalance[:AVERage]?
- FETCh:SUMMary:GIMBalance:MAXimum?
- FETCh:SUMMary:GIMBalance:MINimum?
- FETCh:SUMMary:IQOFfset[:AVERage]?
- FETCh:SUMMary:IQOFfset:MAXimum?
- FETCh:SUMMary:IQOFfset:MINimum?
- FETCh:SUMMary:POWer[:AVERage]?
- FETCh:SUMMary:POWer:MAXimum?
- FETCh:SUMMary:POWer:MINimum?
- FETCh:SUMMary:QUADerror[:AVERage]?
- FETCh:SUMMary:QUADerror:MAXimum?
- FETCh:SUMMary:QUADerror:MINimum?
- FETCh:SUMMary:SERRor[:AVERage]?
- FETCh:SUMMary:SERRor:MAXimum?
- FETCh:SUMMary:SERRor:MINimum?
- FETCh:SUMMary:CRESt?
- FETCh:SUMMary:TFRame?
- FETCh:PLCI:CIDGroup?
- FETCh:PLCI:PLID?
- FETCh:CYCPrefix?

FETCh:SUMMary:EVM:USQP[:AVERage]?

Returns the average "EVM PUSCH QPSK" value from the result summary list.

Example

```
"FETC:SUMM:EVM:USQP?"
```

Returns the average PUSCH QPSK EVM.

Characteristics

*RST value: -

SCPI: device-specific

Mode

UL

FETCh:SUMMary:EVM:SDQP[:AVERage]?

Returns the average "EVM DMRS PUSCH QPSK" value from the result summary list.

Example

```
"FETC:SUMM:EVM:SDQP?"
```

Returns the average DMRS PUSCH QPSK EVM.

Characteristics

*RST value: -

SCPI: device-specific

Mode

UL

FETCh:SUMMary:EVM:USST[:AVERage]?

Returns the average "EVM PUSCH 16QAM" value from the result summary list.

Example

```
"FETC:SUMM:EVM:USST?"
```

Returns the average PUSCH 16QAM EVM.

Characteristics

*RST value: -

SCPI: device-specific

Mode

UL

FETCh:SUMMary:EVM:SDST[:AVERage]?

Returns the average "EVM DMRS PUSCH 16QAM" value from the result summary list.

Example

```
"FETC:SUMM:EVM:SDST?"
```

Returns the average DMRS PUSCH 16QAM EVM.

Characteristics

*RST value: -

SCPI: device-specific

Mode

UL

FETCh:SUMMary:EVM:UCCH[:AVERage]?

Returns the average "EVM PUCCH" value from the result summary list.

Example

```
"FETC:SUMM:EVM:UCCH?"
```

Returns the average PUCCH EVM.

Characteristics

*RST value: -

SCPI: device-specific

Mode

UL

FETCh:SUMMary:EVM:UCCD[:AVERage]?

Returns the average "EVM DMRS PUCCH" value from the result summary list.

Example

```
"FETC:SUMM:EVM:UCCD?"
```

Returns the average DMRS PUCCH EVM.

Characteristics

*RST value: -

SCPI: device-specific

Mode

UL

FETCh:SUMMary:EVM:UPRA[:AVERage]?

Returns the average "EVM PRACH" value from the result summary list.

Example

```
"FETC:SUMM:EVM:UPRA?"
```

Returns the average PRACH EVM.

Characteristics

*RST value: -

SCPI: device-specific

Mode

UL

FETCh:SUMMary:EVM:PCHannel[:AVERage]?
FETCh:SUMMary:EVM:PCHannel:MAXimum?
FETCh:SUMMary:EVM:PCHannel:MINimum?

Returns the "EVM Phys. Channel" value from the result summary list.

Example

```
"FETC:SUMM:EVM:PCH?"
```

Returns the average physical channel EVM.

Characteristics

*RST value: -

SCPI: device-specific

Mode

UL, DL

FETCh:SUMMary:EVM:PSIGnal[:AVERage]?
FETCh:SUMMary:EVM:PSIGnal:MAXimum?
FETCh:SUMMary:EVM:PSIGnal:MINimum?

Returns the "EVM Phys. Signal" value from the result summary list.

Example

```
"FETC:SUMM:EVM:PSIG?"
```

Returns the average physical signal EVM.

Characteristics

*RST value: -

SCPI: device-specific

Mode

UL, DL

FETCh:SUMMary:EVM[:ALL][:AVERage]?
FETCh:SUMMary:EVM[:ALL]:MAXimum?
FETCh:SUMMary:EVM[:ALL]:MINimum?

Returns the "EVM All" value from the result summary list.

Example

`"FETC:SUMM:EVM?"`

Returns the average overall EVM.

Characteristics

*RST value: -

SCPI: device-specific

Mode

UL, DL

FETCh:SUMMary:FERRor[:AVERage]?
FETCh:SUMMary:FERRor:MAXimum?
FETCh:SUMMary:FERRor:MINimum?

Returns the "Frequency Error" from the result summary list in Hz.

Example

`"FETC:SUMM:FERR?"`

Returns the current mean Frequency Error in Hz.

Characteristics

*RST value: -

SCPI: device-specific

Mode

UL, DL

FETCh:SUMMary:SERRor[:AVERage]?
FETCh:SUMMary:SERRor:MAXimum?
FETCh:SUMMary:SERRor:MINimum?

Returns the "Sampling Error" from the result summary list in ppm.

Example

`"FETC:SUMM:SERR?"`

Returns the current mean Sampling Error in ppm.

Characteristics

*RST value: -

SCPI: device-specific

Mode

UL, DL

FETCh:SUMMary:IQOFfset[:AVERage]?
FETCh:SUMMary:IQOFfset:MAXimum?
FETCh:SUMMary:IQOFfset:MINimum?

Returns the IQ offset from the result summary list in dB.

Example

`"FETC:SUMM:IQOF?"`

Returns the current IQ-offset in dB

Characteristics

*RST value: -

SCPI: device-specific

Mode

UL, DL

FETCh:SUMMary:GIMBalance[:AVERage]?
FETCh:SUMMary:GIMBalance:MAXimum?
FETCh:SUMMary:GIMBalance:MINimum?

Returns the IQ gain imbalance from the result summary list in dB.

Example

`"FETC:SUMM:GIMB?"`

Returns the current gain imbalance in dB.

Characteristics

*RST value: -

SCPI: device-specific

Mode

UL, DL

FETCh:SUMMary:QUADerror[:AVERage]?
FETCh:SUMMary:QUADerror:MAXimum?
FETCh:SUMMary:QUADerror:MINimum?

Returns the mean "Quadrature Error" from the result summary list in degrees.

Example

```
"FETC:SUMM:QUAD?"
```

Returns the current mean Quadrature Error in degrees.

Characteristics

*RST value: -

SCPI: device-specific

Mode

UL, DL

FETCh:SUMMary:POWer[:AVERage]?
FETCh:SUMMary:POWer:MAXimum?
FETCh:SUMMary:POWer:MINimum?

Returns the "Power" value from the result summary list in dBm.

Example

```
"FETC:SUMM:POW?"
```

Returns the average power in dBm.

Characteristics

*RST value: -

SCPI: device-specific

Mode

UL, DL

FETCh:SUMMary:CRESt?

Returns the crest factor from the result summary list in dB.

Example

```
"FETC:SUMM:CRES?"
```

Returns the current crest factor in dB.

Characteristics

*RST value: -

SCPI: device-specific

Mode

UL, DL

FETCh:SUMMary:TFRame?

Returns the trigger to subframe value.

Example

"FETC:SUMM:TFR?"

Returns the trigger to frame value

Characteristics

*RST value: -

SCPI: device-specific

Mode

UL, DL

FETCh:PLCI:CIDGroup?

Returns the cell identity group detected by the DSP kernel. If no valid value has been detected yet, the command will return -1.

Example

"FETC:PLCI:CIDG?"

Returns the current CID group detected.

Characteristics

*RST value: -

SCPI: device-specific

Mode

UL, DL

FETCh:PLCI:PLID?

Returns the cell identity detected by the DSP kernel. If no valid value has been detected yet the command will return -1.

Example

"FETC:PLCI:PLID?"

Returns the current detected cell identity.

Characteristics

*RST value: -

SCPI: device-specific

Mode

UL, DL

FETCh:CYCPrefix?

Returns the cyclic prefix type detected by the DSP kernel. If no valid value has been detected yet the command will return -1.

Example

```
"FETC:CYCP?"
```

Returns the current cyclic prefix length type.

Parameters

NORM	Normal cyclic prefix length detected
EXT	Extended cyclic prefix length detected

Characteristics

*RST value: -

SCPI: device-specific

Mode

UL, DL

7.6 FORMat Subsystem

List of commands

- FORMat[:DATA] [?]

FORMat[:DATA] [?]

Specifies the data format for the data transmission between the LTE software and the remote client. Supported formats are ASCII, PACKED or REAL32.

Example

```
"FORM REAL"
```

The software will send binary data in Real32 data format.

Parameters

ASCii | PACKED | REAL

Characteristics

*RST value: ASCii

SCPI: conforming

Mode

UL, DL

7.7 INITiate Subsystem

List of commands

- INITiate[:IMMediate]
- INITiate:REFResh

INITiate[:IMMediate]

Starts a new measurement sequence. If a measurement sequence is already in progress the command will have no effect.

Example

`"INIT"`

Attempts to start a new measurement.

Characteristics

*RST value: -

SCPI: device-specific

Mode

UL, DL

INITiate:REFResh

This command updates the current IQ measurement results to reflect the current measurement settings. Note no new IQ data is captured. I.e. the measurement settings apply to the IQ data being currently in the capture buffer. The command applies exclusively to IQ measurements. It requires available IQ data.

Example

`"INIT:REFR"`

The R&S FSQ-K101/K105 will update the IQ results

Characteristics

*RST value: -

SCPI:device-specific

Mode

UL, DL

7.8 INPut Subsystem

List of commands

- INPut:IQ:BALanced[:STATe][?]
- INPut:IQ:IMPedance[?]
- INPut:ATT<1..4>[?]
- INPut:DIQ:SRATe[?]
- INPut:DIQ:RANGe[:UPPer][?]

INPut:IQ:BALanced[:STATe][?]

Specifies whether the IQ inputs are symmetrical (balanced) or asymmetrical (unbalanced). Note that this command requires option B71.

Example

```
"INP:IQ:BAL ON"
```

Specifies symmetrical (balanced) IQ inputs.

Parameters

ON|OFF

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

UL, DL

INPut:IQ:IMPedance[?]

Specifies the input impedance for the IQ inputs. Note that this command requires option B71.

Example

```
"INP:IQ:IMP LOW"
```

Specifies low input impedance for IQ inputs.

Parameters

LOW | HIGH

Characteristics

*RST value: LOW

SCPI: device-specific

Mode

UL, DL

INPut:ATT<1..4>[?]

Configures the RF attenuation used by the analyzer specified via the suffix <1..4>.

Example

```
"INP:ATT2 10 dB"
```

Sets the mechanical attenuation of analyzer 2 to 10 dB.

Parameters

Numeric value

Characteristics

*RST value: 10 dB

SCPI: conforming

Mode

RF, UL, DL

INPut:DIQ:SRATe[?]

Configures the digital IQ source sampling rate in Hz.

Example

```
"INP:DIQ:SRAT 5MHz"
```

Sets the source sampling rate to 5 MHz.

Parameters

Numeric value

Characteristics

*RST value: 10 MHz

SCPI: device-specific

Mode

DigIQ, UL, DL

INPut:DIQ:RANGe[:UPPer][?]

Configures the full scale level used for digital IQ mode in Volt.

Example

```
"INP:DIQ:RANG 0.7"
```

Sets the full scale level to 0.7 V.

Parameters

Numeric value

Characteristics

*RST value: 1 V

SCPI: device-specific

Mode

DigIQ, UL, DL

7.9 MMEMory Subsystem

List of commands

- MMEMory:LOAD:DEM
- MMEMory:STORe:DEM

MMEMory:LOAD:DEM

Restores previously saved demodulation settings. The input file must be of type "*.allocation" and depends on the link direction that was currently selected when the file was saved. Only files with correct link directions can get loaded.

Example

```
"MMEM:LOAD:DEM 'D:\USER\Settingsfile.allocation'"
```

Characteristics

*RST value: -

SCPI: device-specific

Mode

UL, DL

MMEMory:STORe:DEM

Stores the current demodulation settings to a file. The resulting file type is "*.allocation". Existing files will be overwritten.

Example

```
"MMEM:STOR:DEM 'D:\USER\Settingsfile.allocation'"
```

Characteristics

*RST value: -

SCPI: device-specific

Mode

UL, DL

7.10 SENSe Subsystem

The SENSe command is used to set and get the values of parameters in the remote software.

List of commands

[SENSe][:LTE]:UL:DEMod:CDCoffset[?]

Defines if DC offset gets compensated.

Example

```
"SENS:UL:DEM:CDC ON"
```

Activates the DC-offset compensation.

Parameters

ON|OFF

Characteristics

*RST value: ON

SCPI: Device specific

Mode

UL

[SENSe][:LTE]:UL:DEMod:AUTO[?]

Activates or deactivates automatic demodulation for UL.

Example

```
"SENS:UL:DEM:AUTO ON"
```

Activates the auto-demodulation for UL.

Parameters

ON|OFF

Characteristics

*RST value: ON

SCPI: device-specific

Mode

UL

[SENSe][:LTE]:UL:DEMod:CBSCrambling[?]

Specifies whether the scrambling for coded bits shall be used or not.

Example

```
"SENS:UL:DEM:CBSC ON"
```

Activates scrambling for coded bits.

Parameters

ON | OFF

Characteristics

*RST value: ON

SCPI: device-specific

Mode

UL

[SENSe][:LTE]:UL:DEMod:CESTimation[?]

Configures the channel estimation type for UL.

Example

```
"SENS:UL:DEM:CEST PIL"
```

Use pilots only for channel estimation.

Parameters:

PIL	Pilot only
PILPAY	Pilot and payload

Characteristics

*RST value: PIL

SCPI: device-specific

Mode

UL

[SENSe][:LTE]:UL:DEMod:MODE[?]

Specifies the analysis mode for UL.

Example

```
"SENS:UL:DEM:MODE PUSC"
```

Use PUSCH/PUCCH analysis mode.

Parameters:

PUSC	In this analysis mode the PUSCH/PUCCH channels are analyzed.
PRAC	In this analysis mode only the PRACH is analyzed.

Characteristics

*RST value: PUSC

SCPI: device-specific

Mode

UL

[SENSe][:LTE]:UL:DEMod:SISYnc[?]

Specifies whether the suppressed interference synchronization shall be used or not.

Example

```
"SENS:UL:DEM:SISY ON"
```

Activates the suppressed interference synchronization.

Parameters

ON | OFF

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

UL

[SENSe][:LTE]:UL:TRACking:PHASe[?]

Configures the phase tracking type for UL.

Example

```
"SENS:UL:TRAC:PHAS PILPAY"
```

Use pilots and payload for channel estimation.

Parameters:

OFF	Deactivate phase tracking
PIL	Pilot only
PILPAY	Pilot and payload

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

UL

[SENSe][:LTE]:UL:TRACking:TIME[?]

Activates or deactivates timing tracking for UL.

Example

```
"SENS:UL:TRAC:TIME ON"
```

Activates timing tracking.

Parameters

ON|OFF

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

UL

[SENSe][:LTE]:FRAMe:COUNt:STATe[?]

Activates or deactivates overall frame count.

Overall Frame Count specifies whether a specified number of frames are to be captured and analyzed.

Example

```
"FRAM:COUN:STAT ON"
```

Activates overall frame count.

Parameters

ON | OFF

Characteristics

*RST value: ON

SCPI: device-specific

Mode

UL, DL

[SENSe][:LTE]:FRAMe:COUNt[?]

Sets the number of frames to analyze.

Example

```
"FRAM:COUN 10"
```

Sets 10 frames to analyze.

Parameters

Numeric value

Characteristics

*RST value: 1

SCPI: device-specific

Mode

UL, DL

[SENSe][:LTE]:FRAMe:COUNt:AUTO[?]

Sets the number of frames to analyze in accordance to the EUTRA/LTE standard.

Example

"FRAM:COUN:AUTO ON"

Activates automatic setting of number of frames to analyze.

Parameters

ON | OFF

Characteristics

*RST value: ON

SCPI: device-specific

Mode

UL, DL

[SENSe][:LTE]:PREamble:SELect[?]

Configures the preamble to be analyzed.

Example

"SENS:PRE:SEL ALL"

Select all preambles for analysis.

Parameters:

ALL	Select all preambles
0...number of analyzed preambles	Select a single preamble

Characteristics

*RST value: ALL

SCPI: device specific

Mode

UL

[SENSe][:LTE]:SLOT:SELect[?]

Configures the slot to be analyzed.

Example

"SENS:SLOT:SEL S1"

Selects slot1 for analysis.

Parameters

S0 Selects slot0

S1 Selects slot1

Characteristics

*RST value: S0

SCPI: device specific

Mode

UL

[SENSe][:LTE]:SUBFrame:SELect[?]

Configures the subframe to be analyzed.

Example

```
"SENS:SUBF:SEL ALL"
```

Select all subframes for analysis.

Parameters:

ALL Select all subframes

0...9 Select a single subframe

Characteristics

*RST value: ALL

SCPI: device specific

Mode

UL, DL

[SENSe]:FREQuency:CENTer[?]

Configures the current center frequency for RF-mode in Hz. Modifiers like MHz or GHz may also be used.

Example

```
"SENS:FREQ:CENT 2GHZ"
```

Set the center frequency to 2 GHz.

Characteristics

*RST value: 1GHz

SCPI: conforming

Mode

UL, DL

[SENSe]:IQ:DITHer[:STATe][?]

Activates or deactivates input dithering.

Example

```
"SENS:IQ:DITH ON"
```

Activate input dithering

Parameters

ON|OFF

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

UL, DL

[SENSe]:IQ:LPASs[:STATe][?]

Activates or deactivates the baseband input lowpass.

Example

```
"SENS:IQ:LPAS ON"
```

Activate the input lowpass.

Parameters

ON|OFF

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

UL, DL

[SENSe]:POWer:AUTO:TIME[?]

Configures the auto level track time.

Example

```
"SENS:POW:AUTO:TIME 200ms"
```

An auto level track time of 200 ms gets set.

Characteristics

*RST value: 100 ms

SCPI: device-specific

Mode

UL, DL

[SENSe]:POWer:AUTO<1..4>[?]

Activates or deactivates auto level. The suffix defines for which analyzer the setting shall take effect.

Example

```
"SENS:POW:AUTO2 ON"
```

Activate auto level for analyzer number 2.

Parameters

ON|OFF

Characteristics

*RST value: ON

SCPI: device-specific

Mode

UL, DL

[SENSe]:POWer:ACHannel:AACHannel[?]

Selects the ACLR Assumed Adj. Channel Carrier in the general settings menu.

Example

```
"SENS:POW:ACH:AACH UTRA384"
```

Selects an UTRA signal with a bandwidth of 3.84MHz as assumed adjacent channel carrier.

Parameters

EUTRA	Selects an EUTRA signal of the same bandwidth like the TX channel as assumed adjacent channel carrier.
UTRA128	Selects an UTRA signal with a bandwidth of 1.28MHz as assumed adjacent channel carrier.
UTRA384	Selects an UTRA signal with a bandwidth of 3.84MHz as assumed adjacent channel carrier.
UTRA768	Selects an UTRA signal with a bandwidth of 7.68MHz as assumed adjacent channel carrier.

Characteristics

*RST value: EUTRA

SCPI: device-specific

Mode

UL, DL

[SENSe]:POWer:NCORrection[?]

Activates or deactivates Noise Correction for ACLR measurements.

Example

```
"SENS:POW:NCOR ON"
```

Activates noise correction.

Parameters

ON|OFF

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

UL, DL

[SENSe]:SWAPiq[?]

Specifies if the IQ data shall be swapped.

Example

```
"SENS:SWAP ON"
```

Activate IQ-swapping

Parameters

ON|OFF

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

UL, DL

[SENSe]:SWEep:TIME[?]

Specifies the time of a single sweep. The capture time therefore defines the amount of data that is recorded during a single sweep.

Example

```
"SWEep:TIME 30"
```

Sets the capture time to 30 ms.

Parameters

Numeric value

Characteristics

*RST value: 20.1 ms

SCPI: device-specific

Mode

UL, DL

SENSe:INPut[?]

Configures the current signal source. Signal sources can be baseband, digital IQ and Radio Frequency. (Remark: In the current remote control version "File" is not supported as signal source)

Example

```
"SENS:INP DIQ"
```

Select digital IQ as signal source.

Parameters

RF	Select radio frequency input as signal source.
AIQ	Select analog IQ input (baseband) as signal source.
DIQ	Select digital IQ input as signal source
FILE	<Not supported yet>

Characteristics

*RST value: -

SCPI: device-specific

Mode

UL, DL

7.11 TRACe Subsystem

List of commands

- TRACe[:DATA]?

TRACe[:DATA]?

Returns all the measured data that relates to the currently selected measurement type. The data format returned is particular to the currently selected measurement type and is specified below.

- Capture Buffer
- EVM vs Carrier
- EVM vs Symbol
- EVM vs Subframe
- Spectrum Emission Mask
- Adjacent Channel Power
- Inband Emission
- Channel Flatness
- Channel Flatness SRS
- Group Delay
- Flatness Difference
- Constellation Diagram
- DFT Precoded Constellation
- CCDF
- Allocation Summary
- Bitstream

Parameter

TRACE1 | TRACE2 | TRACE3 | LIST

Return values

The returned values are scaled in the current measurement unit. For some measurements the unit may change depending on the unit-settings specified in the General Setup menu (or set by the UNIT:EVM-command).

ASCII format (FORMat ASCII):

In ASCII format, a list of values separated by commas is returned (Comma Separated Values = CSV). Empty fields will return NaN.

Binary format (FORMat REAL,32):

If the transmission takes place using the binary format (REAL,32), the data are transferred in block format (Definite Length Block Data according to IEEE 488.2). They are arranged in succeeding lists of I and Q data of 32 Bit IEEE 754 floating point numbers.

Capture Buffer

<Not implemented yet (returns nothing)>

EVM vs Carrier

Returns the EVM-vs-Carrier-values as list over all carriers. Depends on the Subframe selection that can be made in the General Settings.

Trace1: Mean values (averaged over all subframes) [dB | Percent]

Trace2: Minimum values (nothing if a single subframe is selected) [dB | Percent]

Trace3: Maximum values (nothing if a single subframe is selected) [dB | Percent]

EVM vs Symbol

Returns the EVM-vs-Symbol-values as list over all symbols. If a single subframe is selected in the General Settings, only the symbols of the selected subframe will be returned.

Trace1: Mean values [dB | Percent]

EVM vs Subframe

Returns the EVM-vs-Symbol-values as list over all subframes.

Trace1: Mean values [dB | Percent]

Spectrum Emission Mask

Returns the spectrum emission mask results as follows.

Trace1: Clear power values [dBm]

Trace2: Nothing

Trace3: Nothing

List: Spectrum Emission Mask (SEM) summary results.
Result data will be returned as a fixed number of 625 trace points in floating point format in groups of 9 comma separated values as follows:

- 1st Value -Index in the table of results
- 2nd Value -Start frequency band (Hz)
- 3rd Value -Stop frequency band (Hz)
- 4th Value -RBW (Hz)
- 5th Value -limit fail frequency (Hz)
- 6th Value -Power absolute (dBm)
- 7th Value -Power relative (dBc)
- 8th Value -Limit distance (dB)
- 9th Value -Failure flag (1 = fail, 0 = pass)

Adjacent Channel Power

Returns the ACLR power values as vector.

Trace1: Clear power values [dBm]

Trace2: Nothing

Trace3: Nothing

List: Nothing

Inband Emission

Returns the relative inband emission of the currently selected slot. Always returns nothing if all subframes are selected in the general settings menu.

Trace1: Relative resource block indexes (X axis of the plot)

Trace2: Relative inband emission values [dB]

Trace3: Upper limit line values [dB]

Channel Flatness

Returns the spectrum flatness of the currently selected slot in dB as list over the considered frequency span. Depends on the subframe selection that can be made in the General Settings.

Trace1: Mean values (averaged over all subframes) [dB]

Trace2: Minimum values (nothing if a single subframe is selected) [dB]

Trace3: Maximum values (nothing if a single subframe is selected) [dB]

Channel Flatness SRS

Returns the spectrum flatness sounding of the currently selected slot in dB as list over the considered frequency span. Depends on the subframe selection that can be made in the General Settings.

Trace1: Mean values (averaged over all subframes) [dB]

Trace2: Minimum values (nothing if a single subframe is selected) [dB]

Trace3: Maximum values (nothing if a single subframe is selected) [dB]

Group Delay

Returns the channel group delay of the currently selected slot in ns as list over the considered frequency span. Depends on the Subframe selection that can be made in the General Settings.

Trace1: Mean values (averaged over all subframes) [ns]

Trace2: Minimum values (nothing if a single subframe is selected) [ns]

Trace3: Maximum values (nothing if a single subframe is selected) [ns]

Flatness Difference

Returns the channel flatness difference of the currently selected slot in dB as list over the considered frequency span. Depends on the Subframe selection that can be made in the General Settings.

Trace1: Mean values (averaged over all subframes) [dB]

Trace2: Minimum values (nothing if a single subframe is selected) [dB]

Trace3: Maximum values (nothing if a single subframe is selected) [dB]

Constellation Diagram

This measurement represents I and Q data. Data will be returned as an array of interleaved I and Q data until all data is exhausted.

Trace1:

All detected data-points will be returned. The amount of data can be narrowed by changing settings in the "Constellation Selection" menu. Only data points that meet the requirements specified in the "Constellation Selection" menu will be returned.

The the constellation data will be sweeped and returned in the following order:

Subframe0 ⇨ Symbol0 ⇨ First Carrier to last Carrier of Symbol 0
Subframe0 ⇨ Symbol1 ⇨ First Carrier0 to last Carrier of Symbol 1
Subframe0 ⇨ …
Subframe0 ⇨ Last Symbol of Subframe0 ⇨ First Carrier to last Carrier
Subframe1 ⇨ Symbol0 ⇨ First Carrier to last Carrier of Symbol 0
Subframe1 ⇨ Symbol1 ⇨ First Carrier to last Carrier of Symbol 1
Subframe1 ⇨ …
Subframe1 ⇨ Last Symbol of Subframe0 ⇨ First Carrier to last Carrier
…
Last Subframe

Trace2:

Returns the I and Q values of the pilot symbols.

DFT Precoded Constellation

Not implemented yet. (returns nothing)

CCDF

Returns the complementary cumulative distribution function results in percent as list over the power level in dB. The first value returned represents the number of following values. Trace1 will return the probablility-values (Y-Axis) while Trace2 will return the corresponding power-level-steps (X-Axis).

Trace1: Probability values (Y-Axis) [Percent]

Trace2: Corresponding power steps (X-Axis) [dB]

Allocation Summary

The Allocation Summary wil be returned line by line. The result-data has to be interpreted differently for downlink and uplink.

The data will be returned in groups of 6 comma separated values as follows:

- 1st value – Subframe Number
- 2nd value – Allocation ID

  -1 = Not analyzed
  0 = Data symbol
  1 = Reference symbol
  -40 = PUSCH
  -41 = DMRS PUSCH
  -42 = SRS PUSCH
  -50 = PUCCH
  -51 = DMRS PUCCH
  -70 = PRACH

- 3rd value – Number of RB
- 4th value – Offset RB
- 5th value – Modulation

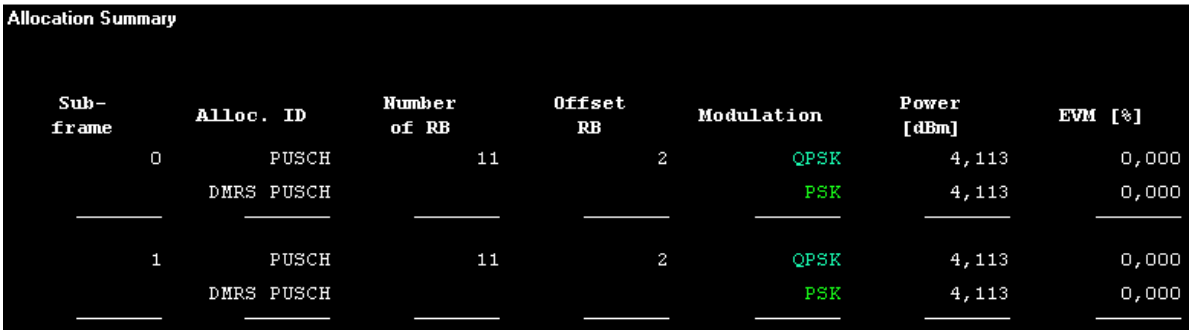
0 = Unrecognized
1 = RBPSK (both constellation points are located on the X-axis)
2 = QPSK
3 = 16QAM
4 = 64QAM
5 = 8PSK
6 = PSK
7 = Modulation Mixture
8 = BPSK

- 6th value – Power in dBm
- 7th value – EVM in dB or percent

Each transmitted group represents one line of the summary table.

This command is not available for Real32 data format and will therefore always return ASCII formatted data

Example:



Allocation Summary

Sub-frame	Alloc. ID	Number of RB	Offset RB	Modulation	Power [dBm]	EVM [%]
0	PUSCH	11	2	QPSK	4,113	0,000
	DMRS PUSCH			PSK	4,113	0,000
1	PUSCH	11	2	QPSK	4,113	0,000
	DMRS PUSCH			PSK	4,113	0,000

SCPI would return the following:

```
S|A I|R|R|M|P          | E
u|l D|B|B|o|o          | V
b|l  | | |d|w          | M
f|o  |N|O|u|e          |
r|c  |u|f|l|r          |
a|a  |m|f|a|           |
m|t  |b|s|t|           |
e|i  |e|e|i|           |
 |o  |r|t|o|           |
 |n  | | | |         .|

0,-40,11,2,2,4.1130397023002,1.19224177197452E-06,
0,-41,,,6,4.1130397023002,1.14742899626208E-06,
1,-40,11,2,2,4.1130397023002,1.17671756783011E-06,
1,-41,,,6,4.1130397023002,1.14618350366413E-06
```

Bitstream

Just like the allocation summary, the bitsteam data will be returned in groups. You have to distinguish between bitwise and hexadecimal data format.

The data will be returned in comma separated values as follows:

- 1st value – Subframe number
- 2nd value – Modulation:

  0 = Unrecognized
  1 = RBPSK (both constellation points are located on the X-axis)
  2 = QPSK
  3 = 16QAM
  4 = 64QAM
  5 = 8PSK
  6 = PSK
  7 = Modulation Mixture
  8 = BPSK

- 3rd value –

  Hexmode: Number of Symbols to be transmitted
  Binary Mode: Number of bits to be transmitted

- 4th and following values till modulation type subframe number changes –

  Hexmode: Comma-separated stream of two-digit hexadecimal numbers
  Binary Mode: Comma-separated stream of binary numbers

This command is not available for Real32 data format and will therefore always return ASCII formatted data

Example

Bit Stream

Sub-frame	Modulation	Symbol Index	Bit Stream
0	QPSK	0	01 01 02 03 00 00 01 02 02 00 00 02 02 03 02 00
0	QPSK	16	00 00 01 00 00 01 03 02 03 00 01 02 02 01 02 01
0	QPSK	32	03 00 03 01 01 01 01 02 02 02 01 03 02 03 01 02
0	QPSK	48	03 00 01 01 01 00 02 03 03 03 01 00 03 00 00 02
0	QPSK	64	03 00 00 02 02 02 02 03 02 01 01 00 01 00 02 02
0	QPSK	80	03 03 03 03 02 01 03 00 01 01 01 02 02 00 03 02
0	QPSK	96	01 01 00 03 00 00 02 00 02 01 00 02 02 01 03 02
0	QPSK	112	02 02 02 00 00 03 02 02 02 00 03 00 03 03 00 01
0	QPSK	128	01 00 03 00 01 03 00 03 00 01 02 00 00 01 03 00
0	QPSK	144	02 02 02 02 02 00 01 01 02 02 01 02 03 03 03 00
0	QPSK	160	02 02 00 02 02 03 00 01 01 03 01 02 02 01 03 00

SCPI would return the following:

```
S|M|N S| B     i                                                    |
u|o|u y| i     n                                                    |
b|d|m m| t                                                          |
f|u|b b| H                                                          |
r|l|e o| S     e                                                    |
a|a|r l| t     x                                                    |
m|t|  s| r                                                          |
e|i|o  | e                                                          |
 |o|f  | a                                                          |
 |n|   | m                                                          |
```

```
0,2,1584,01,01,02,03,00,00,01,02,02,00,00,02,02,03,02,00,00,
00,01,00,00,01,03,02,03,00,01,02,02,01,02,01,03,00,03,01,01,
01,01,02,02,02,01,03,02,03,01,02,03,00,01,01,01,00,02,03,03,
03,01,00,03,00,00,02,03,00,00,02,02,02,02,03,02,01,01,00,01,
00,02,02,03,03,03,03,02,01,03,00,01,01,01,02,02,00,03,02,01,
01,00,03,00,00,02,00,02,01,00,02,02,01,03,02,02,02,02,00,00,
03,02,02,02,00,03,00,03,03,00,01,01,00,03,00,01,03,00,03,00,
01,02,00,00,01,03,00,02,02,02,02,02,00,01,01,02,02,01,02,03,
03,03,00,02,02,00,02,02,03,00,01,01,03,01,02,02,01,03,00,00,
01,02,00,03,00,02,00,01,01,03,03,03,00,03,01,01,01,00,02,01,
00,01,02,02,02,02,02,01,00,03,01,…
```

<continues like this till next datablock starts or end of data reached>

7.12 TRIGger Subsystem

The trigger subsystem is used to synchronize device action(s) with events.

List of commands

TRIGger[:SEQuence]:MODE[?]

Configures the trigger mode used.

Example

```
"TRIG:MODE IMM"
```

Free trigger will be used for measurements.

Parameter

EXTernal	Use an external trigger during measurement
IMMediate	Run measurement in "free trigger"-mode
POWer	Use an IF power trigger during measurement

Characteristics

*RST value: IMMediate

SCPI: device-specific

Mode

UL, DL

TRIGger[:SEQuence]:HOLDoff[?]

Configures the trigger offset.

Example

```
"TRIG:HOLD 5MS"
```

Sets the trigger offset to 5 ms.

Parameter

numeric value in seconds

Characteristics

*RST value 0 s

SCPI: conforming

Mode

UL, DL

TRIGger[:SEQuence]:LEVel<1..4>:POWer[?]

Configures the IF Power Trigger Level of the analyzers used in RF mode. The suffix <1..4> specifies to which analyzer the setting applies to.

Example

```
"TRIG:LEV1:POW -10"
```

Sets the IF power trigger level used by analyzer 1 to -10 dBm.

Parameters

Numeric value in dBm

Characteristics:

*RST value: -20 dBm

SCPI: device-specific

Mode

UL, DL

7.13 UNIT Subsystem

List of commands

- UNIT:EVM[?]
- UNIT:BSTR[?]

UNIT:EVM[?]

Specifies the units for EVM results.

Example

```
"UNIT:EVM PCT"
```

EVM results to be returned in %.

Parameter

DB	EVM results returned in dB
PCT	EVM results returned in %

Characteristics

*RST value: DB

SCPI: device-specific

Mode

UL, DL

UNIT:BSTR[?]

Specifies if the bit stream gets displayed using bits or using symbols.

Example

```
"UNIT:BSTR BIT"
```

Bit stream gets displayed using Bits.

Parameter

SYMbols	Bit stream gets displayed using Symbols
BITs	Bit stream gets displayed using Bits

Characteristics

*RST value: SYMbols

SCPI: device-specific

Mode

UL, DL

7.14 Table of Softkeys with Assignment of Remote Commands

GENERAL SETTINGS		
General Settings	Standard	Not supported yet.
	Duplexing	CONFigure[:LTE]:DUPLexing <TDD | FDD>
	Link direction	CONFigure[:LTE]:LDIRection <DL | UL>
	Frequency	[SENSe]:FREQuency:CENTer <value>
	Source	[SENSe]:INPut <RF | AIQ | DIQ>
	Level Settings	Not available.
	Auto Level	[SENSe]:POWer:AUTO<1..4> <ON | OFF>
	Reference Level (RF)	CONFigure:POWer:EXPected:RF<1..4> <value>
	Attenuation	INPut:ATT<1..4> <value>
	Ext Att	DISPlay[:WINDow]:TRACe:Y:RLEVel:OFFSet <value>
	Reference level (BB)	CONFigure:POWer:EXPected:IQ<1..4> <value>
	Trigger Mode	TRIGger[:SEQuence]:MODE <EXT | IMM>
	Trigger Offset	TRIGger[:SEQuence]:HOLDoff <value>
	IF Power Trigger Level	TRIGger[:SEQuence]:LEVel<1..4>:POWer <value>
	Capture Time	[SENSe]:SWEep:TIME <value>
	Overall Frame Count	[SENSe][:LTE]:FRAMe:COUNt:STATe <ON | OFF>
	Num. of Frames to Analyze	[SENSe][:LTE]:FRAMe:COUNt <value>
	Auto Acc. to Standard	[SENSe][:LTE]:FRAMe:COUNt:AUTO <ON | OFF>
	EVM Unit	UNIT:EVM <DB | PCT>
	Bit Stream Format	UNIT:BSTR <SYM | BIT>
	Subframe Selection	[SENSe][:LTE]:SUBFrame:SELect <ALL | value>
	Slot Selection	[SENSe][:LTE]:SLOT:SELect <S0|S1>
	Preamble Selection	[SENSe][:LTE]:PREamble:SELect <ALL | value>
	Assumed Adj. Channel Carrier	[SENSe]:POWer:ACHannel:AACHannel <EUTRA|UTRA128|UTRA384|UTRA768>
	ACLR Noise Correction	[SENSe]:POWer:NCORrection
	MIMO Analyzer Configuration	CONFigure:ADDRess<1..4>
Advanced Settings	Swap IQ	[SENSe]:SWAPiq <ON | OFF>
	Input high impedance	INPut:IQ:IMPedance <LOW | HIGH>
	Input balanced	INPut:IQ:BALanced[:STATe] <ON | OFF>
	Input lowpass	[SENSe]:IQ:LPASs[:STATe] <ON | OFF>
	Input dithering	[SENSe]:IQ:DITHer[:STATe] <ON | OFF>

	Auto level track time	[SENSe]:POWer:AUTO:TIME <value>
	Source sampling rate	INPut:DIQ:SRATe <value>
	Full scale level	INPut:DIQ:RANGe[:UPPer] <value>
	Couple Screens	Not supported yet.
DEMOD SETTINGS		
Uplink Demodulation Settings	Analysis Mode	[SENSe][:LTE]:UL:DEMod:MODE <PUSC | PRAC>
	Channel Estimation Range	[SENSe][:LTE]:UL:DEMod:CESTimation <PIL | PILPAY>
	Compensate DC Offset	[SENSe][:LTE]:UL:DEMod:CDCOffset <ON | OFF>
	Scrambling of Coded Bits	[SENSe][:LTE]:UL:DEMod:CBSCrambling <ON | OFF>
	Auto Demodulation	[SENSe][:LTE]:UL:DEMod:AUTO <ON | OFF>
	Suppressed Interf. Sync.	[SENSe][:LTE]:UL:DEMod:SISYnc <ON | OFF>
	Phase Tracking	[SENSe][:LTE]:UL:TRACking:PHASe <OFF | PIL | PILPAY>
	Timing Tracking	[SENSe][:LTE]:UL:TRACking:TIME <ON | OFF>
Uplink Signal Characteristics	Channel Bandwidth	CONFigure[:LTE]:UL:BW <BW1_40 | BW2_50 | BW3_00 | BW5_00 | BW10_00 | BW15_00 | BW20_00>
	Number of Resource Blocks	CONFigure[:LTE]:UL:NORB <value>
	Cyclic Prefix	CONFigure[:LTE]:UL:CYCPrefix <NORM | EXT | AUTO>
	TDD UL/DL Allocations	CONFigure[:LTE]:UL:TDD:UDConf <0..6>
	Cell Identity Group	CONFigure[:LTE]:UL:PLCi:CIDGroup <0..167>
	Identity	CONFigure[:LTE]:UL:PLCi:PLID <0..2>
	Frame Number Offset	CONFigure[:LTE]:UL:SFNO <value>
	Configurable Subframes	CONFigure[:LTE]:UL:CSUBframes <1..10>
	Subframe configuration table	Enable PUCCH: CONFigure[:LTE]:UL:SUBFrame<0…9>:ALLoc:CONT <PUSC | PUCC>
		Modulation: CONFigure[:LTE]:UL:SUBFrame<0…9>:ALLoc:MODulation <QPSK | QAM16 | QAM64>
		Number of RB: CONFigure[:LTE]:UL:SUBFrame<0…9>:ALLoc:RBCount <value>
		Offset RB: CONFigure[:LTE]:UL:SUBFrame<0…9>:ALLoc:RBOffset <value>
		Power [dB]: CONFigure[:LTE]:UL:SUBFrame<0…9>:ALLoc:POWer <value>

Uplink Advanced Signal Characteristics	Demodulation Refer. Signal	Sequence: `CONFigure[:LTE]:UL:DRS:SEQUence <IQF | TGPP>`
		Group Hopping: `CONFigure[:LTE]:UL:DRS:GRPHopping <ON | OFF>`
		Sequence Hopping: `CONFigure[:LTE]:UL:DRS:SEQHopping <ON | OFF>`
		Enable n_PRS: `CONFigure[:LTE]:UL:DRS:ENPR <ON | OFF>`
		Relative Power PUSCH: `CONFigure[:LTE]:UL:DRS[:PUSCH]:POWer <value>`
		n_DMRS: Not available
		Delta Sequence Shift: `CONFigure[:LTE]:UL:DRS:DSSHift <value>`
		Relative Power PUCCH: `CONFigure[:LTE]:UL:DRS:PUCCH:POWer <value>`
	Sounding Refer. Signal	Present: `CONFigure[:LTE]:UL:SRS:STAT <ON | OFF>`
		Sequence: Not available
		Rel. Power: `CONFigure[:LTE]:UL:SRS:POWer <value>`
		SRS Subframe Conf. `CONFigure[:LTE]:UL:SRS:SUConfig <value>`
		SRS BW Conf. C_SRS `CONFigure[:LTE]:UL:SRS:CSRS <value>`
		Conf. Index I_SRS `CONFigure[:LTE]:UL:SRS:ISRS <value>`
		SRS Bandwidth B_SRS `CONFigure[:LTE]:UL:SRS:BSRS <value>`
		Transm. Comb. K_TC `CONFigure[:LTE]:UL:SRS:TRComb <value>`
		Hopping BW b_hop `CONFigure[:LTE]:UL:SRS:BHOP <value>`
		Freq. Domain Pos. n_RRC `CONFigure[:LTE]:UL:SRS:NRRC <value>`
		SRS Cyclic Shift N_CS `CONFigure[:LTE]:UL:SRS:CYCS <value>`
	PUSCH Structure	Frequency Hopping Mode: `CONFigure[:LTE]:UL:PUSCh:FHMode <NONE|INTer|INTRa>`

		Info. In Hopping Bits `CONFigure[:LTE]:UL:PUSC:FHOP:IIHB <value>`
		PUSCH Hopping Offset `CONFigure[:LTE]:UL:PUSC:FHOFfset <value>`
		Number of Subbands: `CONFigure[:LTE]:UL:PUSCh:NOSM <value>`
	PUCCH Structure	Number of RBs for PUCCH: `CONFigure[:LTE]:UL:PUCCh:NORB <value>`
		N_PUCCH: `CONFigure[:LTE]:UL:PUCCh:NPAR <value>`
		Format: `CONFigure[:LTE]:UL:PUCCh:FORMat <F1N | F1S | F1AN | F1AS | F1BN | F1BS | F2 | F2A | F2B>`
		Delta Shift: `CONFigure[:LTE]:UL:PUCCh:DESHift <value>`
		Delta Offset: `CONFigure[:LTE]:UL:PUCCh:DEOFfset <value>`
		N(1)_cs: `CONFigure[:LTE]:UL:PUCCh:N1CS <value>`
		N(2)_RB: `CONFigure[:LTE]:UL:PUCCh:N2RB <value>`
	PRACH Structure	PRACH Configuration: `CONFigure[:LTE]:UL:PRACh:CONF <value>`
		Restricted Set: `CONFigure[:LTE]:UL:PRACh:RSET <ON | OFF>`
		Frequency Offset: `CONFigure[:LTE]:UL:PRACh:FOFFset <value>`
		Ncs Conf: `CONFigure[:LTE]:UL:PRACh:NCSC <value>`
		Logical Root Sequ. Index: `CONFigure[:LTE]:UL:PRACh:RSEQ <value>`
		Sequence Index (v): `CONFigure[:LTE]:UL:PRACh:SINDex <value>`
		Freq. Res. Index: `CONFigure[:LTE]:UL:PRACh:FRINdex <value>`
		Half Frame Ind. t1_RA: `CONFigure[:LTE]:UL:PRACh:HFINdicator <value>`
	Global Settings	UE ID/n_RNTI: `CONFigure[:LTE]:UL:UEID <value>`

DISPLAY GRAPH LIST		
PVT ⇩	CAPTURE BUFFER	CALCulate<1|2>:FEED 'PVT:CBUF'
EVM ⇩	EVM VS CARRIER	CALCulate<1|2>:FEED 'EVM:EVCA'
	EVM VS SYMBOL	CALCulate<1|2>:FEED 'EVM:EVSY'
	EVM VS SUBFRAME	CALCulate<1|2>:FEED 'EVM:EVSU'
SPECTRUM ⇩	SPECTRUM MASK	CALCulate<1|2>:FEED 'SPEC:SEM'
	ACP	CALCulate<1|2>:FEED 'SPEC:ACP'
	POWER SPECTRUM	CALCulate<1|2>:FEED 'SPEC:PSPE'
	INBAND EMISSION	CALCulate<1|2>:FEED 'SPEC:IES0'|'SPEC:IES1'
	CHANNEL FLATNESS FLAT GRDEL	CALCulate<1|2>:FEED 'SPEC:GDEL'|'SPEC:FLAT'|'SPEC:FSRS'
	CHANNEL FLATNESS DIFFERENCE	CALCulate<1|2>:FEED 'SPEC:FDIF'
CONSTELL ⇩	CONSTELL	CALCulate<1|2>:FEED 'CONS:CONS'
	DFT PRECOD CONSTELL	CALCulate<1|2>:FEED 'CONS:DFTC'
	CONSTELL SELECTION	Not available.
STATISTICS / MISC ⇩	CCDF	CALCulate<1|2>:FEED 'STAT:CCDF'
	ALLOCATION SUMMARY	CALCulate<1|2>:FEED 'STAT:ASUM'
	BIT STREAM	CALCulate<1|2>:FEED 'STAT:BSTR'

Softkeys of the Setup Menu

CONFIG ANALYZER CONNECTION	Not available.
DATA SOURCE INST FILE	Not available.
SHOW LOGGING	Not supported yet.
SYSTEM INFO	Not supported yet.

Softkeys of the File Menu

LOAD DEMOD SETTINGS	`MMEMory:LOAD:DEM <filename>`
SAVE DEMOD SETTINGS	`MMEMory:STORe:DEM <filename>`
SAVE IQ DATA	Not supported yet.

Softkeys of the Display Menu

FULL SCREEN	Not available.
SPLIT SCREEN	Not available.
BACKGROUND COLOR	Not available.
HARDCOPY	Not supported yet.
HARDCOPY TO CLIPBOARD	Not supported yet.

Softkey MKR

MKR	Not available.

Softkey Open In Separate Window

OPEN IN SEPARATE WINDOW	Not available.

Appendix

A Import and Export of Data

This section describes how to import and export data from and to the EUTRA/LTE software.

The software will process the following types of data files the user may manipulate:

- I/Q data
- Frame description
- Screenshots
- Limit line definitions

A.1 IQ Data

Purpose

The EUTRA/LTE software is able to process I/Q data from a file rather than from the R&S FSQ/FSV instrument hardware. Captured I/Q data can also be stored in various formats for e.g. processing with other external tools or for support purposes.

Format

I/Q data can be formatted either in binary form or as ASCII files. The data is linearly scaled using the unit Volt (if a correct display of e.g. Capture Buffer power is required).

For **binary format**, data is expected as 32-bit floating point data, Little Endian format (also known as LSB Order or Intel format).

(EXAMPLE: 0x1D86E7BB in hexadecimal notation will be decoded to -7.0655481E-3.)

The data order can be either IQIQIQ or II..IQQ..Q.

To generate iqw-files of the correct format, the following Matlab code can be used, assuming that x is the complex valued IQ-symbol column vector and the file name is stored in sExportFileName as string:

```
% open file
fid = fopen(sExportFileName, 'w');
% make complex data real according to I Q I Q I Q …
x= [real(x) imag(x)].';
fwrite(fid, x(:), 'float32');
fclose(fid);
```

For **ASCII format**, data is expected as I and Q values in alternating rows, separated by new lines:

<I value 1>
<Q value 1>
<I value 2>
<Q value 2>
…

Usage – IMPORT

To use externally stored data, switch to input source File in the "General Settings" dialog box. Each time you start a new measurement, you will be prompted for the file name.

Usage – EXPORT

To export captured I/Q data, select "FILE", "Save IQ Data".

A.2 Frame Description

Purpose

The frame description is used to describe the complete modulation structure of the signal, such as bandwidth, modulation, etc.

Format

The frame setup is stored as an XML file. XML files are very commonly used to describe hierarchical structures in an easy-to-read format for both humans and PC. A typical frame setup file is shown below:

```
<FrameDefinition LinkDirection="uplink" TDDULDLAllocationConfiguration="0"
RessourceBlocks="50" CP="auto" PhysLayCellIDGrp="Group 0" PhysLayID="ID 0"
N_RNTI="0" N_f="0"  NOfSubbands="4" N_RB_HO="4"  NOfRB_PUCCH="4" DeltaShift="2"
N1_cs="6" N2_RB="1" NPUCCH="0" DeltaOffset="0" PUCCHStructureFormat="F1 normal"
N_c_fastforward="1600" HoppingBitInformation="0"  FrequencyHopping="None"
DemRefSeq="3GPP" DemPilBoostdBPUSCH="0" DemPilBoostdBPUCCH="0" GroupHop="0"
SequenceHop="0" EnableN_PRS="1" Delta_ss="0" N_DMRS1="0" N_DMRS2="0"
SoundRefSeq="3GPP" SoundRefBoostdB="0" SoundRefPresent="0" SoundRefSymOffs="13"
SoundRefCAZAC_u="2" SoundRefCAZAC_q="0" SoundRefCAZAC_alpha="0"
SoundRefCAZAC_mode="2" SoundRefB="0" SoundRefC="0" SRSSubframeConfiguration="0"
SoundRefN_CS="0" SoundRefK_TC="0" SoundRefN_RRC="0" SoundRefb_hop="0"
SoundRefI_SRS="0" SoundRefk0="24" SoundRefNumSubcarrier="132">
  <Frame>
    <Subframe>
      <PRBs>
        <PRB Start="2" Length="10" Modulation="QPSK" PUCCHOn="0"
BoostingdB="0"/>
      </PRBs>
    </Subframe>
  </Frame>
  <stControl PhaseTracking="1" TimingTracking="0" CompensateDCOffset="1"
UseBitStreamScrambling="1"  ChannelEstimationRange="2" AutoDemodulation="1" />
</FrameDefinition>
```

All settings which can be entered via "Demod Settings" can also be found in the frame setup file.

Additional allocations can be entered by adding additional PRB entries in the PRBs list.

The following restrictions apply to the frame setup content:

- At least one PRB must exist.
- Only one frame can be allocated in this software version.

Usage – IMPORT

To load a stored frame setup, select "FILE", then "Load Demod Setup".

Usage – EXPORT

To save a frame setup, select "FILE", then "Save Demod Setup".

A.3 User Defined Reference Symbols

Purpose

To offer maximum flexibility, it is possible to load a user-defined iq sequence for the reference signal. These symbol sequence consists of I/Q symbols. The reference symbols are mapped onto the physical carriers as defined in section "EUTRA/LTE Test & Measurement Assumptions made by Rohde & Schwarz".

Format

How to create user-defined I/Q symbol sequences is described in section "IQ Data".

The length of the I/Q symbol sequence must be a multiple of 2. If not enough I/Q symbols are available for mapping, the I/Q symbols are repeated.

Usage – IMPORT

The I/Q symbol definition file must be placed in the same folder as the EUTRA/LTE application binary ("%Program folder%\Rohde-Schwarz\EUTRA LTE" by default).

► The name of the Reference Symbols definition file must be *EutraUL_Pilots.iqw*

A.4 Limits

Purpose

The limit definition is used to specify user-defined limits, as the EUTRA/LTE standard does not describe explicit limits at the moment.

Currently, limits are only used in the Result Table ("MAIN", then "Display List").

Format

The limit definition can be provided as XML. An example, including comments on how to use the definition, can be found in the following paragraph:

```
<?xml version="1.0" encoding="utf-8"?>
<Limits>
  <UL>
    <EVM>
      <PUSCHQPSK Mean="0.175"/><!--Unit: linear (1 = 0 dB, 0.1 = -20 dB)-->
      <PUSCH16QAM Mean="0.125"/><!--Unit: linear (1 = 0 dB, 0.1 = -20 dB)-->
      <PUSCH64QAM/><!--Unit: linear (1 = 0 dB, 0.1 = -20 dB)-->
      <PhysicalChannel/><!--Unit: linear (1 = 0 dB, 0.1 = -20 dB)-->
      <PhysicalSignal/><!--Unit: linear (1 = 0 dB, 0.1 = -20 dB)-->
      <All/><!--Unit: linear (1 = 0 dB, 0.1 = -20 dB)-->
      <DemodulationReference/><!--Unit: linear (1 = 0 dB, 0.1 = -20 dB)-->
      <SoundingReference/><!--Unit: linear (1 = 0 dB, 0.1 = -20 dB)-->
    </EVM>
    <FrequencyError/><!--Unit: [Hz]-->
    <SamplingClockError/><!--Unit [ppm]-->
    <IQOffset/><!--Unit: linear (1 = 0 dB, 0.1 = -20 dB)-->
    <IQGainImbalance/><!--Unit: linear (1 = 0 dB, 0.1 = -20 dB)-->
    <IQQuadraturError/><!--Unit: [°]-->
    <PowerTotalPhysChan/><!--Unit: [W]-->
    <PowerTotalDemodRef/><!--Unit: [W]-->
    <PowerTotalSoundingRef/><!--Unit: [W]-->
    <PowerTotal/><!--Unit: [W]-->
    <CrestFactor/><!--Unit: linear (1 = 0 dB, 10 = 10 dB)-->
  </UL>

</Limits>
```

Limit definitions which are not required may be skipped by making no entries or by deleting the complete tag.

Usage – IMPORT

The bit definition file must be placed in the same folder as the EUTRA/LTE application binary ("%Program folder%\Rohde-Schwarz\EUTRA LTE" by default). The file name must be Default.eutra_limits. The file is read once during the start-up process of the software.

B Measurements in Detail

This section provides a detailed explanation of the measurements provided by R&S FSQ/FSV-K101/-K105 and provides help for using R&S FSQ/FSV-K101/-K105 to measure the characteristics of specific types of DUT.

B.1 Signal processing of the EUTRA /LTE uplink measurement application

Symbols

$a_{n,l}, \hat{a}_{n,l}$	data symbol (actual, decided)
$A_{k,l}$	data symbol after DFT-precoding
$\Delta f, \Delta \hat{f}_{\text{coarse}}$	carrier frequency offset between transmitter and receiver (actual, coarse estimate)

Δf_{res}	residual carrier frequency offset
ζ	relative sampling frequency offset
$H_{l,k}, \hat{H}_{l,k}$	channel transfer function (actual, estimate)
i	time index
$\hat{i}_{\mathrm{coarse}}, \hat{i}_{\mathrm{fine}}$	timing estimate (coarse, fine)
k	subcarrier index
l	SC-FDMA symbol index
n	index of modulated QAM symbol before DFT precoding
N_{DS}	number of SC-FDMA data symbols
N_{FFT}	length of FFT
N_{g}	number of samples in cyclic prefix (guard interval)
$N_{k,l}$	noise sample
N_{s}	number of Nyquist samples
N_{TX}	number of allocated subcarriers
Φ_l	common phase error
r_i	received sample in the time domain
$R'_{k,l}$	uncompensated received sample in the frequency domain
$\tilde{r}_{n,l}$	equalized received symbols of measurement path after IDFT
T	duration of the useful part of an SC-FDMA symbol
T_{g}	duration of the guard interval
T_{s}	total duration of SC-FDMA symbol

B.2 Introduction

The following description provides a brief overview of the digital signal processing used in the R&S FSQ/FSV's EUTRA/LTE uplink measurement application.

Between the received IF signal as the point of origin to the actual analysis results such as EVM, the digital signal processing can be divided into four major groups:

Data capture

Synchronization

Channel estimation / equalization

Analysis

} EUTRA / LTE uplink measurement application

The remainder of this description is structured accordingly.

B.3 Signal Processing

Data Capturing

The block diagram in Figure 7-1 shows the R&S FSQ hardware from the IF section to the processor running the EUTRA/LTE uplink measurement application. The selectable IF filter bandwidth ranges from 300 kHz to 50 MHz. The A/D converter samples the IF signal at a rate of 81.6 MHz. The digital signal is converted down to the complex baseband, is lowpass-filtered, and is resampled to the nearest multiple of the target sampling rate. The decimation filters suppress the aliasing frequencies arising from the subsequent downsampling to the target rate. Up to 16 M samples of the now available I/Q data can be stored in the capture buffer. (More capture buffer is available with the additional R&S FSQ-B100/-B102 option.)

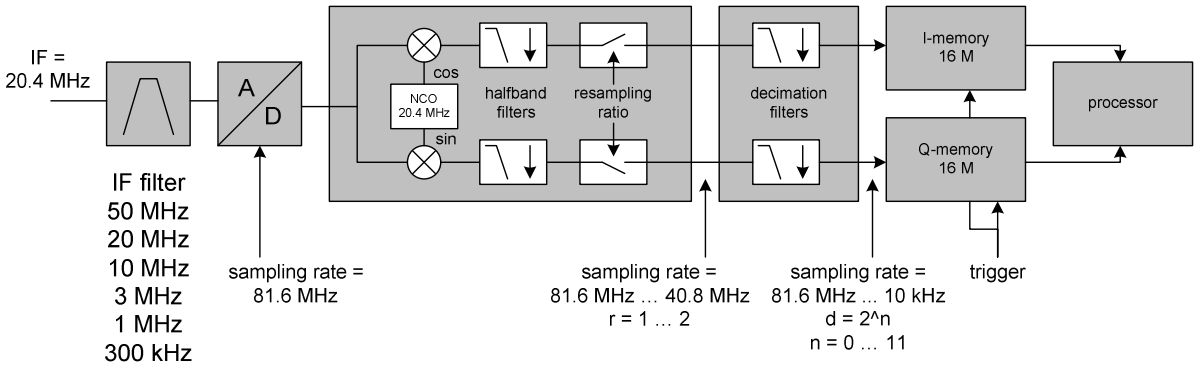


Figure 7-1: Data Capturing Mechanism of the R&S FSQ

B.4 EUTRA/LTE Uplink Measurement Application

The block diagram in Figure 7-2 shows the general structure of the EUTRA/LTE uplink measurement application from the capture buffer containing the I/Q data up to the actual analysis block.

After synchronization a fully compensated signal is produced in the reference path (purple) which is subsequently passed to the equalizer. An IDFT of the equalized symbols yields observations for the QAM transmit symbols $a_{n,l}$ from which the data estimates $\hat{a}_{n,l}$ are obtained via hard decision. Likewise a user defined compensation as well as equalization is carried out in the measurement path (cyan) and after an IDFT the observations of the QAM transmit symbols $\tilde{r}_{n,l}$ are provided. Accordingly, the measurement path might still contain impairments which are compensated in the reference path. The symbols of both signal processing paths form the basis for the analysis.

Synchronization

In a first step the areas of sufficient power are identified within the captured I/Q data stream which consists of the receive samples r_i. For each area of sufficient power, the analyzer synchronizes on subframes of the uplink generic frame structure [3]. After this coarse timing estimation, the fractional part as well as the integer part of the carrier frequency offset (CFO) are estimated and compensated. In order to obtain an OFDM demodulation via FFT of length N_{FFT} that is not corrupted by ISI, a fine timing is established which refines the coarse timing estimate.

A phase tracking based on the reference SC-FDMA symbols is performed in the frequency domain. The corresponding tracking estimation block provides estimates for

- the relative sampling frequency offset ζ,
- the residual carrier frequency offset Δf_{res},
- and the common phase error Φ_l.

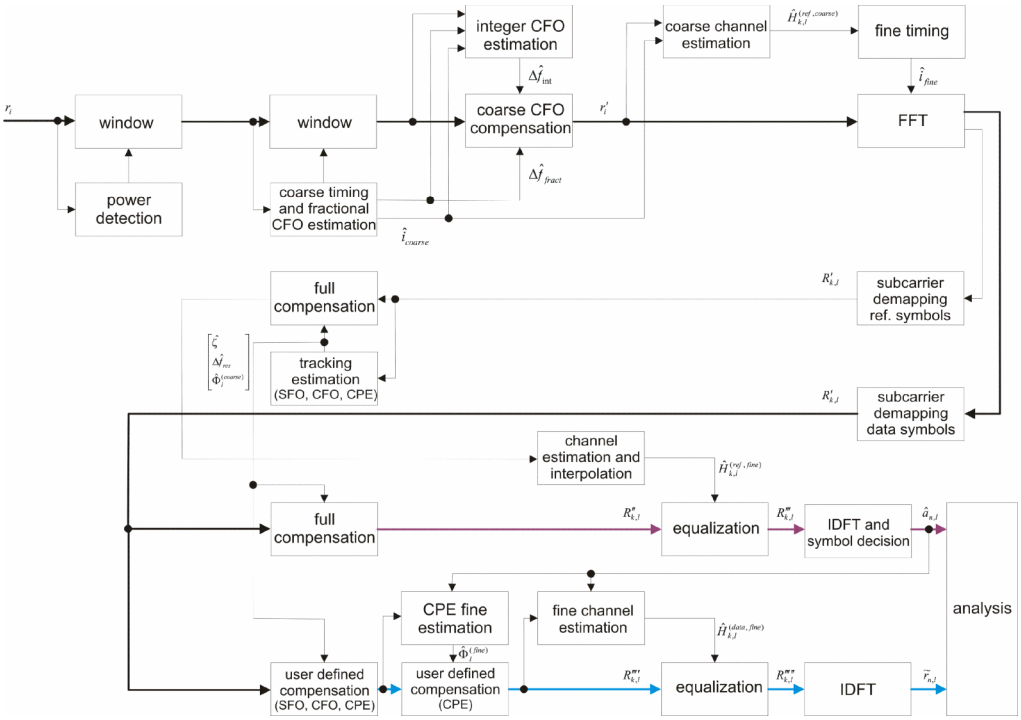


Figure 7-2: EUTRA/LTE Uplink Measurement Application

According to references [4, 5], the uncompensated samples $R'_{k,l}$ in the DFT-precoded domain can be stated as

with

$$R'_{k,l} = A_{k,l} \cdot H_{k,l} \cdot \underbrace{e^{j\Phi_l}}_{\text{CPE}} \cdot \underbrace{e^{j\,2\pi \cdot N_s/N_{FFT} \cdot \zeta \cdot k \cdot l}}_{\text{SFO}} \cdot \underbrace{e^{j\,2\pi \cdot N_s/N_{FFT} \cdot \Delta f_{res} \cdot T \cdot l}}_{\text{res.CFO}} + N_{k,l} \quad (1)$$

- the DFT precoded data symbol $A_{k,l}$ on subcarrier k at SC-FDMA symbol l,
- the channel transfer function $H_{k,l}$,
- the number of Nyquist samples N_s within the total duration T_s,
- the duration of the useful part of the SC-FDMA symbol $T = T_s - T_g$,
- the independent and Gaussian distributed noise sample $N_{k,l}$.

Within one SC-FDMA symbol, both the CPE and the residual CFO cause the same phase rotation for each subcarrier, while the rotation due to the SFO depends linearly on the subcarrier index. A linear phase increase in symbol direction can be observed for the residual CFO as well as for the SFO.

The results of the tracking estimation block are used to compensate the samples $R'_{k,l}$ completely in the reference path and according to the user settings in the measurement path. Thus the signal impairments that are of interest to the user are left uncompensated in the measurement path.

After having decoded the data symbols in the reference path, an additional data-aided phase tracking can be utilized to refine the common phase error estimation.

Analysis

The analysis block of the EUTRA/LTE uplink measurement application allows you to compute a variety of measurement variables.

- **EVM**

The most important variable is the error vector magnitude which is defined as

$$EVM_{n,l} = \frac{\left|\tilde{r}_{n,l} - \hat{a}_{n,l}\right|}{\sqrt{E\left\{\left|a_{n,l}\right|^2\right\}}} \quad (2)$$

for QAM symbol n before precoding and SC-FDMA symbol l. Since the normalized average power of all possible constellations is 1, (2) can be simplified to

$$EVM_{n,l} = \left|\tilde{r}_{n,l} - \hat{a}_{n,l}\right| \quad (3)$$

The average EVM of all data subcarriers consequently results in

$$EVM_{data} = \sqrt{\frac{1}{N_{DS} N_{TX}} \sum_{l=0}^{N_{LB}-1} \sum_{n=0}^{N_{TX}-1} EVM_{n,l}^2} \quad (4)$$

for N_{DS} SC-FDMA data symbols and the N_{TX} allocated subcarriers.

- **I/Q Imbalance**

The I/Q imbalance contained in the continuous received signal $r(t)$ can be written as

$$r(t) = I\ \Re\{s(t)\} + jQ\ \Im\{s(t)\} \quad (5)$$

where $s(t)$ is the transmit signal and I as well as Q are weighting factors describing the I/Q imbalance. We define that $I := 1$ and $Q := 1 + \Delta Q$.

The I/Q imbalance estimation makes it possible to evaluate the

$$modulator\ gain\ balance = |1 + \Delta Q| \quad (6)$$

and the

$$quadrature\ mismatch = \arg\{1 + \Delta Q\} \quad (7)$$

based on the complex-valued estimate $\Delta\hat{Q}$.

- **Basic In-Band Emissions Measurement**

The in-band emissions are a measure of the interference falling into the non-allocated resources blocks.

The relative in-band emissions are given by

$$Emissions_{relative}(\Delta_{RB}) = \frac{Emissions_{absolute}(\Delta_{RB})}{\frac{1}{|T_s| \cdot N_{RB}} \sum_{t \in T_s} \sum_{c}^{c+12 \cdot N_{RB}-1} |Y(t,f)|^2} \quad (8)$$

where T_s is a set of $|T_s|$ SC-FDMA symbols with the considered modulation scheme being active within the measurement period, Δ_{RB} is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g. $\Delta_{RB} = 1$ or $\Delta_{RB} = -1$ for the first adjacent RB), c is the lower edge of the allocated BW, and $Y(t,f)$ is the frequency domain signal evaluated for in-band emissions. N_{RB} is the number of allocated RBs .

The basic in-band emissions measurement interval is defined over one slot in the time domain.

- **Other measurement variables**

Without going into detail, the EUTRA/LTE uplink measurement application additionally provides the following results:

- Constellation diagram
- Spectral flatness
- Group delay
- I/Q offset
- I/Q imbalance
- Crest factor

References

[3] 3GPP TR 36.211, 3rd Generation Partnership Project; Technical Specification Group Access Network; Physical Channels and Modulation (Release 8), V1.1.1.

[4] M. Speth, S. Fechtel, G. Fock, and H. Meyr, "Optimum Receiver Design for Wireless Broad-Band Systems Using OFDM – Part I," IEEE Transactions on Communications, vol. 47, no. 11, pp. 1668-1677, November 1999.

[5] M. Speth, S. Fechtel, G. Fock, and H. Meyr, "Optimum Receiver Design for OFDM-Based Broadband Transmission – Part II: A Case Study," IEEE Transactions on Communications, vol. 49, no. 4, pp. 571-578, April 2001.

Glossary

T3GPP	3rd Generation Partnership Project
Application path	The path the setup software installed the R&S FSQ/FSV-K101/-K105 EUTRA/LTE analysis software ("%Program folder%\Rohde-Schwarz\EUTRA LTE" by default)
ARQ	Automatic Repeat Request
AWGN	Additive White Gaussian Noise
BB	Baseband
BCH	Broadcast channel
BER	Bit Error Rate
BW	Bandwidth
CAPEX	Capital Expenditures
CAZAC	Constant Amplitude Zero Auto-Correlation
CCDF	Complementary Cumulative Distribution Function
CFO	Carrier Frequency Offset
CINR	Carrier to Interference and Noise Ratio
CIR	Channel Impulse Response
CP	Cyclic Prefix (Guard Interval)
CPE	Common Phase Error
CQI	Channel Quality Indicator
CTF	Channel Transfer Function
DFT	Discrete Fourier Transform
DFT-s-OFDM	DFT-spread-OFDM
DMRS	Demodulation Reference Signal
DL	Downlink
DUT	Device under Test
EUTRA	Evolved Universal Terrestrial Radio Access
EUTRAN	Evolved Universal Terrestrial Radio Access Network
EVM	Error Vector Magnitude
FDD	Frequency Division Duplex
FFT	Fast Fourier Transform
GCL	Generalized chirp like
GERAN	GSM EDGE Radio Access Network

HSDPA	High Speed Downlink Packet Access
HSUPA	High Speed Uplink Packet Access
IDFT	Inverse Discrete Fourier Transform
IF	Intermediate Frequency
IFFT	Inverse Fast Fourier Transformation
ISI	Intersymbol Interference
LAN	Local Area Network
LTE	Long Term Evolution
MBMS	Multimedia Broadcast Multicast Services
OFDM	Orthogonal Frequency Division Multiplexing
OFDMA	Orthogonal Frequency Division Multiple Access
OPEX	Operational Expenditures
PAPR	Peak to Average Power Ratio
PDCCH	Physical Downlink Control Channel
PRB	Physical Resource Block
PS	Packet Switched
PRACH	Physical Radio Access Channel
Program folder	The path where programs are installed; by default, this is C:\Program Files
PUCCH	Physical Uplink Control Channel
PUSCH	Physical Uplink Shared Channel
QAM	Quadrature Amplitude Modulation
QoS	Quality of Service
QPSK	Quadrature Phase Shift Keying
RAT	Radio Access Technology
RB	Resource Block
RF	Radio Frequency
R&S FSQ/FSV	Rohde & Schwarz Signal Analyzer
SAE	System Architecture Evolution
SC-FDMA	Single Carrier Frequency Division Multiple Access
SFO	Sampling Frequency Offset
System root	The path where Microsoft Windows is installed; by default, this is C:\WINNT
TDD	Time Division Duplex

TTI	Transmission Time Interval
UE	User Equipment
UL	Uplink
UMTS	Universal Mobile Telecommunications System
UTRA	UMTS Terrestrial Radio Access
UTRAN	UMTS Terrestrial Radio Access Network
WCDMA	Wideband Code Division Multiple Access

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